

BASIC SCIENCES • ANATOMY

— STUDY NOTES

Veterinary Arthrology Notes: Classify Any Joint, Name Its Movement (PDF)

Arthrology — also syndesmology — is the anatomy of the joints, and a joint does not have to move. These notes are the **method**: the one question the whole classification turns on, the joints with no cavity, the two classification axes and the single term the textbooks genuinely disagree about, everything a synovial joint is built from, the seven shapes with a named example of each, the movement vocabulary in full, and the four separate things that stop a joint moving.

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- 1 · The branch, and the one question
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- 3 · Two axes, and the word that moves
- 4 · Inside a synovial joint
- 5 · The cartilage
- 6 · Seven shapes
- 7 · Movement, and what stops it

LEVEL

Vets & veterinary students

EDITION

2026-09-06

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LEARNING OBJECTIVES

After working through these notes you will be able to:

- ✓ **State** the principle the whole joint classification rests on, in one sentence.
- ✓ **Classify** any joint on both axes — by tissue and by mobility — and say which scheme you are using.
- ✓ **Name** the three universal features of a synovial joint, and the additions that are not universal.
- ✓ **Explain** why articular cartilage is the part that does not recover.
- ✓ **Identify** each of the seven joint shapes and give a named domestic-animal example.
- ✓ **Distinguish** flexion, extension, abduction, adduction, rotation and circumduction by the plane each is defined against.
- ✓ **List** the four limits on joint movement, and say which one the source is least sure of.

TL;DR

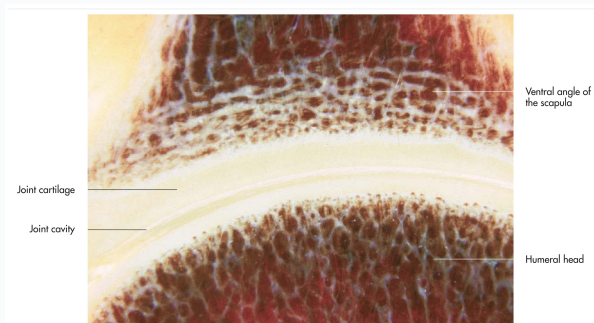
Arthrology — also syndesmology — is the anatomy of the joints, and a joint does not have to move. These notes are the **method**: the one question the whole classification turns on, the joints with no cavity, the two classification axes and the single term the textbooks genuinely disagree about, everything a synovial joint is built from, the seven shapes with a named example of each, the movement vocabulary in full, and the four separate things that stop a joint moving.

AT A GLANCE

THE BRANCH	Arthrology = syndesmology = the anatomy of joints
THE ONE QUESTION	Is there a gap between the two bones, or not?
RANGE OF MOVEMENT	= range of motion. Limited by four separate things
NO GAP	Synarthrosis — fibrous, cartilaginous or bony
A GAP	Diarthrosis — a cavity filled with synovia
ALWAYS PRESENT	Capsule · cavity · hyaline articular cartilage
CAPSULE	Stratum fibrosum (outer) + stratum synoviale (inner)
CARTILAGE	Avascular, alymphatic, aneural. Fed mostly by diffusion
MOVEMENT CLASSES	Gliding · angular · rotary

01 1 • The branch, and the one question

- **Arthrology** (*arthrologia*) = the anatomy of the joints. Also **syndesmology**. Same subject, two names.
- A joint is a **junction between two skeletal elements**. It does not have to move: sutures, tooth sockets and the horse's fused radius and ulna are all joints.
- The organising sentence, worth learning: mobility “**depends entirely on the form of the gap between them**”.
- No gap → **synarthrosis**. A gap, filled with synovia → **diarthrosis**. Everything else is a subdivision of those two.
- Out of scope, deliberately: joint **disease**, arthroscopy and joint surgery; individual named joints; the muscles that produce a movement.



A joint gap in a real specimen — dog shoulder, plastinated longitudinal section. Scapula above, humeral head below, cartilage pale, cavity the dark line between. Image — König & Liebich, *Veterinary Anatomy of Domestic Animals*, 7th ed. Reproduced for educational reference.

