Cerebrospinal Fluid And Its Influence On Health

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Cerebrospinal Fluid and its Influence on Health

1. Introduction

Cerebrospinal fluid (CSF) is a clear (colorless and transparent) ultrafiltrate of plasma contained within the ventricles of the brain and the subarachnoid spaces of the cranium and spine.

It is an alkaline (pH 7.4) extracellular fluid.

It performs vital functions, including providing nourishment, waste removal, and mechanical protection to the brain.

Some 150 ml of cerebrospinal fluid (CSF) is present around the central nervous system with a distribution of 125 ml within the subarachnoid spaces and 25 ml within the ventricles.

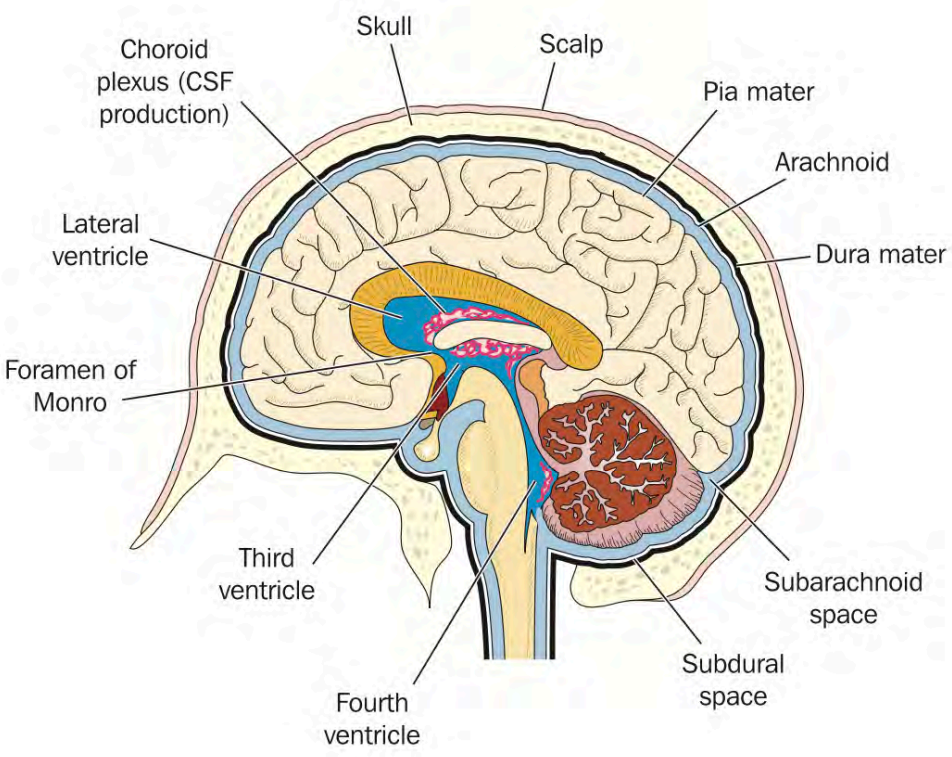


Figure 1 - Ventricles of the brain and subarachnoid spaces

2. Location and Movement

CSF movement is characterized by both circulatory and fluctuant movements:

- Circulatory movement due to hydrostatic pressure gradients occurs primarily with CSF secretion at the choroid plexuses, and with CSF resorption at the arachnoid granulations.
- The fluctuates is in a rhythmic ebb and flow in both the cranium and the spinal canal.

