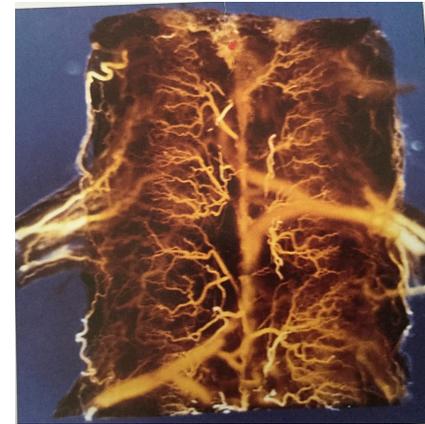


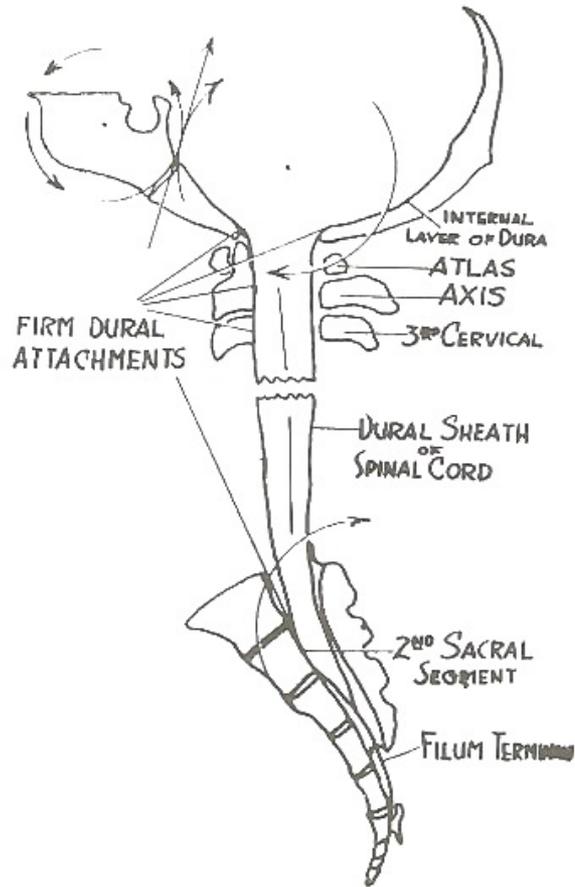
Diagnosis and Treatment of the Dura



- AOA Convention 2016
- Kenneth Lossing DO

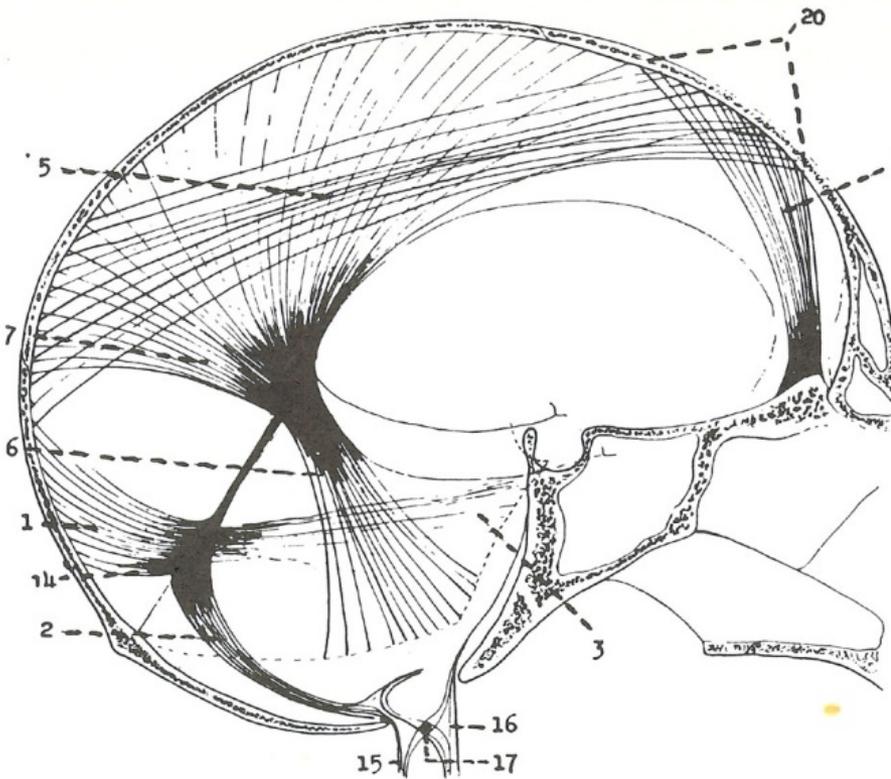


Sutherland Model, 1899-1954



- Based on palpation
- Patient supine
- **Spinal Dura ascends during inhalation phase**
- Falx Cerebri
- Falx cerebelli
- Tentorium cerebelli
- Diaphragm sellae

Arbuckle Model



- Based on dissection in **200 pediatric autopsies.**
- Found **white collagen** fibers regularly arranged in the yellow elastic fibers

Arbuckle Model

- 20 different regularly oriented directional fibers in Dura mater.
- **Anterior and Posterior spinal fibers.**

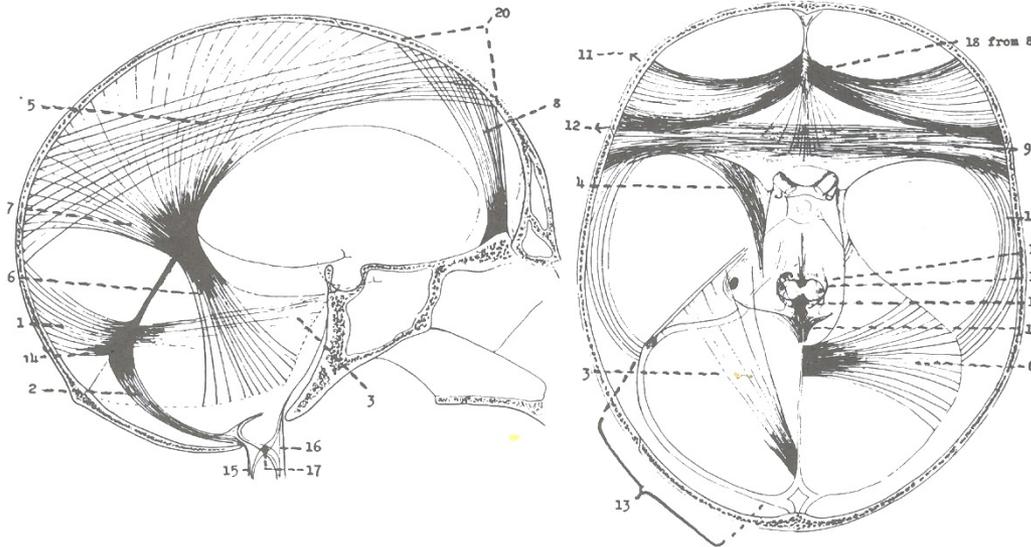


FIG. 1. — STRESS FIBERS OF THE DURA MATER

HORIZONTAL.