02 2 • The joints with no cavity

JOINT	JOINED BY	EXAMPLE	PERMANENT?
Syndesmosis	Collagenous tissue across a gap	Dew claws of the ox	Yes
Suture	Thin fibrous layer, skull only	Interfrontal, internasal	No — ossifies with maturity
Gomphosis	Periodontal membrane, peg in socket	A tooth in its alveolus	While the tooth is there
Synchondrosis	Hyaline cartilage	Epiphyseal plate	Usually not — most fuse as growth ceases
Symphysis	Fibrocartilage, usually median	Pelvic symphysis	Usually, though many ossify
Synostosis	Bone	Horse radius + ulna	Yes, irreversibly

- No capsule, and the fibrous layer of the **periosteum runs continuously over** the joint from one bone onto the next. In a synovial joint it stops at the cartilage margin.
- Suture edges are named for their cut: *serrata* (interlocking), *squamosa* (bevelled, overlapping), *plana / harmonia* (plain abutting), *foliata*.
- “Immovable” is the older books' word and it is too strong for a symphysis. Read it as **no joint cavity**, not as a measurement.

03 3 • Two axes, and the word that moves

CLASSIFICATION

Two axes, and one word that moves

What joins the bones — and how far it travels.

BY TISSUE

Fibrous — collagen
Cartilaginous — cartilage
Synovial — a fluid gap

BY MOBILITY

Synarthrosis — none
Amphiarthrosis — slight
Diarthrosis — free

Amphiarthrosis moves between them

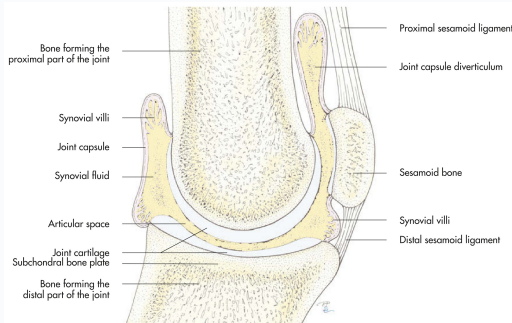
König gives it to a tight synovial joint, Regional to the cartilaginous class.

The two classification axes, and the one term that moves between them. Diagram — Vet-eBooks.com, drawn for this guide.

- **By tissue:** fibrous · cartilaginous · synovial. **By mobility:** synarthrosis · amphiarthrosis · diarthrosis.

- They agree at both ends and disagree in the middle. **König:** *synarthrosis* = any continuous union, and *amphiarthrosis* = a **tight synovial** joint, e.g. the sacroiliac. **Classical scheme:** fibrous = synarthrosis, cartilaginous = **amphiarthrosis**, synovial = diarthrosis.
- **In an exam, name the scheme, then classify the joint.** Neither mapping is wrong.
- A third, older scheme classifies by shape: *arthrodia* (gliding), *enarthrosis* (ball-and-socket), *ginglymus* (hinge), *trochoid* (pivot).

04 4 • Inside a synovial joint



Every component of a synovial joint, named — including the subchondral bone plate and a capsule diverticulum. Image — König & Liebich, *Veterinary Anatomy of Domestic Animals*, 7th ed. Reproduced for educational reference.

CAPSULE LAYER	MADE OF	EXPLAINS
Stratum fibrosum	Dense irregular tissue, continuous with periosteum	Slow healing (limited blood supply) and pain on stretch (rich sensory supply)
Stratum synoviale	<i>Intima synovialis</i> of synoviocytes over <i>stratum subsynoviale</i>	Villi and folds; synovia production; type-A synoviocytes phagocytose, type-B secrete proteins

