



Cervical anatomy

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Overview: building the cervical spine

- Atlas
- axis
- ligaments
- muscles
- fascia
- the vert
- And how to apply to common cases

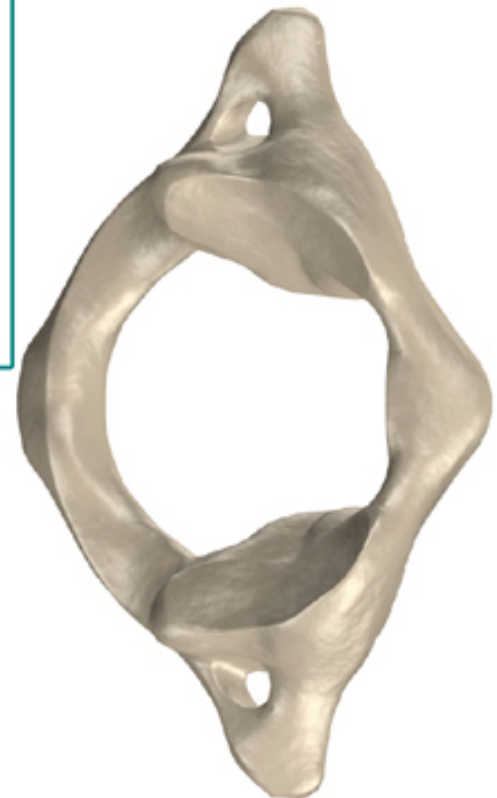


Atlas

- Ring of bone
- Lateral mass on each side
- Transverse process
- Superior projects medially and inferior articular facet projects medially to C2
- superior articular facet
- 3 cm canal

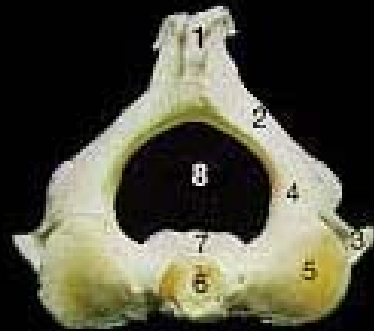


Atlas



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Axis



Axis (Superior View)



Axis (Anterior View)



Axis (Inferior View)

- 1 Spinous Process
- 2 Lamina
- 3 Transverse Process
- 4 Pedicle
- 5 Superior Articular Surface
- 6 Odontoid Process (Dens)
- 7 Body
- 9 Inferior Articular Surface



Atlanto-Occipital Joint

- Allows flexion and extension and slight side to side motion
- almost NO rotation
- Stability dependent on ligaments:

ALL, attaches to tubercle on axis, then small contin to skull

apical ligament

tectorial membrane (broad ligamentous sheet)
(continuation of PLL)

cruciate ligament

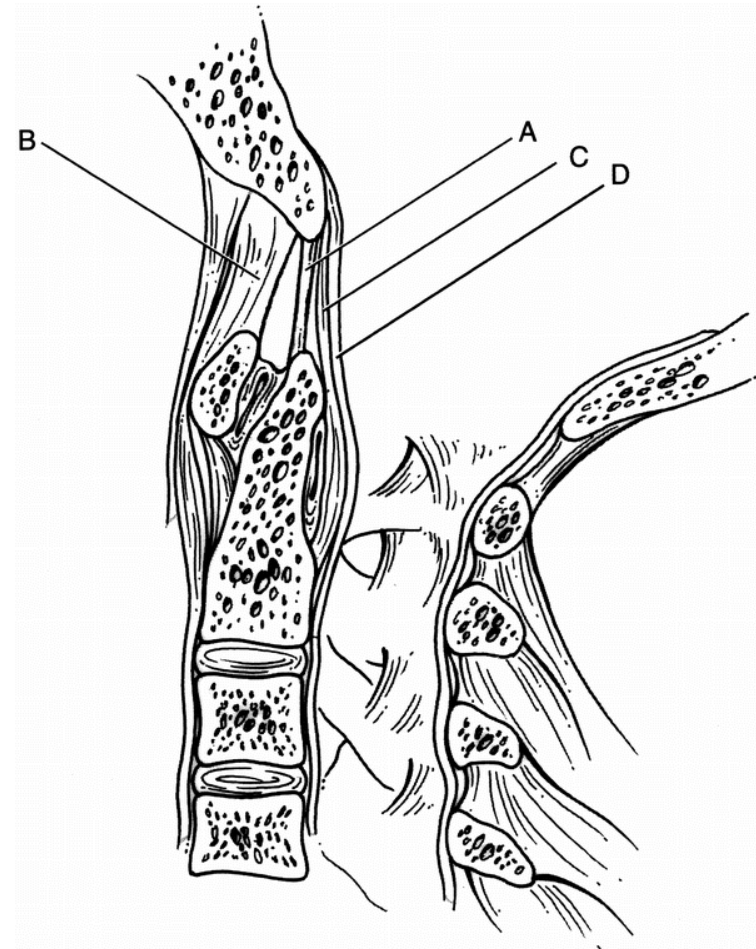
--formed by rostral and caudal longitudinal bands

Alar ligaments

arise from dens, connect to medial occipital condyle
limit rotation of AO joint

dorsal atlanto-occipital membrane
(continuation of Ligamentum flavum),
--remember overlays vert, C1