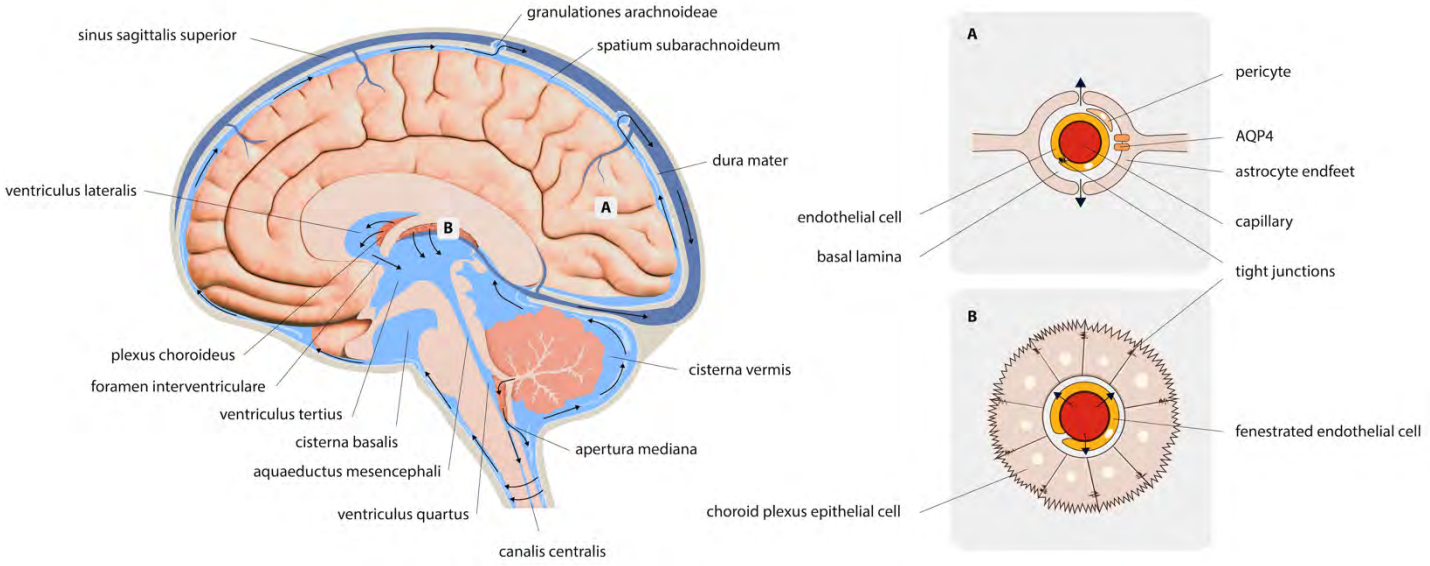


Figure 3 - Mobility of the cerebrospinal fluid

CSF is continuously secreted by the choroid plexus with a stabile composition and propelled along the neuroaxis from the site of secretion to the site of absorption.

This propelling is done by the rhythmic systolic pulse wave within the choroidal arteries.

It is scientifically not clear whether it concerns a real flow, an absorption/resorption process along the whole central nervous system or a combination of both.

Some other systems help the movement of the CSF but to a lesser extend:

- Respirational frequency.
- Posture.
- Venous pressure in the jugular vein.
- Physical effort of the individual.
- Even time of the day (sleep, rest or active).

Besides waste elimination, the glymphatic system also facilitates brain-wide distribution of several compounds, including glucose, lipids, amino acids, growth factors, and neuromodulators.

Intriguingly, the glymphatic system function mainly during sleep and is largely disengaged during wakefulness.

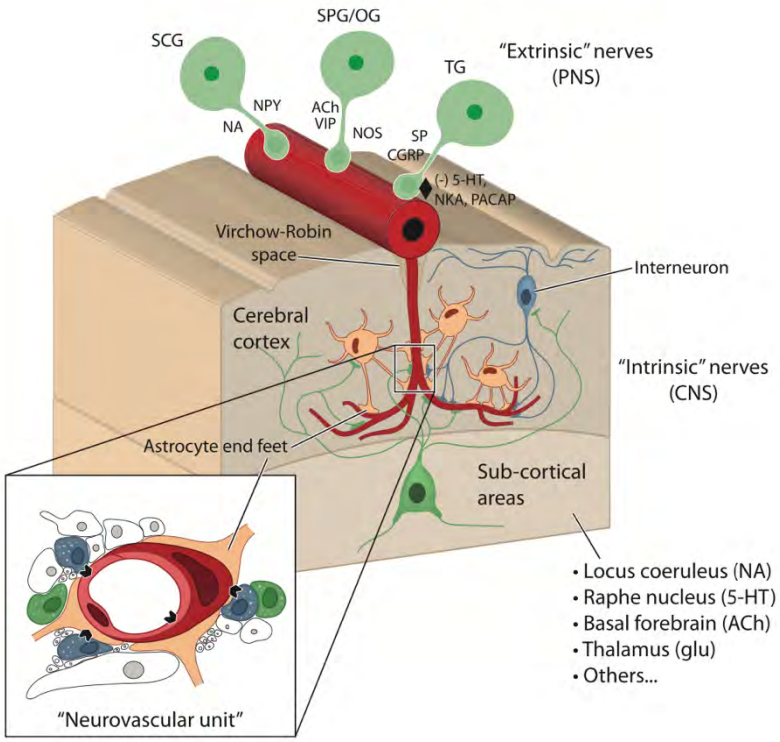


Figure 14 - Blood - Brain - Barrier

Symptoms:

- High fever (also in newborn).
- Stiff neck.
- Headache with vomiting and nausea.
- Sensitivity to light.
- Seizures.
- No appetite nor thirst.
- Sometimes skin rash.
- In newborn:
    - Fever.
    - Constant crying.
    - Sleepiness and irritability.
    - Vomiting.
    - Poor feeding.
    - Stiffness neck and whole body.
    - Convex fontanel.

5.3. Subarachnoid Hemorrhage

This is an extravasation of blood in the subarachnoid space (between pia and arachnoid membranes.

It is mostly caused by a head trauma, but it can also come spontaneously because of a ruptured cerebral aneurism or arteriovenous malformation.