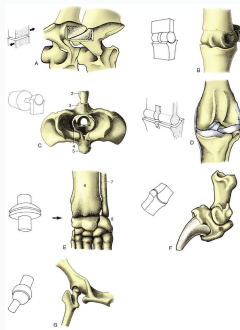
- **Always three:** capsule, cavity containing synovia, hyaline articular cartilage. Everything else is an addition.
- **Synovial fluid** = an **ultrafiltrate of plasma** + polymerised **hyaluronan** added by the synovial cells.
- Ligaments are **intracapsular**, **capsular** or **extracapsular** — on one stifle, the **cruciates** and the **collaterals**. But the cruciates are inside the **capsule** and **outside the cavity**, excluded from it by synovial membrane. Most ligaments are collagenous; the nuchal ligament is the elastic exception.
- The fibrous layer and the ligaments carry **proprioceptive** endings registering position and rate of change of position; **other** receptors register pain.

- **Menisci** (crescent, incomplete) and **articular discs** (complete, divide the cavity) compensate for **incongruent** surfaces — **disputed**: Dyce says congruence "can hardly explain their presence" and proposes they **split a complex movement across two levels** (TMJ: hinge below the disc, sliding above it). Meniscal **horns** are heavily **proprioceptive**; a regrown one is dense collagen, not fibrocartilage.
- A **labrum** deepens a socket; **fat pads** let the membrane change shape; a **synovial sheath** wraps a tendon, its layers continuous along the **mesotendon**.

05 5 • The cartilage

- **Avascular, alymphatic, aneural**. Everything about its repair follows from that.
- Fed **for the most part bradytrophically, by diffusion**. The synovia above and the marrow vessels beneath are both **secondary** routes, not the main one. Metabolism is **anaerobic**.
- **Weeping lubrication**: anionic GAGs bind water; compression squeezes it out, release draws it back. That cycle both lubricates and carries nutrients in and waste out. An immobilised joint does not pump.
- Three zones — superficial, middle, deep — then calcified cartilage with **tidemarks**, then the **subchondral bone plate**, which takes the axial load.
- **Synovial fossae** are normal rough non-articular pits. Not lesions.

06 6 • Seven shapes



The seven types, each with the geometric solid beside the real bone. A plane, B hinge, C pivot, D condylar, E ellipsoidal, F saddle, G spheroidal. Image — Dyce, Sack & Wensing, Textbook of Veterinary Anatomy, 5th ed. Reproduced for educational reference.

SHAPE	AXES	NAMED EXAMPLE
Plane	Gliding (in theory)	Vertebral articular processes
Hinge <i>ginglymus</i>	Uniaxial	Elbow; equine fetlock
Pivot <i>trochoidea</i>	Uniaxial	Atlantoaxial; proximal radioulnar

SHAPE	AXES	NAMED EXAMPLE
Condylar	Uniaxial + some rotation	Femorotibial; the two mandibular
Ellipsoidal	Biaxial	Canine carpus; atlanto-occipital
Saddle <i>sellaris</i>	Biaxial	Canine distal interphalangeal
Spheroidal	Multiaxial	Hip. Also the shoulder, in shape only

- **Simple** = one pair of surfaces (shoulder). **Composite** = more than two, moving at more than one level in one capsule (carpus).
- A **pivot** works two ways: the peg turns in a fixed ring (proximal radioulnar), or the ring turns on a fixed peg (atlantoaxial).
- **Some incongruence is required** — it holds a wedge of synovia between the surfaces. They become congruent only in the **close-packed position**, at the limit.
- Shape is a **permission, not a prediction**: the shoulder is spheroidal, and domestic species use it for flexion and extension. Real joints “correspond very imperfectly to the theoretical models”.

07 7 • Movement, and what stops it

MOVEMENT	PLANE OR AXIS	MEANS
Gliding	—	Nearly flat surfaces slide: carpal and tarsal rows
Flexion	Sagittal	The angle between the segments closes
Extension	Sagittal	The angle opens; the segments come into line
Abduction	Transverse	Away from the median plane
Adduction	Transverse	Back towards the median plane
Rotation	Axis perpendicular to the surface	Spin. Internal = cranial surface medially
Circumduction	A combination	The distal end describes a circle

- Three classes: **gliding**, **angular**, **rotary** — usually combined.
- Pure **translation** probably never occurs: articular surfaces are always curved. The plane joint is defined as if it did.
- **In the digits**, abduction and adduction are read against the **axis of the limb**, not the median plane — the digits spread and converge.
- **Rotation** direction must be stated: internal carries the cranial surface **medially**, external **laterally**.
- **Overextension** (dorsal flexion): the standing horse’s **fetlock** sits here, not in neutral.