- 1. Falx cerebri inferior
- 2. Falx cerebelli—tripod—19 } —from torcular mass
- 3. Tentorium
- 4. Sphenoidal
- 5. Falx cerebri superior

VERTICAL

- 6. Tentorium
- 7. Falx cerebri posterior
- 8. Falx cerebri anterior—crista galli tripod—18

TRANSVERSE—9

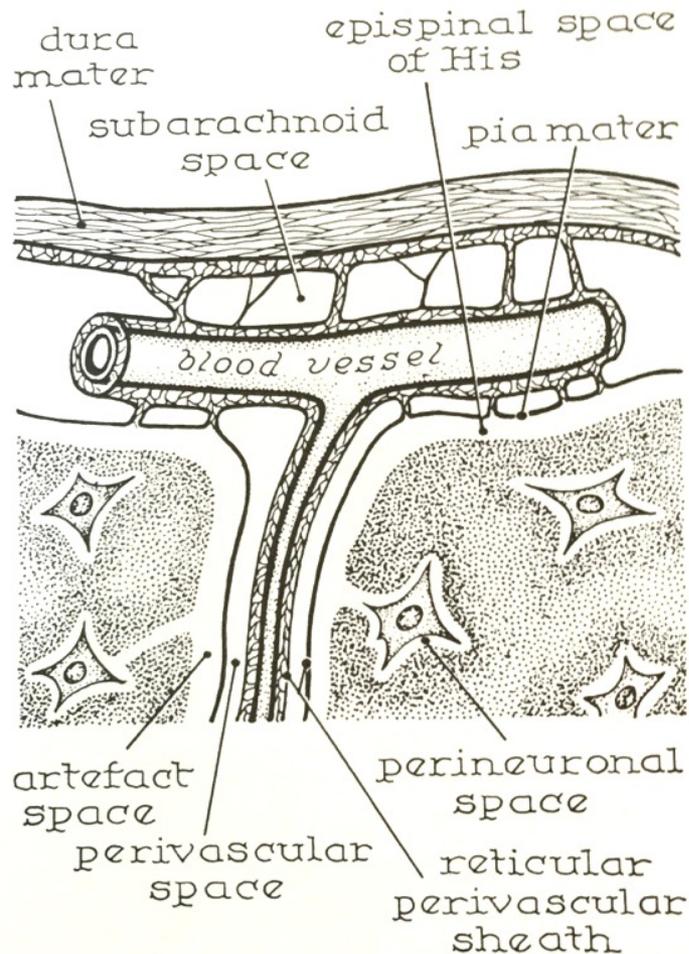
CIRCULAR

- 10. Squamosal
- 11. Vault { anterior } from metopic area—20
- 12. Vault { middle }
- 13. Vault { posterior }
- 14. Posterior fossa or cerebellar—from torcular mass

SPINAL

- 15. Posterior—tripod } 17 { lateral fibers intersect
- 16. Anterior—tripod } { around vertebral artery

Histology of the Dura Mater



- “As it’s name suggests (Dura mater= hard mother) this outermost membrane layer is of tough consistency and made of dense connective tissue. **The collagenic fibers tend to run longitudinally in the spinal Dura**, but more irregularly in the cranial Dura.”
- Type: Some histology books say dense regular, some say dense irregular, depending on where they looked.

Half a World Away- Dissection

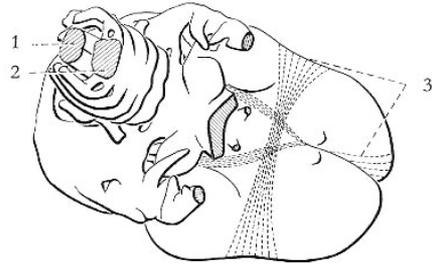


Fig. 175

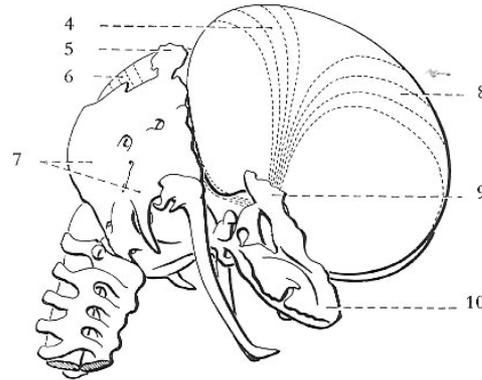


Fig. 176

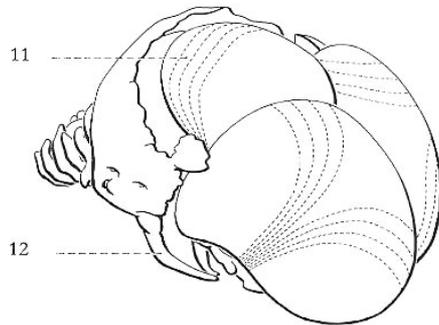


Fig. 177

- 3,8 –right frontal Dural girdle, anlagen of coronal and sagittal sutures, and part of falx.
- 4 –right parietal Dural girdle
- 6,11–occipital Dural girdle, connective tissue anlagen of lambdoidal suture

Dural Girdles

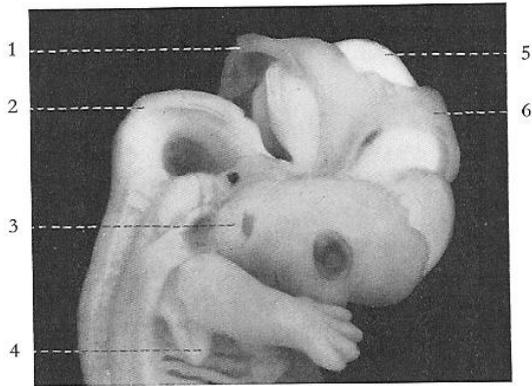


Fig. 178

- 1–retromesencephalic Dural girdle
- 6 –premesencephalic Dural girdle
- 7,12 –falx

