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A Guide Book of

# CAMEL SURGERY

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**ABU DHABI FOOD CONTROL AUTHORITY**

## PREFACE

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Ministry of Economy, Abu Dhabi – United Arab Emirates

A Guide Book of Camel Surgery

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Due to the scarcity of books on camel surgery, it was a need of the time to compile a reference book encompassing elective and some most commonly performed surgical procedures in this animal. Therefore, an attempt has been made to undertake this task which might be helpful for the veterinary students in general and the newcomers entering this field in particular. We don't claim it to be a standard book, but hopefully it will be a good contribution to the literature already existing on this topic. Had we strived for perfection, this book would have never been completed. Being a guide book, it has been designed to be brief and every surgical procedure included in it has been explained stepwise and documented with the original photographs taken pre, intra and postoperatively except in a few instances where the photographs either could not be taken due to non-availability of the case, the camera facility or where the hand made sketches would better explain the procedure. The quality of some of the photographs may not be up to the mark, for which the authors seek excuse.

This book represents only the first step of what will be a continuous process of scientific work to achieve a still better understanding of surgical manipulations on this wonderful animal. Most of the techniques presented in this book can be performed without a fully equipped operation theater; rather some of them may even be performed under the field conditions. The methodologies given in this book are based on our practical experience of camel surgery spread over 10 years in the state of Abu Dhabi, United Arab Emirates; which has given us promising results. That is why the references have not been quoted in the text; rather a list of suggested readings has been given at the end of each chapter for further information and comparative evaluation. The steps given in the surgical techniques; however, are in no way final and some of the surgical procedures may be very similar to the

ones described by the other workers. The purpose of this book is to give guidelines only rather than to lay down hard and fast rules. Some practitioners may perform certain techniques in slightly different ways with equally good results.

The selection of anesthesia, suture material, suture types, cover of antibiotics and the use of other necessary medicines has been referred to in the course of discussion but has mainly been left on the discretion of the individual performing the procedure in his / her particular environment and the available facilities. The operator is always the best judge to decide his preferences.

Different techniques of restraint and anesthesia have been covered in a separate chapter to avoid their repetition for every surgical procedure. Hence, only the recommendations regarding the most suitable technique for restraint and anesthesia for the surgical procedure in question are given in the text. Similarly, the general account about preparation of the surgery site is given in the section of presurgical considerations and hence, is not described separately for each topic.

Chapter 16 titled "Case Reports" includes some interesting surgical procedures which may be of interest to the field worker.

The book may not have covered all the surgical topics; but as has been mentioned in the beginning, it has been confined to only those topics that are encountered frequently by the practicing veterinarian. There are no appreciable surgical diseases of the respiratory system except tracheotomy which is sometimes performed as a relief measure for the inoperable obstruction of the upper respiratory tract. Hence, no account of this system has been added in the book. The readers are cordially invited to give their comments and suggestions so that the next edition of the book makes its appearance with noticeable improvement.

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for accomplishing “**A Guide Book of Camel Surgery**” which encompasses the most commonly performed surgical procedures in this animal. The book, concisely written and with original illustrations on the operative techniques would hopefully serve as an invaluable reference for the undergraduate and postgraduate veterinary students in general and the veterinarians engaged in camel practice in particular.





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Race area - AlWathba - United Arab Emirates



# CHAPTER 1

## Presurgical Considerations

This chapter basically covers those important steps which must be given due consideration before a surgical procedure is undertaken. Adherence to these basic requirements will undoubtedly result in a better outcome with minimal postoperative complications leading to a relatively pleasant convalescence period and an early rehabilitation of the patient.

### 1. Preoperative Evaluation:

Clinical examination and routine laboratory evaluation consisting of packed cell volume (PCV), total protein (TP) and complete blood count (CBC) of the patient are normal preoperative indications and apply to both emergent and elective surgical procedures. In the elective case, the surgical procedure should be postponed if the physical condition and laboratory profile of the patient are not normal, the underlying causes should be investigated and efforts be made to correct them. However, this may not be possible in an emergency. In such a situation the owner should be made aware of any problems before subjecting the animal to surgery. Even in normal elective surgery, the risks are always present and these should also be explained to the owner before hand. If indicated, fluid replacement should be carried out before a surgical procedure is undertaken.

### 2. Surgical Judgment:

Surgical judgment only comes through experience and learning from ones own mistakes and careful observation of the mistakes made by the others. The surgeon who makes same mistakes continuously

will never attain good surgical judgment and his patients will always be at risk.

The surgeon should always stick to professional honesty. If a surgical procedure is beyond his capabilities or the surgical and technical facilities with him are not adequate, he should feel himself morally bound to refer the case to someone who is more capable and better equipped to undertake that particular procedure. This decision will rather add to his respect.

### 3. Asepsis and Antisepsis:

Being a desert animal, the camel is said to be hard, adaptive to adverse environmental conditions and somewhat resistant to low grade infection and this is true to a certain extent. However, with the current intensive husbandry and care, particularly of the racing animals; this belief is staggering and these animals now seem to be more vulnerable to the altered environmental conditions. Therefore, adherence to the aseptic surgical technique seems to be mandatory. In the field conditions however, a clean; if not aseptic, surgical procedure can always be carried out and this is quite acceptable.

As far as surgery is concerned, three determinants of infection at the surgery site can be pointed out. These are the host defense, the physiologic derangement and the risk of bacterial contamination at the time of surgery or thereafter.

Routine control methods include aseptic surgical technique, identification of high risk patients, correction of systemic imbalances such as acid-base disturbances and the prophylactic use of antibiotics.

The surgical procedures can broadly be classified into three categories and the extent to which the practice of asepsis and antisepsis is carried out will depend on this classification:

1. **Clean Surgery:** In this category, the gastro-intestinal, urogenital or respiratory tract is not entered.
2. **Clean-contaminated Surgery:** The surgery in this category involves surgical manipulations of the gastrointestinal, urogenital and respiratory systems but there is no significant spillage of contaminated contents during surgery.
3. **Contaminated-dirty Surgery:** This category denotes those surgical procedures in which there is gross spillage of contaminated body contents into the body cavities. Fresh traumatic wounds also fall in this category.

After categorizing the surgical procedure, appropriate precautions should be taken for the well being of the patient and to avoid postoperative infection. Routine use of sterile drapes, wearing of cap, mask and sterile gown and gloves will be a good policy which would go a long way towards preventing most of the postoperative problems.

### 4. Preparation of Surgical Site:

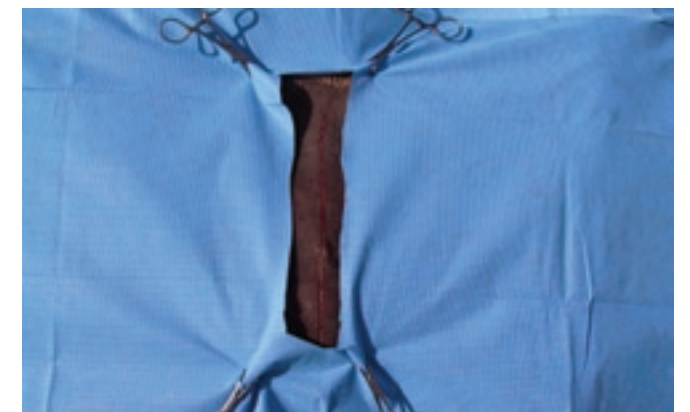
The preparation of the surgery site commences with removal of the hair by clipping or even shaving, not just from the incision site but from an adequate area surrounding the surgical site. A neat square or rectangular shaved area with clean edges is pleasing to the eyes. Clipping/shaving of 15cm around the proposed incision site is taken as a standard, particularly from the ends of the proposed incision so that if the incision needs to be extended, it could be extended through the prepped area. Shaving is followed by scrubbing the area with any Iodine-based scrub solution. Scrubbing should commence at the proposed incision site and progress towards the periphery. One should never come back onto a previously scrubbed area. Two to three scrubs are sufficient to render the surgical site adequately clean for surgery (Fig.1.1).

### 5. Draping the Surgery Site:

Efficient draping of the surgery site is mandatory to perform an aseptic surgical procedure. When using fabric drapes, the standard four drape technique is followed with a slit drape on top. Most of these



**Fig.1.1** Preparation of the surgical site for left flank laparotomy. Note that an ample area has been prepared. The rope to control the hind limb has been tied caudal to the tuber coxae to avoid its coming in contact with the operation site.



**Fig 1.2** Draping of the surgical site. Note the towel clamps going through the drape into the skin to avoid its displacement.

drapes are made of cotton woven with a specific thread density with minimum seams to minimize migration of the bacteria through the material.

At present, sterile plastic adhesive drapes (incise drapes) or drapes made from impervious material are mostly used (Fig.1.2). Their purpose is to help prevent contamination of the surgery site by immobilizing the bacteria. The sterile adhesive plastic drapes are now also available with an active antimicrobial ingredient present in them. These drapes are however, disposable and costly and hence, may be out of reach of an average practitioner. If draping is not done, the surgeon must minimize contact with parts of the animal that have not been scrubbed.

\* See Appendix D

6. Postoperative Infection and Role of Antibiotics:

Prevention of postoperative infection is always a goal of the surgeon but as a rule of thumb; it is sufficient to say that antibiotics should never be taken as a substitute for asepsis or to cover flaws in the surgical technique. However, at occasions, infection may occur in spite of all the measures taken to prevent it. In the event of infection, the surgeon has to decide his/her course of action, as the well being of the patient carries the most importance. In some surgical wounds, provision of drainage at the most ventral part of the wound may suffice but some of them will require more aggressive treatment. If the condition seems to be serious, it is always advisable to get a culture and sensitivity test before proceeding for antibiotic treatment. Surgical dissection along tissue planes, gentle tissue handling, proper hemostasis, correct selection of the suture material and the suturing technique, minimum possible operating time and perfect closure of the dead space definitely go a long way towards preventing most of the postoperative complications.

If at all, under special conditions; it is decided to take the cover of antibiotics, these should be used at the correct dosage, at the correct time and for the correct period of time. These should be started pre-operatively, or at the latest during surgery, to be of maximum benefit. Administration of prophylactic antibiotics beyond 4 hours postsurgically has little to no effect on the incidence of postoperative infection. Topical antibiotics used during surgery should be nonirritating to the tissues; otherwise, the damage done to the tissues will outweigh the advantageous effects of the antibiotics.

Suggested Readings:

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# CHAPTER 2

## Suture Materials and Suture Needles

Sutures and ligatures are indispensable to maintain proper approximation of the tissues during any surgical procedure. The proper selection of the suture material for any operation carries the most importance, as a wrong selection will result in a failure endangering the life of the patient. The following are some of the points which should be kept in mind when selecting the suture material for a particular surgery.

1. The suture should maintain its strength till complete healing of the wound occurs.
2. It should cause minimal tissue reaction and should not create a favorable environment for growth of micro-organisms.
3. It should be non-capillary, non-allergenic, non-electrolytic and non-carcinogenic.
4. The selection of the suture material should be based upon scientific reasons and not on traditions.
5. It should be comfortable for the surgeon to handle and should give secure knots which should not untie by themselves and above all should be economical to use but not at the expense of the patient's life.

The surgeon must be aware of the advantages and disadvantages of the suture he intends to use for a particular procedure. The selection of the suture size and type should be based upon its biological properties in various body tissues and the purpose it is being used for. The rate of healing of a particular tissue should also be taken into account and the surgeon should also consider if the postoperative infection or drainage is likely to occur. Catgut, for example, will disappear more rapidly in the presence of infection as a result of increased local

phagocytic activity, but on the other hand, braided synthetic materials such as polyglycolic acid must be used under aseptic conditions, which is not always possible in large animal surgery particularly the camel. Once infection occurs, the synthetic materials will serve as a nidus and will actually harbor the pathogens. In short, the selection of the suture material is a dilemma and generally rests upon the surgeon's experience and judgment for a particular surgical procedure.

The other factors which would contribute towards outcome of a procedure are the size of the suture material, suture holding power of the tissues, the spacing between the sutures and their tightness, suture pattern and the quality of the knots, as given below.

### Suture Size\*:

The size of the suture and the suture holding power of the tissue are in a way inversely proportional. If on one hand, the larger size sutures hold the tissues more effectively; these, on the other hand, will give rise to foreign body reaction that is greater than that caused by the sutures of a smaller diameter and thus delay the healing process.

### Suture Spacing and tightness:

Widely spaced sutures lead to poor apposition of the wound edges and may contribute towards dehiscence. It is therefore, preferable to increase the number of sutures than to increase the size of the suture material. Generally speaking, the sutures should be as far from each other as they are wide and should not be very tight. Too tight sutures cause ischemia at the wound edges and will result in delaying the healing process.

\* See appendix G

### Suture pattern and knots:

A wide variety of suture patterns to be used under different circumstances is available to the surgeon and they also affect the expected results if not used properly and skillfully. Knotting the suture carries much importance, as the knot is the weakest point of the suture and actually decreases the strength of the suture material. The simplest and smallest knot that will fulfill the purpose should be used. This will reduce the amount of the foreign material that the animal has to digest, extrude or encapsulate. Tying a secure knot is an important part of any surgical procedure. Knot failure can result in hemorrhage of a major blood vessel, herniation or even evisceration and death of the patient.

### A. Suture materials:

Common surgical procedures routinely involve suturing of the internal organs, ligation of blood vessels, closure of the muscular and subcutaneous organs and deeper tissues. As these sutures are not to be removed, such suture materials have to be used that are either digested or hydrolyzed by the patient. These suture materials are known as absorbable suture materials. The sutures used on the skin are made from nonabsorbable material and are removed after healing of the wound takes place. Another classification of the suture materials is monofilament and multifilament sutures based upon the number of strands the suture contains. Some of the most commonly used sutures in each category are briefly mentioned below.

### Absorbable Sutures:

These sutures, per se, do not retain their tensile strength for a longer time but do hold the tissues together till the union takes place, provided proper type and size of the suture material is selected depending upon the biological properties of different body tissues. The most commonly used absorbable sutures in veterinary practice are given below with their merits and demerits. The selection of the suture will however, depend upon the individual's own experience.

#### 1. Catgut:

Catgut is one of the most frequently used suture materials and is made from collagen obtained from submucosa of the sheep intestine or serosa of the beef intestine. It is available in individual packets

(Fig. 2.1) and in cassettes (Fig. 2.2) and may be plain or chromic (treated with basic chromium salts). Plain catgut loses its strength in 3-7 days, whereas the chromic catgut maintains its strength in the body tissues even up to three weeks depending upon its degree of chromicization. This material is gradually digested by acid proteases from inflammatory cells and its rate of absorption varies depending on the nature of the tissue the material is implanted in and to some extent on the size of the suture. Generally it gets absorbed rapidly when implanted in highly vascular areas and if exposed to the gastric juices or other organ enzymes. Catgut is easy to work with but swells up when wet with a decrease in knot holding ability. Therefore, the suture should be ended with three knots and the cut ends of the suture should be left longer than other types of suture material to minimize the chances of untying.



Fig 2.1 Catgut (packets).



Fig 2.2 Catgut (cassette).



## 2. Polyglycolic acid and polyglactin 910:

These synthetic absorbable suture materials are increasingly becoming popular and have largely replaced catgut. These are available under the trade name of “Dexon, Safil and Vicryl” (Fig. 2.3). These all are polymers and are extruded as filaments. Polyglycolic acid (Dexon and Safil) is a polymer of glycolic acid (hydroacetic acid) and Polyglactin 910 (Vicryl) is a polymer containing glycolic acid and lactic acid in a ratio of 90 to 10. These compounds, no doubt are invaded by the macrophages, but their disappearance is independent of local cellular reaction. These are hydrolyzed into natural body metabolites in comparison to catgut which is absorbed by phagocytosis. These are also non-antigenic, as none of them contains protein. Because these materials have low coefficient of friction, it is necessary to start with a surgeon's knot and have multiple throws to prevent the knots from slipping or untying. These materials have also been used successfully for closure of skin wounds in the human and veterinary patients.

## 3. Polydioxanone:

This polymer of paradiioxanone is a synthetic monofilament suture and is available under the trade name of “PDS”. It is also degraded by hydrolysis, but more slowly as compared to Dexon and Vicryl. Being monofilament, it has the advantage of not harboring the bacteria even in the infected tissues.

## 4. Collagen:

It is prepared from flexor tendons of the steers, is like catgut but is smoother and more uniform than it. It is occasionally used in eye surgery.

## Nonabsorbable Sutures:

These sutures retain their tensile strength for a period of more than 60 days. These are routinely used as skin sutures, but may be used on the internal organs under specific conditions. The following are the main sutures available in this category.

### 1. Silk:

It is a continuous protein filament produced by the silkworms. It is then braided, dyed and coated with wax or silicon (Fig. 2.4). It has a superb handling quality with good knot holding properties. It is multifilament, possesses capillary action and therefore, should not be used in the presence of infection,



Figure 2.3 Polyglycolic acid (Safil).

because it will provide refuge for bacteria. Although it is grouped under the nonabsorbable category, it does lose its strength slowly and disappears over several years.

### 2. Cotton:

It is a useful and economical suture material. It handles well, but produces more tissue reaction than silk and potentiates infection due to harboring of bacteria. In such a situation, the problem does not solve unless the offending material is removed. The most common application of cotton material in the large animals is in the form of umbilical tape used for retention sutures in cases of prolapse of uterus, vagina and rectum (Fig. 2.5).

### 3. Nylon:

Nylon is a long chain polymer and is available in monofilament (Dermalon and Ethilon) and multifilament (Nurolon) forms. Multifilament form is braided to give the suture some roughness which provides better knot retention than the monofilament form. However, the monofilament form is preferred, as there are no interstices in it to harbor bacteria. It is relatively an inert material and when implanted in the tissues, a thin connective tissue capsule is produced around the suture and this is one of its major advantages when used as a buried suture. One of the disadvantages of this suture is its stiffness, thus offering resistance to bending during knotting. This property of the suture is called “memory” which may be defined as the suture's ability to resist bending forces and to return to its original configuration. This property makes it difficult to knot securely and additional throws required for security produce a bulky knot. For easy



Figure 2.4 Silk (cassette).

handling, the suture should be stretched out after its removal from the packet.

## 4. Polypropylene and Polyethylene:

These are usually available in monofilament form and are the most desirable in this class (Fig. 2.6). They are also stiff, and like nylon, possess “memory”, but their knot security is better than that of nylon. They are among the least reactive sutures and are more suitable to be used in the infected wounds than the braided synthetic materials.

## 5. Polymerized caprolactam:

These are synthetic suture materials and are represented by “Supramid and Vetafil” and are available for veterinary use only. Their twisted fibers are coated to minimize capillary action and therefore, behave like other braided materials. These are available in cassettes in chemically sterilized form and hence, are primarily used for skin closure only (Fig. 2.7).

## 6. Polyesters:

The polyesters consist of “Dacron” which is available in coated, impregnated and uncoated forms under different brand names. The coated forms come under the names of “Tevdek, Ethiflex, Polydek, Ethibond and Ticron” whereas “Mersilene and Dacron” are the uncoated forms. The uncoated sutures will naturally have more tissue drag than the coated forms. Coating or impregnating, no doubt decreases the capillary action of the suture, but reduces knot holding ability. These materials are not reactive when implanted in the tissues. These are strong sutures and are used in situations where prolonged strength is required. They are multifilament

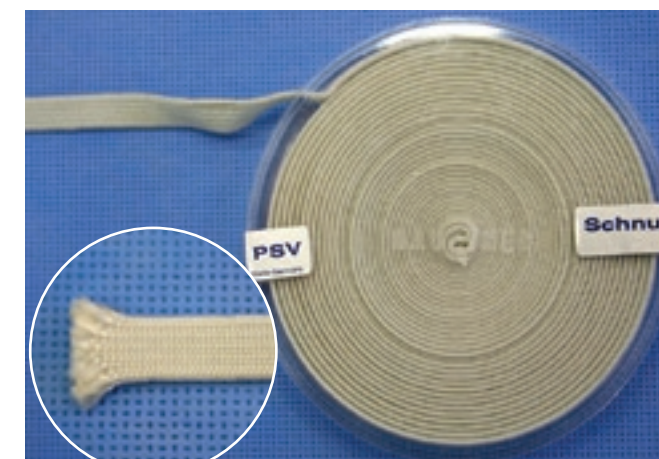


Figure 2.5 Umbilical tape made of cotton used in case of prolapse of uterus, vagina and rectum.

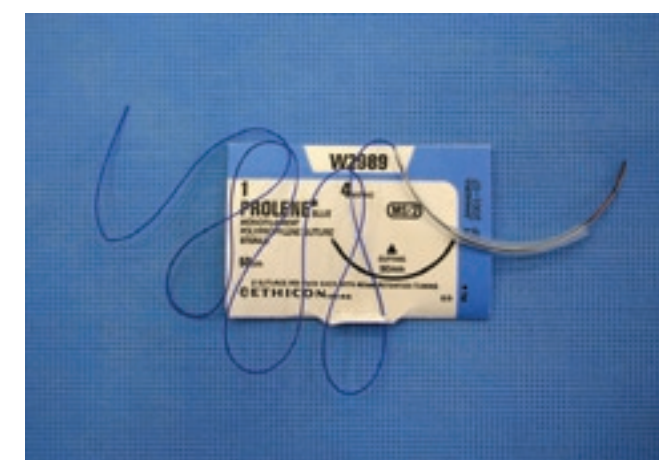


Figure 2.6 Polypropylene (Prolene).



Figure 2.7 Polymerized caprolactam (Supramid).

in nature and therefore, the bacteria and the tissue fluids can penetrate their interstices giving rise to a nidus of infection and converting contamination into infection. These sutures should therefore, be used under aseptic conditions only.



### 7. Stainless Steel:

Stainless steel is an alloy of iron, nickel and chromium and is available in multi or monofilament forms. It is the strongest of all the suture materials, but is difficult to handle, as it kinks easily. It is also one of the most unreactive suture materials and can be sterilized repeatedly. Being strong, it can cut through the tissues as well as the surgeon's gloves. It does not harbor bacteria and therefore, can be used even in the phase of infection. Its use in the large animals is however, not frequent.

### 8. Skin Stapling Devices:

The use of disposable skin stapling devices is becoming increasingly popular due to the speed with which they can be applied and their metallic nature which does not provide a conducive environment for bacterial growth (Fig. 2.8). The only limitation is the cost of the device which restricts its use in the large animal surgery. Its use however, must be considered where risk to the animal's life due to a longer anesthetic time overweighs the cost of the stapling device.



Figure 2.8 Skin Stapling Device.

rapidly penetrate through the tissue but will not cut through it.

The round body needles, also known as atraumatic or non-cutting needles have no edges and are unlikely to cut through the tissue (Fig. 2.10). They are generally used for abdominal viscera, abdominal wall, vessels and other fragile tissues. These needles are actually round just behind the tip and the remaining portion of the shaft is oval so that the rotational or angular displacement of the needle is prevented within the jaws of the needle holder.

Long stemmed needles, such as "Gerlach and modified Buhner tape" needles are quite strong and stiff (Fig. 2.11). They are very useful for placing heavy retention sutures in cases of vaginal and uterine prolapse.

Out of the vast varieties of the suture needles, the selection of the needle will of course depend on the type of the tissue to be sutured, its location and accessibility and the size of the suture material.

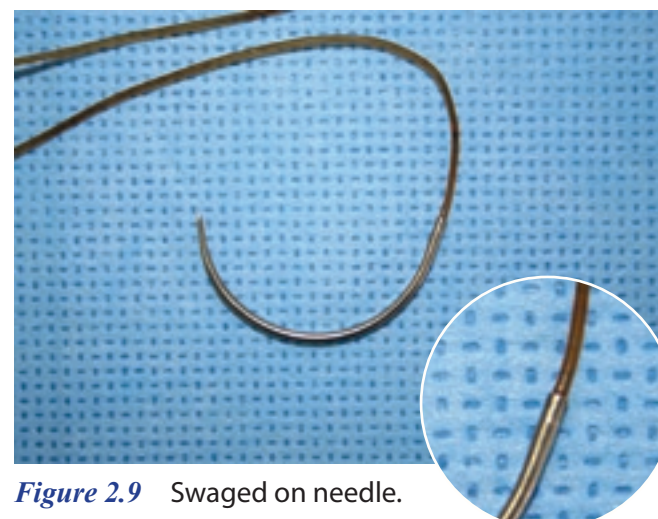


Figure 2.9 Swaged on needle.



Figure 2.10 Round needles (L) and Cutting needles (R).



Figure 2.11 Modified Buhner tape needle.

### B. Suture Needles:

Suture needles come in different shapes and sizes and have three basic components: the eye, the body or shaft and the point. The needle may have a closed eye or a spring eye or it may be swaged (eyeless). The swaged-on needles are permanently attached to the suture (Fig. 2.9). The advantage of the swaged-on needle is that the tissues are subjected to a less trauma because the needle and the suture are approximately of the same diameter and therefore, instead of double only single strand of suture is pulled through the tissue.

The body of the needle may be round, oval, flat or triangular and be straight or curved. The curvature may be  $\frac{1}{4}$ ,  $\frac{3}{8}$ ,  $\frac{1}{2}$ ,  $\frac{5}{8}$  circle or half-curved. Flat and triangular bodies may come with conventional or reverse cutting edges. In the conventional type, the cutting edge is provided on the concave surface of the body whereas in reverse cutting needle, the cutting edge is on the convex side. The reverse cutting needle has the advantage that it causes minimal trauma to the transfixed tissue and therefore, is preferred by the surgeons. A taper cut needle is a further modification where the cutting point is combined with a round body, so that the needle will

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# CHAPTER

# Suture Patterns and Ligatures 3

## Basic Suture Patterns:

Suture patterns are basically divided into interrupted and continuous sutures, out of which only the most commonly used, will be described here with the recommendations that one should get him/herself mastered with those patterns which would best suit for particular surgical procedures.

### Simple interrupted Suture:

This is the most widely used suture pattern at one or another point and especially on the skin, in almost all the surgical manipulations. The needle and the suture are inserted at a variable distance from one side of the incision going from outside in, crossing the incision at right angles and coming out from inside out on the other side. The knot of the suture should rest on one side rather than on the center of the incision (Fig. 3.1). When using on the skin, the point of insertion of the needle is normally kept 1cm away from the margin of the incision and approximately the same distance is kept between the successive sutures. However, the distance between the sutures will depend on the tension on the wound margins and aiming at leaving no gaps between them. The skin sutures should be tied only optimally, just to appose the skin margins and not be made too tight to invert them.

### Simple Continuous Suture:

This suture line, as the name indicates, is started at one end of the incision and is continued till the other end taking small bites from the wound margins. The first knot is tied at the starting end of the wound and the second knot at the finishing end (Fig. 3.2).

This suture pattern is used in those tissues that are elastic in nature where the suture line is not subjected to tension. This is a time saving technique, but the disadvantage is that if the suture line breaks at one point, whole of the suture line will lose its strength and efficacy.

### Interrupted Horizontal Mattress Suture:

This suture pattern is useful in large skin wounds, as one can save time and some suture material as compared to simple interrupted suture. After passing the suture through both edges of the wound at right angles, the suture needle is again passed through both edges of the wound at a variable distance (about 1cm) from the point of exit. In this way, the exposed parts of the suture lie parallel to the wound edges (Fig. 3.3). These sutures if tied tightly, cause eversion of the wound margins and also have a tendency to reduce their blood supply that may lead to necrosis of the wound edges. Therefore, the suture should be tied so as to just appose the wound margins.

### Continuous Horizontal Mattress Suture:

The technique of applying this suture is similar to that given for interrupted horizontal mattress suture except that it is continuous (Fig. 3.4). The main advantage of this suture pattern is its economy in both the time and the cost.

### Vertical Mattress Suture:

This suture pattern involves taking a superficial bite close to the wound edge and then passing across

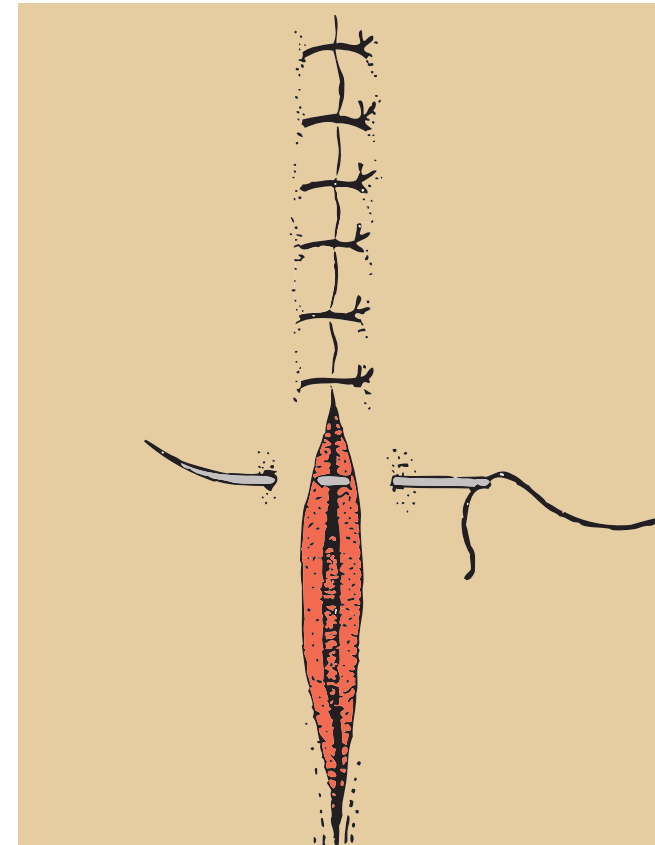


Figure 3.1 Simple interrupted suture.

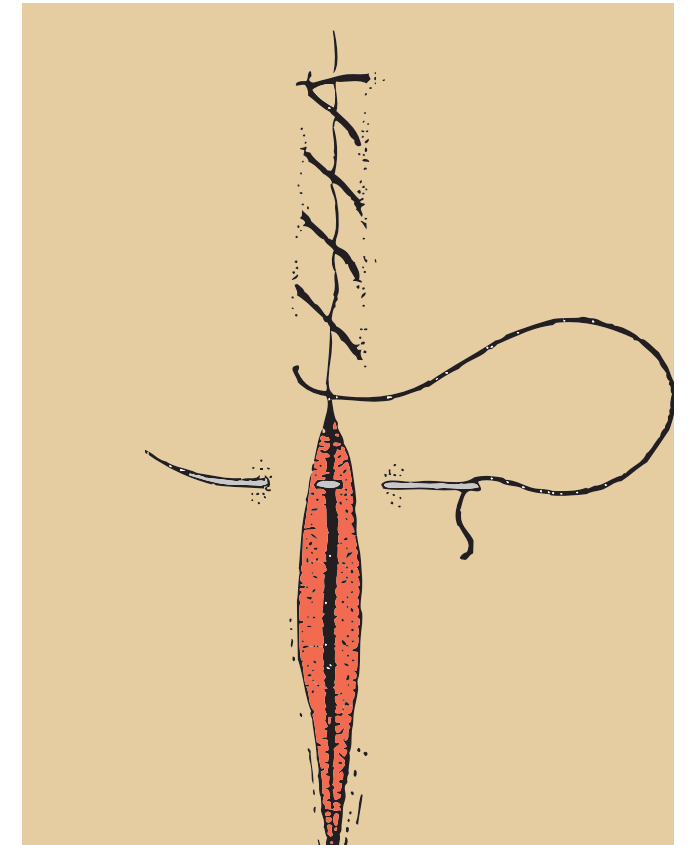


Figure 3.2 Simple continuous suture.

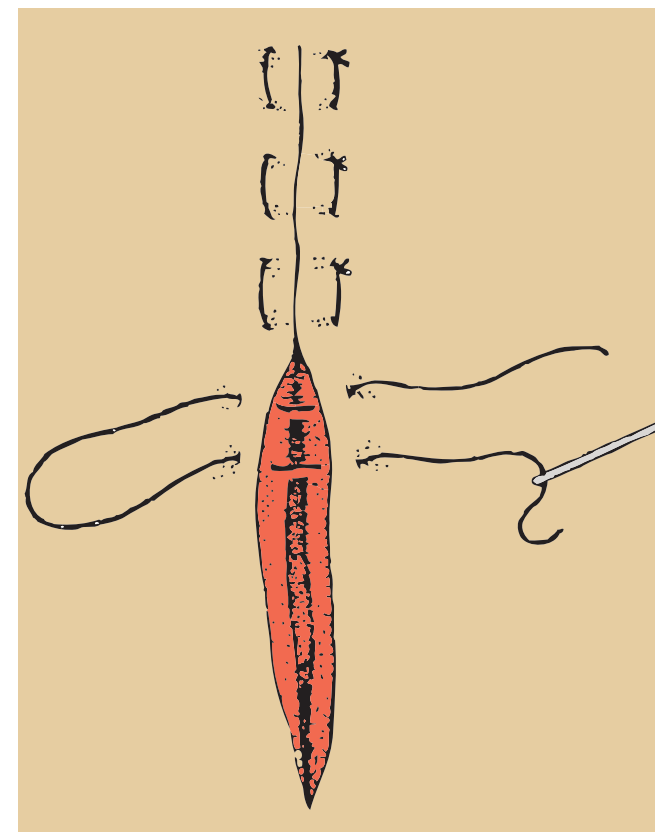


Figure 3.3 Interrupted horizontal mattress suture.

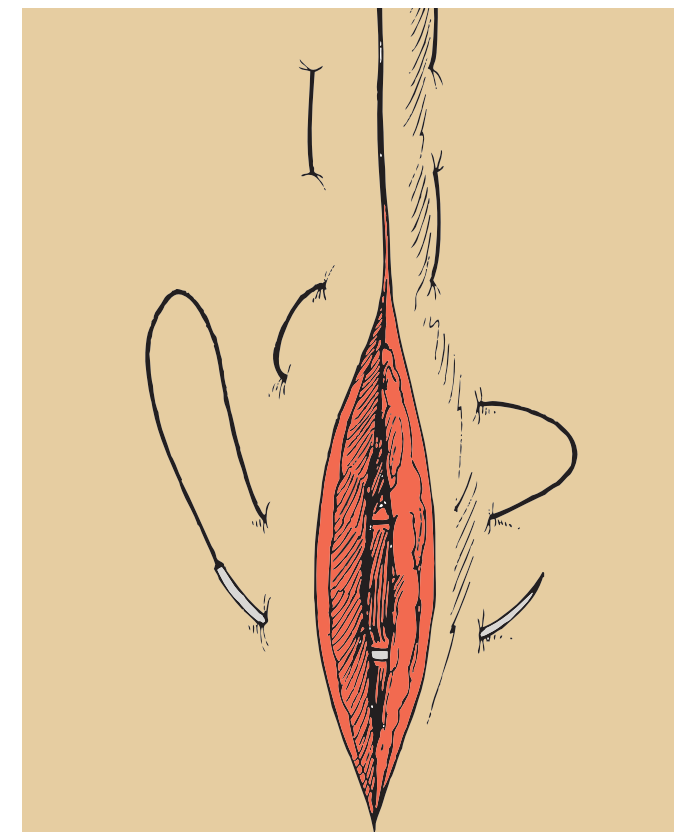


Figure 3.4 Continuous horizontal mattress suture.



the incision to take a small bite on the opposite side. The needle is then held in the jaws of the needle holder in a reverse direction, passed through the skin at a distance of about 1cm and returned to the other side at approximately the same distance from the point of initial entry and knotted there (Fig. 3.5). The superficial bites of the suture will adequately approximate the wound edges along with relieving some tension on the suture line through the bites that were taken at a distance. This suture has the advantage over the horizontal mattress suture in that it allows better circulation to the wound edges, thereby decreasing the chances of their necrosis.

#### Cruciate Suture:

This suture is used by some surgeons when the wound edges are under tension. The suture is started as a simple interrupted suture but not tied. The needle is then brought back towards the entry side, pierced through the skin at a variable distance and exited towards the other side parallel to the first one. The two ends of the suture are then knotted with a moderate tightness. This will make an "X" on the surface of the wound (Fig. 3.6). This suture pattern is also known as "Cross Mattress" suture, as it crosses the wound margins in the form of "X".

#### Continuous Lock Stitch Suture:

This pattern is just a modification of the simple continuous suture. The suture is started as usual and then the needle is passed through a preformed loop of the suture material and is tightened. Each subsequent suture is locked until the end of the incision is reached. To end the suture, the needle is now introduced from the side of exit going towards the other side of the wound leaving a loop of the suture to which it is tied (Fig. 3.7). This pattern, when precisely applied, will result in good approximation of the wound margins. It is a time saving technique and works well for the closure of laparotomy incisions.

#### Near-Far-Far-Near Suture:

This is one of the best tension relieving sutures but is not very frequently used in large animal surgery. The first bite is made close to the wound margin and the wound is then crossed at right angles to exit on the other side at a greater distance from the wound edge. The wound is then crossed over to come to the original side. The needle is then inserted

at a distance farther from the wound edge than the original entry point, directed into the wound to emerge close to the wound edge on the other side. The suture ends are then tied with moderate tightness (Fig. 3.8).

#### Far-Far-Near-Near Suture:

This suture pattern is just like the vertical mattress sutures but the bites are taken in the reverse order. The first bite is made about 2cm away from the wound margin; going deep into the tissue, crossing the wound at right angles to exit on the other side at about the same distance. The needle is then held in the needle holder in a reverse direction and is inserted close to the wound margin, crossing the wound at right angles and exiting on the other side at the same distance. The suture ends are then tied with moderate tightness (Fig. 3.9). It has an advantage that the operator can visualize the depth the needle is traversing through the tissue. This suture pattern well approximates the tissues, obliterates the dead space and simultaneously acts as tension relieving sutures and proves very useful to repair deep transverse or longitudinal cuts of the soft but solid organs such as the tongue.

#### Suture Patterns For Hollow Organs:

A great care should be exercised when placing sutures on the hollow organs, as leakage of their contents such as gas and fecal material from the intestines or the contents of a post cesarean uterus, can result in grave consequences. Luckily, the plus point of hollow organs surgery is that a fibrin clot provides an almost immediate seal and these organs heal very quickly and become remarkably secure in 7 to 10 days, particularly when the serosal surfaces are brought together. However, any suture pattern that results in eversion of the mucous membrane is detrimental and can lead to leakage of the septic contents, resulting in peritonitis and possible death of the patient.

The classical suture patterns used on hollow organs are either the inverting or the apposing sutures. When suturing any segment of the intestinal tract, it should be kept in mind that the suture must include the submucosal layer, because this is the layer of strength due to its collagen fibers and thus has the maximum suture holding power. Suture

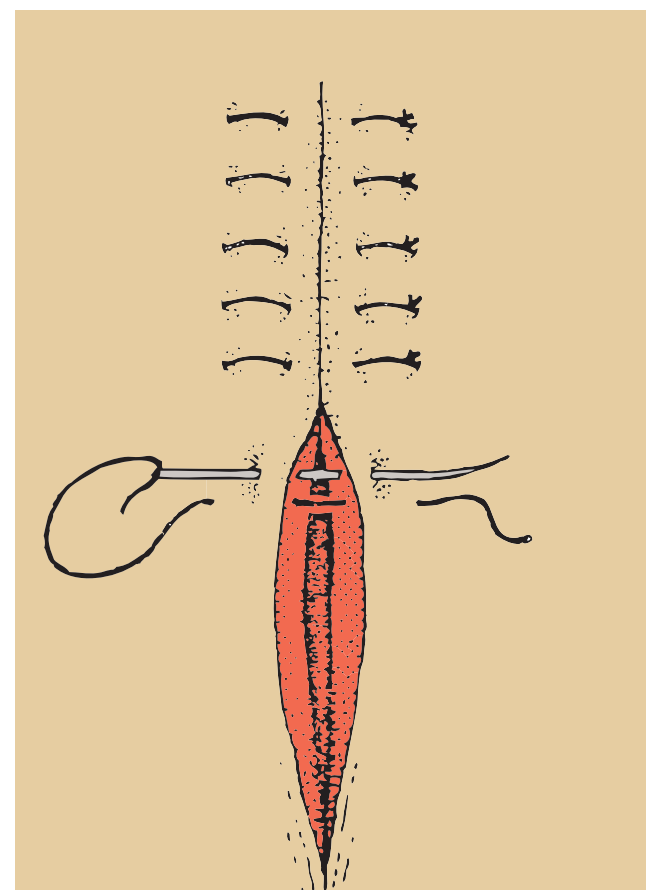


Figure 3.5 Vertical Mattress suture.

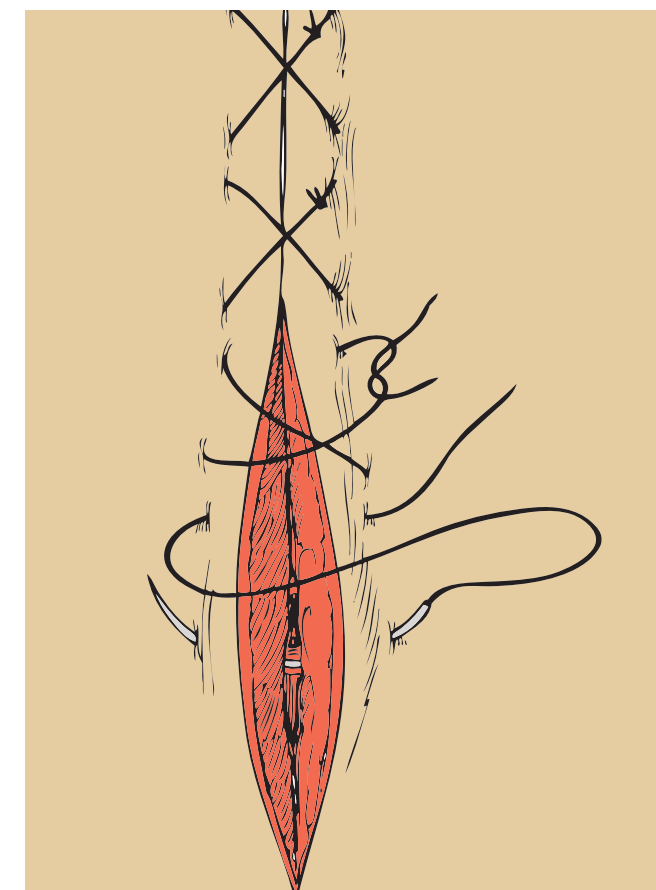


Figure 3.6 Cruciate suture.

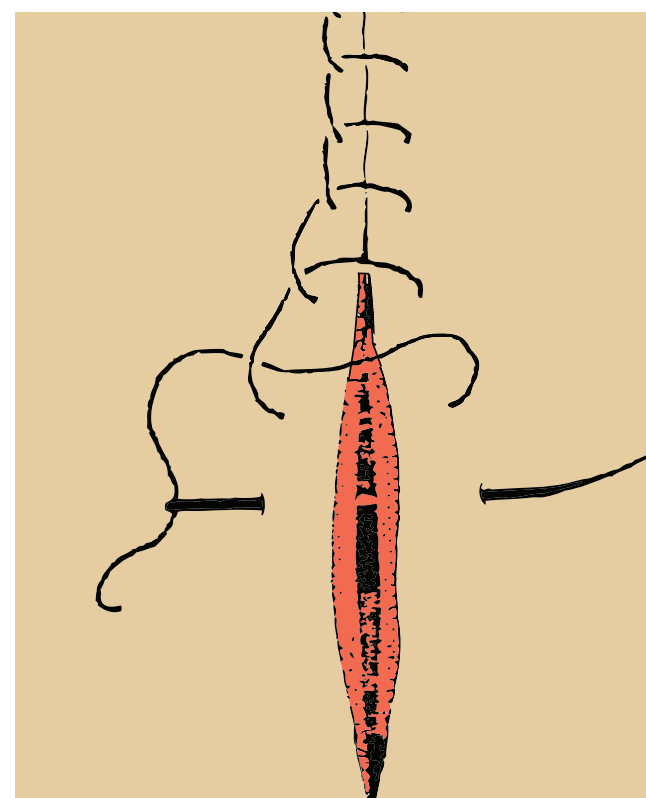


Figure 3.7 Continuous lock stitch suture.

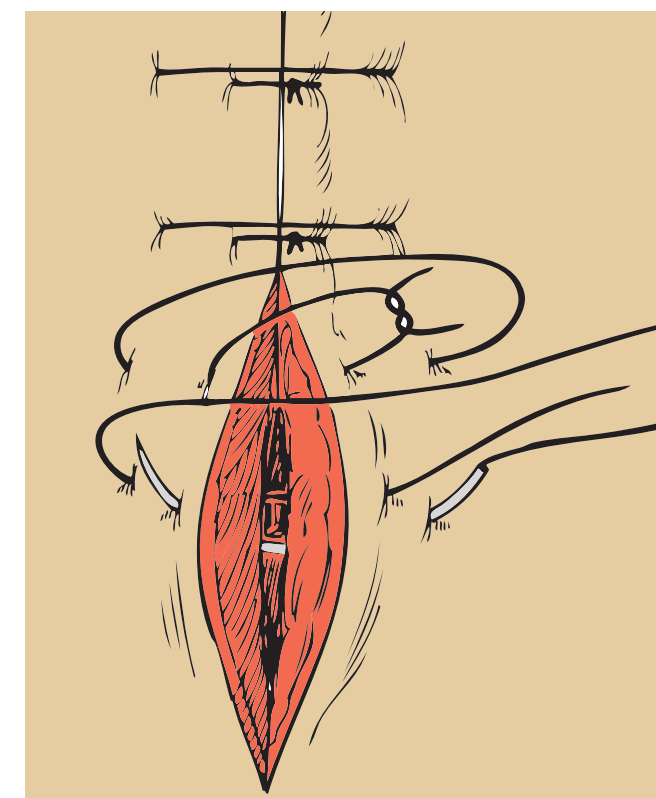


Figure 3.8 Near-Far-Far-Near suture.

needles used on the hollow organs should be round bodied (non-cutting) and preferably swaged on to reduce the size of the hole made in the wall of the organ.

The sutures used in the hollow organ surgery may be interrupted or continuous, the former being safer, as the integrity of whole of the suture line will not be compromised if one suture becomes untied, which is not the case when a continuous suture line is used to close a defect in the hollow organ. We routinely use continuous suture pattern to close the ruminal and uterine incisions and have never encountered such a problem. The objection to the continuous suture line therefore, seems to be more of a theoretical rather than of a practical nature. The following are the main suture patterns being routinely used for closure of the hollow organs.

#### **Lembert Suture:**

The Lembert suture may be used in an interrupted or continuous pattern and is regarded as the classic suture for gastrointestinal surgery. The suture is started at a point about 1.5-2.0cm away from the wound margin, directed through the tissue from outside towards cut edge of the incision going through the serosa, muscularis and the submucosa, but not through the mucosa and exits on the same side close to the edge of the incision. It is then reinserted close to the incision edge on the other side, passing through the same layers and exiting the same distance lateral. The two ends of the suture are then tied to each other and the wall of the viscus automatically inverts (Fig. 3.10). At no stage the suture should penetrate the lumen of the viscus. This suture is also suitable to close the hysterotomy and rumenotomy incisions. When used in a continuous pattern, the first knot is given at the proximal end of the incision and when proceeding towards the distal end the same spacing is used as in the interrupted suture and is tied to itself at the end point.

#### **Halsted (Interrupted Quilt) Suture:**

This is just a modification of the Lembert suture and essentially equals to two Lembert sutures parallel to each other. When tied the knot comes on one side of the incision (Fig. 3.11). This suture pattern is strong, well approximates the tissue and compresses it minimally.

It is not commonly used in large animal practice, but is reported to be quite suitable for friable tissue.

#### **Cushing Suture:**

This is a continuous suture pattern in which the bites are made parallel to the wound edges. Like Lembert suture, it also goes through the upper three layers of the viscus only. The suture crosses the incision at right angles and is tied to itself at the proximal and the distal end of the wound. At each bite, the needle is inserted at a point about half the way back from the exit point of the previous bite and exited about the same distance forward. This precaution gives good approximation of the incision edges and does not result in puckering of the tissue (Fig. 3.12).

#### **Connell Suture:**

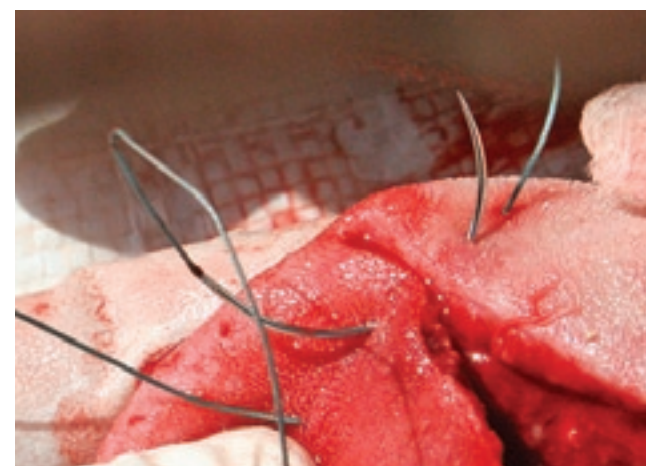
This suture is similar to the Cushing suture except that the suture material penetrates all the four layers of the viscus. The directions of both the sutures are the same and both of them will invert the tissue. The disadvantage of this pattern is the contamination and possible infection of the suture material, as it passes through the lumen of the organ and is exposed to its contents that are of course not sterile.

#### **Parker-Kerr Oversew Suture:**

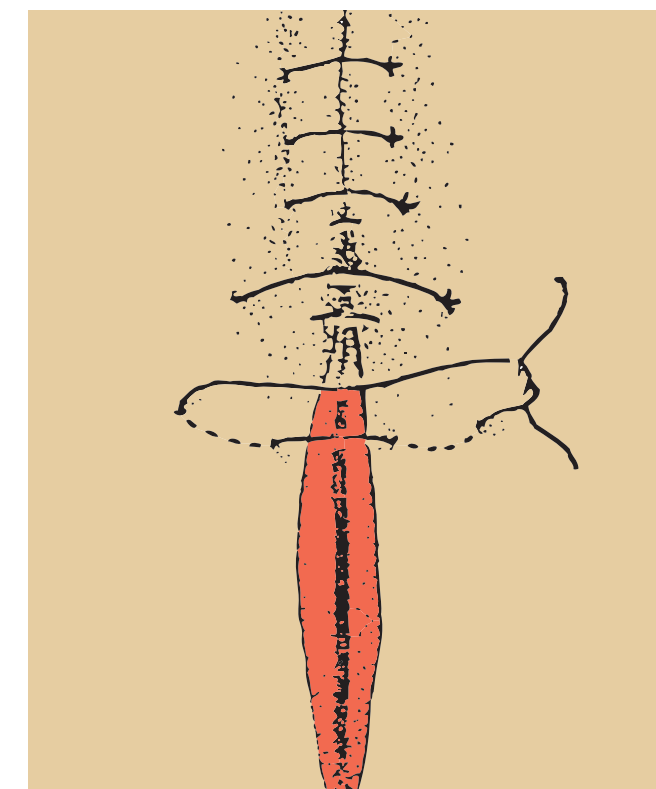
This pattern is used to close the stump of a hollow viscus and is essentially a Cushing pattern oversewn by continuous Lembert pattern. The first layer of the suture is placed over a long pair of forceps applied on the end of the stump. The forceps are then withdrawn slowly, simultaneously pulling the suture in both directions. This will result in inverting the wound edges without opening the lumen, thus preventing contamination. This suture line is then oversewn by continuous Lembert suture using the same suture material brought back and tied at the start point of the first suture layer (Fig. 3.13). The suture pattern can also be reversed in this technique using the Lembert suture as the first layer and the Cushing suture as the second layer.

#### **Purse-String Suture:**

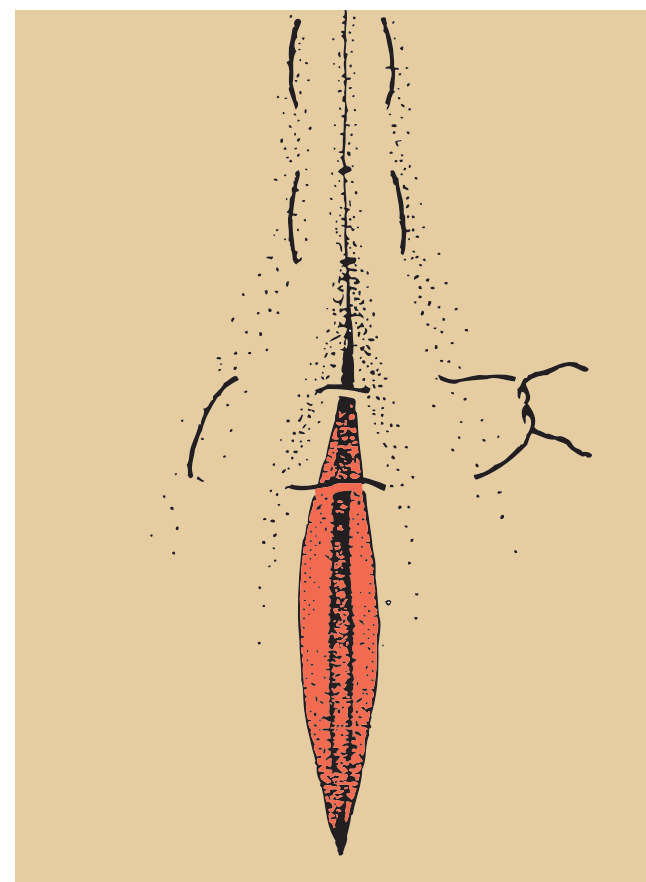
This pattern consists of a continuous suture placed in a circle around a circular or oval opening. The suture is however, tied when the entire circumference of the circle has been completed (Fig. 3.14).



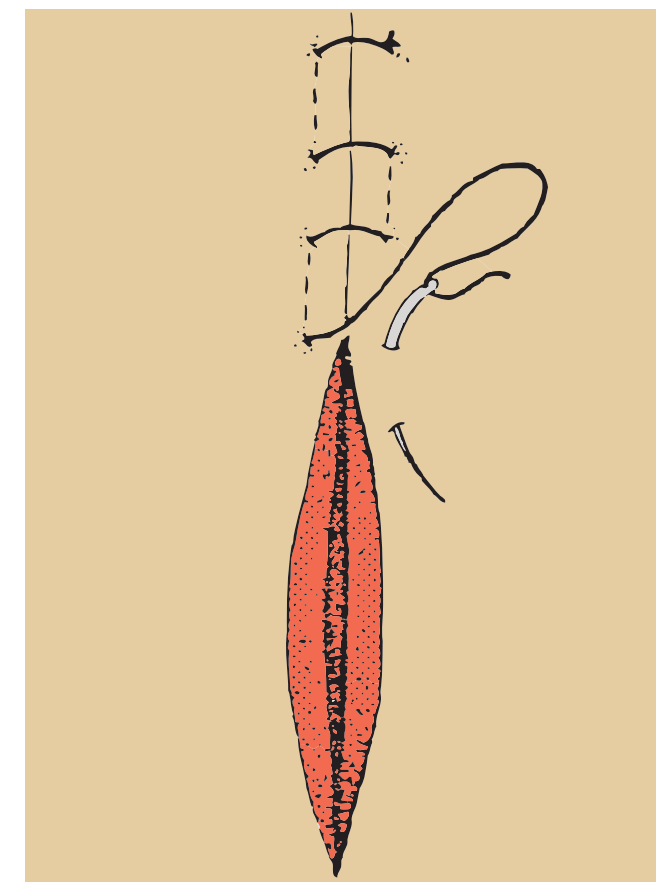
**Figure 3.9** Far-Far-Near-Near suture.



**Figure 3.10** Lembert suture.



**Figure 3.11** Halsted (Interrupted Quilt) suture.



**Figure 3.12** Cushing suture. Note the entry and exit point of the needle at each bite.



This technique is used to oversee an opening that aids in evacuation of the gas from the gastrointestinal tract, such as trocar puncture of the rumen in cases of bloat or narrowing of the anal opening to prevent prolapse of rectum after its reduction. Like the classic Cushing suture, this suture also does not penetrate the lumen.

#### Simple Interrupted Crushing Suture:

This suture pattern can be successfully used to close the enterotomy incision or to perform end to end intestinal anastomosis with better results, as it does not compromise the intestinal lumen as compared to any of the inverting suture pattern. It can be used to gently appose the wound edges; or the suture, initially placed through all the layers of the gut, can; during knotting, be made tight to an extent that it crushes through its mucosal layer to rest on the submucosa. The collagen fibers in the submucosal layer resist crushing and provide strength to the closure. The suture is placed approximately 3 to 4mm from the wound edges. The advantage of crushing is that the chances of contamination of the suture material are eliminated, as the suture is not exposed to the gut contents.

#### Utrecht Sutures:

This technique was developed at the University of Utrecht, the Netherlands to improve the fertility of cattle following cesarean section. It is a general finding that adhesions often develop between the uterus and the neighboring visceral organs along the suture line when the suture patterns are exposed and this adversely affects the fertility of the animal. In this technique, the suture knots and the suture pattern are not exposed. Therefore, the adhesions do not develop between the uterus and the visceral organs.

The starting knot is made using oblique bites to bury the knot within the inverted suture. Similarly, the continuous suture pattern is inserted using oblique bites which results in minimal exposure of the suture material but close apposition of the wound edges (Fig. 3.15). It is important that each suture be pulled tightly following its insertion; otherwise, the wound edges may gap allowing the uterine contents to leak. The final knot is also buried using the standard three step technique of

“inserting the needle from superficial to the deeper tissue, then from deeper to the superficial tissue to exit on the other side; leaving the loop of the suture, and then again inserting the needle from superficial to the deeper tissue from the other side exiting near the suture loop”. The suture loop is used for making the knot. As all the suture strands are coming from the deeper tissue, the knot will bury when tied.

#### Ligatures:

A ligature is essentially a loop of suture that is used to occlude a blood vessel either before or after its severance. The simple ligature can be modified as a transfixation ligature by passing it through the middle of the vessel and then tying it on its both sides (Fig. 3.16). It can also be used to occlude several small blood vessels passing through a tissue, but care should be exercised not to include more tissue in the ligature, as it may slip leading to its failure. If at all a large amount of tissue has to be ligated, the three clamp technique should be used. This technique involves application of three strong pairs of forceps on the pedicle of the tissue to be severed. The proximal forceps is removed and the ligature is placed on the bed of the crushed tissue created by the forceps (Fig. 3.17 a to d). Instead, the ligating material may be taken around the forceps and the later is removed while the first throw of the ligature is being placed. It is better to loosen the middle forceps a little while tightening the ligature. It will make the ligature more secure, as the tissue becomes more rounded after the forceps is loosened. Further throws are then placed to complete the ligature. If the amount of tissue is large, it is better to apply a transfixation ligature instead of the simple one. The pedicle is then cut between the distal and the middle forceps. Before removing the middle forceps, the end of the stump is held in a tissue forceps to check its efficacy before it is released.

While transfixing the pressure vessels, such as an artery, it is better to first apply a simple ligature and then transfix the vessel distal to the ligature. This is more secure and also will not allow any leakage of blood from the point of insertion of the needle for transfixation.

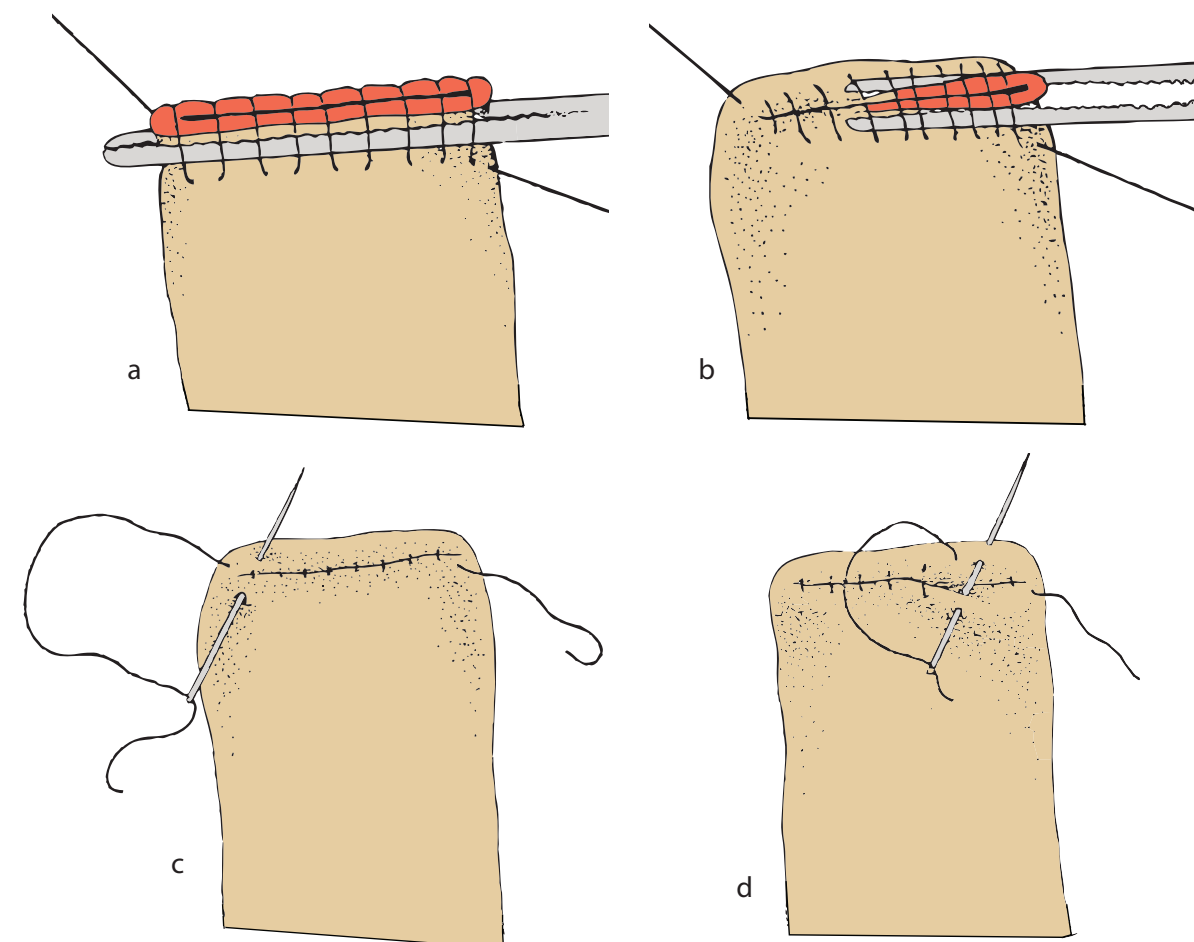


Figure 3.13 Parker-Kerr Oversew suture (a - d).

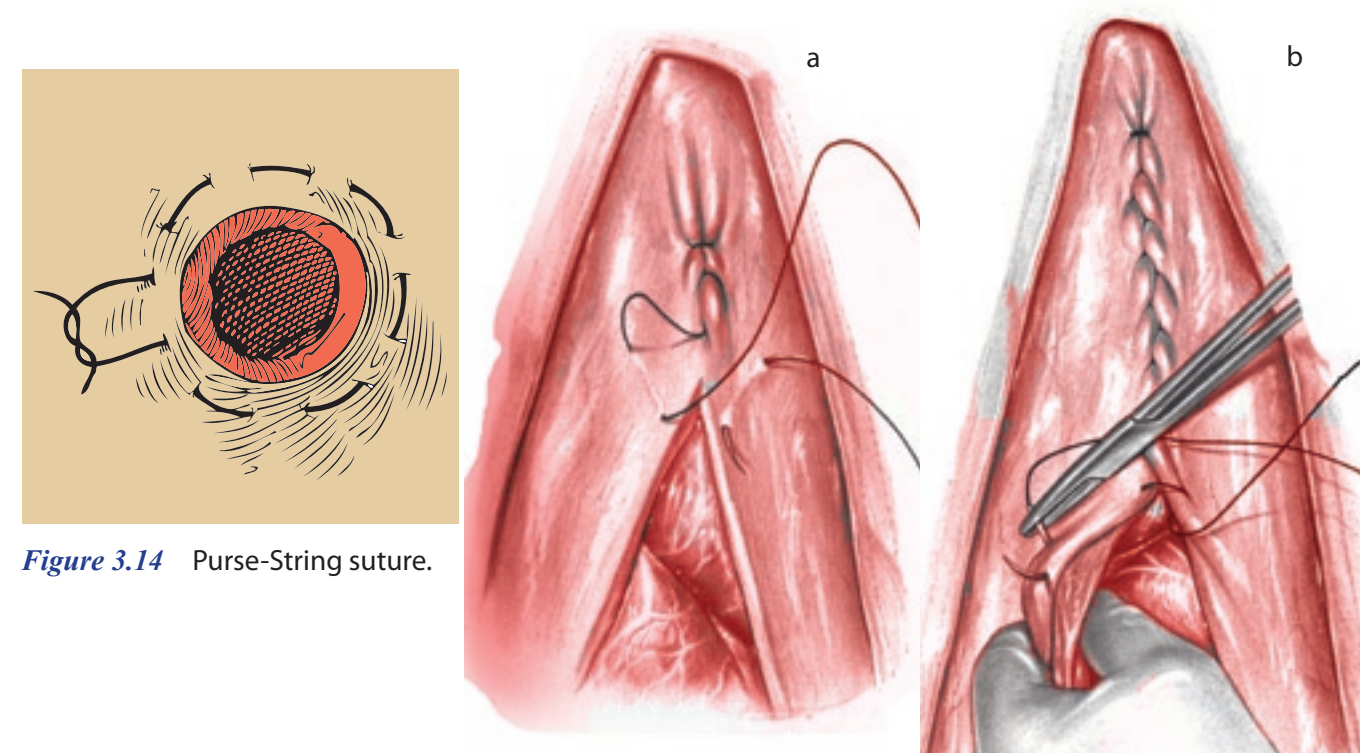
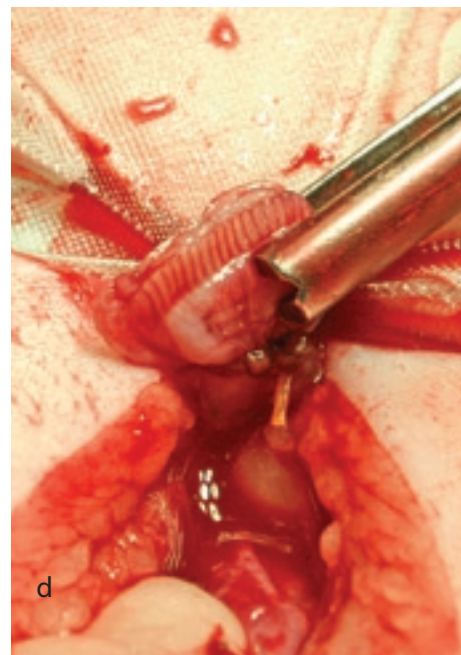
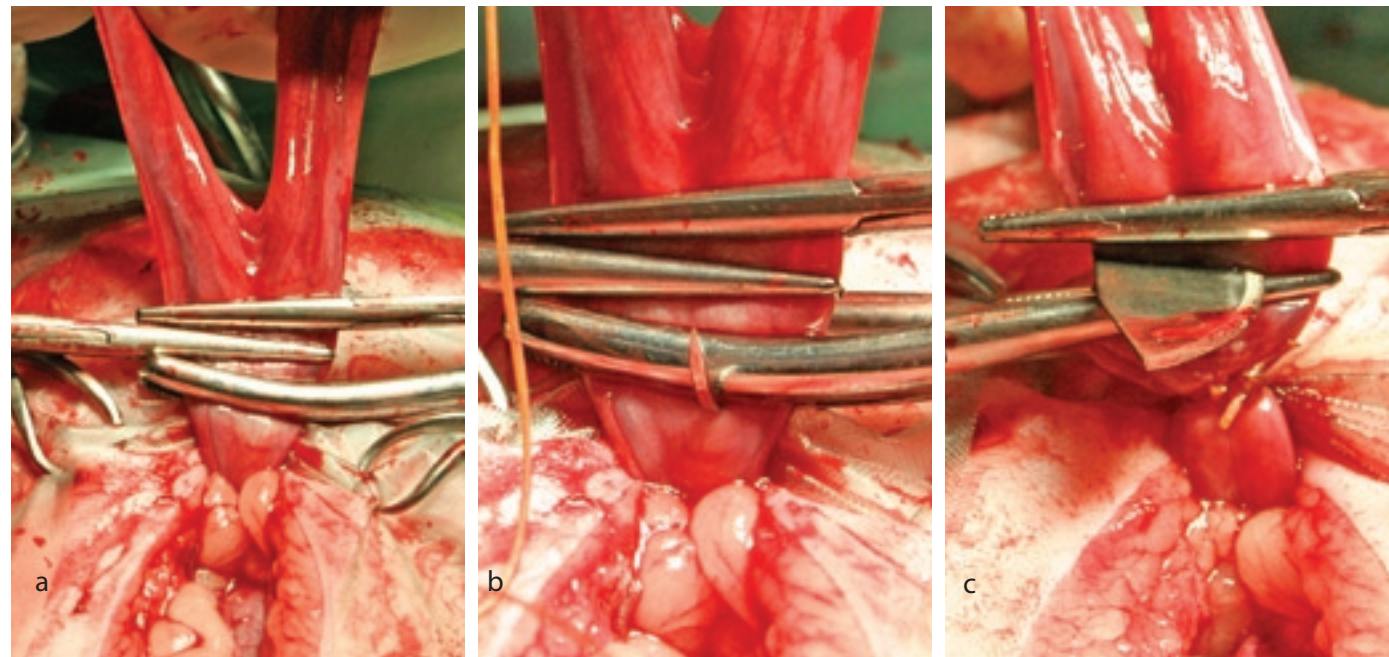
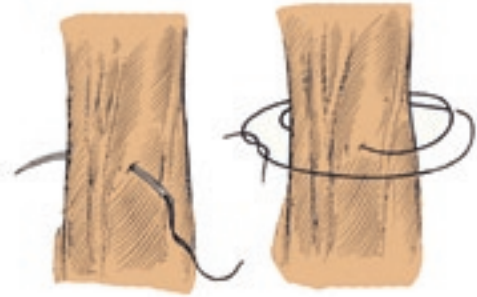


Figure 3.14 Purse-String suture.