WHAT STOPS A JOINT	HOW
1 The surfaces	They become congruent at the limit; the synovial wedge is squeezed out
2 Ligaments	Extracapsular tension — but Dyce doubts it is needed in a normal joint
3 Bone on bone	The olecranon prevents forceful elbow overextension
4 Muscle	Passive insufficiency, then active opposition — possibly the largest factor

- Dyce's own hedge, kept: it is **uncertain whether ligament braking is required in normal circumstances**, and the contraction of the **opposing muscles** may matter most.
- Horse, matched pair: **spring joint** (elbow) — ligaments eccentric and **proximal** to the axis, tension greatest in neutral, so the joint springs out of it. **Spiral joint** (stifle) — eccentric and **distal**, tension rises with movement, so it brakes. Same trick, opposite result.

KEY TERMS — QUICK GLOSSARY

Synarthrosis

A continuous union between two bones — no joint cavity.

Diarthrosis

A joint containing a cavity filled with synovia.

Amphiarthrosis

A joint of very restricted movement. **Which one** depends on the scheme: König means a tight synovial joint, the classical scheme means the cartilaginous class.

Stratum fibrosum

The capsule's outer layer: dense irregular tissue, continuous with periosteum, poorly vascularised, richly innervated.

Stratum synoviale

The capsule's inner layer: synoviocytes over subsynovial tissue. Type A phagocytose, type B secrete proteins.

Bradytrophic

Slow-feeding — the word used of articular cartilage, which lives by diffusion.

Close-packed position

The point at which the two surfaces become congruent, the synovial wedge is squeezed out, and movement is checked.

Overextension

The terminal position beyond full extension — where the standing horse's fetlock sits.

QUICK REVISION — REMEMBER THESE

- 1 **Mobility depends entirely on the form of the gap.** That is König's sentence and it is the whole classification.
- 2 **A joint need not move.** Sutures, tooth sockets and the horse's fused radius and ulna are all joints.

- 3 **Amphiarthrosis is the term to define before using it.** König: a tight SYNOVIAL joint (sacroiliac). Classical: the CARTILAGINOUS class (pelvic symphysis).
- 4 **The capsule's outer layer explains two clinical facts** — poor blood supply, so slow healing; rich sensory supply, so pain on stretch.
- 5 **Cartilage has no vessels, no lymphatics and no nerves.** It is fed by diffusion and lubricated by water squeezed out of it under load.
- 6 **Some incongruence is required** to keep a wedge of synovia between the surfaces. They become congruent only at the limit — and that is one of the four brakes.
- 7 **Shape is a permission, not a prediction.** The shoulder is spheroidal; domestic species use it for flexion and extension.

MEMORY AIDS

Read the prefix, know the gap — **syn-** = together, no gap. **di-** = apart, a cavity. **amphi-** = in between — and that is exactly why the books cannot agree where to put it.

AB away, AD adds to the middle — **Abduction** carries a part **away** from the median plane; **adduction** brings it back **towards** it.

Sagittal swings, transverse spreads — Flexion and extension are pendular in a **sagittal** plane; abduction and adduction are pendular in a **transverse** one. Rotation spins about an axis **perpendicular** to the surface.

TEST YOURSELF — ACTIVE RECALL

Cover the answers and try to retrieve each one from memory first — self-testing beats re-reading.