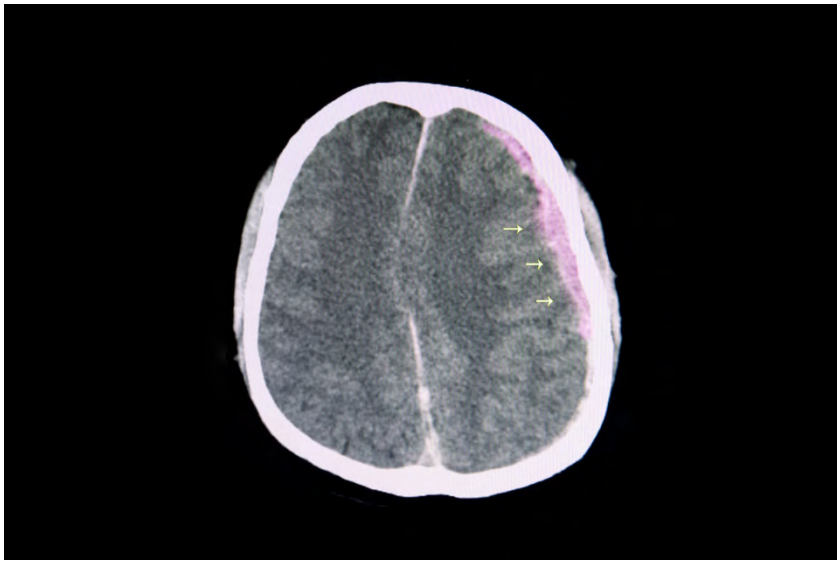


Figure 21 - Subarachnoid hemorrhage

The pressure gradient between the subarachnoid spaces and the venous sinus is also important to ensure CSF drainage. This pressure gradient is between 3 and 5 mmHg.

Villous absorption of CSF, either in the brain or in the spine is a dynamic process which adapts the filtration rate to CSF pressure.

Arachnoid villi in lumbosacral nerve roots increase CSF absorption in the upright position in response to gravity, and the absorbed CSF then enters the lymphatic system.

CSF can also be absorbed by the olfactory mucosa and the cranial and spinal nerve sheaths (especially from the trigeminal, optic, facial, and vestibulocochlear nerves), the ependyma and extracellular fluid according to pressure gradients.

From the cranial nerve sheets, it drains further in the lymphatic system.

Absorption towards the interstitial compartment occurs via Virchow-Robin perivascular spaces.

CSF stasis is associated with:

- Abnormal mechanical cord tension.
- Vertebral subluxation.
- Diminished respiratory function.
- Increased sympathetic tone.
- Facilitated spinal segments.
- Tension in the dura mater.

The reduction of CSF turnover may contribute to the accumulation of metabolites seen in aging and neurodegenerative diseases.

Stasis can produce what is known as plaquing in the brain.

There are many neurodegenerative diseases like Parkinson’s, Alzheimer’s, and multiple sclerosis that can come from plaque building up and metabolic wastes not being taken away.

We know that upper cervical techniques can sometimes bring a more normal flow back to the brain and spinal cord.

Upper cervical lesions (losses of mobility and/or positional abnormalities) can cause tractions on the brain and spinal cord, creating a reduced flow of CSF.

- Cryptococcal antigen.
- Glucose.
- Glutamine.
- Lactate dehydrogenase.
- Oligoclonal banding to look for specific proteins.
- Myelin basic protein.
- Total protein.
- Whether there are cancerous cells present.
- Opening pressure.

These laboratory tests look for:

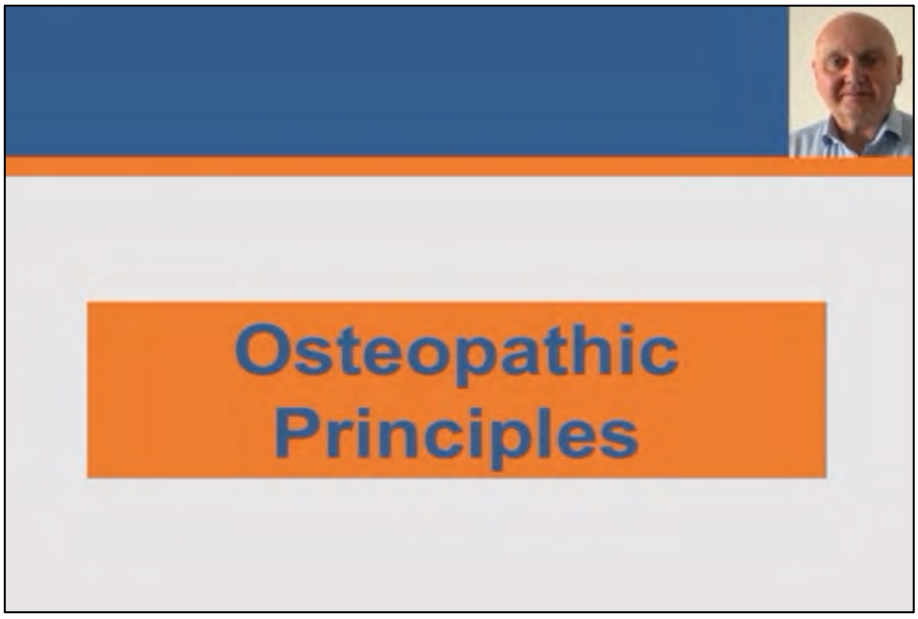
- Cancer.
- Encephalitis.
- Hepatic encephalopathy.
- Infection.
- Inflammation.
- Reye syndrome.
- Meningitis due to bacteria, fungus, tuberculosis, or a virus.
- Multiple sclerosis.
- Alzheimer disease.
- Amyotrophic lateral sclerosis.
- Pseudotumor Cerebrii.
- Normal pressure hydrocephalus.