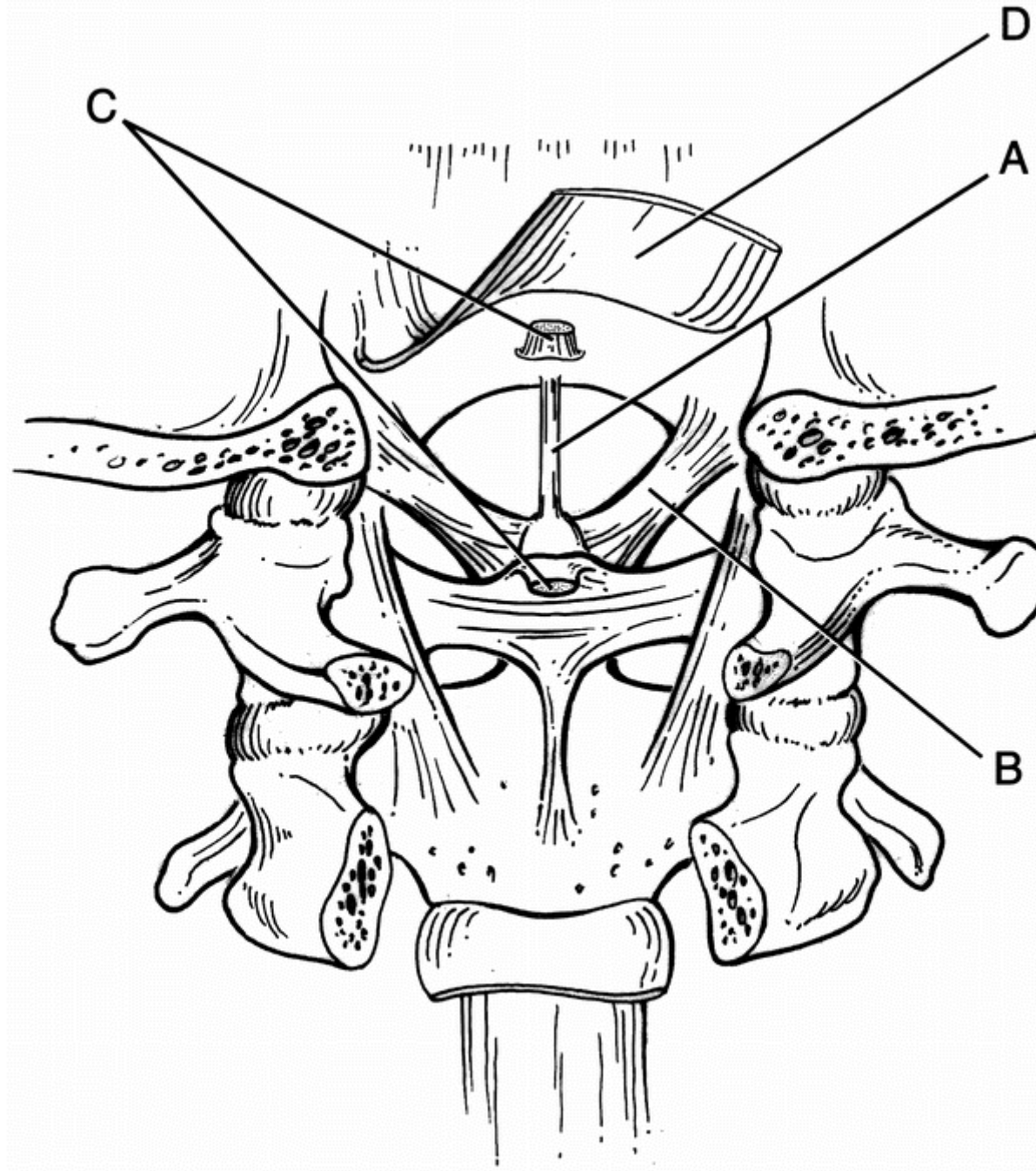
C1 and C2 nerves pass dorsally to occipitocervical and C1/2 joint capsules, NOT ventral to facets UNLIKE other cervical vertebrae



Draw

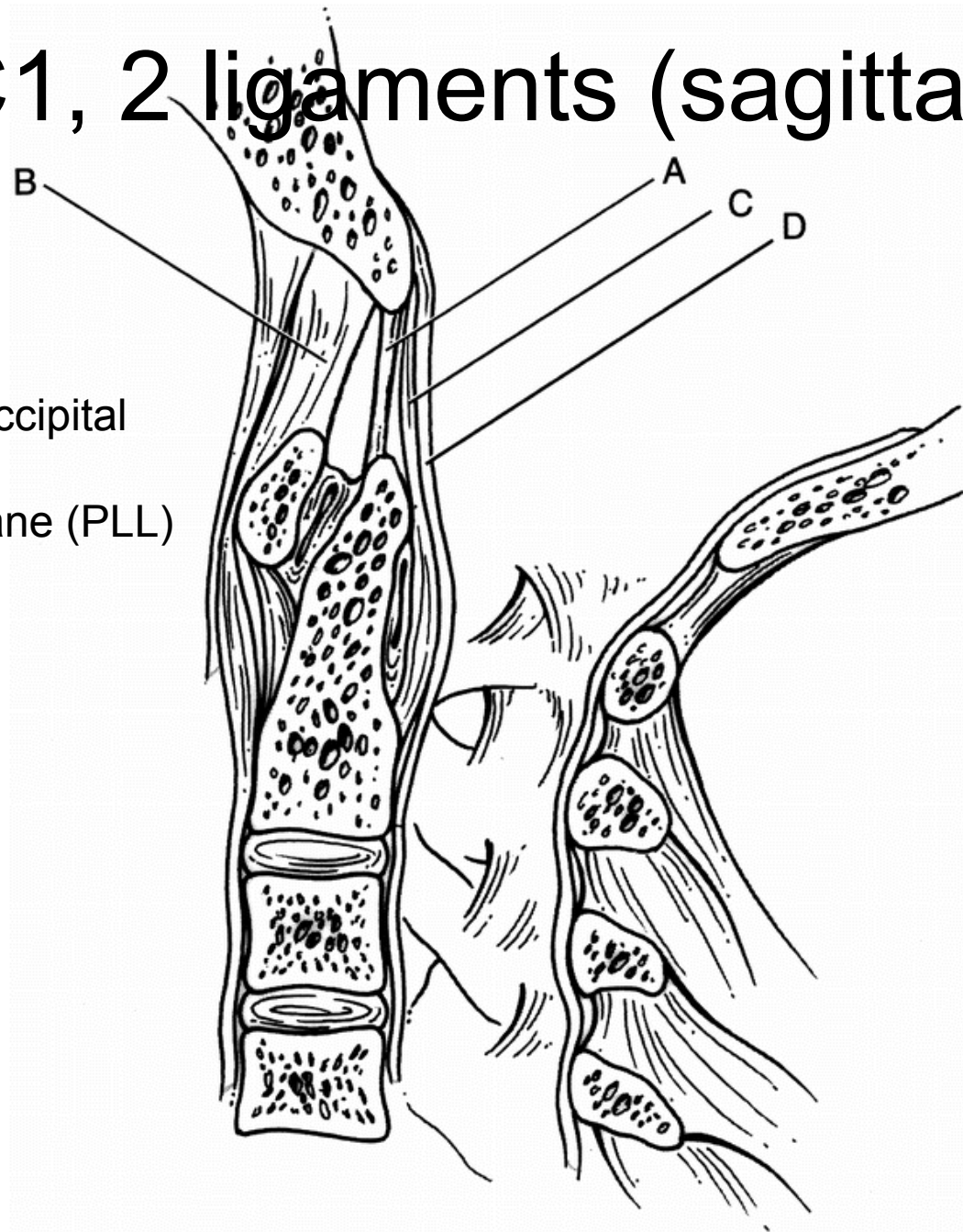
view)

A- apical
B- alar
C- criciform
D- tectoral



Draw C1, 2 ligaments (sagittal view)

- A- apical
- B- anterior alantooccipital
- C-cruciform
- D-tectorial membrane (PLL)



Movements allowed in the craniocervical region

Range of Joint Motion motion (degrees)

Occiput–C1 Combined flexion/extension 25
Lateral bending (unilateral) 5
Axial rotation (unilateral) 5