Figure 3.15 Utrecht suture. Note the suture needle being inserted in an oblique direction in the uterine wall.

**Figure 3.16** Transfixation ligature. See the needle going through the middle and the suture material going around the pedicle to transfix it.



**Figure 3.17 a to d** Successive steps illustrating the three clamp technique when more amount of tissue needs to be ligated.

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# Instrumentation

## CHAPTER 4

In routine large animal surgical practice, only a limited number of instruments are used unless some particular surgical procedure is undertaken that requires some additional special instruments pertaining to that surgery. The main purpose of this chapter is to give guidelines to the new entrants in this field about proper handling, use and care of the instruments so that minimal trauma is inflicted to the tissue during surgery. This will ultimately result in a better healing of the operated organs with few postoperative complications.

### Standard Set of Clinical Instruments

The standard set of clinical instruments commonly used in routine surgical procedures consists of the following instruments per tray and suffices for most of the basic procedures. The specific instruments used for particular procedures will be mentioned in the respective sections.

1. Scalpel handles No.3 and No.4. (1 each).
2. Thumb tissue forceps (1).
3. Adson tissue forceps (1).
4. Allis tissue forceps (4).
5. Straight or curved sponge forceps (1).
6. Operating Scissors (1 each).
  - Straight and curved Mayo scissors.
  - Straight and curved Metzenbaum scissors.
  - Sharp/sharp (S/S) operating scissors.
7. Suture cutting scissors (1).
8. Needle holder (1).
9. Straight and curved Halsted mosquito forceps (6 each).
10. Straight and curved Kelly forceps (2 each).

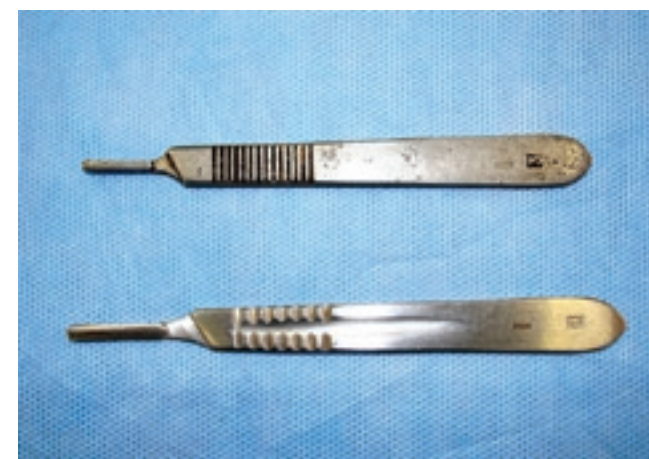
11. Straight Pean forceps (2).
12. Straight and curved Ochsner forceps (2 each).
13. Rochester – Carmalt forceps (2).
14. Ferguson angiotribe (1).
15. Saline bowl (1).
16. Towel forceps (8).
17. Hand held and self-retaining retractors (1 each).

### Proper use of the instruments:

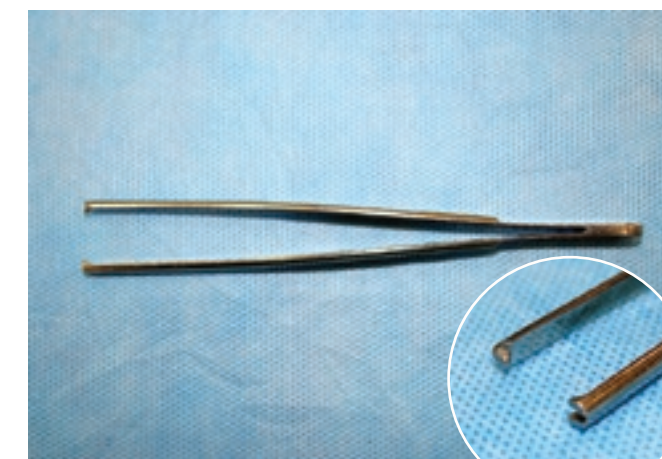
It should be taken as a general rule that the instrument is used only for the purpose it is meant for and should be handled in the correct way to get maximum performance required of it. Following is the general account of some of the basic instruments that are normally used in routine or special surgical procedures.

#### 1. Scalpel Handle (Bard Parker handle):

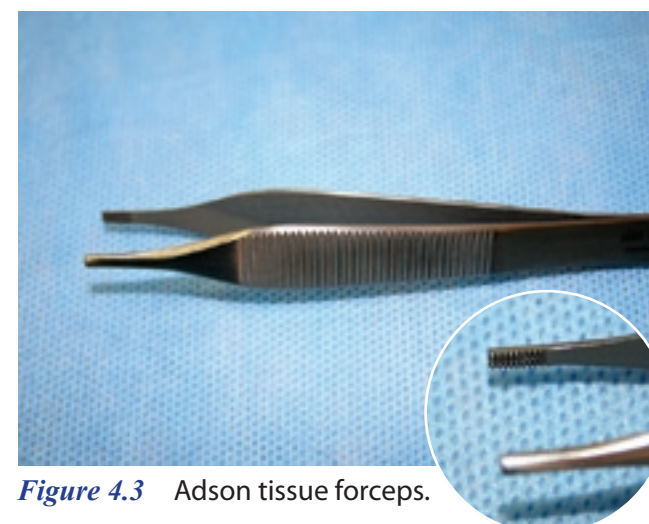
These are used for sharp dissection of the tissue with minimal damage to the surrounding tissue. These are detachable handles and are numbered 3 and 4. The blades used on them are disposable and are very sharp. The blades are numbered as No.10, 11, 12, 15, 20, 21 and 22; the first four adjust on No.3 and the last three fit on No.4 scalpel handle (Fig.4.1). The scalpel should be held so that it is under complete control of the operator. It is grasped between the thumb and the third and fourth fingers with the index finger placed on its back. While making an incision, proper pressure should be applied on the blade with the index finger, the aim being that a full thickness skin incision is given with a single stroke to avoid slicing of the skin with repeated efforts. It usually happens to the neophyte surgeon



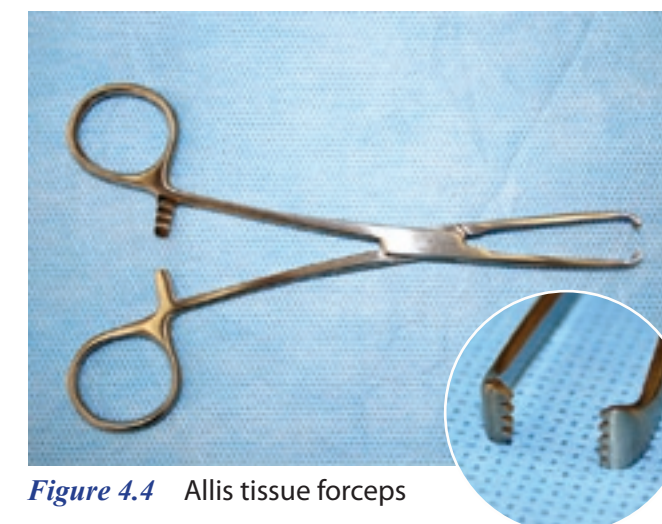
**Figure 4.1** Scalpel handle No. 3 (above) and No. 4 (below).



**Figure 4.2** Thumb tissue forceps. Note the teeth of the forceps.



**Figure 4.3** Adson tissue forceps.



**Figure 4.4** Allis tissue forceps

when adequate pressure is not applied necessary to cut through full thickness of the skin. To remove a used blade from the scalpel handle, it is grasped with a needle holder at its base, slightly bent to clear it from the hub of the handle and then pushed up over the end of the handle to remove it.

#### 2. Thumb Tissue Forceps:

The commonly used tissue forceps has two teeth on one jaw and one tooth on the other (2:1) and is used for grasping and holding the tissues (Fig.4.2). The teeth bite into the tissue and prevent its slipping from the instrument. Some surgeons are of the view that the teeth are traumatic to the hollow organs, while the others think that repeated slipping of the tissue from the toothless forceps may be more damaging to the tissues. However, the arguments go either way. The forceps should be held between the thumb and the index and middle fingers like a pen

in the left hand while the needle holder or the scalpel is held in the right hand. A left handed surgeon may find it easy in the reverse order.

#### 3. Adson Tissue Forceps:

This is a very delicate forceps with relatively long tips which have either very fine 2:1 teeth or transverse grooves on their inner sides (Fig.4.3). It is used for holding very delicate or soft tissues, such as joint capsules, synovial sheaths and the like tissues.

#### 4. Allis Tissue Forceps:

This is one of the grasping forceps with a ratchet device on the handles and is used for holding relatively larger amount of tissue. It has opposing edges, generally with five short teeth on one and four short teeth on the other jaw (Fig.4.4). When locked with the ratchet, the teeth on one jaw adjust in the recesses between the teeth of the other jaw and the



tissue is held more securely. They are used to grasp tissues like fascia and tendons and should not be used on visceral organs, as they are too traumatic for these tissues.

#### 5. Sponge Forceps:

This forceps also has ratchets on its handles and the tips are oval in shape with grooves on the inner sides (Fig.4.5). They are normally used in the inguinal approach for cryptorchidism to grasp the inguinal process.

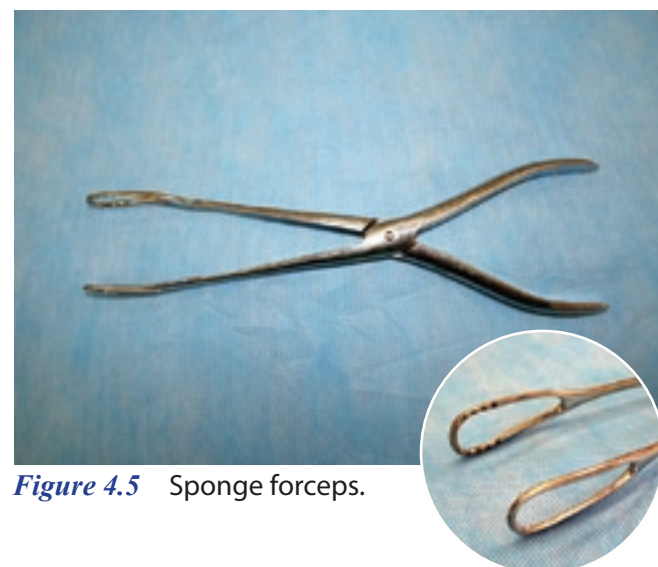


Figure 4.5 Sponge forceps.

#### 6. Scissors:

The Mayo (Fig.4.6) and Metzenbaum (Fig.4.7) are the most commonly used scissors during any surgical procedure. Generally speaking, the scissors should be light weight and sharp. One or both tips of the scissors may be blunt or sharp and hence, they can also be classified as sharp/sharp, sharp/blunt (Fig.4.8) and blunt/blunt scissors. Attention should be given to handling of the scissors during cutting of the tissues. The surgeon should have a complete control over the instrument and a wrongly held scissors will affect his efficiency. The scissors should be held by placing the thumb and the ring finger through the rings and setting the middle finger under and the index finger along the lower blade to act as supporting fingers. This gives a good control over the instrument which is necessary for controlled cutting of the tissues and dissection between the tissue planes. The last joint of the thumb and the ring finger should rest in the rings of the scissors and they should not be allowed to slip through them, otherwise one will feel it difficult to work properly. The scissors must not be closed unless the operator visualizes the tips of the blades, otherwise he may damage some important structure. The operating scissors should never be used for cutting the suture material; otherwise their cutting edges will become blunt.



Figure 4.6 Straight and curved Mayo scissors.



Figure 4.7 Curved Metzenbaum scissors.

#### 7. Suture Cutting Scissors:

Littauer stitch scissors which is generally used for the purpose has an indent on the tip of one jaw whereas the other tip is flat and blunt (Fig.4.9). It works well for cutting the ends of the sutures intra-operatively and for removal of skin sutures after healing of the wound. For cutting the ends of the sutures during operation, the blades of the scissors are used whereas the tips are used for removal of

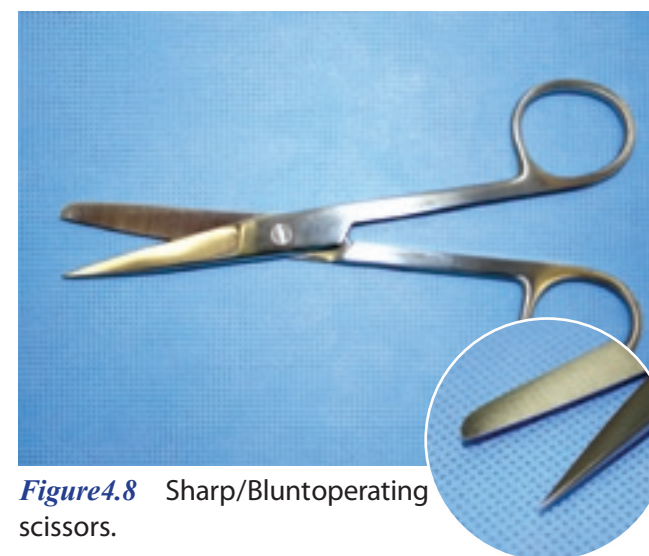


Figure 4.8 Sharp/Blunt operating scissors.



Figure 4.9 Suture cutting scissors.

the skin sutures. The suture is lifted up by holding its cut ends with a small hemostat and the indent in the tip of the blade of the scissors is passed under it and the suture is severed by closing the blades of the scissors.

#### 8. Needle Holder:

The needle holder or needle driver may be of the Mayo-Hegar (Fig. 4.10), Olsen-Hegar (Fig. 4.11) or Mathieu type (Fig. 4.12). The Olsen-Hegar type has a suture cutting scissors incorporated into the jaws and so can be used as a needle holder and suture cutting scissors at the same time. The heads of the needle holders have serrations so that the suture needle does not turn side ways during placement of the suture. The needle holder is held the same way as the surgeon would hold a scissors. Only the curved needles are held in the needle holder and



Figure 4.10 Mayo-Hegar needle holder.

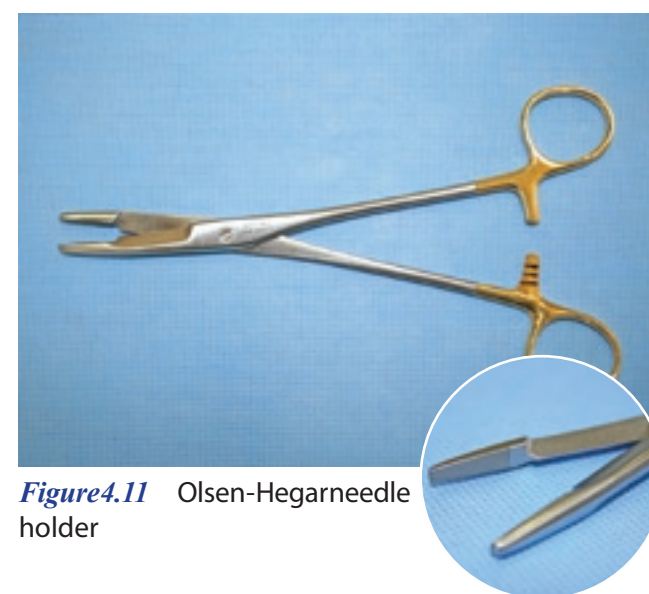


Figure 4.11 Olsen-Hegar needle holder

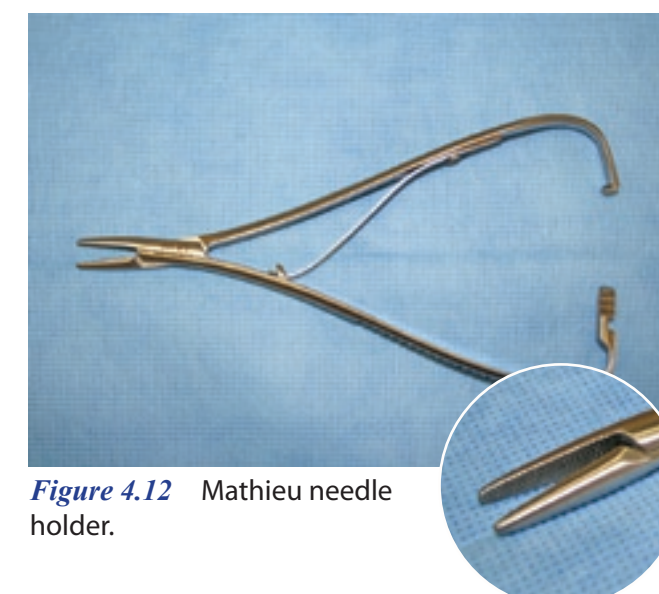


Figure 4.12 Mathieu needle holder.



the straight needles are held by hand. The needle should be grasped at its thicker portion almost in the middle rather than at the tip, as the tip can bend or break easily.

#### 9. Halsted Mosquito Forceps:

These are the smallest forceps and are used to clamp the ends of the small blood vessels to establish hemostasis (Fig.4.13). Hemostatic forceps are frequently used in conjunction with electrocautery. Curved forceps should be affixed to the blood vessel with the curved jaws pointing upward. After grasping the end of the blood vessel, the tip of the hemostat should be elevated a little to facilitate passing of the ligature around it.

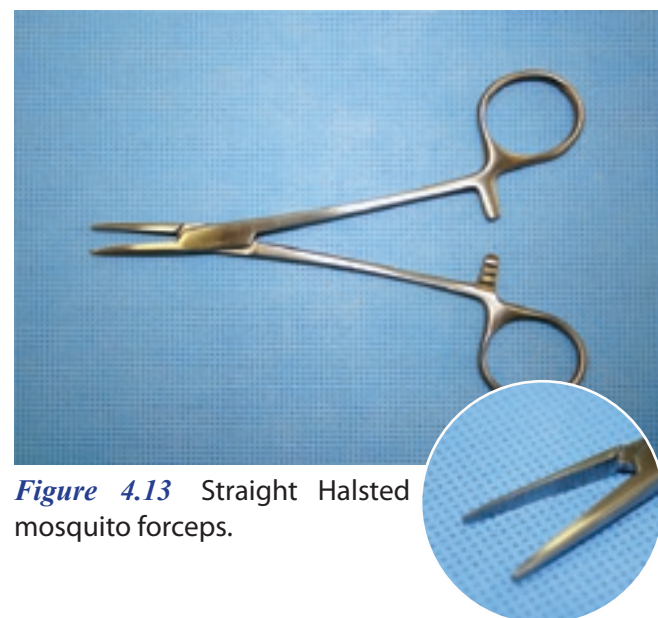


Figure 4.13 Straight Halsted mosquito forceps.

#### 10. Kelly Forceps:

These forceps are slightly larger than the mosquito forceps and are more suitable when ligation of larger blood vessels is needed (Fig.4.14). Sometimes very small amount of tissue along with the bleeding vessel may have to be taken into the forceps for ligation. In such a situation, as little tissue should be grasped in the forceps as possible. If large amount of tissue is taken in the ligature, the possibility of either the blood vessels not being occluded properly or slipping of the stump out of the ligature would exist leading to bleeding and obscuring the surgical field.



Figure 4.14 Straight Kelly forceps.

#### 11. Pean Forceps:

This forceps come with cross or longitudinal serrations on the jaws that are helpful in providing a good hold on the tissues (Fig.4.15). They are semi-crushing to the tissues and their application is normally restricted to the tissues that are destined to be removed from the body such as a tissue pedicle to be cut after ligation.

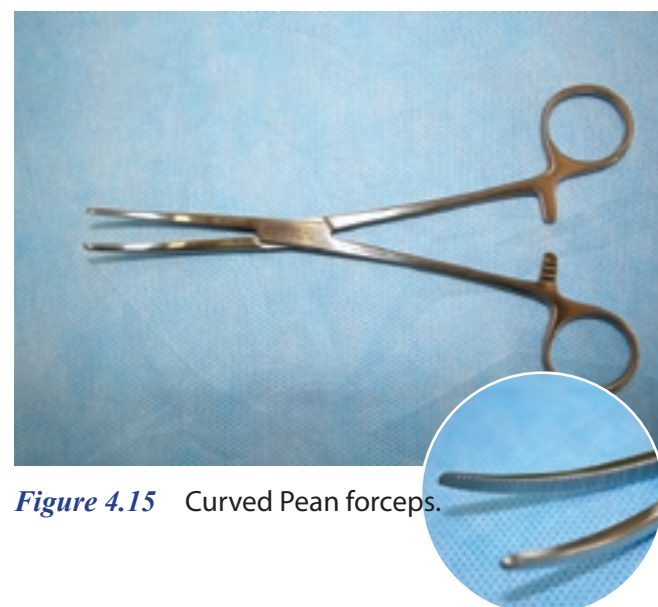


Figure 4.15 Curved Pean forceps.

#### 12. Ochsner Forceps:

This forceps has transverse serrations on the jaws with 2:1 teeth on their tips (Fig.4.16). They hold the tissue quite securely and are used for the same purpose as the Pean forceps. This forceps has an additional advantage of the teeth on its tips that add to its firmness.

#### 13. Rochester – Carmalt Forceps:

The jaws of this forceps have longitudinal serrations on the jaws, but the anterior third of the jaws also

are serrated transversely, thus making sort of small squares which increase the tissue holding power of the instrument (Fig.4.17). The longitudinal serrations serve to make a bed in a tissue pedicle for placement of ligature due to which the ligature fits in properly and the chances of its slippage are reduced to the minimum.

In order to minimize tissue trauma the smallest forceps that would securely hold the tissue should be used. Similarly, delicate forceps can get sprung if forced closed on excessive tissue masses.

#### 14. Ferguson Angiotribe:

This forceps has a deep groove on one jaw and a corresponding ridge on the other jaw with transverse serrations on the sides of either jaw (Fig.4.18). The ridge perfectly fits in the groove and the serrations on the jaws fix in each other in a dovetail fashion when the forceps is closed and locked with the ratchets. This is the most crushing of all the forceps and is basically used to crush small blood vessels in a tissue pedicle leaving no need to put a ligature. It should however, be used sparingly for this purpose and only for the pedicles with small blood vessels in them, as larger blood vessels may not be occluded completely. Sometimes postoperative bleeding has been noticed from the tissue crushed with the angiotribe.

#### 15. Saline Bowl:

This is a simple stainless steel bowl to keep sterilized water in it for moistening the swabs to be used during surgery (Fig.4.19). It should be plain without any grooves in it, so that it can be cleaned easily.

#### 16. Towel Forceps:

The towel forceps are of two types: Backhaus (Fig.4.20) and Jones towel clamps. These are used to attach drapes to the animal's body and pass through the drape and the skin of the animal.

#### 17. Hand held and Self-retaining Retractors

These are used to retract the tissues aside to maintain exposure at the surgical site. Hand held retractors are held by an assistant, whereas the self-retaining retractors anchor themselves against the wound edges (Fig.4.21). When abdominal or thoracic retractors are used, sterilized moist sponges or towels should be placed between the retractor blades



Figure 4.16 Straight Ochsner forceps.

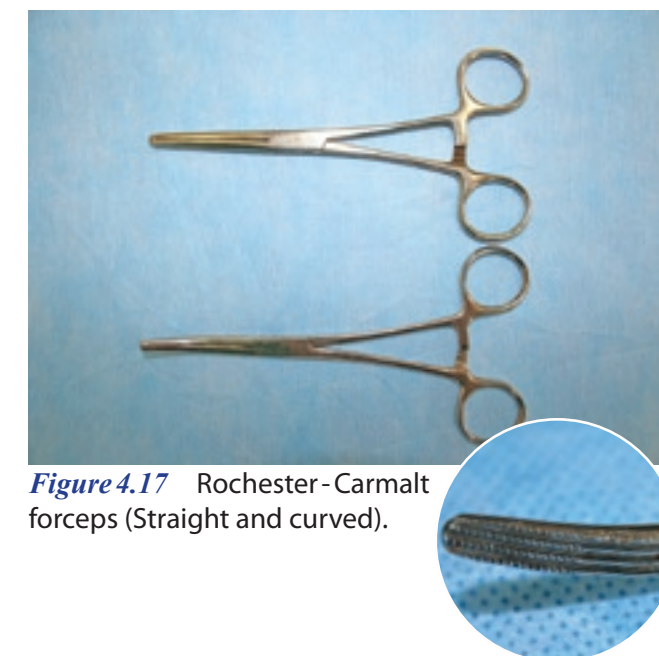


Figure 4.17 Rochester-Carmalt forceps (Straight and curved).



Figure 4.18 Ferguson angiotribe.





Figure 4.19 Saline bowl.



Figure 4.20 Backhaustowelforceps.

and the tissues to minimize trauma to the wound edges.

In addition, **Universal Bandage Scissors** is an almost daily used instrument in any small or large animal practice. It has plastic handles and the tip of the lower blade is also covered with a plastic cap (Fig.4.22). The plastic covered tip makes it quite easy to insert this blade of the scissors under the bandage without causing injury to the skin. The blades have serrations/dentitions on their cutting edges that help cutting through even thick layers of the bandage.

Apart from standard set of clinical instruments, the following instruments prove very useful for most commonly performed surgical manipulations.

### 1. Vulcellum Forceps:

This is a heavy, long handled forceps with a ratchet device and 2:2 long and sharp teeth at its tips (Fig.4.23). The space between the teeth on one jaw is greater than that on the other jaw and hence, the teeth of the latter very well adjust in the space between the teeth of the former. The teeth, when fixed in the organ, do not allow the latter to slip out of the forceps and the surgical procedure can be carried out with ease. It is very useful for grasping the dulaa in cases of dulaa resection.

### 2. Rumenotomy Forceps:

This forceps is also equipped with a ratchet device and 2:2 short but sharp teeth at its tips. There are small grooves on the sides of the teeth of both the jaws which allow the teeth to perfectly fix in the corresponding grooves when the instrument is closed

and locked with the ratchet (Fig. 4.24). It does not allow the tissue to slip out of it and due to its short teeth, is less traumatic to the tissues. It is mainly used to grasp the rumen wall during rumenotomy. It can however, also be used for grasping the dulaa.



Figure 4.21 Self-retaining retractors.



Figure 4.22 Universal Bandage Scissors.

### 3. Uterine Holding Forceps:

This is a rubber shod forceps to hold the uterine wall after hysterotomy incision, so that the uterus does not fall back into the peritoneal cavity when the fetus is being removed (Fig. 4.25). It is an atraumatic forceps, does not cause much pressure on the uterine wall to compromise its vasculature which leads to uncomplicated healing of the hysterotomy incision.

### Preparation of Instruments:

While preparing the instruments for surgery, it should be always kept in mind that proper sterilization of the instruments is one of the most important factors necessary to carry out an aseptic surgical procedure. The other factors of course, include proper preparation and draping of the operation site, preparation of the surgeon and the supporting staff and strict adherence to the operating room conduct rules mentioned under operating room protocol (see chapter 5).

Autoclaving, using moist heat from the steam is the most reliable method for preparing instruments for aseptic surgery. Gas sterilization using ethylene oxide gas is used for instruments that would get damaged by the heat of autoclaving. Cold (chemical) sterilization is commonly used in large animal practice for preparation of instruments by immersing them in commercially available chemical solutions. Some of these solutions may be quite irritating to the tissues, so one must be careful not to damage the tissues rather than doing anything good to them. Boiling the instruments is still a popular method to prepare them for surgery, but it should be restricted only for contaminated or dirty surgery and in no way is recommended for clean surgery. The boiling also dulls the sharp instruments.

As part of the overall planning, all the necessary instruments anticipated to be used in a surgery under plan, should be prepared before hand so that one may not be handicapped during the procedure. The misconception that there is no need to use sterilized instruments to operate in already contaminated tissues may be detrimental to the patient with devastating results, as the non-sterilized instruments may introduce a serious infection to the system.

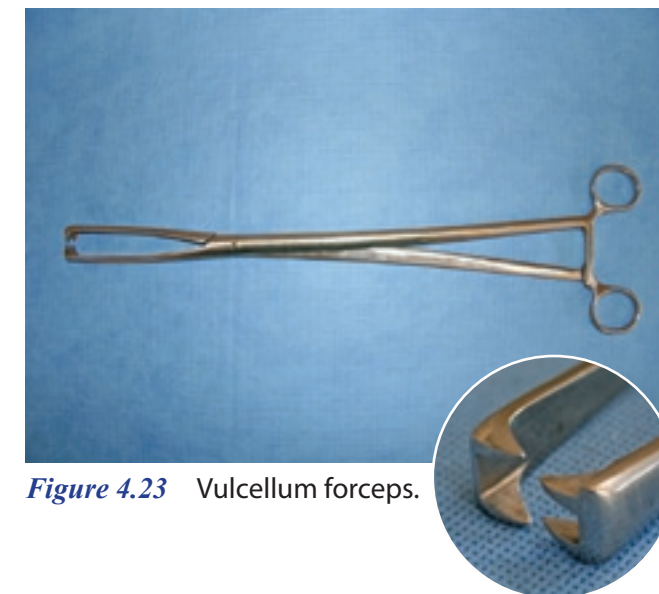


Figure 4.23 Vulcellum forceps.

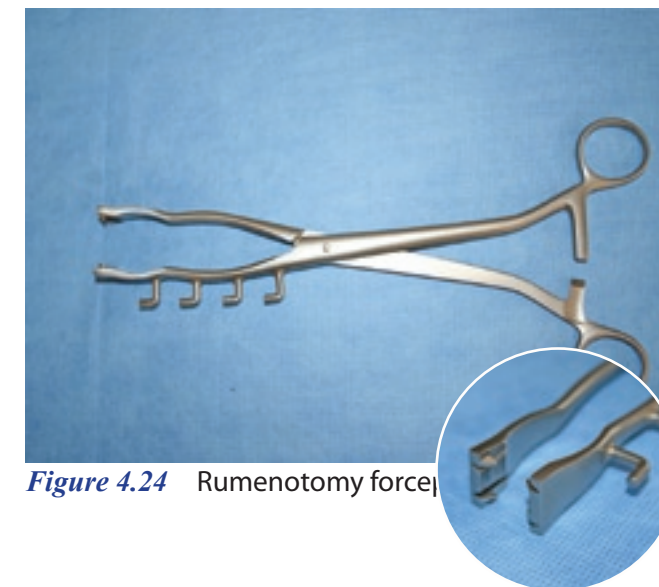


Figure 4.24 Rumenotomy forceps.



Figure 4.25 Uterine Holding forceps.



# CHAPTER

# 5

## Operating Room Protocol

The objective of this chapter is to give an idea of how to perform an aseptic surgical procedure and how to move about in the operation theater in order to avoid contamination. Operation theater in the hospital plays an important role towards well being of the patient and therefore, the rules laid down for working in the operation suit should be strictly adhered to and the sanctity of the operating room should be respected in letter and spirit. The operating room protocol essentially involves successive procedural steps including opening the packs, scrubbing, gowning and gloving and taking all the precautions discussed hereafter to carry out a surgical procedure in the aseptic environment.

All the people working in the operating room should be properly attired and should use caps and masks. The mask must be worn close to the face, tied securely so that breathing occurs through the mask and not around the perimeter and fixed so that it does not become loose during the operation. Scrub suits should be worn by all surgeons and operating room personnel. The shoes used in the operation theater should never be worn outside its premises.

### 1. Opening the Packs:

There are essentially two types of packs; the sterilized gown pack and the sterilized instruments pack, that are to be opened as the first step before the start of any surgical procedure. These packs are opened by the surgeon himself, by his assistant or by any other skilled operating room personnel without touching their inside surfaces (Fig.5.1, 2, 3 and 4).

The pack of the sterile gloves is then peeled open and the gloves are flicked over the sterile gown

without being touched (Fig.5.5 and 6). It is important to select gloves that fit as exactly as possible. The larger gloves are difficult to manage while the tight gloves fatigue the hands.

Sterile packs of the suture materials, scalpel blades are presented to the surgeon by peeling back the flaps and allowing the surgeon to grasp the item with the forceps or the item may be simply flung over the sterile instrument tray just before the start of surgery.

### 2. Scrubbing Technique:

Before starting to scrub, caps and masks are put on. The scrub follows a routine and comprises the following steps and is taken as a standard in most of the well established operation theaters.

1. The fingers should be free of finger rings and nails should be short, clean and in case of lady surgeons, free of polish. Long finger nails should be cut prior to proceeding.
2. The cap should cover all of the hair and a hood should be worn for beards.
3. The brush container is opened taking care not to touch the brush.
4. The water tap is opened with the elbow or foot and water flow is adjusted so that it does not flow with force to wet the scrub suit worn by the surgeon and the assistant surgeon.
5. The hands and arms to above the elbows are washed with good soap lather for at least 1 minute (Fig. 5.7).
6. The brush is taken out from the container and the finger nails, sides of the hands, between the fingers; palm and back of the hands are scrubbed with scrub solution taking no less than 1 minute



Figure 5.1 Step 1. Gently throwing the gown on the table after peeling off its pack.



Figure 5.2 Step 2. Uncovering the gown by lifting up one end of the cover.



Figure 5.3 Step 3. Lifting up the second end of the cover.



Figure 5.4 Step 4. Fully uncovered gown with hand towels (white) over the gown.



Figure 5.5 Peeling off the pack of the sterile gloves without touching the inside cover.



Figure 5.6 Throwing the covered gloves on the gown.



- for each. The brush is then discarded (Fig.5.8 to 5.10).
- Using the hands, the arms are then washed with a rotary movement proceeding from the wrist to 1 inch below the elbows, taking at least 1 minute for each arm (Fig.5.11).
  - Holding the hands higher than the elbows, the hands and arms are rinsed under running water and the water is allowed to spread from finger tips to the elbows.
  - The hands are again washed with soap and rinsed for 1 minute.
  - The hands and arms are kept away from the scrub suit and are dried with a sterile towel provided in the gown pack or packed separately (Fig.5.12 to 5.14). Care should be exercised to avoid letting the towel contact the front of the scrub suit by holding the towel well away from the body while drying the hands and arms.
  - The hands and arms are now considered surgically clean and should touch nothing but that which is sterile.

**This scrub is popularly known as “6 scrub” and must be performed prior to each surgery.**

### 3. Gowning and Gloving:

The gown is lifted from the open wrap, carried away from the table, held by the inside seams of the underarm area and allowed to unfold (Fig. 5.15).

The inside of the gown faces the surgeon. The arms are inserted into the sleeves but not pushed through the cuffs when “closed gloving technique” is to be employed (Fig. 5.16). A non-scrubbed assistant closes the back of the gown (Fig.5.17 & 5.18). The closed gloving technique employs the following steps.

- The hands are held in the sleeves 2 inches above the cuff edge (Fig. 5.19).
- The left thumb is hooked under the turned down cuff of the right glove on the palmar surface and the glove is picked up.
- The right thumb is hooked under turned down cuff of the right glove on dorsal surface and the glove is flipped over the right hand (Fig.5.20).
- The sleeve of the gown is grasped and pulled, pushing the right hand into the glove simultaneously (Fig. 5.21 & 5.22).
- The process is repeated for the left hand while substituting right thumb for the left (Fig.5.23 & 5.24).

- The gloving procedure may also be carried out in the reverse order. Care must be exercised not to allow the fingers of either hand to come in direct contact with the outside of either glove. After gowning and gloving, the hands should be clasped together and held above the waist and should never be folded against the chest (Fig. 5.25).

### Open gloving technique:

For minor surgical manipulations, such as draining of abscesses, enucleation of small tumor masses and repair of skin lacerations etc. gowning is not necessary. Wearing of sterile gloves only using the open gloving technique will suffice. The glove pack is peeled open on a table still wrapped in the inner sterile covering. The inner covering is then unfolded without touching the gloves. The left glove is picked up with the right hand from the folded cuff, is flipped over the left hand and the fingers and thumb are adjusted in their respective places without unfolding its cuff (Fig.5.26 to 5.28). Then the right glove is picked up with the gloved left hand in its folded cuff and is flipped over the right hand adjusting the fingers and the thumb in the respective places (Fig.5.29 & 5.30). The cuffs are then unfolded and straightened without touching the naked arm area (Fig. 5.31 to 5.33).

### 4. Operating Room Conduct:

- If a “break in the technique” occurs such as brushing against a non-sterile object with the gown or gloves, one should not hesitate to change them. It is much better to re-gown or re-glove than to risk disaster for the patient in the form of postoperative infection as a result of careless practice.
- All attempts to touch the face must be avoided after one is scrubbed and gowned (no matter how itchy it is, one should not scratch the nose).
- Unnecessary or unexpected quick movements should be avoided.
- Traffic in or out of the operating room should be kept to a minimum. There is conclusive evidence that operating room traffic and swirling of air as a result of traffic is a major factor in producing high bacterial counts in the atmosphere.
- All sterile surfaces should be kept dry. Moisture allows rapid transfer of bacteria through a drape, no matter how tight its thread weave is. A common

error is to allow spillage of saline on to the operating room table or instrument tray.

- If something is about to fall, let it fall rather than grab on it and contaminate the hands. Everything below the waist and below the edge of the surgical table is considered to be non-sterile.
- The back should never be turned on a sterile area, as the back of the gown is not sterile.
- Neither the surgeon should lean on a non-sterile area after he is gowned nor a non-sterile assistant should lean over a sterile area. A common error is when a non-sterile assistant leans over a sterile area to deliver a sterile instrument. This can be avoided by carefully presenting the instrument to the surgeon. As far as the scalpel blades and suture materials are concerned, these can be delivered to a sterile table by opening the peel back wrappers so that the contents are “flicked” forward; this can be done without leaning over the table or touching the item.

It should always be kept in mind that breaking the technique can nullify all the other efforts of presurgical preparation of the patient, surgeon and the equipment to perform an aseptic surgical procedure.



**Figure 5.7** Dispensation of soap through foot-operated soap dispenser to wash hands and arms.



**Figure 5.8** Scrubbing of finger nails with soap and brush.



**Figure 5.9** Scrubbing back of the hand.





Figure 5.10 Scrubbing between the fingers.



Figure 5.11 Washing of arms with rotary movement with the other hand.



Figure 5.16 Insertion of arms into the sleeves without taking the hands outside the gown cuffs.



Figure 5.17 Closure of the gown top by the assistant.



Figure 5.12 Holding the hands up to allow water to drip towards elbows.



Figure 5.13 Drying the hand with the sterile towel provided in the gown pack.



Figure 5.18 Tying the back straps of the gown.



Figure 5.19 Unfolding the gloves cover with hands still in the cuffs of the gown.



Figure 5.14 Drying the arm. Towel should not be taken from the arm back towards the hands.



Figure 5.15 Unfolding the gown.



Figure 5.20 Flipping the glove over the right hand.



Figure 5.21 Pulling the sleeve of the gown and the glove up adjusting the fingers and thumb in their respective places.





**Figure 5.22** Right hand perfectly adjusted in the glove.



**Figure 5.23** Flipping the glove over the left hand.



**Figure 5.28** Adjusting the fingers and thumb in the glove.



**Figure 5.29** Picking up the right glove from inside of its folded cuff.



**Figure 5.24** Both hands gloved with the aseptic technique.



**Figure 5.25** Hands clasped together above the waist without touching the chest.



**Figure 5.30** Flipping the glove over the right hand.



**Figure 5.31** Unfolding and straightening the cuff of the right glove.



**Figure 5.26** Picking up the left glove from the folded cuff.



**Figure 5.27** Flipping the glove over the left hand.



**Figure 5.32** Unfolding and straightening the cuff of the left glove.



**Figure 5.33** Open gloving technique completed.



# CHAPTER

# 6

## Restraint and Anesthesia

The camel; for all practical purposes, is classified as a semi domesticated animal; hence, physical restraint with or without slight sedation is necessary even in docile animals to carry out clinical examination and/or minor surgical manipulations. For major surgical interventions, one must go for local or regional blocks, deep sedation, tranquilization or general anesthesia.

### A. Physical Restraint

The following methods are generally used to control the animal in the standing and sternal position.

#### Standing Position:

##### 1. Nose halter (Khataam in Arabic language):

It is used to control the movements of the head and to make the animal to sit by pulling it with slight downward jerky movements. To make a nose halter, a rope is passed around the neck in the form of a loop with its free end being wound around both the jaws and again passed through the loop around the neck. Ready to use nose halters are also available with a metal ring at one end through which the free end of the rope is passed (Fig. 6.1).

A muzzle made of cotton / nylon strings or even metallic wires is also used to prevent bite attempts by vicious animals in the habit of biting the people (Fig. 6.2)

##### 2. Tying of Fore limb:

In the standing position, right or left fore limb is flexed at the knee joint and a rope is passed around the pastern and forearm in a figure of 8 fashion and

fastened tightly (Fig. 6.3). The hind limb can not be secured in this position.

##### 3. Grasping the nostrils:

Holding the animal from the nostrils and the lower lip greatly helps controlling the animal. The nostrils seem to be the most sensitive part of the body and even a very fractious animal would surrender when his/her nostrils are firmly grasped (Fig. 6.4).

##### 4. Hobbling (Gaithing in Arabic language) of the limbs:

A rope is passed around both the fore limbs and sometimes around the hind limbs with a turn in between the legs just above the fetlocks and tied securely (Fig. 6.5). This will render the animal unable to move either of the limbs in any direction to hit the person. This method is also routinely used to keep the animal from running. In the breeding males, this is a common practice in the non-breeding season to keep them controlled. Even in the breeding season, they are kept hobbled except when they are let loose for mating.

In the hind limbs, the rope is similarly passed just above the stifle joints and tied tightly (Fig. 6.6). This will cause a firm pressure on the quadriceps muscles of both the limbs and the animal will not be able to move them in any direction. This is however, done only sometimes when it is required to control the animal in the standing position at the time of physical examination, particularly the rear body.



**Figure 6.1** Nose halter (Khataam) to control head movements and to make the animal to sit.



**Figure 6.2** Muzzle to prevent bite attempts by the animal.



**Figure 6.3** Tying of fore limb.



**Figure 6.4** Grasping nostrils and lower lip to control the animal.



**Figure 6.5** Hobbling of the forelimbs to prevent kicking by the animal.



**Figure 6.6** Tying the hindlimbs together above the stifle joints to control movements of the hind limbs.



### Sternal Position:

#### 1. Tying of both fore and hind limbs:

In the sternal position, the fore limbs can either be tied separately with ropes or one of the fore limbs is first tied and then the same rope is passed over the neck to tie the other limb. For the hind limbs, a rope is passed underneath both the pasterns, the free ends of the rope are passed medial to thighs and firmly tied over the lumbar region (Fig. 6.7). In situations where the lesions are just in the posterior part of flank area or the sites from where the rope normally passes for tying the hind limbs, the rope may be passed from in front of the hump to make the site easily accessible for surgical manipulations (Fig. 6.8).



**Figure 6.7** Tying of both fore and hind limbs..

#### 2. Casting the animal:

After tying the fore and hind limbs of the animal in the sternal position, it can be cast in the desired lateral recumbency with the head firmly controlled by the attendant (Fig. 6.9). The attendant normally grasps the nostrils and keeps pressure on the neck of the animal with one of his knees.

In case of castration; the upper hind limb is further pulled forward and tied to the upper fore limb which gives enough space for surgical manipulation (fig. 6.10).

*Note : Slight sedation of the animal always proves advantageous along with physical control.*



**Figure 6.8** The rope passed from under the hind pasterns and in front of the hump to keep the flank area clear.

In addition to the standard physical restraint methods described above, the following non-conventional methods are sometimes used to control the untrained and vicious animals:

1. A long rope is passed around all the legs in 2-3 circles and both the ends of the rope are pulled tightly in opposite directions by the attendants (Fig. 6.11) forcing the animal to sit/fall down. As soon as the animal falls down, one of the attendants at once controls the head and pulls it back while the other holds the tail and pulls it backwards so that the animal is unable to stand up again. Then the fore and hind limbs are tied in the conventional methods.
2. Another technique is to apply nose halter to the camel and the end of the rope is tied to a fixed pole. Then a long rope is passed around all the legs in 2-3 circles and the ends of rope are

held steadily by two attendants (Fig. 6.12). This proves enough to keep the camel controlled in the standing position. This technique is useful for quick examination and giving injection to the animal.

3. A long rope is taken and one of its ends is tied in the center of the hobble of the forelimbs. The other end of the rope is then passed in between the hind limbs and is pulled backwards while the other attendant pulls the animal forwards with the help of nose halter till the animal falls down and then the animal is controlled as described above (Fig. 6.13).



**Figure 6.9** The sedated animal cast in the left lateral recumbency. See the attendant grasping the nostrils to control the head movements.



**Figure 6.10** Suitable restraint for castration. Note tying of upper hind limb to the corresponding forelimb to get enough space for surgery.



**Figure 6.11** Passing a long rope in 2-3 circles around all the legs to throw the animal down.



**Figure 6.12** Tying the end of the nose halter to a pole and passing a rope around all the legs to control the vicious animals.

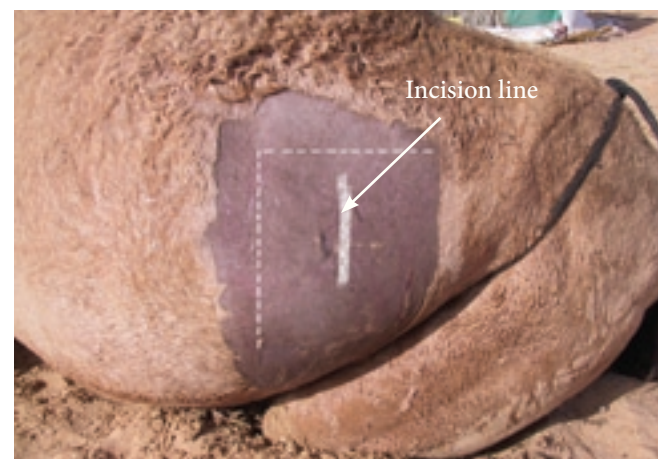


**Figure 6.13** A rope tied in the center of hobble of forelimbs and pulled backwards to cast the animal.





**Figure 6.14** Infiltration of the local anesthetic at the proposed incision site.



**Figure 6.15** Inverted "L" block to block the nerves entering the surgical field.

## B. Anesthesia:

Anesthetics are used for a variety of reasons, such as to minimize or eliminate pain, relax muscles and even to facilitate clinical examination and diagnostic procedures. Different anesthetic regimens in practice for other animals also hold true in the camel. In the camel however, sedation of the animal is preferred to local infiltration as it provides an easy restraint and is also safe for the operator. A detailed discussion of those procedures does not fall under the scope of this book; hence, only those anesthetic techniques will be described here that are used in routine practice and serve the purpose very well. The practitioner may choose any of these according to his needs. Needless to say here that many alternatives are also available and personal preferences may also differ. For specific techniques, the reader may consult any standard book on anesthesia.

### 1. Local and Regional Analgesia

The two analgesic agents most commonly used are 2% solution of lignocaine hydrochloride and 2% mepivacaine hydrochloride. Local and regional analgesic techniques that are routinely used are given below.

#### a. Local Analgesia:

This implies injection of the analgesic agent at the proper incision or surgery site to desensitize a limited local area. A small amount of analgesic agent is injected at an initial site with a small needle and then a longer needle is inserted through

the initial desensitized region and the analgesic agent is deposited. The skin and the subcutaneous tissues are infiltrated first and then the deeper layers such as muscles and the facial planes. Infiltrating injections should be made in straight lines and fanning should be avoided as it causes tissue trauma. This technique can be used for suturing wounds and for removing small cutaneous lesions. It may also be used in the form of a "line block" for laparotomy where the analgesic agent is injected along the line of incision (Fig. 6.14). However, this will cause tissue edema which may affect wound healing.

#### b. Regional Analgesia:

Regional analgesia is desensitizing a given region by blocking the major nerves supplying that area. This technique is quite commonly used and can be described under the following sub-heads.

##### i). Inverted L Block.

This is the simplest way of regional analgesia for flank or paramedian laparotomies. The analgesic agent is deposited in the form of an inverted "L" to create a wall of analgesia enclosing the surgical field thereby blocking all the nerves entering their in (Fig. 6.15)

##### ii). Paravertebral Block:

This technique involves blocking of the last thoracic and first and second lumbar nerves to achieve analgesia of the flank region as they supply sensory and motor innervation to the skin, fascia, muscles

and peritoneum of the flank. This region, particularly in the camel; may be the only choice for laparotomy to carry out rumenotomy, cesarean section and surgical manipulations on the abomasum and the intestines. The land marks to locate these spinal nerves are the tips of the transverse processes of the lumbar vertebrae. Anatomically, the nerve is most localized at the intervertebral foramen. After exit from the intervertebral foramen the nerve divides into dorsolateral and ventral branches and both of the branches are blocked, as described below; to completely desensitize the flank region.

#### Technique:

The tip of the transverse process of the first lumbar vertebra in the camel is not palpable; hence, the site is estimated relative to the distance between the transverse processes of the second and third lumbar vertebrae. An imaginary line, parallel and 2cm lateral to the midline of the body; is drawn from anterior edge of the transverse process of the second lumbar vertebra going about 10cm anteriorly. This point corresponds to the anterior border of the tip of first lumbar transverse process and is taken as the site for blocking the last thoracic nerve. A 16 gauge, 10cm long needle is introduced vertically at this point and when the point of the needle touches the anterior border of the tip of the first lumbar transverse process, the needle is slightly withdrawn and redirected under the tip and 10ml of the local anesthetic solution is deposited at this point. This will block the ventral branch of the last thoracic nerve. The needle is then gradually withdrawn and during this act, another 10ml solution is infiltrated to block the dorsal branch of the nerve.

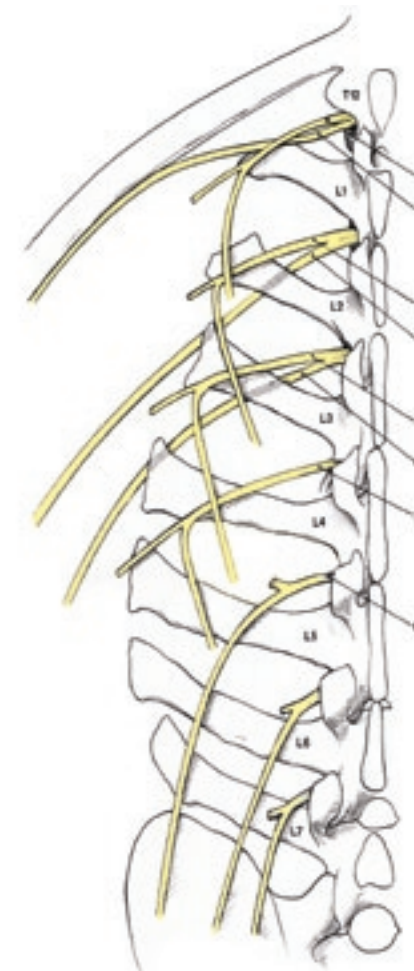
The midpoint of the lateral edge of the second lumbar transverse process is taken as the site to block the first lumbar nerve. After insertion of the needle at this point, 5ml solution is injected just above the transverse process and another 5ml is deposited during the act of withdrawing the needle. This will block the dorsolateral branch of the first lumbar nerve.

Similarly, to block the dorsolateral branch of the second lumbar nerve 5ml solution is deposited just above the lateral tip of the third lumbar transverse process and another 5ml is injected while withdrawing the needle. The needle is then redirected towards posterolateral edge of the second lumbar transverse process and 10 ml of the solution is

deposited under the process to block ventral branch of the first lumbar nerve.

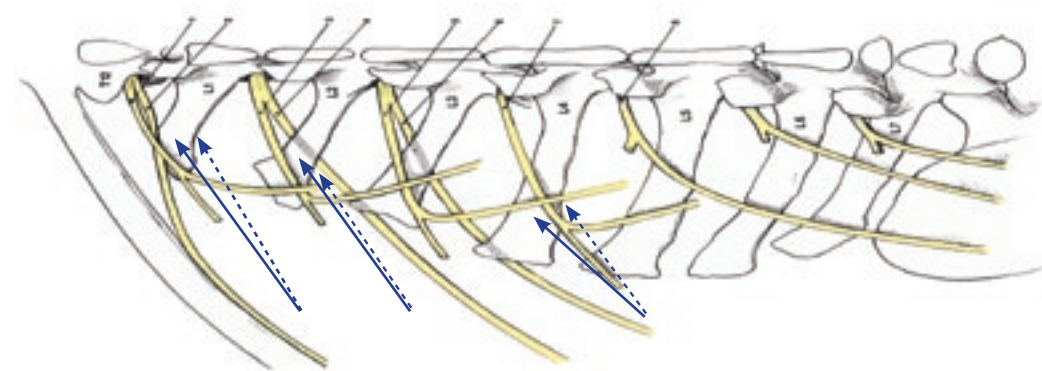
To block the dorsolateral branch of the third lumbar nerve, 5ml solution is injected at the posterolateral edge of the fourth lumbar transverse process and another 5ml is deposited during the act of withdrawing the needle. The needle is then redirected under the ventral aspect of the third lumbar transverse process and 10ml of the solution is deposited there. This will block the ventral branch of the second lumbar nerve.

The induction period of anesthesia is 10 to 15 minutes and the duration period is from 45 to 60 minutes. The incision site is tested and if the block has been properly placed, the animal does not resist the skin incision. Looking at the position of the last thoracic and 1st & 2nd lumbar nerves and their branches ( Fig. 6.16 ), one can appreciate the specific sites for injection of the local anesthetic drug as described above.



**Figure 6.16** Relative positions of the last thoracic and 1st & 2nd lumbar nerves and their branches for carrying out the paravertebral block.





**Figure 6.17** Arrows showing the sites of injection to block the dorso-lateral (—→) and ventral (---→) branches of the last thoracic and 1st and 2nd lumbar nerves.

### iii). Paralumbar Block (Magda Technique):

This technique, developed by Magda and modified by Cakala involves lateral approach to block the branches of the last thoracic and 1st and 2nd lumbar nerves by depositing the analgesic agent close to the ends of the first, second and fourth lumbar vertebrae respectively (Fig. 6.17). A 16 gauge, 10cm long needle is introduced under each transverse process towards the midline and 10ml solution is injected. The needle is then slightly withdrawn and is redirected cranially and caudally and another 5ml solution is deposited at each site. This will block the ventral branches of the nerves. Then the needle is redirected slightly dorsal and caudal to the transverse processes and 20ml of the analgesic solution is injected to block the dorsolateral branches of the nerves. This technique does not paralyze the lumbar muscles; therefore, lateral deviation of the spine does not occur. However, in the camel, as the surgery is not done with the animal in the standing position this point has no practical significance.



**Figure 6.18** Relaxation of the anal sphincter under the effect of epidural anesthesia.



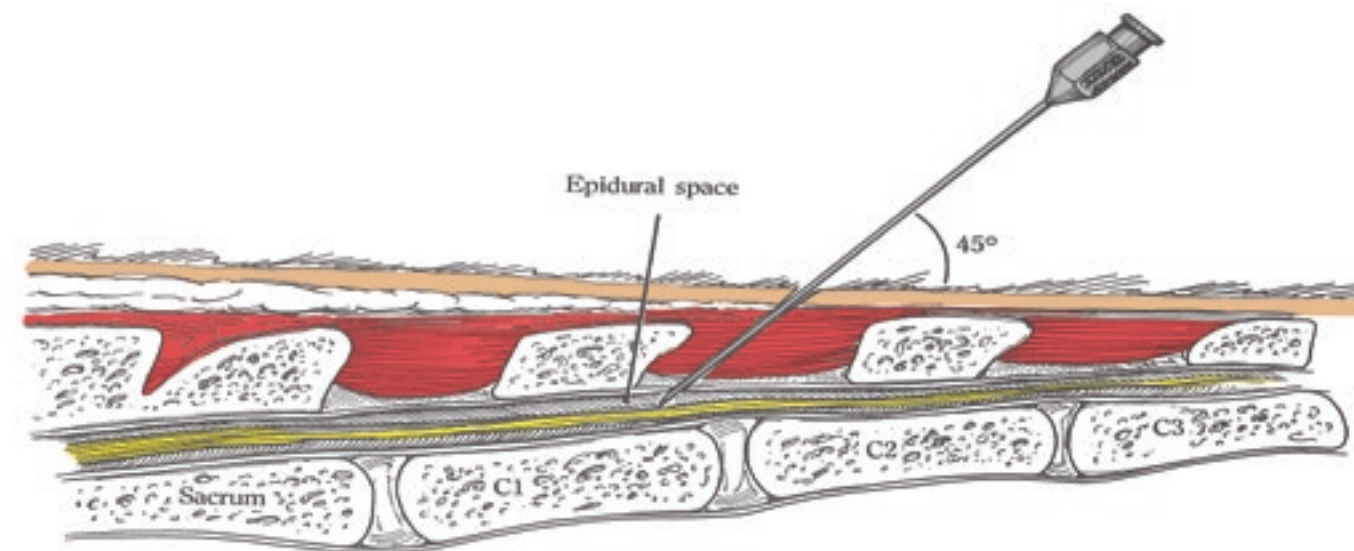
**Figure 6.19a** Epidural anesthesia.

### iv). Epidural Anesthesia:

This technique involves deposition of local analgesic solution between the dura mater and periosteum of the spinal canal (epidural space) to desensitize the caudal nerve roots after they emerge from the dura mater. According to the area of spread of the analgesic solution and the extent of the area in which sensory and motor paralysis develops, it can be divided into cranial (high) or caudal (low) epidural anesthesia. This effect actually depends upon the volume of the solution injected and on the diffusibility of the analgesic agent.

The usual dose is 1ml per 50kg of body weight of 2% solution of Lignocaine hydrochloride to get caudal epidural anesthesia which will result in loss of

sensory innervation of the anus, vulva, perineum and caudal aspects of the thighs but motor control of the hind legs is not affected. An effective block is indicated by a flaccid tail, ballooning of the posterior part of the rectum and relaxation of the anal



**Figure 6.19b** Epidural anesthesia. See the angle of the needle with position of its point in the epidural space.

sphincter (Fig. 6.18). For cranial epidural anesthesia, the usual dose is 1ml per 5 kg of body weight and it can be used for pelvic limb surgery and udder amputation in conjunction with deep sedation.

In the camel, as most of the surgical manipulations are done in the recumbent position, the dose varies between the doses for caudal and cranial epidural anesthesia. We, according to the condition we are dealing with; use the dose rate ranging between 0.5 to 1 ml of 2% solution of Lignocaine hydrochloride per 10kg of body weight in the sacro-coccygeal space to induce caudal and cranial epidural anesthesia respectively and to get the effects in between them. The cases of tail amputation, rectal prolapse, perineal lacerations, uterine prolapse, rectovaginal fistula, persistent hymen, transverse vaginal septum, vaginal adhesions, minor surgical manipulations on the hind limbs, repair of teat fistula and udder amputation can be effectively handled within this dose range. For manipulations on the udder and teats, it is always advisable to deeply sedate the animal along with epidural anesthesia. The dose of the anesthetic solution can be increased up to 1.5 ml per 10 kg of body weight to achieve complete relaxation of the hind legs for a longer time of up to two hours.

### Technique:

A 16 gauge needle is introduced into the sacro-coccygeal space at 45 to 50 degree angle exactly on the midline with the bevel of the needle pointing forward till its point touches the floor of the spinal canal (Fig. 6.19 a&b). No blood should ooze out of

the needle and if it happens, the needle should be slightly withdrawn, redirected and the anesthetic solution is then injected. If the needle is correctly placed, no resistance is felt while injecting the anesthetic solution.

### v). Ocular Analgesia:

Four point retrobulbar block is commonly performed by injecting the analgesic solution through the eyelids; both dorsally and ventrally and at the medial and lateral canthi (Fig. 6.20). A slightly curved, 8 to 10cm long 18 gauge needle is directed to the apex of the orbit from each of the four points and 10 ml of the analgesic solution is injected at each site. This will give a satisfactory anesthesia for enucleation of the eyeball, (See chapter 13).



**Figure 6.20** Ocular analgesia. Note the position of the needles for four-point retrobulbar block.



**vi). Nerve blocks for the limbs:**

The most common nerve blocks for surgical manipulations on the foot are the Volar and Planter nerve blocks in the fore and hind limbs respectively. After surgical preparation of the site, 5ml of 2% solution of Lignocaine hydrochloride is injected about 2 inches above the fetlock joint just cranial to the lateral border of the superficial flexor tendon on the medial as well as lateral side of the limb. The sites of the injection are gently massaged for dispersion of the analgesic solution into the perineural tissue which would subsequently diffuse into the neural tissue to produce its analgesic effects in the area supplied by those nerves. The other nerve blocking sites in the limbs that are commonly used in the horses such as Median, Ulnar, Peroneal and Posterior Tibial nerve blocks for detection of seat of lameness or minor surgical manipulations are not generally used in the camel and hence, are not mentioned here.

**vii). Intravenous limb Anesthesia:**

This technique is used to achieve local analgesia of the distal limb and has virtually replaced the techniques of specific nerve blocks of the limbs. It involves intravenous injection of local analgesic solution distal to a previously applied tourniquet.

**Technique:**

The animal is restrained in the desired lateral recumbency and the tourniquet of rubber tubing or with an umbilical tape is applied below the carpus or hock. The dorsal common digital vein in the metacarpal or metatarsal region is selected to inject 10 to 20ml of 2% solution of Lignocaine or Mepivacaine

hydrochloride (Fig. 6.21). It is important to avoid the use of lignocaine with epinephrine, because this combination may cause vasoconstriction sufficient to prevent desensitization. The needle is then withdrawn and the injection site is massaged to prevent hematoma formation. Anesthesia of the distal limb is achieved within 5 minutes and persists for about two hours if the tourniquet remains in place. At the end of the operation, the tourniquet should be released slowly over a period of 10 to 15 seconds and the limb will regain normal sensation in about 5 minutes. Toxicity related to the entrance of the anesthetic drug into general circulation has not been reported.

**2. Analgesia, Sedation and Tranquilization**

Analgesic agent is a substance that temporarily abolishes awareness of pain. Sedatives are narcotic agents used to calm a nervous, vicious or excited animal whereas tranquilization brings about behavioral changes in the animal, where by the patient becomes relaxed and unconcerned about its surroundings (Fig. 6.22). The main drugs used in the camel in this connection include acepromazine, xylazine, detomidine, chloral hydrate and diazepam.

In routine practice the animal can be sedated with Xylazine and Ketamine Hydrochloride at the dose rate of 0.4 mg. per kg of body weight of each drug given intravenously. Both the drugs can be mixed in the same syringe. The recommended dose is for a perfectly healthy animal and should be modified according to the health status of the individual. Hence, the physical examination is mandatory and laboratory evaluation should be carried out if thought necessary. It is however, advisable to administer half of the recommended dose initially and supplemented if necessary. The effect lasts for 30-40 minutes and recovery period is about 60-70 minutes.

Camels are prone to regurgitation and aspiration pneumonia, especially if the pressure is exerted on the abdominal cavity, such as in lateral recumbency. It is therefore, advisable to keep the animal fasting at least for 24 hours prior to induction of sedation or tranquilization provided the situation does not demand an emergent procedure to be carried out. In such a situation, it is better to go for a regional or local block with slight sedation if necessary.



**Figure 6.21** Intravenous limb anesthesia. Note the needle in the dorsal common digital vein in the metacarpal region.



**Figure 6.22** A 6 year old male camel deeply sedated for castration using xylazine and ketamine combination intravenously.



**Figure 6.23** General anesthesia with a combination of Isoflurane, Nitrous oxide and Oxygen. Note the position of the self-retaining mouth gag and endotracheal tube.

**3. General Anesthesia**

Most of the surgical procedures in the camel can be performed under sedation and local anesthesia. However, the use of general anesthesia; injectable or gas inhalation, becomes mandatory in some situations such as for internal fixation of fractures and the procedures like limb and udder amputations; the later two procedures can also be carried out under cranial epidural anesthesia along with deep narcosis or under total intravenous anesthesia (TIVA) using 10% aqueous solution of a combination of equal quantities of Chloral hydrate and Magnesium sulphate. An intravenous dose of 12g per 100 kg of this mixture is used to effect. The general anesthesia provides ideal situation for aseptic surgery, proper handling of tissues and hemostasis which go a long way towards better outcome and minimal postoperative complications.

Before induction of general anesthesia the animals should be kept fasting unless the urgency of the problem precludes it. In the adult animals, the food should be withheld for 36 to 48 hours and water for 12 to 18 hours. This precaution will decrease the chances of potential hazards of bloat and regurgitation with possible aspiration of the ruminal contents in this animal. To proceed for gas inhalation anesthesia the animal is deeply sedated and the endotracheal tube is passed as described below.

**Technique of Endotracheal Intubation:**

Sedation of the animal with xylazine and ketamine hydrochloride at the recommended dosage is the standard procedure with us before induction of

inhalation anesthesia. After premedication, endotracheal intubation may be accomplished by blind passage of the tube into the pharynx coupled with external manipulation of the larynx. In our routine practice, we keep the mouth of the animal opened with a self-retaining mouth gag and pass the endotracheal tube with direct digital manipulation of the oropharynx. A soft, pliable rubber pipe of a diameter smaller than that of the endotracheal tube is taken and passed through the lumen of the later. The rubber pipe is then digitally passed into the larynx by pushing aside the epiglottis and the endotracheal tube is then slid over it into the larynx and down into the trachea. The rubber pipe is then taken out. The animal is then anesthetized with gas inhalation anesthesia and the mouth gag is removed when the animal is fully anesthetized (Fig. 6.23).

Inhalation gas anesthesia, such as isoflurane or halothane combined with Nitrous oxide (NO<sub>2</sub>) and Oxygen (O<sub>2</sub>) is the best choice, as the depth of the anesthesia can be easily controlled and recovery is also smooth and rapid. When halothane or isoflurane is used for induction, the initial concentration is kept on 5% to complete induction. The anesthesia is then maintained by an oxygen flow of 4 to 5 liters per minute with the halothane or isoflurane concentration of 1 to 3% for the adult animal. Calves can generally be maintained at a concentration of 1 to 1.5%. The recovery from anesthesia is usually smooth, but the animal should be supported in the sternal recumbency to eliminate the chances of aspiration of the ruminal contents.

### C. Transportation of injured animals:

Although most of the cases in the camels can be treated at the farm, yet it sometimes becomes necessary to bring the animals to the hospital when it is not possible to treat them in the field; such as for internal fixation of fractures and major abdominal surgical manipulations. Special precautions should be observed when the traumatized animals need to be shifted to the hospital. This is particularly true when the animal is suffering from fractures/dislocations, as slight mishandling may convert a simple fracture into a compound or complicated one during shifting rendering the prognosis more grave than those of the original injury.

In case the animal is suffering from fracture of a limb bone, the later should be immobilized with a heavy bandage with wooden or metal splint incorporated in it. Even temporary Plaster of Paris cast may be applied to avoid any further damage to the limb. Deep sedation of the animal is always advisable and quite helpful in such situations. All the limbs are tied with ropes and then the animal is placed in a vehicle or ambulance with the help of a crane or the crane fitted vehicle itself. A soft bedding should be provided on the floor of the vehicle being used to transport the animal to avoid skin bruises. An attendant must be present with the animal to control its unexpected movements. The driver should have strict instructions to drive the vehicle smoothly and to avoid sudden application of the brakes. While in the hospital, the animal is then hung with the crane arm and taken to the operation theater for proper treatment (Fig. 6.24).



**Figure 6.24** Shifting of the sedated animal to the operation theatre with the help of crane.

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# CHAPTER 7

## Monitoring of the Surgical Patient

**M**onitoring is defined as the observation, measurement and recording of clinical and physiological variables. Surgical patients are monitored because they are in a dynamic and potentially compromised physiologic state, needing repeated assessment of the selected variables. The evaluation of the surgical patient may be based on the following criteria.

### 1. General Condition:

The evaluation of parameters of general condition of a surgical patient, such as its attitude, alertness, appetite and frequency of defecation and urination are valuable but still are nonspecific indicators.

Attitude and alertness are mental states that reflect the overall comfort and condition of the patient. Normalcy of these parameters is a reflection of adequate brain perfusion and oxygenation.

A good appetite is a further indication that the animal is enjoying an overall physical comfort. Injury, illness and a non-familiar environment definitely alter or affect the appetite of a patient. However, in camels it may be quite a variable parameter, as this animal generally retains the appetite in minor physiologic alterations.

The frequency of urination is of course difficult to monitor but must be a concern in a critically ill patient. As far as defecation is concerned, it can be monitored. The formation of fecal pellets and their shape and loose or watery feces will give a clue of the gastrointestinal tract function.

Monitoring water consumption is a useful method of evaluating the overall condition of the patient. The camel, due to its habitat and physiology, is of course, famous for conservation of its body water

but the intensive husbandry of the modern camel has definitely given rise to this concern. Therefore, decreased water consumption in a surgical patient is a definite indication for thorough monitoring of the cardiovascular parameters.

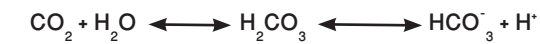
### 2. Body Temperature:

It should be monitored on daily basis unless the clinical condition of the patient dictates more frequent monitoring. A slight rise in body temperature is expected for about 48 hours after surgery and anesthesia due to pain, stress of anesthesia and break down of proteins from tissue destruction. A fever that persists or starts after 48 hours of surgery is generally not related to surgical or anesthetic stress. Common reasons for postoperative fevers include infection of the surgical site or body cavities. Local, draining surgical wound infections and peritonitis generally cause mild to moderate fever. Treatment of fever with non-steroidal anti-inflammatory drugs to improve patient's comfort is controversial, because it may mask local or systemic infection. Fevers approaching the critical temperatures and fevers that significantly affect the appetite and well being of the patient should be treated immediately on the basis of the probable cause.

### 3. Ventilation Status:

Close monitoring of the patient's ventilation, oxygenation, hydration and acid-base status during preoperative and postoperative period is of paramount importance and ensures early recognition and effective management of surgical complications.

Blood gas monitoring should be used to assess the respiratory and acid-base status of the intensive care patients and to evaluate ventilation during general anesthesia. Carbon dioxide accumulation from reduced ventilation results in respiratory acidosis through the release of hydrogen ions as under.