These analysis search for structural diseases and this is of course very good.

Functional problems are here of a lesser concern.

Indications for testing the CSF through lumbar puncture:

- Severe headache.
- Stiff neck, longer than 2 weeks.
- Seizures.
- Confusion and hallucinations.
- fatigue, lethargy, or generalized muscle weakness.
- Consciousness disfunctions.
- severe nausea
- Persistent fever.
- light sensitivity
- Tremor.
- Generalized numbness.
- Poor coordination.



Video 1 - Osteopathic principles

8.2. Cardiovascular Approach

Concerning the quality of the CSF, we know that the arterial quality in flow and content as well as the venous drainage are important.

The central nervous system and CSF needs:

- Oxygen.
- Correct and sufficient nutrients such as glucose.
- Normal flow speed.
- Absorption of waste products and toxins.

To meet these qualities, we have to:

- Treat the heart – lung system by:
    - Correcting the eventual somatic dysfunctions $T_{1\text{-}5}$ (sympathetic relation to and from heart and lungs). This region is also responsible for the sympathetic tone of the arteries of skull and brain.
    - Correcting the eventual somatic dysfunction in the upper cervicals since they can have an influence through the vagus nerve on the function of heart and lungs.
    - Correcting the position and mobility of heart, lungs and diaphragm.
    - Correcting eventual muscle weakness of heart and specifically right atrium.
    - Increasing the exchange surface of oxygen and carbon dioxide.