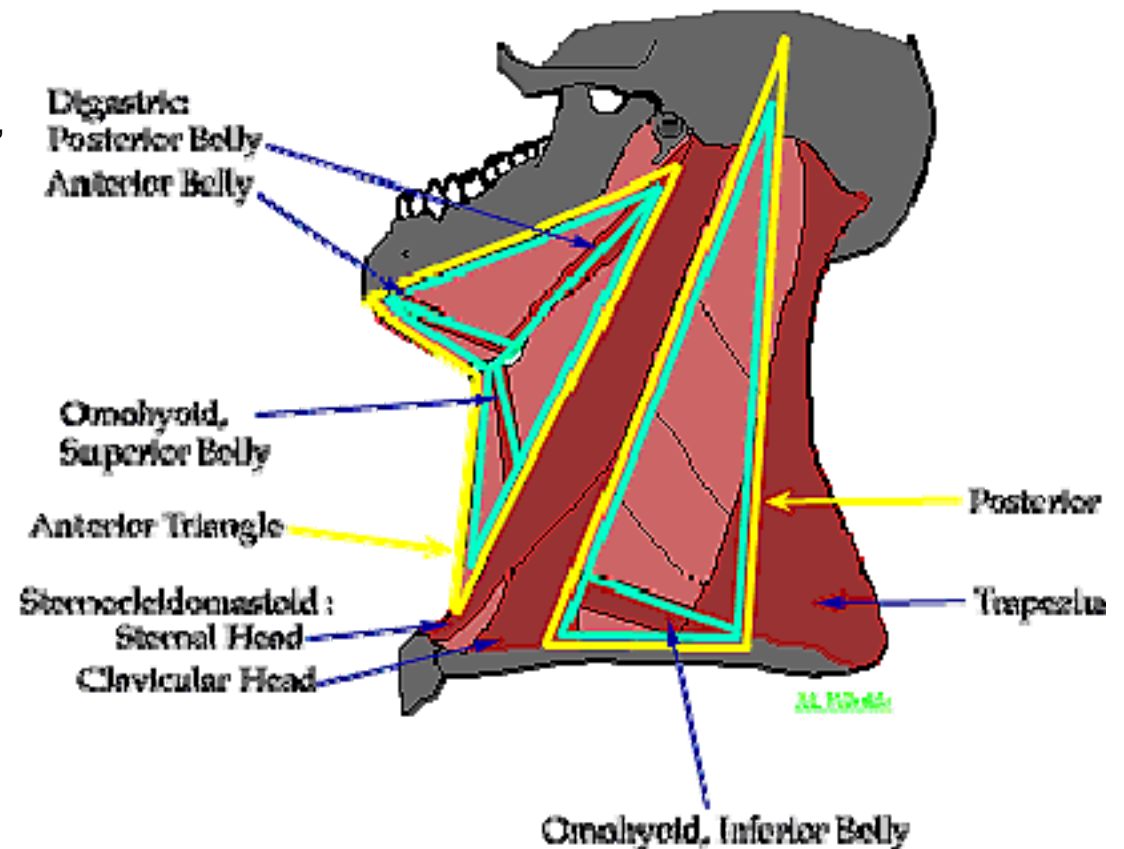
C1–C2 Combined flexion/extension 20
Lateral bending (unilateral) 5
Axial rotation (unilateral) 40

Surface anatomy of neck



Neck triangles

- Anterior triangle
 - 4 triangles:
 1. **muscular triangle**--formed by the midline, superior belly of the omohyoid, and SCM
 2. **carotid triangle**--formed by the superior belly of the omohyoid, SCM, and posterior belly of the digastric
 3. **submental triangle**--formed by the anterior belly of the digastric, hyoid, and midline
 4. **submandibular triangle**--formed by the mandible, posterior belly of the digastric, and anterior belly of the digastric
- Posterior triangle
 1. **supraclavicular triangle**--formed by the inferior belly of the omohyoid, clavicle, and SCM
 2. **occipital triangle**--formed by inferior belly of the omohyoid, trapezius, and SCM



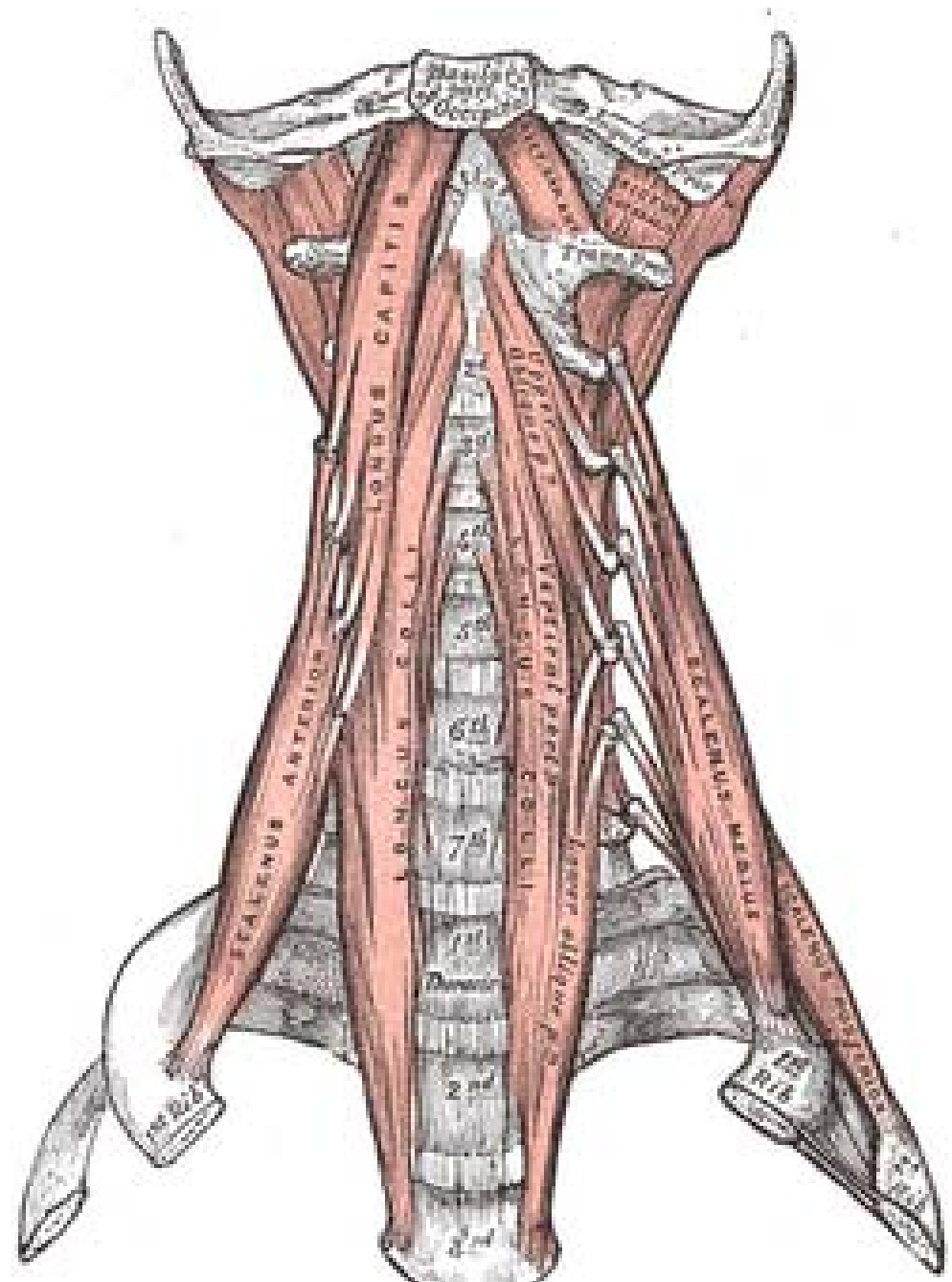
Cervical fascia

- Investing
 - surrounds entire neck, splitting to enclose the SCM and trapezius and parotid glands
- Visceral (pretracheal)
 - deep to infrahyoid, surrounds visceral space, including thyroid, trachea and esophagus
 - attached to hyoid bone and thyroid cartilage
 - laterall blends into carotid sheath
- prevertebral
 - surrounds vertebral column and muscles
 - within prevertebral fascia, anterior, slightly lateral lie cervical sympathetic plexus, usually at 1st rib level, C6, and atlantooccipital complex