Respiratory acidosis and hypoxemia are commonly encountered in patients under general anesthesia. Although arterial blood gas monitoring gives most accurate results with regard to respiratory system, venous samples can also provide information relative to disposition of the cardiovascular system. Venous blood containing high partial pressure of oxygen is an indication that peripheral shunting of arterial blood is taking place around or through the capillary bed and this is encountered in endotoxic shock.

### 4. Cardiovascular Monitoring:

This system should be monitored before, during and after surgery regardless of the procedure performed. Color of the mucous membranes, capillary refill time, pulse frequency and amplitude, cardiac auscultation and skin turgor estimation of the hydration status can give good information about the animal's condition.

The color changes in the mucous membranes (brick red in the vasodilatory phase of septic shock, progressing through the cyanotic "muddy" appearance in the vasoconstriction phase), a weak and irregular pulse and capillary refill time of greater than 3 seconds with cold extremities are obvious clinical signs of a severe hypovolemic situation. Although these signs do not give a quantitative estimate of the volume deficit, they do indicate an urgent need for rapid infusion of intravenous fluids. The quantity of fluids given is based upon the patient's response to therapy rather than on any previous calculations.

### 5. Fluid, Electrolyte and Acid-Base Balance:

In general there are four essential principles of fluid therapy: the replacement of existing deficits, the fulfillment of the maintenance requirements, the replacement of the anticipated additional losses and monitoring of the patient's response to therapy.

Effective monitoring of the fluid and electrolyte balance requires an understanding of the distribution of total body water into different body compartments. Total body water normally accounts for 50-65% of the body weight depending upon the age of the animal; the neonates having a higher percentage than the adults and old animals. Assuming the total body water as 60% of the body weight, approximately 40% is in the intracellular and 20% is in the extracellular compartment. The water of the extracellular compartment is further distributed into interstitial (10%), intravascular (4%) and transcellular water (1.5%). The remainder 4.5% water of the extracellular compartment is contained in bones and dense connective tissue. Both the intracellular and extracellular compartments communicate and compensate each other in the hour of need.

Sodium is the primary extracellular cation, Potassium is mainly concentrated intracellularly, where as Chlorides and Bicarbonates are major extracellular anions. Disturbances in the fluid and electrolyte balances with consequent acid-base abnormalities are expected in the surgical patient due to fluid and blood loss from the extracellular compartment. This loss results in hypovolemia which is defined as the depletion of extracellular fluid, which in turn results in reduced plasma and interstitial volumes. Severe reduction in extracellular water results in a potentially life threatening decrease in tissue perfusion.

The effect of volume depletion on acid-base balance and plasma sodium, potassium and bicarbonate concentrations is variable. Most hypovolemic patients may have normal acid-base measurements. However, the base line laboratory data must be obtained before instituting the fluid and electrolyte therapy to avoid over correction of the problem. This should be a particular concern with the fluids containing potassium, as both hyperkalemia and hypokalemia are detrimental to the cardiac functioning.

The usual reason for administering fluid therapy in the surgical patients is the volume replacement. Dehydration up to 5% is clinically unapparent. Severe weakness, capillary refill time of more than 4 seconds, 2-3 times increased heart rate, obviously sunken eyes; prolonged skin tenting and dry mucous membranes are signs of 10-12% dehydration. Accuracy of evaluation of intermediate hydration states develops with the clinical experience. Most

of the domestic animals undergo coma or collapse to dehydration ranging between 12 - 15 %. A perfectly healthy camel can tolerate up to 40% of dehydration due to the reasons that plasma volume is maintained at the expense of tissue fluid and hence the circulation is not impaired. The erythrocyte of camel is small and oval and therefore, is able to circulate even in situations of increased blood viscosity. The kidneys are also capable to concentrate the urine to a marked degree to reduce water loss. The urine can become thick like syrup and can have twice the salt contents of sea water. Camels can take very large quantities of water at a time to replenish the previous fluid losses. In other animals this can result in severe osmotic problems, but in camels this problem does not occur because the water is absorbed very slowly from their stomach and intestines, allowing time for equilibration. In addition, the erythrocytes of this animal can swell up to 240% of normal size without bursting whereas the erythrocytes of the other species can swell only up to 150% before they burst. They can also extract water from their fecal pellets to the extent that these can be used immediately for fuel upon voiding. A further adaptation solely for heat is involved in the ability of camel to have large fluctuations in body temperature ranging between 36.5 °C to 40 °C. During day time, camels' body acts as a heat sink, while in the cool night of the desert, excess body heat is dissipated by conduction. However, it does not hold true when dealing with a diseased animal. Therefore, it is advisable to correct the problem in the early stages, as undue delay can result in irreversible damage to the system and death of the animal. Volume replacement is a crucial part and is aimed at improving the cardiac output, tissue and organ perfusion and the acid-base status.

Two basic approaches are available in fluid replacement of the surgical patient. The first approach is to adopt the standard protocol devised to meet the anticipated deficits and the second approach is to obtain clinical and laboratory data on the individual patient and to administer the appropriate fluids to meet the patient's specific requirements.

The first approach is simple and is very suitable for the practitioners working in the field and is also quite satisfactory during routine elective surgery. However, for a systemically ill patient, it is better to obtain the base-line values of the patient's fluid volume, acid-base balance and electrolyte status.

The practical methods available for assessing volume deficits in the surgical patient include the surgeon's clinical assessment and knowledge of the pathophysiology of the disease, estimation of PCV (Packed Cell Volume) and TPP (Total Plasma Protein) and probably the most important, the serial evaluation of the response to replacement therapy by both clinical examination and estimation of PCV and TPP.

The volume of fluid deficit required is calculated on the basis of the dehydration percentage and weight of the animal according to the following formula:

liters deficit = 
$$\frac{\% \text{ dehydration} \times \text{body weight (kg)}}{100}$$

Example:

$$\frac{7\% \times 500 \text{ Kg}}{100} = 35 \text{ liters}$$

As a general rule, half of the calculated fluid may be given in the first 3-4 hours and the rest is administered during the following 12 hours to avoid any chances of pulmonary edema. However, the attending clinician should be the best judge to decide the protocol according to the condition of the patient.

Diagnosis of Acid-Base Imbalance:

Two methods currently used in veterinary medicine to evaluate acid-base status of a patient are the blood-gas analyzer, which provides accurate measurements of pH, Pco<sub>2</sub> and Po<sub>2</sub> and the Harleco CO<sub>2</sub> apparatus which measures total Carbon dioxide. The pH represents the net effect of the influences of the respiratory (Pco<sub>2</sub>) and metabolic (HCO<sub>3</sub><sup>-</sup>) mechanisms. A Pco<sub>2</sub> of greater than 45 mmHg indicates respiratory acidosis, whereas a Pco<sub>2</sub> of less than 35 mmHg indicates respiratory alkalosis.

The magnitude of the metabolic component is identified either by the bicarbonate concentration (HCO<sub>3</sub><sup>-</sup>) or the base deficit / excess status. Base deficit / excess is a more accurate measurement for quantitative changes in the metabolic component. Base deficit / excess is defined as the titratable acid or base respectively when titrating to a pH of 7.4 under standard conditions of Pco<sub>2</sub> (40 mmHg), temperature (38 °C) and complete hemoglobin saturation. A base deficit of less than -4 mEq/L indicates metabolic acidosis and a base excess of more than +4 mEq/L indicates metabolic alkalosis.

In large animals, most acid-base imbalances of respiratory origin occur during anesthesia as a result of hypoventilation or hyperventilation. To identify acid-base disturbances of this origin, arterial blood samples are necessary which can be easily taken when the animal is under anesthesia. Treatment of respiratory acidosis involves proper ventilation. Respiratory alkalosis is generally iatrogenic or compensatory.

In evaluating acid-base imbalances of metabolic origin, venous blood samples suffice. Severe metabolic acidosis should be treated with infusions of Sodium bicarbonate. Using the blood-gas data from a patient suffering from severe uncompensated metabolic acidosis, the following equation can be used to calculate the required bicarbonate therapy to correct the problem.

$$\text{Required HCO}_3^- = \frac{\text{Base deficit} \times \text{Body weight(Kg)} \times 0.3}{\text{Equivalent weight of bicarbonate}}$$

Example:

Laboratory Data:

pH	7.20
Pco <sub>2</sub>	32 mmHg
HCO <sub>3</sub> <sup>-</sup>	12 mEq / L
Po <sub>2</sub>	85 mmHg
Base deficit	13.5 mEq / L

Calculation of the required bicarbonate therapy:

$$\frac{13.5 \times 500 \times 0.3}{12} = 168.75 \text{ gm of HCO}_3^-$$

The bicarbonate deficit may also be calculated from the bicarbonate level using the following formula.

$$\frac{(\text{Measured HCO}_3^- \text{ level}) - (\text{Normal HCO}_3^- \text{ level}) \times \text{Body weight (Kg)} \times 0.3}{\text{Equivalent weight of bicarbonate}}$$

$$\frac{(12) - (25) \times 500 \times 0.3}{12} = 162.5 \text{ gm of bicarbonate}$$

This example demonstrates the general approximation between using base deficit and the measured bicarbonate levels.

The factor 0.3 is an approximation of the volume of distribution of bicarbonate, which is mostly accounted for by the extracellular fluid compartment.

If blood-gas machine is not available, Harleco Carbon dioxide apparatus can be used to measure bicarbonate excess or deficit in the light of the following formula. The addition of acid to serum or plasma results in the liberation of free Carbon dioxide, which is almost completely bicarbonate in origin.

$$\text{Total CO}_2 = \text{Dissolved CO}_2 (\text{Pco}_2 \times 0.03) + \text{HCO}_3^-$$

Whereas the dissolved carbon dioxide = ( 40 × 0.03) = 1.2 mEq / L. The bicarbonate; can therefore, be estimated by the following formula.

$$\begin{aligned} \text{HCO}_3^- &= \text{Total CO}_2 - \text{Dissolved CO}_2 \\ &= \text{Total CO}_2 - 1.2 \text{ mEq / L} \end{aligned}$$

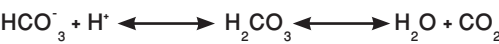
The cases of metabolic alkalosis (Base excess) can also be calculated using the same formula. If specific therapy is required; such as in abomasal disorders, normal saline solution can be administered and the acid-base status is monitored until it returns to normal. This will replace the lost volume and restore depleted chloride levels, which are the cause of alkalosis. Dilute hydrochloric acid, administered until the base excess is corrected, can also improve the condition of the animal. Typical preparation of diluted hydrochloric acid contains 0.1 N solution i.e 100 mmol H<sup>+</sup>/L [mEq/L] in dextrose 5% or 0.9% NaCl. Hydrogen ion deficit in [mEq] can be calculated as under:

$$0.3 \times \text{weight (kg)} \times \text{measured HCO}_3^- - \text{desired HCO}_3^-$$

Rate of H<sup>+</sup> replacement should not exceed 0.1 - 0.2 mEq/kg/hour.

As far as requirements of electrolytes and correction of acid-base abnormalities are concerned, one should always decide on the basis of the laboratory base line values. The required fluid and electrolyte therapy should be carried out at the earliest, as time factor in such cases is very important and undue delay may lead to irreversible damage to the animal.

It is always better to send samples for laboratory evaluation during the treatment as well to check improvements in the base line values and to avoid any chances of under or over correction. However, it is always better to under correct the problem and let the final tuning be done by the animal itself. For example, over administration of bicarbonate to a patient suffering from metabolic acidosis will produce more carbon dioxide which could potentially diffuse across the blood-brain barrier in preference to bicarbonate.



This increased carbon dioxide concentration in the CSF could cause the same reaction to be driven to the left, increasing hydrogen ion concentration in the CSF and thereby resulting in acidosis of cerebrospinal fluid, known as paradoxical acidosis of the CSF.

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# CHAPTER

# 8

## Wound Management

The aim of this chapter is to discuss some fundamental principles of wound management in large animals with particular emphasis on camel. Wounds can be handled in many ways and these sometimes heal despite what we do, rather than because of what we do.

For a better and systematic understanding of this important topic, it has been summarized in the following order.

### Initial Assessment:

1. An overall, whole body condition of the animal is assessed.
2. Vital signs are examined and any signs of shock or exhaustion are noted.
3. A careful history is taken, as it may have an important bearing on the management of the injury, such as handling of a punctured wound is quite different from that of a simple injury.
4. The location of the wound with its regional anatomy and damage to the important structures such as muscles, tendons, bones, blood vessels and nerves is then assessed to give reasonable prognosis.

### How to Decide:

The decision whether to close a wound to achieve primary intention healing or to let it heal by secondary intention actually should be based upon experience, duration, the extent of damage to the tissue, the degree of contamination and the anatomic location of the injury. Our experience shows that it amounts to losing of time if one strives for primary intention healing in the camels.

The so called “Golden period”, that is the time soon after injury during which the wound is contaminated, but not to a point where the contamination can not be overcome by the natural defence mechanisms of the body is highly variable. This period is usually a number of hours, but its length varies. The classic example is the difference between a wound on the head and a wound on the distal extremity of the limb. A wound on the head may heal by first intention even after 24 hours delay, whereas a wound on the distal limb may not respond to primary closure after several hours.

As a rule of thumb, any wound showing signs of infection, as evidenced by heat, pain and swelling should not be closed. It should be left open to heal by secondary or by the process of tertiary intention. On the basis of this discussion, the following guidelines are suggested to achieve the desired objective as far as wound healing is concerned.

### Primary-Intention Healing:

If the conditions favorable for primary closure of the wound exist, go for the following steps.

1. Chemical restraint of the animal such as with tranquilization or even with general anesthesia in too fractious animals is preferable to carry out desired surgical manipulations. Local or regional anesthesia may be used in docile animals.
2. Direct infiltration of the wound edges with local anesthetic is avoided because it may drive contamination deeper into the wound.
3. Necessary excision and debridement of the wound is done to convert a contaminated wound

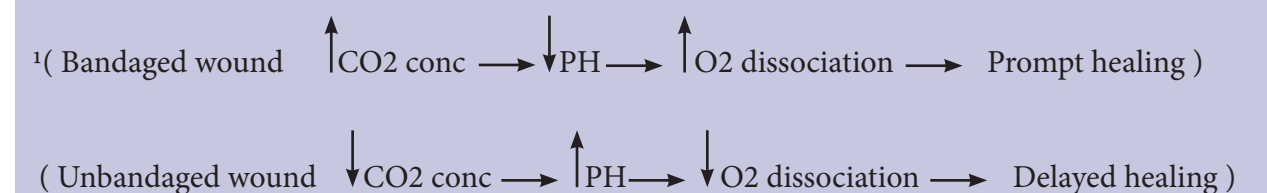
into a surgically clean wound. Excision and debridement involves selective removal of dead tissue from the wound. Any foreign material present in the affected area is removed during this maneuver.

4. Edges of the wound and an ample area around it is clipped or, in most instances shaved. The wound is covered with sterile, moist gauze to prevent introduction of hair into the wound.
5. The wound is thoroughly washed and gently scrubbed with any Iodine based solution. Strong disinfectants are avoided for the purpose because these are cytotoxic and result in further cellular damage. High pressure lavage units prove more effective in removing bacteria than conventional techniques; as high pressure lavage of the wound does not; as it was once believed, force bacteria deeper into the wound or cause significant tissue injury.
6. After preparation of the wound, as given at No.5, the wound needs to be closed without undue tension. Tension relieving suture patterns, such as vertical or horizontal mattress sutures may be used to overcome this problem (*see chapter 3*).
7. It is always advisable to obliterate the dead space whenever possible. This can be accomplished by deep closure of the wound with absorbable suture material.
8. Other than antibiotics, non-steroidal anti-inflammatory drugs are used to diminish pain from inflammation.
9. Corticosteroids are not usually used in the treatment of traumatic wounds, as they negatively affect the course of wound healing.
10. Where possible, postoperative bandages are used to help obliterate the dead space and to prevent edema.

### Secondary-Intention Healing:

When the animal is presented with a wound that has gone beyond the golden period or if the tissue loss is so extensive that primary closure is impossible, the wound is left to heal by second intention. In this process, the wound bed fills with granulation tissue and the skin re-establishes its continuity by epithelialization or wound contraction. The following guidelines are suggested for a better outcome.

1. The wound should be regularly cleaned and dressed with appropriate medicine when it is granulating and the treatment should be continued till complete healing occurs.
2. Where ever possible, the wound should be protected with a bandage. A bandaged wound is protected from self or external mutilation, is safe guarded against edematous swelling and also heals much faster compared to an unbandaged wound due to increased oxygen dissociation in the wounded area as shown under<sup>1</sup>.
3. The intact skin ventral to the wound should be smeared with a bland ointment to protect it from serum scalds.
4. Once the granulation bed has established, there is no need to use topical antibiotics because of the innate resistance to infection of this tissue.
5. Parenteral antibiotics are only used in the initial stages of wound healing, unless signs of diffuse infection develop.
6. Exuberant granulation tissue “proud flesh” is not a usual problem in the camels as seen in the equine family. However, if it exists, it must be removed until it approximates the surrounding skin; otherwise, migration of epithelium will be severely retarded. Excision of granulation tissue with a sharp scalpel is the treatment of choice.
7. If bone or tendon is exposed as is often seen in traumatic wounds on the distal limb (Fig. 8.1), it





must be covered with granulation tissue before epithelium covers the defect.

8. In some cases, sequestrum of bone may be seen if the periosteum has become dried or if the initial injury has chipped off a piece of bone. It must be removed as soon as it is identified.

### Tertiary-Intention Healing

It may be called delayed primary closure of the wound. In this, the wound is allowed to heal to a certain point by secondary intention and then prepared for surgery. The excessive granulation tissue is excised along its borders and the skin edges are sutured close to seek healing by primary intention.

### Use of Drains and Setons

The basic aim of drainage is to facilitate healing by removing unwanted material from a particular location. The main indications for the use of drains can be summarized as under.

1. When there is a potential problem of postoperative seroma formation.
2. Internal fixation of fractures when complete obliteration of dead space is not possible.
3. Contaminated wounds.
4. Drainage of the thoracic and peritoneal cavity whenever contamination or infection is considered to be a problem such as after cesarean operation or surgical procedures on the gastrointestinal tract.

It should however, be kept in mind that drains may act as a “two-way” street; that is they may even potentiate infection if not properly used. Hence, one should pay careful attention to aseptic technique at the time of placement and postoperative management of the drains. Be sure that the drains are not being used as a substitute for meticulous debridement or careful closure of the wound.

At present, penrose drains are being most commonly used in large as well as small animal surgery. Their use; however, should be restricted to wounds and obliteration of subcutaneous dead space. It is a thin latex tube usually ranging from 7 to 12mm in diameter. It functions by capillary action and gravity flow, with drainage occurring around the drain, rather than through its lumen. In many cases, its use is sufficient to minimize postoperative

accumulation of blood or fluid. It is normally kept in place for 7 to 10 days or is removed as soon as its function is over. Keeping the drain in for a long time will predispose the wound to retrograde infection from airborne and skin contamination. In addition, the drain itself acts as a foreign body and a daily drainage of less than 50ml per day may be purely drain induced.

#### Technique:

1. The drain is inserted so that its one end exits ventral to the primary incision and the other end is retained within the wound by a suture that can be removed later. The drain should not be brought out through the primary incision, as it encourages drainage through the incision leading to its non-healing.
2. An intact area ventral to the primary incision is selected for the emergence of the other end of the drain.
3. A stab incision is given in the selected area and the free end of the drain is exited from it and anchored there with a suture (Fig.8.2).
4. The primary incision is then sutured.
5. The drain is cleaned daily and covered with a bandage if possible to minimize the occurrence of retrograde infection.

#### Setons:

These are also used to provide drainage to the wounds that have a pocket formation. Although this technique is old, yet works quite well. An incision is given at the most dependent part of the wound (Fig. 8.3) and a piece of bandage or umbilical tape is passed between the existing and the newly given incision (counter opening) to keep it patent for effective drainage of the wound, which will lead to its early and smooth healing (Fig.8.4). The seton is normally smeared with a suitable anti-septic to prolong the action of the drug. The seton is changed with each dressing and is removed when it is no longer needed.

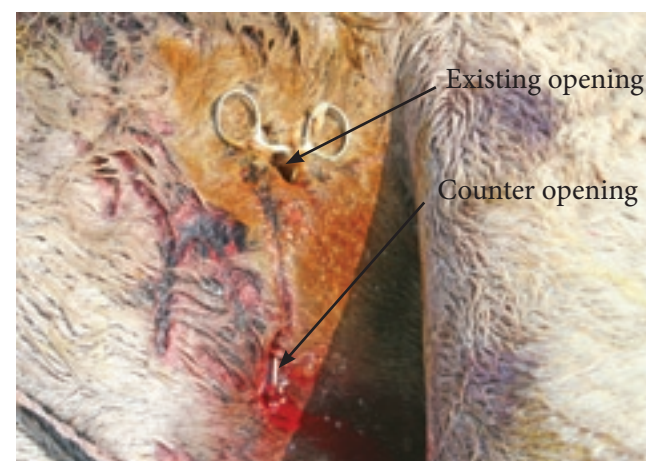
**Figures 8.5 through 8.37 represent some of the accidental or otherwise injuries most commonly encountered in routine practice. These were treated in line with general principles of wound management as outlined in the chapter. Necessary notes have been given with each case.**



**Figure 8.1** Exposed bones and tendons in distal limb wounds.



**Figure 8.2** Use of penrose drain. Note the exit of the drain through the incision in the intact skin below the original injury.



**Figure 8.3** Making a counter opening at the most dependent part. Along forceps is passed through the existing and the new opening to pull a piece of bandage through the wound cavity to act as seton.



**Figure 8.4** Seton in place



**Figure 8.5** Long nails are one of the causes of injury to the toe. In long standing and neglected cases, chronic purulent lesions may result in disarticulation at the distal or even proximal interphalangeal joint. The long toenail can even break when the animal walks on hard surface.

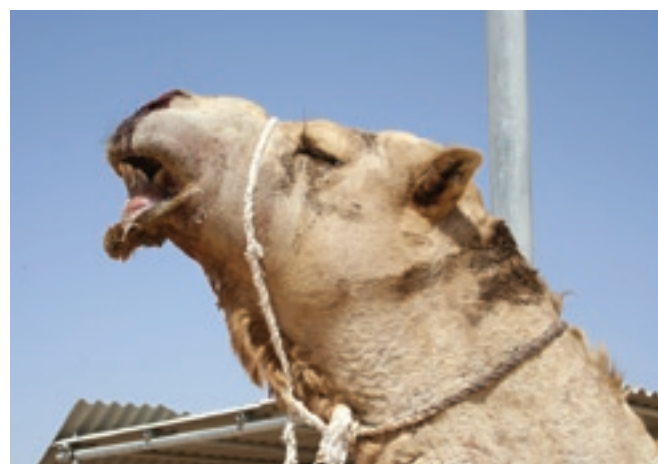




**Figure 8.6** An extensive injury due to a barbed wire involving the right forelimb and the digit. The injury was so serious that it resulted in necrosis of the foot in spite of the best possible management of the wound. The limb had to be amputated from the proximal third of the metacarpal bone to save the life of the animal, as it was having good ancestry.



**Figure 15.7** A deep perforating wound of the hock joint with discharge of synovial fluid in a dromedary heifer. Continued dressing and care of the wound resulted in healing but ended up in partial ankylosis of the joint with the animal facing great difficulty in attaining a sternal posture. The animal used to fall on the opposite side while trying to sit.



**Figure 8.8** A vicious adult male camel suffering from facial edema/inflammation after being pulled forcefully by a car. The animal was successfully treated with steroid medication for the first 3 days followed by non-steroidal anti-inflammatory drugs, cover of broad spectrum antibiotic along with local wound management and cold applications.

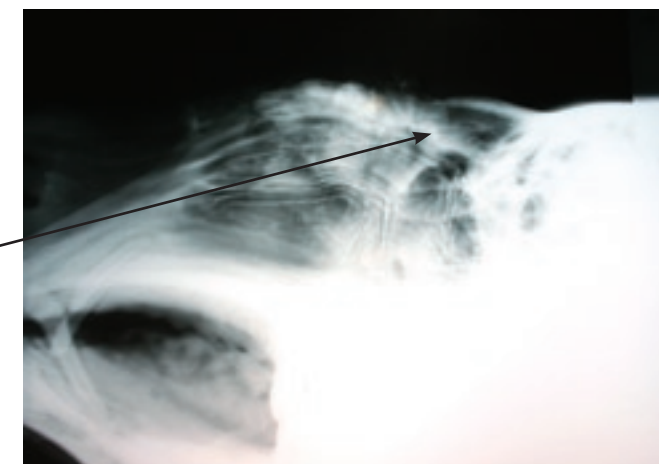
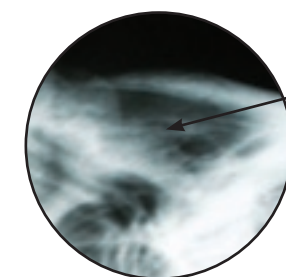


**Figure 8.9** A 2 year old racing camel suffering from facial paralysis after falling down during exercise. Animal was kept in the hospital for a long period on vitamins (B1, E) but with no improvement.

**Figure 8.10** A 4 year female camel with almost healed wound over nasal bones after treatment. The wound normally results due to pressure of the nose halter especially when the latter is made of a metal chain. In some situations, fracture of the nasal bones occurs due to violent pulling of the nose halter by the attendant (Fig. 8.11).



**Figure 8.11** Fracture of the nasal bones due to forceful pulling of the nose halter by the attendant. Such cases are presented with a depression in the roof of the nasal cavity and difficult respiration.



**Figure 8.12** A male camel with hobbles on forelimbs trying to cover a female in the breeding season. This may result in a great pressure over the croup and posterior hump region leading to hematoma, abscessation and/or fistulation. See fistula of the hump (chapter 13 and Fig. 8.34 and 8.35).



**Figure 8.13** A female camel showing signs of peroneal nerve damage as a result of intramuscular injection in the gluteal region by the owner.







**Figure 8.14** A 2-year-old female racing camel with relaxation/overstretching of the tendo-achilles after strenuous exercise. The animal fell down and could not go back to racing. These animals show marked relaxation of the tendo-achilles during rest and show slight lameness while walking. A prolonged, uninterrupted rest may result in improvement.



**Figure 8.15** An adult female with chronic unhealed wound on lateral side of right tibia. The owner treated the wound by himself using dettol and insecticides. Note the miserable condition of the wound. This wound did not respond to treatment due to extensive damage to the deeper structures.



**Figure 8.16** An adult female camel with multiple deep wounds on the right chest wall as a result of falling over a barbed iron fence many times. The animal fell down each time under her own weight while trying to get up. There was also a non-displaced fracture of the 7th rib. The owner washed the wounds with insecticide lotion. At the time of examination, the animal was dull with no respiratory distress. The wounds were treated meticulously along with intravenous infusions as needed and the animal showed remarkable recovery.



**Figure 8.17** Sloughing of the anal orifice in an old female as a result of suturing the anal opening by a quack. This was done to get milk from the dam after death of her calf. This is a common practice with Bedouins to suture both the anal opening and the nostrils to force the female to accept another calf for suckling and allow milking.



**Figure 8.18** An undertreated extensive wound on the right gluteal region and base of the tail as a result of male camel biting during rutting season. The original wound was quite deep with extensive muscle damage.



**Figure 8.19** An adult female camel with heavy tick infestation all over the body with resultant focal dermatitis, loss of weight and emaciation with the passage of time. The ticks were manually removed from all over the body followed by insecticide spray which resulted in great improvement in the physical condition of the animal.



**Figure 8.20** A 3-year-old male camel with fluctuating swelling just over the left jugular groove. Exploratory puncture of the swelling revealed pus. Thinking it an abscess, it was drained. However, the lining membrane was indicative of a dermoid cyst with hair growth (Fig. 8.21). The cyst wall was then removed, the cavity was thoroughly cleaned with sterile normal saline solution and the skin edges were closed. The healing was uneventful. The lesion was originally a dermoid cyst that got infected as a result of puncture by the owner.



**Figure 8.21** Note the hair growth on the cyst wall (arrow).







**Figure 8.22** A deep punctured wound in the left axilla due to a metal rod of the enclosure that penetrated the region. These wounds normally heal uneventfully due to effective ventral drainage. The animal however, should be kept at rest till the wound heals as continuous movement of the lips of the wound during walking will retard the healing process.



**Figure 8.23** Firing wounds around both hocks. The owner treated the camel for lameness of unknown origin with firing. The firing resulted in marked fibrous reaction around the joints and the animal was reluctant to move due to pain and inflammation. High pressure lavage with regular dressing of the wounds relieved the animal from sufferings.



**Figure 8.24** A 3 years old dromedary heifer with congenital goiter. The owner did firing on and around the lesion in an attempt to cure the disease. Palpation revealed hard mass on the right side (fibrosed) and a gaseous swelling on the left side. This practice can lead to more damage to the gland if the firing iron gets deeper. Sometimes the owners or the quacks misdiagnose the lesion as an abscess and try to drain it with grave consequences.



**Figure 8.25** A deep male camel bite wound on the right lateral thigh in a 2 year old dromedary heifer. Such injuries are common in the rutting season when the young heifers resist or refuse mating. These wounds are normally quite damaging to the muscles due to the canine teeth of the male going deep into the flesh. These wounds need extensive care with proper drainage for healing to occur.

**Figure 8.26** A deep wound just above the right elbow as a result of an irregular wooden bar piercing through the area. As the wound was quite deep with irregular skinned edges, it was allowed to heal through secondary intention. The wound took about 2 months to heal.



**Figure 8.27** A classic case of "in turned" toe nail causing pressure injury and granulomatous reaction at the toe. Such cases normally need disarticulation of the toe to bring the animal back to normal walk, as has been done for the fellow toe. The toe nail was trimmed to normal to avoid damage to the toe.



**Figure 8.28** Complete severance of the left tendo-achilles with a sharp metal plate that hit the site during a strong wind whorl (hurricane). Repair of the cut tendons has been described with special suture techniques, but in the camel, it seldom proves successful, as this animal keeps sternal recumbent posture for most of the time that results in excessive stretch and stress on the tendon.



**Figure 8.29** An adult female suffering from extensive body burn injuries. The animal was being transported in a truck when the blanket on the animal caught fire as a result of cigarette smoking by a half-slept and drowsy attendant. She was treated with mollient ointments along with intravenous fluid therapy as required. It was a long term treatment but the results were quite encouraging.







**Figure 8.30** An extensive deep injury of the left axillary region in a young male racing camel as a result of falling over the fence of the racing track. The cranial and caudal margins of the skin defect were sutured while the central part was left open for drainage and dressing. It took about 2 months for complete healing of the wound.



**Figure 8.31** An extensive injury with multiple fracture of the left orbit in an adult female during transportation in a truck. The fractured pieces were removed and the wound was washed and cleaned with sterile normal saline solution. The skin edges were trimmed, apposed and sutured (see Fig. 8.32). The animal recovered very well.



**Figure 8.32** The animal shown in Fig. 8.31; two weeks after the accident. Note the healing of the wound with restoration of the functional eye.



**Figure 8.33** An accidental injury just over the left jugular groove in the middle cervical region. Being fresh, the wound was debrided, cleaned and sutured. The wound healed through primary intention.



**Figure 8.34** Bilateral hump hematoma in an adult female as a result of great pressure by a very heavy male during mating (see Fig. 8.35). The treatment was delayed for the organization of the hematoma to occur. It was drained 3 weeks after, the blood clots were removed and the wounds on both the sides took about 3 months for complete healing.



**Figure 8.35** A small area was shaved and disinfected with Pyodine on the right side of the hump for exploratory puncture with a disposable sterile syringe. Note frank blood in the syringe.



**Figure 8.36** An old female suffering from a chronic, ulcerating wound below the left eyelid with a similar lesion on the right side. According to the owner; the wounds were the result of constant rubbing of the area with straps of the nose halter. The raw surfaces of the wounds were quite thick and refractory to conventional wound management.



**Figure 8.37** Complete surgical excision of the indurated tissues of the wound shown in Fig. 8.36. The margins of the cutaneous wounds were apposed with interrupted horizontal mattress sutures with Supramid USP 2. No subcutaneous sutures were applied. The wounds on both the sides healed through primary intention.





**Suggested Readings:**

1. **Brown,L.L. et al.** (1978). Evaluation of wound irrigation by pulsatile jet and conventional methods. Am.J.Surg. 187:170.
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# CHAPTER

## Left Flank Laparotomy 9

### Standard Technique

The flank or paralumbar fossa is roughly a triangular area bounded dorsally by the transverse processes of the lumbar vertebrae and the last rib cranially, whereas the caudal boundary is formed by the tuber coxae proximally and the sheath of the external abdominal oblique muscle distally. The lateral abdominal muscle layers in this area between the skin and the peritoneum from without inward are, the fascia (deep layer of which is closely adherent to the first muscle layer), the external abdominal oblique, the internal abdominal oblique, the transversus abdominis and the transversalis fascia; the later being in turn closely adherent to the transversus abdominis muscle. The peritoneum lies medial to the transversalis fascia and is closely adherent to it. In the camel the flank area is comparatively narrow as compared to that in the cattle. Literally speaking the paralumbar fossa acts as the main entrance to the abdominal cavity not only in the large but also in the small ruminants. That is why it is being described as a separate topic to avoid its repetition for the surgical procedures requiring this approach.

### Indications:

Most commonly performed intra-abdominal manipulations in the camel such as rumenotomy and cesarean section are performed through left flank laparotomy. The surgical procedures on the abomasum and intestines like enterotomies and end to end intestinal anastomosis are normally done through the right flank. The procedure is basically the same, no matter which side is chosen by the operator to enter the abdominal cavity. Due to the fact that rumenotomy and cesarean section make a large part of the routine work, the left flank laparotomy is chosen as a standard procedure for description.

Flank laparotomy is also a major indication to explore certain intra-abdominal disorders not diagnosed clinically. This is known as exploratory laparotomy which can simultaneously be used as a diagnostic as well as therapeutic procedure.

### Control and Anesthesia:

The animal is controlled in the sternal recumbency and the surgery site is shaved and prepped in a standard fashion (Fig. 9.1 & 9.2). The animal is sedated with Xylazine and Ketamine hydrochloride and the incision site is desensitized with line or inverted “L” block using 2% solution of Lignocaine hydrochloride (Fig. 9.3). Alternatively, the flank area may be desensitized with paravertebral block. The area is then draped for surgery (Fig. 9.4).

### Operative Steps:

1. A vertical incision, almost in the middle of the paralumbar fossa; is given starting from 4 to 5cm ventral to the transverse processes of the lumbar vertebrae and extending down for a distance of 20 to 25cm (Fig. 9.5). For rumenotomy, it is better to make this incision a little cranial to the midway point. For cesarean section, the incision may be started 8 to 10cm ventral to the transverse lumbar processes and extended up to 30 to 40cm. These specifications may however, be modified according to the needs.
2. The skin is separated from the subcutaneous tissue to reveal fibers of the external abdominal oblique muscle. This layer is incised vertically to reveal the internal abdominal oblique muscle (Fig. 9.6). The incision in this layer may not be quite as extensive as that of the skin.



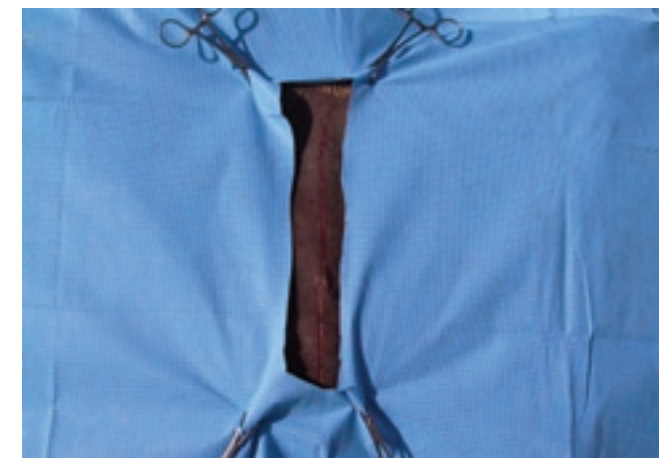
**Figure 9.1** Preparation of the surgery site. Washing of the left flank with pyodine scrub before shaving.



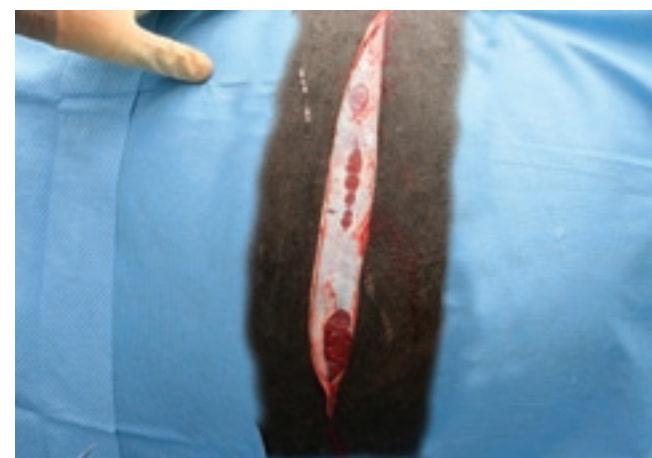
**Figure 9.2** Prepped site after shaving, scrubbing and drying.



**Figure 9.3** Line block at the proposed incision site.



**Figure 9.4** Draping of the surgery site. The towel clamps should go through the drape into the skin to avoid displacement of drape during surgery.



**Figure 9.5** Incision through the skin and subcutaneous tissues to expose external abdominal oblique muscle.



**Figure 9.6** Incision through the external abdominal oblique muscle to expose internal abdominal oblique muscle.



3. A similar incision is given in the internal abdominal oblique muscle to expose the glistening aponeurosis of the transverse abdominal muscle. The internal abdominal oblique muscle is the thickest and most substantial of the layers encountered at this site and also the most difficult to incise with precision (Fig. 9.7). In spite of the regional anesthesia, this muscle layer will usually demonstrate involuntary “quivering” or spastic contractions when incised. Care should be taken to avoid deviation of the incision cranially due to direction of the fibers and the motion of the structure as it is being incised. This muscle is picked up with a tissue forceps and is carefully nicked with a scalpel in its dorsal part. The incision through this muscle is then completed with a blunt pointed scissors. Lateral retraction of this muscle layer will expose the transversus abdominis which is entered in its dorsal part through a small nick. This entry should be very careful and guarded to avoid accidental cutting of the rumen wall or damage to the spleen which is lying just under the incision (Fig. 9.8). The incision is then extended with blunt pointed scissors through this muscle and the peritoneum for entrance into the peritoneal cavity. This incision is also usually less extensive than the one in the preceding layer.

#### Closure of Laparotomy Incision:

1. The peritoneum, transversalis fascia and transverse abdominal muscles are closed with simple interrupted or horizontal mattress sutures using chromic catgut or polyglycolic acid suture USP 3 or 4 (Fig. 9.9).
2. The internal abdominal oblique muscle is identified and approximated the same way (Fig. 9.10). The external abdominal oblique muscle is similarly identified and repaired (Fig. 9.11). In small or very weak animals the internal and external abdominal oblique muscles may be sutured as a single layer. It is better to anchor this suture line to the deeper muscle layer at various intervals to obliterate the dead space.
3. The subcutaneous tissue is apposed with continuous suture using chromic catgut or polyglycolic acid USP 2 suture material (Fig. 9.12). It is again advisable to anchor this suture line to the underlying tissue at different intervals to obliterate the dead space.

4. The skin closure is performed with simple interrupted or horizontal mattress sutures using heavy polymerized suture material such as supramid or vetafil USP 3 (Fig. 9.13). Prolene or silk sutures may also be used for the purpose.

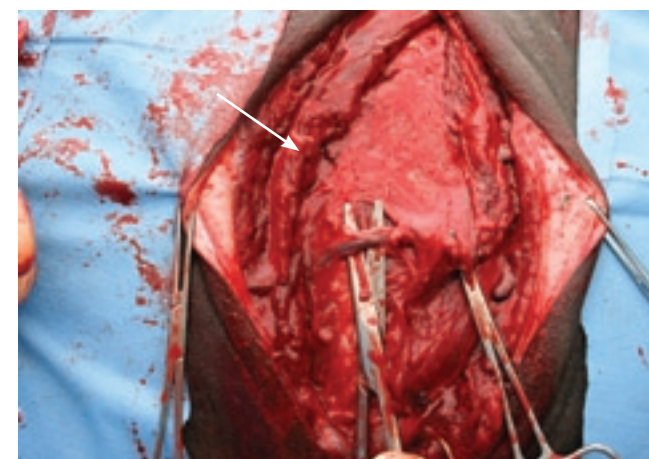
The suture pattern and or the suture material may vary according to the choice of the surgeon. However, only one type of suture material should be used for all the layers of buried sutures.

#### Postoperative Care:

1. The animal should be kept in an enclosure separate from the other animals to avoid infliction of any trauma.
2. Cover of systemic antibiotics is recommended for a period of 5 to 7 days, which should be started a day before surgery.
3. Daily cleaning and dressing of suture line with some mild antiseptic lotion or antibiotic cream.
4. Soft food in small quantities should be given to the animal to avoid an increase in the intra-abdominal pressure till complete healing of the wound occurs.
5. Supportive fluid therapy should be instituted whenever indicated.

#### Possible Complications:

1. Infection of the suture line may take place, which would be apparent after 5 to 6 days. In such a situation 3 to 4 or even more ventral most skin sutures should be removed for regular cleaning and dressing of the wound to let it heal by secondary intention (Fig. 9.14).
2. Dehiscence of the abdominal suture line with resultant evisceration is a disastrous complication and should be handled on emergency basis.
3. Peritonitis is a potent complication which would manifest by high rise of temperature, animal going off-food with dullness and depression. This complication is normally due to dirty surgical procedure and can be avoided by adhering to aseptic surgical technique. In the field conditions however, observance of strict asepsis is not possible, but the problem can be avoided to a large extent by relatively clean surgery.
4. Incisional hernia may occur in some cases as a long term complication which should be repaired if warranted (Fig. 9.15).



**Figure 9.7** Incision through the internal abdominal oblique muscle (arrow) to expose transverse abdominal muscle.



**Figure 9.8** Incision through the transverse abdominal muscle. Note the spleen lying just under the incision.



**Figure 9.9** Closure of peritoneum, transversalis fascia and transverse abdominal muscle with interrupted horizontal mattress sutures using chromic catgut USP 4.



**Figure 9.10** Closure of the internal abdominal oblique muscle with interrupted horizontal mattress sutures using chromic catgut USP 4.



**Figure 9.11** Closure of the external abdominal oblique muscle with interrupted horizontal mattress sutures using chromic catgut USP 4.



**Figure 9.12** Closure of subcutaneous tissue with continuous suture line using chromic catgut USP 2.





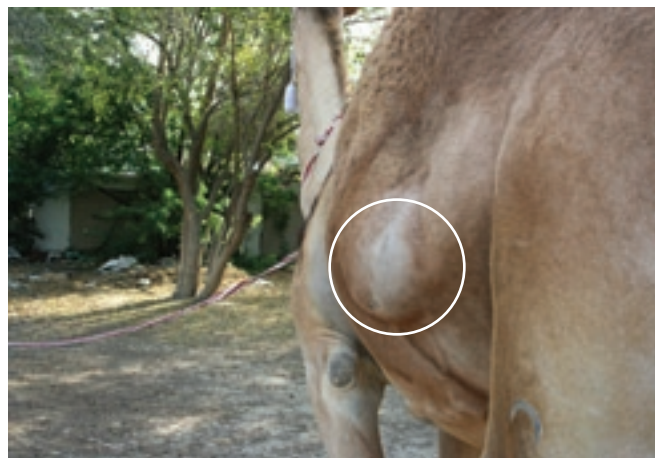
#### Suggested Readings:

1. **Gahlot, T.K.** (2000). Surgery of the dromedary camel. In: Selected topics on Camelids by Gahlot, T.K. 1st. Ed. Chandan Sagar Well, Bikaner, India.
2. **Hofmeyr, C.F.B.** (1974). The digestive system. In: Text book of large animal surgery. Edited by F.W. Oehme and J.E. Prier. Baltimore, Williams & Wilkins.
3. **Lack, J., Heckmati, P., Shahrastri, H. and Nowrouzian, I.** (1981). Laparorumenotomy in the camel. J. Vety. Faculty, Univ. Tehran. 36:40-52.

**Figure 9.13** Closure of skin incision with horizontal mattress sutures using supramid USP 3.



**Figure 9.14** Suture line infection. Ventral most sutures removed to provide drainage and effective dressing of the wound.



**Figure 9.15** Incisional hernia 6 months after laparotomy which was done for Cesarean section.



# CHAPTER

# 10

## Oral and Gastrointestinal Surgery

The oral cavity of the camel is typical of a ruminant and is designed for efficient handling of large volumes of plant roughages. Both upper and lower lips are extremely mobile and the fact that fighting and biting; especially between the breeding males are common in the rutting season, the lips and the surrounding structures are more prone to injuries as compared to other ruminants. The buccal vestibule contains large, conical buccal papillae that are cornified and are directed caudally towards the pharynx.

Some of the surgical affections of the oral cavity and the gastrointestinal system that are commonly encountered by a practicing veterinarian are given below.

### 1. Injury to the Upper / Lower Lip

The upper and/or lower lip may get lacerated with sharp objects, like hooks and barbed wires etc. in and around the enclosure (Fig.10.1). The extent of the tear may go backward to a variable degree.

#### Control and Anesthesia:

The animal is sedated and controlled in the desired lateral recumbency.

#### Operative Steps:

1. The site is thoroughly washed with Iodine based solution and clean dried. Loose and dead tissues are removed with a sharp scissors till the wound is fresh (Fig 10.2). If the wound margins are irregular, necessary but minimal debridement should be carried out to get accurate apposition of the wound edges.

2. The first layer of continuous sutures is placed in the deeper tissue (oral side), using Polyglycolic acid USP 2. Horizontal mattress sutures may also be a good choice. The suturing should start from the caudal end of the wound; however, it is better to first put a skin suture in the cranial end to get proper apposition of the wound edges (Fig. 10.3). During suturing, the cheek papillae may come in the way and these should be trimmed as required.
3. The second layer of simple interrupted or continuous sutures is placed in the subcutaneous tissue with buried knots using the same suture material (Fig. 10.4).
4. The skin is closed with simple interrupted or horizontal mattress sutures with USP 2 nonabsorbable suture material (Fig. 10.5).

#### Postoperative Care:

1. The animal should be kept in separate enclosure to avoid infliction of any injury by the other animals. There should also be no poles or sharp objects in the enclosure to avoid self mutilation of the wound.
2. The suture line is daily cleaned and dressed with antibiotic spray till the sutures are removed after two weeks (Fig. 10.6).
3. The use of systemic antibiotics is optional.

#### Possible Complications:

1. Break down of the suture line due to contamination and subsequent infection or self mutilation.



Figure 10.1 Injured lower lip with a barbed wire.



Figure 10.2 The wound after debridement.



Figure 10.3 Suturing of deeper layers of the wound. Note the skin suture (arrow) in the cranial end to get proper apposition of wound margins.



Figure 10.4 Closure of the subcutaneous tissue.



Figure 10.5 Skin closure with Supramid USP 2.



Figure 10.6 Healed wound. The sutures were removed after 15 days.





**Figure 10.7** An old commissure wound after debridement.



**Figure 10.8** The wound shown in Fig. 10.7 after repair.

## 2. Injury to the Oral Commissure:

This condition is occasionally encountered in camels following hooking of buccal commissure with a fixed iron hook, iron bar or a barbed wire (Fig. 10.7). The extent of the tear may vary extending from the commissure going backward to a variable degree. The steps taken to repair the injury with post operative care are essentially the same as described for the injury of the lips (Fig. 10.8). Development of the oral fistula can be an added complication in case there is partial healing in the cranial end and disruption of the suture line in the caudal end of the wound.

## 3. Oral /Buccal Fistula

This condition may result as a postoperative complication of injury to the oral commissure as mentioned under “injury to the oral commissure” or be a sequel to direct trauma by any sharp/blunt pointed object or hook that pierces through full thickness of the cheek (Fig. 10.9). The oral commissure in this condition is intact. The size and direction of the lesion varies according to the pulling force exerted by the animal to get rid of the offending object.

### Control and Anesthesia:

The animal is sedated and controlled in the required lateral recumbency.

### Operative Steps:

The repair procedure is essentially the same as described for injured lips except that commissure is intact in this condition and one has to repair only the fistula (Fig. 10.10). Care has to be taken to

achieve anatomical apposition of the wound margins. In case of irregular wound margins, necessary but minimal trimming should be carried out to get proper alignment of the wound edges. If the fistula is in close proximity to the commissure, the later may also be incised which would render it more convenient to suture the defect.

### Postoperative Care and Possible Complications:

These are essentially the same as described for repair of the injury to the lips.

## 4. Lingual Injury

The lingual injury is not very common, but the tongue may get injured with a barbed wire or any other offending object. The injury may be a superficial laceration or quite deep cut involving partial thickness of the tongue (Fig. 10.11). Bleeding from mouth attracts attention of the owner and examination of the oral cavity reveals the problem. In old standing cases; accompanied with glossitis the tongue may be seen protruding from oral cavity with dribbling of saliva and the animal is unable to swallow. The superficial lacerations may be left as it is to heal, but the deep cuts need to be repaired.

### Control and Anesthesia:

The animal is deeply sedated and controlled in the lateral recumbency. Under light sedation, the animal keeps moving its tongue making suturing of the defect difficult.

### Operative Steps:

1. The tongue is made stationary by an assistant with pressure by his fingers underneath the organ.



**Figure 10.9** Oral fistula (4 days old). Note the lacerated tissue.



**Figure 10.10** Normal apposition of wound edges after repair of the fistula.

2. The wound is thoroughly washed and cleaned with standard solution of Potassium permanganate. Trimming of the wound margins if needed, should be very minimal (Fig. 10.12).
3. The wound edges are properly aligned and apposed with Far-Far-Near-Near suture pattern using Polyglycolic acid USP 0. The bites taken far from the wound margins should go deeper into the tissue to well approximate them. This will obliterate the dead space and will also relieve tension over the superficial sutures (Fig. 10.13 a&b). Use of chromic cat gut is not recommended, as it will lose its tissue holding strength rapidly due to continuous exposure to the oral and salivary secretions.

### Postoperative Care:

1. The animal is given soft food till complete healing of the wound, as fibers of the hard and dry grass may disrupt the suture line and the healing process. The calves should better be fed only on milk.
2. As the suture line, being in the oral cavity can not be kept dry and aseptic, parenteral cover of antibiotics is recommended.
3. In case of glossitis; non-steroidal anti-inflammatory medications should be given to relieve the swelling.

### Possible Complications:

Infection and break down of the suture line.

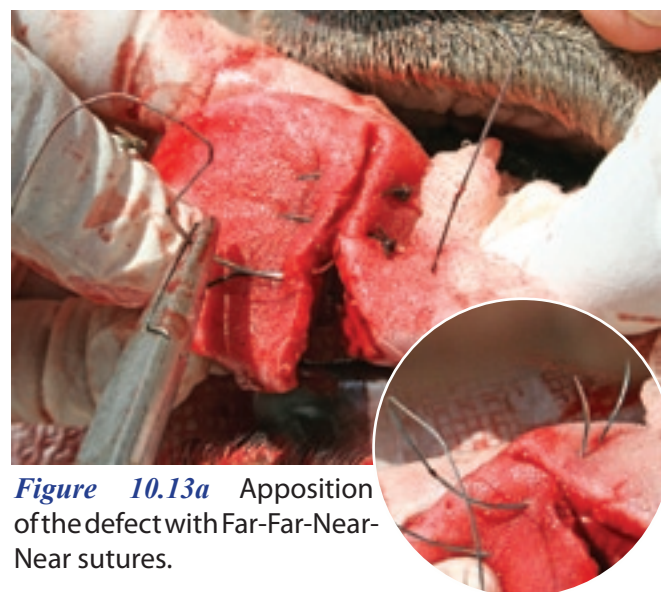


**Figure 10.11** A deep, almost full thickness transverse cut in the tongue.



**Figure 10.12** The wound after necessary debridement.





**Figure 10.13a** Apposition of the defect with Far-Far-Near sutures.



**Figure 10.13b** Perfect apposition of wound margins after suturing.

### 5. Elongated Cheek / Buccal Papillae

As mentioned in the beginning, the lining membrane of the cheeks is covered by long, cornified conical papillae that are directed caudally. In adult camels, particularly in the racing animals, these papillae get elongated to such an extent that these are caught between the cheek teeth during eating and mastication and get injured and inflamed (Fig. 10.14). This results in painful mastication and the animal also does not eat properly, sometimes even going off-food. In some cases, the papillae become hyperemic. The only remedy is to trim these papillae.

#### Control and Anesthesia:

The animal is sedated and controlled in the sternal position with the mouth kept opened with a self-retaining mouth gag (Fig. 10.15).

#### Operative Steps:

1. One of the cheeks is manually retracted laterally and the papillae, especially those in the middle are trimmed as deemed necessary with a sharp, long handled curved scissors (Fig. 10.16). A 25 cm long "Metzenbaum-Fino" or "Wertheim" scissors works well. The same is repeated for the other cheek.
2. There is no appreciable bleeding; however, it is better to wash the oral cavity with standard solution of Potassium permanganate and apply alum lotion on the cut surfaces of the papillae. Slight bleeding that occurs is normal and is self limiting.

#### Postoperative Care:

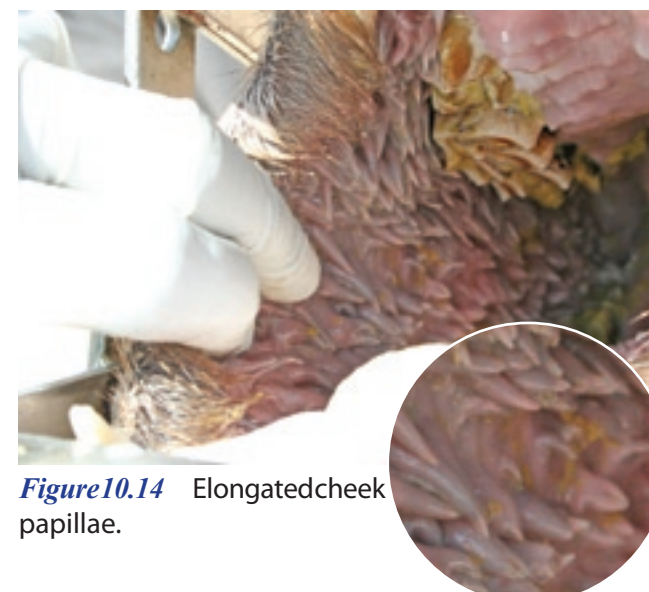
1. The systemic cover of non-steroidal anti-inflammatory drug is recommended for a period of 3 to 4 days. Cover of parenteral antibiotics is optional.
2. Only green fodder should be given to the animal for a period of one week.

#### Possible Complications:

Occasional intermittent bleeding has been noticed in those cases in which the papillae were grossly hyperemic and inflamed. Intravenous injection of Vitamin K at the recommended dose rate proves beneficial. Calcium therapy also helps in such cases.

### 6. Dulaa (LAHA) Resection (Elective Procedure)

Of all the domesticated animals, the camel has the longest soft palate with an average length of 16cm in the adult. It stretches from the end of the hard palate caudally over the epiglottis to the level of the arytenoid cartilage. Palatine diverticulum is a peculiar expandable diverticulum that occurs on the ventral median aspect of the soft palate. It is better developed in the male as compared to the female animal. The palatine diverticulum is popularly known as *dulaa*, an arabian word for a balloon like structure. In the rutting season, the male often protrudes it from the oral cavity producing a peculiar gurgling sound that forms a part of the sexual display to attract the females (Fig. 10.17).



**Figure 10.14** Elongated cheek papillae.

#### Indications:

The camel is an obligatory nose breather. During racing, functional obstruction of the nasopharyngeal airway by the dulaa is an important cause of exercise intolerance in the male racing animals. Surgical resection of the dulaa in the adult male is a practical way to improve air movements in the upper airway that enables him to compete more effectively in the race. The procedure has often resulted in improvement of performance in the racing animals.

#### Control and Anesthesia:

The animal is sedated, controlled in the sternal recumbency and the mouth is kept opened with a self-retaining mouth gag.

#### Operative Steps:

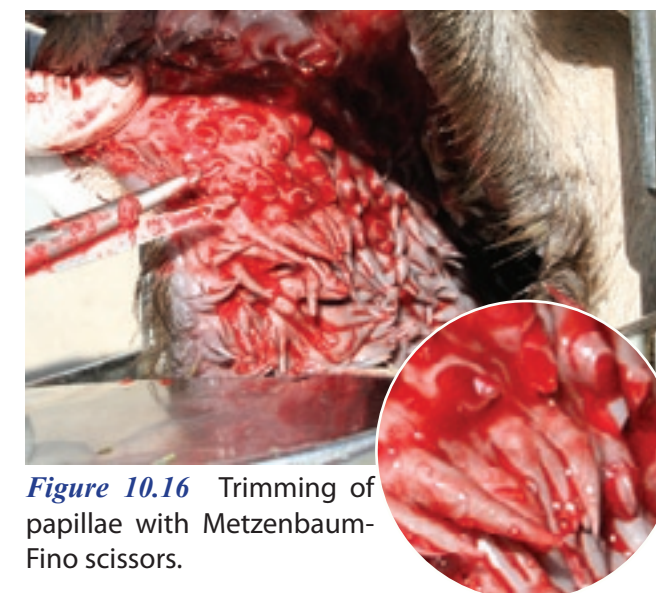
1. Dulaa is grasped with 2-3 vulcellum forceps and pulled out of the mouth to its full extent (Fig. 10.18).
2. It is then resected at its base using a 25 cm long "Metzenbaum-Fino" or "Wertheim" scissors. Normally there is no or negligible bleeding during or after the procedure (Fig. 10.19 a,b,c & d).
3. The dissection should be careful and not be very deep to avoid accidental severance of the palatine artery. Normally it does not happen; however, if this complication occurs, the bleeding point is grasped with a long forceps and ligated with chromic catgut USP 1 using the hand-tie knot.

#### Postoperative Care:

1. Antibiotic cover is not needed routinely. However, systemic cover of non-steroidal



**Figure 10.15** Opening of mouth with a self-retaining mouth gag.



**Figure 10.16** Trimming of papillae with Metzenbaum-Fino scissors.



**Figure 10.17** Protrusion of dulaa by a breeding male during rutting season.





**Figure 10.18** Dulaa grasped with vulsellum forceps and pulled out for resection.



**Figure 10.19a** Starting point of dulaa resection at the base of the organ.



**Figure 10.19b** Successive steps showing resection of half of the dulaa.



**Figure 10.19c** Completely resected dulaa.

anti-inflammatory drug of choice is recommended for 3-4 days.

2. The animal should be fed on green and soft food only for a period of 7 to 10 days and also given rest for a week.

#### Possible Complications:

Normally there are no major complications of this surgery. However, occasionally the animals have been noticed going partially off food for 2 to 3 days following dulaa resection. This may be due to slight inflammation at the surgery site or too close resection of the dulaa. The condition is transitory and self limiting and the animal gradually returns to normal health in a few days. Supportive fluid therapy mixed with tonics should be instituted in such cases till the animal recovers completely.

#### 7. Impacted and/or Traumatized Dulaa

In some cases the dulaa gets entrapped in the oropharynx along with the food material. The animal can not protrude it and is unable to take food or water. If the animal attempts to drink water it comes out through the nostrils. If not noticed for 2 to 3 days, it may become infected with fetid odor. In the other condition the dulaa gets injured either with the camel's own canine teeth or by biting of another male camel during rutting season. The injury results in damage of mucosal lining and rupture of blood vessels in the dulaa. With the passage of time, it becomes inflamed, hemorrhagic and hangs out of the mouth (Fig. 10.20) or gets impacted in the oropharynx. The impaction of dulaa in the oropharynx is clinically manifested by continued extension of the head and neck by the animal

which probably provides him relief during breathing (Fig. 10.21). Both the impacted and injured conditions require prompt surgical intervention to provide relief to the animal.

#### Control and Anesthesia:

In case the inflamed dulaa alone or along with the food material is entrapped in the oropharynx, the animal is slightly sedated, controlled in the sternal position and the mouth is kept opened with a self-retaining mouth gag. Full dose sedation may interfere with respiration and be a risk to the life of the animal.

#### Operative Steps:

1. The impacted food material which in most of the cases, is dry grass; is removed manually till the passage gets cleared (Fig. 10.22).
2. The dulaa is then taken out with hand and is inspected for any injuries. It is usually injured and edematous in almost all the cases; hence, its resection is advisable. Resection is done at its base with a long scissors as described in the elective procedure of dulaa resection (Fig. 10.23).
3. A well lubricated probang is then passed into the esophagus up to the rumen to ensure patency of the passage (Fig. 10.24).
4. In the other condition, when the dulaa gets injured and edematous and hangs out of the buccal cavity, it is simply grasped and severed at its base (Fig. 10.25). In some cases, the injured and inflamed dulaa (without impaction of food) gets impacted in the oropharynx. It is grasped with hand or caught with Vulsellum forceps, pulled out and resected at its base.
5. It is advisable to wash the oral cavity with standard solution of Potassium permanganate after resection of the dulaa.

#### Postoperative Care:

The postoperative care includes soft food and systemic cover of antibiotics and non-steroidal anti-inflammatory drugs for a period of 5 to 7 days.

#### Possible Complications:

The postoperative complications are essentially the same as described for dulaa resection under the elective procedure. However, the intensity of the complications may be greater in these cases.



**Figure 10.19d** Slight smearing of the buccal cavity with blood (normal).



**Figure 10.20** Injured and inflamed dulaa hanging out of the mouth.



**Figure 10.21** Clinical sign of impaction of dulaa in the oropharynx. See the extension of the head and neck.





**Figure 10.22** Manual removal of impacted grass from the oropharynx.



**Figure 10.23** Resection of damaged dulaa after removal of the impacted food material.



**Figure 10.24** Passing of a probang up to the rumen to ensure patency of the passage.



**Figure 10.25** Inflamed and damaged dulaa (post-resection). Appreciate the intense damage to the organ.

## 8. Esophagotomy

The esophagus is approximately 1.5 meters long tube in the adult camel and has a large capacity. Its mucosal lining has secreting glands, the secretions of which apparently serve the purpose of moistening the rough forage which is the normal diet of the camel. In the cervical region it is contained in a gutter like channel bounded by the vertebral bodies dorsally and ventrally directed transverse processes laterally. In the cranial three quarters of the neck, it lies directly dorsal to the trachea. In the caudal fourth, it lies dorso-laterally on its left side. Ventrally, it is bordered by the Sternothyrohyoideus and Sternoccephalicus muscles and laterally by the large external jugular veins.

Esophageal obstruction in the camel is not very common; however, cases have been recorded that necessitated esophagotomy for the removal of the

obstructed material. The obstructed material may be a bolus of food, plastic bags, plastic balls or a piece of cloth. The most common sites for obstruction are the thoracic inlet, at the level of the base of the heart and the rumeno-esophageal junction. However, obstruction may occur at any point. No matter what is the point of obstruction, dysphagia is the most common and most important sign of the condition. Excessive salivation, regurgitation of fluid soon after ingestion and tympany are clinical signs of the disease. The site of obstruction is determined through endoscopy or simply by passing a stomach tube or a probang.

An attempt should first be made to dislodge the choked material by passing a stomach tube or a probang. Care should however, be taken not to push the stomach tube or probang forcefully;

otherwise, the esophagus may rupture with fatal consequences

The surgical procedure is mainly done in the cervical esophagus. Beyond thoracic inlet, esophagotomy in the camel or any other large animal is not so feasible, because one has to do thoracotomy to approach the esophagus which in itself is a major and more elaborated surgery as compared to esophagotomy alone.

### Indications:

When the obstruction is in the cervical esophagus and the conservative methods to dislodge the obstructed material fail, it becomes necessary to do esophagotomy to provide relief to the animal. Although it is not a benign procedure but also has no alternative. Without surgery the fate of the animal is obvious; hence, with surgery one has everything to gain and nothing to lose.

### Control and Anesthesia:

The animal is deeply sedated and secured in the right lateral recumbency. The operation site is infiltrated with local anesthesia. If gas inhalation anesthesia is available, the animal may better be put under general anesthesia.

### Operative Steps:

1. A skin incision is given on the left ventro-lateral aspect of the neck (just lateral to the trachea) at the level of the obstruction (Fig. 10.26).
2. Taking care not to damage the vital structures in the vicinity, the esophagus is approached through blunt dissection and is exteriorized through the skin incision (Fig. 10.27). A stomach tube passed through the oral cavity will help identifying the esophagus.
3. A long, blunt instrument such as a closed curved scissors is passed in between the esophagus and the under lying muscles to hold it in place so that it does not slip back during manipulation (Fig. 10.28).
4. A longitudinal incision going through all the layers of the esophagus is given to expose its lumen. It is advisable to give incision on a healthy portion of the esophagus caudal to the obstruction and to remove the obstructed material with a grasping forceps (Fig. 10.29 a&b). If incision caudal to the obstruction is not feasible as in the case of obstruction near the base of the neck, the



**Figure 10.26** Skin incision at the level of esophageal obstruction.



**Figure 10.27** Exteriorization of the esophagus.

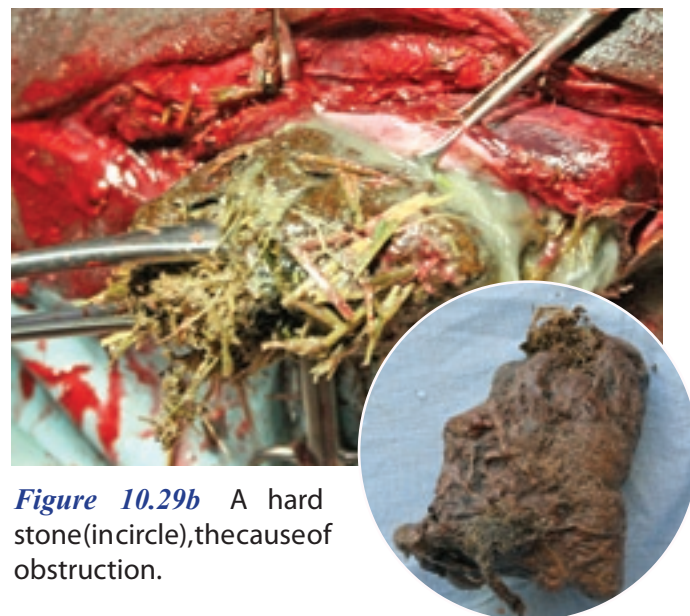


**Figure 10.28** A curved operating scissors passed under the esophagus to immobilize it.





**Figure 10.29a** Esophageal incision showing accumulation of grass cranial to the obstruction.



**Figure 10.29b** A hard stone (in circle), the cause of obstruction.

incision cranial to the obstruction may be given. The baseline objective is to give the esophagotomy incision on the healthy portion to get better healing of the esophageal wound, because the esophageal wall at the obstruction site is usually compromised due to the pressure of the obstruction and may not hold sutures well.

5. After removal of the obstruction, it is always better to pass a stomach tube through the oral cavity going beyond the esophageal incision or through the esophagotomy incision up to the rumen to ensure that the esophageal lumen is patent (Fig. 10.30).
6. The incision site is then thoroughly washed with sterilized normal saline solution to render it clean.
7. The mucosa and the upper layers of the esophagus are sutured separately with simple interrupted sutures using Polyglycolic acid USP 0 suture material (Fig. 10.31 a&b). The sutures should not be very tight. The knots of the mucosal sutures; if kept inside, may act as nidus for infection where as the outside knots may create dead space between the mucosal and the upper lying layers. The arguments go either way, but most of the workers prefer to keep the knots outside.
8. The esophagus is then returned to its place.
9. No sutures are placed in the muscles of the neck.
10. The subcutaneous tissue is closed with simple continuous sutures using the same suture material.

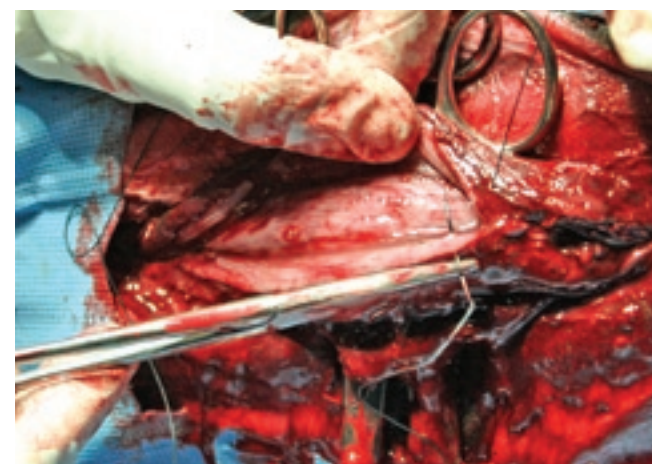


**Figure 10.30** Passing of stomach tube from the esophagotomy incision. Note the ingesta in the tube coming from the rumen.

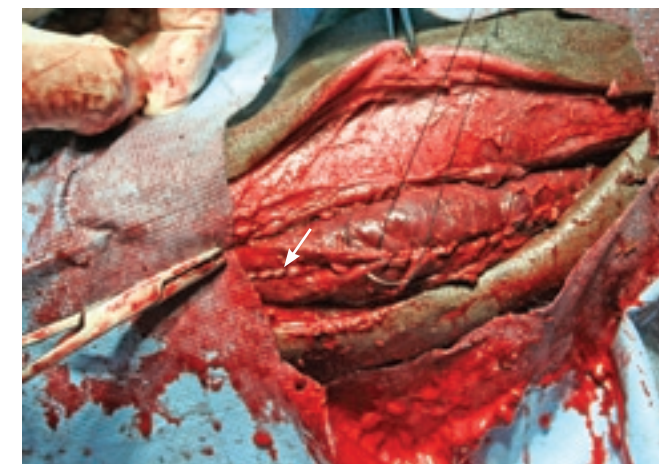
11. The skin incision is closed with simple interrupted or horizontal mattress sutures using any nonabsorbable suture material (Fig. 10.32).