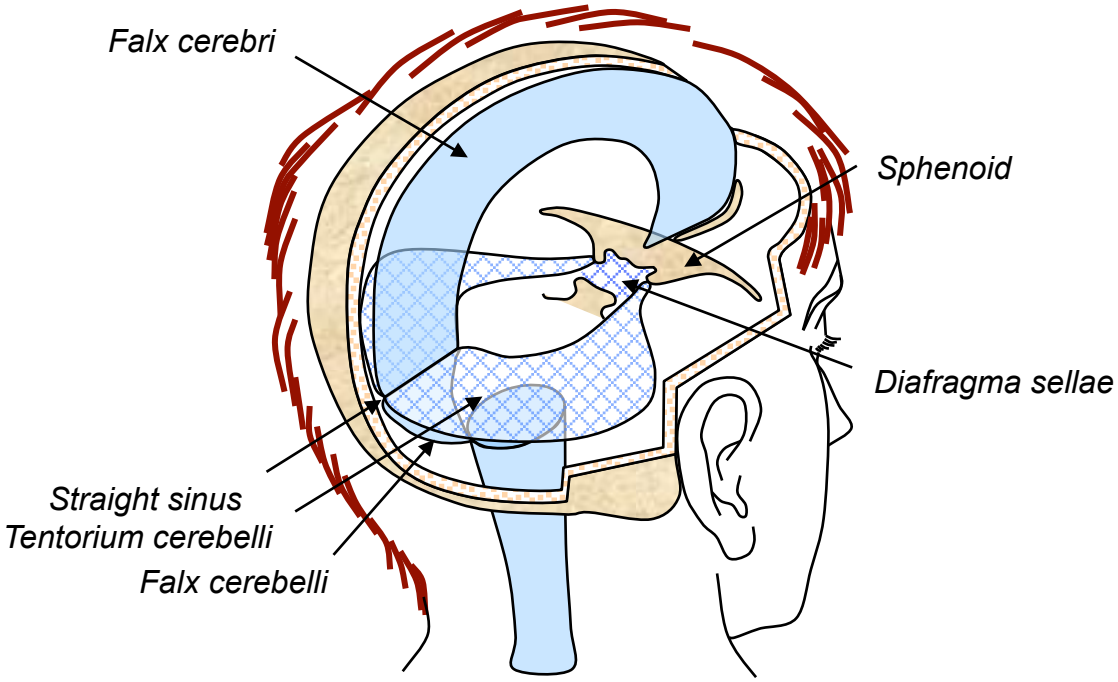


Figure 28 - The dural fascia in the skull

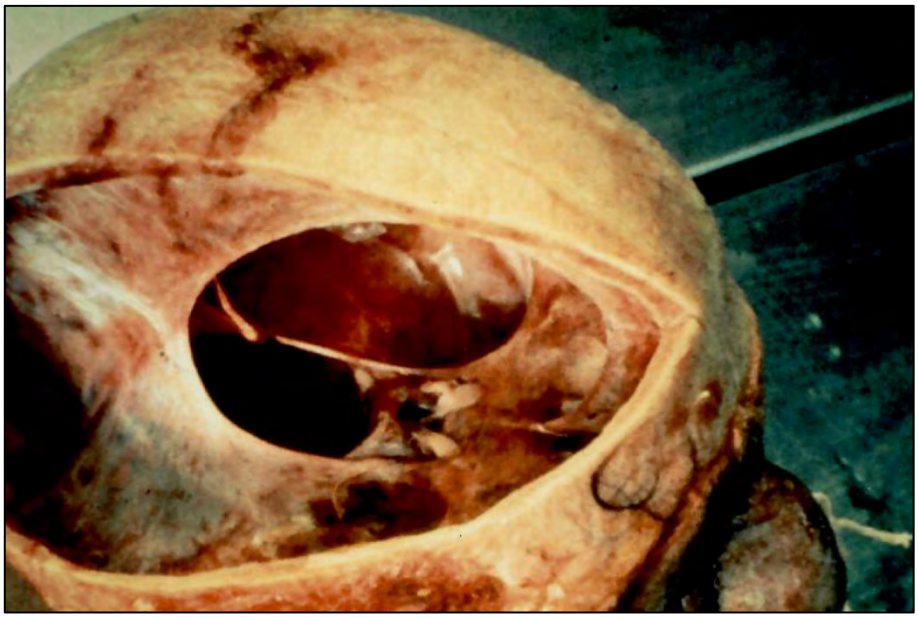


Figure 29 - The membranous system

The external part of the dura mater, the periosteal or endosteal layer covers the inner surface of the skull.

8.3.2.3. Frontal Plane Dysfunctional Proportions

- Central face-line not straight.
- Eye-line not horizontal.
- Ear-line not horizontal.
- Chin deviates.
- This means that the SBS is in a rotation/sidebending lesion.
- Possible cervical consequences:
    - Occiput in sidebending lesion.
- Possible TMJ consequences:
    - Unilateral compression lesion.
- Possible consequences on whole body posture standing:
    - Scoliosis with compensations in the frontal plane.

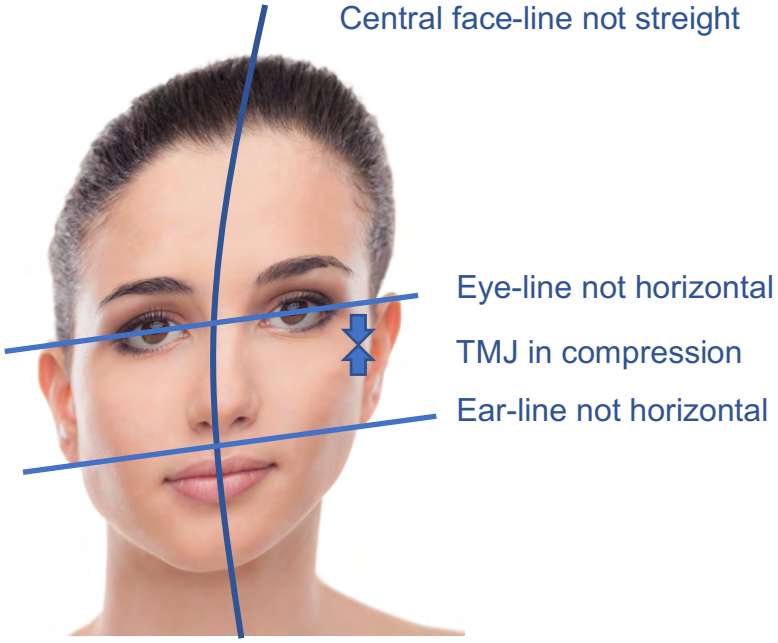


Figure 33 - Rotation/sidebending face or banana face

8.3.2.4. Horizontal Plane Dysfunctional Proportions

- One eye looks smaller and is closer to the table.
- One ear looks smaller and is closer to the table.
- This means that the SBS is in lateral strain
- Possible cervical consequences:
    - Atlas in rotation lesion.
- Possible TMJ consequences:
    - Unilateral posterior lesion.
- Possible consequences on whole body posture standing:
    - Rotational pattern in the horizontal plane.

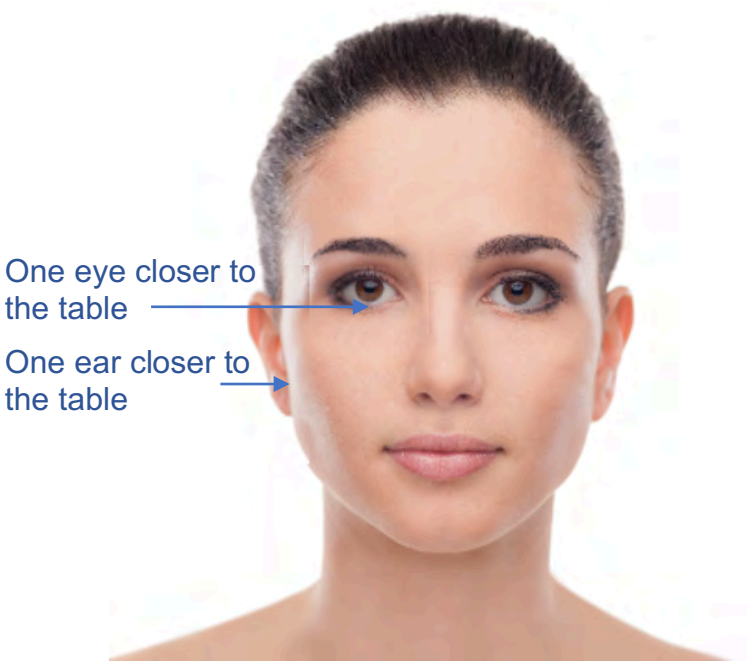


Figure 34 - Lateral strain deformity

Mobilization of the frontal bone

The patient is supine on the table.