Cervical musculature

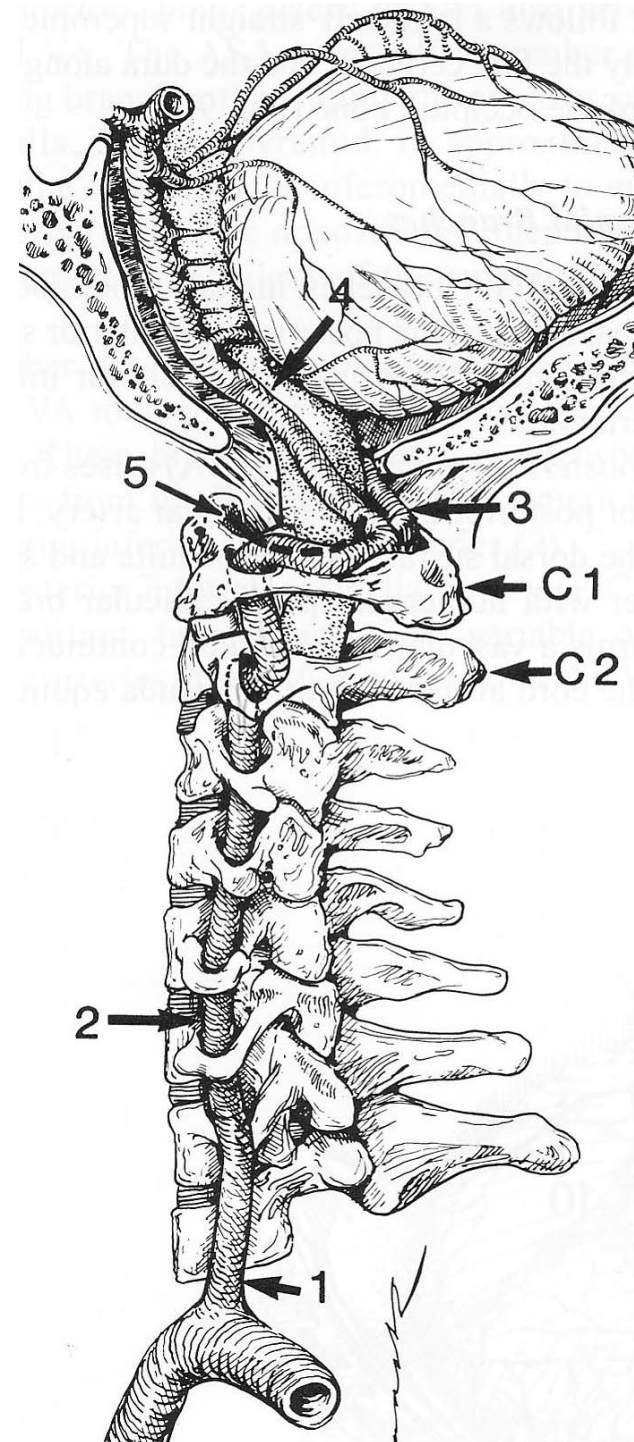
- superficial
 - **platysma, SCM, infrahyoid** (sternohyoid, sternothyroid, omohyoid, and thyrohyoid, innervated by ansa cervicalis (except thyrohyoid—CN XII)).
 - infrahyoid group helps swallowing
- deep
 - **scalene group**—anterior, medius, and posterior
 - form roof over cupula over lung; arise from transverse process; innervated by C4-C8 ventral rami
 - **longus group**--rectus capitis anterior, longus capitis, longus coli
 - ventral rami C1-C6, flex head and c spine

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The Vert

- The paired vertebral arteries arise from the **subclavian aa**
- They ascend through the transverse processes of the upper 6 cervical vertebrae
- Pass behind the lateral mass of C1 and enter the dura *behind* the occipital condyle
- Ascend through the foramen magnum and join to form the **basilar artery**



The Vert, summary of key pts of course:

- Ascends through foramen transversaria
- Accompanied by vertebral veins and sympathetic plexus fibers from cervicothoracic ganglion
- Medial to intertransverse muscles
- Lateral bend at atlas
- Curve back on superior surface of atlas
- Between **rectus capitis lateralis**, superior articular process of atlas
- With the ventral ramus of the first occipital nerve and curves with it horizontally around lateral and dorsal aspect of superior articular process
- Transverses articular process, dorsal arch of atlas, rostral to dorsal ramus of 1st cervical nerve
- Vertebral vein originates from plexus of veins from internal venous plexus and suboccipital triangle, accompanies vert through foramen transversaria and exits at (usually) sixth cervical transverse process

The Vert

The **extradural** part consists of 3 segments:

V1

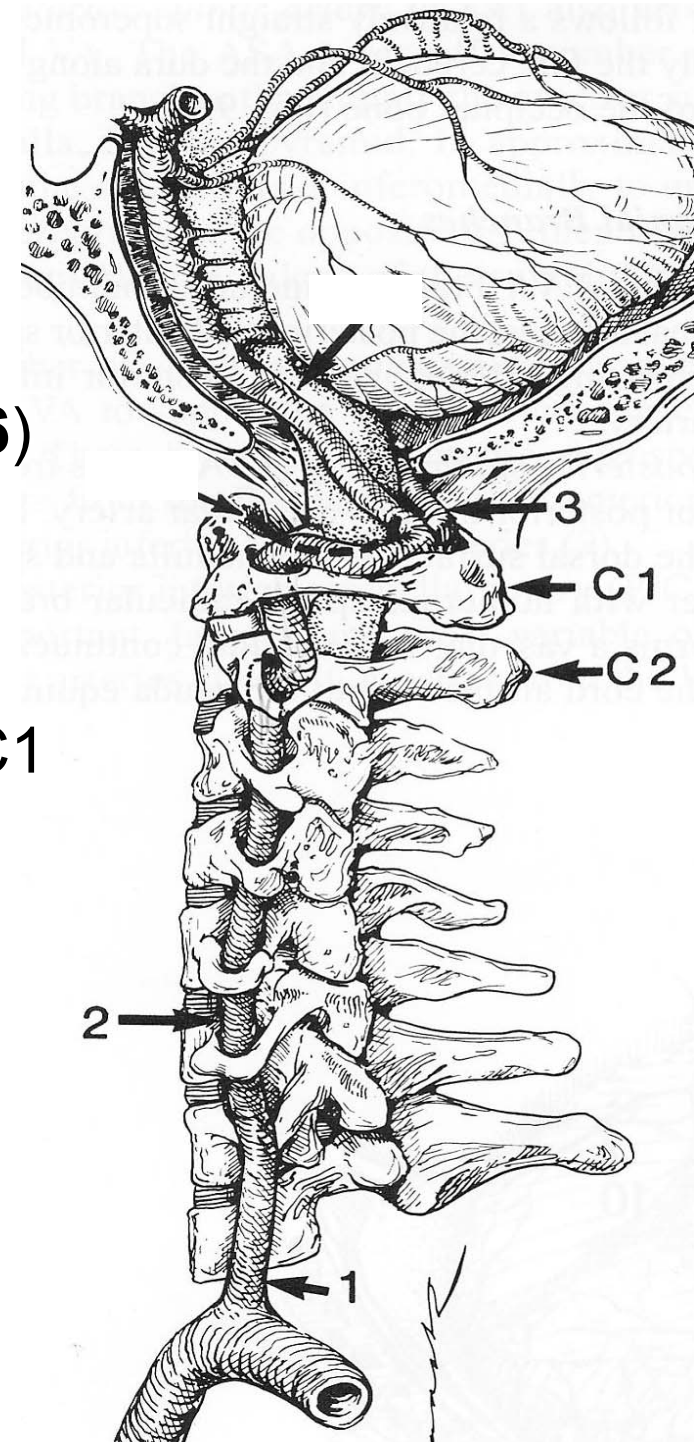
origin at subclavian a → lowest
transverse foramen (*usually C6*)