#### Postoperative Care:

1. The animal is put on parenteral antibiotics for a period of two weeks.
2. The animal is given only liquid diet in the form of gruel for 7 to 10 days and then gradually returned to soft and normal food. If the animal refuses to take food, a stomach tube may be passed up to the esophageal suture line, but not going beyond it; and the diluted gruel should be given through the stomach tube.



**Figure 10.31a** Suturing of the mucosal layer of the esophagus.



**Figure 10.31b** Suturing the esophageal wall above the mucosal layer. Note mucosal sutures are still visible (arrow).

3. The intravenous fluid therapy with tonics should be considered whenever warranted by the clinical condition of the animal.
4. The suture line is daily cleaned and dressed with a mild antiseptic.
5. The skin sutures are removed after two weeks.

#### Possible Complications:

1. Break down of the esophageal suture line with consequent leakage of its contents into the periesophageal tissue.
2. Development of esophagocutaneous fistula manifested by exuding of esophageal contents through the defect in the skin.
3. Stenosis of the esophagotomy site may be evident clinically as a long term complication.



**Figure 10.32** Closure of skin incision with interrupted horizontal mattress sutures.



## 9. Rumenotomy

The rumen occupies the major portion of the abdominal cavity, lies in its left side and has a capacity of approximately 100 liters. The interior of the rumen is lined by stratified squamous epithelium but its glandular sacs are lined by simple columnar epithelium and the mucous membrane is smooth unlike that of the other ruminants.

### Indications:

1. Rumen foreign bodies and bloat.
2. Rumen impaction/overload refractory to medical treatment.

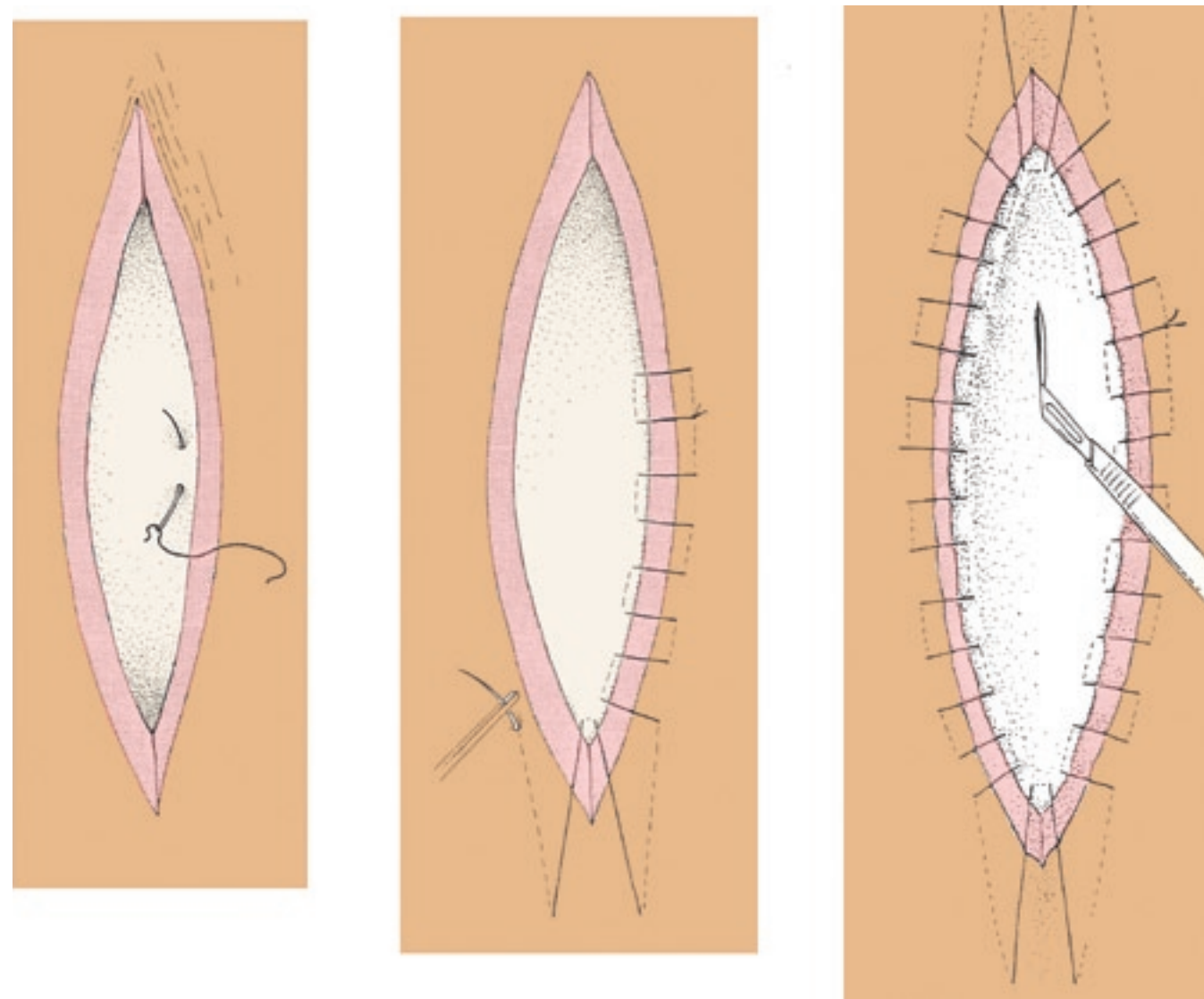
### Control and Anesthesia:

Animal is secured in the sternal position and the left flank area is prepared in a standard fashion for

aseptic surgery. The surgery field is desensitized with paravertebral anesthesia or the animal may be sedated and the incision site is desensitized with a line or an inverted "L" block.

### Operative Steps:

1. Left flank laparotomy is performed (*see chapter 9*).
2. The rumen wall is grasped out and sutured all around with the skin before incising it. A continuous inverting suture pattern is used to pull the rumen over the edge of the skin incision (Fig. 10.33). Suture material, such as supramid USP 3 or 4 should be used for this purpose. In addition, two large, inverting sutures should be placed at the ventral edge of the incision, so that



**Figure 10.33** Rumen fixation sutures to avoid spillage of the rumen contents into the peritoneal cavity.



**Figure 10.34a** Exteriorized foreign body (theropes used to tie the bundles of grass).



**Figure 10.34b** Foreign body being removed (in this case, the weight of the foreign body was 60.5 kg).

the rumen projects well over the skin edge. This avoids contamination in the ventral region. Suturing of the rumen wall to the skin is the most important step in this surgery to avoid contamination of the peritoneal cavity. Use of Weingarths rumenotomy set, rumenotomy board or a rubber rumenotomy shroud is also used for the same purpose. No doubt these aids are quicker and easy to use, but they are liable to be displaced with consequent contamination of the peritoneal cavity with the rumen contents which may prove disastrous. Hence, suturing option ranks much better for the purpose.

3. The rumen wall is incised and the foreign body or the impacted food material is removed manually (Fig. 10.34 a&b). In case of impaction, all of the impacted food material is never removed; rather about one-fourth is left inside.
4. After removal of the offending material, the rumeno-reticular orifice is examined for any material lodged there in. Alkalinizing products may be instilled at this stage in cases of rumen overload and mineral oil may also be poured in if indicated.
5. The surgeon's contaminated gloves are then discarded and new ones are put on.
6. The rumen incision is sutured in two layers of continuous inverting sutures using chromic catgut or Polyglycolic acid USP 4 suture material; the first layer being the Cushing and the second layer of Lembert sutures.

7. The surgical site is irrigated with polyionic fluid prior to removal of the rumen fixation sutures.
8. The rumen is replaced in the cavity and the peritoneal cavity is examined for any blood clots that may have gone into the cavity during laparotomy incision.
9. The laparotomy incision is closed in a routine manner (*see chapter 9*).

### Postoperative Care:

Postoperative medication will vary with the indication of rumenotomy. In case of rumen overload, intensive fluid therapy is often needed. The general/routine postoperative care will include:

1. Systemic cover of antibiotics for 7 to 10 days.
2. Soft food for two weeks to be given in small quantities at a time. The animal is then returned to normal food gradually.
3. Regular cleaning and dressing of the suture line with antibiotic spray.

### Possible Complications:

These are essentially the same as outlined for left flank laparotomy (*see chapter 9*) along with complications related to rumenotomy, such as break down of the rumen suture line with consequent spillage of the rumen contents into the peritoneal cavity with grave or even fatal results.



## 10. Enterotomy and Intestinal Anastomosis:

Enterotomy and simple end to end intestinal anastomosis can be applicable to all parts of the jejunum and ileum, as these are the freely moveable parts of the small intestine and hence, lend themselves easily for surgical manipulations. The duodenum is relatively fixed portion and is difficult to exteriorize and manipulate. The total length of the small intestine averages 40 meters while the large intestine is approximately 19.5 meters long. The convoluted jejunum is placed mainly in the right flank and the right abdominal region and on the sternum in the median plane, while its terminal portion lies left to the median plane.

The main blood supply is via various branches of the cranial mesenteric artery that fan out in the mesentery and intercommunicate on the mesenteric border forming vasa recta that terminate in the wall of the intestine.

There are four coats in the intestinal wall (serosa, muscularis, submucosa and mucosa). Serosa is a thin, weak film of tissue on the outside of the intestine that is contiguous with the peritoneum. It affords no holding power to the suture material but is often responsible for the rapid seal that follows an anastomosis or closure of an enterotomy incision. The muscularis is composed of an outer longitudinal layer and an inner circular layer. This layer has also very little suture holding power. The submucosa holds the mucosa and the muscularis together while supporting a vascular, lymphatic and nervous complex. This is the layer of strength due to its high collagen fiber contents and must be included in the sutures to ensure proper strength of the suture line. Mucosa is composed of multiple villi which increase the surface area.

In the camel, surgery on the small intestine is not very common. However, certain situations such as intestinal obstructions due to foreign bodies or rarely impacted food material may necessitate enterotomy or resection of a part of the jejunum and end to end anastomosis to establish intestinal continuity. The surgeon is often faced with making a decision of whether or not to resect a piece of bowel or to do enterotomy to remove the obstructed material. The most important consideration relates basically to blood supply which will ultimately determine bowel color, warmth, peristalsis, necrosis or presence of pulsating vessels. Specific etiologies

that may force a resection and anastomosis include severely impacted foreign bodies, trauma, vascular accidents and neoplasms.

The selection of the suture material and the suture pattern carries great significance in the intestinal surgery. Therefore, a brief review is being given here as guide lines.

### Suture Material:

For most enterotomies and intestinal anastomosis an absorbable suture material such as chromic catgut or preferably polyglycolic acid USP 0 or 1 is recommended. This is especially vital if the suture material is to enter the lumen.

### Suture Pattern:

The basic objective while selecting the suture pattern is to avoid compromising the luminal diameter of the gut. Much controversy exists regarding suture patterns which may be everting, inverting and simple interrupted. The simple interrupted pattern may be just appositional or crushing type.

The everting pattern such as horizontal mattress sutures may help eliminate compromise of the luminal diameter but will expose the mucosa and usually involves more adhesion formation with the surrounding structures.

The inverting patterns such as Lambert's sutures do provide a rapid serosa to serosa seal which was once thought necessary; but these patterns decrease the luminal diameter of the gut which may end up with stenosis at the surgery site in the long term.

End to end simple interrupted sutures are currently most popular due to their simplicity, speed, reliability and lack of luminal compromise. Suture is placed through all the layers and tied either on the top of the serosa (like skin sutures) or pulled tight until buried from mucosa to serosa and rests on the submucosa; popularly known as simple interrupted crushing sutures. This suture pattern provides good end to end seal, does not compromise the lumen of the gut and also does not expose the suture material to the luminal contents.

### Control and Anesthesia:

The approach to the bowel is normally done through right flank laparotomy and hence, the animal is controlled in the sternal position slightly tilted towards the left side. The animal is sedated and the right flank area is desensitized with paravertebral

block. Instead the surgical site may be desensitized with a line or inverted "L" block.

### Operative Steps:

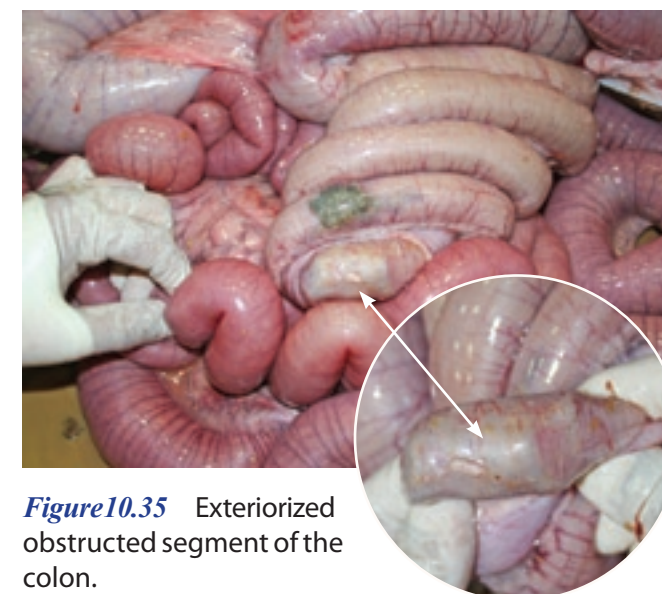
#### A. Enterotomy:

1. Right flank area is prepared and draped for surgery in a standard fashion and laparotomy is performed.
2. The intestinal loop is manipulated intra-abdominally to check any point of obstruction. Normally it is possible to manually feel any hard mass in a segment of the jejunum or ileum.
3. The suspected segment of the obstructed intestine is exteriorized (Fig. 10.35), laid off the incision on moistened laparotomy pad and evaluated for its viability on the basis of the points mentioned above.
4. If it is decided to do enterotomy, an incision is given on the antimesenteric border either cranial or caudal to the obstruction and the obstructed material is removed with a grasping forceps (Fig. 10.36). The incision should be large enough which would easily permit removal of the foreign body without laceration of the intestinal wall.
5. After removal of the foreign body, the viability of the obstructed segment should again be checked and if found satisfactory, the enterotomy incision is closed with simple interrupted crushing sutures (Fig. 10.37). Normally three sutures per centimeter should suffice for proper seal of the incision.

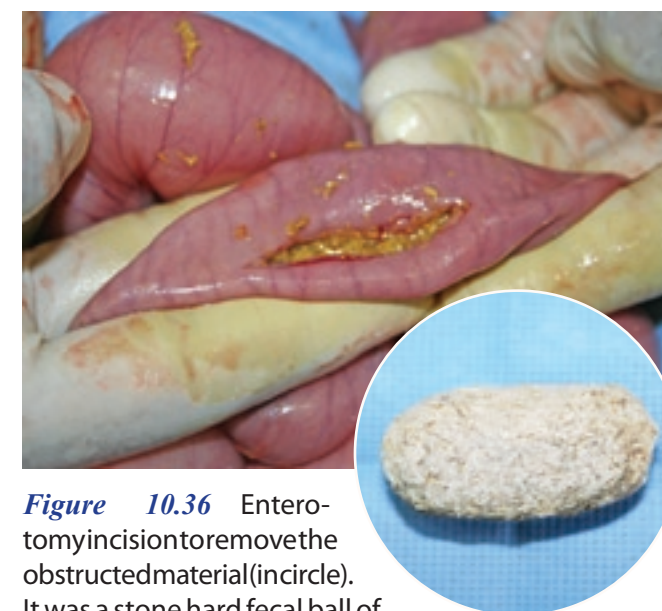
In case of even the slightest doubt about viability of the affected segment, it is better to perform resection of the compromised segment and do end to end anastomosis as described below.

### Resection and End to End Anastomosis:

1. The affected intestinal segment is exteriorized and laid off the incision on the moistened laparotomy pad.
2. The appropriate arteries supplying the affected segment are double ligated and separated. The anastomosing vasa recti may be ligated with chromic catgut USP 2/0 suture at the proposed transection site (Fig. 10.38).
3. The bowel is held by the assistant within his index and middle fingers or intestinal clamps to prevent spillage of the ingesta (Fig. 10.39).
4. The proposed segment to be removed is then



**Figure 10.35** Exteriorized obstructed segment of the colon.

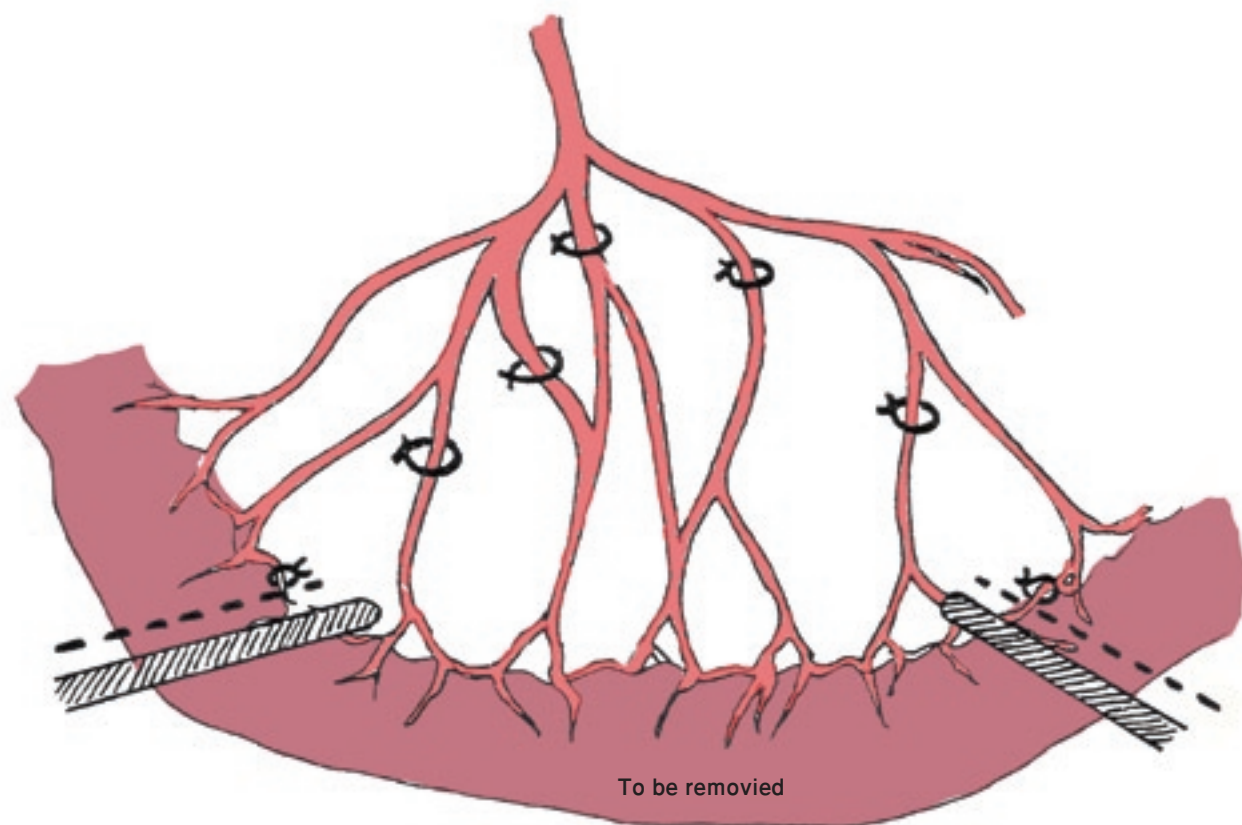


**Figure 10.36** Enterotomy incision to remove the obstructed material (in circle). It was a stone hard fecal ball of an adult animal..



**Figure 10.37** Closure of enterotomy incision with simple interrupted crushing sutures using Polyglycolic acid USP 0.





**Figure 10.38** Ligation of vessels and vasa recti for the intestinal segment destined for resection ( schematic diagram).

incised with a scalpel or sharp scissors cutting away from the mesentery at a 60 degree angle (Fig. 10.40). This assures adequate blood supply to the antimesenteric corner and also helps restoring the normal lumen of the gut.

5. The first suture is placed on the mesenteric border in the form of a simple interrupted through and through suture with the knot on the serosa. The suture should be made slightly tight so as not to compromise the blood supply. The second suture is placed in the antimesenteric border in the same way (Fig. 10.41). This will ensure proper alignment of the gut. The knot is snugged down until it just dimples the serosa, cuts through the mucosa and rests on the submucosa. It must be snug but not so tight that it compromises the blood supply.
6. Then each half is sutured till the job is completed. The sutures should be approximately 4mm from the cut edge and the same distance apart (Fig. 10.42 a&b).
7. At the completion of the anastomosis the assistant gently milks some ingesta past the anastomosis. No leaks should be evident. If excessive

pressure is exerted, almost any anastomosis can be seen to leak.

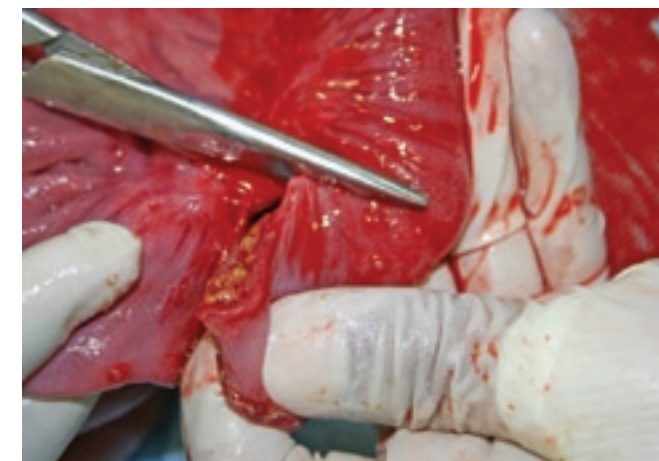
8. Before returning the bowel to the abdomen, it is gently rinsed with sterile normal saline solution. The omentum is wrapped around the anastomosis site and the intestinal segment is returned to the abdomen.
9. All dirty instruments are put aside and the surgeons change their gloves.
10. If peritoneal cavity was contaminated, it should be lavaged with warm ringer's solution and antibiotics are instilled intraperitoneally.
11. Routine closure of the laparotomy incision is done.

#### Postoperative Care:

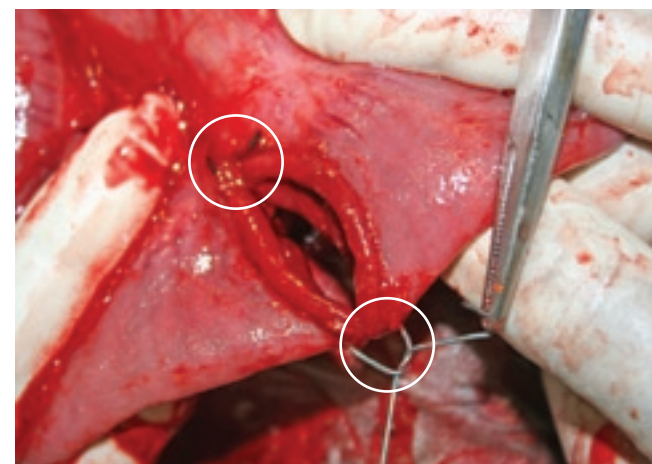
1. Parenteral cover of antibiotics is taken for 7-10 days.
2. Small amount of water can be given after about 16 hours of surgery; but better to put the animal on intravenous fluids.
3. Small amounts of only green fodder can be given a day after surgery. Normal feeding may be resumed after 3-4 days of surgery.



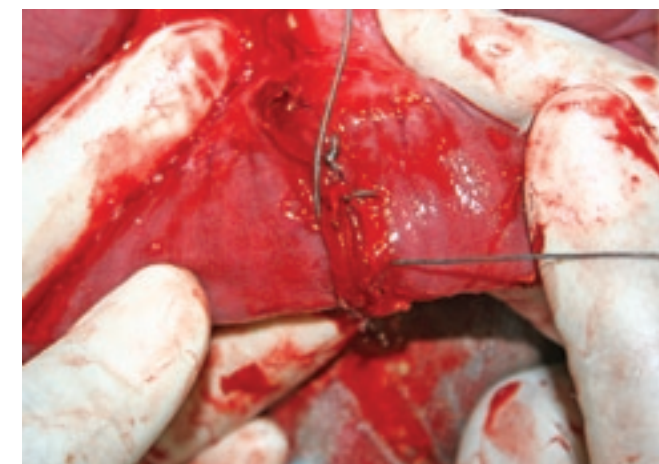
**Figure 10.39** Holding the intestinal segment to prevent spillage of ingesta.



**Figure 10.40** Resection of the compromised segment with a sharp scissors.



**Figure 10.41** First suture on the mesenteric and second on the antimesenteric border. Note precise alignment of the cut ends.



**Figure 10.42a** Suturing the remaining part of the segment.

4. Routine care of the laparotomy wound should be taken.

#### Possible Complications:

1. Break down of anastomosis which can be suspected with:
  - ▶ Fever.
  - ▶ Anorexia.
  - ▶ Dehydration.
  - ▶ Depression.
  - ▶ Leukocytosis with left shift.
2. The animal with postoperative peritonitis due to leaking anastomosis or dirty surgery is a serious complication. An ounce of prevention is worth a pound of cure.
3. Adhesions of the anastomotic site with the surrounding tissue are a long term complication, but rarely a problem.



**Figure 10.42b** Completed anastomosis.



# 11. Prolapse of Rectum

This condition has been mostly seen in the male camels in the rutting season. The exact cause is not known; however, it may be due to increased back pressure during the act of covering, as the male animals are excessively used for breeding during this season (Fig. 10.43). In the initial stages, the prolapsed portion of the rectum gets reduced by itself when the animal stands up. But with the passage of time and repeated coverings, the prolapsed portion becomes edematous, inflamed and sometimes traumatized and stays permanently prolapsed (Fig. 10.44). The conditions that result in increased straining such as severe constipation or those that result in increased peristaltic activity of the gut, such as severe diarrhea and/or infectious diseases which result in diarrhea can also end up in prolapse of rectum. However, these causes have not been much incriminated to result in prolapse of rectum in the camel.

## Control and Anesthesia:

The animal is slightly sedated and controlled in the sternal position supplemented with epidural anesthesia.

## Operative Steps:

1. The prolapsed rectum is thoroughly washed with any iodine based scrub removing all the material sticking to it. Sometimes, the rectal mucosa is also partially devitalized and needs to be surgically cleared off (Fig. 10.45).
2. The prolapsed rectum is then lubricated and reduced very carefully and gently to avoid any further damage to the organ.
3. The anal opening is narrowed with a line of purse-string suture using umbilical tape (Fig. 10.46 a,b&c). The suture line should preferably go through the external anal sphincter or in close proximity to it. The tightness of the suture should be such that it easily permits introduction of two fingers into the anal canal for escape of gases (Fig. 10.47) The ends of the umbilical tape are tied using slippery knot, so that it can be untied and loosened for manual removal of the fecal material whenever needed and then tightened again till removal of the suture (Fig. 10.48).
4. The line of purse-string suture is kept in place for 7 to 10 days and the rectum is evacuated of fecal material daily or on alternate days or as needed.



**Figure 10.43** Prolapse of rectum during mating.

The technique described above works well in most of the cases. However, in small percentage of cases it may not prove fruitful and the prolapse recurs. In such cases and in those where the prolapsed portion is badly mutilated or where reduction of the prolapsed rectum is not possible, one should resort to amputation of the affected part, which is carried out as follows:

1. The hand is inserted in the lumen of the prolapsed rectum and a series of interrupted horizontal mattress sutures are placed 360 degrees around the circumference of the bowel using chromic catgut or Polyglycolic acid USP 2 or 3 suture material (Fig. 10.49 a,b &c).
2. The cut ends of the sutures are kept longer to keep traction so that the sutured portion does not retract when amputated distal to the suture line (Fig. 10.50).



**Figure 10.44** Permanent prolapse of rectum. See the devitalized rectal mucosa.



**Figure 10.45** The prolapsed rectum (washed and cleaned).



**Figure 10.46a** Step 1. Passing the needle through the dorsal part of the anal sphincter. See the position of the Buhner needle.



**Figure 10.46b** Step 2. The Buhner needle piercing through the left lateral anal sphincter.



**Figure 10.46c** The last step of applying the suture. It is better to keep the knot on the lateral side.



**Figure 10.47** Checking the anal orifice for escape of gases.



**Figure 10.48** Completed purse string suture.



3. The prolapsed portion is amputated approximately 3 cm distal to the suture line (Fig. 10.51 a,b&c).
4. The cut edges of the bowel are then apposed with a continuous suture line using the same suture material (Fig. 10.52 a&b)
5. After completion of the sutures, the long ends of the mattress sutures are cut short and the sutured segment is allowed to retract in (Fig. 10.53).

#### Postoperative Care:

1. The animal should be kept on systemic non-steroidal anti-inflammatory and antibiotic medication for 7 to 10 days and is also not allowed free access to food; rather is kept on small quantities of green fodder.
2. In case of purse string sutures, the site should be daily cleaned and dressed with antibiotic spray.
3. After removal of the purse string sutures, the wound holes should be well taken care of till complete healing takes place.
4. The animal should not be used for breeding purpose for at least one month.

#### Possible Complications:

1. The purse string sutures may cut through the skin if not placed properly and deep under the skin or if tied too tightly. In the later case, straining efforts by the animal to evacuate its bowels will result in this complication. This complication is also possible if the rectum is not evacuated as needed in the postoperative period.
2. Fecal incontinence, in case the external anal sphincter is very badly damaged. However, this complication seldom occurs.



**Figure 10.49a** Step 1. Inserting the needle through full thickness of the healthy rectal wall.



**Figure 10.49b** Step 2. Passing of the suture material through eye of the needle.



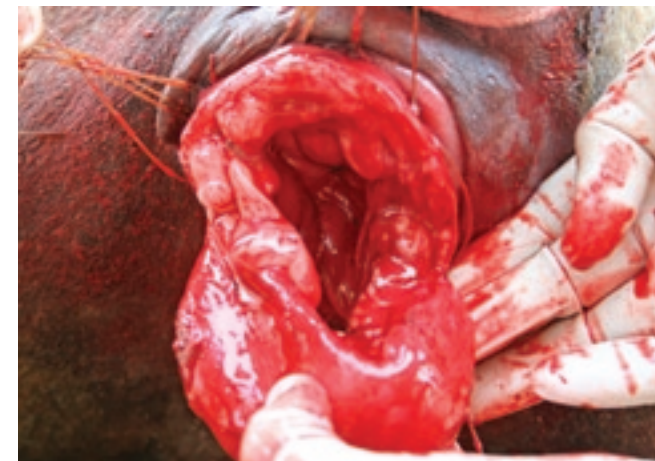
**Figure 10.49c** Step 3. Placement of interrupted horizontal mattress sutures through the base of the prolapsed rectum.



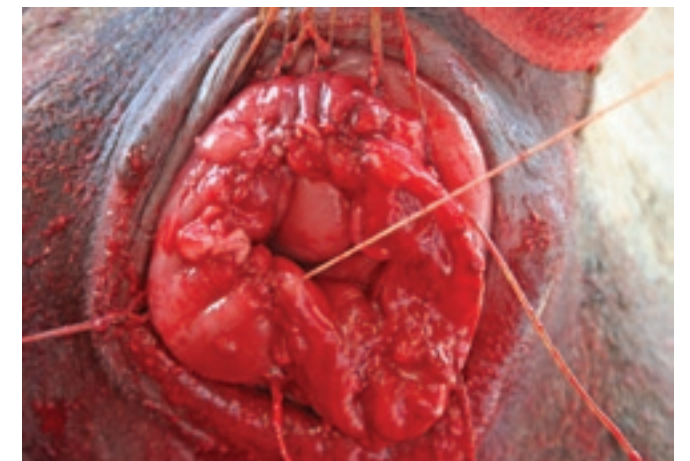
**Figure 10.50** Grasping the ends of the sutures to maintain continued traction on the prolapsed rectum.



**Figure 10.51a** Step 1. Amputation of prolapsed portion.



**Figure 10.51b** Step 2. Amputation halfway in progress.



**Figure 10.52a** Apposing of the two cut edges of the rectum with continuous suture pattern using catgut USP 2.



**Figure 10.52b** Apposition of the cut ends of the mucosal layer with simple continuous sutures.



**Figure 10.53** Completed amputation. See the retracted rectum. The relaxation of the anal sphincter is due to epidural anesthesia.



## 12. Atresia Ani

This is a rare congenital condition in which the anal opening is absent. The anatomical site of the anal opening is usually marked by a scar (Fig. 10.54). The animal is presented with the complaint of not passing the feces and variable degree of distended abdomen. The clinical examination reveals the problem. This is an emergency and should be handled as such.

### Control and Anesthesia:

The calf is slightly sedated with Xylazine hydrochloride given intramuscularly at the dose rate of 0.1 mg/kg body weight and is controlled in the lateral recumbency.

### Operative Steps:

1. The tail is wrapped in a bandage and firmly held by an assistant in an upward direction.
2. The skin is held in the Allis forceps at the scar representing the normal site of anal opening, slightly pulled backwards and a circular piece of skin is removed with a sharp, curved Mayo scissors. The opening in the skin should be slightly larger than the normal anal opening so that it attains its normal size when healing takes place.
3. The blind end of the anal canal normally bulges out through the skin opening which is caught with the Allis forceps and is cut with the scissors and the cut end is immediately caught with another Allis forceps. In some cases, slightly deep dissection may be necessary to locate the blind end of the anal canal; especially in cases of atresia recti.
4. The moment the blind end of the anal canal is cut, the muconium will start flowing out (Fig. 10.55). A slight hand pressure on the belly will increase its flow rate. When the muconium stops flowing out or its flow is minimal, the cut skin edge is sutured with the cut edge of the anal opening all around (360 degrees) with horizontal mattress sutures using USP 0 monofilament nonabsorbable suture material. The knots of the sutures should be kept outside. These sutures should be tightened only moderately, otherwise chances of stenosis of the anal opening would exist.

### Postoperative Care:

The anal area and the suture line is daily cleaned and dressed with antibiotic spray till removal of

sutures which are normally removed after 10 days. Systemic cover of antibiotics is optional.

### Possible Complications:

1. Infection of the suture line which can be avoided by daily careful cleaning and dressing of the area.
2. Stenosis of the anal opening may be a long term complication which could be avoided if the skin opening was kept a little larger at the time of corrective surgery. If however, it happens a second surgical procedure will be mandatory for its correction.



**Figure 10.54** A 2-day-old female calf with atresia ani. Note the scar indicating the site of anal opening.



**Figure 10.55** Flowing out of muconium.

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# CHAPTER

# 11

## Urogenital System

### A. Male Urogenital System:

#### 1. Castration

Testes are ovoid in shape and are located in the perineal position. At the age of about 7 months, they lie caudally to the superficial inguinal ring and are usually descended in the scrotum by second to third year of age. They are quite small but increase in size at the onset of puberty. It has been noticed that they become enlarged and protrude when the animal is sexually active in the rutting season and return to their normal size in the sexually dormant season. Usually one testicle is higher in position and in the vast majority of animals the right testicle is smaller than the left.

#### Indications:

Castration is normally an elective procedure; but is also indicated in cases of testicular trauma, scrotal abscesses, irreparable bite wounds in the scrotal region and orchitis.

#### Control and Anesthesia:

The animal is deeply sedated and controlled in the left lateral recumbency with the upper hind leg pulled forward and tied securely. The scrotal and the surrounding area is copiously scrubbed with any Iodine based solution and then properly cleaned off with Spirit Methylated.

#### Technique:

There are several techniques of castration. The two main surgical techniques are the open and the closed methods, depending on whether the tunica vaginalis are opened or not. We are describing here the open method.

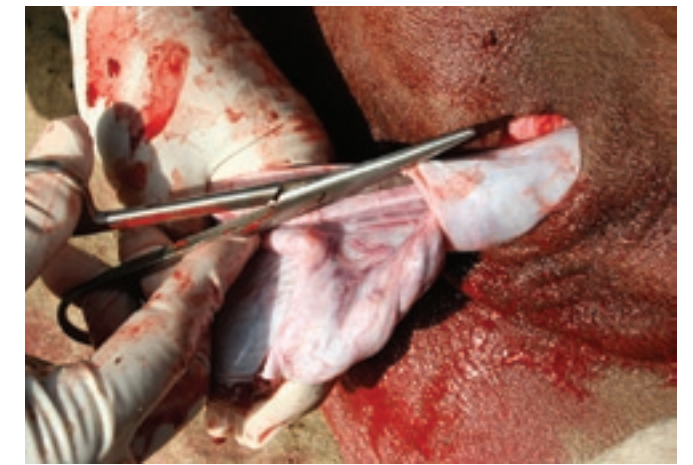
#### Operative Steps:

1. A small incision is given on the left scrotal pouch and the testicle is squeezed out unlike that in the horse in which a large incision is recommended (Fig.11.1); the reason being that there is negligible postoperative swelling and discharge in this animal<sup>1</sup>.
2. The tunica vaginalis is freed from its attachments as high up as possible and is incised longitudinally with an operating scissors (Fig.11.2).
3. The vascular and nonvascular portions of the spermatic cord are separated from each other through the mesorchium (Fig.11.3).
4. First the non-vascular portion is severed using an emasculator or is simply transfixed with USP 2 chromic catgut and severed distal to the ligature (Fig.11.4 a&b.). This helps in easy and maximal exteriorization of the vascular portion.
5. The vascular portion of the cord is maximally exteriorized and is ligated with chromic catgut USP 2 (Fig. 11.5 a). The cord is then transfixed below the ligature using the same suture material (Fig. 11.5b). A carmalt forceps is firmly applied below the transfixation ligature and the cord is severed distal to it (Fig. 11.6 a&b). Severance of the spermatic cord using only the emasculator has sometimes been noticed to result in a failure with consequent postoperative bleeding.
6. The same procedure is repeated on the right testicle.
7. In our experience, closure of the scrotal incisions with a horizontal mattress suture using catgut USP 2 helps preventing contamination of the

<sup>1</sup> Personal experience.



**Figure 11.1** Small incision made over the scrotal sac to squeeze out the testicle.



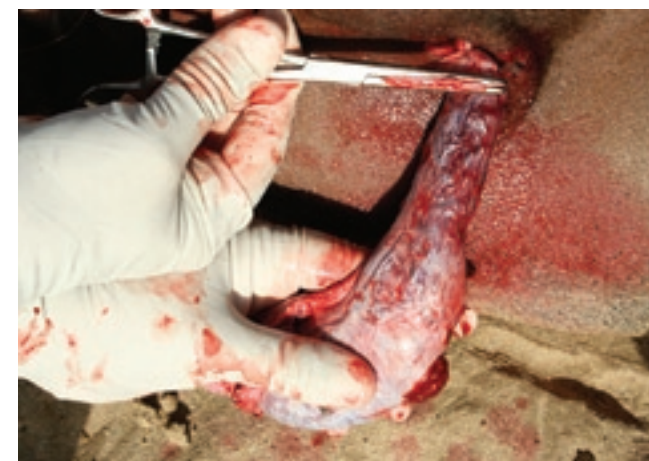
**Figure 11.2** Longitudinal incision in the tunica vaginalis.



**Figure 11.3** Separation of vascular and non-vascular portions.



**Figure 11.4a** Transfixation of the non-vascular portion with chromic cat gut USP 2.

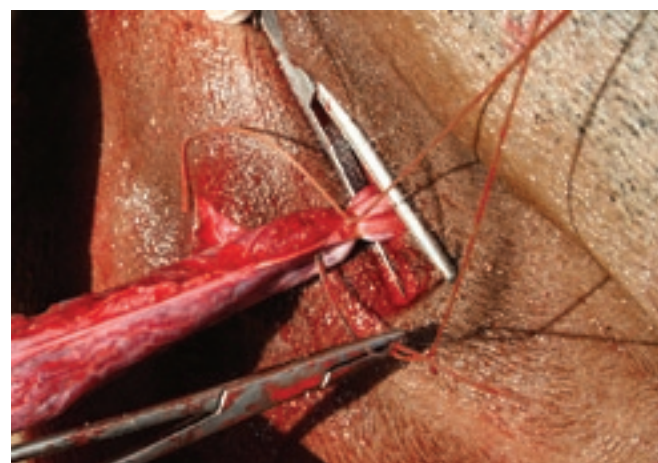


**Figure 11.4b** Severance of the non-vascular portion below the ligature.



**Figure 11.5a** Simple ligation of the vascular portion with chromic cat gut USP 2.





**Figure 11.5b** Transfixation of the vascular portion below the simple ligature.



**Figure 11.6a** Clamping of the vascular portion.



**Figure 11.6b** Severance of the vascular portion distal to clamp.



**Figure 11.7** Closure of the skin incision with chromic catgut USP 2.

surgery site and we use it in our routine practice without any postoperative swelling or other complications (Fig.11.7). The reason for using catgut to suture the scrotal incision is that it does not need to be removed.

8. The site is cleaned with a sterilized swab and sprayed with antibiotic spray.

#### Postoperative Care:

If the surgical procedure is reasonably clean and is done with sterilized instruments, use of parenteral antibiotics in the postoperative period is not necessary.

#### Possible Complications:

1. Immediate postoperative bleeding may result in case of failure of proper crushing and occlusion of the blood vessels when only emasculator is used for castration. In cases where the spermatic

cord is ligated, the chances of this complication practically do not exist unless the ligature slips.

2. Edema of the scrotum and the prepuce has occasionally been noticed in those cases where the scrotal incisions were large and left open.
3. Scirrhus cord (chronic hyperplastic inflammation of the spermatic cord) is a rare complication. It manifests itself as a reddish-brown mass protruding above the normal skin (Fig.11.8). It requires surgical intervention; the cord should be dissected out completely and severed at the healthy portion with an emasculator (Fig.11.9). Ligation of the spermatic cord with catgut or any other absorbable suture material in such cases is generally not recommended, as it may serve as a nidus for infection in the already infected tissue. In these cases, usually there is bleeding from the scrotal wounds during and after surgery. The scrotal pouches should be tightly plugged with



**Figure 11.8** Protruded scirrhus cord.



**Figure 11.9** Dissection of the scirrhus cord before emasculation.

gauze sponges and the wound edged be closed with temporary retention sutures. The plugs are removed after 2 to 3 days followed by regular dressing of the wounds till complete healing. Cover of systemic antibiotics should be taken in these cases.

*Note : Another technique of castration has been used by the authors through a single, prescrotal midline incision in which one of the testes is pushed cranially towards the midline in the prescrotal region, is firmly held there and a small incision is given over the testis (Fig. 11.10). The testis is then squeezed out with digital pressure, the spermatic cord is maximally exteriorized and is severed the same way as described in the open method technique (Fig. 11.11). Then the other testis is pushed towards the same incision, is exteriorized and the spermatic cord is severed the same way. The incision is then closed with a single horizontal mattress suture using chromic catgut USP 2 (Fig. 11.12). This method is time saving and gives very good results with negligible postoperative complications.*



**Figure 11.10** Incision over the testis at the midline prescrotal region.



**Figure 11.11** squeezing out the testis and exteriorization of the spermatic cord.

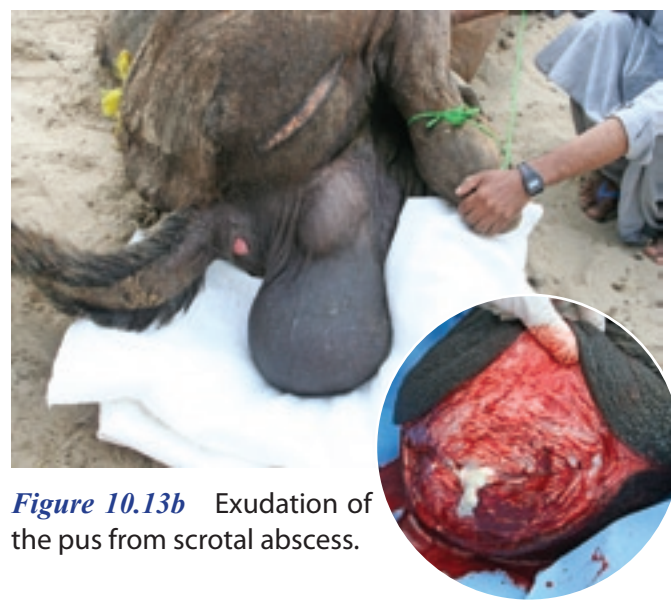


**Figure 11.12** Suturing of the midline incision with chromic catgut USP 2.

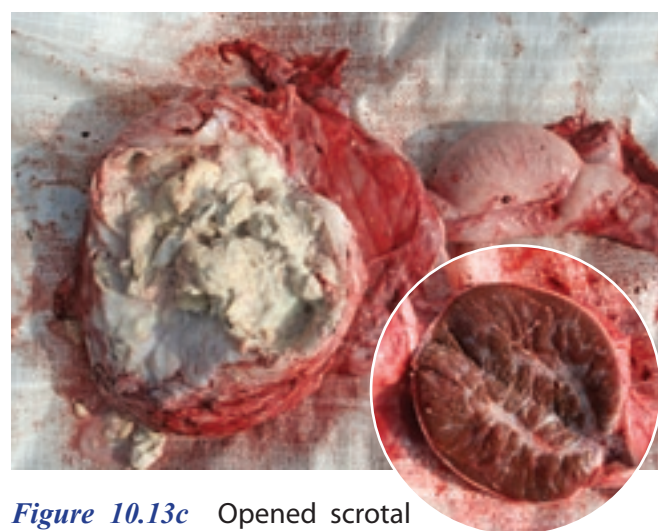




**Figure 10.13a** Left scrotal abscess with a small penetrating cutaneous wound.



**Figure 10.13b** Exudation of the pus from scrotal abscess.



**Figure 10.13c** Opened scrotal abscess and the atrophied, degenerated testicle.

testicular parenchyma result in painful orchitis. In some cases, chronic abscessation in the scrotal skin has been noticed with resultant testicular atrophy and degeneration as a result of pressure being exerted by a large scrotal abscess (Fig. 11.13 a,b & c).

#### Control and Anesthesia:

In case the injury is superficial and is only involving the partial thickness of the scrotal skin, the animal is controlled in the sternal position under slight sedation, but if the injury is deep enough affecting the testicular tissue and castration of the animal becomes mandatory, it should be cast and controlled in the left lateral recumbency under deep sedation.

#### Operative Steps:

These will vary according to the severity of the condition as mentioned below.

#### Superficial Wounds:

The superficial scrotal wounds will only require thorough cleaning and dressing of the wound daily till healing takes place. A course of systemic antibiotics and non-steroidal anti-inflammatory drug is recommended in these cases. The animal should be kept in a separate enclosure away from the other animals.

#### Deep Wounds:

The deep wounds involving testicular parenchyma need unilateral or bilateral orchidectomy. If only one testicle is damaged in a breeding animal with

good ancestry, unilateral orchidectomy should be done to save his breeding potential; otherwise both testicles should be removed. In cases of unilateral orchidectomy, great care should be taken not to damage the scrotal septum.

The procedure is the same as described for elective castration, except that the scrotal incisions are kept relatively large and open for effective postoperative management. The wound normally heals without complications.

#### Postoperative Care:

1. The animal should be kept in a separate enclosure away from the other animals.
2. The scrotal pouches should be daily cleaned with some mild antiseptic solution and dressed appropriately according to the condition of the wounds.
3. A systemic cover of broad spectrum antibiotics and non-steroidal anti-inflammatory drugs should be given for a period of 7 to 10 days.

#### Possible Complications:

1. Infection and exuberant granulation of the scrotal skin, particularly when proper care of the wounds is not taken.
2. Severe hemorrhage can result usually due to inadequate emasculatation of the testicular artery or considerable bleeding can occur due to accidental rupture of one of the branches of the external pudendal vein in the scrotal wall or septum.
3. Excessive swelling of the surgical site can occur because of inadequate drainage.
4. Development of scirrhus cord due to chronic infection. This is generally related to poor technique and improper postoperative care. It should be dealt with as described under the complications of the normal castration procedure.

### 3. Hydrocele

Sometimes unilateral or bilateral accumulation of the serous fluid is noticed between the visceral and parietal layers of the tunica vaginalis resulting in scrotal enlargement. The condition is generally believed to be the result of mild trauma to the tunic. It manifests as a soft, fluctuating, painless swelling with a normal size and contour of the testicle which helps the clinician to differentiate this condition from orchitis and scrotal hematoma.

The rational treatment is castration of the animal, as the use of diuretics seldom helps or gives only transitory relief. The control, anesthesia and operative steps are the same as described for the normal castration procedure. However, it is better to have large scrotal incisions which should be left open for effective drainage of the wounds in the postoperative period. In cases of unilateral hydrocele in a valuable breeding animal, the orchidectomy of only the affected side should be done, care being taken not to damage the scrotal septum.

#### Postoperative Care:

1. This procedure is just like normal castration, but as the scrotal incisions are kept open, the postoperative care consists of daily dressing of the surgical site till complete healing.
2. In cases of unilateral orchidectomy, care should be taken to avoid iatrogenic trauma to the septum during control and dressing of the surgical site.

#### Possible Complications:

These are essentially the same as described for castration.

### 4. Orchitis

Orchitis is not common in the camel. However, the condition may occur following trauma or scrotal skin injuries during fighting between the male animals in the rutting season. Although rare in the camel, the condition can also arise from a primary infection or by hematogenous spread of bacteria into the testes superinfecting the pre-existing traumatic, viral or parasitic damage. Orchitis is more commonly unilateral and may also involve epididymis. During the acute phase of the disease, the affected testis is inflamed and hyperemic with local heat and swelling and becomes grossly enlarged attaining two to three times its normal size (Fig.11.14). The localized inflammation usually causes temperature dependent degeneration in the unaffected testis. The condition is quite painful to produce an altered gait. When the condition progresses to a chronic phase, the testis becomes shrunken, fibrotic and adherent to the tunic and scrotum. Abscesses may also break through the scrotal skin. ( *see clinical case report No. 6. P.211*).

## 2. Scrotal Bite Wounds

As the testes are located high in the perineal region between the thighs and also become enlarged and protrude caudally in the rutting season, they become more accessible to the other male camels and hence, are prone to bite injuries. The bite wounds may be quite superficial affecting the scrotal skin only or be deep enough involving the testicular tissue as well. The bite wounds result in inflammation, hematoma and even infection in the old standing cases. These wounds demand immediate attention and treatment. The scrotal wounds apparently looking superficial may be accompanied by a large hematoma in the scrotal sacs causing swelling extending up to the sheath area. Deep scrotal bite wounds involving the





**Figure 11.14** Right sided orchitis.

Because of the degree of destruction that occurs, the prognosis for saving the affected testis is hopeless. In a valuable breeding animal, removal of the affected testis is recommended at the earliest possible stage of the disease to avoid temperature dependent degeneration of the unaffected testis. In cases of bilateral orchitis, the prognosis for future breeding is hopeless and hence, castration should be done as soon as it is safe to do so.

The **control, anesthesia, operative steps, postoperative care and possible complications** are essentially the same as described for castration. In old standing cases, adhesions may develop between the testis and the scrotum. The adhesions must be broken down with blunt dissection to fully expose the testis and the spermatic cord for emasculation. In cases of infected orchitis, it is advisable to keep the scrotal incisions large and open to provide for drainage and dressing till complete healing of the wounds. Cover of systemic antibiotics is recommended in such cases.

## 5. Urethrostomy

The urethra in the male animal extends from the neck of the urinary bladder to an external orifice at the dorsal surface of the urethral process of the free end of the penis. The urethral process is flanked by two folds of mucous membrane supported by a cartilage. The glans penis is represented by the urethral process. The penile urethra in the camel is narrow and the sigmoid flexure is pre-scrotal in contrast to the bovine bull in which it is post-scrotal and this difference should be kept in mind when planning penile or urethral surgery in this animal.

The most important indication of urethrostomy

is the obstruction of urethra with calculi. Sand masturbation in the camels is the main cause of ascending urinary tract infection with subsequent formation of urethral calculi in the post-scrotal urethra leading to partial or complete obstruction to the urine outflow. The penile urethra can also get obstructed, the most common site being the distal sigmoid flexure of the penis. The mortality rate is quite high in animals with complete obstruction. Mucous plugs can also cause urethral obstruction. Failure to relieve the obstructed urethra results in death from uremia due to rupture of the urinary bladder. Rupture of urethra with escape of urine subcutaneously in the sheath and the ventral abdominal wall with attending cellulitis and septicemia can also prove fatal.

The presenting signs of urethral obstruction will vary depending upon the degree of obstruction. The usual signs of incomplete obstruction are urinary incontinence with prolonged act of urination, repeated forceful spurts of urine ejected posteriorly with forceful strokes of tail to the sheath and keeping the hind legs wide apart during this action. In cases of complete obstruction, the animal is anuric, shows signs of abdominal discomfort with frequent contraction of the sheath and protrusion of the penis.

### Control and Anesthesia:

The animal is controlled in the sternal recumbency and high epidural anesthesia is induced. If needed the animal may be put in lateral recumbency. The tail is wrapped with a bandage and firmly tied at the back of the animal or held away by an attendant. In the lateral recumbency, upward pulling of the upper leg with a rope passed around it in the flexed position gives space and greatly facilitates the surgical procedure.

### Operative Steps:

The decision to perform surgery should depend upon the clinical evaluation of the patient. In cases where the urinary bladder is already ruptured, there is no point to undertake the procedure. If the urinary bladder is still intact, the procedure involves transection and extirpation of the penis as follows. The animal should also be castrated at the same time.

1. A skin incision is given exactly on the midline in the post-scrotal region.

2. After careful blunt dissection, the penis is dissected free from its dorsal arteries and veins and transected to leave an 8 to 12cm proximal stump. It is a common error to isolate an insufficient amount of penile stump prior to anchoring it to the skin. Normally the urine should escape as soon as the penis is transected. If not, the obstruction lies somewhere in the proximal urethra and it should be carefully dislodged and removed before proceeding further.
3. The arteries and the veins are ligated with chromic catgut or polyglycolic acid USP 1 suture material.
4. The stump of the exposed penis is directed caudoventrad and is anchored to the skin with two sutures on either side. The sutures should pass through the skin, tunica albuginea and corpus cavernosum penis, taking care to ensure that the urethral lumen is not compromised.
5. The urethra at the end of the penile stump is split and its edges are sutured to the lateral aspects of the penis. The sutures should go down to, but not through the urethral mucosa.
6. The distal portion of the transected penis is extirpated.
7. The edges of the skin incision proximal and distal to the urethrostomy site are apposed with simple interrupted or horizontal mattress sutures using nonabsorbable USP 2 suture material.

### Postoperative Care:

1. Systemic cover of antibiotics is taken for a period of 7 to 10 days.
2. Other supportive measures, such as intravenous fluids, diuretics and general therapy for shock should be given, if indicated.
3. Surgical site should be daily cleaned and dressed till complete healing and suture removal.

### Possible Complications:

1. The main complication that may arise is the stricture formation at the urethrostomy site. It is generally a result of narrow urethral opening or improper handling of the soft tissue at the time of surgery.
2. Infolding of the skin at the surgery site leading to obstruction to urine outflow. This usually happens if the proximal penile stump was of insufficient length causing excessive tension on the skin margins.

In some cases, the calculi are located only in the post-scrotal urethra with minimal inflammation of the later and the surrounding tissues. In such cases, instead of transection and extirpation of the penis, the calculus can simply be removed through a urethral incision (urethrotomy) as follows:

After exposure of the urethra, a small incision is given directly on the calculus. The calculus is removed and the urethral incision is closed with simple interrupted or continuous sutures of absorbable USP 2/0 suture material. We prefer polyglycolic acid suture material for the purpose, as it does not initiate inflammatory process in the tissues.

Prior to closure of the urethral incision, a catheter of a suitable size should be passed into the urethra both proximally and distally to ensure patency of its lumen. The catheter may also be kept in the urethra during closure of the incision in order to minimize the chances of narrowing of its lumen. The catheter is taken out after the suturing is completed. The upper third of the skin incision is closed and the remainder is left to heal by secondary intention.

**The postoperative care is the same as described above.**

## 6. Phimosis

The inability to protrude the penis at the time of service can be attributed to many reasons, such as congenital or acquired stricture of the preputial orifice or development of adhesions between the penile and peripenile tissue due to localized trauma, hemorrhage and/or abscessation in and around the prepuce. In old standing cases, the adhesions become fibrotic and present difficulties to exposure of the penis for surgery. Inflammation of the penis (balanitis) or prepuce (posthitis) is not only painful leading to unwillingness to copulate, but also can result in development of adhesions between the penis and the prepuce, preventing protrusion of the former. Cases have also been recorded in the racing camels where a temporary loose suture with a stainless wire was placed at the preputial opening as a remedial measure for sand masturbation. These sutures sometimes become ineffective with the passage of time and are replaced with the new ones. This practice results in repeated trauma to the preputial opening with consequent stricture formation leading to the condition of phimosis. The animals with good ancestry when retired from race are



generally used for breeding purpose and the problem needs to be rectified if it exists.

The problem has also been noticed in the non racing camels intended to be used for breeding purpose. The clinical examination of these camels generally shows no abnormality in the preputial orifice or any adhesions in the preputial cavity. The cause of phimosis in these animals may be other than what would need surgical correction, such as hormonal or psychological problems.

In the animals that need surgical intervention, the following corrective procedures may be used depending upon the underlying cause of the abnormality.

#### Control and Anesthesia:

The animal is controlled in the lateral recumbency under high epidural anesthesia, as this anesthesia helps in taking the penis out manually. Without anesthesia it is quite difficult to take the penis out of the prepuce.

#### Operative Steps:

##### A. Stricture of the preputial orifice:

The stricture of the preputial orifice, congenital or acquired due to remedial suture for sand masturbation or any other type of trauma is handled as under.

1. A wedge of preputial skin, fascia and mucosa from just behind the ventral aspect of the preputial orifice is removed. The size of the wedge to be removed will depend upon the severity of the preputial stricture.
2. The skin and the mucosal layer are sutured together with simple interrupted or horizontal mattress sutures using monofilament non absorbable USP 2 suture material to avoid reunion of the cut edges of the skin.

##### B. Adhesions between the penile and peripenile tissues:

1. The tip of the penis is manually taken out and held with a piece of gauze to prevent its slipping back. Even under general anesthesia, it may be difficult to fully expose the penis without tearing the adhesions.
2. The adhesions are manually broken with lubrication of the area till the penis is freed from the surrounding tissues. After the penis is extruded, even forcibly, all fibrotic tissue masses are excised

down to the tunica albuginea.

3. There will be some bleeding during this maneuver but this is normally self limiting.
4. The penis and the preputial cavity are well smeared with the lubricant mixed with some antibiotic or any antibiotic cream.

#### Postoperative Care:

1. In cases of correction of the stricture of the preputial orifice, the surgery site is daily dilated manually till complete healing so that the incision edges do not reunite.
2. In cases of adhesions, the penis should be daily taken out of the preputial cavity and well lubricated till complete healing otherwise the adhesions will reform with greater intensity.

#### Possible Complications:

1. Narrowing of the preputial orifice if proper post-operative care is not taken. It may also result in paraphimosis, as the penis may not retract into the preputial cavity once it is taken out by the animal itself.
2. The adhesions between the inner preputial lining and the penis may form again with greater intensity. It is also a result of improper postoperative care.

### 7. Paraphimosis

Inability of the animal to withdraw the penis into the prepuce may be due to congenital or acquired strictures of the prepuce, paralysis of the penis, balanoposthitis or injury to the penis during copulation or sand masturbation. The sand particles stick to the penis and consequently prevent its retraction into the preputial cavity. Due to continuous exposure of the penis to the external environment, it becomes edematous, swollen, inflamed and suffers damage to its increasingly friable integument and hence the animal can not retract it into the prepuce (Fig. 11.15).

The treatment must aim at to reduce edema, prevent further trauma to the penile integument and provide support for the penis until it can be returned to the prepuce. In the bovine bull, conservative treatment by manual retraction of the penis inside the sheath using lubricants may help in some recent cases. In the early stages the edema can be dissipated by the use of cold water



**Figure 11.15** Paraphimosis. Note the edematous swelling of the organ.

hosing and cold packs, whereas in the later stages the use of anti-inflammatory drugs and diuretics may prove helpful. In these cases also, surgical enlargement of the preputial orifice may become necessary before the penis can be replaced. In the camel, this procedure however, is seldom successful due to shape, size and direction of the prepuce and prescrotal position of the sigmoid flexure.

In untreated cases, the penis can become strangulated within a relatively short period of time. The prognosis in such cases is therefore, guarded and surgical treatment involving partial penectomy often becomes necessary.

#### Partial Penectomy.

The operative steps, postoperative care and the possible complications are the same as described for transection and extirpation of the penis under the procedure of urethrostomy in cases of urethral calculi.

### 8. Amputation of the Prepuce (Circumcision)

The prepuce is a pendulous, triangular structure facing backwards and has cranial and caudal retractor muscles, which help in directing the penis forward during erection for copulation. It is composed of only a single fold consisting of external and internal laminae. The lamina interna of the skin and that of the pars libera penis separate when the animal is 2 to 3 years of age to form the preputial cavity. The preputial orifice lies at the apex of the triangle and



**Figure 11.16** Prolapsed and inflamed prepuce.

faces caudoventrally.

#### Indications:

Prolapse of the prepuce is occasionally seen in the breeding as well as in the racing camels. There is protrusion of the parietal preputial lining followed by trauma with subsequent edema/inflammation that ultimately prevents retraction of the prolapsed prepuce. The usual cause is masturbation in the sand and in this process the preputial mucosa gets injured, swollen and protrudes (Fig. 11.16). Sometimes discoloration of the prepuce is also observed. Conservative treatment may be successful, but in most of the cases preputial amputation (circumcision) remains the ultimate choice.

#### Control and Anesthesia:

The animal is sedated and controlled in the lateral recumbency. Induction of epidural anesthesia can be used to an advantage to eliminate movements of the hind limbs which would also act as a safety measure for the operator.

#### Operative Steps:

As the preputial orifice in the camel is quite narrow as compared to that of the bovine bull, the standard procedure used for preputial amputation in the latter is not practicable in the former. The procedure in use by the authors has given quite good results and is being described below:

1. The index finger or thumb of the left hand is introduced inside the preputial cavity and the prolapsed portion of the prepuce to be resected is extended. A tourniquet with an umbilical tape is applied at the apex of the preputial triangle just





**Figure 11.17** Application of the tourniquet at apex of the preputial triangle.



**Figure 11.18** An oblique incision through both layers of the lateral half of the prepuce.



**Figure 11.19** Suturing of the outer and inner most cut edges of the prepuce with Safil USP 0.



**Figure 11.20** Replacement of the sutured prepuce after removal of tourniquet.

above the prolapsed prepuce (Fig.11.17). This temporarily occludes the blood vessels as well as stabilizes the prolapsed prepuce for easy handling and surgical manipulations.

2. An oblique incision; along the proposed line of amputation, going through both the layers of upper half of the prolapsed portion of the prepuce is given (Fig.11.18 ).
3. The outer and the inner most cut edges of the prepuce are apposed with interrupted horizontal mattress sutures using Polyglycolic acid USP 0 suture material (Fig.11.19).
4. Then the lower half of the prepuce is cut and apposed in the same way.
5. The tourniquet is then removed and the sutured portion is allowed to retract (Fig.11.20).
6. The preputial cavity is well lubricated with glycerin mixed with a broad spectrum antibiotic solution.

#### Postoperative Care:

The animal is put on parenteral antibiotics and the preputial cavity is daily infused with lubricant mixed with antibacterial agents to avoid any chances of stenosis till complete healing takes place. The tissue distal to the sutures ultimately sloughs.

#### Possible Complications:

Stenosis of the preputial orifice may be noticed as a long term complication leading to phimosis.

*Note : The purpose of giving an oblique incision, rather than transverse, is to get an oval orifice instead of circular. The circumferential diameter of the oval orifice is greater than that of the circular, thus minimizing the chances of narrowing of the orifice during the healing process and preventing chances of phimosis as a possible postoperative complication.*

### 9. Anti-Masturbation Sutures

The young racing animals often get the habit of masturbation in the sand. As a result, there may be injury to the penis, but the main concern of the owner is deterioration of health of the animal as a result of this habit.

#### Control and Anesthesia:

The animal is sedated and controlled in the lateral recumbency with the upper hind leg pulled backward with a rope passed around the flexed stifle joint.

#### Operative Steps:

There are a number of techniques in use by the camel owners and the practicing veterinarians. The basic aim of each technique is to offer some kind of resistance to protrusion of the penis out of the prepuce without any obstruction to the urine outflow. The technique developed by us is described here and it has given good results without any discomfort to the animal.

1. A 14 gauge sharp pointed hypodermic needle is passed through upper or lower lateral half of the prepuce about 1cm caudal to the preputial tip to exit in the center of the preputial cavity (Fig.11.21).



**Figure 11.21** Passing of hypodermic needle through lateral half of the preputial tip to exit in the center.

2. The tip of the needle is passed through a 2-3mm long piece of a stiff plastic rod (Fig.11.22). A piece of insemination rod works well for the purpose. Then the needle is passed through the other lateral half of the prepuce to exit on the other side (Fig.11.23).



**Figure 11.22** Passing the needle through a piece of stiff plastic rod (insemination rod).



**Figure 11.23** Passing the needle through the other lateral half.

3. A 10 cm long piece of 0.9 mm diameter stainless steel wire with a small loop made on its one end is passed through the bore of the needle and the later is taken out (Fig.11.24). This will result in passage of the stainless steel wire through the lumen of the plastic rod already placed in the center of the preputial cavity.
4. A small piece of intravenous tubing is passed over the unlooped portion of the wire and this end of the wire is passed through the loop on the other end and is bent on itself (Fig.11.25 a&b). While doing so the small finger of the operator is kept between the preputial tip and the wire so that it does not become tight on the preputial orifice to interfere with normal urination. The piece of the intravenous tubing is then slipped over the joint (Fig. 11.26) so that the tail hairs are not caught in the looped end when the animal moves his tail in the cranio-caudal direction.





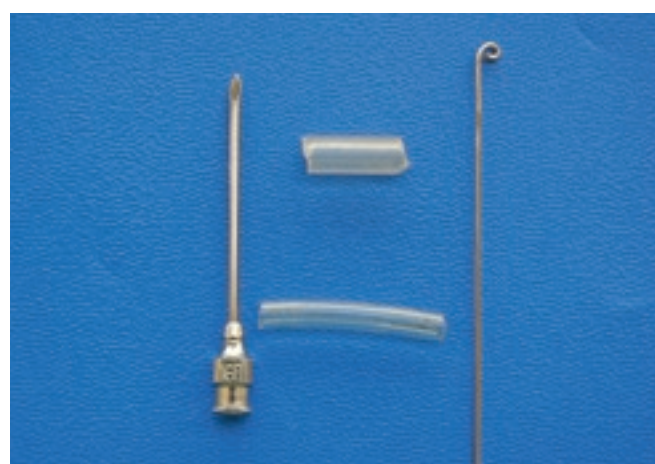
**Figure 11.25a** Passing the unlooped end of the wire through a piece of the intravenous tubing.



**Figure 11.25b** The unlooped end of the wire passed through the looped end and bent on itself.



**Figure 11.26** The piece of intravenous tubing slipped over the joint.



**Figure 11.27a** Material used for the preputial suture; (L to R): hypodermic needle 14G, piece of insemination rod (center up), piece of intravenous tubing (center down) and stainless steel wire 0.9 mm looped at one end.



**Figure 11.27b** In-situ arrangement of the materials used. The hypodermic needle is then removed and the ends of the wire are adjusted as shown in Fig. 11.25b and 11.26.

Figure 11.27 a&b depict the materials used and their arrangement/ position in the tip of the preputial cavity respectively

#### Postoperative Care:

The suture site should be dressed with antibiotic spray for 2-3 days. In case there is slight inflammation at the site, it should be periodically splashed with cold water.

#### Possible Complications:

The only possible complication may be inflammation at the site with transitory difficulty in urination, which usually subsides in a day or two with cold water application. If not, the offending suture should be removed and a new one applied with moderate tightness.

## B. Female Urogenital System

### 1. Cesarean Section

The uterus in the camel is bicornuate with a short smooth body. The left horn is longer than the right one even during the fetal life and virtually all pregnancies occur in the left horn. The broad ligament is attached laterally to the uterus.

#### Indications:

1. Dystocia; where the manual attempts are not fruitful; such as in cases of malpresentation, malposition, emphysematous, macerated or mummified fetuses.
2. Uterine torsion; although not very common, but is an absolute indication for this surgery, as the methods used to correct uterine torsion in the cattle are usually not applicable in the camel due to hump.
3. As a rule of thumb, the decision whether or not to go for cesarean section should be done in the early stages of dystocia, as an animal that has suffered a long period of fetal manipulation or attempts at fetotomy and is systemically compromised is not a good candidate for this surgery.

#### Control and Anesthesia:

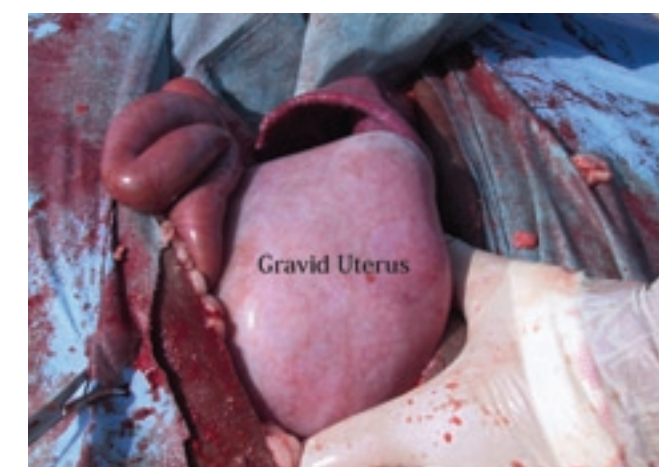
The animal is sedated, secured in sternal recumbency and left flank area is shaved and liberally scrubbed with any Iodine based solution and then cleared off with spirit methylated. The operative site is desensitized with paravertebral anesthesia or a line or inverted "L" block. It is advantageous to keep the animal with the body tilted at 45-60 degrees towards the right side. The animal is covered with a large drape, the incision site being exposed through a slit in the drape.