The osteopath sits at the head of the patient.

The frontal bone is brought in a ventral (anterior) lift.

The frontal bone is then tested and mobilized:

- Around a craniocaudal axis in right and left rotation.
- Around an anteroposterior axis in left and right sidebending.
- Around a laterolateral axis in flexion and extension.

Video 3 - Mobilization of the frontal bone

Testing for mobility and mobilization use the same grips.

Rotation of the temporal bones

The patient is supine on the table.

The osteopath sits at the head of the patient.

The osteopath contacts both temporal bones.

Video 9 - Rotational correction of the temporal bones

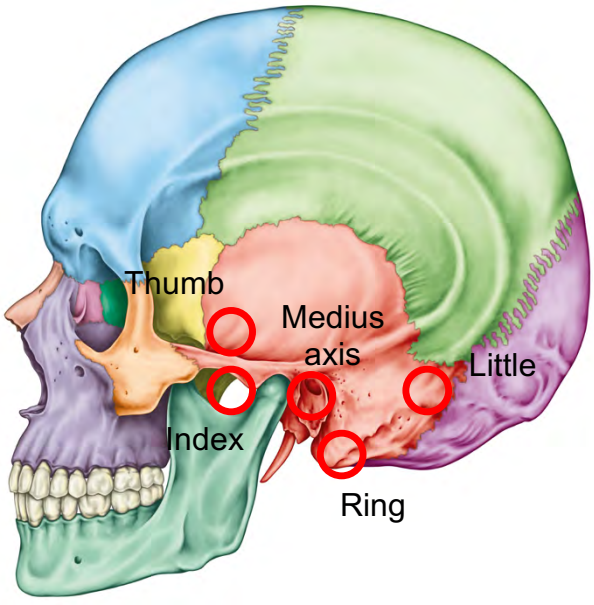


Figure 41 - Finger position on the temporal bone

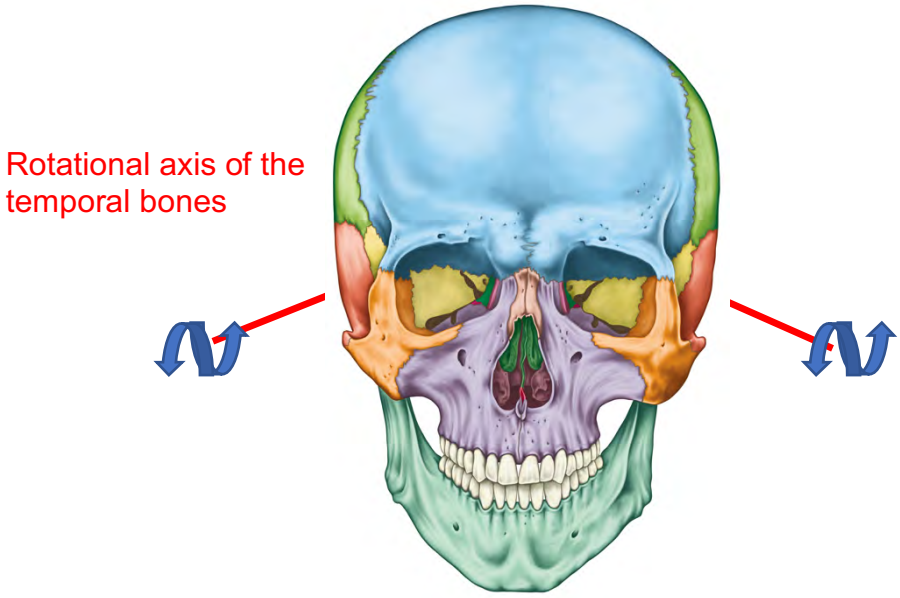


Figure 42 - Rotation of the temporal bones

When we correct the rotation of the temporal bones, we have to realize that we do this with the patient in a supine position.

However, asymmetrical tractions from below (sternocleidomastoideus for example) can in a standing position influence the rotational symmetry of the temporal bones.

It is therefore important to correct all spinal somatic dysfunctions to get a balanced posture in a standing and sitting position (influence of gravity).