1. State the principle the whole joint classification rests on, and the two categories it produces.
2. Name the three fibrous joints with a veterinary example of each.
3. Two textbooks classify the sacroiliac joint differently. Explain, in one sentence each.
4. What three features does every synovial joint have, and what does the capsule's outer layer explain?
5. Why is articular cartilage the part that does not recover, and how is it fed?
6. Give the seven joint shapes with one named example each.
7. Define abduction and adduction, and say what changes when they are applied to the digits.
8. List the four limits on joint movement, and name the one the source itself doubts.

ANSWERS

1. Mobility "depends entirely on the form of the gap between them". Either the tissue runs continuously between the two bones — a **synarthrosis** — or there is a real cavity filled with synovia — a **diarthrosis**.
2. **Syndesmosis** — the dew claws of the ox on the metapodium. **Suture** — the interfrontal or internasal suture of the skull. **Gomphosis** — a tooth in its alveolus, held by the periodontal membrane.
3. **König**: *amphiarthrosis* = a tight SYNOVIAL joint, and the sacroiliac is his example. **Classical scheme**: *amphiarthrosis* = the CARTILAGINOUS class, so the sacroiliac is simply a diarthrosis. Name the scheme first.

4. A **capsule**, a **cavity** containing synovia, and **hyaline articular cartilage**. The **stratum fibrosum** has a limited blood supply, so it heals slowly, and is richly supplied with sensory fibres, so a stretched or injured capsule hurts — which is why a joint that fills with fluid is painful even when nothing is torn.
5. It is **avascular, alymphatic and aneural**, fed **for the most part by diffusion** — synovia and marrow vessels are both secondary routes; its metabolism is anaerobic. Loading squeezes water out of the matrix and unloading draws it back — **weeping lubrication** — so an immobilised joint does not pump.
6. **Plane** — vertebral articular processes. **Hinge** (*ginglymus*) — elbow. **Pivot** (*trochoidea*) — atlantoaxial. **Condylar** — femorotibial. **Ellipsoidal** — canine carpus. **Saddle** (*sellaris*) — canine distal interphalangeal. **Spheroidal** — hip.
7. Both are pendular movements in a **transverse** plane: abduction carries a part away from the median plane, adduction back towards it. Applied to the **digits** they are read against **the axis of the limb** instead, and mean the digits spreading and converging.
8. The **shape of the surfaces; ligament tension; bony contact** (the olecranon blocks elbow overextension); and **muscle tension**. Dyce writes that it is **uncertain whether ligament braking is required in normal circumstances**, and that opposing muscle may be the most important factor.

WHEN TO REFER OR ESCALATE

- A reduced range of movement: the cause need not be in the joint. Three of the four brakes — ligaments, bony contact, muscle — lie outside it, and only some show on a radiograph.
- A painful distended joint: the pain is capsular, not cartilaginous. Cartilage has no nerve supply at all.
- Rough pits on an articular surface at post-mortem: **synovial fossae** are normal, and are not worn-through cartilage.
- A standing horse's fetlock is in **overextension**, not neutral — which is why the suspensory apparatus is loaded in an animal doing nothing.
- No supination or pronation in the equine forelimb: the radius and ulna are a **synostosis**.

SOURCES

1. König HE, Liebich H-G. *Veterinary Anatomy of Domestic Animals: Textbook and Colour Atlas*, 7th ed. Thieme — §1.4 Arthrology, pp. 37–41, and Figs. 1.30 and 1.33.
2. Dyce KM, Sack WO, Wensing CJG. *Textbook of Veterinary Anatomy*, 5th ed. Saunders/Elsevier — movement and its limits, pp. 52–55, and Fig. 1.25 (p. 56).
3. *Veterinary Anatomy: The Regional Gross Anatomy of Domestic Animals* — the classical scheme and the movement classes, pp. 15–19.
4. Dellmann H-D, Eurell J. *Dellmann's Textbook of Veterinary Histology*, 6th ed. Blackwell — weeping lubrication, synovial fluid and the meniscal horns, p. 59.
5. Constantinescu GM. *Illustrated Veterinary Anatomical Nomenclature*, 4th rev. ed. — the naming authority for the Latin used here.

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