#### Operative Steps:

1. Standard left flank laparotomy is performed (*see chapter 9*).
2. After entering the peritoneal cavity, spleen is seen lying proximally just under the incision. Care should be taken not to damage it. It can be easily pushed aside to look for the gravid uterus.
3. Gravid uterine horn is then held in both the hands and an attempt is made to exteriorize it which sometimes seems to be quite difficult or even impossible, especially in cases of emphysematous

fetus and uterine torsion. Therefore, care should be taken not to apply much force to exteriorize it; otherwise it may rupture. In such cases, it is acceptable even if the uterus is brought up to the laparotomy incision (Fig. 11.28). The peritoneal cavity is packed with laparotomy pads or towels before incising the uterine wall.

4. The incision on the gravid horn is made parallel to its long axis and on its greater curvature because this area has the fewest blood vessels (Fig. 11.29). Care should be taken not to injure the fetus if it is still alive. The incision should be long enough to allow easy extraction of the fetus without further tearing of the uterine wall. This point is most important.



**Figure 11.28** Exposing the gravid uterus.



**Figure 11.29** Uterine incision.



5. The edges of the hysterotomy incision are firmly held with the uterine holding forceps, so that the uterus does not fall back into the peritoneal cavity when the fetus is being removed.
6. The limb of the fetus, whichever is easily accessible; is held by hand and taken out. The other limb is then caught and exteriorized. In case, these are the fore limbs; the head is then grasped, brought to the incision and taken out along with the limbs. In case of hind limbs, the fetus is simply pull out. The fore limbs and head will follow (Fig 11.30 a, b &c).
7. The uterus should be held firmly by the operator while the assistants pull out the fetus. During this maneuver, maximum care should be taken to avoid contamination of the peritoneal cavity.
8. The placenta which is diffuse, epitheliochorial in nature and without cotyledons is removed if it is easily detachable. Usually it can be detached easily (Fig.11.31).
9. Antibiotic boluses are placed in the uterus prior to its closure.
10. The uterus is closed with two layers of sutures; the first being the Cushing and the second continuous Lembert sutures using chromic catgut USP 4 on a round body needle. The suture knots on both ends should be buried.
11. The Utrecht method of uterine closure involving a single layer of continuous inverting pattern has been claimed to result in less adhesions and an improvement in fertility of cattle following cesarean section (Fig. 11.32 a,b &c).
12. After closure of the uterus, it is replaced in position.
13. The abdominal cavity is cleared off any blood clots, sponged to remove any excessive fluid and is as maximally cleaned as possible.
14. Closure of the laparotomy incision is done in a standard fashion (*see chapter 9*).

*Note : The synthetic suture materials, such as Polyglycolic acid may be used instead of catgut. These suture materials are expensive compared to catgut but have extended tissue holding power and functional life.*

#### Postoperative Care:

1. Antibiotics should be administered for a period of two weeks.
2. Suture line is daily cleaned and dressed with

antibiotic spray till the sutures are removed. During this period, the animal should be allowed only restricted activity.

3. Supportive therapy is also instituted in accordance with the clinical condition of the animal.

#### Possible Complications:

1. All the complications laid down for laparotomy plus break down of the uterine sutures with fatal consequences.
2. Uterine adhesions with the surrounding visceral organs or even with the abdominal wall. These adhesions have been reported to result in decreased fertility rate of the animal.

#### 2. Prolapse of Uterus

Prolapse of uterus immediately or within two to three days after parturition has quite often been seen in the camel and requires prompt attention and correction to avoid further damage and mutilation of the organ (Fig.11.33). The most common cause is dystocia when forced extraction is applied to pull the fetus out. Other possible causes include infection of the uterus following abortion, retained placenta and chronic metritis. The whole uterus is seen hanging out and if not attended in time, it becomes edematous, congested or even lacerated and severely traumatized leading to grave prognosis.

#### Control and Anesthesia:

Animal is sedated and controlled in sternal recumbency with her front portion at a lower position and high epidural anesthesia is induced with 40-50 ml of 2% solution of Lignocaine hydrochloride or other local anesthetic solution used for the purpose.

#### Corrective Procedure:

1. A clean cloth or drape is placed under the prolapsed uterus and the organ is thoroughly washed with clean water (Fig.11.34). A water hose may even be used for the purpose.
2. This cloth or drape is replaced by a new one and the cleaned uterus is placed over it.
3. The assistants hold the uterus up with the help of the cloth under it, while the clinician starts reducing the uterus back into the cavity using the standard technique (Fig.11.35 a,b &c). It is



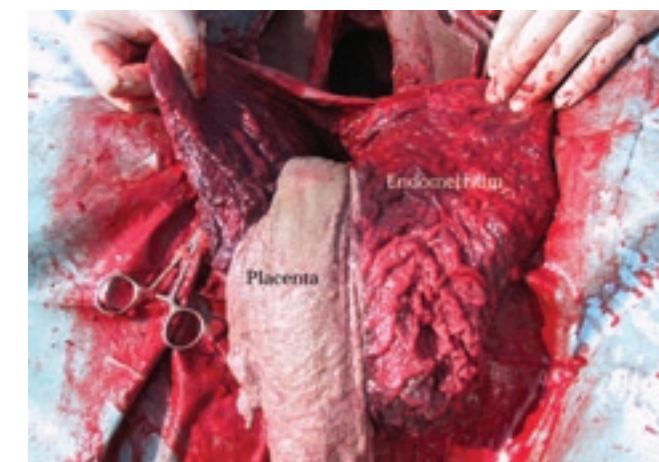
**Figure 11.30a** The hindlimbs pulled out through the uterine incision.



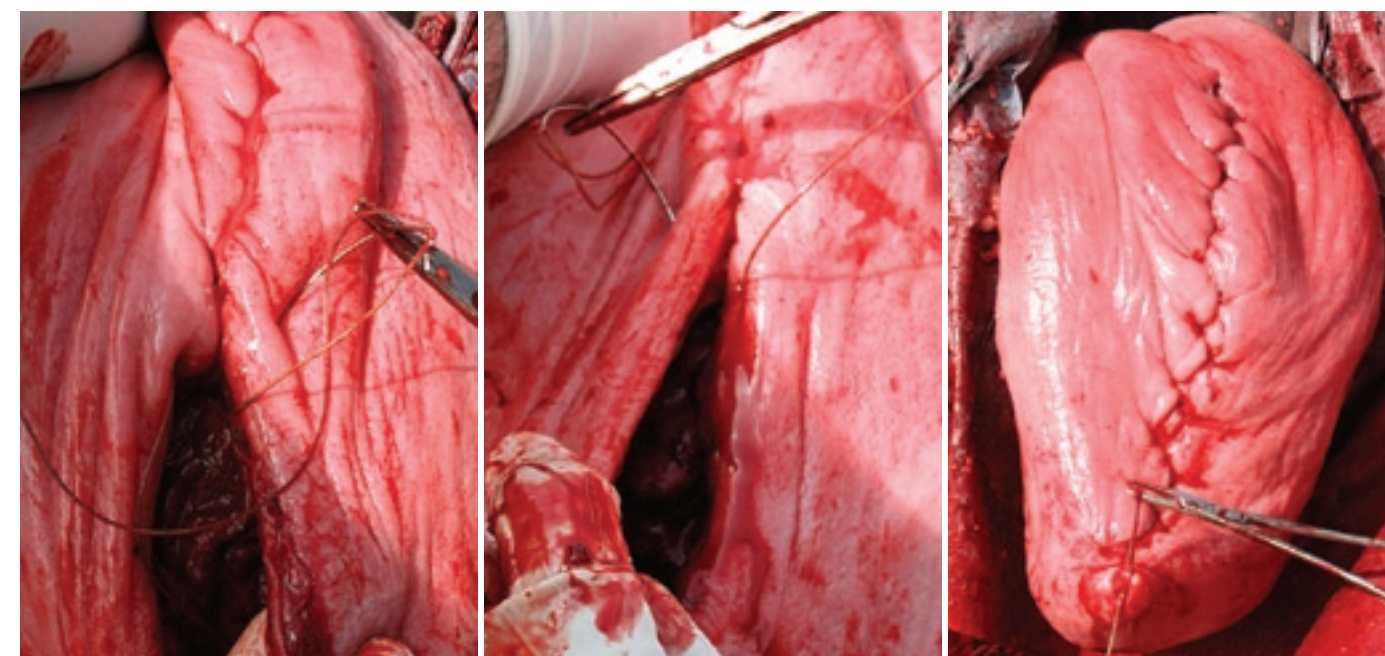
**Figure 11.30b** The fetus exteriorized up to the thorax.



**Figure 11.30c** The head of the fetus being taken out.



**Figure 11.31** Detachment of the placenta.



**Figure 11.32a,b&c** Representing different steps of the Utrecht suture pattern. See chapter 3 for details and schematic diagrams.





**Figure 11.33** Prolapse of uterus.

- a laborious job but can be accomplished with patience.
4. After reduction, it is repositioned, particularly the left horn; to its normal place by manual manipulation.
  5. Antibiotic boluses are placed in the uterus before applying retention sutures on the vulval lips.
  6. The vulval lips are apposed with two horizontal mattress sutures using umbilical tape, making sure that they do not interfere with urination (Fig.11.36 a,b,c &d). These sutures are necessary, otherwise; the prolapse will recur.

#### Postoperative Care:

1. The sutures are protected with antibiotic spray and are daily cleaned and dressed with the same drug.
2. Systemic antibiotics should be given till removal of the vulval sutures, which are normally removed after 7-10 days.

#### Possible Complications:

1. Edema of the vulval lips if the retention sutures are too tight.
2. Tearing of the vulval lips in the event of severe straining by the animal, which is usually due to infection and irritation of the uterine wall. In such a situation, proper cleaning of the uterine cavity should be carried out and intensive antibiotic therapy should be instituted with the application of a truss instead of vulval retention sutures.



**Figure 10.34** Washing & cleaning of the prolapsed uterus.



**Figure 11.35a** Lifting up the uterus by assistants while the operator tries to reduce it.



**Figure 11.35b** Uterus is almost reduced.



**Figure 11.35c** Complete reduction and reposition of the uterus. Note that full arm of the operator is introduced for proper reposition of the uterus, particularly its left horn.



**Figure 11.36a** Buhner tape needle being passed through the vulval lips.



**Figure 11.36b** Umbilical tape going through the vulval lips.



**Figure 11.36c** Tying ends of the umbilical tape.



**Figure 11.36d** Vulval suture completed. The suture should be moderately tight not to interfere with urination.



### 3. Prolapse of Vagina

The vagina is an elastic organ and is about 25-30cm long. The hymen or its remnant marks the separation between the vulva and the vagina. The prolapse of vagina is sometimes seen in late pregnancy or even in non-pregnant animals (Fig.10.37). A slight protrusion of vagina is seen while the animal is sternal and normally disappears in the standing position. However, in advanced or old standing cases the condition persists even in the standing position.



**Figure 11.37** Vaginal prolapse in a pregnant animal.

#### Control and Anesthesia:

The animal is secured in the sternal recumbency and epidural anesthesia is induced with 20ml of 2% solution of local anesthesia.

#### Corrective Procedure:

1. The prolapsed vagina is thoroughly cleaned with standard solution of Potassium permanganate and the compromised tissues if any are carefully debrided.
2. It is then lubricated with some antibiotic ointment and reduced gently.
3. The best remedy is to apply one temporary horizontal mattress retention suture on the vulval lips using umbilical tape. The pregnant animal should be closely watched, so that the suture is removed at the time of delivery; otherwise, the vulval lips can tear apart very badly while the animal strains during parturition.
4. In non-pregnant animals, the suture may be left for a longer time and is removed prior to breeding season or when the condition of the animal is considered fit for its removal.

#### Postoperative Care:

1. A course of systemic antibiotics is recommended for a period of 7 to 10 days.
2. The pregnant animal should be closely watched for any untoward signs till the suture is removed at the time of delivery.

#### Possible Complications:

1. Tearing of the vulval lips if the retention suture is not removed at the time of delivery.
2. Chronic vaginitis in case the animal is not properly taken care of.

### 4. Perineal Laceration

Perineal lacerations occur during parturition when the head and/or limbs of the fetus are forced caudad and dorsad. In some cases, this injury has been seen occurring during forceful traction of an oversized fetus or with violent expulsive efforts by the dam or forceful pulling of the fetus with some degree of its malposition. The injury can also occur during forced extraction of the fetus before full dilation of the birth canal. The injury can be classified into three categories.

1. **First degree lacerations:** When only mucosa of the vagina and vulva are involved.
2. **Second degree laceration:** When submucosa and muscularis of the vulva, anal sphincter and the perineal body are involved, but there is no damage to the rectal mucosa (Fig.11.38).
3. **Third degree lacerations:** When there is tearing through the rectovaginal septum, musculature of the rectum, vagina and the perineal body (Fig.10.39). Repair of third degree perineal laceration is necessary to return the animal to breeding soundness.

Generally, surgery is not performed on emergency basis, as the torn tissue is edematous, necrotic and contaminated. It is advisable to wait for 5 to 6 weeks or even more to allow the mutilated tissues to heal before attempting repair (Fig. 11.40). Repairs attempted before this period are usually unsuccessful.



**Figure 11.38** Second degree perineal laceration. Note the intact rectal mucosa.



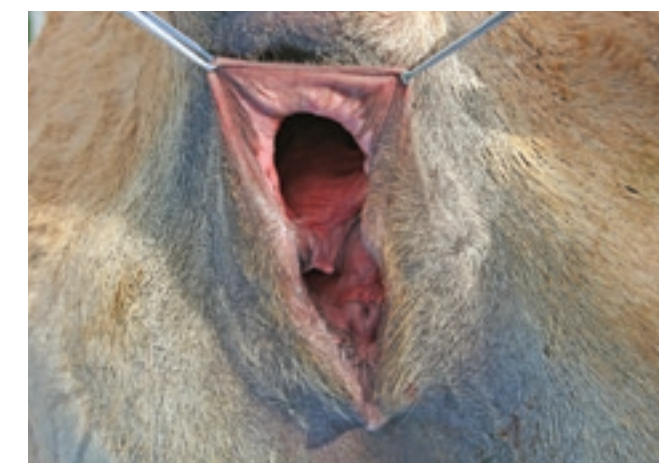
**Figure 11.39** Third degree perineal laceration. Note extensive tearing through the rectovaginal septum.

#### Control and Anesthesia:

The animal is controlled in sternal recumbency under high epidural anesthesia.

#### Operative Steps:

1. An incision is made along the scar tissue at the junction of the rectal and vaginal mucosa, separating the two structures (Fig. 11.41). The completed incision should extend from the shelf formed by the intact rectum and vagina to the dorsal commissure of the vulva.
2. The vaginal mucous membrane and the submucosa are reflected ventrally from the line of incision to form a flap of tissue approximately 2 to 2.5cm wide (Fig. 11.42). This will result in the formation of a sort of shelf over which the rectal and vaginal mucosa is separated cranially for a distance of 2 to 3cm. At this point the operator should determine if further dissection is necessary by estimating the ease with which the vaginal mucosa can be brought in apposition; the baseline objective being that the mucosa should form the roof of the vagina without or with minimal tension on the suture line.
3. Closure of the shelf is accomplished by apposing the vaginal roof with continuous horizontal mattress sutures using Polyglycolic acid USP 1 suture material. The suturing is started just cranial to the defect and is terminated at the dorsal commissure of the vulva. This will invert the vaginal mucosa and form the first layer of the repaired roof of vagina.



**Figure 11.40** An old standing case of perineal laceration showing healing of the torn tissues.



**Figure 11.41** Separation of the rectal and vaginal walls.



4. The second row of interrupted sutures of Polyglycolic acid USP 2 is placed between the rectal and vaginal wall starting from the cranial end and terminating at the dorsal commissure of the vulva (Fig. 11.43). Each suture should pass through the rectal submucosa, perivaginal tissue and the vaginal mucosa on both sides of the common vault and tied securely. These sutures should not pierce through the rectal mucous membrane.
5. The walls of the perineal body are then apposed and sutured in a similar fashion with simple interrupted sutures using Polyglycolic acid USP 1. Here also, 2 to 3 layers of sutures may be necessary. Closure of the deep layers of the perineal body should commence cranially and terminate caudally (Fig.11.44 a & b).
6. The skin of the perineum is slightly undermined and closed with simple interrupted or horizontal mattress nylon sutures.



**Figure 11.42** Deep dissection between the vaginal and rectal walls.



**Figure 11.44a** Closure of deep layers of the perineal body.

#### Postoperative Care:

1. Antibiotics of choice are administered for 7 to 10 days.
2. The suture line is daily cleaned and dressed with antibiotic spray.
3. The skin sutures are removed after 2 weeks.
4. Soft food in small amounts for about 2 weeks is given.

#### Possible Complications:

As this area cannot always be kept clean, so the chances of contamination of the surgery site do exist, which may result in infection and break down of the sutures in the perineal body and those of the skin. The problem can be avoided by careful attention and proper dressing of the surgery site.



**Figure 11.43** Suture placement between the rectal and vaginal walls.



**Figure 11.44b** Terminal sutures in the perineal body. See clear demarcation between the anal and vulval orifices.

#### 5. Vaginal Adhesions

This condition has been seen in the camel, with various speculations as far as etiology is concerned. The clinical examination reveals adhesions of the vaginal walls that are sometimes so severe that one is unable to introduce even fingers into the vaginal cavity. The most probable cause one can think of is severe injuries to the vaginal walls during previous parturition in dystocia or uterine prolapse cases, particularly when these are handled unskillfully. However, in some cases; the history of previous parturition indicates normal delivery. Cases of vaginal adhesions have also been seen in the heifers.

There is a common practice with the "Bedouin" to give multiple sharp cuts on the vaginal wall all around and the clitoris with a view to improve the fertility and conception rate of the animal. This is thought to be the most common cause for development of this condition, as the vaginal adhesions will form when the injured vaginal wall heals in apposition.

#### Control and Anesthesia:

The animal is controlled in the sternal position under epidural anesthesia. The tail of the animal is wrapped in a bandage and securely tied upwards or held by an assistant.

#### Corrective Steps:

In recent cases, the adhesions can be broken down manually with copious lubrication of the hand and arm. It is always better to wear long gloves. The procedure requires patience and step by step advancement till the cervix is felt. Then a finger is introduced in the cervical canal to ensure its patency. Some bleeding will be noticed from the vaginal cavity; however, it is self limiting. The vaginal walls are well smeared with lubricant mixed with some non-irritant antibiotic, such as strepto-penicillin. In some old standing cases, the adhesions are too severe to be broken. These are hopeless cases and hence; forceful efforts to undo the adhesions should be avoided, as it may result in rupture of the vaginal wall with fatal consequences.

#### Postoperative Care:

The vaginal walls should be smeared daily with a lubricant mixed with the same antibiotic for 5-6 consecutive days till the vaginal walls completely heal. This is very important; otherwise,

the adhesions may develop again with more intensity.

#### Possible Complications:

1. Bleeding from the vaginal walls is usually transitory, but sometimes may last for a longer time and the animal may need necessary therapy to arrest bleeding.
2. Rupture of the vaginal wall due to forceful efforts to undo the adhesions with consequent prolapse of a segment of bowel which almost proves fatal.
3. The adhesions may develop again if proper post-operative care is not taken.

#### 6. Transverse Vaginal Septum

Vaginal septum is one of the congenital anomalies and is a sequel to faulty cannulization of embryonic vagina. It hinders in the penile intromission and can lead to reproductive failure. The clinical examination reveals a septum at the level of vestibulo-vaginal junction just cranial to the urethral opening (Fig.11.45).

#### Control and Anesthesia:

The animal is controlled in the sternal position under epidural anesthesia.

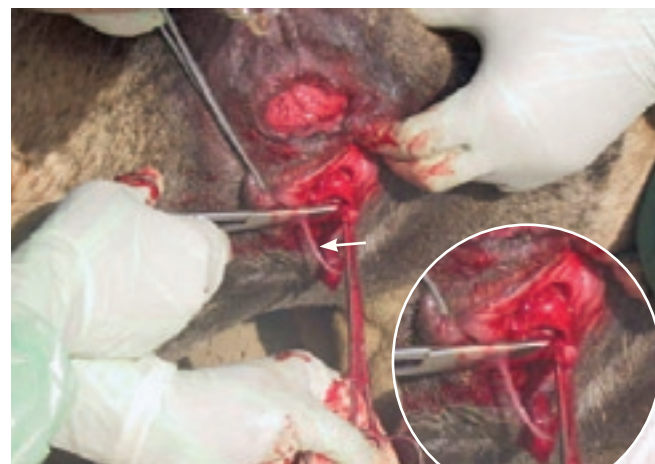
#### Corrective Steps:

1. The tail is wrapped in a bandage and held up by an assistant or tied securely at the back.
2. The area is thoroughly washed with any Iodine based solution and dried.
3. The vulval lips are grasped with atraumatic forceps and held apart.
4. The septum is grasped in the center with Allis forceps and a circular piece is severed with a fine, curved Metzenbaum scissors. A variable quantity of milky white fluid normally escapes as soon as the septum is severed (Fig.11.46).
5. The remaining part of the septum is then carefully trimmed from its margins to the extent that the operator's hand will easily pass beyond the septum site. The bleeding is negligible and no ligation of any point is needed.
6. A well lubricated gloved hand is then introduced into the vagina up to the cervix to ensure its patency.
7. If indicated, intrauterine passeries may be placed in the tract.





**Figure 11.45** Lateral reflection of the vulva lip to expose the vaginal septum.



**Figure 11.46** Severance of the vaginal septum with the scissors. Note the escape of milky white fluid from vaginal cavity (arrow).

#### Postoperative Care:

1. The animal should not be mated for about two weeks, so that the wound heals properly.
2. During this period, occasional digital dilatation and stretching of the surgical site should be done to avoid any stricture formation.

#### Possible Complications:

1. Bleeding from the surgery site is normally not a problem, but may be noticed if quite a deep dissection is done. However, it is self limiting in most of the cases and does not need interference. Slight digital pressure with a swab of diluted epinephrine solution (1:10,000) usually solves the problem.
2. Stricture formation at the surgery site which may need another surgical intervention.

vestibulo-vaginal junction that may or may not allow introduction of even one finger (Fig. 11.47).

#### Control and Anesthesia:

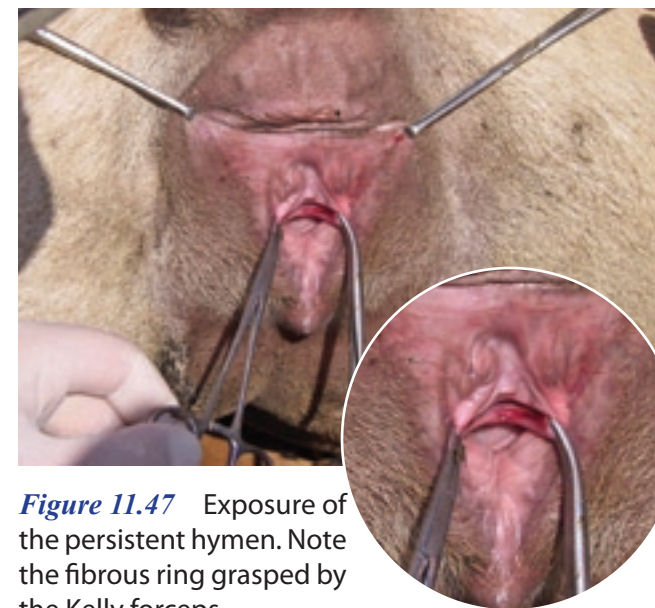
The animal is controlled in the sternal position and caudal epidural anesthesia is induced.

#### Operative Steps:

1. The tail of the animal should better be wrapped in a bandage and tied to one side or preferably held up by an assistant. The hairs at the base of the tail are clipped to avoid chances of contamination.
2. The area is cleaned and washed thoroughly with any Iodine based scrub solution.
3. It is better to pass a urethral catheter, so that one may not damage the meatus urinarius accidentally.
4. The lips of the vulva are held apart with atraumatic forceps.
5. The fibrous ring is held at one point with the Allis forceps and is dissected all around (360 degrees) with blunt pointed, curved Metzenbaum Scissors (Fig. 11.48 a&b). There is no appreciable bleeding during this maneuver.
6. After cutting of the fibrous ring, well lubricated gloved hand is introduced into the vagina. The hand should go fairly easily into the vaginal cavity. If not, further careful dissection of the ring is done till the desired objective is achieved.
7. The vaginal cavity is then smeared with some non-irritant antibiotic cream or paste.

### 7. Persistent Hymen

The hymen is a 360 degrees fibrous ring which marks the separation between the vulva and vagina and makes vaginal examination difficult in the young animal. At puberty, it most probably, becomes relaxed under hormonal influences and offers no resistant to intromission at the time of first mating. However, in some individuals it is relatively stronger making intromission difficult or even impossible. The animal is presented with the history of failure of intromission by the male or resistance on the part of the female to accept the male. The digital examination reveals a tight ring like structure at the



**Figure 11.47** Exposure of the persistent hymen. Note the fibrous ring grasped by the Kelly forceps.

8. Mating of the female is then allowed after 7 to 10 days.
9. Any other accompanying reproductive problem should be treated simultaneously.

#### Postoperative Care:

1. The surgery site should be daily checked, digitally dilated and smeared with antibiotic ointment.
2. Parenteral antibiotic cover is normally not needed.

#### Possible Complications:

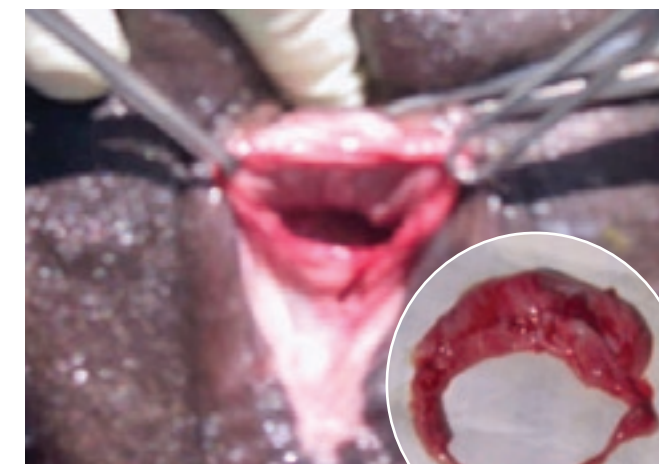
1. Bleeding from the surgery site in case the dissection was deeper than required.
2. Damage to the urethral opening in case of careless dissection.
3. Stricture formation at the surgery site may be noticed as a long term complication and may present a problem at the time of parturition.

### 8. Recto-Vaginal Fistula

Recto-vaginal fistulas due to rupture of the dorsal vaginal wall and ventral wall of the rectum are occasionally noted, especially in the mare in which parturition is violent. However, the condition; although not very frequent, has also been observed in the camel. The condition is normally a result of difficult parturition when one of the limbs or rarely the head of the fetus gets entrapped in the roof of the vagina and consequently pierces through it and the ventral rectal wall in unassisted cases of dystocia in the eve of continuous straining by the



**Figure 11.48a** Severance of the hymen ring.



**Figure 11.48b** Completely severed hymen ring (in circle). Note enlargement of the vestibulo-vaginal junction after resection of persistent hymen.

animal. This may also happen in cases of dystocia when handled by the quacks without correcting the malposition or malpresentation of the fetus. The anal sphincter in these cases is usually intact and the fistulous tract may lie immediately cranial or a little further to the anal opening. Prompt repair of the defect is not necessary; rather it is advisable to wait until the edema and swelling have subsided and the granulation tissue and wound edges have completely healed. This period may vary from 4 to 6 weeks.



In very old standing cases, some fecal material and mucopurulent discharge are expelled from the vulva and in some animals the fecal material has also been seen accumulated in the vaginal cavity, which in turn may result in ascending urinary tract infection or reproductive problems.

#### Control and Anesthesia:

The animal is controlled in the sternal position under epidural anesthesia.

#### Operative Steps:

1. The tail is bandaged, directed upwards and firmly tied or held by an assistant.
2. The area is thoroughly washed with any Iodine based scrub solution and clean dried.
3. The intact part of the anal canal caudal to the defect is cut open. It renders dissection and separation of the vaginal and rectal walls much easier for suturing.
4. The dorsal wall of the vagina and the ventral rectal wall are separated through careful dissection with the scissors up to the cranial end of the fistula.
5. The next repair steps are the same as described for the repair of perineal lacerations except that no sutures are needed in the perineal body.

#### Postoperative Care:

1. Parenteral cover of antibiotics is taken for a period of 7 to 10 days.
2. The surgery site is periodically checked to ensure intactness of the suture line. The perineal skin sutures should be daily cleaned and dressed.

#### Possible Complications:

1. Break down of the suture line is the main post-operative complication, as the surgery site always remains contaminated due to fecal material and the vaginal secretions. In such a case, patience is required and the defect should be repaired after sometime when the tissues regain their normal status. Such wounds do pose irritating problems but ultimately heal up in due course of time.
2. Ascending urinary or reproductive tract infection may be an infrequent sequel.

### 9. Atresia Vulvi

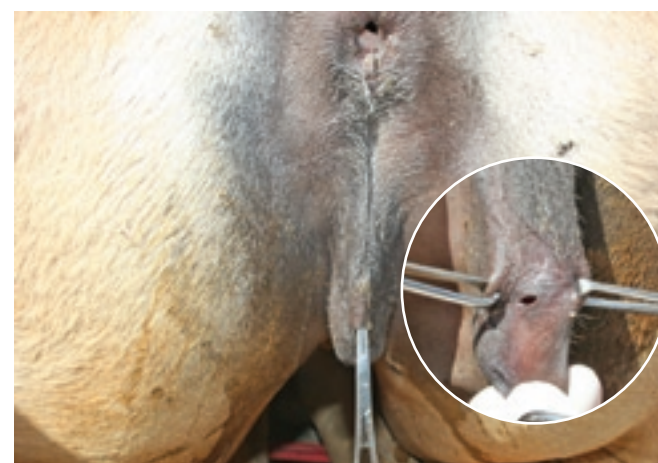
This is a very rare congenital condition in which the vulval lips do not become separated at the midline. The case may be presented for treatment soon after birth or when the animal becomes adult. A very small, pin point opening is however, present at the distal end of the external genitalia for the escape of urine. However, only some drops of urine will escape from this opening and most of the urine remains accumulated in the vaginal cavity. A longitudinal median scar marks the demarcation line between the vulval lips (Fig.11.49 a&b).

#### Control and Anesthesia:

The calf is controlled in the lateral recumbency and the site is desensitized with local infiltration anesthesia, where as the heifer is controlled in the sternal recumbency under light sedation and epidural anesthesia.



**Figure 11.49a** Atresia vulvi in a 2 days old calf.



**Figure 11.49b** Atresia vulvi in an adult heifer. Note the small opening for escape of urine.

#### Operative Steps:

1. A full thickness small incision is given in the middle of the median scar to separate the united vulval lips. As soon as the incision is completed, a small quantity of the accumulated urine will escape through it (Fig. 11.50 a&b).
2. A blunt probe of a suitable diameter is passed from the incision downwards to exit through the opening for the escape of urine and the incision is extended up to it and then upwards with a sharp scissors up to the dorsal commissure of vulva. A blunt pointed instrument such as a long closed needle holder is introduced into the vaginal cavity to evaluate its patency (Fig.11.51) If the instrument goes in fairly easily, the prognosis is good, otherwise; the owner should be told accordingly.
3. The skin and the mucosa of the respective vulval lips are sutured with horizontal mattress sutures using monofilament USP 0 nonabsorbable suture material (Fig.11.52 a&b).

#### Postoperative Care:

1. Post operative care consists of daily cleaning of the suture line and spraying it with antibiotic spray till removal of the sutures.
2. Parenteral cover of antibiotics is normally not needed.

#### Possible Complications:

Narrowing of the vulval opening may be encountered as a long term complication when the surgery is done in the calf, that would interfere with mating when the animal becomes adult. In such a situation, the vulval orifice should be enlarged towards the anal opening as required. The skin and the respective vulval lip mucosa should be sutured after this surgery.



**Figure 11.50a** Fullthicknessskinincisionatthemedian scar in the calf.



**Figure 11.50b** Fullthicknessskinincisionatthemedian scar in the heifer.



**Figure 11.51** Introductionofaclosedneedleholderinto the vaginal cavity in the heifer to ensure its patency.





**Figure 11.52a** Suturing of the skin with the respective vulval lip mucosa in the heifer.



**Figure 11.52b** Suturing of the skin with the respective vulval lip mucosa in the calf.

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# CHAPTER

# 12

## Orthopedic Surgery

**S**urgery of the bones and joints in camels like other large animals is not very rewarding. The basic aim of fracture fixation is to arrest movement at the fracture site, or immobilization of the fracture. In some situations, the methods of external or internal fixation of fractures can be used with varying degree of success. In simple fractures below the carpal and tarsal (hock) joints, external fixation methods such as application of Plaster of Paris bandage or Polyester-Polyurethane band can be used with varying results. Plaster casts are also used to supplement internal fixation devices used in repair of certain fractures and they reduce the excessive force on the bones of the lower limb, especially during recovery from anesthesia. However, as a general rule; internal and external fixation methods are not used simultaneously on the same fracture, as by doing so one gathers disadvantages of the both. As far as internal methods of fracture repair, such as intramedullary pinning or bone plating are concerned, some success has been achieved, particularly in calves or very young animals.

Before dealing with individual bones, it would be better to outline the basic principles of external and internal methods of fracture fixation, so that one may attempt a fracture case with better functional results.

The other important point to be strictly observed is adherence to the aseptic technique. All the basic rules for aseptic surgery should be followed in letter and spirit. It should always be kept in mind that there is no substitute for asepsis.

### 1. External Methods of Fracture Fixation:

Out of the many techniques in use for external fixation of fractures, the one; that at times, can be used

to an advantage in the camel is the application of a Plaster Cast or Polyester-Polyurethane band.

The basic principle for external fixation is to incorporate all the joints below and one joint above the fracture site in the bandage in order to arrest movement at the fracture site. This limits the use of this method to fractures below the carpal and tarsal joints. The cast should not end in the middle of a long bone, because the fulcrum effect produces severe sores and places excessive pressure on the diaphysis.

#### Technique:

The materials to be used, such as plaster bandage (Fig. 12.1), Polyester-Polyurethane bands (Fig. 12.2), stockinette (Fig. 12.3), rolled cotton and bandage scissors (Fig. 12.4) should be laid down in an orderly fashion prior to anesthetizing the animal so that these are readily available when needed. Delay in application of the cast allows the plaster to cure in “shells” which generally reduces its strength.

1. The animal is anesthetized and secured in the lateral recumbency with the affected leg up.
2. Any wounds if present and if considered that these will not interfere with fracture healing; are debrided, sutured and treated as required. This will depend upon experience and careful evaluation of the case. This is a very critical decision and should weigh more than anything else for the well being of the patient. If the decision is positive, sterile, non-adhering dressings are applied to the wounds under the cast to prevent stockinette from adhering to the wound. These steps are not required in simple fractures.
3. The leg is passed through stockinette of a suitable size/diameter according to the circumference of the fractured limb. When more padding than



Figure 12.1 Plaster of Paris.



Figure 12.2 Polyester-Polyurethane band.



Figure 12.3 Different sizes of Stockinette.



Figure 12.4 Universal Bandage Scissors.

this is applied, the weight of the animal soon compresses the padding and the cast becomes loose resulting in abrasions. The proximal and distal ends of the stockinette should extend 10-15cm beyond the intended line of termination of the fixation bandage and the foot of the animal respectively, so that it could be reflected over the bandage to avoid any irritation to the skin by the later.

4. The fracture is reduced using the method of extension, counter extension and local manipulation.
5. The limb is firmly held by the assistants in the reduced position and the Plaster of Paris bandage (plaster cast) or Polyester-Polyurethane band (P&P band) is wrapped around the limb with moderate tightness. The application of bandage is always started from the foot of the animal going up to the proposed point of termination of

the bandage. Four to six layers of P&P band or 6-8 layers of plaster cast or even more are used according to the size and weight of the animal. The proximal and distal ends of the stockinette are then reflected over the bandage and fixed there with a piece of adhesive tape (Fig. 12.5). Application of the first roll is critical. It should be closely applied without tightening; otherwise circulatory embarrassment of the limb will result. The operator must be careful not to dimple the cast with fingers. Such indentations result in abrasions.

6. The bandage is allowed to dry before the animal is allowed to stand up. The Plaster of Paris bandage takes up to one hour or a little more (depending upon the season) to dry but the Polyester-Polyurethane band dries up and becomes hard very quickly in about 5-8 minutes. However,





**Figure 12.5** Application of Plaster of Paris cast for mid-shaft metacarpal fracture in a one-year-old male camel calf.

about 20 minutes should be given to allow the P&P band to set before the animal is allowed to stand. The animal should be assisted during the act of standing.

7. Regular follow up of the case is done up to complete healing of the fracture before the fixation bandage is removed. The progress of callus formation should periodically be assessed by radiographic examination.

#### Cast Care:

The cast should be periodically felt for areas of excessive warmth. There are generally warm spots on the posterior aspect of the fetlock and in the carpal region because of blood vessels in these areas. However, excessive heat is abnormal and indicates the need for examination of the limb. A certain amount of experience is needed to judge what in fact abnormal warmth in the cast is. Excessive swelling above the cast generally indicates trouble and the cast should be changed. One should not rely on the changes in the white blood cell count or a rise in body temperature to predict trouble under a cast. By the time these parameters change, the situation may have become irreversible. The animals on medication, like Phenylbutazone must be watched even more closely, as the effects of such products can mask problems under the cast. In cases of compound fractures; even with a small wound at the fracture site, the cast should be changed every 8-10 days. The season of the year will also govern this time period. This interval can however, be increased as the wound heals.



**Figure 12.6** Oscillating Saw.

#### Cast Removal:

No time period can be specified for removal of the fixation devices, as many factors, such as age, weight and temperament of the animal, type and site of the fracture, accuracy of reduction and immobilization, health status of the animal and metabolic bone diseases affect the bone healing process. Therefore, the decision about cast removal should always be based upon the clinical and radiographic evidence of fracture healing. Casts are best removed with an oscillating saw (Fig. 12.6). The cast is cut in half by cuts on its medial and lateral aspects and then removed. Because the cast cutters can cut through the skin, care should be taken during cast removal.

#### Possible Complications:

The main complication related to the casts is the pressure sores. This complication however, is never severe enough so as to decide for euthanasia of the animal. They are usually minor and are much less serious than the original injury that warranted cast application. With sensible management, they usually heal uneventfully.

#### 2. Internal Methods of Fracture Fixation:

These methods involve application of the fixation devices directly on the bone; hence, are also known as bone splintage principles. These methods are mainly represented by intramedullary pinning and bone plating. Under normal conditions, a fractured bone heals by formation of a periosteal and endosteal callus which stabilizes the fracture and allows bony union between the fracture fragments.

As far as large animals are concerned, intramedullary pinning does not really provide rigid fixation to eliminate hundred percent movements at the fracture site which should always be the goal to achieve an early return to full function of the fractured limb. Another point is that in the camel like all other large animals, the humerus and the femur are the only bones amenable to bone pinning. The pin can not be inserted into other bones without penetrating the adjacent joint. The other outstanding disadvantage of the use of pins or nails is that they can not provide the stability and strength to allow for ambulation in the heavy animals. Hence, intramedullary pinning has virtually no place for repair of long bone fractures in the camel.

If the fracture is well stabilized with a bone plate, an altered pattern of fracture healing characterized by haversian remodeling and minimal or no callus formation occurs; the so called "Primary bone healing" which is still questionable in the large animals. However, for this purpose, the "Association for the study of Internal Fixation (ASIF)" has designed special bone screws and bone plates and has laid down basic principles for their application to achieve interfragmental and axial compression that leads to early healing of the fractured bone. This is probably the only system that has a chance of withstanding the constant forces to which the implants are subjected in the large animals during the healing period. Interfragmental and axial compression refer to vertical and horizontal compression of the fracture fragments respectively. Therefore, the interfragmental compression is used to reattach either the detached small bone fragments (butterfly fragments) to the main shaft of the bone or for getting the vertical compression between the main fracture fragments in cases of long oblique or spiral fractures, whereas the axial compression is used to compress the main fracture fragments horizontally against each other in cases of transverse or near transverse fractures.

Compression per se does not stimulate osteogenesis, but by bringing the ends of the fractured bone in close apposition, movement and periosteal reaction are reduced to a minimum and healing occurs by creeping substitution in both cortical and cancellous bone, known as primary bone healing. To achieve interfragmental and axial compression, four basic principles as laid down by "ASIF" are :

1. Anatomical reduction of the fracture fragments

2. Stable internal fixation
3. Atraumatic handling of bone and soft tissue
4. An early pain-free active mobilization following surgery.

The beneficial effects of these principles can be achieved through the techniques described below. In large animal orthopedics, however; achievement of these goals is questionable and primary bone healing normally does not occur even when the fracture is repaired by compression plating. The only purpose to lay down an outline of these techniques here is to give an idea to the working veterinarian, so that; if feasible, he may be able to try them in the hour of need.

Before going into the details of the procedures for interfragmental and axial compression of the fracture fragments, it will be worthwhile to give here a brief account of some of the special instruments, bone screws and self compression bone plates required for the "ASIF" method of internal fixation.

#### A. Instruments:

1. **Bone holding clamps:** These are of different types and sizes to hold the fracture fragments in place during surgical manipulations (Fig. 12.7).
2. **Drill machine:** This may be pneumatic, electric or hand driven. In the large animals however, a pneumatic or electric drill machine is used, as it is very difficult or at times even impossible to drill a hole in the bone with a hand driven drill machine (Fig. 12.8).
3. **Drill bits:** For drilling holes in the fracture fragments for insertion of the bone screws (Fig. 12.9).
4. **Drill sleeve:** For perpendicular drilling for 3.2mm drill bits (Fig. 12.10).
5. **Depth gauge:** Used to check the length of the screw to be used (Fig. 12.11).
6. **Countersink:** For bevelling the hole in the near cortex to receive screws with hexagonal heads (Fig. 12.12).
7. **Bone tap:** It is used to cut threads in the drill holes of the bone before insertion of the bone screws. A 2.7, 3.5 and 4.5mm diameter tap is required for 2.7, 3.5 and 4.5mm cortical screw respectively. However, the 3.5mm diameter tap is also used for 4.0mm cancellous bone screw (Fig. 12.13).
8. **Tap sleeve:** For bone taps of 3.5 and 4.5mm





**Figure 12.7** Kern bone holding clamps (above)  
Lowmann's bone holding clamps (below).



**Figure 12.8** Drill machines; electrical (left) and manual (right).

diameter. The 3.5mm diameter tap sleeve may also be used as a drill sleeve for 3.2mm drill bits (Fig. 12.14).

9. **Hexagonal screw drivers:** with 2.5 and 3.5mm recess across flats to be used for 3.5 and 4.5mm screws respectively (Fig. 12.15).

10. **Load guide:** For central and eccentric drilling of the screw holes in the plate (Fig. 12.16). Using the load guide, the screw is inserted at one end of the oval hole i.e. eccentrically, thereby placing the plate under tension as the conical head of the screw engages the plate.



**Figure 12.9** Drill bits.

#### B. Bone Screws:

The screws available in most compression-plating systems are of cortical and cancellous types. Cortical bone screws are designed for use in hard bones and the cancellous screws are used more in the soft bones of the young animals and occasionally in the metaphyseal areas of the adult animal.

Screws can be applied through the plate into the underlying bone or may be used to secure fragments of the bone together in the repair of a comminuted fracture. In the later case, the screw is generally inserted using the "lag screw principle" to achieve maximum compression between two pieces of the bone (see interfragmental compression).

#### 1. Cortical Bone Screws :

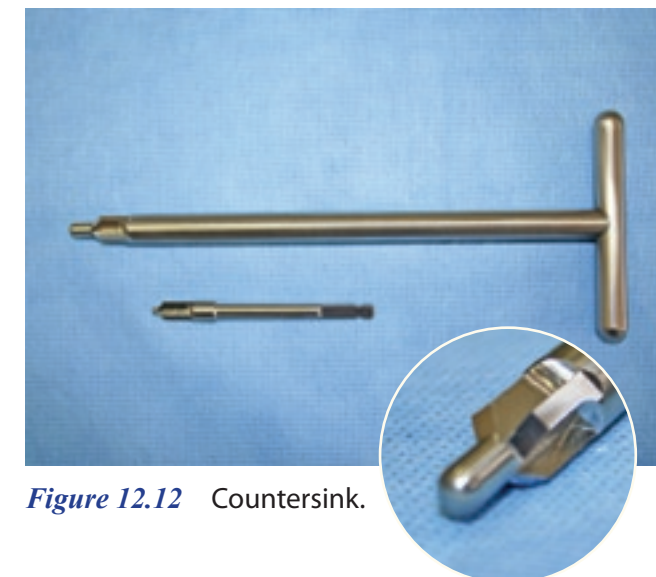
The shafts of these screws have full length threads (Fig. 12.17) and are available in different sizes (Table 12.1). Of course, these screws are not normally used for interfragmental compression, but can be



**Figure 12.10** Drill sleeve / Tissue protector.



**Figure 12.11** Depth gauge.



**Figure 12.12** Countersink.



**Figure 12.13** Bone tap.



**Figure 12.14** Tap sleeve.



**Figure 12.15** Hexagonal screw driver.



**Figure 12.16** Load guide.



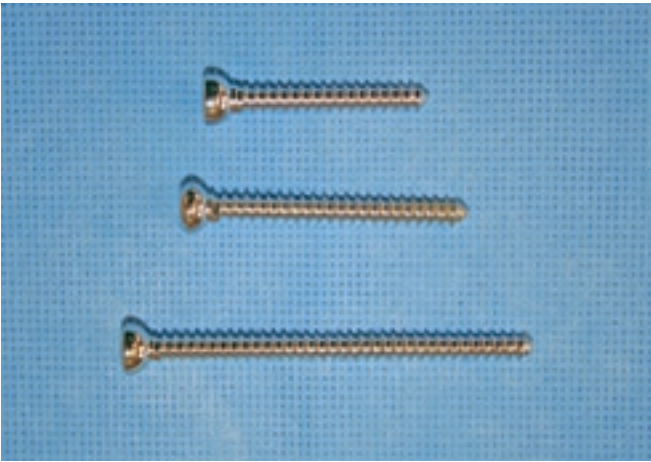


Figure 11.17 Cortical bone screws.

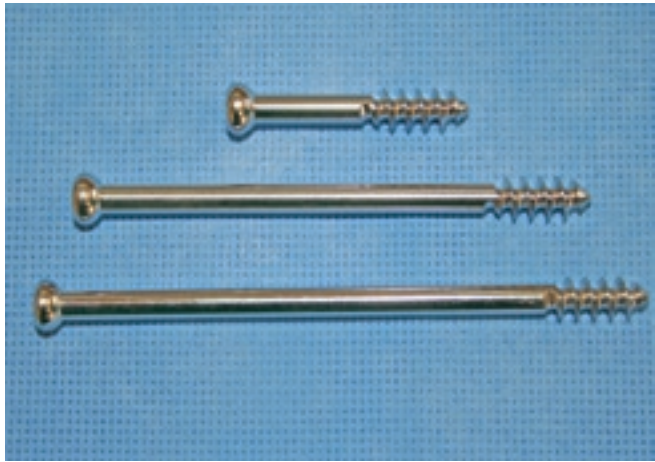


Figure 11.18 Cancellous bone screws.



Figure 12.19 Self compression bone plates.

used for this purpose in the form of lag screws if they obtain a hold in the far cortex only. Hence, it requires a larger hole to be drilled in the near than in the far cortex. The hole in the far cortex has to be tapped. The large hole in the near cortex is called the “gliding hole” and the small hole in the far cortex is called the “thread hole”.

**2. Cancellous Bone Screws :**

The principle of this screw is that the shaft of the screw is only partially threaded (Fig. 12.18) so that the threads take hold only in the far cortex and thus pull the latter in the upward direction when the screw is tightened. Hence, these screws are used to achieve interfragmental compression. These are classified into three categories on the basis of the extent of threading of the shaft of the screw (Table 12.2). The threaded portion of the shaft is called core of the screw.

Apart from the screws shown in table 12.2, small cancellous screws of 4.0mm thread diameter with short thread (16mm) and full thread are also available with the length range of 10 to 26mm with 2mm successive increments in length. These screws however, are not used in large animals.

**C. Self Compression or Dynamic Compression Bone Plates:**  
These plates have spherical gliding holes (Fig. 12.19), come in different sizes and are classified on the basis of the size of the screws they take, the number of the holes or length of the plate and the width of the web of the plate.

On the basis of the size of the screws the plates take, these are categorized as mini plates (1.5 and 2.0mm), small fragment plates (2.7mm) and standard 3.5 and 4.5mm plates. Out of these, only 3.5 and 4.5mm plates can be used in small camel calves and somewhat larger animals to a varying degree of success; hence, a brief account of these plates only is given here. The number of holes or length of the plate determines the selection of the plate to be used for a particular bone. The 4.5mm plates are further classified as narrow and broad webbed plates with respective web width of 12 and 16mm. The last two sizes of plates (3.5 and 4.5mm) are available under different specifications (Table 12.3).

**Interfragmental Compression:**  
Interfragmental compression is attained by using a screw in the lag effect. The principle of the lag screw is that the threads of the screw take hold only in the far cortex so that the fracture fragments are pulled

Table 12.1 Cortical screw dimensions in millimeter.					
Screw Category	Length of screw	Diameter of thread	Thread pitch	Diameter of core	Diameter of head
2.7* mm	6 - 40 with 2 mm successive increments.	2.7	1.0	1.7	5.0 with 2.5 mm hexagonal recess in the center.
3.5 mm	10 - 40 with 2 mm successive increments.	3.5	1.25	2.25	6.0 with 2.5 mm hexagonal recess in the center.
4.5 mm	14 - 70 with 2 mm successive increments.	4.5	1.5	3.0	8.0 with 3.5 mm hexagonal recess in the center.

\* Not used for camels, just for general information

Table 12.2 Cancellous screw dimensions in millimeter.						
Screw Category	Length of thread	Length of screw	Thread diameter	Diameter of core	Diameter of shaft	Diameter of head
Standard thread	16	30 - 110 with 5 mm successive increments.	6.5	3.0	4.5	8.0 with 3.5 mm hexagonal recess in the center.
Long thread	32	30 - 110 with 5 mm successive increments..	6.5	3.0	4.5	8.0 with 3.5 mm hexagonal recess in the center.
full thread	Full shaft	30 - 110 with 5 mm successive increments.	6.5	3.0	4.5	8.0 with 3.5 mm hexagonal recess in the center.

Table 12.3 Size of bone plates with number of holes and length of the plate.		
Size of Bone plates	No. of holes	Length of plate
3.5 mm	2 - 12	26 - 146 mm (with an increase of 12 mm for each hole). The standard length of a 2 hole plate is 26 mm and that of a 3 hole plate is 38 mm and so on. The plate can be ordered either on hole or length basis. The plates can take 3.5 mm diameter cortical and 4.0 mm diameter cancellous screws. These plates are also available with the hole range of 7 - 22 and the length range of 86 - 218 mm with an increment of 12 mm in length for each hole.
4.5 mm	( 2 -16) Narrow Webbed	39 - 263 mm ( With a successive increment of 16 mm per hole). The standard length of the 2 hole plate is 39 mm and the length of the 3 hole plate is 55 mm and so on. So the plate can be ordered either on holes or length basis
	(5-18) Broad Webbed	87 - 295 mm ( With a successive increment of 16 mm per hole). The standard length of a 5 hole plate is 87 mm and the length of 6 hole plate is 103 mm and so on. Both narrow and broad webbed plates can take 4.5 mm diameter cortical and 6.5 mm diameter cancellous screws.



together when the screw is tightened. This effect can be achieved by using either a cancellous screw or a cortical bone screw with lag effect. For the cancellous screw, after drilling the hole, the thread is cut with a cancellous bone tap in the far cortex; however, in pure cancellous bone, instead of using the bone tap; a special malleolar screw, which has a triangular tip and obviates tapping, can be used. Thread diameter of the malleolar screws is 4.5mm and the length varies from 25 to 70mm with 5mm successive increments in length. The diameter of the head is 8mm with 3.5mm recess in the center. The details of the procedures to get interfragmental compression with the cancellous and cortical screws are given below.

**Procedure for interfragmental compression with 6.5mm diameter cancellous screws**

1. The fracture is reduced and the near and far cortices are drilled with either 3.2 or 3.6mm drill bit.
2. Then the near cortex is over drilled with 4.5mm drill bit.
3. The length of the screw to be used is measured with the depth gauge.
4. The far cortex is tapped with 6.5mm cancellous bone tap.
5. The screw is then driven in and optimally tightened.

Looking at the dimensions of the cancellous screws given in table 12.2, one can appreciate that the screw will take hold only in the far cortex and when tightened, will pull it up to result in interfragmental compression.

**Procedure for interfragmental compression with 4.5mm cortical screw**

1. The near cortex is drilled with a 4.5mm drill bit using a 4.5mm tap sleeve.
2. A drill sleeve with an external diameter of 4.5mm and an internal diameter of 3.2mm is inserted into the hole until it meets the far cortex.
3. The far cortex is drilled using a 3.2mm drill bit.
4. The drill sleeve is then taken out and the length of the required screw is measured with a depth gauge.
5. The far cortex is tapped out using a 4.5mm cortex tap.
6. A countersink is cut in the near cortex for the head of the screw.

7. The screw is then driven in and tightened. As the screw will take hold only in the far cortex, it will result in interfragmental compression when tightened.
8. If a single compression screw is used, it must be inserted so that it bisects the angle formed by the perpendicular on the bone and perpendicular on the fracture line.

**Axial Compression:**

Axial compression of a long bone fracture with a plate can be achieved either by placing a plate with round holes under tension using a tension device or by using a bone plate with spherical or oval gliding holes (self compression or dynamic compression plate). The holes of the self compression plates contain an inclined plane which allows the screws to produce plate translocation upon tightening. At present, as the self compression bone plates are most commonly used to achieve axial compression, only this technique is being described here. These plates are easy to use and will produce the required compression at the fracture site when correctly applied. The plate is applied as a tension band plate on the side of the bone under tension; which means that the plate is applied under tension but the fracture itself is under compression. If the cortex opposite the plate is intact and the plate is under tension, the tensile forces under the plate are converted into compressive forces. This is known as “Tension Band Principle”. It is necessary that the plate is applied according to the principles outlined in the “AO” manual to achieve the required effects of the tension band principle. This principle is however, only applicable to single, transverse or short oblique fractures.

As far as comminuted fractures are concerned, these are first reconstructed using the lag screws for interfragmental compression. The bone plate is then applied under compression between the two main fragments of the bone, thus bridging the comminuted area. This ensures that the majority of the forces are transmitted from the proximal to the distal fragment, thereby reducing unwanted forces on the comminuted area. Excessive compression however, may disturb the repair. A plate applied in this manner is called a neutralizing plate.

Bones should be plated from one metaphysis to the other if possible to avoid stress concentration at the ends of the plate. If double plating is performed,

**Table 12.4 Guide lines for use of bone screws, drill bits, bone taps and screw drivers ( in millimeters).**

	Mini Screws	Small Screws		Large Screws	
	Cortical	Cortical	Cancellous	Cortical	Cancellous
Diameter	1.5 & 2.0	2.7 & 3.5	3.5 & 4.0	4.5	6.5
Drill Bit	1.1 & 1.5	2.0 & 2.5	2.0	3.2	3.2
Bone Tap	1.5 & 2.0	2.7 & 3.5	3.5 & 4.0	4.5	6.5
Screw Driver	1.5	2.5	2.5	3.5	3.5

the plates should end in different areas of the metaphysis to avoid stress concentration. Both plates are generally applied under compression to achieve maximum stability.

Every fracture case does not lend itself to plating. For the application of a plate, the minimum requirement is that each of the proximal and distal fracture fragments should be long enough to receive at least three screws (six cortices) in the small calves and four screws (eight cortices) in the large animals respectively. The selected plate should be just short of the length of the bone excluding the extremities of the later.

**Technique for using 4.5mm self compression bone plate to achieve axial compression:**

1. A 3.2mm hole is drilled on tension side of the bone about 1cm away from the fracture line in one of the fracture fragments.
2. The plate is held against the bone with its hole opposing the drill hole in the bone and the length of the screw to be used is estimated with the depth gauge.
3. The threads are then tapped in the screw hole with 4.5mm diameter bone tap.
4. The screw is driven until its head just touches the plate.
5. The fracture is reduced and held with the bone holding forceps so that the plate is aligned parallel to the long axis of the bone.
6. The plate is slide across the bone (translocation of the plate) to cause the screw head to engage the hole of the plate at its far edge away from the fracture line.
7. A hole is then drilled through the bone using 1mm load guide in the screw hole nearest the fracture site in the other fracture fragment. The hole must be drilled using the yellow load guide with the arrow of the guide pointed towards the fracture site. This is important since the load

guide contains an eccentrically placed hole that will allow the screw being used to compress the fractured bone end by translocation of the plate.

8. The length of the screw is estimated and the threads are tapped in the same way as was done for the other fragment.
9. The second screw is now driven, the bone clamp is removed and the screw is tightened, followed by tightening of the first screw.

Because the screws are placed eccentrically, tightening will press the conical head of the screw down against the edge of the spherical gliding hole of the plate thus forcing the fragments together and compressing them.

The remaining holes on both sides of the fracture site are drilled using the green neutral drill guide and the screws are placed and tightened the same way as described above.

General guidelines for the use of drill bits, bone taps and screw drivers to be used for different bone screws are given in table 12.4 for quick reference.

**Postoperative Care In General:**

1. Broad spectrum antibiotic cover is taken for 10-14 days or as required. The choice of the antibiotic rests with the attending practitioner. However, if postoperative infection occurs one should resort to culture and sensitivity test.
2. The animal should be confined in a capacious enclosure separate from the other animals to avoid any trauma during locomotion or from other animals.
3. Periodic radiographic examination should be carried out to evaluate the progress of the callus formation.
4. If indicated, the plate is removed when there is clinical and radiographic evidence of complete fracture healing.

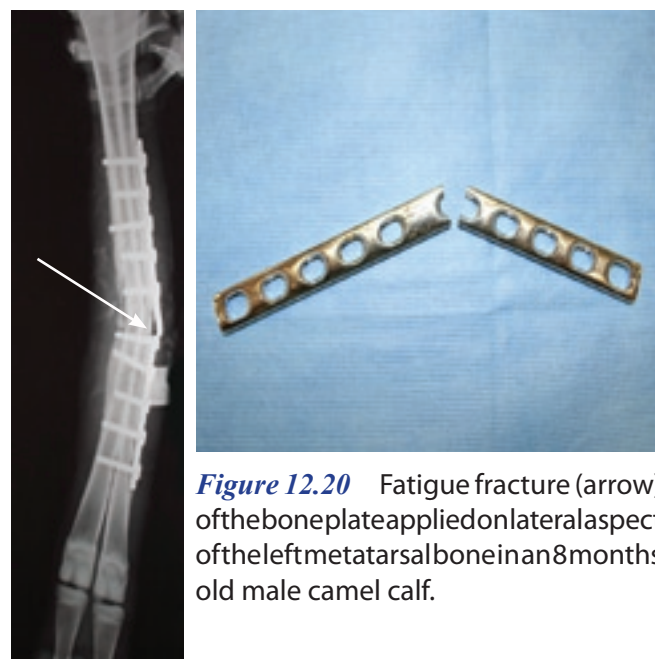


*Note: Controversy still exists whether or not the plate should be removed after fracture healing. The general consensus is that it may be left inside if it is causing no problems to the animal; otherwise, it should be removed.*

#### Possible Complications In General:

Out of the many postoperative complications, the following are the most important.

1. Instability at the fracture site leading to delayed and nonunion. Interposition of soft tissue between the fracture fragments can also result in these complications.
2. Mal-union; when the bone heals in an angular deformity.
3. Infection and osteomyelitis.
4. Of course rare, fatigue fracture of the plate can occur due to excessive stress on it with accompanying re-fracture of the bone (Fig.12.20).



**Figure 12.20** Fatigue fracture (arrow) of the boneplate applied on lateral aspect of the left metatarsal bone in an 8 months old male camel calf.

## SPECIFIC FRACTURES AND DISLOCATIONS

In this section those fractures will be discussed that are commonly encountered in the camel and can be dealt with the existing and most commonly used methods for fracture repair.

### 1. Fracture of the Mandible:

The mandible or the lower jaw bone consists of two halves which fuse during the first few months after birth. The incisive part of the body harbors six incisors and two canine teeth. The mandibular symphysis reaches to a point half way between first and second premolar tooth. There are four cheek teeth on each side of the mandible; namely, premolar 2 and molars 1, 2 and 3. The cheek teeth and the incisors are important from interdental wiring point of view in cases of mandibular fractures.

Fracture of the mandible is one of the most common fractures in the camel, particularly in the rutting or breeding season. In this season, camels become vicious and tend to bite each other leading to abnormal stress on the mandible with resultant bilateral fracture. Fractures of this bone have also been recorded following external violence like blow against a blunt object, following an auto-mobile accident or falling down with the face striking against the ground with force. The fracture usually occurs

across the tushes (first premolar); however, it may also occur cranial or caudal to this site (Fig. 12.21 a, b & c).

Most of the fractures are transverse, but oblique and multiple fractures may also be encountered. A technique using a rectangular wooden plate and plaster of paris bandage has been described to immobilize the mandibular fracture. However, we mainly use the technique of interdental wiring described below which works very well for transverse fractures. It is simple, convenient and economical and can be easily performed in the field conditions. For oblique or multiple fractures, one might have to resort to transfixation technique or bone plating, as in these fractures the cranial fracture fragment tends to displace caudally when the wires are tightened to immobilize the fracture site. The common instruments and the stainless steel wires used for interdental wiring for repair of the mandibular fracture are shown in figure 12.22

#### Interdental Wiring:

#### Control and Anesthesia:

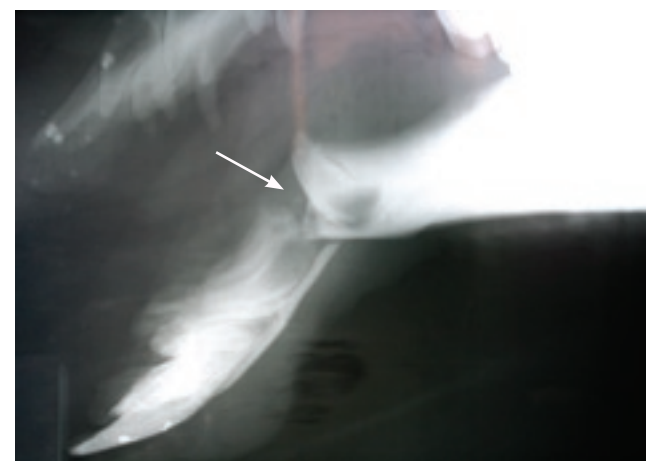
The animal is controlled in sternal recumbency and appropriately sedated.



**Figure 12.21a** Bilateral fracture of the mandible. Note hanging of the lower jaw; a typical clinical sign.



**Figure 12.21b** Bilateral fracture of mandible across the tushes; the most common site of the fracture.



**Figure 12.21c** Radiographic picture showing transverse fracture across the tushes (arrow).



**Figure 12.22** Common instruments used for interdental wiring (left to right): Buhner needle, Kirschner wire (1mm), Jacob's chuck with key, Stainless steel wire, Wirecutter, Wire twister and needle holder.

#### Operative Steps:

1. Oral cavity is flushed with standard Potassium permanganate solution and any debris and blood clots are removed.
2. A hole is drilled across the gums of first two cheek teeth (second premolar and first molar) on both sides with 1mm Kirschner wire loaded on a pin chuck. Instead, the use of a "Buhner Needle" is also quite convenient for the purpose and we normally use it in our routine practice (Fig. 12.23). In some animals, the first cheek tooth is quite small and the space between the first and second cheek tooth does not hold the wire effectively. In such cases, the space between the second and third cheek tooth (first and second molar); although a little difficult, may be used.



**Figure 12.23** Making a recess with Buhner needle in between the first two cheek teeth for the passage of wire.





**Figure 12.24** Passing of Stainless steel wire through the hole made between the first two cheek teeth with the medial end of the wire passing through the space between the central incisors.



**Figure 12.25** Twisting of the medial and lateral ends of the wire on each other with a wire twister.



**Figure 12.26a** Cutting of twisted ends of the wires with a wire cutter.

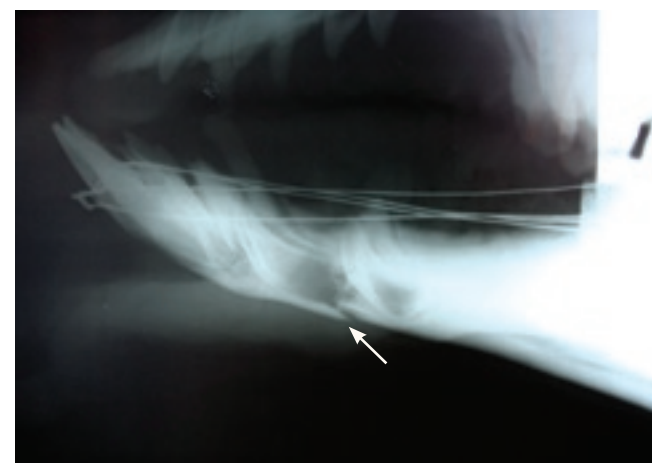


**Figure 12.26b** Bending of the twisted cut ends of wire towards roots of the central incisors.

3. Two 1.0 or 1.2mm diameter stainless steel wires of appropriate length are taken and each is passed through the pre drilled holes on either side. The medial end of each wire is passed through the space between the central incisors (Fig. 12.24).
4. The lower jaw is pulled forward to achieve reduction.
5. After achieving the reduction, the medial and lateral ends of the respective side wires are twisted on each other with a wire twister (Fig.12.25). During this maneuver, the assistant keeps his hand firmly under the fracture site to maintain reduction. Care should be taken to keep an even pressure on both the sides during twisting to avoid right or left lateral deviation of the jaw.
6. The twisted ends are cut with a wire cutter about 1cm away from the base and the cut ends are bent towards the roots of the incisors (Fig.12.26 a&b), so that they do not injure the lower lip. Postoperative x-ray picture (Fig. 12.27) shows the exact position of the interdental wires.

#### Postoperative Care:

1. Antibiotic cover is taken for 7 to 10 days and only soft food and green fodder is advised for a period of 2 to 3 weeks.
2. Periodic follow-up of the case is mandatory, as there may be slight downward deviation of the cranial fracture fragment due to embedding of the wires in the gingival tissue (Fig.12.28). This is a normal happening and in such a situation the wires should be retightened whenever necessary.



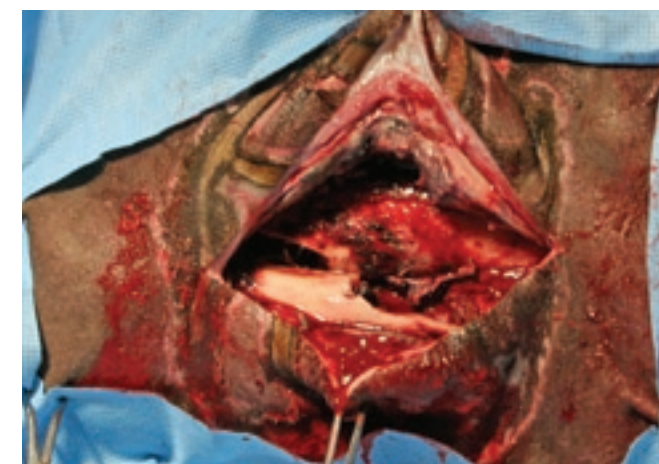
**Figure 12.27** Radiographic pictures showing proper position of the interdental wires. Note exact reduction of the fracture fragments (arrow).



**Figure 12.28** Downward deviation of the cranial fracture fragment and formation of submandibular abscess (arrow).



**Figure 12.29** Downward deviation of the cranial mandible with mal-occlusion of the jaws due to non-repair of the fracture.



**Figure 12.30** Exposure of the fracture site. Note obliquity of the fracture line.

3. The wires are removed after clinical and radiographic evidence of callus formation.

#### Possible Complications:

1. In some cases, submandibular abscess develops (See Fig.12.28), which should be drained immediately and dressed subsequently; otherwise, strong chances of development of osteomyelitis and non-union would exist.
2. Osteomyelitis and delayed or even non-union.
3. Mal-union with downward deviation of the jaw in cases of substandard or no repair (Fig. 12.29). This leads to mal-occlusion of the jaws with resultant difficulty for the animal to grasp fodder. In such cases up to 2 months postfracture, the bone may be refractured, properly reduced and stabilized with interdental wiring.

#### Plating:

As mentioned above, the oblique and multiple fractures of the mandible not amenable to interdental wiring; can be successfully immobilized with a bone plate. However, it is imperative that the reduction should be precise to avoid even slight lateral deviation of the jaw that would result in prehension and mastication problems.

The animal is put under general anesthesia and controlled in the lateral recumbency.

#### Operative steps:

The fracture site is exposed through a lateral skin incision (Fig. 12.30).

The blood clots and tissue debris if any are removed carefully and the fracture fragments are reduced and held in position. A 4.5 mm. narrow webbed, self





**Figure 12.31** Application of a 6 hole plate. Note the perfect reduction of the fracture. The 3rd screw on the right side was not used, as it would go into the fracture line.

compression bone plate is placed on the bone and secured with a suitable sized bone holding clamp. A 5 to 6 hole plate, applied in a neutralizing manner as described under the standard technique of plating serves the purpose very well (Fig. 12.31). It is recommended that fractures on both sides of the bone should be plated. However, in our experience; if fracture on one side is perfectly stabilized, the fracture on the other side can be managed with interdental wiring technique.