V2

ascending in foramen of the
transverse processes of C6→C1

V3

passes medially behind lateral mass of C1 and across the groove on the upper surface of the lateral part of the posterior arch of the atlas; then foramen magnum → dura



The Vert

V3:

passes medially behind lateral mass of C1 and across the groove on the upper surface of the lateral part of the posterior arch of the atlas; then foramen magnum → dura

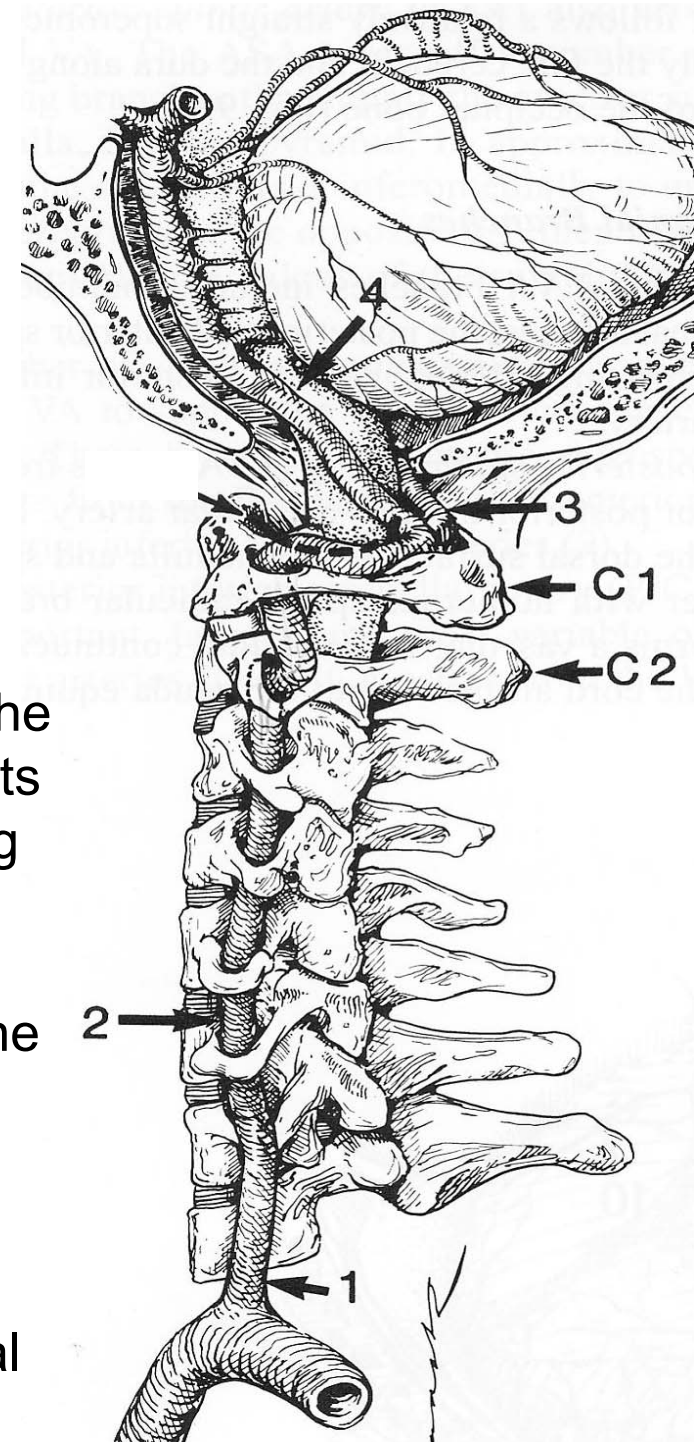
- Partially covered by **atlantooccipital membrane**, **rectus capitis**, and is surrounded by a **venous plexus** made up of anastomoses from deep cervical and epidural vv.
- 50% lie in a groove, 50% are surrounded by bone to some extent, or completely



The Vert

Anterior Meningeal Artery :

- arises from **medial** surface of **extradural** vertebral artery immediately above the transverse foramen of C3.
 - Enters the spinal canal and ascends *between the PLL and dura*, at the level of the apex of the dens, it courses medially to join its mate from the other side (forming an arch over the tip of the dens)
- Then sends branches to supply the dura in the region of the clivus, and anterior foramen magnum, and upper spinal canal
 - Anastomoses with ascending pharyngeal and dorsal meningeal aa



The Vert

V3 gives off ? branches:

- 1) **Posterior meningeal** from post VA as it courses around the lateral mass of the atlas- tortuous course then perforates the dura of the posterior foramen magnum

Ascends near falx cerebelli and divides near the torcula into several branches to supply the dura of the **posterior part of the posterior fossa**, and **posterior tentorium**, and posterior falx cerebelli

- 2) **Posterior Spinal A:** (may also arise from intradural VA or off PICA): courses medially, and upon reaching the lower medulla, divides into an **ascending** and **descending branches**

Ascending branch: through foramen magnum → **restiform body**, gracile and cuneat tubercles, rootlets of XI, and choroid plexus near foramen of Magandie

Descending branch: passes between dorsal rootlets on posterolateral surface of spinal cord and supplies the superficial **dorsal half of the spinal cord**, and anastomoses with radicular aa.