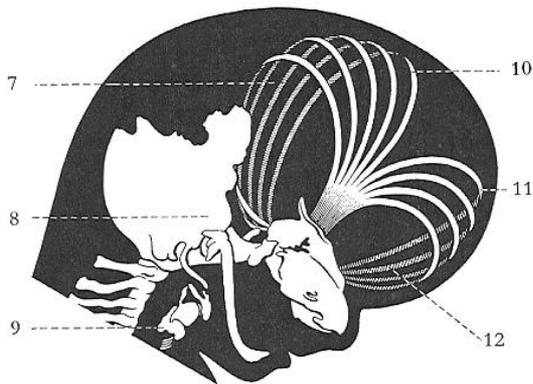
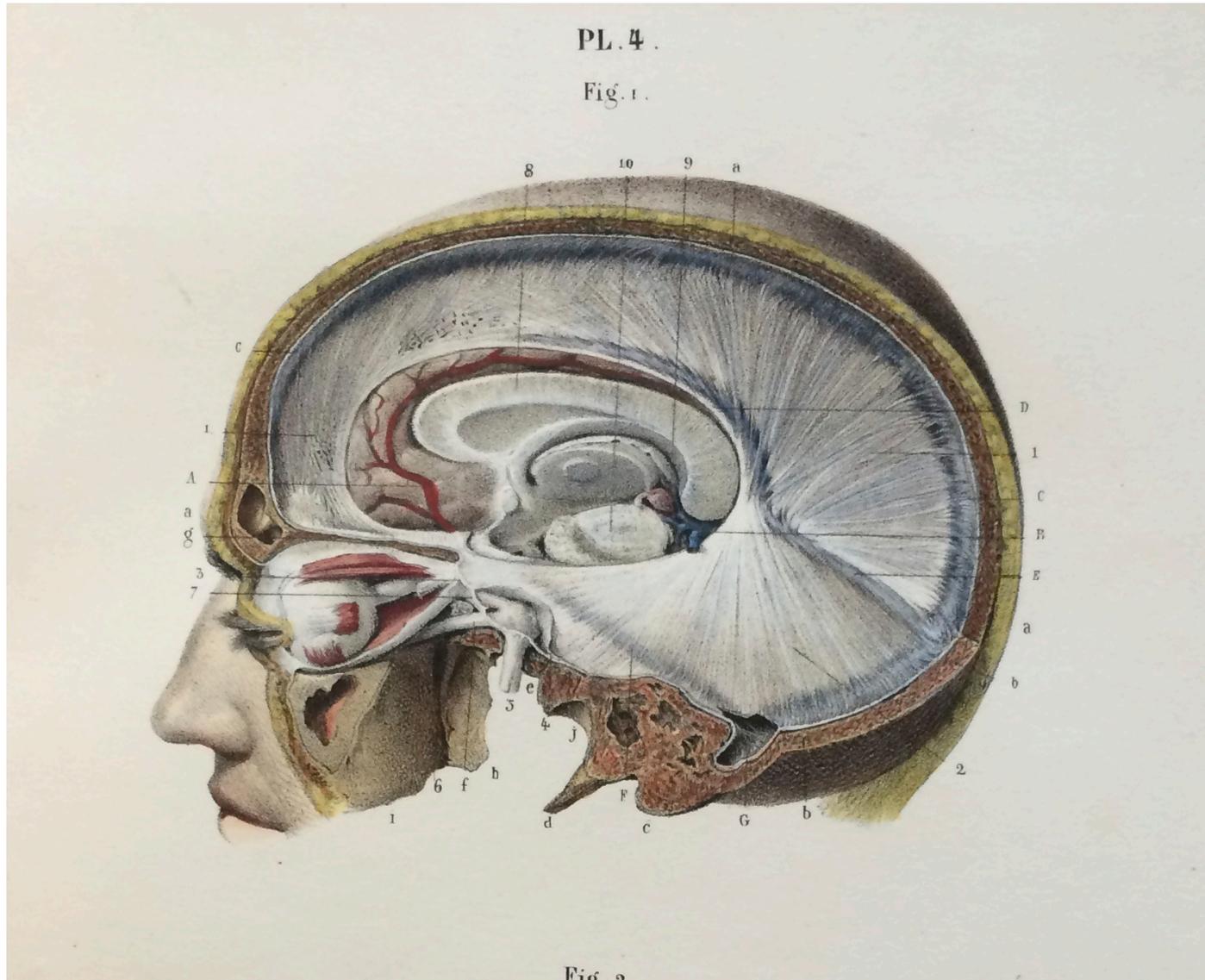


Fig. 179

Neurology, Hirschfeld, 1853 France



PL. 5.

Fig. 2 .

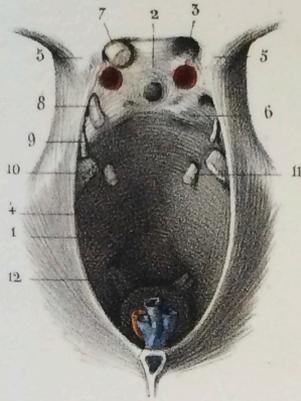
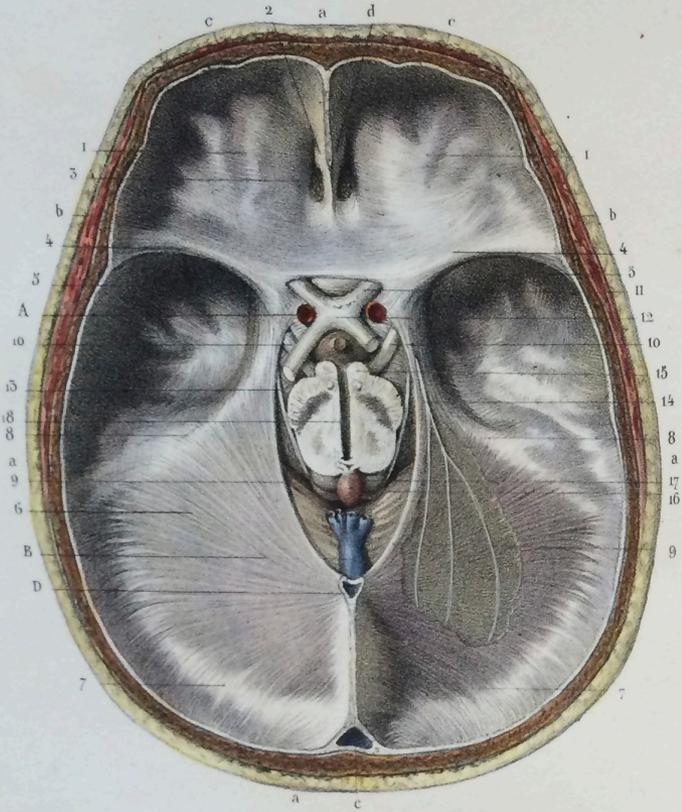


Fig. 1 .



Dessiné d'après nature par Linné

Fig. 3 .