**Postoperative care and possible complications** are the same as outlined in general discussion.

## 2. Actinomycosis:

Actinomycosis; as it does not fall under fractures, but it is being described here, as the classic lesion is that of osteomyelitis of the mandible with formation of bacterial colonies in the bone. Osteomyelitis follows direct extension of infection from the gums or periodontium, presumably following injury by foreign bodies or as a complication of periodontal disease from other causes.

Actinomycosis or lumpy jaw is caused by *Actinomyces bovis* which are Gram positive, branching higher bacteria and are normal mouth and intestinal commensals and have a world wide distribution. In the camel, the disease has been mainly seen affecting the horizontal ramus of the mandible in the region of the interdental space or caudal to it at the level of the second premolar.

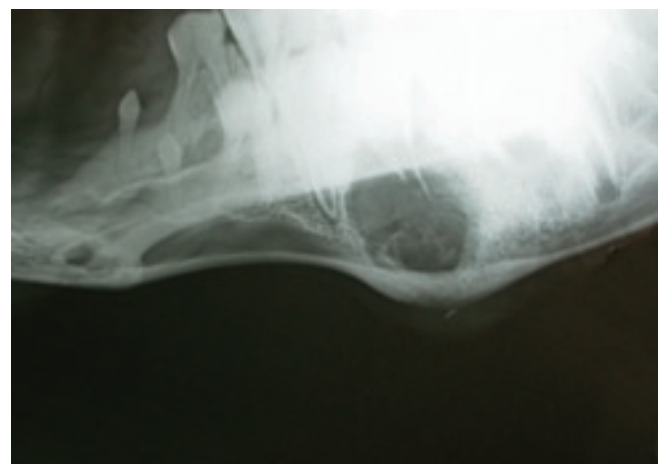
The disease starts as a low grade inflammatory reaction, which is followed by proliferation of the connective tissue; which, with the passage of time takes the form of a thick walled, hard tumor like mass (Fig. 12.32). The radiographic examination of the lesion reveals typical radiolucent cavities suggestive of osteolysis due to long standing infectious process (Fig. 12.33). In the later stages, sinuses and tracts develop with discharge of sulphur granules (Fig. 12.34). In our experience, the tumor like mass has to be removed to unmask the lesion with occasional curetting and regular dressing of the latter. The healing of the lesion is very slow and sometimes even unrewarding.

## Control and Anesthesia:

The animal is deeply sedated and controlled in the lateral recumbency with the affected side up.



**Figure 12.32** Actinomycotic lesion of the right mandible. Note the outgrowth still covered by intact skin.



**Figure 12.33** Radiographic picture of actinomycotic lesion showing radiolucency indicative of osteolysis.



**Figure 12.34** Note the purulent draining tract of actinomycosis. It was about 2 cm deep lesion.



**Figure 12.35** The actinomycotic lesion after curetting. Note the firing scar around the lesion; a popular treatment with the bedouins.

## Operative Steps:

1. A longitudinal skin incision is given in the center of the swelling and the skin flaps are undermined to fully expose the reactive tissue.
2. The mass is removed with the help of an osteotome and hammer to unmask the normal bone and the lesion.
3. The lesion is normally like a crater / sinus tract in the bone going deep to a variable distance (Fig. 12.35). Sample is taken for culture and sensitivity test and then the sinus tract is curetted to remove all the diseased bone till the lesion bleeds frankly.
4. The cavity is plugged with Penicillin till the laboratory result is received. In our experience, Penicillin works well. However, the lesion should be regularly dressed on the basis of the culture and sensitivity result with parenteral use of the same drug.

## Postoperative Care:

1. The lesion is cleaned and dressed on alternate days with the antibiotic recommended by the laboratory.
2. Parenteral use of the same antibiotic for an extended period of time or even till the lesion heals.
3. The lesion may need to be curetted periodically to get rid of the diseased bone.

## Possible Complications:

The lesions are quite slow to heal in most of the cases, but with consistent and continued treatment they may go on to heal.

## 3. Fracture of the Humerus

In the adult animal, the humerus is quite a massive bone, particularly in the proximal part. The important feature of this bone is the musculo-spiral groove which makes plating of this bone a challenge for the clinician.

Fracture of the humerus is quite common in the racing animals due to falls during racing or exercise. However, it has occasionally been recorded in the breeding stock also as a result of severe trauma. The fracture is clinically manifested by flexion of the limb with dragging of the toe during progression and other cardinal signs of the fracture (Fig. 12.36 a&b). Most of the fractures are spiral or long oblique (Fig. 12.37). The condition is quite evident clinically and the palpation reveals abnormal mobility and crepitation in the fractured region. Bone plating may be tried to immobilize the fracture, but the prognosis is not favorable and the treatment is generally not recommended. If at all bone plating is decided, it is applied on the cranial aspect of the shaft, as this is the tension side of the bone. The plate should be bent with the help of plate benders according to the contour of the bone. The radial nerve

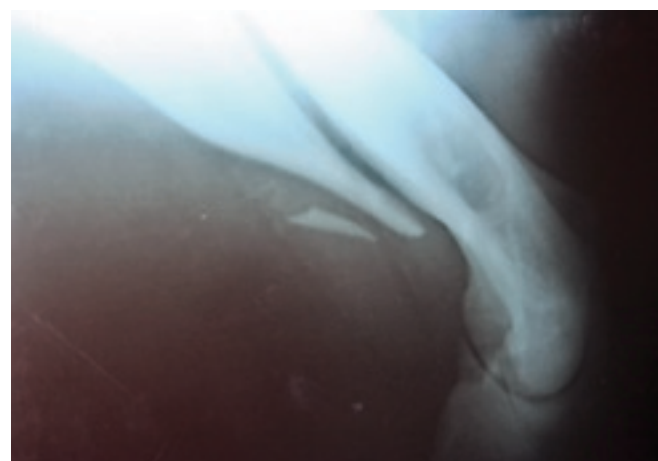




**Figure 12.36a** Fracture of right humerus in an adult racing male. Note flexion of the limb with toenails touching the ground.



**Figure 12.36b** Fracture of left humerus. Note local inflammation and firing marks.



**Figure 12.37** X-Ray picture of the fractured humerus of the animal shown in fig. 12.36a. Note the spiral nature of the fracture.

methods of fracture fixation do not work, as it is not possible to incorporate the elbow joint in the cast. In the calves and possibly in the very small animals the fracture may be immobilized with a bone plate. In fracture of both the radius and ulna; which is normally the case, the plate is applied only on the radius because this is the main weight bearing bone.

#### Control and Anesthesia:

The animal is put under gas inhalation anesthesia and secured in the lateral recumbency with the fractured leg up.

#### Operative Steps:

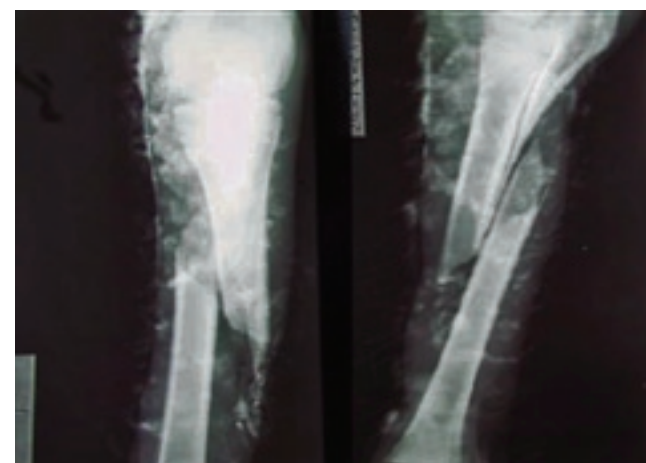
1. Standard preparation of the surgery site is performed by clipping of hair and scrubbing the area with any Iodine based scrub solution.
2. The leg is wrapped in a sterile drape from foot up to above the elbow with the surgery site exposed through a slit in the drape.
3. A cranio-medial skin incision is given throughout the length of the bone taking care not to damage the cephalic vein which travels just along the incision line.
4. The fracture segments are exposed by careful undermining and reflecting the extensor carpi radialis laterally and deep digital flexor medially. The fracture ends are cleared of any soft tissues and blood clots.
5. The fracture is reduced manually; a plate of a suitable size is selected and applied on the cranial aspect of the bone as described under the

which travels through the musculo-spiral groove should be saved, as damage to this nerve will result in radial paralysis nullifying all the expected positive results of the procedure.

#### 4. Fracture of the Radius and Ulna

The radius and ulna are fused in the adult, but the two components are clearly evident in the young animal. The shaft of the radius is compressed cranio-caudally. The cranial cortex is slightly convex and represents the tension side of the bone.

The fracture of this bone is not very common. The clinical and radiographic examination will clearly reveal the type of the fracture and position of the fracture fragments (Fig. 12.38). The external



**Figure 12.38** Antero-posterior (left) and lateral (right) view of an overriding, short oblique fracture of the radius and ulna in a 6 months old male calf.

standard technique of bone plating (Fig. 12.39 a&b). As the cranial aspect is slightly convex, the plate should be bent according to the contour of the bone to eliminate any gaps between the bone and the plate.

6. The operative field is thoroughly washed with sterile normal saline solution. The subcutaneous tissue is apposed with Polyglycolic acid USP 1 continuous sutures and the skin incision is closed with simple interrupted sutures using nonabsorbable USP 2 suture material.
7. The leg is wrapped in a heavy bandage or better in a temporary plaster cast and the animal is assisted during recovery period and while trying to stand to avoid any trauma to the injured limb

and/or the animal. This is very important, since the plate may dislodge or even break if the animal falls down violently while trying to stand during recovery period.

**Postoperative Care and Possible Complications** are the same as outlined in the general discussion and the latter should be handled accordingly as demanded by the clinical condition of the patient.

#### 5. Fracture of the Metacarpus or Metatarsus

The only remaining rays of metacarpal and metatarsal bones are the 3rd and 4th metacarpals and metatarsals which are fused together except in the distal fifth where they diverge to form separate articulations with the corresponding digits. A shallow groove or faint line indicates the line of fusion between the two bones. The metacarpal bone is more massive than the metatarsal, but both are approximately of the same length.

The fractures of these bones are quite common and are generally compound (open) in nature due to no muscle mass in this area (Fig. 12.40). In simple fractures, the application of a plaster cast or polyester-polyurethane band will suffice, but these methods should be avoided in cases of compound fractures unless the site and type of the fracture precludes the possibility of bone plating.

In compound fractures, the application of a cast with a window against the wound has been practiced,



**Figure 12.39a (left)** An oblique A/P view of the fracture shown in Fig. 12.38 after plating.



**Figure 12.39b (right)** The lateral view of the fracture shown in Fig. 12.38 after plating.





**Figure 12.40 (left)** Short oblique mid-shaft fracture of the metatarsal in a 2 months old female camel calf.



**Figure 12.41 (right)** The fracture shown in Fig. 12.40 after plating. Note accurate reduction of the fracture.

but the window undoubtedly represents the weakest point of the cast. In our experience, instead of a window it is much better to apply a full cast with a change of bandage after every 7 to 10 days and still better, the fracture should be immobilized with a bone plate of a suitable size applied either on the lateral or medial aspect of the bone if the fracture in question fulfils the prerequisites for bone plating (Fig.12.41). Both the metacarpal and metatarsal bones are basically central weight bearing bones and either of the side will act as a tension side. The technique, postoperative care and possible complications of these fractures are the same as described in the general discussion.

**Figure 12.42** An oblique, mid-shaft fracture of the left fore medial first phalanx.



## 6. Fracture of the Phalanges

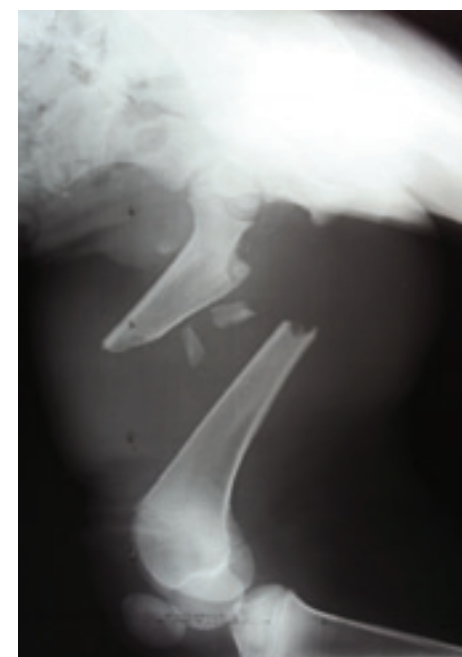
There are two digits in each of the four limbs and each digit consists of three phalanges and two proximal sesamoid bones. Unlike the other domestic mammals, the distal sesamoid remains cartilaginous and is known as navicular cartilage. It is flat and crescent shaped and is suspended axially and abaxially by the ligaments.

The fractures of the phalanges in both the fore and hind limbs are not very common but may occur due to violent falling or external trauma (Fig. 12.42). Most of these fractures are simple and non-displaced and can be easily stabilized with a plaster cast or polyester-polyurethane band applied from foot to just below the carpal or tarsal joint using the standard technique described earlier. Long oblique

phalangeal fractures may also be immobilized with interfragmental compression technique using cancellous bone screws. The animals after recovery may show different degrees of lameness; therefore, will not be suitable for racing.

## 7. Fracture of the Femur

The femur is a long and relatively slender bone and is slightly convex cranially. The distal extremity is relatively massive and the lateral epicondyle is smooth and bigger than the medial. The fracture may occur in any part of the bone shaft and is overriding in most of the cases (Fig. 12.43).



**Figure 12.43** An almost transverse, overriding fracture of proximal shaft of the left femur in one month old female camel calf.

As discussed earlier, the fracture of this bone does not lend itself to external methods of fixation. Hence, the only choice that remains is to try for internal methods of fracture treatment. Out of these, the best choice; and that also in very young and light animals, is the application of a bone plate if the fracture in question fulfils the requirements for this procedure that are outlined in the general account of orthopedics. If one decides to immobilize the fracture of this bone with a bone plate, the following guide lines will help accomplish the procedure.

### Control and Anesthesia:

The animal is put under general anesthesia and controlled in the lateral recumbency with the fractured leg up and the surgery site is prepared and draped in a standard fashion.

### Operative Steps:

1. Select a suitable sized 4.5mm, broad webbed self compression bone plate according to the length of the bone in question. As a general rule, the plate should be just short of the length of bone excluding the intra-capsular portions of the proximal and distal extremities.
2. The shaft of the femur is exposed through standard lateral approach.
3. The skin incision is given from greater trochanter to the lateral condyle of the bone.
4. Tensor fasciae latae is separated from the biceps part of the gluteobiceps muscle through out the extent of the skin incision.

5. The Vastus lateralis is retracted cranially and the biceps part of the gluteobiceps caudally to expose the shaft of the femur.
6. Any blood clots and devitalized tissue are removed and the fracture site is cleaned.
7. The selected plate is applied on the lateral aspect of the bone as described under the standard technique of bone plating (see inter-fragmental and axial compression techniques).
8. The incised edges of the tensor fasciae latae and the biceps part of the gluteobiceps muscle are sutured together with polyglycolic acid USP 2 suture material using continuous suture pattern.
9. The subcutaneous tissue is apposed with continuous suture line using the same suture material and the skin incision is closed with non-absorbable USP 2 simple interrupted or horizontal mattress sutures.

**Postoperative care and possible complications** are essentially the same as described under general discussion of the procedure.

## 8. Fracture of the Tibia

The tibia is slightly shorter than the femur; is triangular in shape proximally and tapers down towards the slender distal extremity which is flattened craniocaudally.

The fracture of the tibia also does not offer good prognosis, especially in well grown animals (Fig. 12.44). In the calves or very small and light animals, immobilization of the fracture may be considered with a bone plate if the fracture fulfils the requirements for its application. The plate is applied on the medial surface of the shaft of the bone which is relatively straight and subcutaneous.

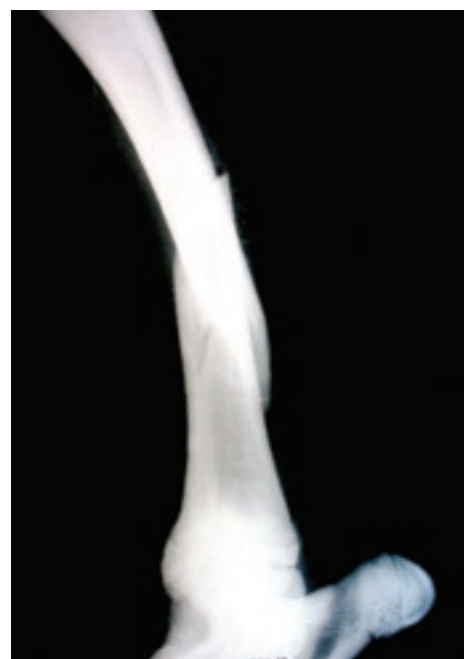
### Control and Anesthesia:

The animal is controlled in the lateral recumbency with the fractured limb underneath and general anesthesia is induced.

### Operative Steps:

1. A skin incision is given on the medial aspect of the bone and the skin edges are minimally undermined to get reasonable space which would easily accommodate a 4.5mm, broad webbed self compression bone plate (Fig. 12.45). The criteria for selection of the bone plate are the same as for other long bones.





**Figure 12.44 (left)** An oblique, over-riding fracture of the distal shaft of right tibia in an adult female.



**Figure 12.45 (right)** The fracture of tibia shown in Fig. 12.44, immobilized with a bone plate. The results were not encouraging and the animal was slaughtered.

2. The saphenous nerve and the vessels cross the operative field obliquely approximately in the middle and should be saved.
3. The procedure for the application of the bone plate is the same as given under general discussion.
4. The subcutaneous tissue and the skin are closed routinely.



**Figure 12.46** Clinical manifestation of upward fixation of patella. The owner did firing as a therapeutic measure. However, the firing has been done on the posterior instead of anterior aspect of the joint that did not prove beneficial.

### 9. Upward Fixation of Patella

Before understanding the mechanism of upward fixation of patella, one should be thoroughly familiar with the nature and arrangement of the femoro-patellar ligaments.

The patella is an elongated bone which is approximately twice as long as it is wide. The apex of the bone is pointed and is directed distally. The lateral patellar ligament is represented by fibers running between the lateral surface of the patella and the lateral aspect of the tibial tuberosity. These fibers, in association with the powerful insertion of the gluteobiceps muscle on the patella and on the lateral aspect of the tibial tuberosity form the lateral patellar retinaculum which runs between the lateral epicondyle of the femur and distolateral aspect of the patella. The middle patellar ligament is the only well defined ligament of the patella and represents the insertion of quadriceps femoris muscle. It arises from the craniodistal aspect of the patella as a strong wide fibrous band and is attached to the tibial tuberosity. The medial femoropatellar ligament is actually the medial patellar retinaculum which

runs between the medial epicondyle of the femur and the patella and is poorly defined anatomically as compared to that in the bovine and equine species. Therefore, medial patellar desmotomy in the camels is not so feasible. Even in the horses, conservative methods of treatment such as appropriate conditioning and development of the quadriceps muscle tone with training are tried first and the surgical intervention is considered as a last resort.

The condition has mostly been seen in the racing camels. The poorly conditioned animals with straight conformation of the limbs seem to be more prone to this affection.

### Clinical Manifestation:

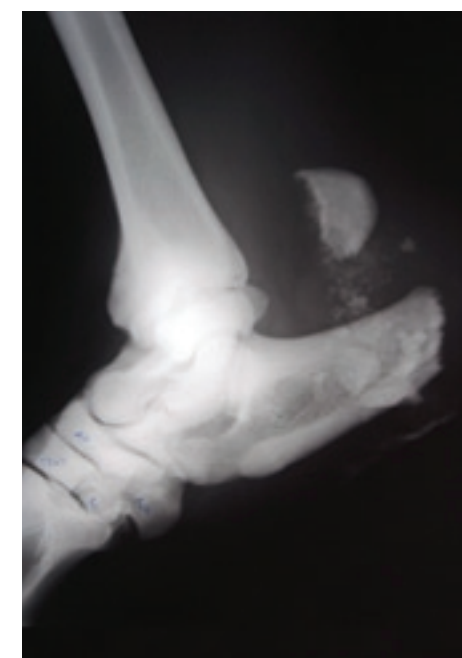
Sudden jerk to the stifle or the limb as the animal moves is the main presenting sign of the problem. Sometimes the limb is dragged in the extended position (Fig. 12.46) with the fetlock flexed and then the patella is dislodged with a sudden jerk and the animal assumes the normal gait, but the symptoms usually reappear after rest.

### Possible Treatment:

The conservative and traditional treatments, such as firing around the stifle joint and injection of irritant drugs like lugol's iodine at the site of the medial patellar ligament may provide relief in certain cases. The underlying object of these counter irritant treatments is to initiate local inflammatory reaction with consequent fibrous reaction around the joint which would stabilize the joint in the long run.

### 10. Fracture of Os-Calcis

The tuber calcis is a traction epiphysis (apophysis) which serves as the site of insertion for the powerful tendo-achilles. Avulsion or traction fracture of the Os-Calcis is not very common in the camel, but has been seen in the young animal as a result of direct trauma or powerful contraction of the tendo-achilles during exercise, jumping or racing. As the fractured piece of the bone is under constant distracting forces due to the pull of tendo-achilles, it is pulled up to a variable degree which can be appreciated on the lateral radiographs of the fracture (Fig. 12.47). The radiographs will also help decide



**Figure 12.47** Avulsion fracture of the tuber calcis. Note upward distraction of the fractured piece due to pull of the tendo-achilles.

that if possible, which method out of the "tension band wiring" or "tension band plating" should be used to repair the fracture. These methods convert the normal distracting force of the tendo-achilles to a compressive force which is necessary to achieve an accurate reduction and its maintenance for the bony union to occur. Minimally displaced fractures may be left as it is to heal with restricted activity of the animal.

In small and light animals, the prognosis may be favorable but in large and heavy animals, the prognosis is guarded.

### Control and Anesthesia:

The animal should preferably be put under general gas inhalation anesthesia. If this facility is not available, the animal can be deeply sedated and high epidural anesthesia is induced to control the movements of the hind limbs. It is then controlled in the desired lateral recumbency with the fractured limb up.

### Operative Steps:

All the steps are observed for an aseptic surgical procedure and the fractured bone is exposed through the caudo-lateral approach giving an incision starting from above the tuber calcis, going down up to the distal end of the bone.

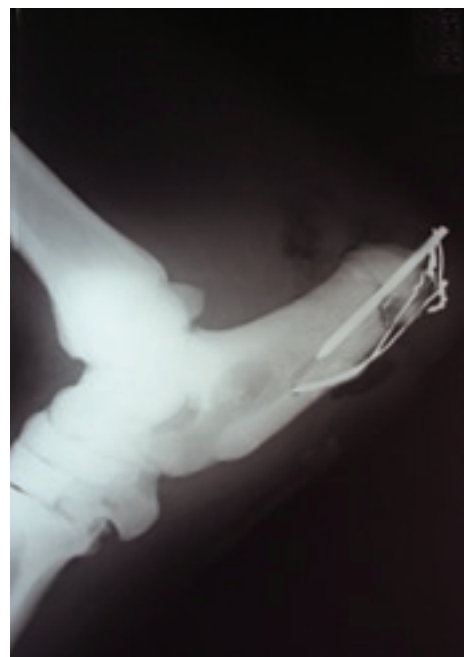
One of the following methods may be used to immobilize the fracture based upon the decision made in the light of the site and type of the fracture.

#### A. Tension Band Wiring:

This technique can be used to an advantage where the fracture in question does not fulfill the pre-requisites for tension band plating.

1. The fracture is reduced and a 2 to 3mm diameter Steinmann intramedullary pin is driven into the bone through the tip of the tuber calcis to end in the distal part of the distal fracture fragment.
2. A transverse hole is drilled with a 1.5mm diameter drill bit through the caudal cortex of the bone just distal to the point of the pin.
3. A 1.2mm diameter stainless steel orthopedic wire is passed through the drill hole and the two limbs of the wire are crossed over each other at the back of the bone in a figure of "8" fashion. One of the free ends of the wire is passed around the Steinmann pin protruding out of the tuber calcis and then both the free ends of





**Figure 12.48**  
Fracture of the tuber calcis shown in Fig. 12.47 immobilized with tension band wiring

2. Periodic radiographs should be taken to evaluate the position of the internal implants and progress of the callus formation.

#### Possible Complications:

1. The main complication is failure of the procedure to maintain the fracture in the reduced position. In such a case, the animal should better be sacrificed.
2. Infection of the fracture site leading to bone resorption and thus resulting in loosening of the internal implants and failure.

### 11. Fetlock Disarticulation

The cases of toe tumors are generally handled by disarticulation of the toe or disarticulation at the proximal interphalangeal joint (*see chapter 15 P.190*). However, in very advanced cases of malignant lesions of the foot extending beyond the toes, osteomyelitis and other such conditions that are affecting whole of the foot, amputation of the later at the fetlock joint may be considered.

#### Control and Anesthesia:

The animal is sedated and controlled in the lateral recumbency with the affected leg up. In case of fore limb, the volar nerves are blocked or preferably intravenous limb anesthesia is used to desensitize the fetlock and foot region. For the hind limbs, high epidural anesthesia is the selection of choice.

#### Operative Steps:

1. Two curved skin incisions, one on the cranial and the other on the caudal aspect just below the fetlock joint are given (Fig. 12.49). The ends of the incisions meet each other on the medial and lateral aspects of the joint. The cranial skin flap is kept a little larger than the caudal so that the suture line comes on the caudal aspect of the distal extremity of the metacarpal or metatarsal bone instead of being in the center.
2. Both the skin flaps are undermined to expose the articulation (Fig. 12.50).
3. The common digital blood vessels are doubly ligated above the articulation on both the lateral and medial aspects and transected in between the ligatures (Fig. 12.51).
4. The joint is disarticulated (Fig. 12.52) and any bleeding points are ligated with catgut USP 1.

the wire are tightly twisted around each other (Fig. 12.48).

4. The proximal end of the Steinmann pin is cut just flush with the tuber calcis to the extent that it will not irritate the overlying skin; but at the same time, not allowing the orthopedic wire to slip or disengage itself.
5. This arrangement will not allow the upward displacement of the proximal fracture fragment due to the strong pull of the tendo-achilles and will cause compression at the fracture site under the following mechanical rule.

The pull of the tendo-achilles will try to displace the proximal fracture fragment upward, whereas the pull of the tension band wire will be in the opposite direction and thus the resultant vector going in between these two opposite pulling forces will result in compression at the fracture site.

#### B. Tension Band Plating:

A tension band plate of a suitable size applied on the caudal aspect of the bone may give better stabilization at the fracture site. The procedure is the same as outlined under general principles of bone plating.

#### Postoperative Care:

1. It is better to apply a temporary Plaster of Paris cast for about two weeks to provide additional support to the internal implants.

5. The protruding portions of the flexor tendons are trimmed as necessary.
6. The area is thoroughly washed and cleaned with sterile normal saline solution.
7. The skin flaps; if large are trimmed as needed and sutured together with nonabsorbable USP 2 suture material (Fig. 12.53). The purpose of trimming the skin flaps is not to leave any dead space between the bone and the skin.
8. The limb is bandaged up to the knee or hock joint.

#### Postoperative Care:

1. The bandage is changed twice a week with proper cleaning and dressing of the suture line.
2. Cover of appropriate antibiotic should be given for a period of two weeks.
3. The sutures are removed after two weeks if healing by first intention takes place (Fig. 12.54); otherwise the central sutures are removed for proper cleaning and dressing of the wound to allow it to heal by secondary intention.

#### Possible Complications:

Infection of the suture line and the wound is the main postoperative complication. In such a situation, the wound may take up to two months to heal completely.



**Figure 12.49** Curved incision on the cranio-distal aspect of the fetlock joint.



**Figure 12.50** Undermining the skin flap.



**Figure 12.51** Ligation of the blood vessels with chromic catgut USP 1 (arrows).



**Figure 12.52** Disarticulation of the joint. Note the distal articulating surfaces of the 3rd and 4th metatarsal.





**Figure 12.53** Skin closure with Supramid USP 2.



**Figure 12.54** First intention healing after fetlock disarticulation. See the scar of the suture line.

## 12. Dislocations

Joint dislocations in the camel are not common except those of the shoulder, tarsus and very rarely the fetlock joint in the racing animals as a result of violent falling during racing or exercise (Fig. 12.55 a&b). The dislocations may also be accompanied with fractures that make the problem more complicated with grave prognosis. Even simple dislocations do not carry good prognosis in this large animal and hence, no attempt is made for their relocation



**Figure 12.55a** Lateral dislocation of the fetlock joint.



**Figure 12.55b** Dislocation of the central tarsal bone (arrow).

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# CHAPTER 13

## Surgery of the Skin and Adnexal Tissues

In this section, miscellaneous conditions most commonly affecting the skin and adnexal tissue in different parts of the body will be discussed. In fact these conditions make a large part of day to day work. The following conditions carry the most importance.

### 1. Injury to the Nostrils

The nostrils in the camel are slit like openings and are placed obliquely sloping dorsoventrally from the lateral (caudal) to the medial (rostral) commissure and face laterally. Nostrils often get lacerated to a variable length and in different directions due to violent pulling of nose-strings by the attendants/owners in a bid to control vicious animals. These injuries may be fresh or old. Sometimes these are partially healed and are presented for cosmetic repair (Fig. 13.1).

#### Control and Anesthesia:

The animal is deeply sedated and controlled in the lateral recumbency with the injured nostril facing up.

#### Repair Procedure:

1. The site is thoroughly scrubbed with any Iodine based solution, cleaned and prepared for surgery.
2. Edges of the lacerated nostrils are debrided and freshened with a sharp scissors or scalpel blade (Fig. 13.2).

3. The two halves of the cut nostrils are apposed, anatomically aligned and sutured together with continuous sutures using Polyglycolic acid USP 1 suture material. Deeper layers of the defect are sutured first from caudal to the cranial end (Fig. 13.3). As this portion is quite thick, two to three layers of the suture lines may be needed to completely obliterate the gap up to the skin.
4. The skin is sutured with nonabsorbable USP 2 suture material such as silk or nylon on a reverse cutting suture needle (Fig. 13.4).

#### Postoperative Care:

1. Postoperative care comprises daily cleaning of the suture line and protecting it with antibiotic spray.
2. The systemic cover of antibiotics is normally not needed; however, it depends upon the condition of the wound and discretion of the surgeon.
3. The skin sutures are normally removed two weeks later.

#### Possible Complications:

1. Infection and break down of the suture line. Infection results in irritation and then the animal rubs it against any fixed object leading to disruption of the suture line.
2. Difficult respiration may be noticed in cases in which more than required debridement of the tissues is done during the repair process leading to narrowing of the nares.



Figure 13.1 Old standing transverse cuts on both nostrils.



Figure 13.2 Anatomical apposition of the freshened cut edges.



Figure 13.3 Suturing of the deep layers of the defect.



Figure 13.4 Apposition of the skin margins with interrupted horizontal mattress sutures.

### 2. Fistula of the Hump and Withers

The hump of the camel is composed of fibrous connective tissue and fat and is very important for the life of the animal. It contains most of the body fat and a well developed hump is a sign of good health (Fig. 13.5). In emaciated animals, the hump becomes small and flops over to one side once all the fat reserves get depleted (Fig. 12.6). During periods of poor energy intake, the camel is capable of metabolizing the fat in the hump, which shrinks as a result of starvation.

The conditions of the hump fistula (Fig. 13.7), wither fistula and wither galls (Fig. 12.8) most commonly affect the camels used for draught and riding purposes. The conditions basically start as pressure sores and in unattended cases lead to ulcerating

wounds followed by purulent fistulous tracts in the region. The camel bite wounds on the hump have a great tendency to become fistulous tracts.

A typical case of bilateral hump fistula was recorded; that, according to the owner, resulted due to covering of a female by a very heavy male. As a result of great pressure over the caudal part of the hump, it got pressed and contused and the fistulous tracts appeared after about one month of covering (Fig. 13.9).

Both the conditions are quite tedious to heal because the pus gravitates down and establishment of effective drainage is quite difficult in such cases. The treatment is usually not rewarding; however, if possible one should try to provide drainage in order to get healing. Repeated debridement and irrigation of





**Figure 13.5** Hump of a healthy animal. Note bilateral symmetrical slope from top to bottom.



**Figure 13.6** Hump of an emaciated animal. Note depletion of fat with leaning towards right.

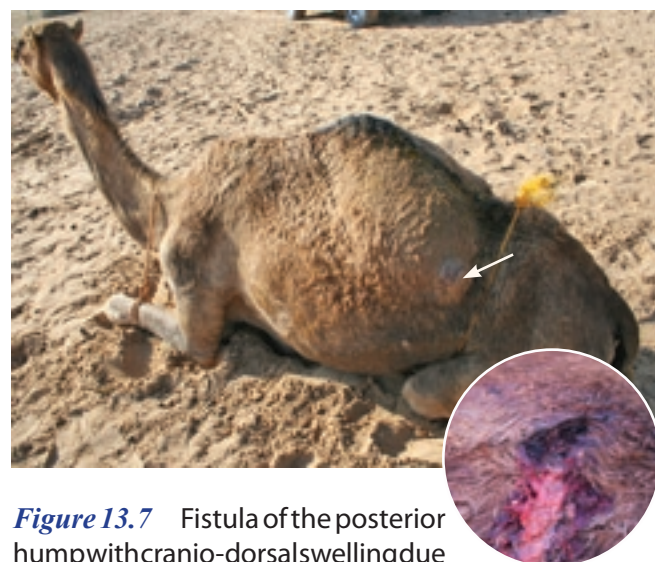
the wound to clean the fistulous tracts and pouring of antibiotic solution in them may help in a small percentage of cases.

#### Control and Anesthesia:

The animal is controlled in the sternal position and sedation may not be necessary. Firm grasping of the nostrils suffices.

#### Operative Steps:

1. The hairs on and around the affected area are shaved and the site is thoroughly scrubbed and washed clean.
2. The depth and direction of the fistula is estimated by passing a blunt probe, seton needle or a long forceps with its jaws closed through the existing opening (Fig.13.10 a&b).
3. It is better to pass a seton through the fistulous tract for effective application of the medicines and provision of drainage. To accomplish this, the probe or seton needle is introduced up to the extreme depth of the fistula and the skin is made to bulge there by pressing the end of the instrument up. An incision is given on top of the bulge with the scalpel. Then a long forceps is passed through the tract. When the jaws of the forceps exit from the new opening, a piece of bandage impregnated with a strong antiseptic drug, such as Tincture of Iodine, is grasped in the jaws and the forceps is pulled out. The piece of bandage; now called a seton, will also come along with the forceps. The two ends of the



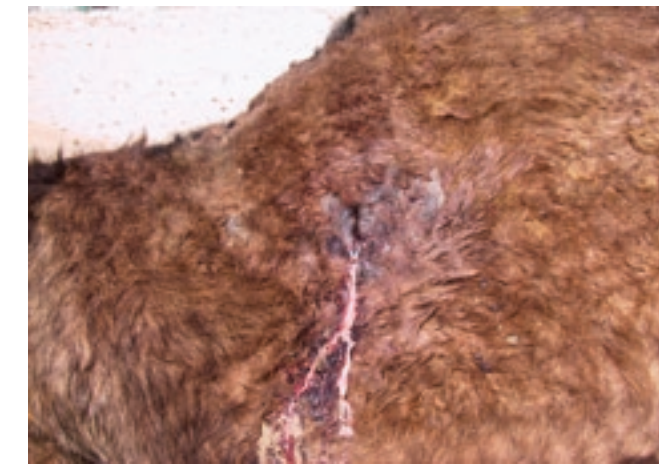
**Figure 13.7** Fistula of the posterior hump with cranio-dorsal swelling due to pus accumulation.

seton are then tied with each other in the form of a loop (Fig.13.11 a&b).

4. In very deep wounds, the setoning may be quite difficult or even impossible. In such cases, the opening of the tract should be enlarged as much as possible, so that the wound can be cleaned properly. The wound cavities are then flushed with clean water under pressure to remove the tissue debris and appropriate medicine is applied. The cleaning and dressing of the wound is carried out daily or on alternate days. The healing of such wounds may take a long time and in certain situations, the wound may even refuse to heal such as in case of very deep fistulous tracts with no ventral drainage.



**Figure 13.8** Wither galls.



**Figure 13.9** Exudation of pus from the hump fistula.



**Figure 13.10a** Estimation of depth and direction of hump fistula with a closed long forceps.



**Figure 13.10b** Estimation of depth and direction of wither gall.



**Figure 13.11a** Setoning of the hump fistula.



**Figure 13.11b** Setoning of the wither galls.





**Figure 13.12** Healing of the withers galls. See Fig. 13.11b for comparison.

(Fig. 13.14). The cysts do not normally disturb the animal and the surgery is done for cosmetic reasons in the show animals.

#### Control and Anesthesia:

The animal is sedated and controlled in the required lateral recumbency.

#### Operative Steps:

1. The site is prepared for aseptic surgery.
2. The goal of cyst surgery is en-block excision of the mass without rupturing it in situ.
3. As the cyst is normally freely movable, an elliptical skin incision; around the cyst is given and it is enucleated with careful dissection of the pericyst tissues. In very pendulous cysts, a straight Carmalt forceps is applied at the base of the swelling and the lesion is resected distal to the forceps (Fig. 13.15 a,b & c).
4. Normally there is no bleeding; however, any bleeding point is ligated with catgut USP 0.
5. The subcutaneous tissue if needed, is apposed with catgut or polyglycolic acid USP 0 suture and the skin is closed with nonabsorbable USP 2 suture material (Fig. 13.16 a&b).

#### Postoperative Care:

There is not much of a postoperative care except care of the suture line.

#### Possible Complications:

The only, but rare complication is break down of the suture line due to infection.

#### Postoperative Care:

1. The seton is changed daily or on alternate days, each time smeared with antiseptic drug of choice.
2. As these wounds are usually deep, they should be copiously washed with plain water before changing the seton. Pressure hosing of the wound may also be done to remove all the unwanted contents there in, such as pus and the dead and devitalized tissues.
3. The wounds with seton usually take a long time to heal, but eventually come up with improvement sooner or later (Fig. 13.12). The cleaning and dressing of the wound with appropriate drugs as demanded by its condition should be carried out till complete healing occurs.

#### Possible Complications:

1. The wound may refuse to heal due to inaccessibility of its depth.
2. Very rarely, the fistulous tract at the withers may open into the thorax with fatal consequences.

### 3. Dermoid Cysts

Dermoid cysts have been reported in the camel and commonly occur in the jugular groove and on the skin of the ear (Fig. 13.13). The cysts vary in size and are usually congenital in origin. They manifest as soft, fluctuating, clearly defined and freely movable swellings. Paracentesis of the swelling reveals a coffee colored, thin fluid. The cyst wall is usually pigmented and has coarse, large hairs on the surface



**Figure 13.13** Dermoid cyst in the right jugular groove.



**Figure 13.14** Hairs on the cyst wall. The cyst wall was incised after its en-block enucleation.



**Figure 13.15a** Clamping the skin at the base of the cyst. Two clamps were applied, as the base was quite large.



**Figure 13.15b** Resection of the cyst distal to the clamps.



**Figure 13.15c** The cyst after complete resection. See the still intact wall of the cyst (arrow).



**Figure 13.16a** First skin suture being applied in the center of the wound for proper apposition of skin margins.



**Figure 13.16b** Complete closure of cutaneous wound with interrupted horizontal mattress sutures.



#### 4. Abscesses

Abscesses have quite commonly been noticed in the camels, particularly in the black ones and may develop on any part of the body. However, most of the abscesses have been seen in the parotid, pre-scapular, gluteal and inguinal regions (Fig. 13.17 a,b,c & d). Subcutaneous abscesses in the udder region are also quite common, particularly in the black camels (Fig. 13.18). Jaw abscesses are commonly associated with tooth decay or *Actinomyces* species infection (See Figure. 12.28).

The size of the abscess may be very small or as large as a basket ball and may be superficial or deep in the muscles. *Actinomyces pyogenes*, *Corynebacterium pseudotuberculosis* and *Staphylococcus aureus* are common causes of muscle abscesses. The route of infection may be exogenous through a skin abrasion / wound or hematogenous in cases where the skin is intact.

In the initial stages, the swelling is warm, hard and painful, but becomes fluctuating and soft in a few days. The clinical signs are quite indicative of the condition; however, the diagnosis can be confirmed by an exploratory puncture with a sterilized needle. In old standing cases where the abscesses have been draining off and on without proper treatment, fibrous reaction develops in the surrounding tissues; particularly in the loose skin areas such as preputial region, giving rise to fibrosis that requires an elaborated surgical manipulation (Fig.13.19). As far as treatment is concerned, it should be taken as a rule of thumb that the only treatment of the abscess is its proper drainage. The use of antibiotics to suppress the suppurative process in an abscess is never indicated. Superficial abscesses may drain spontaneously but the deep abscesses seldom drain to the body surface and need to be drained surgically. As the line of treatment of the abscesses any where on the body surface is practically the same, a general discussion is being given instead of dealing with the individual abscess sites.

#### Control and Anesthesia:

The control and anesthesia will depend on the severity of the condition. However, it is always advisable to sedate the animal on humanitarian grounds. For abscesses in the vascular areas, such as parotid region it is better to deeply sedate the animal so that vital structures in the vicinity may not be damaged due to unexpected movements of the animal. The

animal is restrained in the desired recumbency according to the site and position of the lesion.

#### Operative Steps:

1. The area is washed and cleaned of any dirt or other material sticking in the operative field.
2. The abscess is drained at the most dependent part and the abscess cavity is cleared of its contents. Any loose and devitalized tissues are removed with blunt pointed scissors. The abscess cavity may also be curetted to remove the tissue debris. It is also advisable to remove the pyogenic membrane. In case of small abscess, it is better to incise it to its full extent. In case of large abscesses, a seton may be passed through its cavity instead of opening the cavity throughout.
3. In circumscribed swellings, the abscess may be dissected out with its walls intact as can be easily done in cases of lymph node abscesses, where the intact lymph node can be dissected out from the surrounding tissues. In such situations, the wound can also be closed after thorough cleaning of the cavity with sterilized normal saline solution ( See case No.4, chapter 16).

#### Postoperative Care:

1. The abscess wound is daily washed, cleaned and dressed with a suitable antiseptic drug.
2. In cases of deep abscesses, parenteral cover of antibiotics is recommended after drainage.
3. In cases where setoning is done, the seton should be changed with each dressing and it should be removed when it is no longer needed.
4. The suture line is dressed as needed where en-block enucleation of the abscess is done.

#### Possible Complications:

1. In superficial abscesses, the postoperative complications are practically non existent if proper cleaning and dressing of the abscess wound is carried out. These wounds heal quite rapidly with proper postoperative care.
2. In deep abscesses or where provision of proper drainage is difficult such as abscesses in the inguinal and gluteal regions, the healing process may take a long course. The presence of necrotic or infected tissue in the deeper layers of the abscess wound cavity also results in delayed healing unless the underlying cause is addressed.



Figure 13.17a Abscess in parotid region.



Figure 13.17b Abscess in the pre-scapular region.



Figure 13.17c Abscess in the gluteal region.



Figure 13.17d Abscess in the inguinal region.



Figure 13.18 Subcutaneous abscess in the udder region.



Figure 13.19 Fibrous reaction (fibrosis) around a long standing, untreated preputial abscess in a breeding camel.



## 5. Hernia

The external abdominal hernia basically consists of the hernial ring and the hernial swelling. The hernial swelling, in turn comprises the hernial sac which is essentially a pouch of the skin with or without peritoneal layer and the hernial contents. The hernial contents usually consist of a loop of bowel, omentum or both. Very rarely the other abdominal organs such as urinary bladder, uterus or a part of the rumeno-reticulum may form the hernial contents. The size of the hernial ring and the condition of the hernial contents (reducible or otherwise) are the major factors governing the prognosis of the case.

The umbilical and the ventral abdominal hernias are the major types occasionally seen in the camel (Fig. 13.20). In the umbilical hernia, the hernial ring is usually small and therefore, the hernia can be repaired easily and with good results; especially in the young animals. The ventral abdominal hernias; being acquired in nature, may have the hernial rings of variable sizes and thus the prognosis depends upon the size of the hernial ring, the hernial swelling, the condition and type of the hernial contents, the age and size of the animal. If the hernia is reducible and the size of the hernial ring is not bigger than that which would allow introduction of up to 4-5 fingers, the repair should be attempted. The repair procedure for both the umbilical and the ventral abdominal hernia is essentially the same except with some minor differences, especially if the abdominal hernia is irreducible due to adhesions forming between the hernial contents and the hernial sac or the incarcerations where the hernial contents are too voluminous to be reduced through a relatively small hernial ring.

### Control and Anesthesia:

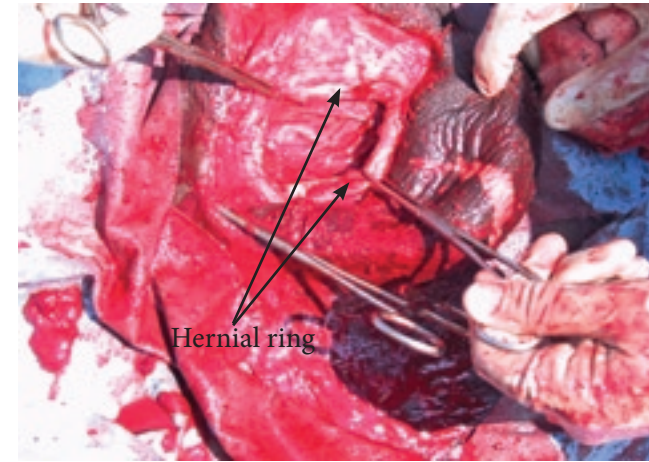
1. The animal should be kept fasting for at least 36 to 48 hours before repair is attempted.
2. The animal is preferably put under gas inhalation anesthesia. If this is not available, the animal is deeply sedated and the surgery site is infiltrated with local anesthesia. The animal is then controlled in the desired lateral recumbency and slightly tilted to the opposite side for easy surgical manipulations.



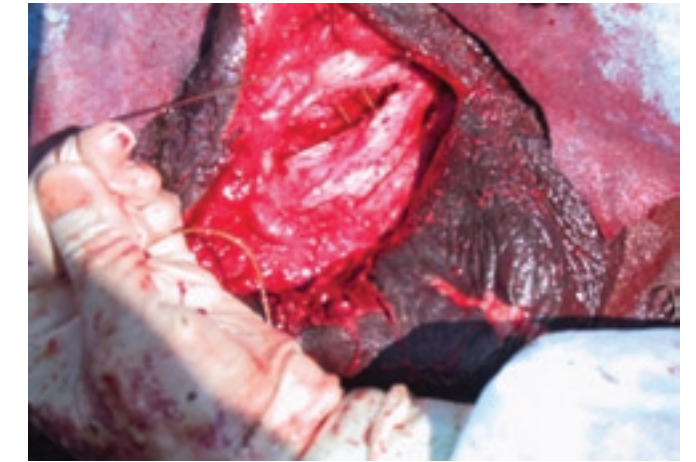
**Figure 13.20** Right ventral abdominal hernia in an adult female.

### Operative Steps:

1. In case of reducible hernia, the hernial contents will fall back into the abdominal cavity when the animal is put in the desired recumbency. A guarded cranio-caudal skin incision is given in the center of the hernial sac. Careful dissection of the subcutaneous tissue will partially or completely expose the hernial ring (Fig.13.21). In case of irreducible hernia due to adhesions between the hernial sac and the contents, these have to be broken down with blunt dissection till the contents are free to be reduced. Great care should be taken while undoing the adhesions not to damage the hernial contents, particularly if they are the intestinal loops.
2. In incarcerated hernia, it is always better to enlarge the hernial ring for easy reduction of the contents instead of reducing them forcibly which may result in their rupture or irreparable damage.
3. After reduction of the hernial contents and exposure of the hernial ring, the latter should be freshened all around with blunt pointed scissors before suturing is undertaken.
4. The ring is sutured with Polyglycolic acid USP 3 suture material using simple interrupted or horizontal mattress sutures (Fig.13.22).
5. The subcutaneous tissue is apposed with continuous suture line using USP 2 of the same suture material and the skin incision is closed with simple interrupted or interrupted horizontal mattress sutures using nonabsorbable USP 2 suture material (Fig.13.23).



**Figure 13.21** Exposure of hernial ring after undermining the subcutaneous tissues.



**Figure 13.22** Suturing the hernial ring with interrupted horizontal mattress sutures.

### Postoperative Care:

1. The cover of parenteral antibiotics is recommended for a period of 7-10 days.
2. The suture line should be cleaned and dressed as required and taken care of from external trauma or self mutilation by the animal.

### Possible Complications:

1. Infection and break down of the suture line with consequent evisceration.
2. Peritonitis.
3. Recurrence of hernia as a long term complication.

## 6. Amputation of Tail

### Indications:

Tail gangrene is the main indication for this surgical procedure (Fig. 13.24). However, tumors of the tail, irreparable tail injuries and tail necrosis are also the major causes for tail amputation.

### Control and Anesthesia:

The animal is controlled in the sternal position and epidural anesthesia is induced by 20ml of 2% solution of Lignocaine hydrochloride.

### Operative Steps:

1. A healthy portion of the tail above the gangrenous or the affected part is selected and prepared for surgery.
2. Two elliptical skin incisions; one on the dorsal



**Figure 13.23** Skin closure with Prolene USP2 on a reverse cutting swaged on needle.



**Figure 13.24** Tail gangrene with loss of hair from the affected portion.



and the other on the ventral aspect of the tail are given. The ends of the incisions meet each other laterally on either side.

3. The skin flaps are undermined carefully so that the coccygeal veins on either side of the dorsal aspect and the middle coccygeal artery on the ventral aspect of the tail are not damaged.
4. Intercoccygeal joint near the base of the skin flaps is identified and the veins and the artery are doubly ligated with chromic catgut USP 0 above this joint and severed in between the ligatures.
5. The diseased portion of the tail is then disarticulated at the intercoccygeal joint using a scalpel blade.
6. The skin flaps; if long are trimmed as necessary. The ventral flap is trimmed shorter than the dorsal one so that the sutures rest on the ventral aspect of the tail. The dorsal and ventral flaps are sutured together with nonabsorbable USP 2 suture material on a reverse cutting needle. We prefer horizontal mattress sutures with the knots kept on the dorsal flap.
7. If possible, the tail is bandaged to protect it from any trauma and soiling.

#### Postoperative Care:

1. The suture line is dressed on alternate days with change of bandage.
2. In case of infection of the suture line, the central two sutures should be removed for proper cleaning and dressing of the wound.
3. The sutures are removed after two weeks.

#### Possible Complications:

1. In case of gangrene, the condition may recur if all the diseased portion of the tail is not removed.
2. Infection of the suture line and wound, which should be dealt with accordingly.

## 7. Udder Amputation

The udder of the camel consists of four quarters, each drained by a teat. It is supported in the inguinal area and held against the abdomen by the median and collateral ligaments. In the non-lactating animal, the udder is quite small but becomes much bigger and fully functional at the time of lactation. It is supplied mainly by the external pudendal arteries derived from the external iliac trunks, but also receives some blood from the perineal



**Figure 12.25** Left udder fibrosis. See the normal right udder with teats.

and subcutaneous abdominal arteries. The venous blood is drained by the caudal superficial epigastric vein (milk vein), the external pudendal and the perineal vein.

Total or half udder amputation is indicated in cases of udder fibrosis with or without purulent sinus tracts (Fig. 12.25). In some cases, the udder tissue becomes gangrenous as a sequel to untreated mastitis. The surgery plan differs according to the condition the animal is suffering from. In the former category, the udder has to be amputated whereas in the later case, the gangrenous udder tissue can simply be removed (Fig. 12.26) through a skin incision large enough that would permit easy removal of the gangrenous mass (see case No. 8 chapter 16). A large incision will also be helpful for cleaning and dressing of the wound in the postoperative period.

#### Control and Anesthesia:

As a matter of principle, the surgery either for half or total udder amputation should be done under complete general anesthesia, preferably gas inhalation anesthesia. However, if this facility is not available, the operation may be performed under deep narcosis supplemented with high epidural anesthesia to control movements of the legs.

#### Operative Steps:

##### A. Half udder amputation.

1. After anesthesia, the animal is controlled in the desired lateral recumbency with the affected side up.
2. The upper hind limb is lifted upward and backward and firmly secured.

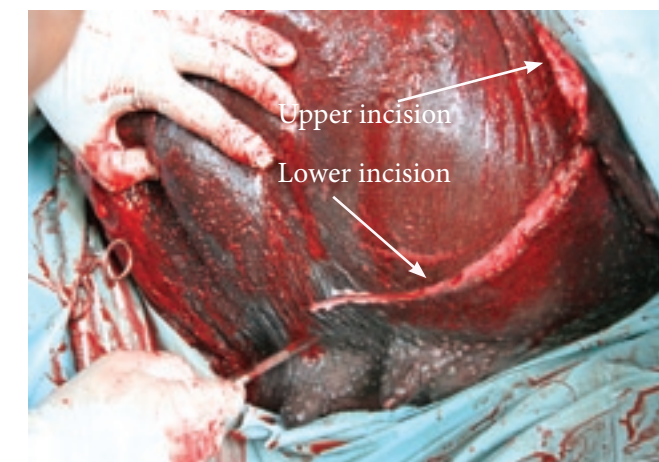


**Figure 13.26** Gangrenous udder tissue hanging down. It can be removed with any grasping forceps.

3. Surgical preparation of the operation site is carried out.
4. A skin incision is given starting from the cranial to the caudal end of the udder just above the teats and another incision to the same extent is given between the teats of the two sides. The cranial and caudal ends of these incisions meet each other at the same point (Fig. 13.27 a & b).
5. The skin; from the upper incision, is undermined up to the inguinal region with blunt dissection (Fig. 13.28).
6. The pudendal vessels are found approximately in the middle of the udder tissue and one has to give a cautious incision in the lateral sheath of the suspensory ligament to expose them.
7. These vessels are doubly ligated and transected in the middle (Fig. 13.29). It is always better to ligate the artery and vein separately to avoid the possibility of formation of an arterio-venous fistula at any later stage.
8. In the cranial end of the incision, the caudal superficial epigastric vein (milk vein) is also doubly ligated and severed in between the ligatures.
9. The two halves of the udder are then separated through the incision already given in between the teats of the two sides. This separation should always be done through blunt dissection, preferably with the finger tips to avoid any damage to the underlying healthy udder tissue.
10. Venous connections between the right and left halves of the udder exist. These vessels and any other bleeding points in the operation field are ligated with chromic catgut USP 0.



**Figure 13.27a** A cranio-caudal curved incision just above the teats.



**Figure 13.27b** Lower skin incision between the teats of both sides. Note the ends of the incision meeting at one point.



**Figure 13.28** Undermining the upper skin flap.



11. Any loose and devitalized tissues in the operative field are dissected out and the operation site is thoroughly washed with sterile normal saline solution. The dead space is obliterated with catgut sutures to avoid seroma formation (Fig. 13.30). Obliteration of the dead space is the most important step.
12. Any redundant skin is trimmed as required and the subcutaneous tissue is sutured with chromic catgut USP 2.
13. The skin incision is closed with nonabsorbable USP 2 suture material (Fig. 13.31).

#### B. Total udder amputation:

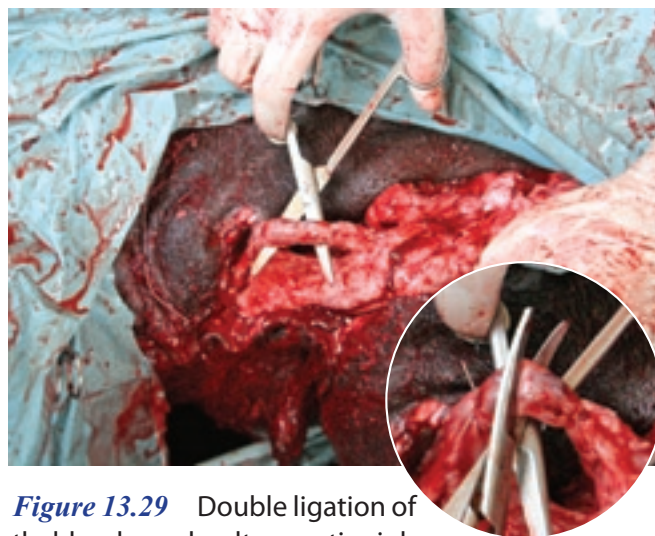
1. The technique is basically the same, except that the cranio-caudal incisions are given on either side of the udder just above the teats to meet each other on the respective ends. All the blood vessels on either side are ligated as was done for half udder amputation technique.
2. A great care should be taken to carry out the surgical procedure in the best possible manner and to obliterate the dead space perfectly in order to achieve uninterrupted healing; otherwise, healing by secondary intention may take a long time.

#### Postoperative Care:

1. Systemic cover of antibiotics is given for a period of two weeks.
2. Daily cleaning and dressing of the suture line is done till suture removal.
3. In case infection takes place; which usually is expected, 3 to 4 sutures at the most dependent part should be removed to provide for drainage and proper dressing. If demanded by the situation, all the sutures may be removed at different time intervals for proper cleaning and dressing of the wound. In such cases, cleaning and dressing of the wound may be done on alternate days. Due to the size of the wound, it may take months to heal.

#### Possible Complications:

Suture break down and infection of the wound is the most important postoperative complication. If this happens, the steps mentioned in the postoperative care should be vigorously followed.



**Figure 13.29** Double ligation of the blood vessel and transection between the ligatures (in circle).



**Figure 13.30** Apposition of the deeper and subcutaneous tissue to obliterate the dead space.



**Figure 13.31** Skin closure with interrupted horizontal mattress sutures.

## 8. Teat Fistula

The teat structure from without consists of the epidermis, papillary layer, dermis, the muscular layer, connective tissue and the mucosa. The epidermis is made up of stratified squamous epithelium. The papillary layer is richly supplied with capillaries and the nerves. The muscular layer lies between the dermis and the connective tissue, the latter supporting the mucosal lining of the teat sinus.

The number of teat orifices (external openings) of the streak canals or the papillary ducts may vary from 1 to 2 or even 3, but the main orifice lies almost in the middle of the tip of the teat. Some animals have only one teat orifice. The teat sphincter is formed by an annular ring of muscle around the streak canal. The teat or papillary sinus is lined with mucosa and the circular or annular fold demarcates gland sinus from the teat sinus.

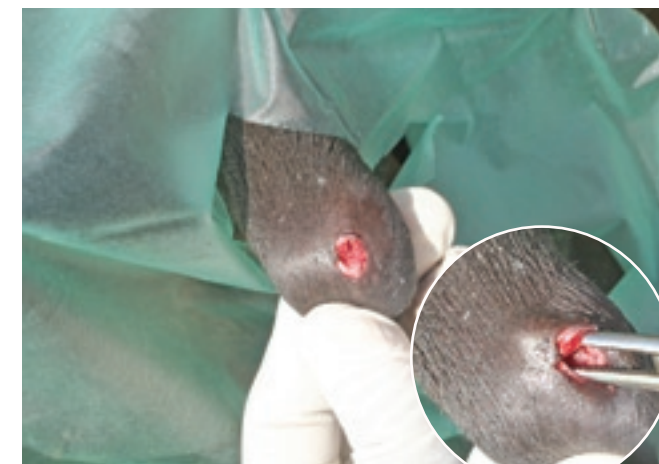
Teat fistula is a deep penetrating wound that extends to the teat canal and generally results as a sequel to injury to the teat canal with barbed wire or a sharp object (Fig. 13.32). The extent of the injury varies from a small hole to the full teat length. The milk continuously oozes out through the defect and if not attended to in the early stages, the chances of ascending infection with resultant mastitis exist.

#### Control and Anesthesia:

The procedure is done under deep sedation supplemented with high epidural anesthesia to arrest movements of the hind limbs with the animal controlled in the required lateral recumbency.

#### Operative Steps:

1. All the precautions should be strictly observed to carry out an aseptic surgical procedure.
2. The wound edges are freshened with a sharp scissors to remove any devitalized tissue and foreign material. Debridement is one of the most important procedures in repairing these injuries (Fig. 13.33).
3. The teat canal is sutured with simple interrupted or simple continuous sutures using Polyglycolic acid USP 0 or 2/0 suture material on a swaged on atraumatic needle (Fig. 13.34). A second layer of sutures is placed jointly through the connective tissue and the muscular layer using the same suture material. These sutures should be pulled taut so that the closure forms a liquid seal (Fig. 13.35).



**Figure 13.32** A small fistula of the left fore teat.



**Figure 13.33** Freshening of the fistula edges with the scissors.



**Figure 13.34** Suturing of the teat canal with Polyglycolic acid USP 0.





**Figure 13.35** A continuous suture line through the muscular layer.



**Figure 13.36** Skin closure with interrupted horizontal mattress sutures.

4. The skin edges are closed with simple interrupted or horizontal mattress sutures using prolene USP 1 suture material on a swaged-on needle or supramid on a reverse cutting needle (Fig.13.36).
5. The skin sutures are removed after two weeks.

#### Postoperative Care:

1. The suture line is protected with antibiotic spray and parenteral antibiotic cover is also given for 7-10 days.
2. If the animal is in milking condition, a sterile teat plug is inserted into the teat canal. The milk is daily removed and a fresh sterile teat plug is again inserted.
3. Intramammary antibiotics should be infused into the affected teat if indicated.
4. Culture and sensitivity test of the milk from the affected udder quarter should be undertaken if needed.

#### Possible Complications:

1. Mastitis is the most important complication and this complication should always be kept in mind while dealing with such cases, which necessitates strict adherence to the aseptic surgical technique.
2. Infection and break down of the suture line, which is again due to substandard surgical technique.

### 9. Infectious Lymphadenitis

The lymphatic system is divided into three major components: 1) a lymph capillary network that collects lymph from throughout the body, 2) variable

sized collecting vessels that carry lymph from the capillaries to the venous system and 3) filtering units, the lymph nodes. Lymph nodes filter incoming particulate matter entering with the lymph.

The lymphatic system of the camel is characterized by a few ganglia with conglomerations in the usual areas (Fig. 13.37). The arrangement of the lymph nodes in camels is very special, particularly the location of the external thoracic and lower cervical nodes in front of the chest are important from lymphadenitis point of view.

As the lymph nodes filter the particulate matter entering in them from different body tissues, they are liable to get infected in cases of invasions of the body by bacterial, viral or fungal agents through hematogenous route. The inflammation and infection of the lymph nodes and subsequent fibrous reaction (fibrosis) around them has quite often been seen in this animal; most particularly in the black camel. The cervical lymph nodes are most commonly involved followed by the popliteal, superficial inguinal, mandibular and superficial parotid lymph nodes (Fig. 13.38 a,b,c & d). The disease starts as infection of the lymph node/nodes and in unattended cases, fibrous reaction around them keeps on increasing simulating a fibroma of varying size. The lesions in the cervical region are usually multiple, whereas those in other areas manifest as a single swelling of varying size. Surgery plan for removal of the diseased lymph nodes is almost the same but due to the fact that cervical lymph nodes are most commonly involved, they are taken here as a specimen case.

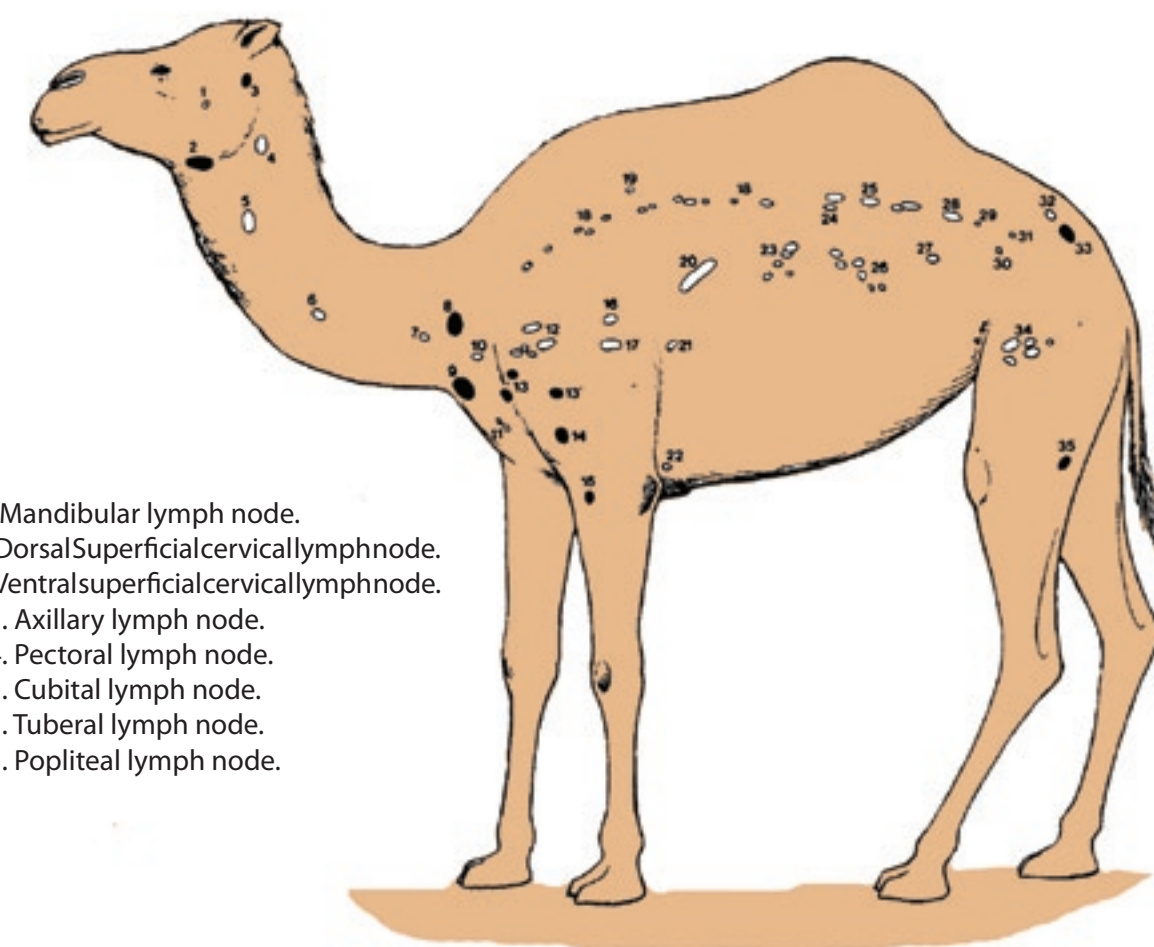
#### Control and Anesthesia:

The animal is deeply sedated and controlled in the desired lateral recumbency according to the site of the lesion.

#### Operative Steps:

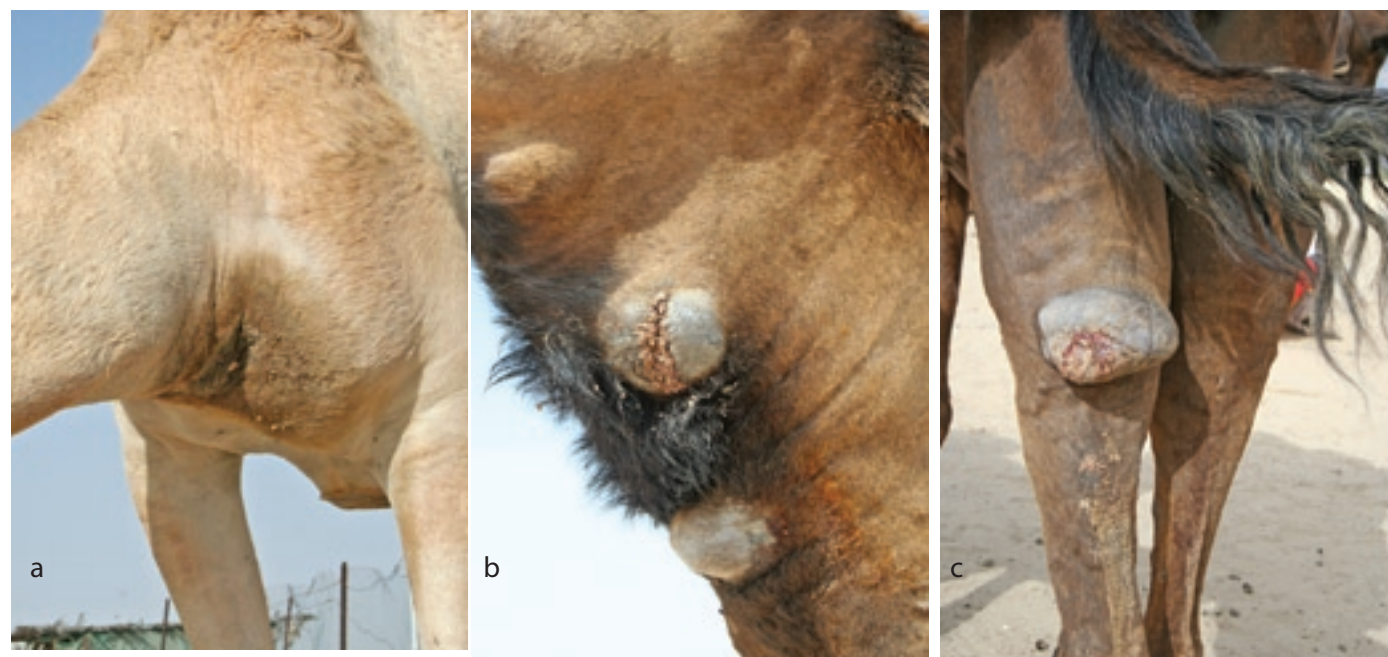
1. The site is washed and cleaned for surgery.
2. An elliptical skin incision is given in the center or around the swelling and the skin margins are undermined towards their respective sides for enucleation of the fibrous mass. Care is taken to save enough skin that would allow proper apposition and suturing of the skin margins. In very large swellings, a wedge shaped portion of the fibrous tissue from the center of the swelling may first be removed (Fig. 13.39). This will give room and facilitate further dissection of the fibrous mass encapsulating the infected lymph node/nodes (Fig. 13.40 a&b).