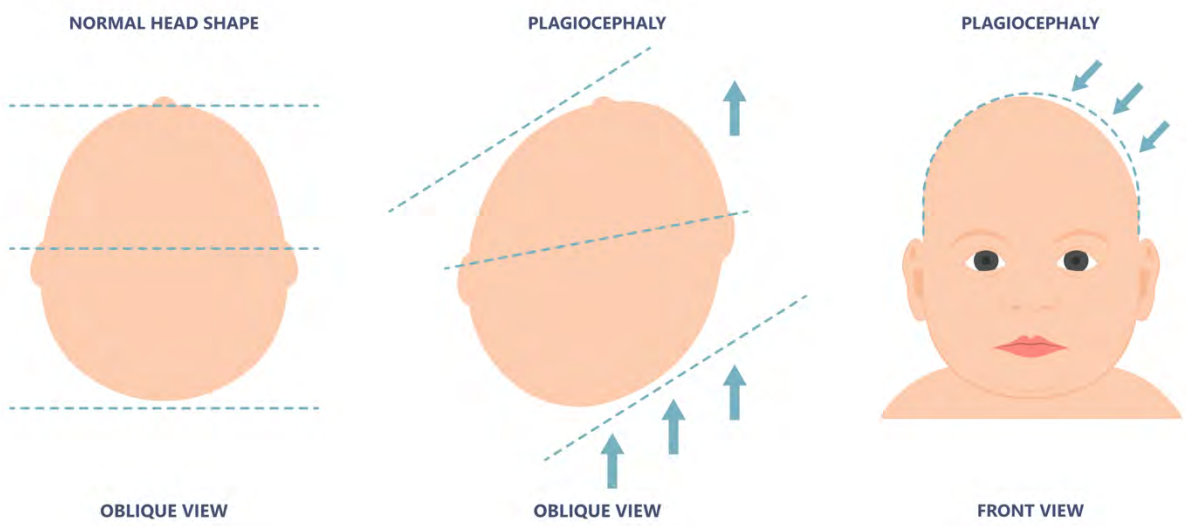


Figure 46 - Typical plagiocephaly

A pillow under one side of the skull during sleep is an option.

Prone position of the baby when he/she is awake works preventive and corrective.

An example of postural correction

Flat head syndromes

In these cases, the posterior side of the head is flattened.

Beside the local osteopathic treatment, the correct pillow can cure this problem.

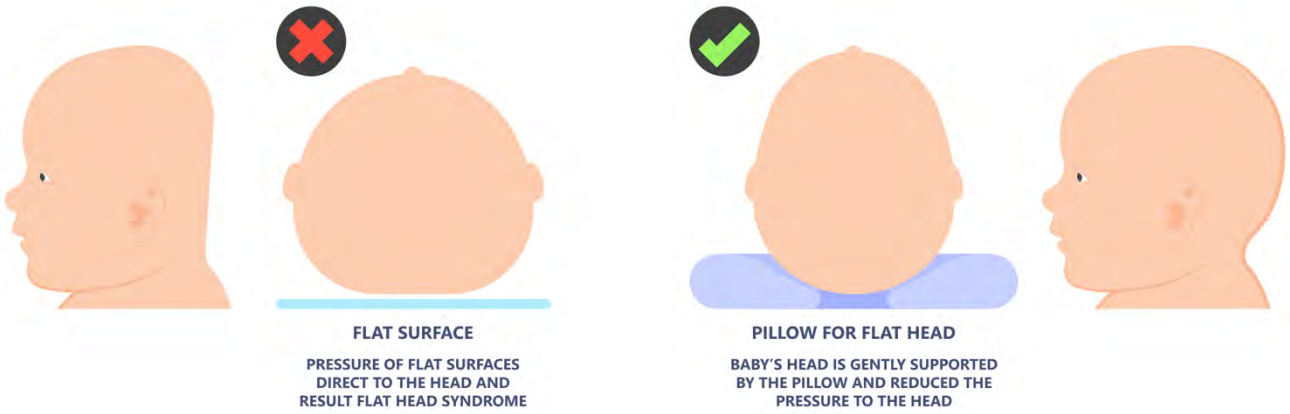


Figure 47 - Pillow for flathead syndrome

Changing the baby's position during sleep is a good advice towards parents.

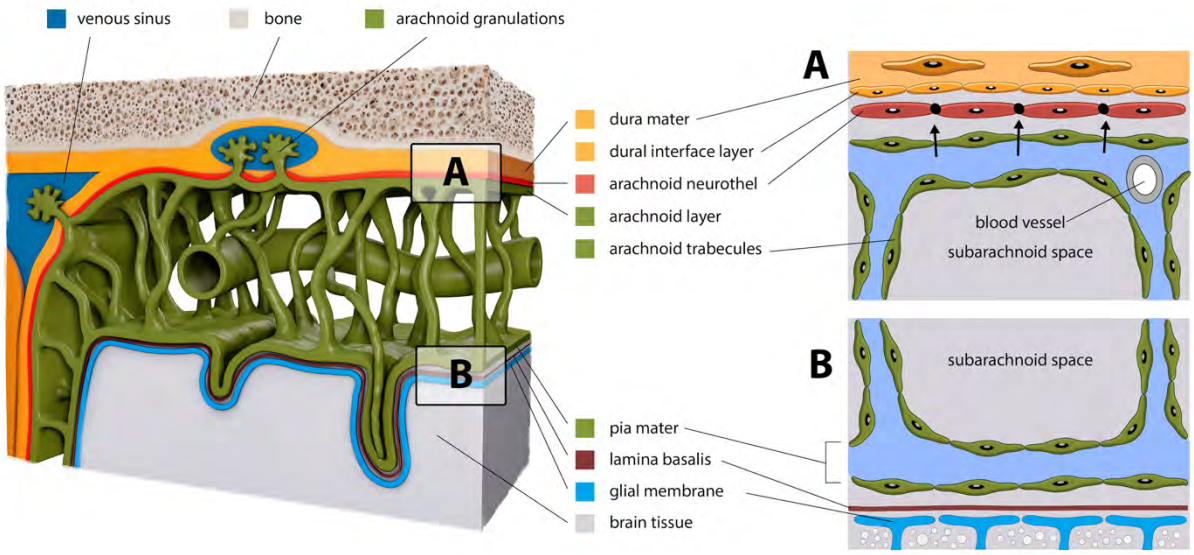


Figure 48 - Trabecular structure

The subarachnoid space must be seen as a container surrounding the brain, spinal cord and part of the nerves such as cauda equina.