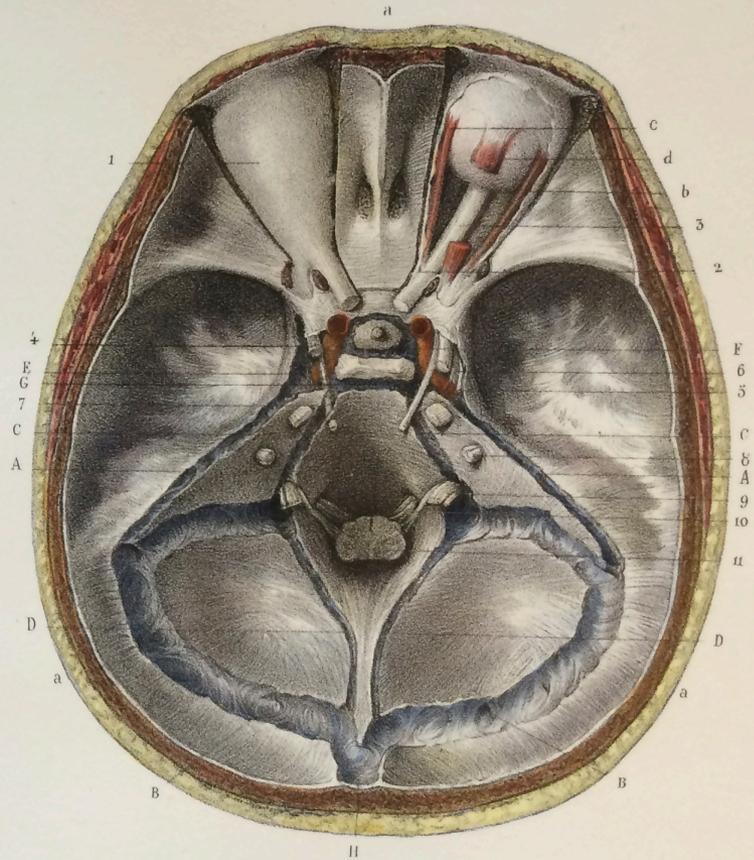
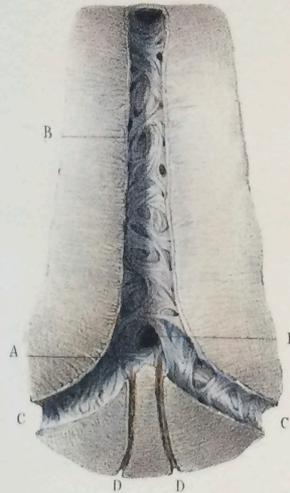
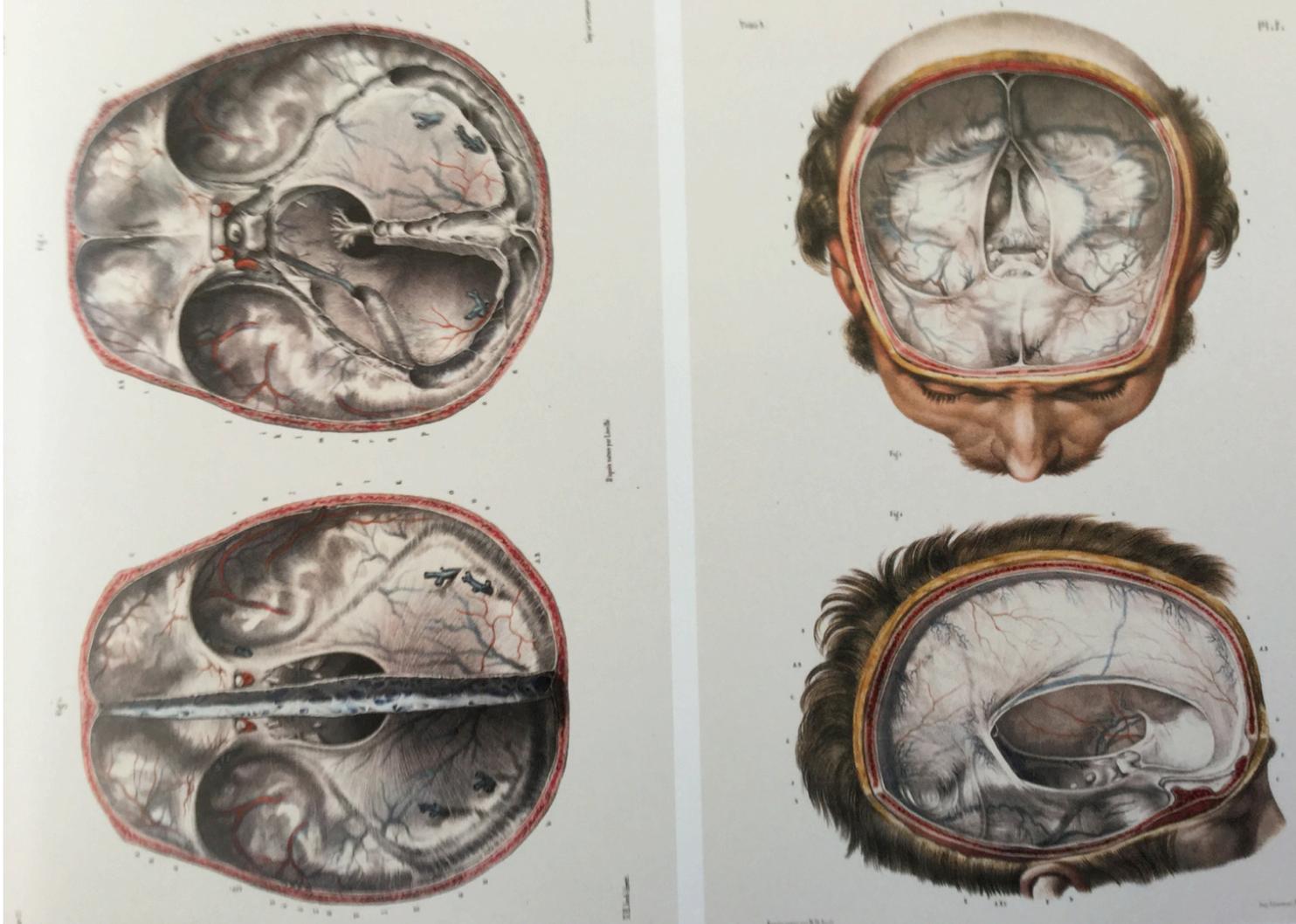


Fig. 4 .



Préparé par LUDOVIC.

1831-1854 France

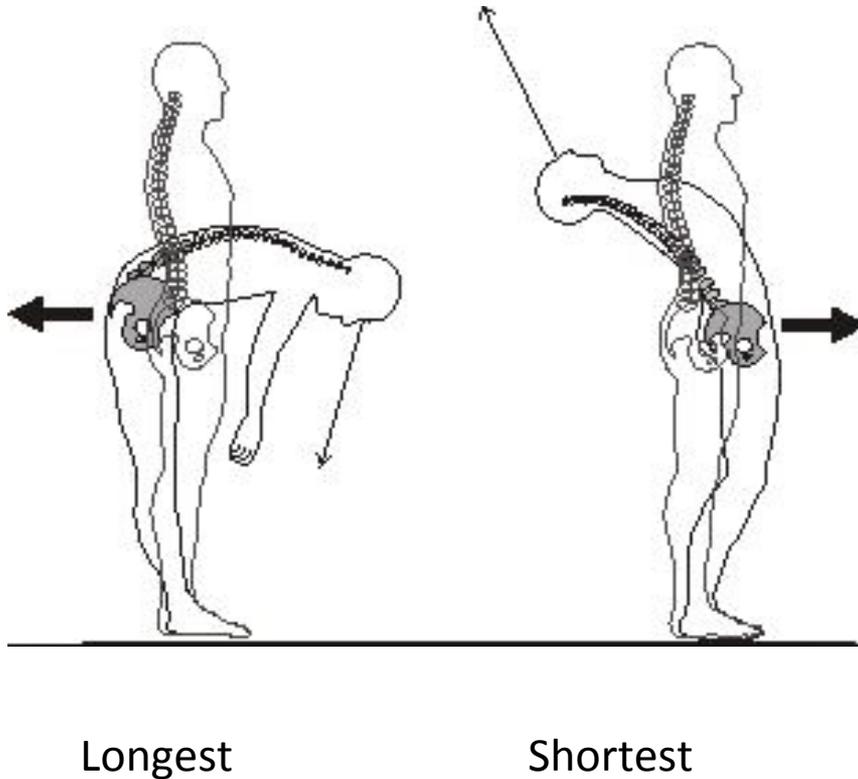


Atlas of Human Anatomy and Surgery,
Bourgery and Jacob

Biomechanics Terminology

- Elastic deformation
- Elasticity
- Plastic
- Stress
- Strain
- Viscosity/viscoelasticity
- **Terms from Breig**
- Telescoping
- Histodynamics