3. The bleeding points are controlled with mosquito hemostats or ligated if possible.
4. Removal of the fibrous mass will expose the infected lymph node that must be removed (Fig. 13.41); otherwise, the condition will recur. Multiple micro abscesses may usually be seen on the cut surfaces of the infected lymph node (Fig.13.42). This indicates that primarily the lymph node is involved and the fibrous reaction around it is secondary which may well be regarded as a defense mechanism of the body to contain the infection. In some cases, frank pus in variable quantity will escape as soon as the infected lymph node is incised in situ and only the remnant of the node is left (Fig. 13.43).
5. The removal of the lymph node will result in bleeding due to severance of its blood vessels. The ends of the severed blood vessels are grasped in the hemostatic forceps and ligated with catgut.



**Figure 13.37** Dispersion of the lymph nodes (solid nodes are palpable and important from disease point view). (Smuts, M.W. and Bezuidenhout A.Y. 1987. *Anatomy of Dromedary*).





**Figure 13.38 a,b,c & d** Infection and inflammation of:  
a) Ventral deep cervical lymph node.  
b) Cranial superficial cervical lymph nodes.  
c) Popliteal lymph node.  
d) Dorsal and ventral superficial cervical lymph nodes.

6. The operation site is then thoroughly examined and the left over fibrous tissue; as much as possible, is removed (Fig. 13.44).
7. First intention wound healing is not expected in these cases. The wound cavity is therefore, tightly plugged with a hemostatic drug such as *Tincture Benzoin Co* and the wound edges are closed with temporary skin sutures (Fig.13.45 a&b).

#### Postoperative Care:

1. Postoperative care involves cleaning and dressing of the wound with the drug of choice of the attending veterinarian till complete healing of the wound.
2. The healing time depends on the size, site and condition of the wound. The wound on the flexor surface of the joint, such as the stifle joint after removal of the popliteal lymph node; may take much longer time than expected.
3. Cover of systemic antibiotics is recommended.

#### Possible Complications:

1. Persistence of purulent fistulous tracts with the wounds not responding to treatment. It is mainly due to incomplete or no removal of the infected lymph node/nodes.
2. Recurrence of fibrosis in the affected region. It is generally much smaller in size than the original one and should be of no significance except a blemish as long as it has no nucleus of infection in it.

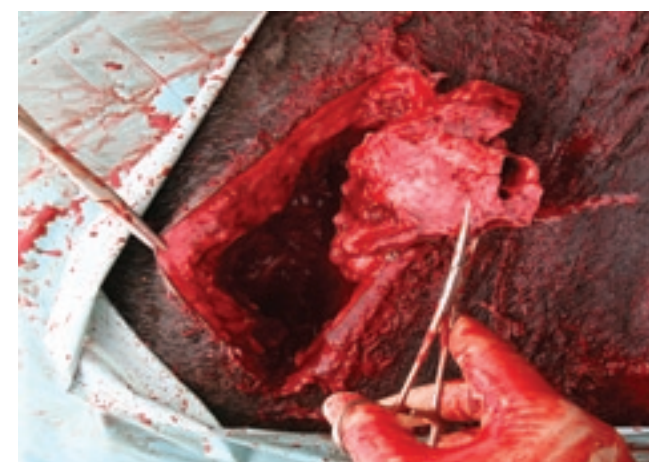
Another condition that mainly involves the superficial lymph nodes and produces abscesses in them is the “*Caseous Lymphadenitis*” caused by *Corynebacterium pseudotuberculosis*. The disease has quite often been documented in the sheep and goats affecting the superficial lymph nodes. The infected lymph nodes contain thick, cheesy pus which is the main characteristic of the disease. As the camels and the sheep and goats are normally



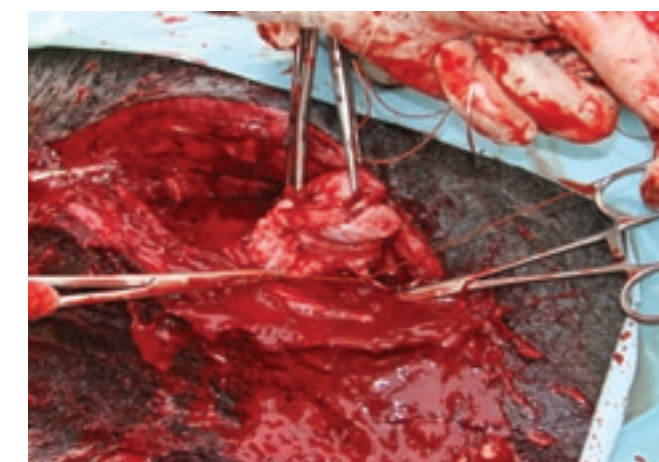
**Figure 13.39** A wedge shaped mass removed from center to facilitate further dissection.



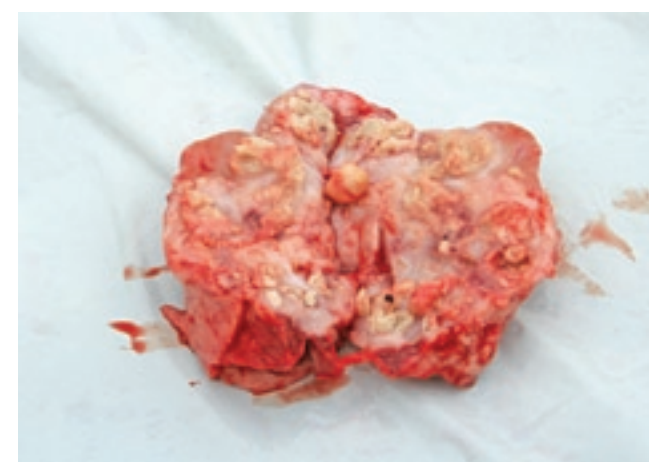
**Figure 13.40a** Further dissection around the fibrous mass.



**Figure 13.40b** Enucleation of the total fibrous mass.



**Figure 13.41** Exposure of the lymph node and ligation of its blood supply for en-block enucleation.



**Figure 13.42** Cut surface of the infected lymph node. Note multiple micro-abscesses on the cut surface.

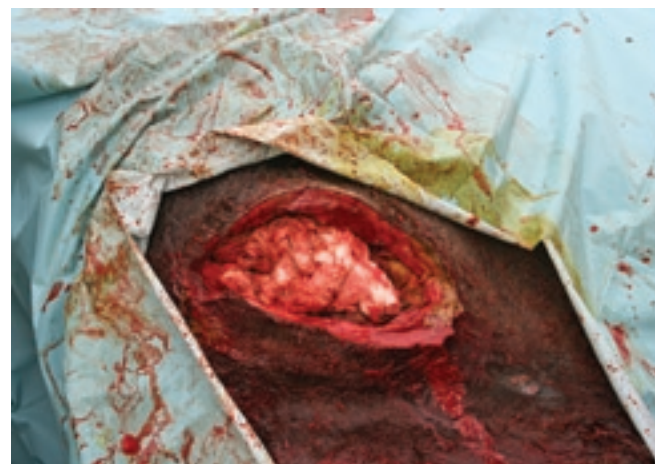


**Figure 13.43** Exudation of pus from the incised lymph node. In such cases, only the outer shell of the node is left which should always be removed to prevent recurrence of the disease.

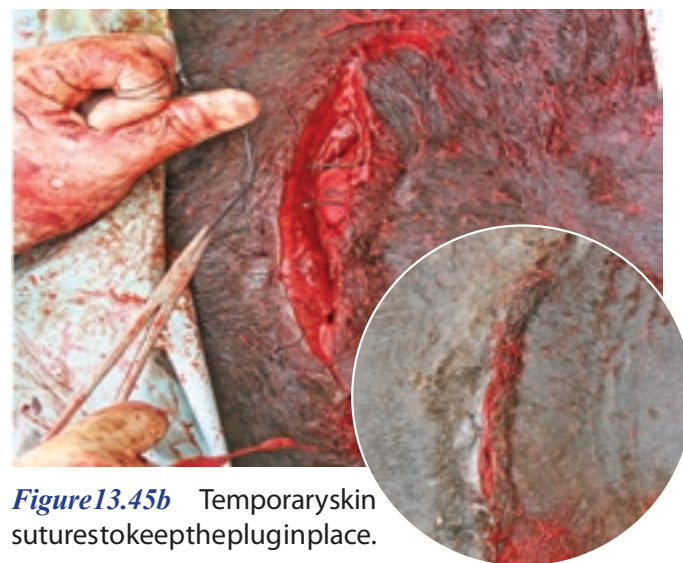




**Figure 13.44** Complete removal of the fibrous mass and the infected lymph node. Note the postresection big gap.



**Figure 13.45a** Plugging of the cavity with gauze to arrest diffuse bleeding.



**Figure 13.45b** Temporary skin suture to keep the plug in place.

housed at the same farm, the camels are liable to contact infection from these animals. It has been mainly seen to affect the chain of the lymph nodes of the limbs (Fig. 13.46 a&b). The disease manifests itself as a series of lymph node abscesses along the lymphatic channels. The abscessed lymph nodes discharge thick, cheesy, caseous pus with inflammation of the surrounding soft tissue (Fig. 13.47). The authors have noted very typical cases of caseous lymphadenitis in the fore and hind limbs and they are being referred here as specimen cases.

#### Control and Anesthesia:

The animal is sedated and controlled in the desired lateral recumbency. In case of hind limbs, low epidural anesthesia will be a good choice when the case is being handled for the first time.

#### Operative Steps:

1. All the abscesses are thoroughly drained, cleaned and washed with standard aqueous solution of Potassium permanganate and dressed with any antibiotic ointment (Fig. 13.48).
2. It is beneficial to pass a seton through these abscesses (Fig. 13.49). This will help in the application of the drug to the deeper tissue and also assist in continuous drainage of the lesions, which in turn will result in an early healing.
3. It should be kept in mind that some discharge from the wounds will always be there as long as the seton is inside, as the seton itself acts as a foreign body.

4. The seton is removed when there is minimal sero-sanguinous discharge from the wounds. After removal of the seton, the wounds will heal promptly (Fig. 13.50).

#### Postoperative Care:

1. It is better to give systemic antibiotic cover for the first 7-10 days of the treatment.
2. The cleaning and dressing of the abscess wounds is done daily or on alternate days. The setons; if used, are changed each time the dressing is done.

#### Possible Complications:

There are no appreciable complications and the wounds heal up very well except that some fibrous



**Figure 13.46a** Caseous lymphadenitis of the left hind leg. Note multiple foci of the disease.



**Figure 13.46b** Caseous lymphadenitis of the right forelimb.

reaction may be noticed in the affected area which is of no significance.

**Lymphangitis** or inflammation of the lymph vessels is yet another disease, sometimes associated with certain bacterial or fungal infections. Lymphatics drain inflammatory agents and products from tissue spaces into the lymph nodes where they should be rendered inactive. Any introduction of the bacteria into the subcutaneous tissue following lacerations, bite wounds and abrasions are liable to elicit inflammatory lymphatic response. This process is an ongoing protective mechanism. *Streptococci* and *Staphylococci* are the two most common bacterial agents involved. The disease may manifest in acute ascending lymphangitis or chronic recurrent lymphangitis resulting in abnormal accumulation or stasis of the normal lymph flow resulting in swelling of the subcutaneous tissue, which also has been called “Elephantiasis” (Fig. 13.51). It is not very commonly seen in camels and generally involves cutaneous lymphatics of the limb resulting in edema and ulceration. Surgical intervention has no place in such cases. Antibiotic and iodine therapy may help in certain individuals.

#### 10. Punctured Foot

The camels differ from the so called advanced ruminants in that the hooves are replaced with callus pads ending in nails and therefore, are classified as “pad footed” animals. The pads are broad, flat and leathery with two toes on each foot and are



**Figure 13.47** Note the cheesy pus exuding from the lesion.



**Figure 13.48** Debridement, cleaning and washing of the lesions. It is better to communicate the lesions with each other.





**Figure 13.49** Passing of a seton through the lesions for proper drainage and dressing.



**Figure 13.50** The healing process in progress. Seton has been removed.



**Figure 13.51** Lymphangitis (elephantiasis) of the left hind in a black camel. Also note the edematous swelling above the hock.

thick layer of yellow elastic connective tissue which in turn is supported by the undivided foot pad or sole.

The punctured foot, as the name indicates is a condition in which the solar surface of the foot is penetrated by some sharp object such as nail, sharp pointed piece of bone, wire, pebbles or a broken glass etc. leading to infection and formation of sinuses through the foot pad (Fig. 13.52). The animal is lame and the site is quite painful to touch. Very deep punctures may also be accompanied with prolapse of the digital cushion (Fig. 13.53).

#### Control and Anesthesia:

The animal is sedated and controlled in the desired lateral recumbency. The fore foot may be desensitized with volar nerve blocks or intravenous limb analgesia. In case of hind limb, epidural anesthesia will be a better choice.

#### Operative Steps:

1. The solar surface of the foot is washed with standard aqueous solution of Potassium permanganate. The site is carefully examined and the offending object, if still present; is removed. The radiographic examination prior to manipulation will be helpful for the detection of radio-opaque foreign bodies.
2. A careful debridement of the lesion is carried out till fresh blood oozes out (Fig. 13.54).
3. The wound is then packed with any antibacterial, preferably sulphonamide powder and the foot is bandaged up to the middle of metacarpal or metatarsal region.

composed of elastic tissue which absorbs the shock of walking. When the foot is placed on the ground, the pads spread preventing the foot from sinking into the sand. Each pad is attached to the flexor tendons and the second and third phalanges of each digit. The pad of each digit is however, fused to each other to form a single pad, which is also called sole of the foot. Camels walk on the pads of the second and third phalanges and toes. The nails do not bear weight but only protect the tip of the toes.

Underlying the two distal phalanges, there is a pair of egg shaped structures known as digital cushions. Each digital cushion consists of soft adipose tissue encapsulated by collagen connective tissue. These structures are supported by an underlying



**Figure 13.52** Punctured foot.



**Figure 13.53** Prolapse of digital cushion following a deep puncture and extensive damage to the structures underlying the digital cushion.

4. The dressing is preferably changed twice a week till complete healing occurs (Fig. 13.55).
5. In some cases, digital cushion may get prolapsed which should be surgically resected as and when required.
6. These cases are quite time demanding to heal, but ultimately heal up with proper care of the case.

#### Postoperative Care:

1. The use of systemic antibiotics is recommended along with local use of the same drug.
2. Cleanliness and keeping the animal in clean environment is very important. The foot must remain bandaged, as it is always in touch with the ground being prone to further infection and trauma. If the bandage comes off, it should be re-applied as soon as possible after thorough cleaning and dressing.

#### Possible Complications:

The condition may aggravate if proper care is not observed. Some cases have been noticed to be quite non-responsive to treatment.



**Figure 13.54** Debridement of the lesion to remove dead and devitalized tissue.



**Figure 13.55** Healing process in progress. The foot should be protected with bandage till complete healing takes place.



### 11. Avulsion of the Foot Pad

This condition has occasionally been seen where the foot pad separates from the overlying structures exposing the thick layer of the yellow elastic connective tissue. The cause is not very clear; however, some infectious agent can not be ruled out. In some cases, trauma is the cause where the foot of the animal strikes against a hard, fixed object during exercise and the foot pad gets avulsed resulting in bleeding. In other cases, there is no bleeding and the condition is suddenly noticed by the owner with foul smell from the affected foot; which gives suspicion that it might be due to some infectious agent (Fig. 13.56).



**Figure 13.56** Avulsion of the foot pad with prolapse of the digital cushion.

#### Control and Anesthesia:

This is not a very painful condition and so the anesthesia is optional. The animal is controlled in lateral recumbency with the affected foot up.

#### Operative Steps:

1. The area is thoroughly washed with any Iodine based detergent solution.
2. The avulsed portion of the foot pad is held with Allis forceps at one point and the portion of the pad still attached is cut all around either with a sharp scissors or a scalpel blade from its attachment with the margins of the foot (Fig. 13.57).
3. There is no appreciable bleeding during this maneuver; however, in traumatic cases, one might be confronted with this problem.
4. In some cases, prolapse of the digital cushion may be seen at one or two points (see Fig. 13.56). In such a case, the prolapsed part of the digital cushion should be severed in level with the surrounding soft tissues before bandaging the foot and this might have to be repeated two to three times before healing takes place.
5. The wounded area is well smeared with any antibiotic ointment, the solar surface of the foot is well padded and the foot is bandaged to above the fetlock joint. Zinc oxide ointment has also given good results.
6. The foot pad starts healing from the margins and covers whole of the solar surface with the passage of time (Fig. 13.58 a&b). Remember, it is a time consuming process!



**Figure 13.57** Excision of the foot pad and cleaning of the area before bandaging.

#### Postoperative Care:

The dressing is done twice a week and the foot should be well bandaged each time to avoid further trauma to the exposed soft tissue. The general postoperative care is the same as mentioned for punctured foot.

#### Possible Complications:

Prolapse of the digital cushion may occur if the foot is not bandaged properly and some hard object such as a stone pierces through it. Actually any condition involving the solar surface of the foot requires an utmost care to avoid further complications, which may outweigh towards poor prognosis than those of the original problem.



**Figure 13.58a** Middle stage of healing. Note growing foot pad over the granulation tissue.



**Figure 13.58b** Later stage healing. It has been noticed that foot pad does not take much time to cover the soft tissues.

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# CHAPTER

# Surgery of the Eye and Ear 14

Like all other large animals, there are only a few surgical diseases of the eye and ear in the camel that can be operated upon successfully. The others are either dealt with in works on medicine or are not advisable to be handled surgically, like cataract (Fig. 14.1), glaucoma, corneal opacity (Fig. 14.2), blindness and the like lesions in the eye and the conditions like otitis interna, media and otitis externa in the ear. Some of the surgical procedures that can be performed to treat certain conditions of the eye and ear are mentioned below.

## 1. Enucleation of Eyeball

The eyeball is situated in the anterior part of the orbital cavity. It is protected in front by the eyelids and conjunctiva, in its middle by the bony orbit and it is related behind to the bulbar fascia, fat and ocular muscles.

The camel eye is large with a soft, dome like expression and has an external fibrous, middle vascular and an internal nervous tunic. The external tunic consists of the sclera and cornea which meet at limbus. The cornea forms about one quarter of the tunic and bulges forward. The vascular tunic lies deep to sclera and comprises choroids, ciliary body and iris. The iris is suspended between the cornea and the lens and divides the space between them into anterior and posterior chambers which are filled with aqueous humor. Both the chambers communicate through the pupil, an opening in the center of the iris through which the light enters the posterior part of the eye. The internal tunic is nervous and contains light-sensitive receptor cells and is called retina.

Enucleation of the eyeball is indicated in cases of tumors (Fig. 14.3), irreparable penetrating wounds with or without panophthalmia, massive trauma with loss of globe contents and enlarged painful glaucomatous eyes.

Although the operation is called enucleation of the eyeball, it is an extirpation for all practical purposes. In enucleation, only the globe is removed whereas extirpation involves removal of everything in the orbit; that is the globe, muscles, adipose tissue and the lacrimal gland.

### Control and Anesthesia:

The animal is deeply sedated and controlled in the desired lateral recumbency. The four point retrobulbar block or ocular analgesia are alternative methods and work well. A successful block is evidenced by ptosis, eversion of the lower eyelid and narrowing of the palpebral fissure.

### Operative Steps:

1. Eyelashes are cut with a sharp scissors; the area is scrubbed with any Iodine based solution and cleaned properly. If there are large amounts of necrotic or neoplastic tissue, some of these may be removed before the surgical scrub.
2. The eyelids are sutured together with simple continuous sutures using silk or any other non-absorbable suture material (Fig. 14.4). The ends of the suture are kept longer and tied together to make a loop for handling, continued traction and stabilizing the eyeball during dissection. Instead of suturing, the eyelids may be grasped with two towel clamps.
3. An incision is given about half centimeter away



**Figure 14.1** Cataract. The animal had bilateral cataract and was completely blind.



**Figure 14.2** Corneal opacity as a result of corneal injury.



**Figure 14.3** Tumor of the eye; an indication for enucleation of the eyeball.



**Figure 14.4** Suturing of the eyelids and making loop of suture to stabilize the eyeball.

from the palpebral border on both the eyelids, the two incisions joining beyond the medial and lateral canthi (Fig. 14.5 a&b). The eyeball is kept pulled with the suture loop and the dissection is continued with a sharp, blunt pointed curved scissors in between the orbit and the eyeball all around, dissecting through the orbital muscles and the connective tissue until the optic stump is reached (Fig. 14.6). Entrance through the palpebral conjunctiva should be avoided. Generally, the dissection on the lower eyelid is done first. All the muscles, adipose tissue, the lacrimal gland and the fascia along with the eyelids and the eyeball are removed. However, in a non-neoplastic condition, such as irreparable trauma, enucleation may be done leaving some retrobulbar tissue to reduce the amount of dead space and intraoperative hemorrhage.



**Figure 14.5a** Incision below the palpebral border of lower eyelid.





**Figure 14.5b** Incision above the palpebral border of the upper eyelid.



**Figure 14.6** Dissection around the eyeball (360°).

4. When the optic stump is reached, it is grasped with a right angled forceps or a similar instrument and is cut distally with a sharp curved scissors in a single stroke so that the animal does not get undue shock. Alternatively, the optic stump may be ligated with absorbable suture material such as catgut or polyglycolic acid and severed distal to ligature (Fig.14.7 a&b).

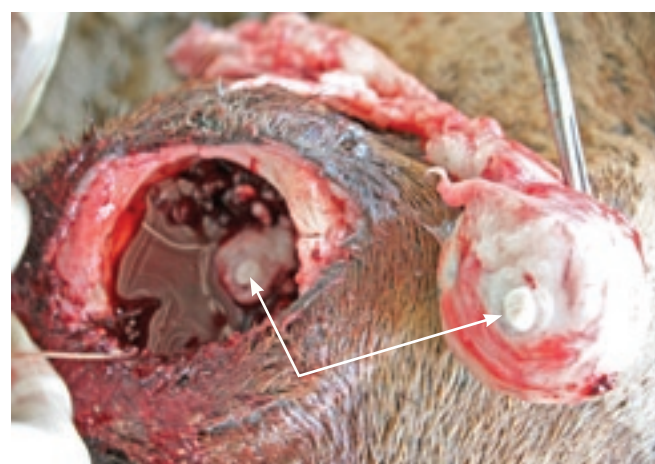
5. Following removal of the eye, considerable dead space is created and it is impossible to obliterate it. The skin edges are closed with simple interrupted or simple continuous sutures. The cavity normally fills with a blood clot that organizes during the healing period. The sutures are removed after two to three weeks. If infection takes place, some of the sutures are removed to permit drainage.

6. If there is a considerable hemorrhage, the orbit may be packed with sterile gauze which can be removed after 2 -3 days by cutting 2-3 sutures when the bleeding has stopped. Alternatively, the tag end of the sterile gauze plug is left exposed (Fig.14.8 a,b & c) and a few centimeters removed daily until all is removed by 4 to 5 days postsurgery. However, it is generally not necessary, as the tight skin sutures allow pressure build up within the orbit which seems to be enough to create hemostasis through a tamponade effect.

7. In extensive neoplastic and infected cases, primary intention healing is not expected. The orbit is then tightly plugged and the eyelids are closed with temporary sutures.



**Figure 14.7a** Ligation of the optic stump with chromic catgut USP 2.



**Figure 14.7b** Severance of optic stump below the ligature. Cut end of the optic nerve is clearly visible (arrow).



**Figure 14.8a** Plugging of the orbit with a piece of gauze.



**Figure 14.8b** Suturing of the eyelids with interrupted horizontal mattress sutures.

8. The plug is removed after two days, the orbit is thoroughly washed and cleaned with any antiseptic solution and dressed with the drug of choice. It is better to cover the site with a four tail bandage to avoid flies and consequent maggot formation. Dressing is continued on alternate days till complete healing takes place.

#### Postoperative Care:

1. Antibiotic cover should be given in cases of sepsis or to prevent it in the postoperative period.
2. If high grade infection develops, the sutures should be removed and the wound is allowed to heal through granulation tissue.

#### Possible Complications:

1. Hemorrhage in the immediate postoperative period, particularly when the skin sutures fail to provide an effective seal to allow the build up of a blood clot in the orbit.
2. Infection of the wound which should be handled effectively through meticulous use of systemic antibiotics and local dressing of the wound.



**Figure 14.8c** Exposure of the tag end of the plug; so that the plug is removed bit by bit in 4-5 days.



## 2. Prolapse of Iris

The iris, a part of the vascular tunic (uvea) of the eye, is a flat ring of tissue attached at its periphery to the sclera and the ciliary body. It is suspended between cornea and the lens and has a central opening; the pupil, through which light enters the posterior part of the eye. It divides the space between the cornea and the lens into anterior and posterior chambers, which communicate with each other through the pupil. Both the chambers are filled with a clear watery fluid, the aqueous humor.

The prolapse of iris through the cornea is a result of perforating injury to the latter by a sharp object such as thorn, blow by a stick or the point of a barbed wire (Fig.14.9 a & b). The injury results in loss of aqueous humor, corneal edema and opacity if the case remains unattended for 2 to 3 days. Hemorrhage and fibrin usually cover the prolapsed portion of the iris and fill up most of the anterior chamber. In long standing unattended cases, panophthalmia will be a sequel.

### Control and Anesthesia:

The animal is put under deep sedation and controlled in the lateral recumbency with the affected eye up. Some drops of local anesthetic solution may be instilled into the eye.

### Salvage Procedure:

In fresh cases, the prolapsed portion of the iris is cut with a sharp scissors (Fig.14.10). The eye is flushed with normal saline solution and dressed with antibiotic ointment. This treatment is daily repeated till recovery. It is better to cover the eye with a sterile piece of gauze after each dressing. With proper and meticulous postoperative care, the chances to save the eyeball in a small percentage of cases, of course without vision, exist. The prognosis however, is not favorable and the condition may lead to panophthalmia in the eve of infection. In such a case or when the injury involves the lens and/or the vitreous body, the only choice that remains is enucleation of the eyeball.

### Postoperative Care:

1. As the eye is a very delicate structure, any problem related to it needs an intensive postoperative care in the form of local medication, preventing from external stimuli and giving cover of systemic antibiotics.



**Figure 14.9a** Prolapse of iris through injured cornea by a barbed wire.



**Figure 14.9b** Prolapse of iris through a small tear in the cornea. Note hemorrhage under the intact part of cornea (arrow).



**Figure 14.10** Surgical excision of the prolapsed iris. The wound healed and the eyeball was saved (without vision) in this animal.



**Figure 14.11** Avulsion of the upper eyelid from medial canthus up to its middle.



**Figure 14.12** Freshening of the wound edges for suturing.

2. The affected eyeball should be protected from direct sun light and dust by covering it with a clean cloth that should be changed every day or even for more than once a day or as needed.
3. The animal should be kept in a separate enclosure to save him/her from any trauma by the other animals. There should also be no fixed object in the enclosure, so that the animal may not self mutilate the injured eye by rubbing against it.

### Possible Complications:

1. Panophthalmia, if an uncontrolled infection takes place.
2. Self mutilation of the eye further aggravating the problem.

## 3. Injury to the Eyelids

The eyelids are musculo-fibrous folds of which the upper is more extensive and mobile. They are intermittently drawn over the eyeball (blinking) to distribute the lacrimal fluid to keep its exposed parts moist and to protect it from external stimuli. Each eyelid consists of an outer skin, a middle musculo-fibrous and an inner mucous membrane layer, called palpebral conjunctiva that faces the eye. Between the lacrimal caruncle and the eyeball is a dorsoventrally oriented conjunctival fold known as third eyelid.

Full thickness tearing of either of the eyelids often occurs as a result of accidental rubbing or invasion by a barbed wire that is often used to make

enclosures for the camels. The condition is also seen in those animals that browse on thorny bushes and trees. As a result of tear, avulsion of the lid margin can occur in the shape of a large piece of the lid hanging down (Fig.14.11). Cutting away the injured eyelid should be avoided, as it will permanently expose the eyeball to the external environmental stimuli inviting problems like conjunctivitis and therefore, a sincere effort should be made to repair the injured eyelid unless injury is really irreparable. Repair is also needed for cosmetic reasons.

### Control and Anesthesia:

The animal is deeply sedated and controlled in the desired lateral recumbency. A few drops of local anesthetic solution are instilled in the eye.

### Repair Procedure:

1. The long hairs around the site are closely trimmed and the area is cleaned with plain water. The eyeball should be protected with a cotton pad soaked in normal saline, so that the hairs do not fall into the eye.
2. The wound edges are trimmed smooth in order to get proper apposition. In case of irregular tear, the wound edges should be trimmed smooth, but to an extent that the near normal configuration of the eyelid is restored (Fig.14.12).
3. The wound edges are accurately apposed and sutured with monofilament nonabsorbable suture material USP 0 on a reverse cutting needle. The





**Figure 14.13a** First suture to be placed in the extreme free end to get proper apposition (arrow).



**Figure 14.13b** Suturing the rest of the eyelid wound.

sutures should go through partial thickness of the skin; otherwise they will irritate the sclera (Fig.14.13 a,b & c).

4. The first suture should be placed in the extreme end of the wound in order to get exact orientation of the injured eyelid. Horizontal mattress sutures are preferred with the knots kept away from the eyeball. The end of the cut suture towards the eyeball should be cut short so that it does not touch and irritate the later.
5. The suture line should be protected with antibiotic ointment.

#### Postoperative Care:

1. The animal should be tied in isolation away from any fixed objects or poles to avoid self mutilation.
2. The suture line should be daily examined and dressed with antibiotic ointment till the sutures are removed after two weeks.

#### Possible Complications:

1. In most of the cases, the recovery is uneventful.
2. The only possible complication that may seldom be encountered is break down of the suture line. This happens due to infection of the suture line which forces the animal to rub it against some object.

#### 4. Entropion

Entropion is an inversion of either one or both the eyelids but mainly has been noticed affecting the upper eyelid in the camel (Fig.14.14). As a result,

the eyelashes rub on the cornea setting up keratitis, conjunctivitis and even progressing to corneal ulcers and suppurative panophthalmitis in long standing cases. The animal is presented with the complaint of watery or pussy discharge from the affected eye. The clinical examination reveals the extent of the condition with variable degree of associated conjunctivitis.

#### Control and Anesthesia:

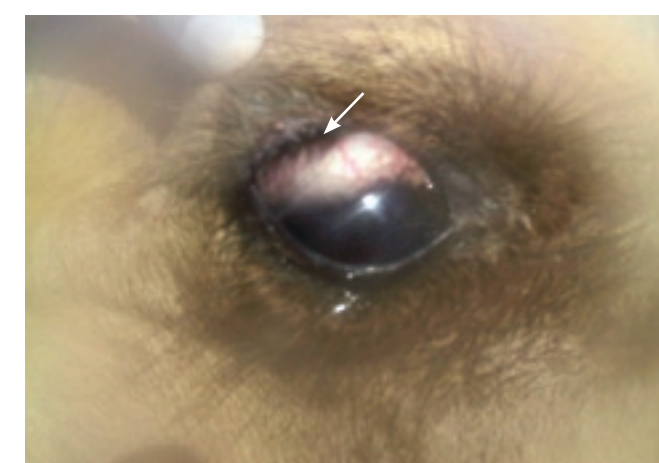
The animal is sedated and controlled in the desired lateral recumbency.

#### Operative Steps:

1. The operation site is closely clipped and thoroughly scrubbed and cleaned. The eyeball should be protected with a cotton pad soaked in normal saline, so that the scrub material and the hair do not fall into the eye.
2. A strip of skin, parallel to and approximately 1cm away from the palpebral border is removed with a sharp scissors from medial to the lateral canthus (Fig.14.15 a&b ). The width of the skin strip depends upon the severity of the condition. However, it is always better to under correct the condition. Over correction may end up in ectropion which is equally harmful to the eyeball, as it will expose it to the external environment, especially the sand particles ending up with the same problems as encountered in entropion.
3. The skin edges of the wound are sutured with horizontal mattress sutures using Prolene or Supramid USP 0 suture material on a reverse cutting needle. The sutures should go through partial



**Figure 14.13c** Completion of the suture line. Note precise apposition of the wound edges.



**Figure 14.14** Entropion of upper eyelid. See the eyelashes touching the surface of the eyeball (arrow).

thickness of the skin only and the knots of the sutures should be kept opposite to the palpebral border so that the cut ends of the sutures may not touch and irritate the eyeball (Fig.14.16).

4. The suture line is smeared with topical ophthalmic antibiotic ointment.

#### Postoperative Care:

1. The suture line is daily cleaned and dressed with antibiotic ointment till removal of the sutures after two weeks.
2. The same ointment is also used to treat the entropion associated conjunctivitis.



**Figure 14.15a** The upper eyelid held and lifted up with two Allis forceps for removal of skin flap.



**Figure 14.15b** Skin flap removed with the scissors. Eyelashes touching the globe are clearly visible (arrow).



**Figure 14.16** Suturing of the skin margins with interrupted horizontal mattress sutures keeping the knots opposite to the palpebral border.



**Possible Complications:**

These are the same as described for eyelid injuries. One additional complication may be development of ectropion due to over correction of the defect.

**5. Ectropion**

Ectropion or eversion of the lower eyelid is not a very common condition, but may affect the lid as a result of cicatrization of the wound there upon or in rare cases due to paralysis of the lid. The condition is characterized by drooping of the affected eyelid with associated epiphora and keratoconjunctivitis, as the eye remains exposed to environmental stimuli, such as dust, sand etc.

**Control and Anesthesia:**

The animal is controlled in the lateral recumbency under sedation or auriculopalpebral nerve block.

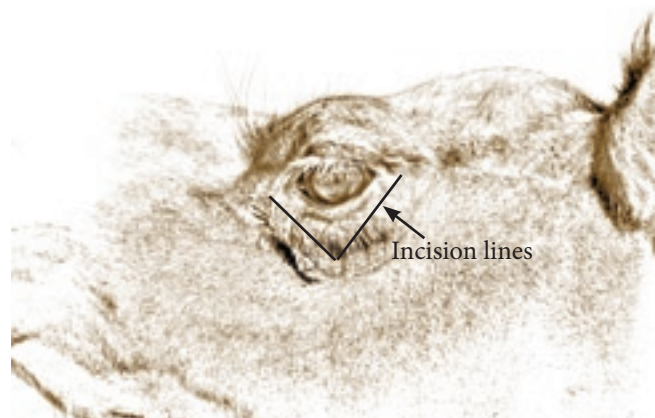
**Operative Steps:**

1. The area under the lower eyelid is closely clipped and prepared for aseptic surgery.
2. A “V” shaped skin incision is given about 1cm below the eyelid and the skin flap is undermined (Fig. 13.17 a).
3. The skin incision is then sutured in a “Y” shape by sliding the flap upward as required depending upon the degree of ectropion.
4. After sliding the skin flap upward, the skin edges of the lower end of the incision are sutured together with simple interrupted or horizontal mattress sutures using nonabsorbable USP 0 suture material to make lower limb of the “Y” and then the edges of the flap are sutured on either side with the incised skin margins to make the upper limbs of the “Y” using the same suture material and pattern (Fig. 13.17 b). This will result in moving the skin flap upwards to correct the condition. This procedure is known as “V-Y” skin plasty.

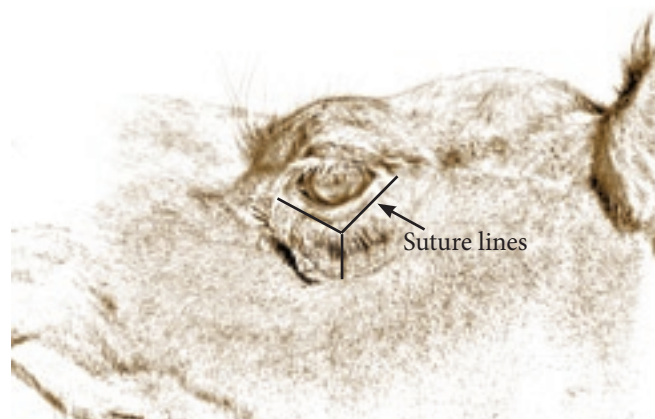
**Postoperative Care and Possible Complications are the same as mentioned for entropion surgery.**

**6. Injury to the External Ear**

The camel ears are small, but its hearing is acute. The auricle or pinna of the ear is shaped like a funnel and its shape is determined by the supporting



**Figure 14.17a** ‘V’ shape incision on the lower eyelid (Schematic sketch).



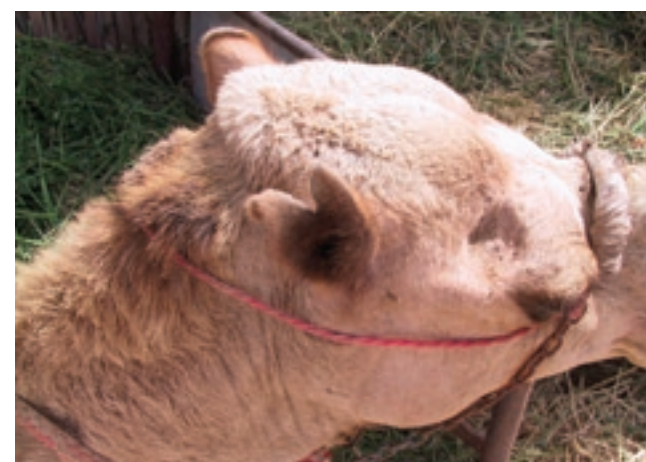
**Figure 14.17b** Suturing of V shape incision in a Y shape to push the palpebral border up to correct ectropion.

auricular cartilage. The auricular skin is provided with long hairs that filter out the sand and dust blowing into the ear canal.

The diseases like otitis externa, media and interna are dealt with in works on medicine. However, auricular cartilage is sometimes cut to a variable length due to barbed wire or some other offending sharp object (Fig13.18 a&b). Sometimes the owners may also cut the structure thinking it as a treatment of certain diseases. This looks ugly, especially in the beautiful racing or show animals and should be repaired.

**Control and Anesthesia:**

The animal is controlled in the desired lateral recumbency under sedation.



**Figure 14.18a** An old longitudinal cut in the pinna with barbed wire.



**Figure 14.18b** A fresh longitudinal cut in the pinna with a sharp object.

**Operative Steps:**

1. The hairs are closely clipped and the site is prepared for aseptic surgery. A swab of clean cotton should be inserted into the ear canal to avoid the water, scrub material or drops of blood entering into the ear canal.
2. In the fresh or recent cases, the wound edges, in case they are irregular; are trimmed smooth for proper alignment and apposition. The trimming should be as minimal as possible to preserve the normal shape of the ear.
3. In old standing cases, the edges of the defect are cut smooth with a sharp scissors. The cutting of the edges should be done with the same objective in mind to preserve, as far as possible; the normal shape of the ear.
4. The external auricular skin is minimally undermined at the wound edges for ease in suturing.
5. The wound edges are apposed and sutured together with simple interrupted or horizontal mattress sutures using Supramid or Prolene USP 0 on a reverse cutting swaged on needle (Fig. 14.19). The sutures should go through the skin and partially through the cartilage. These are just apposing sutures and should not be tight; otherwise the ear may lose its normal shape. No sutures are needed on the inner side.

**Postoperative Care:**

1. The animal should be kept in an environment where it can not rub the ear with some fixed object.
2. The suture line is daily cleaned and dressed with antibiotic spray till healing and suture removal.



**Figure 14.19** Repair of the defect with simple interrupted sutures using supramid USP 2.

**Possible Complications:**

1. Self mutilation of the wound by the animal, which can be avoided by taking due precautions.
2. Normal shape of the ear may not be maintained due to over trimming or tight suturing of the defect.



**Suggested Readings:**

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# Surgical Oncology

## CHAPTER 15

**T**umors or neoplasms have not been very often reported in the camel. This may be due to low prevalence of the disease in this animal or lack of such cases being reported in the literature. Carcinomas of the lungs and adenocarcinomas of the forestomach have been reported in the Bactrian camel with metastatic lesions in the liver, hepatic lymph nodes, heart, aorta and the lungs. The reports of lymphosarcoma and lymphadenopathy also appear in the literature with the most common complaints of anorexia and depression. Squamous cell carcinoma frequently occurs in the flank region, side of the hock and behind the sternal pad but has most commonly been seen on the dorsal part of the nail of the foot and in the interdigital space (Fig. 15.1). Renal cell carcinoma, fibromas and fibromyxomas are also reported as rare occurrences in the camelids with few reports of papillomas and melanomas.

Surgical manipulation of the tumors inside the body cavities is not feasible in this large animal; therefore, some of the tumors most commonly encountered on the body surfaces are being described in this chapter with their possible surgical management which “per se” does not differ much for different lesions. The tumors have been referred to in general and their histological classification has not been emphasized, because the basic aim is to give an outline of the possible surgical procedure to either completely enucleate the tumor or at least reduce its mass to minimize the sufferings of the animal. In the postoperative period, further surgical and / or chemical debridement may be carried out to get the desired or acceptable results.

### 1. Tumors of the Toe / Nail

This is by far the most common tumor the authors have seen in the dromedary camel and may affect either toe in any limb. However, higher incidence has been recorded in the medial toes of the forelimbs. The pectoral limb being the weight-bearing axis of the body of the animal and slight difference in the anatomical configuration between the lateral and medial metacarpal bones and the digits leading to uneven weight bearing may serve as a probable explanation for this discrepancy. The proximal articular surface of the 3rd metacarpal bone is slightly higher than that of the 4th metacarpal and its mediopalmar facet articulates only with the 2nd carpal bone. Its distal articular surface is also at a slightly higher plane than that of the 4th metacarpal bone. The first and second lateral phalanges are also approximately 2-3mm longer than their medial counter parts. This configuration results in slight but noticeable lateral deviation of the fore limbs from knee to the foot (Fig.15.2) and may offer a possible explanation of subjecting the medial toe to more pressure and thus rendering it more prone and vulnerable to pressure injuries, inflammatory reactions and tumor growths. Over grown and excessively in turned toe nails; as has often been noticed in these patients, may also cause excessive pressure on the sole of the already under pressure medial toe, to result in such lesions (Fig. 15.3). The development of the tumor is progressive and the animal is generally presented for treatment when the disease is quite advanced. The swelling at the site with lameness is the common sign.



**Figure 15.1** Tumor involving the medial toe and the interdigital space.



**Figure 15.2** See the noticeable lateral deviation of the limbs from knee to the foot which may result in more pressure on the medial side of the foot.



**Figure 15.3** Tumor growth involving medial toe of the left forelimb. Note excessively “inturned” toe nails causing pressure injury on the toes.



**Figure 15.4a** Tumor growth on the right fore medial toe in the early stages of the disease.

The tumor may involve only the toe (Fig. 15.4 a&b) or the lesion may be quite extensive involving the toe and the sole to a variable degree (Fig.15.5). Depending upon the severity of the case, one may decide to perform disarticulation at the distal or even at the proximal interphalangeal joint with radical excision of the affected part of the foot as detailed below, because only this line of treatment gives the most promising results.

#### A. Disarticulation at the distal interphalangeal joint:

##### Operative Steps:

1. The site is prepared for surgery by thorough washing and drying of the area.



**Figure 15.4b** Tumor growth on lateral side of the medial toe in an advanced stage.





**Figure 15.5** Tumor involving the toe and the sole up to the proximal interphalangeal joint.

2. A transverse incision is given on the dorsal aspect of the toe just caudal to the nail and the dissection is continued till the distal interphalangeal joint is exposed (Fig.15.6).
3. The third phalanx along with toe nail is disarticulated at the joint and removed after dissection of soft tissue attachments (Fig.15.7).
4. The site is examined carefully and any diseased tissue is dissected out. At this point one has to be aggressive in manipulation, so that all the diseased/compromised tissue is removed.
5. The bleeding points are ligated with catgut USP 0. However, in case of diffuse bleeding, the site is plugged with Tincture Benzoin Co and the foot is tightly bandaged.

#### B. Disarticulation at the proximal interphalangeal joint:

This procedure is undertaken in cases of extensive involvement of the digit .

##### Operative Steps:

1. A longitudinal skin incision is given on the dorsal aspect of the involved digit from the proximal interphalangeal joint to the toe nail (Fig.15.8).
2. The skin flaps are undermined on either side to expose the proximal interphalangeal joint (Fig.15.9).
3. The proximal interphalangeal joint is disarticulated and both the second and third phalanges are dissected free from their soft tissue attachments and removed (Fig. 15.10 a&b). During this maneuver, care should be taken to stay as close to the bones as possible to avoid unnecessary

trauma to the digital cushion and other soft tissue structures lying just ventral to the bones.

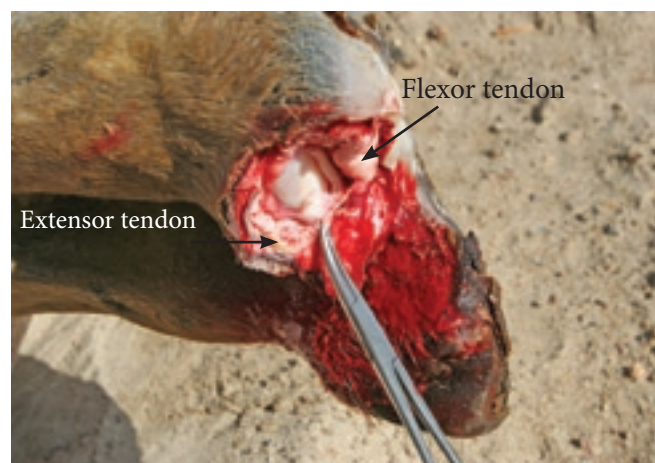
4. In case intravenous limb anesthesia was used, the tourniquet is slightly loosened and the bleeding points are ligated with catgut USP 0.
5. To arrest diffuse type of bleeding, the cavity is plugged with Tincture Benzoin Co with retention sutures on the skin edges and the foot is tightly bandaged (Fig.15.11).

##### Postoperative Care:

1. The cleaning and dressing of the wound is done on alternate days or even twice a week till complete healing takes place. After every dressing, the foot should be bandaged. This wound normally heals through secondary intention.
2. The healing is uneventful, provided whole of the diseased tissue had been removed (Fig.15.12).



**Figure 15.6** Disarticulation at the distal interphalangeal joint. See the distal end of the second phalanx (arrow).



**Figure 15.7** The distal articular surface of the second phalanx is clearly visible after removal of the toe. Also see the cut ends of the extensor and flexor tendons .



**Figure 15.8** A longitudinal skin incision on the dorsal aspect of the involved digit.



**Figure 15.9** Exposure of the proximal interphalangeal joint.



**Figure 15.10a** Disarticulation at the proximal interphalangeal joint.



**Figure 15.10b** Complete removal of 2nd and 3rd phalanx after dissecting them free from their soft tissue attachments.



**Figure 15.11** Packing of the cavity with Tincture Benzoin Co. plug and skin sutures to keep the plug in place.

##### Possible Complications:

1. Immediate postoperative bleeding which may be profuse at times. However, it can be avoided with proper ligation of the blood vessels or tight packing of the wound with plugs of Tincture Benzoin Co and accurate bandaging in cases of diffuse bleeding.
2. Recurrence of the tumor in cases where all the affected tissue is not excised. In such cases a second surgery may be needed.

*Note : In cases of very extensive lesions, disarticulation at the fetlock joint as described in chapter 12 (Orthopedic surgery) may be considered.*





**Figure 15.12** Healing process after disarticulation at the proximal interphalangeal joint.



**Figure 15.13** Tumor of the foot without involvement of the toe or the sole.

## 2. Tumors of the Foot

Apart from the tumors affecting the toe, benign fibromatous swellings may involve the foot independent of the toe nails and the sole (Fig. 15.13). These tumors; when big and on the medial side, may brush against the corresponding foot and interfere with normal locomotion of the animal. They may also get wounded due to the repeated trauma. Even when on the lateral side of the foot, chances of trauma by the offending objects in the surrounding environment do exist. Surgical excision of these lesions will provide relief to the animal.

### Control and Anesthesia:

The animal is sedated and controlled in the required lateral recumbency. The foot area is desensitized with intravenous limb anesthesia. In case of hind limb, epidural anesthesia may be used.

### Operative Steps:

1. The site is prepared for surgery by close clipping and scrubbing of the area.
2. An elliptical skin incision is given in the center of the tumor. The portion of the skin within the incision is excised. This gives a reasonable space for further surgical manipulations.
3. The skin flaps are undermined on their respective sides to fully expose the tumor.
4. The tumor mass is then enucleated taking care not to damage the normal foot structures (Fig. 15.14).
5. The bleeding points are clamped with mosquito hemostat and ligated with catgut USP 1, but to

arrest diffuse bleeding, the cavity is plugged with cotton pad wrapped in a bandage and impregnated with Tincture Benzoin Co. The wound edges are sutured to keep the plug in place.

### Postoperative Care:

The plug is removed after two days and the wound is dressed and bandaged. The dressing is changed twice a week and surgical and/or chemical debridement of the wound is also done as and when required.

### Possible Complications:

These wounds normally heal through secondary intention, as the conditions for primary healing do not exist (Fig. 15.15). The wounds on the foot of the camel need special care and bandaging after each dressing, as further complications can develop if the wound is constantly exposed to the sand and the maggot flies which are normally present on the farms.

## 3. Tumors of the Chest Pad

Chest pad is an important body part of the camel that helps the animal to attain the sternal posture. Apart from wounds, fibromas may develop in the center or posteroventral aspect of the pad (Fig. 15.16 a&b). The lesion is painful, results in difficulty for the animal to attain the sternal posture and also causes interference in locomotion. History reveals that the lesion has been undergoing enlargement for quite sometime. The experience has shown that



**Figure 15.14** Complete enucleation of the tumor.



**Figure 15.15** Healing in progress after tumor excision.

this tremendous fibrous response is actually a result of prolonged irritation of the chest pad due to wounds / sinuses etc. there on. Surgical excision of the tumor on the chest pad should be attempted in order to provide relief to the animal.

### Control and Anesthesia:

The animal is controlled in lateral recumbency under general anesthesia.

### Operative Steps:

1. Excision of the tumor mass is started from the point most easily accessible and is completed gradually. To start with the excision the scalpel blade is used; however, in certain cases the tumor is so hard that one has to use a gigly wire or an embryotomy wire to complete the procedure (Fig. 15.17).
2. The bleeders are held with mosquito hemostats and ligated with catgut. Electrocautery may be used for the purpose if available. However, in field conditions and in situations of diffuse bleeding, hot firing iron may be used to arrest bleeding (Fig. 15.18).
3. No skin is available here for suturing; hence, a thick cotton pad impregnated with Tincture Benzoin Co. is placed over the cut surface and tightly secured with a wide strong bandage tied over the back of the animal. If considered necessary, the animal is tied and kept in the sternal position for an extended period of time. This will also help a little to minimize blood loss due to some pressure from the ground.



**Figure 15.16a** A big mass involving whole of the chest pad. The animal was unable to sit properly.



**Figure 15.16b** A mass on the postero-ventral aspect of the chest pad.





**Figure 15.17** Tumor mass removed with the help of a giggly saw. On histological examination, it was diagnosed as fibroma.



**Figure 15.18** The diffuse bleeding was controlled by touching the bleeding spots with hot iron. The black areas represent the burnt tissues.

4. If bleeding is more than expected, animal should be put on fluid therapy as required.
5. The bandage is removed after a week's time, the wound is cleaned and dressed with any antiseptic or antibiotic cream of choice and again bandaged the same way.
6. This wound takes a long time to heal, as this is normally a big wound and healing process is also slow in this area due to its fatty nature.

#### Postoperative Care:

Postoperative care comprises cleaning and dressing of the wound on alternate days till complete healing. Healing is usually uneventful.

#### Possible Complications:

The only possible complication is recurrence of the lesion, but it does not come back if completely excised. Even if it recurs, the intensity is much less than the original lesion.

#### 4. Tumors of the Stifle

Tumors in the stifle region may occur on any aspect of the joint. They may occur as solitary lesions, but generally have been noticed as diffuse lesions and may involve a considerable area of the skin (Fig.15.19). The solitary tumors are easy to remove, but the diffuse lesions pose problems; as after their removal, enough skin is not available for closure of the skin defect.

#### Control and Anesthesia:

The animal is sedated and movements of the hind limbs are controlled with epidural anesthesia. The animal is then controlled in the required lateral recumbency.

#### Operative Steps:

1. For solitary lesions, an elliptical incision is given around the tumor mass and the later is enucleated after undermining the skin flaps on their respective sides.
2. The bleeding points are ligated with catgut USP 1 and the wound is washed with sterile normal saline solution.
3. The dead space is obliterated and the subcutaneous tissue is apposed with polyglycolic acid USP 2 suture material.
4. The skin edges are sutured with prolene USP 2 swaged on a reverse cutting needle.
5. If indicated, a penrose drain may be adjusted in the wound for effective drainage. In this situation, buried sutures are not recommended.
6. For diffuse lesions, as much of the tumor mass as possible is surgically excised and the wound cavity is plugged with Ticture Benzoin Co and the skin margins are tightened as far as possible with temporary retention sutures to keep the plug from falling out.

#### Postoperative Care:

1. The suture line is cleaned and dressed as and when required.



**Figure 15.19** An extensive growth involving postero-ventral aspect of the right stifle joint.



**Figure 15.20** Tumor mass on the posterior aspect of left hock joint. Small tumor masses are also visible on the cranial aspect of the joint.

2. In case the penrose drain is adjusted in the wound, it should be cleaned regularly and then removed when no longer required as mentioned in the chapter of wound management.
3. If the wound cavity was plugged, the plug is removed after 2 days and the wound is cleaned and dressed on regular basis till healing takes place. Periodic surgical and/or chemical debridement may be necessary.

#### Possible Complications:

Recurrence of the tumor if not completely removed. In malignant diffuse type lesions, the chances of this complication are more.

#### 5. Tumors of the Hock

The tumor may occur at the point of hock or any where around the joint (Fig.15.20). The tumor on the cranial aspect of the joint poses problems to the animal during attaining sternal posture and repeated friction and pressure thus exerted on the lesion results in bleeding and its enlargement.

#### Control and Anesthesia:

The animal is slightly sedated, supplemented with caudal epidural anesthesia and controlled in the desired lateral recumbency.

#### Operative Steps:

1. An elliptical incision is given around the tumor mass and the skin margins, if available are undermined.



**Figure 15.21** The bleeding points touched with hot iron after excision of the mass.

2. The tumor mass is enucleated and the bleeding points are ligated with catgut USP 0 or cauterized with electrocautery. In case of diffuse bleeding in the field conditions, a red hot iron may be used to obliterate the bleeding ends of the vessels (Fig.15.21).
3. There is practically no skin left for suturing of the defect and the sutures also are apt to break down in this region, particularly when the tumor is at the point of the hock. Therefore, no attempt is made to suture the skin defect.
4. A figure of "8" or a four tail bandage may be applied around the joint to protect the wound from soiling.



**Postoperative Care:**

1. The wound is cleaned and dressed as required till complete healing takes place.
2. The wounds at the point of hock after tumor excision may take a long time to heal.

**Possible Complications:**

There are no major complications except that the tumor may recur if it is not completely removed.

**6. Vaginal Tumors**

Small vaginal tumors have been noticed just cranial to the vulval lips which cause hindrance in the mating process or the female resists penile intromission by the male. The tumors may occur singly or be noticed as small multiple circumferential growths (Fig.15.22).

**Control and Anesthesia:**

The animal is controlled in the sternal position under epidural anesthesia.

**Operative Steps:**

1. The tail of the animal is firmly held up by an assistant.
2. The surgery site and the surrounding area is thoroughly washed with any Iodine based solution or standard solution of Potassium permanganate and clean dried.
3. It is advisable to pass a urethral catheter to avoid any injury to the meatus urinarius.
4. The abnormal mass of tissue is held in the Allis forceps and is transfixed at its base with chromic catgut or Polyglycolic acid USP 1 suture material (Fig.15.23).
5. The tumor mass is then severed just distal to the ligature. In case of multiple small tumors, the same procedure is repeated to remove them individually (Fig.15.24).

*Note : Normally these tumors do not recur after excision; however, it is always advisable to send the tumor masses for histopathological examination for further breeding planning.*

**Postoperative Care:**

The surgery site is daily cleaned and smeared with antibiotic ointment or dressed with antibiotic spray.



**Figure 15.22** Small vaginal tumors involving 360° of the vestibulo-vaginal junction.



**Figure 15.23** Ligation of the tumor mass at its base with chromic catgut USP 1.



**Figure 15.24** The site after surgical excision of all the tumor masses.

**Possible Complications:**

The only possible complication that may be encountered in the long run is the recurrence of the tumors.

**7. Preputial Tumors**

These tumors usually occur on the lateral aspect of the prepuce and sometimes become quite big and affect normal locomotion of the animal. These tumors, when big may also interfere with the mating process, as the preputial opening may be pushed to one side due to the tumor mass. Their surgical removal definitely helps the animal towards normalcy.

**Control and Anesthesia:**

The animal is sedated and high epidural anesthesia is induced to desensitize the operative area and to control movements of the hind limbs during surgical manipulations. The animal is then controlled in the desired lateral recumbency.

**Operative Steps:**

1. The upper hind limb is pulled backward and upward and preferably tied with a fixed poll to have an easy access to the lesion.
2. The area is thoroughly washed and clean dried.
3. The surgery plan will differ according to the size and position of the lesion. An en-block surgical excision may be planned for small tumors, as the skin in this region is quite loose and therefore, the subcutaneous tissues and the wound margins can be closed without undue tension on the suture line. For bigger lesions, an elliptical incision is given in the center of the lesion and the skin margins are undermined for its proper exposure. During this maneuver, care should be exercised not to damage the lamina interna and the preputial cavity.
4. The bleeding points are ligated with catgut USP 0.
5. The operation field is thoroughly washed and cleaned with sterile normal saline solution and any loose tissues are excised.
6. The subcutaneous tissue is sutured with catgut or polyglycolic acid USP 2 suture material to fully obliterate the dead space, otherwise great chances of seroma formation would exist.

7. The skin incision is closed with simple interrupted or horizontal mattress sutures using nylon USP 2 suture material.

**Postoperative Care:**

1. The suture line is daily cleaned and dressed with antibiotic spray till the sutures are removed.
2. Parenteral cover of antibiotics is recommended.
3. In case of infection of the suture line or seroma formation, 3 to 4 or as required, sutures at the most dependent part should be removed for proper drainage and dressing and the wound is allowed to heal through secondary intention.

**Possible Complications:**

The most probable postoperative complication is infection of the wound or seroma formation and the case should be handled accordingly.

**8. Tumors of the Parotid / Mandibular Region**

Apart from abscesses in the parotid region and inflammation and infection of the mandibular lymph node, tumors may also occur in this region. Normally the tumor starts in the subcutaneous tissue and then involves the overlying skin (Fig.15.25). In case of benign lesions, surgical excision of the mass with subsequent chemical debridement as required and proper dressing of the wound offers good prognosis.

**Control and Anesthesia:**

The animal is sedated and controlled in the desired lateral recumbency.

**Operative Steps:**

1. The operative area is thoroughly washed and cleaned and the hair in the surrounding vicinity are closely clipped or even shaved.
2. In case the skin is still intact, an incision is given in the center of the swelling and the skin flaps are undermined on their respective sides to expose the lesion. If the overlying skin is already involved, the tumor mass is separated from the surrounding tissue through blunt dissection using blunt pointed scissors or fingers. As much tumor mass as possible; without damaging the





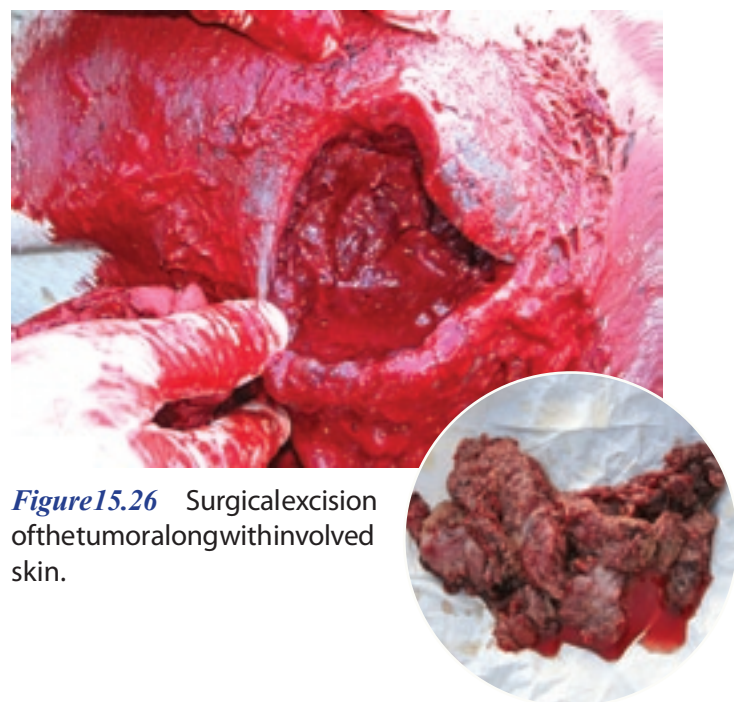
**Figure 15.25** Abnormal growth at the angle of the left mandible.



**Figure 15.27** The cavity plugged with gauze impregnated with Tincture Benzoin Co. Temporary skin sutures used to keep the plug in place. There was no enough skin for proper apposition.

important structures in the operative area, is surgically excised (Fig.15.26).

3. As this is a very vascular area with the tributaries of the external jugular vein lying just under the tumor mass, great care should be exercised to save these blood vessels.
4. The area is washed with sterile normal saline solution, the bleeding points if possible, are clamped with mosquito hemostats and ligated with catgut USP 1; otherwise, the cavity is plugged with a styptic drug with retention sutures on the skin edges (Fig.15.27).



**Figure 15.26** Surgical excision of the tumor along with involved skin.

#### Postoperative Care:

These wounds normally do not heal by first intention; therefore, they are allowed to heal through secondary intention with proper postoperative dressing and care (Fig.15.28). Chemical debridement, whenever thought necessary should be carried out.

#### Possible Complications:

1. The probable intraoperative complication is accidental damage to the main blood vessels in the operative field, which can be avoided by careful dissection.
2. Recurrence of the lesion, in case it was a malignant tumor and was not removed in totality.



**Figure 15.28** Healing of the wound in progress.

#### Suggested Readings:

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# Case Reports

## CHAPTER 16

In this section, some interesting cases that are not encountered in routine practice and a few fracture cases that were successfully handled with internal methods of fracture fixation are presented in the format of Case Reports. The only reason for presenting fracture cases is that these methods should be tried where ever possible, as

in otherwise hopeless cases; these techniques may give a chance to the practitioner to gain everything and loose nothing. For the sake of harmony with the format the book is written in, the cases have been described under the same headings with minor modifications.

### 1. A case of a massive maxillary osteoma in an old female camel.

Tumors in the camels can occur anywhere on the body surface or in the body cavities involving different organs. Squamous cell carcinoma has been reported frequently occurring on the flank, caudal to the chest pad, side of the hock, the hard palate, nasal cavity and dorsal part of the nail of the foot. This tumor has also been reported in the interdigital space of the camel. Fibroma, fibromyxoma, papilloma and melanoma although uncommon, have been reported.

#### Case History:

The case under report was an old female camel presented with a very big stone hard swelling on the right maxilla that also involved the orbit (Fig.16.1). The animal did not have any problem with eating, drinking or mastication but the owner wanted to get it operated due to ugly looking nature of the lesion.

#### Control and Anesthesia:

The animal was deeply sedated and controlled in the left lateral recumbency.

#### Operative Steps:

1. An elliptical skin incision was given in the center of the mass with the ends of the incision joining at the cranial and caudal ends of the lesion.

2. The skin flaps of either side were undermined to fully expose the mass (Fig.16.2).
3. The mass was so adherent to the maxilla that an embryotomy wire was first used to partially detach it from the main bone and then a long chisel was used as a lever for its complete separation (Fig.16.3).
4. The eye which was non-functional and damaged was also enucleated.
5. The wound was thoroughly cleaned with pyodine solution and the skin edges were closed with Supramid USP 2 suture material in horizontal mattress pattern (Fig.16.4).
6. The eye wound was left open to granulate.

#### Postoperative Care:

1. Parenteral cover of antibiotics was given for a period of two weeks.
2. The skin sutures exhibited signs of infection after 6 days; so the sutures in the ventral half of the incision were removed for provision of drainage and proper dressing of the wound.
3. The skin edges in the dorsal half of the wound healed and the sutures were removed after 15 days.
4. Regular dressing of the ventral half of the wound and the orbital cavity ultimately resulted in complete healing in about two months (Fig.16.5).



**Figure 16.1** A hard growth on the right maxilla involving the orbit as well.



**Figure 16.2** Exposure of the mass up to its attachment with the maxilla. Note the chisel being used to dislodge the mass from the bone.



**Figure 16.3** Tumor mass after removal.



**Figure 16.4** Suturing of the skin margins. Note the site after removal of the eyeball.

The histopathological examination of the mass revealed it to be an osteoma.

#### Comments:

Maxillary osteoma does not seem to be a very frequently occurring lesion. We have seen only one case of this nature in our camel practice spread over 10 years. The experience has shown that the tumor can be surgically removed with the possibility to restore the normal shape of the animal's face.



**Figure 16.5** The animal two months postoperation. Note complete healing of the wound.



## 2. En-block surgical excision of inflamed mandibular lymph node in one year old dromedary female.

### Case history:

A one year old female camel was presented with a swelling just at the level of the right mandibular angle (Fig.16.6). The swelling was not very hard on palpation and was freely movable. Exploratory puncture with a sterile 16 gauge hypodermic needle revealed 2 to 3 drops of blood colored fluid. On the basis of its location, subcutaneous nature, texture and mobility, it was diagnosed to be an inflamed mandibular lymph node and its en-block surgical excision was decided. The animal was shifted to the hospital for the purpose.

### Control and Anesthesia:

The animal was controlled in the left lateral recumbency under deep sedation.

### Operative Steps:

1. The operation site was prepared and draped in a standard fashion.
2. An elliptical skin incision was given in the center of the swelling and the skin flap within the incision was removed to expose the center of the lymph node (Fig.16.7).
3. The skin flaps and the subcutaneous tissue on either side of the node were undermined to visualize the entire lesion.

4. The blood vessels in the operating field were doubly ligated and transected between the ligatures.
5. The node was then enucleated by a 360° careful dissection all around (Fig.16.8).
6. The remaining bleeding points were held by the mosquito forceps and ligated with catgut USP 0.
7. The subcutaneous tissue and the skin were closed in a routine manner (Fig.16.9 a, b & c).

### Postoperative Care:

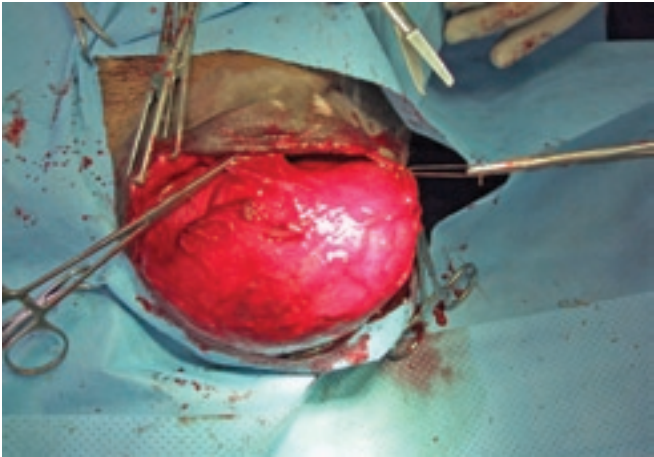
1. The suture line was daily cleaned and dressed with antibiotic spray.
2. Cover of parenteral antibiotics was given for 7 days.
3. The skin sutures were removed after two weeks.

### Comments:

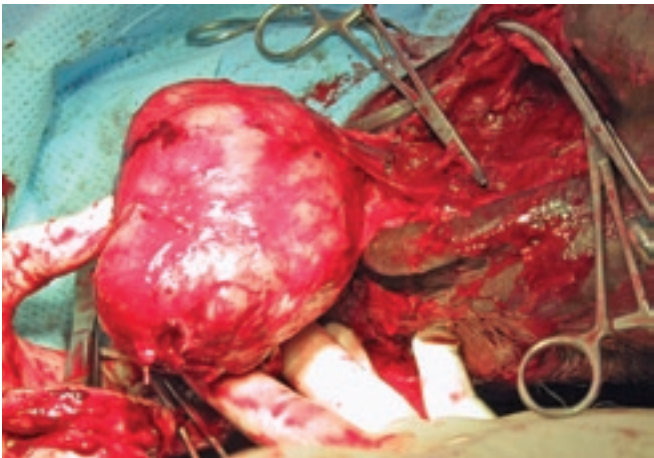
The wound healed by first intention, which demonstrates that the complications of wound healing can be avoided if the surgical procedure is aseptic or at least clean and proper care is observed for hemostasis and obliteration of dead space during surgery.



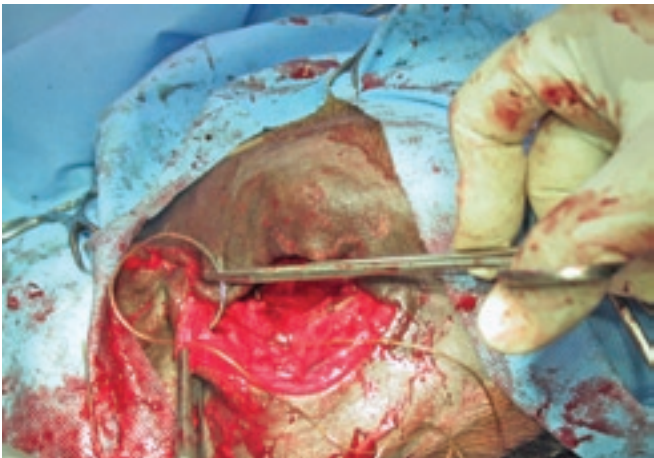
**Figure 16.6** Inflamed mandibular lymph node.