Also gives off branches to deep cervical mm and rarely, PICA

The Vert: intradural segment

The **intradural segment** begins at the dural foramina just inferior to lateral edge of foramen magnum- the dura here is thicker and forms a funnel over 4-6mm of the artery, the **posterior spinal aa** enter the intradural spinal canal through this same foramen, and the C1 root leaves extradurally through this foramen

Once inside the dura, the artery ascends from lateral → upper medial surface of medulla

The intradural component is divided into 2 segments : **lateral medullary** and **anterior medullary**,

The anterior medullary segment begins at the *preolivary sulcus* and passes in front (or between) rootlets of XII, and crosses the pyramid to join the contralateral VA to form the **basilar A** near the pontomedullary sulcus



Also gives off branches to deep cervical mm and rarely, PICA

Anterior-Posterior Anastomoses: On every boards:

1) PCom: ICA → PCA

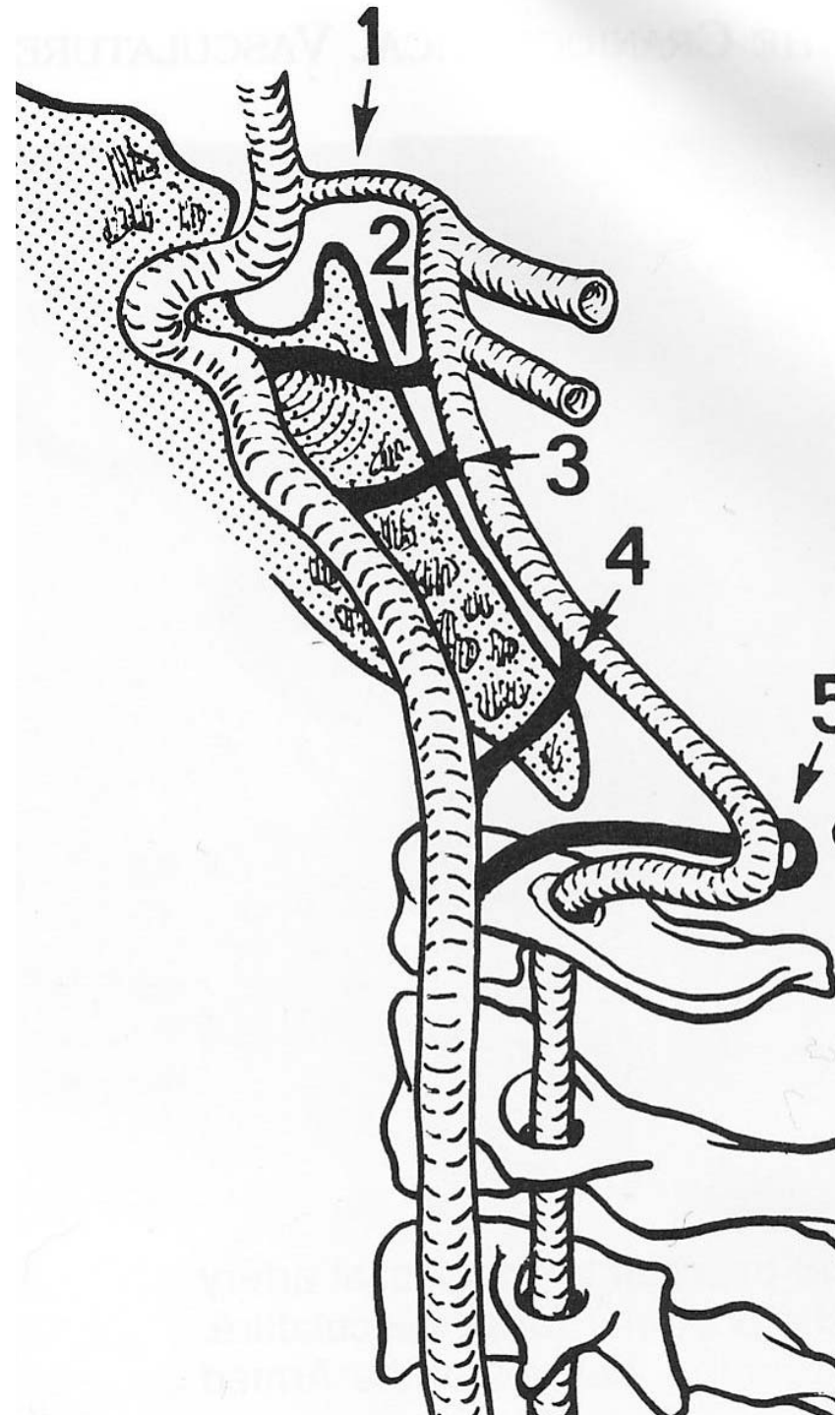
“Fetal” origin of PCA: PCA arises from PCom
Infundibulum: *junctional dilation* at origin at ICA

2) Primitive Trigeminal Artery: posterior cavernous ICA → Basilar (b/t SCA and AICA) **Most common** persistent fetal connection (0.1-0.5%)

3) Persistent Otic Artery: petrous ICA – through IAC → Basilar Very rare, almost never seen angiographically

4) Persistent Hypoglossal Artery: cervical ICA (C1,2)—hypoglossal canal → Basilar Second most common (0.1%), less common than PTA

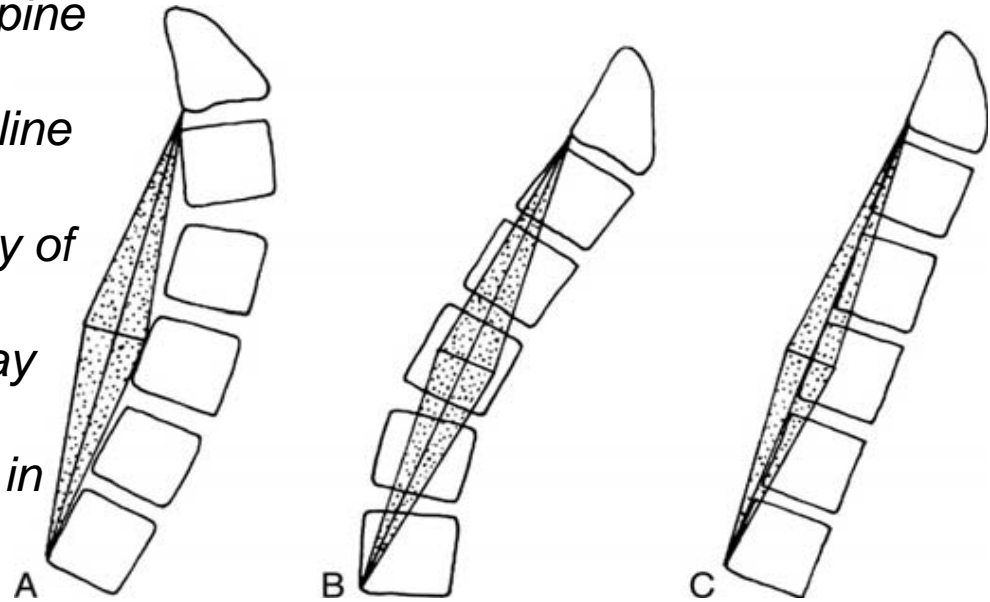
5) Proatlantal Intersegmental Artery: Suboccipital: cervical ICA → Vertebral Runs between arch of C1 and occiput Horizontal course along C1 ring



Non sequitur

- ***Non sequitur*** ([IPA](#): [nɒn 'sɛkwɪtər]) is [Latin](#) for "It does not follow," coming from the dependent verb sequor. The term may refer to:
 - [Non sequitur \(logic\)](#), logical fallacy
 - [Non sequitur \(rhetoric\)](#), a comment which has no relation to the comment it follows

A, a midsagittal section of the cervical spine configured in lordotic posture (“effective” cervical lordosis). A line has been drawn from the dorsocaudal aspect of the vertebral body of C2 to the dorsocaudal aspect of the vertebral body of C7 (solid line). The gray zone is outlined by the other lines. A midsagittal section of a cervical spine in kyphosis (“effective” cervical kyphosis).