Breig Model 1978



- Surgical, radiological and cadaver studies
- The adult spinal canal lengthens 5-7cm from global extension to global flexion.
- **Axial movement of cord seen with respiration.**

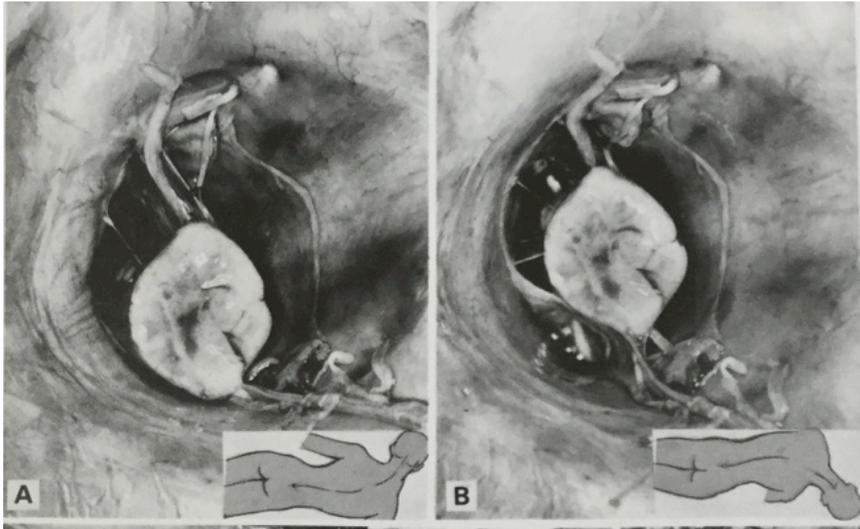
Spinal Cord, Cervical Spine



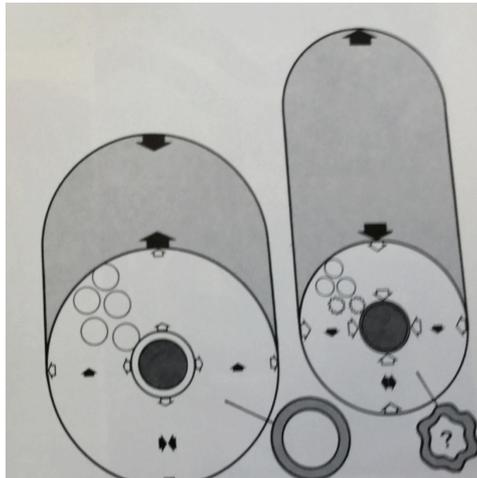
- Left is extension, the vasculature is relaxed
- Right is flexion, vasculature is stretched.

Cord Moves Inside of Spinal Canal

- On lateral flexion, the canal is lengthened on the convex side and shortened on the concave.
- In lateral flexion, the spinal cord moves to the side of increased tension, in left side bending the cord moves to the right side

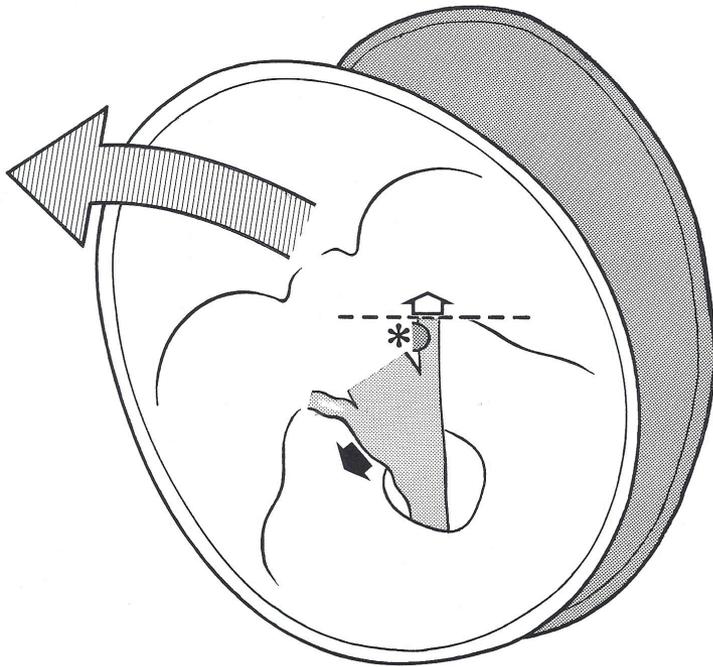


Cord Changes Length and Width



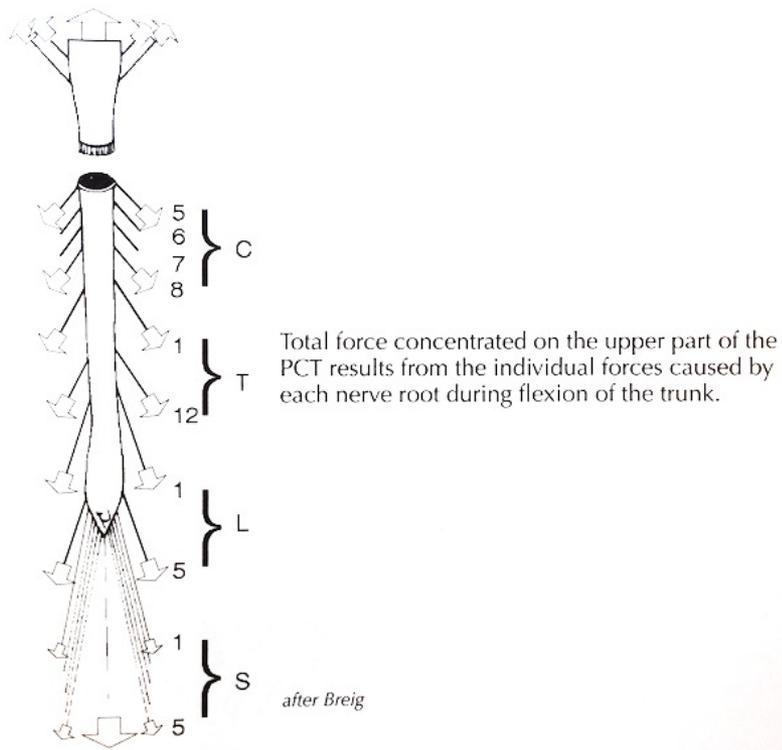
- Left illustration is compression, cord shortens and widens
- Right illustration is traction, cord lengthens and narrows.

Rotation of the Head



- Rotating the head to the left increases the tension in the right trigeminal nerve, and pulls the pons to the left.

Pons-Cord Tract, Transmission of Tension



- Mesencephalon, pons, medulla oblongata, spinal cord, cranial nerves 5-12, and **spinal nerve roots- all react** with plastic deformation of length and curvature to simultaneous alterations in the length and curvature of the spinal canal.
- **All tension in the nerve roots traction on the PCT.**

The atlas of anatomy and Surgery, Bourguery and Jacob 1831-1854, France



- What about the Dural extensions into the nerve roots?
- The **dura is tensed during limb movements** as a result of displacement of the the spinal nerves (Sunderland 1980).