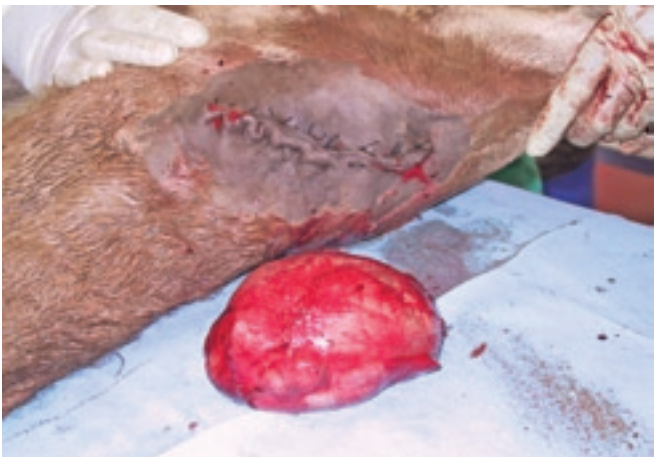
**Figure 16.7** Exposure of the inflamed lymph node through an elliptical skin incision.



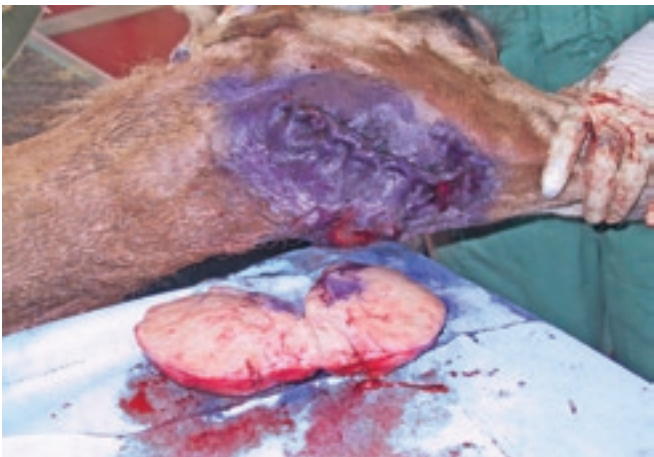
**Figure 16.8** Enucleation of the intact lymph node with 360° dissection around the lesion.



**Figure 16.9a** Closure of the subcutaneous tissue with chromic catgut USP 2.



**Figure 16.9b** Skin wound closure with interrupted horizontal mattress sutures.



**Figure 16.9c** Cut surface of the inflamed lymph node.



### 3. A case of circumferential fibrous swelling of the distal half of right metatarsus in an adult male dromedary camel

**Case History:**

An 8 year old male dromedary camel suffering from 360 degrees swelling of the right distal half of metatarsal area was presented for treatment. The swelling was quite firm and hard but not painful on palpation and was indicative of a fibrous mass (Fig.16.10). The foot was also slightly swollen but the animal was not lame due to these lesions. The cases of elephantiasis have been reported in the literature; however, this swelling had no similarity or resemblance with the former. It was planned to perform 360 degrees surgical excision of the lesion to provide relief to the animal.

**Control and Anesthesia:**

The animal was slightly sedated, supplemented with high epidural anesthesia and was controlled in the left lateral recumbency.

**Operative Steps:**

1. The area was thoroughly washed with Pyodine scrub and clean dried (Fig. 16.11).
2. The fibrous mass was excised with multiple longitudinal elliptical incisions all around (Fig. 16.12 & 16.13).
3. The bleeding points were clamped with mosquito hemostats and ligated with chromic catgut USP 0 where ever necessary (Fig. 16.14).
4. The operated site was washed with normal saline solution (Fig. 16.15), covered with a pad of Tincture Benzoin Co. and bandaged from foot up to the hock joint.

**Postoperative Care:**

First bandage was removed after one week and subsequent dressings and bandaging were carried out twice weekly till complete healing took place.

**Results and Comments:**

This wound was quite big and devoid of skin, but healed very smoothly without any complications such as exuberant granulation or overwhelming infection (Fig. 16.16 a&b). A small amount of pus was however, always noticed each time the bandage was changed which is quite normal in such

a wound. The wound took two and a half months to completely heal. Slight swelling of the foot persisted even after healing, but it did not affect the gait of the animal. In our opinion; such lesions, even if not greatly affecting the usefulness of the animal, should be surgically excised to give a better look and to improve the efficiency of the animal.



**Figure 16.10** A hard, non-painful fibrous swelling involving distal half of right metatarsus.



**Figure 16.11** Scrubbing and cleaning of the surgical site. A tourniquet was applied proximal to the lesion to arrest bleeding.



**Figure 16.12** Longitudinal incision through the lesion.



**Figure 16.13** A longitudinal wedge of the fibrous mass removed for ease in further dissection.



**Figure 16.14** Clamping and ligation of blood vessels.



**Figure 16.15** Complete excision of the lesion all around.



**Figure 16.16a** Healing in progress. Note the smooth appearance of the wound.



**Figure 16.16b** Healing in the last stages. Note the raw surface being covered by the skin.



#### 4. A case of pedunculated growth on the ventral aspect of tail in a male dromedary camel.

Tumors of the tail are among the indications for tail amputation. However, solitary lesions of this nature can be removed in isolation to preserve the beauty of the animal. A rare growth on the ventral aspect of the tail in a male breeding camel is being reported that was surgically excised to maintain integrity of the organ (Fig. 16.17).

**Control and Anesthesia:**

The animal was controlled in the sternal recumbency and low epidural anesthesia was induced to desensitize the tail.

**Operative Steps:**

1. The hairs from the operation site were closely clipped and the area was properly scrubbed and prepared for surgery.
2. The base of the mass was transfixed with Supramid USP 2 suture material (Fig. 16.18) and the mass was transected distal to ligature (Fig. 16.19).

The ligature however, slipped just after the mass was cut and hence, the skin edges were apposed with two horizontal mattress sutures (Fig. 16.20) and the operation site was protected with a bandage.

**Results and Comments:**

The suture line got infected despite regular cleaning and dressing and the wound healed through secondary intention (Fig. 16.21). The operation was done in the rutting season and as the breeding males especially move their tails more vigorously in a cranio-caudal direction in this season, the chances of trauma and contamination of the surgery site become many fold. The suture line being on the ventral aspect of the tail; had a continuous exposure to urine and the fecal material and this was thought to be the most probable cause of this complication. Such surgical procedures may give better results if performed in the non-breeding season.



**Figure 16.17** A pedunculated growth on the ventral aspect of the tail.



**Figure 16.18** Transfixation of the base of the growth with supramid USP 2.



**Figure 16.19** The growth mass after excision distal to the ligature.



**Figure 16.20** Closure of the skin defect with two interrupted horizontal mattress sutures.



**Figure 16.21** Healing of wound through secondary intention.



### 5. A case of lipoma on the ventral commissure of vulva in an adult dromedary camel.

Tumors involving the perineal and the vulval region of the camels are not common, but their occurrence can even not be ruled out. A lipomatous swelling was recorded involving the ventral commissure of the vulva in an adult camel that, according to the owner; was interfering with mating and thus the animal was not becoming pregnant (Fig. 16.22). It was decided to perform surgical excision of the mass with a view to overcome the problem and also to give a cosmetic look to the region.

**Control and Anesthesia:**

The animal was controlled in the sternal position and the operative field was desensitized with epidural anesthesia.

**Operative Steps:**

1. The tail was wrapped in a bandage and firmly held up by an assistant.
2. The operative field was thoroughly scrubbed and rendered surgically clean (Fig.16.23).
3. An elliptical incision was given around the mass taking care to save the lips of the vulva and to preserve its anatomical shape as far as possible. The blood vessels in the operative field were doubly ligated and transected in the middle (Fig.16.24).

4. The skin on the sides was undermined to fully expose the lesion and the mass was extirpated in total (Fig. 16.25 a,b&c).
5. The site was washed with sterile normal saline solution and the subcutaneous tissue was apposed with continuous catgut sutures to fully obliterate the dead space.
6. The redundant skin was excised and the skin edges were closed with interrupted horizontal mattress sutures using Supramid USP 2 on a reverse cutting needle (Fig. 16.26).

**Results and Comments:**

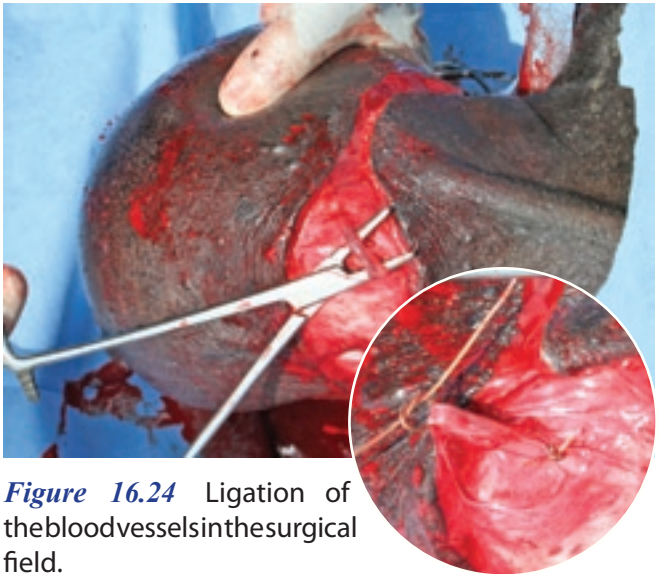
The wound healed through first intention in spite of the fact that contamination and infection of the site was a potential threat due to sand, urine and fecal material. This was made possible through meticulous postoperative care of the operation site and parenteral cover of antibiotics. The animal also became pregnant in the breeding season following surgery. The results indicate that such lesion can be successfully removed with careful surgical manipulations and the animals can be returned to breeding soundness.



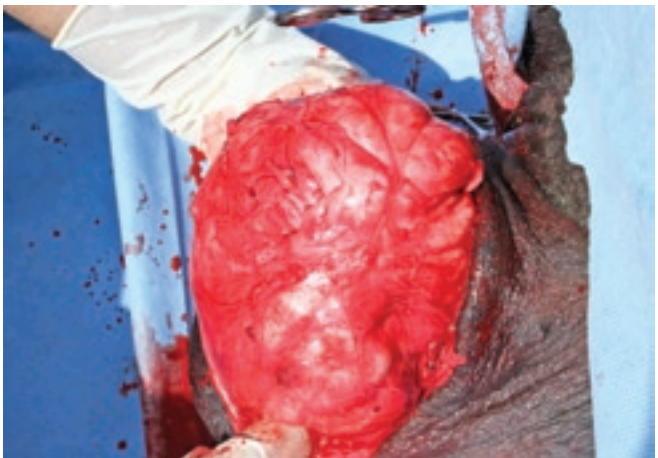
**Figure 16.22** A lipoma on the ventral commissure of vulva pulling the skin ventrally. It acted as a hindrance during copulation by the male.



**Figure 16.23** Preparation and draping of the surgical site.



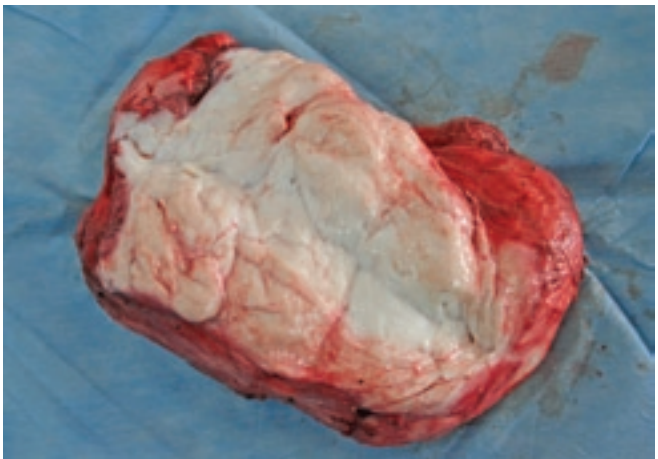
**Figure 16.24** Ligation of the blood vessels in the surgical field.



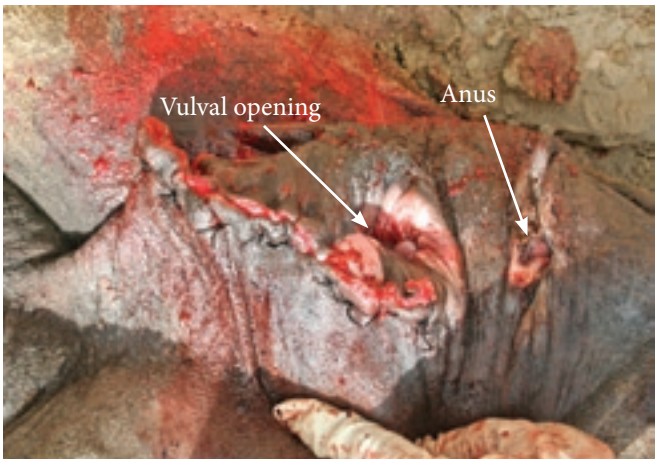
**Figure 16.25a** Fully undermined and exposed lipoma.



**Figure 16.25b** The mass after excision. Note the size of the mass.



**Figure 16.25c** Cut surface of the mass. Fatty tissues is clearly visible.



**Figure 16.26** Closure of skin wound with Supramid USP 2. See the vulval opening on the side of the suture line.



## 6. Testicular degeneration as a result of pressure by a large scrotal abscess in a dromedary camel.

### Case History:

Superficial or deep bite injuries in the scrotal area, especially in the rutting season are not infrequent happenings in the breeding camels. An aged, black breeding camel was presented for treatment with an old, large and pendulous swelling of the left scrotal sac (Fig.16.27). According to the owner, the condition was two years old and had been occasionally treated with parenteral antibiotics during this period with no positive results. The clinical examination of the patient revealed a hard, fibrous mass in the scrotal sac with a small, non-penetrating wound in the scrotal skin. The testis was not palpable, as it was completely surrounded by the fibrous swelling. The right testis had a normal texture and contour. The animal had a normal libido; but probably, due to enlarged and much pendulous left scrotal sac, was unable to mate. As it was a very valuable breeding animal, it was decided to perform left sided orchidectomy to preserve his breeding potential.

### Control and Anesthesia:

The animal was deeply sedated with intravenous administration of 2% Xylazine hydrochloride and 10% Ketamine hydrochloride at the recommended dose rate of 0.4mg / Kg of body weight of each. Both the drugs were mixed in the same syringe. The animal was then controlled in the left lateral recumbency with the upper hind limb pulled forward and securely tied with the upper fore limb.

### Operative Steps:

1. The scrotal area was thoroughly washed with Pyodine scrub and clean dried.
2. A large cranio-caudal skin incision was given on the left scrotal sac (Fig. 16.28). A very thick layer of fibrous tissue was encountered under the skin incision which was dissected away to locate the testis.
3. On one side and above the fibrous mass, a small sized testicle encapsulated by a layer of fibrous tissue was palpated, being not palpable in the intact scrotum due to its complete coverage by the hard fibrous tissue.
4. The fibrous layer was incised to expose the testis and the spermatic cord (Fig.16.29 a&b).

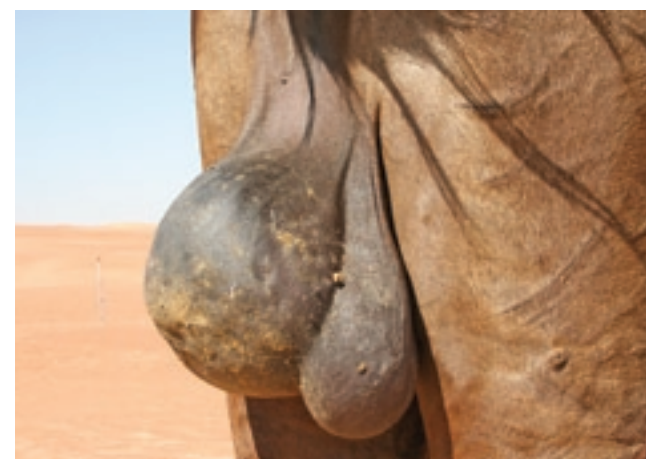
5. The vascular and non-vascular parts of the spermatic cord were separated, ligated with chromic catgut USP 2 and severed below the ligature.
6. The fibrous mass was then separated from the scrotal skin all around and completely enucleated. During this entire maneuver, great care was exercised not to damage the scrotal septum.
7. The cut section of the fibrous mass revealed a large amount of thick, flaky pus, whereas the longitudinal cut section of the testis was of black color representing degeneration of the organ (Fig.16.30).
8. The scrotal cavity was thoroughly washed with normal saline solution, plugged with Tincture of Iodine and temporary retention sutures were applied on the wound edges to keep the plug from falling out.

### Postoperative Care:

1. The animal was put on parenteral antibiotics for one week.
2. The plug was removed on day 4 postoperation, the cavity was properly washed with standard solution of Potassium permanganate and painted with Tincture of Iodine.
3. The wound dressing was carried out twice a week with appropriate drugs according to the condition of the wound till complete healing that took place in 35 days.

### Results and Comments:

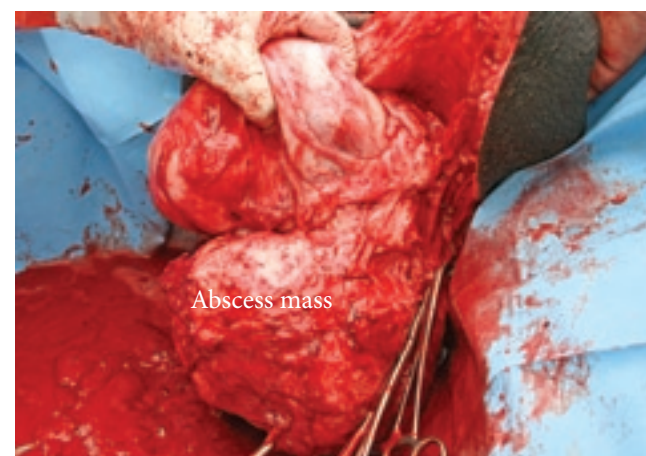
The wound healed through secondary intention without any other complications (Fig. 16.31). The right testis remained normal and was not affected what so ever, by left orchidectomy. The health of the animal also improved and he became more active than before. As the operation was done in the rutting season, the animal started covering the females about two months after surgery. In our opinion, orchidectomy of only the affected side should always be preferred in valuable pedigreed animals to preserve their breeding potential. However, it should be carried out as soon as possible after injury to one side to avoid possible temperature or pressure dependent degeneration of the other testis.



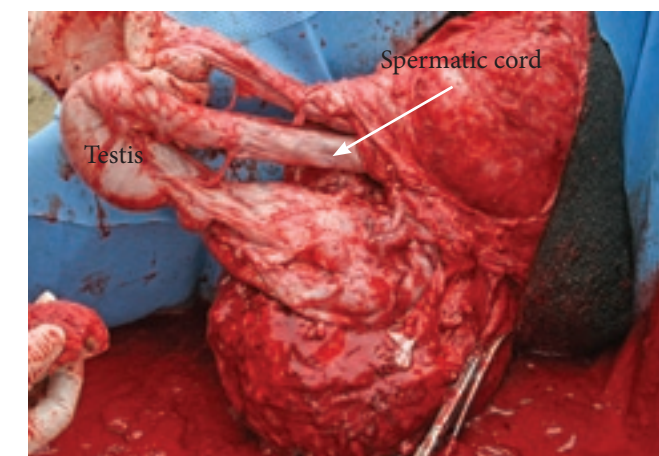
**Figure 16.27** Animal with enlarged left scrotum. Note that the size is almost 4 times the normal right testis.



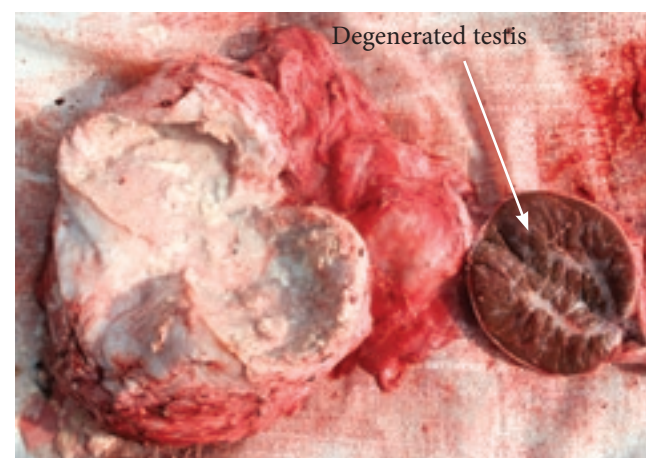
**Figure 16.28** Cranio-caudal incision on the left scrotal sac.



**Figure 16.29a** Isolation of the spermatic cord through incision in the fibrous layer covering the testis.



**Figure 16.29b** Complete separation of the testis and the spermatic cord. Note the amount of fibrous tissue encapsulating the testis.



**Figure 16.30** Flaky pus in the fibrous mass. See the black colored cut surface of the testis representing its degeneration.



**Figure 16.31** The healed wound after left orchidectomy. See the wrinkles on the right scrotum due to healing process.



## 7. A case of multiple dermoid cysts around carpal joint in an adult male dromedary camel.

Dermoid cysts have been reported in the camel and commonly occur in the jugular groove and on the skin of the ear. The cysts vary in size and are usually congenital in origin. They manifest as soft, fluctuating, clearly defined and freely movable swellings. Paracentesis of the swelling reveals a coffee colored fluid. The cyst wall is usually pigmented and has coarse, large hairs on the surface. The case under report represents an unusual site for the dermoid cysts around left carpal joint (Fig.16.32). The animal had no problem with walking and was also not lame, but the lesions represented a blemished knee. It was therefore, decided to operate for these cysts.

### Control and Anesthesia:

The animal was deeply sedated and controlled in the right lateral recumbency.

### Operative Steps:

1. The operation site was thoroughly scrubbed with Pyodine and clean dried.
2. An en-block enucleation of each cyst was tried; but some of the cysts ruptured during the procedure. Thick, black colored discharge was noticed from each cyst cavity (Fig. 16.33) with hair growth on the cyst lining (Fig. 16.34) The cyst

wall however, was removed in each instance (Fig. 16.35).

3. The site was washed and cleaned with sterile normal saline solution, the redundant skin was removed and the skin margins closed with Supramid USP 2 suture material.
4. The carpal area was covered with a bandage applied in a figure of "8" fashion.

### Results and Comments:

The wounds healed through secondary intention. Although some thickening around the joint was noticed that persisted permanently, yet it did not affect the usefulness of the animal. The cyst surgery should always be aimed at en-block excision of the lesion. If the cyst wall ruptures during surgical manipulations, it must be removed; otherwise, the expected results will not be achieved. Although these dermoid cysts were located at an unusual site; these can be operated upon successfully if the basic goals of cyst surgery are adhered to. The other most important point to be kept in mind in such cases is to avoid any damage to the joint capsule, as the negative prognosis of this complication may outweigh the success of surgery.



**Figure 16.32** Multiple dermoid cysts around left knee joint. Note a cyst is also present in the metacarpal area.



**Figure 16.33** Thick black colored discharge from the cyst cavity. The cyst wall is visible above the discharge.



**Figure 16.34** Hair growth on the cyst wall that confirms it a dermoid cyst.



**Figure 16.35** Cyst wall being removed; the most important step of cyst surgery.



## 8. Udder gangrene in a dromedary camel

Udder gangrene may be a sequel to untreated mastitis. Mastitis in the camel may affect the whole or any quarter of the udder. The infection usually takes place through the teat canal.

### Case history:

About 15 year old, black camel suffering from gangrene of the right udder was presented for treatment. History also revealed that the owner had tightly ligated the affected right udder at the base with a rubber band to get sloughing of the inflamed udder which resulted in diminished blood flow to the udder tissue. The affected udder was somewhat dry and badly infected with a very foul smell (Fig.16.36 a&b). The only choice was surgical removal of the diseased udder.

### Control and Anesthesia:

The animal was sedated and controlled in the left lateral recumbency with the upper hind leg pulled forward. Epidural anesthesia was also induced to minimize the movements of the hind limbs.

### Operative Steps:

1. The gangrenous portion was separated from the healthy tissue with the help of sharp scissors and the scalpel blade (Fig.16.37).

2. The pudendal vessels; although not very active, still had some blood flowing through them. These were therefore, ligated before severance.
3. The remaining dead tissues were removed with scissors till the affected udder became relatively free of them (Fig.16.38).
4. The wounded area thus left was vigorously rubbed with saturated solution of Magnesium sulfate.

### Postoperative Care:

1. The animal was put on parenteral antibiotics for a period of 10 days to avoid chances of spread of infection to the other half of the udder.
2. The wound was cleaned and dressed three times a week till complete healing took place.

### Comments:

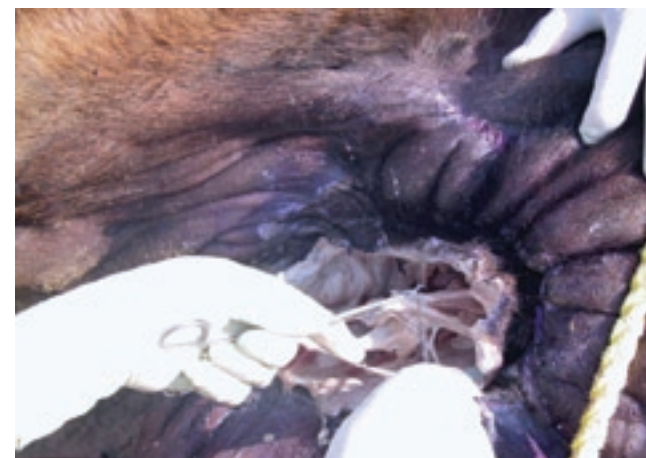
Untreated cases of acute / peracute mastitis or udder edema in the camel have been noticed to progress towards gangrene or chronic mastitis with fibrosis of the affected udder. In either situation, the only choice that remains is surgical removal of the diseased tissue. The prompt and aggressive treatment of mastitis as soon as it is detected should therefore, be instituted to avoid losing udder in the valuable dairy animals.



**Figure 16.36a** Gangrenous right udder. Note the rubber band at the base of the affected udder (arrow).



**Figure 16.36b** Note the dry, gangrenous tissues.



**Figure 16.37** Surgical excision of all the compromised and dead tissues.



**Figure 16.38** The affected site after complete debridement.



## 9. Prolapse of jejunum through ruptured vaginal wall in the pregnant dromedary camel

### Case History:

A full term pregnant camel near parturition was reported to be suffering from straining and prolapse of small intestine through the vulval orifice. The animal was in the desert and it was not possible to shift her to the hospital. The clinical examination revealed prolapse of a loop of jejunum through a tear in the left lateral wall of the vagina. A careful per vaginal examination of the animal was indicative of uterine torsion. Due to pregnancy and constant straining by the animal, it was not possible to reduce the prolapsed intestine and repair the defect in the vaginal wall. It was therefore, decided to first perform cesarean section and then reduce the prolapsed jejunum and repair the vaginal wall.

### Control and Anesthesia:

The animal was sedated, controlled in the sternal recumbency and an intravenous line was set up for fluid administration and other necessary medication. High epidural anesthesia was also induced to control straining by the animal.

### Operative Steps:

1. The prolapsed jejunal loop was thoroughly washed and cleaned off the sticking sand particles. It was then wrapped in a large sterile drape to save it from further trauma and soiling.
2. Cesarean section was performed through the standard left flank approach and a full term dead female fetus was removed.
3. The prolapsed jejunal loop was then reduced carefully. It was now not that difficult, as removal of the fetus provided the reasonable space in the abdominal cavity for its easy replacement.
4. The defect in the vaginal wall was repaired with simple interrupted sutures using Polyglycolic acid USP 2 suture material.
5. Vulval lips were sutured with two horizontal mattress sutures using umbilical tape as a precautionary measure to guard against prolapse of uterus, which sometimes happens in this animal.
6. Adequate topical and parenteral cover of antibiotics was given.

### Postoperative Care:

Parenteral antibiotic cover was given for two weeks with regular dressing of the suture line. Fluid therapy was given for the first three days. The vulval sutures were removed after 4 days. One week postoperation, the laparotomy suture line showed signs of edematous swelling and infection. The ventral most sutures were removed to provide drainage. Regular cleaning and dressing of the wound resulted in complete healing.

### Comments:

This was quite a complicated case, but the animal survived to this catastrophic accident. This indicates that this animal is still hard and quite resistant to the adverse conditions and with better surgical skills and proper care, the results can be quite encouraging.

**Another case** of the same type but more complicated had prolapse of the jejunum and the gravid uterus through the ruptured left lateral vaginal wall (Fig.16.39). The animal was lying prostrate and was in agony when attended. The animal died just after two minutes. The prolapsed gravid uterus was incised immediately after death of the camel to remove the fetus with the idea that it may still be alive. But the fetus was also dead (Fig.16.40).

**The third case** almost of the same category (Fig. 16.41) but less complicated, had prolapse of vagina and the non gravid horn through the cervix with partial expulsion of the placenta (Fig. 16.42). The prolapsed uterine horn and the vagina were carefully reduced (Fig. 16.43) and the live fetus which was in the normal anterior presentation, was delivered (Fig. 16.44).

These three cases under report indicate that at the time of parturition, close observation and timely veterinary aid to the animal can give positive results. Severe straining by the unattended animal may lead to a catastrophe with grave consequences. It is therefore, imperative or at least desirable that the pregnant animal near parturition should be closely watched so that if needed, the veterinary assistance could be sought for in time which may prove helpful to save the lives of both the mother and the baby or at least of one of them.



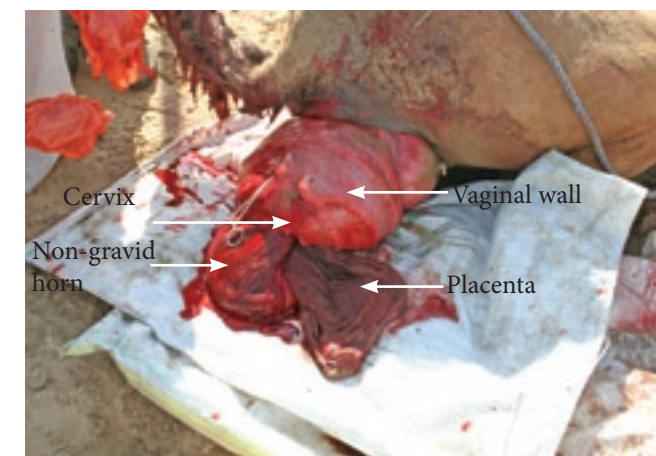
**Figure 16.39** Prolapse of the gravid uterus and jejunal loop through ruptured vaginal wall.



**Figure 16.40** A dead fetus in the prolapsed uterus.



**Figure 16.41** Prolapse of non-gravid uterine horn.



**Figure 16.42** Notice the vaginal wall, non-gravid uterine horn, placenta and cervix.



**Figure 16.43** Reduction of vagina and the non-gravid uterine horn. Note one of the forelimbs of the fetus being taken out.



**Figure 16.44** A live fetus delivered manually.



## 10. A Case of dystocia in a dromedary camel due to hydrocephalic fetus

Hydrocephalus is characterized by an abnormal accumulation of cerebrospinal fluid (CSF) in the cranial cavity (Fig. 16.45 a&b). Congenital hydrocephaly is frequently associated with malformation of the cranium. The degree of malformation may vary from slight doming to an enormous enlargement sufficient to cause dystocia.

### Case history:

A 14 year old female camel suffering from dystocia was brought to the Central Veterinary Hospital, Al-Wathba, Abu Dhabi, UAE for necessary treatment. This was her third parturition and the first two were normal deliveries. Per vaginal examination revealed a big head which could not be manually managed and brought to the birth canal for delivery. It was therefore, decided not to waste time and to perform cesarean section to save the life of the dam, as unfruitful attempts for manual delivery for a longer time in such cases lead to exertion of the animal, probable lacerations of the birth canal and unfavorable postoperative prognosis.

### Control and Anesthesia:

The animal was sedated and controlled in the sternal recumbency slightly tilted towards the right side and the left flank area was prepared for surgery. The operative field was also desensitized with an inverted "L" block.

### Operative Steps:

The animal was put on intravenous fluid therapy and a standard cesarean section was performed (*see chapter 11*) to deliver a hydrocephalic fetus (Fig.16.46 a&b).

**Postoperative Care** comprised parenteral cover of broad spectrum antibiotics for a period of 10 days with fluid therapy as and when needed.

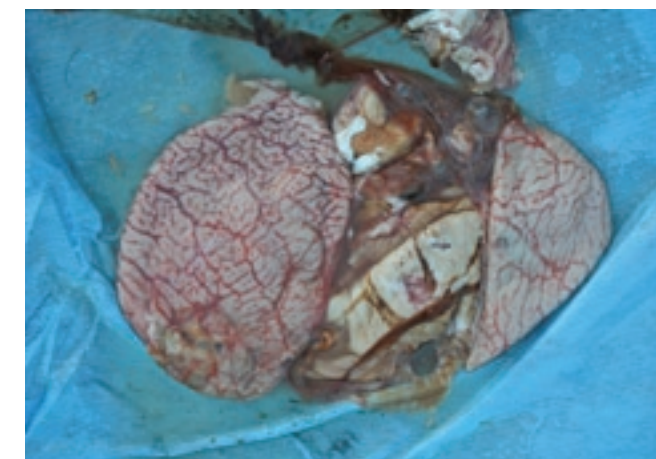
### Results and Comments:

The animal recovered very well from surgery; however, slight infection of the skin and subcutaneous suture line occurred. The offending sutures were removed and the wound healed through secondary intention. Two years after surgery, the animal was reported to have given normal birth to a normal and healthy female calf.

In such cases, it is always better and advisable to perform cesarean section than to waste time and unnecessarily exert the animal in a try to affect manual delivery. Cesarean operation on an exhausted and compromised animal carries poor prognosis. A quick and timely decision in this regard is mandatory for well being of the patient.



**Figure 16.45a** Hydrocephalus; see the accumulation of CSF in the cranial cavity.



**Figure 16.45b** Damaged brain tissue due to increased accumulation of CSF in the cranium.



**Figure 16.46a** Hydrocephalic fetus.



**Figure 16.46b** Note enormous enlargement of the cranium.



## 11. Injury to the foot of a female dromedary camel by a stray bullet

### Case History:

An adult female camel (about 9 year old) was presented with a wound on the medial aspect of the right fore foot. The history revealed that the attendant of the animal noticed a bullet coming from a nearby army training camp that hit the foot of the animal. Clinical examination revealed a wound on the medial aspect of the foot with crepitation at the level of the medial first phalanx. There was no other wound anywhere in the region of the foot. Radiographic examination revealed a bullet in the interdigital space with a comminuted fracture of the medial first phalanx (Fig.16.47 a&b). It was concluded that the bullet entered the foot from the medial aspect, fractured the first phalanx and stopped in the interdigital space without exiting. As the wound was profusely bleeding, the foot was cleaned, dressed and tightly bandaged without any surgical manipulation for removal of the bullet. The bandage was removed after four days and the bullet and the fractured pieces of the bone were removed.

### Control and Anesthesia:

The animal was sedated and secured in the right lateral recumbency. In addition, intravenous limb anesthesia was also used to fully desensitize the area.

### Operative Steps:

1. The existing wound on the medial aspect of the foot was enlarged to expose the fractured bone.
2. All the fractured pieces of the first phalanx were removed and a search was done for the bullet.

3. The bullet could be palpated embedded in the soft tissue, but was not visible.
4. A small, guarded incision was given in the soft tissue over the bullet and the latter was grasped with an Alli's forceps under digital guidance and removed (Fig. 16.48).
5. An X-ray picture was taken to be sure that no fractured piece of the bone was left inside.
6. The wound was not sutured, as it was contaminated. It was simply packed with sulphonamide powder and the foot was bandaged.

### Postoperative Care:

The wound was dressed twice a week with bandaging of the foot till complete healing of the wound took place. Parenteral cover of antibiotics was given for the initial 10 days.

### Comments:

The bullet wounds are normally considered sterile and the general consensus is that the bullet may not be removed if it is not causing any problem. In this case however, this principle could not be applied, because there was a comminuted fracture of the first phalanx with contamination of the wound with sand and grass particles. Therefore, the surgical manipulation became necessary for removal of the bullet and the fractured pieces of the bone. There was a complete healing of the wound in about two months and the animal had no problem with locomotion.



**Figure 16.47a** Antero-posterior view of the foot showing comminuted fracture of the first phalanx with bullet in the interdigital space.



**Figure 16.47b** Lateral view showing the bullet a little caudal to the distal extremities of the first phalanges.



**Figure 16.48** The bullet that hit the foot and resulted in fracture of the right medial first phalanx.



## 12. Plating of metacarpal fracture in a 6 month old female camel calf

Metacarpal or metatarsal fractures are common in the camel and are generally compound in nature due to no muscle mass in this region. Simple fractures of these bones can be effectively handled with external methods of fracture fixation, but the compound fractures can be better treated with bone plating if they lend themselves to this technique.

### Case History:

A 6 month old female camel calf suffering from compound fracture of the left metacarpus; already immobilized with a plaster cast by a private practitioner 4 days ago, was brought to the Central Veterinary Hospital, Al-Wathba, UAE for check-up, as the animal had problem with it, was depressed and off-food. The clinical examination revealed wet spots on the plaster bandage with some foul smelling. The lateral and antero-posterior radiographs showed a mid-shaft fracture of the bone with a butterfly fragment (Fig.16.49 a&b). It was decided to immobilize the fracture with a self compression bone plate.

### Control and Anesthesia:

The animal was put under general gas inhalation anesthesia and secured in the left lateral recumbency.

### Operative Steps:

1. The operative field was prepared by shaving the area from above the carpus to below the fetlock joint, giving a thorough surgical scrub and with standard draping of the leg.
2. The bone was exposed to its full length through medial approach from below the carpus to up to the fetlock joint.
3. The fracture site was cleaned of tissue debris and any soft tissues attached to the fracture ends were removed.
4. The detached piece of bone was screwed to the main shaft with a lag screw using interfragmental compression technique.

5. The fracture was then reduced and immobilized with a 12 hole, 4.5mm, narrow webbed self compression bone plate (Fig.16.50).
6. The subcutaneous tissue and the skin were closed routinely.
7. The limb was further supported with a heavy bandage for a period of 10 days.

### Postoperative Care:

1. The animal was put on parenteral antibiotics for two weeks.
2. The skin sutures were removed after two weeks.
3. Periodic radiographs were taken to evaluate the position of the plate and the screws and progress of the callus formation. A bridging callus was noticed after two and a half months.

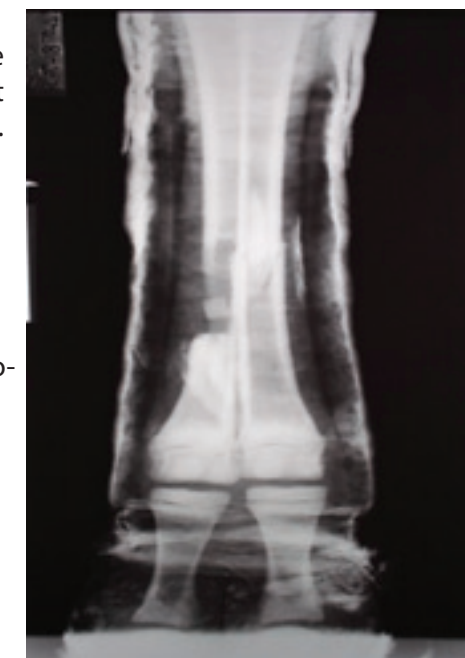
### Results and Comments:

The animal exhibited slight lameness for one week postsurgery and then started normal ambulation. The surgery wound healed without any complications. After a period of three months, slight edematous swelling was noticed with a non-purulent discharge from a point at the level of distal end of the plate. It was not an infection per se; but was a result of metal reaction. The plate was therefore, removed and the wound was thoroughly cleaned and sutured. However, this wound did not heal by first intention and was allowed to granulate.

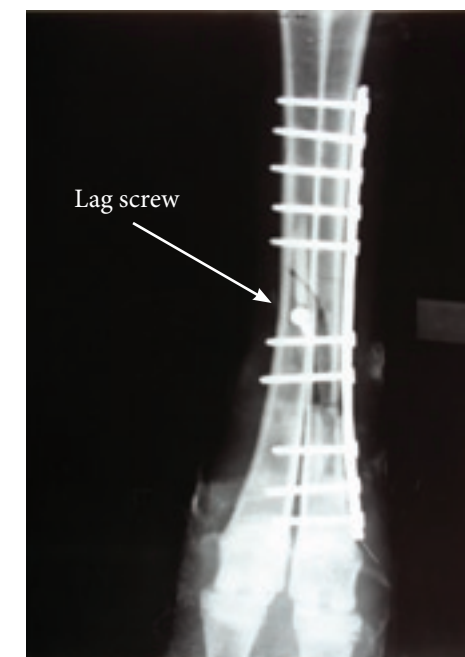
The fixation of this fracture with a bone plate gave quite encouraging results. The same technique was again tried on a mid-shaft metatarsal fracture in an 8 month old male camel calf. This case was also progressing very well, but after about a month the animal fell down very violently while playing with a fellow calf resulting in breaking of the plate and re-fracture of the bone (see figure 12.20). No attempt was made to re-fix the fracture and the calf was sacrificed. It is better to confine such cases to a capacious enclosure and be allowed only restricted activity to avert such unforeseen problems.



**Figure 16.49a (left)** Lateral view of metacarpal fracture. Note butterfly fragment lying to the left and below the fracture site (arrow).



**Figure 16.49b (right)** Antero-posterior view of the fracture shown in Fig. 16.49 a.



**Figure 16.50** Immobilization of the fracture with a 12-hole, 4.5mm, narrow webbed bone plate. First screw from the fracture site in the proximal fragment and third screw in the distal fragment were not used, as their ends would rest in the fracture line leading to possible complication of non-union.



### 13. Treatment of femoral fracture with intramedullary pinning in one month old female camel calf

#### Case History:

A one month old female camel calf suffering from fracture of the left femur was brought to the hospital for repair. The owner had already tried to immobilize the fracture 4 days before with fine strings tightly rolled around the thigh region. As a result, there was a great swelling in the distal part of the limb. The strings were immediately removed and the limb was massaged to dispel the edematous swelling. The animal was then taken for radiographic examination to evaluate the fracture components. It was an almost transverse, overriding fracture of the proximal shaft (Fig.16.51). It was decided to immobilize this fracture with a snugly fitting Steinmann intramedullary pin.

#### Control and Anesthesia:

The animal was put under general gas inhalation anesthesia and secured in the right lateral recumbency.

#### Operative Steps:

1. The operative field was prepared by shaving the area from the gluteal region to below the stifle joint, giving a thorough surgical scrub and with standard draping of the leg.
2. The bone was exposed through the standard lateral approach giving a skin incision from the greater trochanter to the lateral condyle of the femur and through natural separation of the lateral thigh muscles (*see chapter 12*).
3. A 5.0mm diameter Steinmann intramedullary pin, sharp at both ends was introduced into the medullary cavity of the bone in a retrograde fashion and the protruding proximal end of the pin was cut flush with the skin and buried under it (Fig.16.52).
4. As the pin snugly fitted in the medullary cavity and fracture ends also had slight dentitions, the use of cerclage wires to counter act the rotational forces was not considered necessary.
5. The wound closure was done routinely.

#### Postoperative Care:

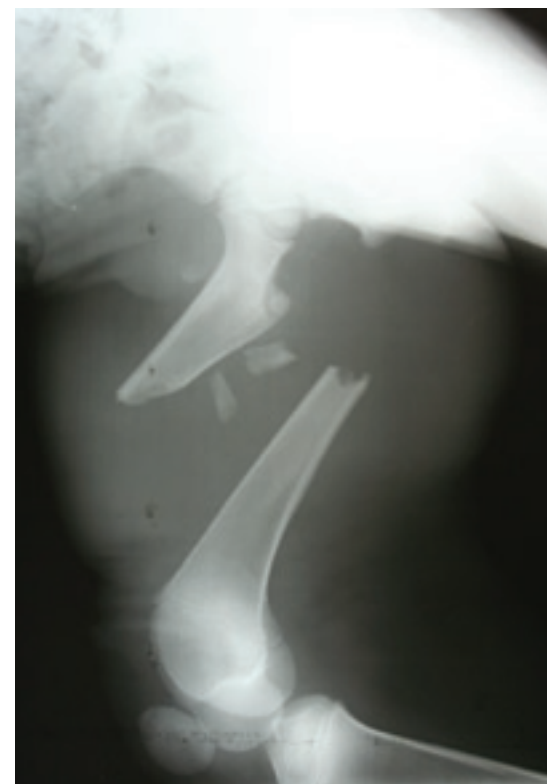
1. The calf was kept in separate enclosure with her mother to avoid any trauma by the other animals.

2. The suture line was kept clean and dressed as required.
3. Parenteral cover of antibiotics was given for two weeks.
4. Follow-up radiographs could not be taken; as three weeks after the operation, the owner sold the calf to another person at a distant place.

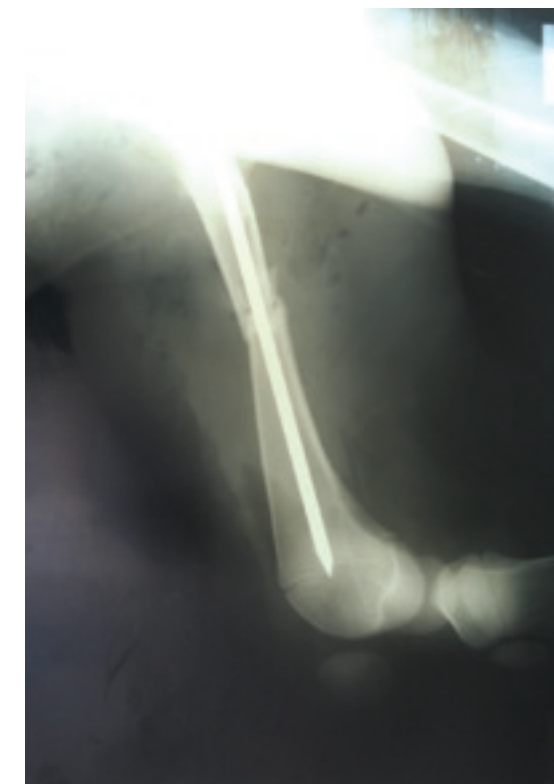
#### Comments:

After about 2 months, the new owner contacted the hospital and complained about a swelling in the left gluteal region just above the level of the greater trochanter of the femur. The owner refused to bring the animal to the hospital from a distant place and insisted us to check the patient on the farm. The clinical examination revealed that the swelling was due to irritation of the skin and the underlying tissues by the proximal end of the pin, which could be palpated. The operated leg seemed to be a little shorter than the corresponding leg, but the animal was ambulating near normal. The radiographic examination of the fracture site could not be done, as the animal was quite far from the hospital but the clinical picture and local palpation was indicative of a good callus formation. The pin was removed through a small skin incision, made at its proximal end. The accumulated fluid and some tissue debris were squeezed out and the site was dressed with Tincture of Iodine. Thereafter, there was no complaint from the owner and the animal was enjoying a good health but had a permanent slight lameness.

Being an almost mid-shaft fracture, it could also have been immobilized with a bone plate and this might have given better results. We chose to fix this fracture with intramedullary pinning, as in our opinion this would give equally good results because the animal was quite young and our decision proved justified. Secondly, it is always advisable not to indulge in more complicated procedures if the same objectives can be achieved with simpler techniques.



**Figure 16.51** An over-riding fracture of the proximal shaft of the left femur (lateral view).



**Figure 16.52** Fracture immobilized with an intramedullary pin. See the distal sharp pointed end of the pin engaged in the distal extremity.



## 14. Treatment of fracture of Radius and Ulna with bone plating in a 6 month old male camel calf

### Case History:

A 6 month old male camel calf suffered from simple fracture of the left radius and ulna as a result of violent falling while playing with his fellows. The clinical examination was evident of all the cardinal signs of a bone fracture. The radiographic examination revealed an oblique, overriding, almost mid-shaft fracture (Fig.16.53). As the radius is a cranio-caudally compressed bone, is not suitable for bone pinning and also does not lend itself for plaster cast because incorporation of the elbow joint in the cast is nearly not possible, it was decided to fix this fracture with a bone plate.

### Control and Anesthesia:

The animal was put under general gas inhalation anesthesia and was secured in the right lateral recumbency.

### Operative Steps:

1. The operative field was prepared and draped in a standard fashion.
2. A cranio-medial approach was used to expose the shaft of the bone. The skin incision was given just medial to the cephalic vein throughout the length of the bone.
3. Taking care not to damage the cephalic vein, the skin and the underlying tissues were undermined to expose the cranial shaft of the bone (*see chapter 12*).
4. The fracture was manually reduced and held with a bone clamp.
5. As the obliquity of the fracture was latero-medial, the fracture fragments were first subjected to interfragmental compression with a lag screw before application of the plate.
6. A 12 hole, 4.5mm self compression bone plate was then applied on the cranial surface of the bone as a neutralizing plate. The plate was

slightly bent according to the convexity of the cranial cortex to eliminate any gaps between the plate and the bone (Fig. 16.54).

7. The operative field was thoroughly flushed with sterile normal saline solution before closure of the wound.
8. The subcutaneous tissues were closed with continuous sutures using Polyglycolic acid USP 2 suture material.
9. The skin was sutured with horizontal mattress sutures using prolene USP 2 suture material.
10. The leg was wrapped in a heavy bandage for one week.

### Postoperative Care:

1. Parenteral cover of antibiotics was given for a period of two weeks.
2. The bandage was removed after one week to check the condition of the suture line. There was a slight edematous swelling around the suture line with no signs of infection. The suture line was painted with Tincture Iodine and the limb was again bandaged for one week.
3. The skin sutures were removed after 3 weeks.
4. The animal was kept in a separate enclosure for two months after surgery.

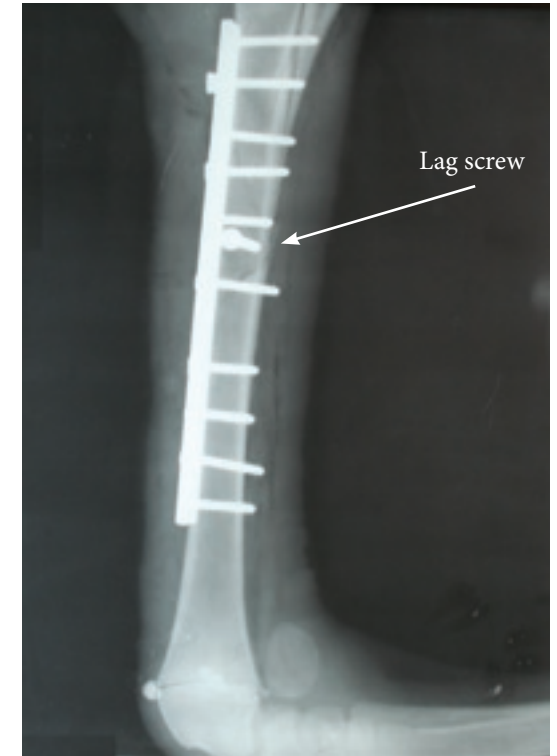
### Results and Comments:

The wound healed without any undue effect. There was no evidence of any complications during the follow up studies up to two months and the animal was walking normally. Three months later, we came to know that the animal had no problems with locomotion but the owner slaughtered it on a marriage ceremony.

The application of a bone plate to fix the fracture of radius and ulna has given promising results. However, it was a very young and light weight



**Figure 16.53** A short oblique, over-riding mid-shaft fracture of the radius and ulna.



**Figure 16.54** Application of a self-compression bone plate on cranial surface of the radius. Note perfect reduction of the fracture fragments with the lag screw.

animal and the expectancy of the same results in the adult and heavy weight animals may not be justified. In the larger animals, additional support with a plaster cast from foot up to the elbow joint for about two weeks may be helpful, as by that time the fracture will become stable due to initiation of the healing process of the fractured bone. In such an arrangement however, strict adherence to the aseptic surgical technique is a prerequisite; the plaster cast should be closely watched for any wet spots, and in case of any problems with the cast, it should be removed without delay, the site should be carefully examined and if advisable, a new plaster cast may be applied. In short, the internal methods of fracture fixation do have a place in large animal orthopedics and there is no harm trying them wherever and whenever possible.



## 15. Two cases of unusual mandibular fractures in the dromedary camel.

Bilateral or rarely unilateral fractures of the mandible across the tushes in the camel are common. Two cases are being described here that do not fall in the conventional category, but were successfully treated with the standard interdental wiring technique.

### Case No.1: Avulsion of the central incisors with loss of left lateral incisor.

A three and a half years old heifer fell down during racing exercise and got avulsion of the central incisors with loss of left lateral incisor. At the time of presentation, the avulsed teeth were hanging down attached only with the soft tissues of the gums (Fig. 16.55).

#### **Control and Anesthesia:**

The animal was controlled in the sternal recumbency under deep sedation.

#### **Operative Steps:**

1. The site was thoroughly washed and cleaned with standard solution of potassium permanganate.
2. The loose and compromised soft tissues were carefully and minimally excised.
3. The avulsed teeth were reduced and securely fixed with interdental wiring (Fig. 16.56). (See chapter 12 for details of the technique).
4. The soft tissues were apposed with interrupted horizontal mattress sutures using Polyglycolic acid USP 2.

#### **Results and Comments:**

The fracture healed without any complications with restoration of normal mandibular contour (Fig. 16.57). The absence of left lateral incisor did not, in any way; affect the healing process or shape of the mandible. As such, the results were quite encouraging and were indicative that interdental wiring technique can be successfully used to handle such injuries in the cranial mandible.

### Case No.2: A transverse fracture of the cranial mandible.

A 3 year old dromedary heifer suffering from fracture of the mandible treated by a quack was presented for treatment 28 days after the accident

(Fig. 16.58). The animal was being maintained on oral liquids (milk and water) given through the right or left commissure caudal to the bandage applied to immobilize the fracture. Hence, the health of the animal was deteriorating day by day. Removal of the bandaged revealed a fracture of the cranial mandible with the fracture line running from in between the right central and lateral incisor to caudal to the left canine tooth (Fig.16. 59).

#### **Control and Anesthesia:**

The animal was controlled in the sternal recumbency under deep sedation.

#### **Operative Steps:**

1. As the fracture was old, a thorough but careful debridement of the fracture line was carried out in order to get proper apposition of the fracture fragments.
2. The fracture was reduced and immobilized by 0.9mm stainless steel interdental wire passed on the left side. Some movement at the fracture site was still noticed and therefore, an additional support was given by passing a piece of same size wire running from the right canine tooth to the left lateral incisor (Fig. 16.60).

#### **Results and Comments:**

This fracture also healed without any complications justifying the use of interdental wiring technique for transverse fractures in the cranial parts of the mandible as well (Fig. 16.61).



**Figure 16.55** Avulsion of central incisors. Note the missing left lateral incisor.



**Figure 16.56** Reduction of the avulsed teeth and immobilization with interdental wiring. See the cranial ends of the wires twisted and curved between the central incisors.



**Figure 16.57** Removal of the wires after complete healing of the fracture.



**Figure 16.58** A transverse fracture of the cranial mandible immobilized by a quack. The animal was in a miserable condition when presented for treatment 28 days after this arrangement.



**Figure 16.59** The transverse fracture of the cranial mandible. Note the devitalized and dead tissues in the fracture line.



**Figure 16.60** Interdental wire on the left side with a wire from right canine tooth to the left lateral incisor for additional support.

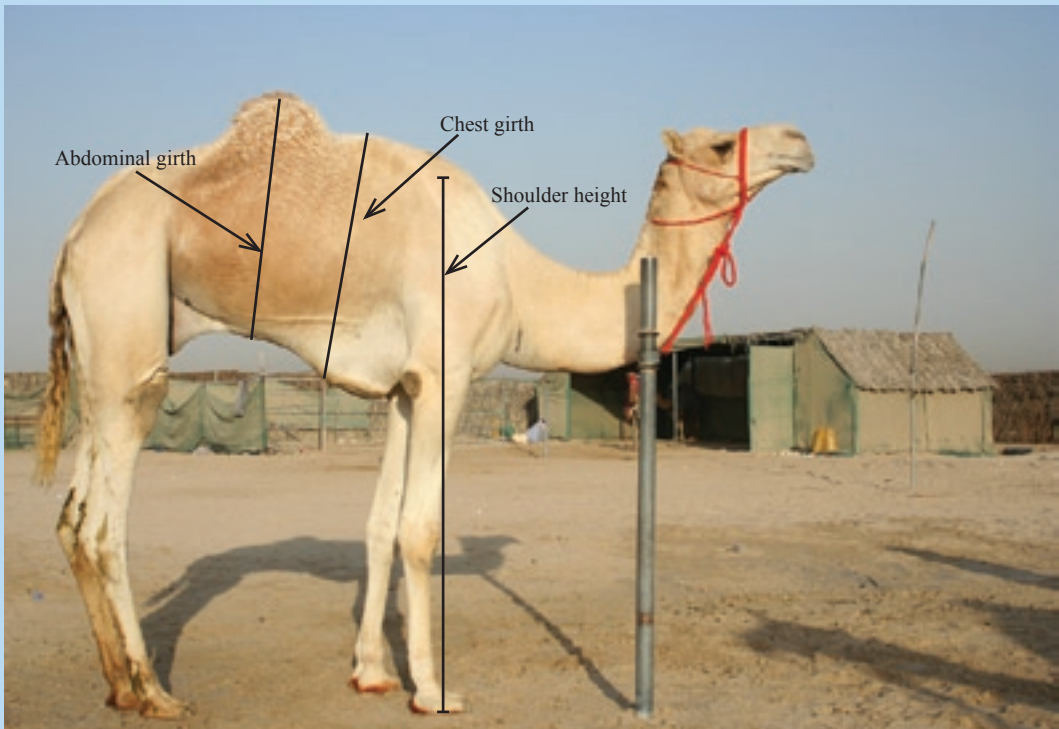


**Figure 16.61** The fixation wires removed after healing of the fracture. Note normal alignment of the jaw.



# Appendix

## Appendix A : Estimation of Camel Weight



Formula i

P = 53 TAH\*

Where :

- P: weight (kg)
- T: chest girth (heart girth) (m)
- A: abdominal girth (hump girth) (m)
- H: shoulder height (m)

Example : A camel of chest girth 1.90 m, of abdominal girth 2.00 m and shoulder height 2.05 m would weigh:  $P = 53 \times 1.90 \times 2.00 \times 2.05 = 495 \text{ kg}$

Formula ii

y = 5.071x - 457\*\*

Where:

- y: weight (kg)
- x: chest girth (cm)

Example : . A camel of chest girth 190 cm would weigh:  $y = (5.071 \times 190) - 457 = 506.5 \text{ kg}$

\*, \*\* R.T. Wilson, 1984 *The Camel* . p.154

## Appendix B : Conversion Table (Weight, Liquid and Temperature)

Weight

- 1 lb = 0.454 kg = 454 g = 16 oz
- 1 kg = 2.2 lb = 1000 g
- 1 g = 1000 mg
- 1 gr = 64.8 mg
- 1 g = 15.43 gr = 1000 mg
- 1 mg = 1000 mcg (µg)
- 1mcg = 1000 ng
- 1 oz = 28.4 g

Dosage Conversion Formula

- mg/kg = mg/lb x 2.2
- mg/lb = mg/kg x 0.454
- 1 ppm = 1 µg/g or 1 mg/kg

Abbreviations

lb = pound(s), g = gram(s), kg = kilogram(s), mg = milligram(s), mcg/µg or ug = microgram(s), ng = nanogram(s), oz = ounce(s), gr = grain(s).

Liquid

- 1 gal = 4 qt = 8 pt = 128 fl.oz. = 3.785 L = 3785 ml
- 1 qt = 2 pt = 32 fl.oz. = 946 ml
- 1 pt = 2 cups = 16 fl.oz. = 473 ml
- 1 cup = 8 fl.oz. = 237 ml = 16 tbsp
- 1 tbsp = 15 ml = 3 tsp
- 1 tsp = 5 ml
- 4 L = 1.057 gal
- 1 L = 1000 ml = 10 dl
- 1 dl = 100 ml
- 1 ml = 1 cc = 1000 µl

Abbreviations

cc = cubic centimeter, fl.oz. = fluid ounce(s), gal = gallon, L =liter, ml = milliliter, dl = deciliter, pt = pint(s), qt = quart(s), tbsp = tablespoon, tsp = teaspoon

Temperature Conversion Formula

- °F = ( °C x 1.8 ) + 32
- °C = ( °F-32 ) x 0.555



Appendix C : Normal Clinical Parameters and Vertebral Formula

Clinical Parameter	Range	Mean
Temperature	36 - 39 ( C <sup>o</sup> ) , 96.8 - 102.2 ( F <sup>o</sup> ) <sup>1</sup>	
Pulse / min.	30 - 50 <sup>2</sup>	30
Respiration / min.	5 - 10	7

<sup>1</sup> May go up to 40.5 C° in extremely hot weather.  
<sup>2</sup> Depends upon age, size, sex and physical condition of the animal

Vertebral Formula : C 7 , T 12 , L 7 , S 5 , Cd 15 - 20

C : Cervical  
T : Thoracic  
L : Lumbar  
S : Sacral  
Cd : Caudal

Appendix D : Normal Hematological Values<sup>3</sup>

Blood Cell Parameter	Unit	Age		
		1 day – 6 months	6 months – 2 years	2 years – 12 years
Hb	gm/dl	10.40 – 13.90	8.50 – 12.0	12.0 – 15.0
PCV	%	24.0 – 31.0	20.0 – 28.0	26.0 – 38.0
MCV	um	29.6 - 35.1	30.0 – 34.0	26.0 – 34.0
RBC	x 10 <sup>6</sup> / µl	7.4 – 10.0	6.5 – 9.0	7.5 – 12.0
WBC	x 10 <sup>3</sup> / µl	7.4 – 10.0	6.6 – 9.0	7.5 – 12.0
Neutrophils	%	53.0 – 68.0	50.0 – 60.0	50.0 – 60.0
Lymphocytes	%	20.0 – 44.0	30.0 – 45.0	30.0 – 45.0
Monocytes	%	0.5 - 10.0	0.3 – 7.0	2.0 – 8.0
Eosinophils	%	0.3 – 2.5	1.0 - 2.5	0 – 6.0
Basophils	%	0.2 - 2.4	0 – 1.0	0 – 1.0
Platelets	x 10 <sup>3</sup> / µl	375 - 820	350 - 450	200 - 700

<sup>3</sup> Wernery et al ., 1999



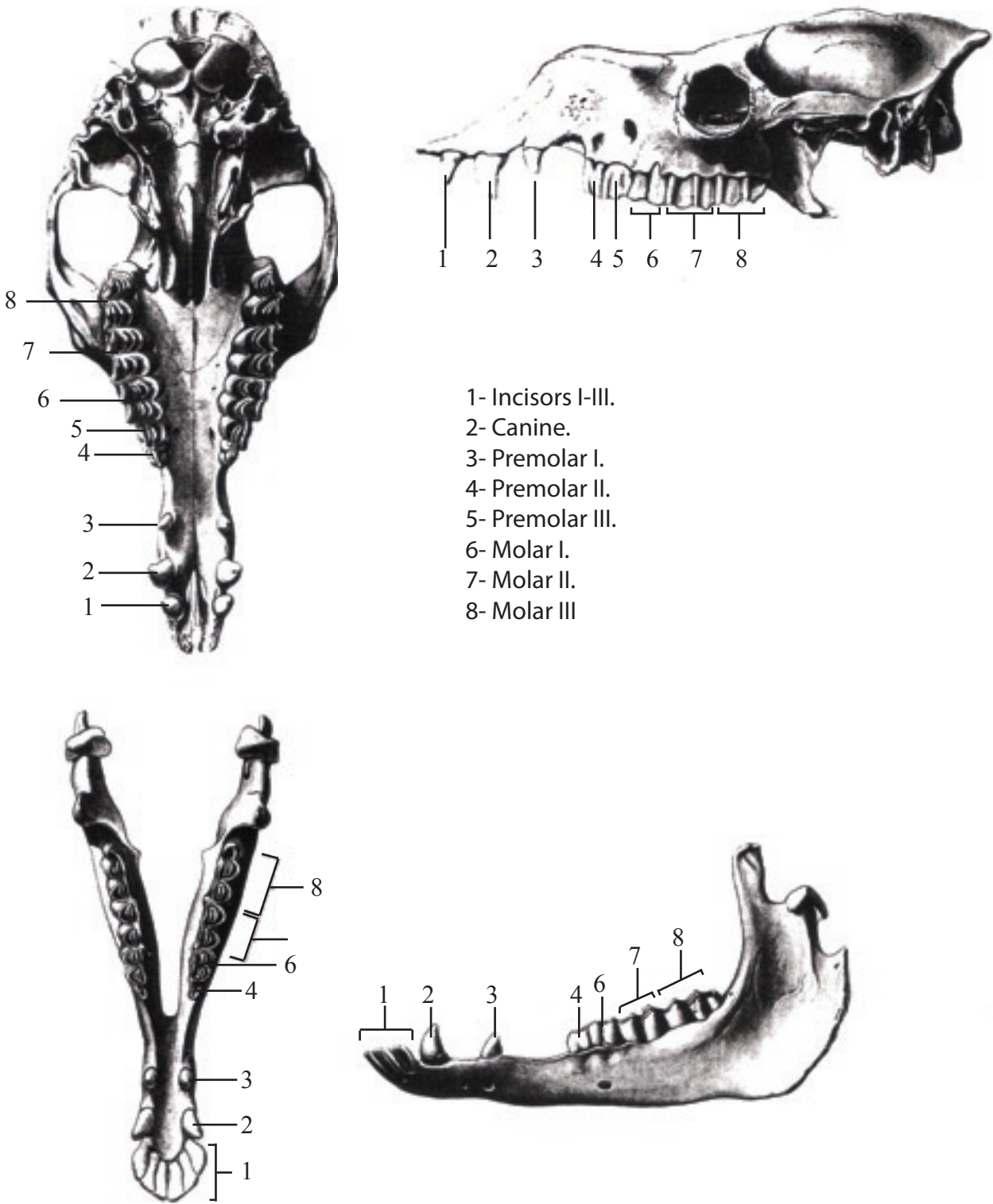
Appendix E : Normal Blood Chemistry Values<sup>4</sup>

Plasma Parameter	Unit	Age		
		1 day – 6 months	6 months – 2 years	2 years – 12 years
LDH	IU/l	520-730	450-550	400-775
CK	IU/l	175-350	85-120	40-120
AST	IU/l	92-200	100-125	60-120
GGT	IU/l	5-15	4-10	3-15
ALP	IU/l	350-750	150-240	60-140
ALT	IU/l	3-15	3-15	3-15
Blood Urea Nitrogen	mg/dl	10-20	10-20	3-15
Total Bilirubin	mg/dl	0-1	0-1	0-1
Creatine	mg/dl	1.1-1.5	0.8-1.3	0.2-2
Albumin	mg/dl	2.8-3.5	1.8-3.5	3-4.5
Iron	µg/dl	37-135	40-120	87-135
Magnesium	mg/dl	2-2.4	2.5-3.5	1.8-2.4
Calcium	mg/dl	10.6-12	9-11	9.5-11.5
Phosphorus	mg/dl	9.6-13.9	6.5-10	3.5-6
Sodium	mm/dl	150-160	148-156	150-160
Potassium	mm/dl	6.5-7.7	5.2-7.8	3.5-5.5
Chloride	mm/dl	110-120	110-115	90-110
Cholestrol	mg %			29-50
Glucose	mg/dl	70-140	75-120	7-110
Fibrinogen	mg/dl	350-450	250-380	250-400

<sup>4</sup> Wernery et al ., 1999

Appendix F : Dental Formula of An Adult Camel <sup>5</sup>

Formula of permanent teeth : 2 ( I 1/3 C 1/1 P 3/2 M 3/3) = 34



<sup>5</sup> Smuts, M.W. and Bezuidenhout A.Y. 1987. Anatomy of Dromedary.



Appendix G : Size designation for surgical suture materials <sup>6</sup>.

American Pharmacopoeia		European Pharmacopoeia	Suture Diameter
Catgut	Suture material absorbable (other than catgut) and nonabsorbable	Suture material absorbable and nonabsorbable	mm- range
USP size	USP size	Metric size	mm
---	11 / 0	0.1	0.010 – 0.019
---	10 / 0	0.2	0.020 – 0.029
---	9 / 0	0.3	0.030 – 0.039
---	8 / 0	0.4	0.040 – 0.049
---	7 / 0	0.5	0.050 – 0.069
7 / 0	6 / 0	0.7	0.070 – 0.099
6 / 0	5 / 0	1	0.100 – 0.149
5 / 0	4 / 0	1.5	0.150 – 0.199
4 / 0	3 / 0	2	0.200 – 0.249
3 / 0	2 / 0	2.5	0.250 – 0.299
3 / 0	2 / 0	3	0.300 – 0.349
2 / 0	0	3.5	0.350 – 0.399
0	1	4	0.400 – 0.499
1	2	5	0.500 – 0.599
2	3 + 4	6	0.600 - 0.699
3	5	7	0.700 – 0.799
4	6	8	0.800 – 0.899
5	7	9	0.900 – 0.999
6	8	10	1.000 – 1.099

<sup>6</sup> B. Braun Vet Care GmbH, Suture materials for veterinary surgery.

Appendix H : Common Traditional Arabic Names of English / Surgical Disease and its Description in English

Traditional UAE Name	English / Scientific Name	Arabic Word
Kalbah	Fibrosis of the popliteal lymph node	كلبه
Shafah	Punctured foot	شافه
Ramah	Abscess	رامه
Laghoob	Papillae of buccal cavity	لغوب
Dulaa / Laha	Palatine diverticulum	لهاء دلا
Tashbeek	Anti-masturbation suture of prepuce	تشبيك
Kes sha'or	Dermoid cyst	كيس شعر
Al Batin	Uterus	الرحم
Fedaq	Hernia	فداق
Bedieh	Rectal / Vaginal Prolapse	بدیه
Khataam	Nose halter	خطام
Gaithing	hobbling	قيد



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