B, note that portions of the vertebral bodies are located dorsally to the gray zone.

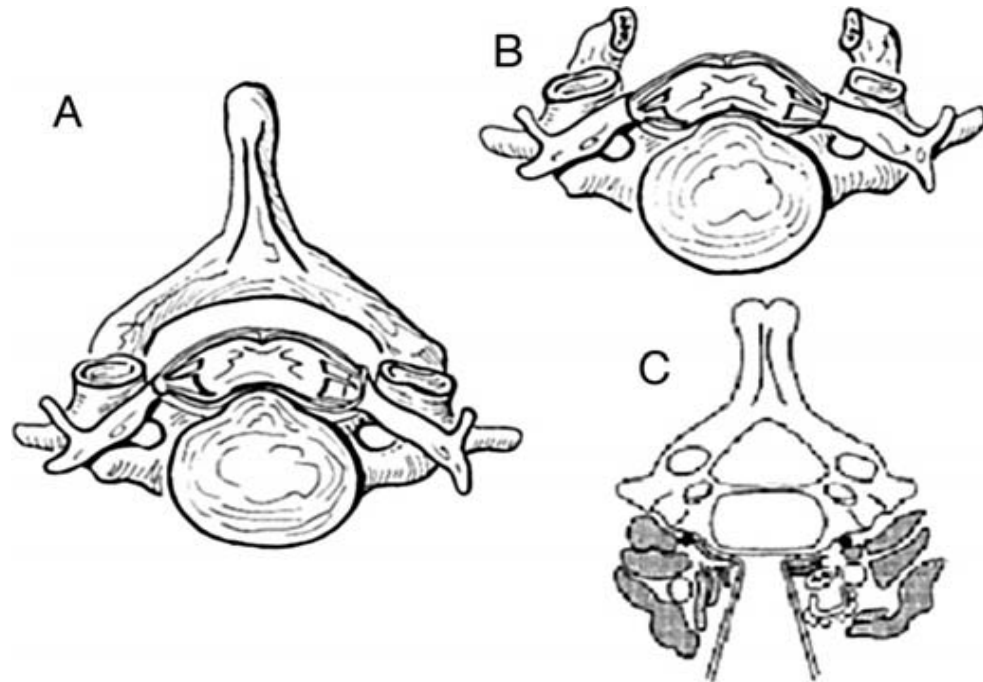
C, a midsagittal section of a “straightened” cervical spine. Note that the most dorsal aspects of the vertebral bodies are located within, but not dorsally to, the gray zone,

*Coronal plane tethering
("coronal bowstring"
effect).*

*A, the nerve roots, or,
more commonly, the
dentate ligaments, may
tether the spinal
cord in the coronal
plane.*

*B, laminectomy may not
relieve the distortion.*

*C, ventral
decompression is a
more-commonly
considered approach,*



*(from, Benzel EC: Biomechanics of Spine Stabilization. Rolling Meadows,
American Association of Neurological Surgeons Publications, 2001 [6]).*

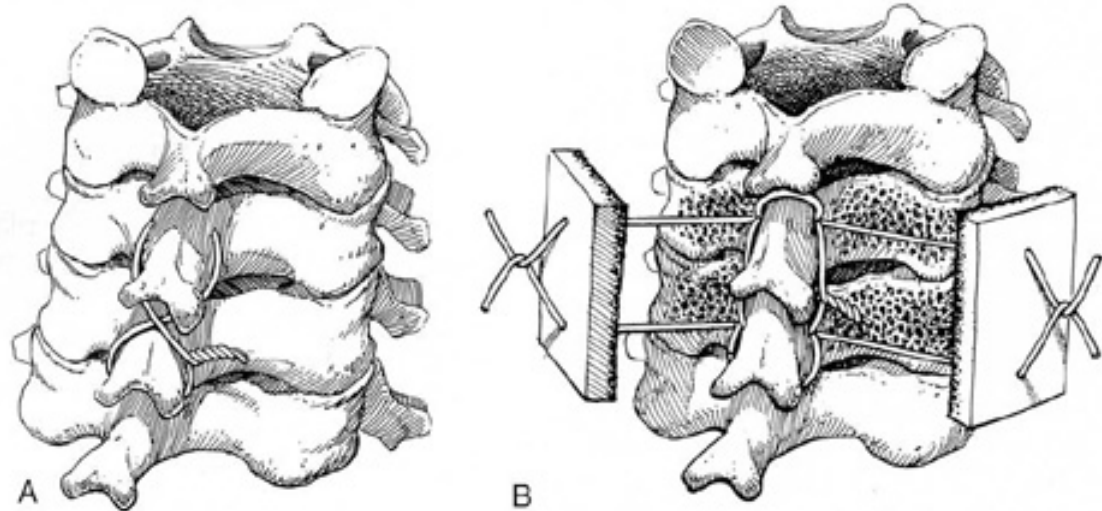
Approaches to occipital cervical region

- 1. Dorsal**
- 2. Ventral**
- 3. Ventral retropharyngeal**
- 4. Transoral**
- 5. Extended maxillotomy**
- 6. Transcondylar**

Spinous process wiring

*Left: The **Rogers interspinous** wiring technique in a figure-eight pattern.*

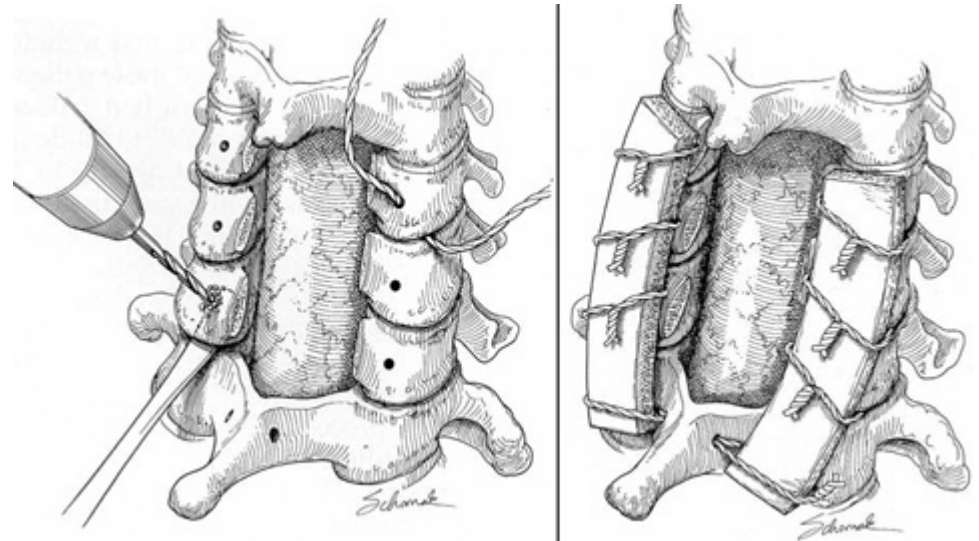
*Right: **Bohlman triplewire** technique. After using the Rogers technique, two separate wires are threaded through the holes in upper and lower spinous processes and corticocancellous bone grafts, which are fastened to the decorticated bone to promote fusion.*



Callahan facet wiring technique.