Dura to the nerve roots

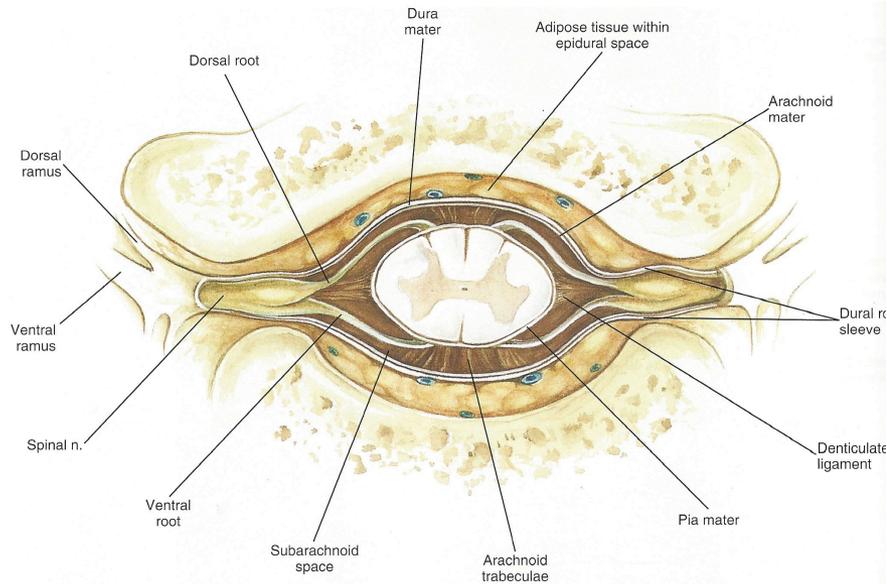
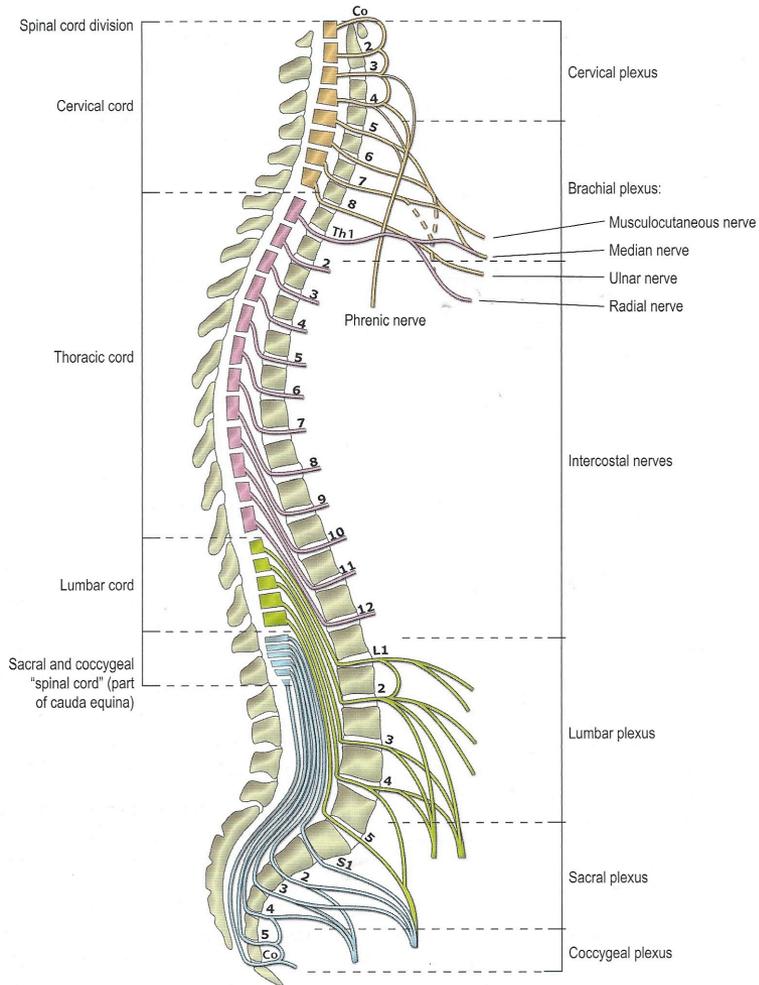


FIG. 3-12 Cross section of the spinal cord showing the meninges and dural root sleeves.

- The Dura extends past the junction of the ventral and dorsal nerve roots near the intervertebral foramen, and **blends with the epineural connective tissue** surrounding the spinal nerve.

What Does This Mean?



- Any tension in the cervical, brachial, lumbar, or sacral plexus affects the amount of tension in the whole Dura and brain (pons cord tract).

Fig. 1.4 General organization of nerve plexuses (after Lazorthes 1981).

Modern Dura Model

- The spinal Dura is suspended by the dentate ligaments, the brainstem by the cranial nerves.
- The pons-cord tract changes length by 4.5-7.5cm (0.8-1.4 cm brainstem, 1.8-2.8 cervical, .9-1.3cm thoracic, 1-2cm in lumbosacral cord) during dorsal extension and ventral flexion.
- The pons cord tract telescopes with dorsal extension.
- The Pons cord tract is continuous with the spinal nerve roots and peripheral nerves.

Modern Dural Model

- Lateral flexion changes the length, width and position of the PCT inside the spinal canal.
- Rotation changes the length, width and position of the PCT in the head and spinal canal.
- The PCT has a plastic adaption to movements of the body.
- Surgically the PCT is seen to move axially with respiration.

Modern Dural Model

- The Dura mater is composed of collagen and elastic fibers arranged in oblique, crossed and longitudinal bands which may be split into several layers.
- During surgery in the head, the cranial Dura was penetrated with extremely small force (not measurable) when the indenter tip was parallel to the predominant direction of the fibers, and 203 lbs. of force (903N), when at right angles (about 50% of the force required to penetrate the human skin).
- The PCT reacts to extremely small forces, less than a gram.

Testing the Dura

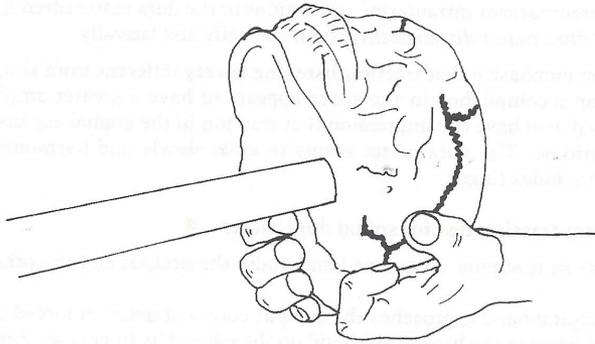


Fig. 5-17: Listening with traction on the cylinder of the dura mater

- Test during flexion or inhalation, add a traction.
- Keep eyes closed, visualize anatomy.
- Immediate resistance= cervical cranial area.
- Distensibility followed by resistance=lower Dura.