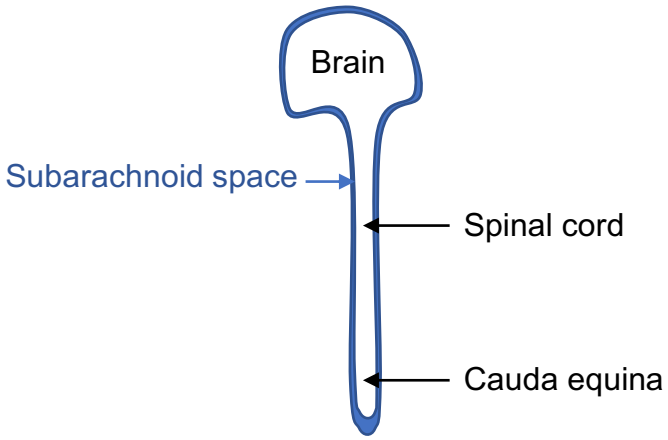
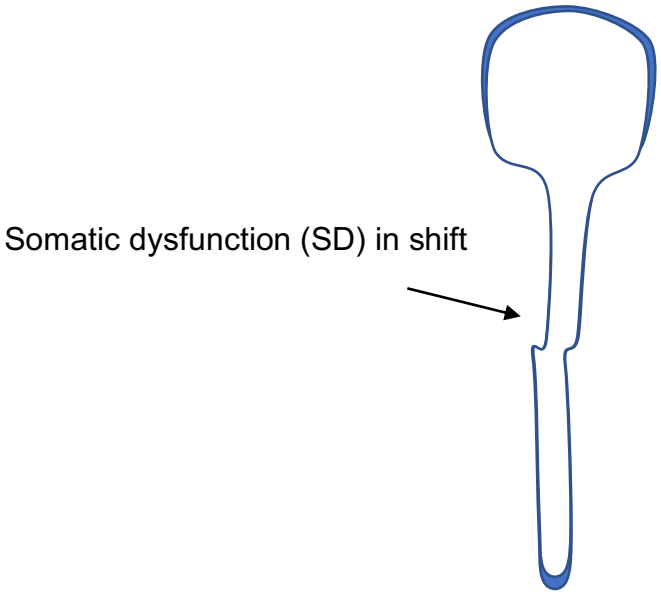


Figure 49 - Subarachnoid sac or container

When in this container or sac, there is one or more obstructions, as can be seen in spinal somatic dysfunctions, this can alter the flow of the CSF or it can cause obstruction with above higher pressure.

The most vulnerable places to get CSF obstruction in the brain is at the level of the upper cervical region.

Example 3:



In this example there is a somatic dysfunction (SD) at spinal level in frontal shift.

The flow at that level is interrupted because of the shift of the subarachnoid space.

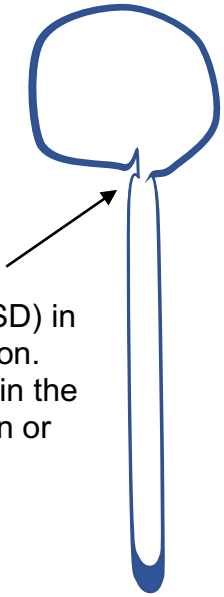
At that level and above, there can be a higher pressure.

At the level of the SD, there is stasis of the CSF, causing poor nutrition of the spinal cord and the involved peripheric nerves.

This can cause local pain and poor healing.

In this example the image is in the frontal plane as well as the shift lesion.

Example 4:



In this example there is a somatic dysfunction (SD) at the upper cervical spine.

The flow at that level is interrupted because of the shift or torsion of the subarachnoid space.

At that level and above, there can be a higher pressure.

At the level of the SD, there is stasis of the CSF, causing poor nutrition of the spinal cord and the involved peripheric nerves as well as in the whole brain.

This can beside local pain and poor healing, cause central nervous dysfunctions.

The upper cervical region is occiput, atlas, axis and C_3.

In the case of scoliosis, I don't think that this causes a circulation problem as long as the scoliosis is harmonious.

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Luc Peeters is an osteopath since 1985. He was the Joint-Principal of the largest Academy of Osteopathy in Europe from 1987 till 2020. He provided curricula, syllabuses and academic recognition from several universities.

This book gives an overview of the cerebrospinal fluid (CSF), its health, diseases and disfunctions as well as a practical approach of CSF disfunctions.

The theory and procedures in this book are checked on their scientific background and esotericism is avoided.

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