Left: This technique does not depend on intact laminae or spinous processes. Holes are drilled perpendicular to the inferior articular masses, and a cable is threaded through each articular mass in a rostral-to-caudal direction, exiting through the joint space.

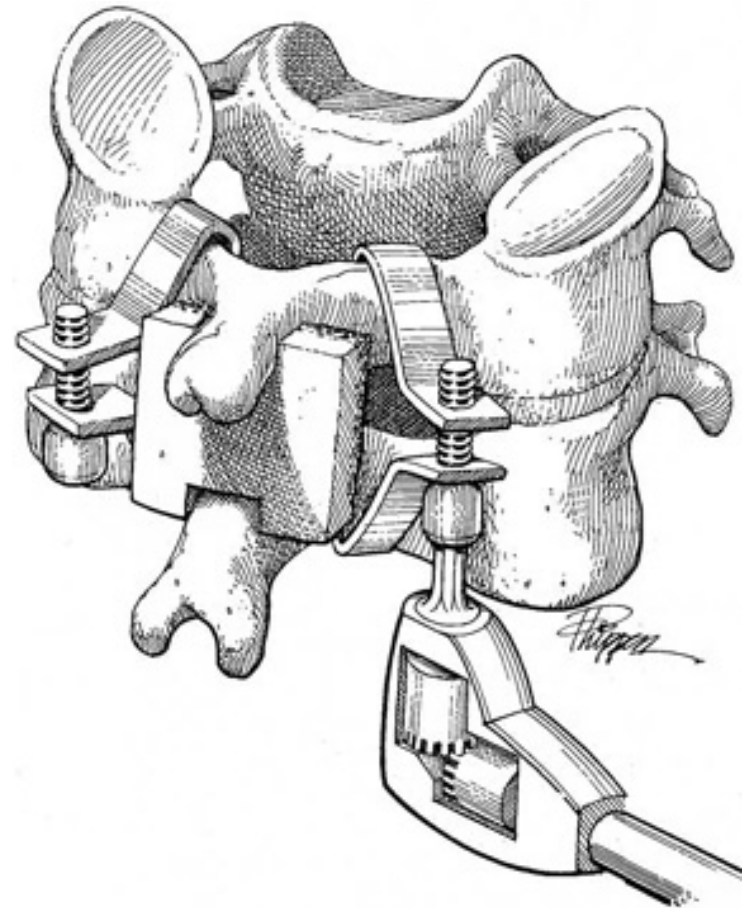
Right: Corticocancellous bone grafts are secured to the articular masses by tightening the wires.



Cahill oblique facet-to–spinous process wiring technique. A cable is passed through a drilled hole in the midportion of the inferior articular facet and is then looped beneath the spinous process one level below. The same steps are repeated on the contralateral side. (Reproduced



Halifax interlaminar clamps applied bilaterally to a single level with an interposed bone strut to promote spinal fusion and stability.



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The Magerl technique

The entrance point for screw insertion is located slightly medial and rostral to the midpoint of the lateral mass.

The direction of the screw is **25°** laterally in the axial plane and parallel to the facet joint in the sagittal plane.

The Anderson technique.

The entrance point for screw insertion is located 1 mm medial to the midpoint of the lateral mass. The direction of the screw is **10°** lateral in the axial plane and **30 to 40°** rostral in the sagittal plane.

The An technique.

The entrance point for screw insertion is located 1 mm medial to the midpoint of the lateral mass. The direction of the screw is **30° lateral** in the axial plane and **15° rostral** in the sagittal plane.

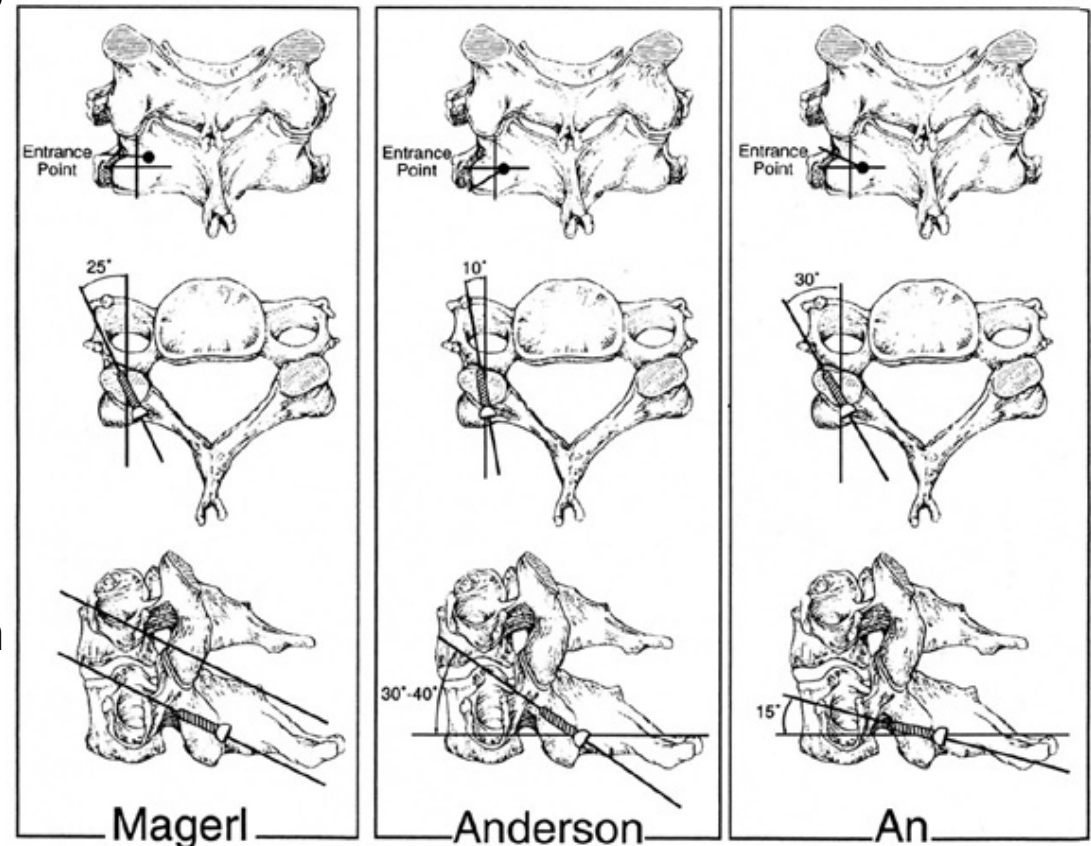


Fig. 8. A: Cervical pedicle screw (left screw) achieves rigid three-column fixation in contrast with lateral mass screw (right screw).

B: Placement of cervical pedicle screws requires precision and thorough knowledge of the anatomy to avoid damage to the vertebral artery and neural elements. The angle of the screw insertion can vary from **25 to 45° medial** to the midline in the axial plane (modified with permission from Jones EL, et al.)

C: In the sagittal plane, the angle of screw insertion should be parallel to the upper endplates for the pedicles of C-5 to C-7 and in a slightly cephalad direction for the pedicles of C-2 to C-4. (Reprinted with