To Check Cranial Vs. Spinal Dura

- To find out if the Dura is more restricted in the skull or in the spinal area, place the patient supine, and do a local listening at C2. If the listening is superior-skull. If the listening is inferior-spinal Dura.

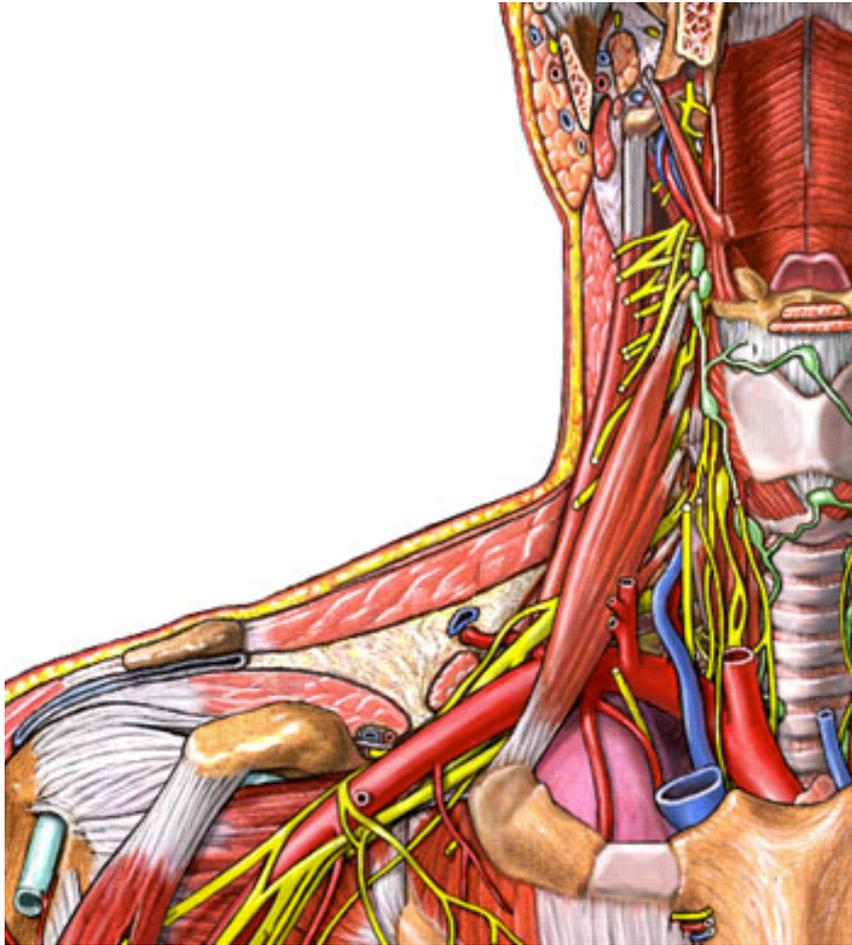
General Listening to the Dura



Fig. 5-5: General listening: seated position

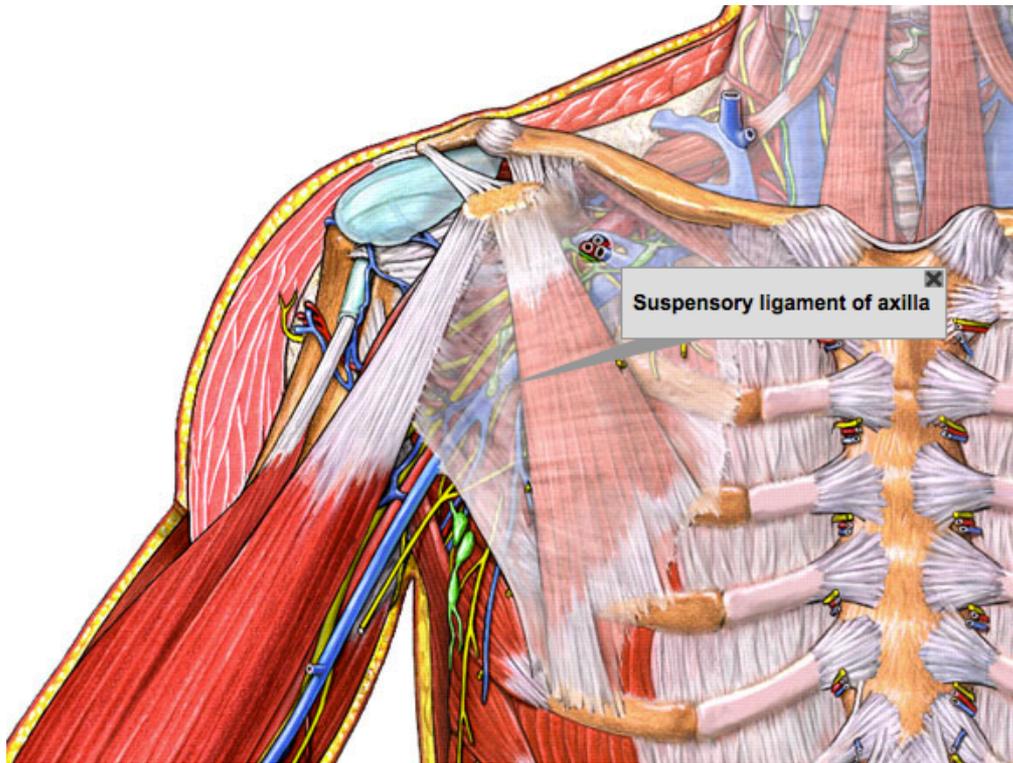
- By compressing the sacrum anteriorly and superiorly, and the cranium inferiorly, we put the spinal Dura on slack, and can listen to it more effectively.
- Listening straight inferior-cranial Dura.
- Listening inferior and a little lateral- cervical Dura.
- Listening inferior and quite lateral- lumbosacral Dura.

Brachial Plexus



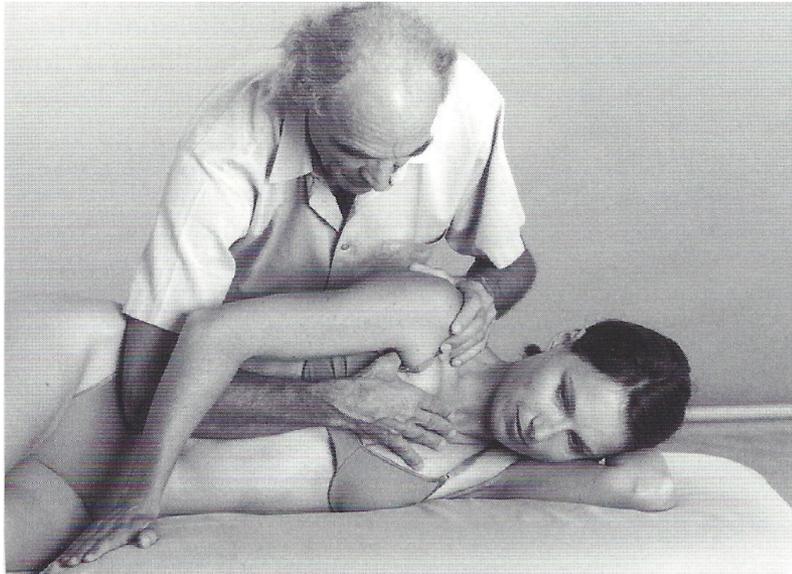
- The Brachial plexus passes between the anterior and medial scalene muscles, near the subclavian artery.

Brachial Plexus



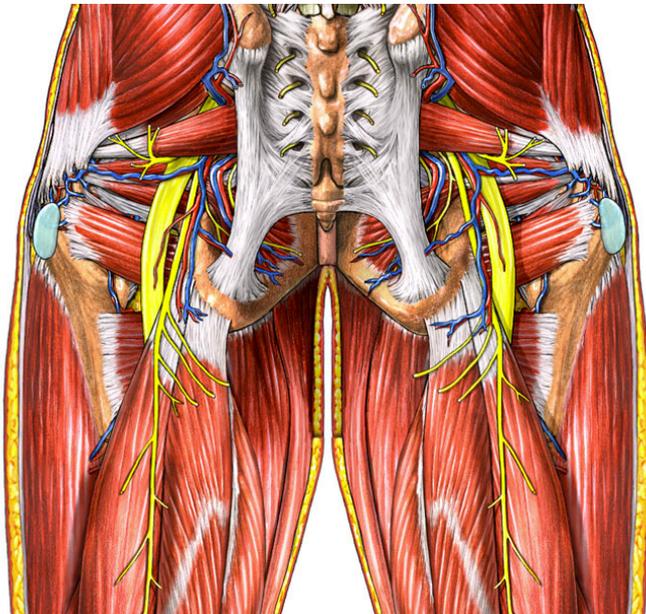
- The brachial plexus (C5-T1 roots) passes behind the clavicle, pectoralis major and minor muscles, along the axillary artery.

Treatment of the Axillary Fascia/ Brachial Plexus



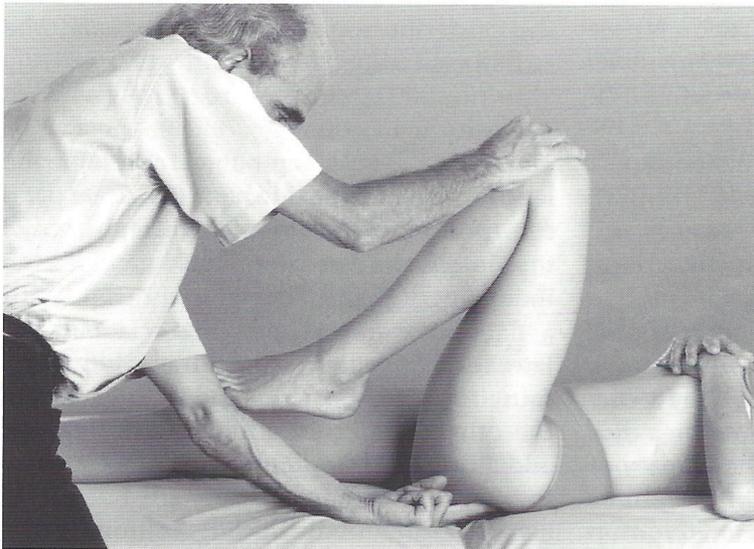
- On the side of a cervical area positive Dural listening test, first check the arm ROM.
- With the patient side lying, treatment side up, place your relaxed thumb near the top of the axilla, just behind pec. minor. Use your other hand on the shoulder to add a slight compression, while gently adding an anterior force to pec. minor, until it melts.
- Recheck arm ROM and spinal Dura test.

Sciatic Nerve



- The sciatic nerve receives roots from L4 to S3, passes through the greater sciatic foramen, and usually under the piriformis muscle, and over the superior and inferior gemelli muscles, and quadratus femoris muscle.
- At this location the nerve should be able to distend 1-2cm.

Sciatic Nerve Treatment



- On the side of a lower spinal Dura listening test, place your finger on the sciatic nerve. Gently engage it inferiorly. Use our other hand on the knee, bring the knee superior, lateral, then medial. Repeat 2-3 times.
- Recheck sciatic distensibility and Dural listening tests.

Testing and Treating Sacral Dura

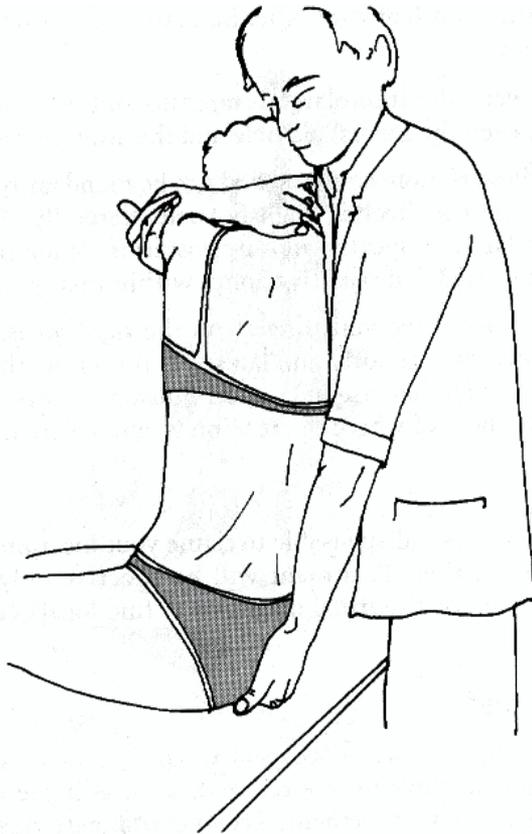


Fig. 5-26: Sacral dura mater test (seated position)

- To test posterior Dura: push the apex anteriorly, and slightly flex the spine. To test the anterior Dura, slightly extend the spine and push the sacral base anteriorly.
- To treat: Take the sacral Dura to the direction of the tension, follow the listening in the sacral hand, and unwind using the body as a lever arm. Repeat the motions until there is no restriction left.

Distending Spinal Dura, Supine and Prone

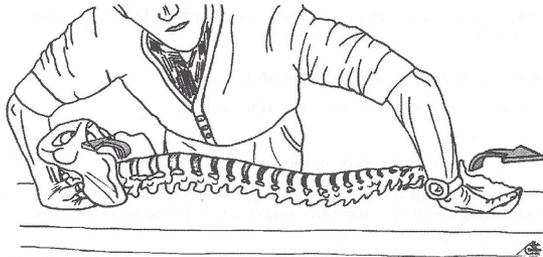


Fig. 6-13: Stretching via the ends of the spinal dura mater in supine position (skeletal view)

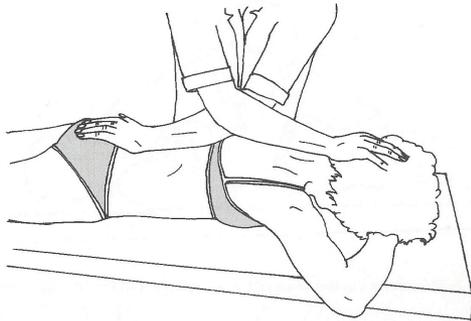


Fig. 6-14: Stretching via the ends of the spinal dura mater in prone position

- In Supine, flex the sacrum, and extend the occiput on C1, distract
- In the prone position, contact head and sacrum, engage the tension, distend.