Structural Cranial Osteopathic Technique
Lisa A DeStefano, DO
Professor and Chairperson
Department of Osteopathic Manipulative Medicine
College of Osteopathic Medicine
Michigan State University

Basic Tenets of Osteopathy
- The body is a unit, and the person represents a combination of body, mind and spirit.
- The body is capable of self-regulation, self-healing, and health maintenance.
- Structure and function are reciprocally interrelated.
- Rational treatment is based on an understanding of these principles: body unity, self-regulation, and the interrelationship of structure and function.

William G. Sutherland, D.O.
- Credited for extending the osteopathic concept and osteopathic manipulative treatment above the craniocervical junction.

The Primary Respiratory Mechanism is a model proposed by Dr. Sutherland to describe the interdependent functions among five components as follows:
- The inherent motility of the brain and spinal cord
- Fluctuation of the cerebrospinal fluid
- Mobility of the intracranial and intraspinal membranes
- Articular mobility of the cranial bones
- The involuntary mobility of the sacrum between the ilia (pelvic bones)
William G. Sutherland, D.O.

- Sutures functioned as joints between the bones of the skull and were intricately fashioned for the maintenance of motion.
- The skull would have normal mobility during health and show restriction in response to trauma or systemic disease.

The cranium is adapted for motion.

- Sutures remain patient throughout life.
- Within the sutures resides tissues whose role is passive transfer of force.

Primary Respiratory Mechanism – first three components

- There is inherent motility of the brain and spinal cord and fluctuation of the cerebrospinal fluid and mobility of the intracranial and intra-spinal membranes.
  - We define this motion as the Cranial Rhythmic Impulse (CRI).
    - Cyclic waveform transferred onto the osseous cranium which is palpable with the human hand.
    - Rate is measured in cycles per minute
      - 1 Hz is defined as one cycle per second
      - 10 Hz is 10 cycles per second
      - .1 Hz is one cycle every 10 seconds or 6 cycles per minute

Amplified Brain Motion
Vasomotion

- First three of Sutherlands components are evidenced in the physiology of vasomotion.
  - Vasomotion is the spontaneous oscillation in tone of blood vessels, independent of heart beat, innervation or respiration.
  - Vasomotion has also been shown to exist in lymphatic vessels.
  - Vasomotor tone is the amount of tension in the smooth muscle inside the walls of blood vessels, particularly in arteries.

Vasomotion

- Critical for maintaining many homeostatic functions.
- Vasomotor tone is regulated by many factors
  - Hormonal control
    - Aldosterone, Angiotensin II, Antidiuretic hormone, Atrial natriuretic peptide, Epinephrine, Norepinephrine
  - Neural control
    - Baroreflex, Chemoreflex, Medullary ischemic reflex
  - Local control
    - Vasodilation in response to local ischemia and accumulation of waste products or Angiogenesis in response to chronic ischemia.

Wave forms of Vasomotion

- Traube-Hering-Mayer (THM) waves were the first oscillations isolated during arterial blood pressure monitoring by as early as the 19th century.
  - Measured at a rate of 0.1 Hz or 6 cycles per minute, it is tension oscillation derived by the sympathetic nervous system.
- Low Frequency Fluctuations
- Very Low Frequency Fluctuations

Inherent Motion

- Low-frequency fluctuations (LFF)
  - frequencies similar to the 0.1 Hz Traube-Hering waves
  - have been described in the brain using inter-cranial pressure measurements, Doppler, and MRI.
  - Measured in CSF flow, venous blood flow, arterial blood flow and brain parenchyma
Inherent Motion

- CSF in interventricular and subarachnoid space of the spinal cord has also been shown to have low-frequency fluctuations.
- Contrary to the low-frequency arterial pulsations of the brain, motion of CSF is greatly enhanced by respiration
  - expiration encourages downward motion
  - inspiration encourages upward motion

Function of the Primary Respiratory Mechanism

- Sutherland believed inherent motion was necessary for tissue cellular respiration, metabolic function, and well-being.
- In fact, low-frequency fluctuations and vasomotion have been linked to tissue oxygenation and neuronal function
- The literature supports altered states of vasomotion in persons with known disease states such as hypertension and diabetes.

Primary Respiratory Mechanism – fourth component - Articular mobility of the cranial bones.

- Reflections of multiple physiological sources of low-frequency oscillations passively distributed throughout the body’s fascia’s are indeed palpable not only on the cranium but throughout the body.
  - Kenneth Nelson, D.O., and Nicette Sergueef, D.O.,31,32 (France) simultaneously recorded palpable CRI and the 0.10 to 0.15 Hz Traube-Hering-Mayer (THM) oscillation (6 to 9 cycles per minute) using laser-Doppler flowmetry in humans.
  - Moskalenko and Kravchenko, using cranial and lumbosacral bio-impedance plethysmography, recorded changes in blood/CSF volume which was synchronous with the THM oscillations at a rate of 6 to 10 cycles per minute.

Sutural Motion evidenced in the literature

Articular mobility of the cranial bones

- Inherent motion of the brain and is associated structures is reflected onto the osseous cranium, where it is palpable.
- This influence is very predictable
- Paired bones rotated internally and externally
- Single bones flex and extend
- Although the quality and amplitude of motion is variable one should have motion.

Bones of the skull are divided into those that are paired and unpaired.

- Paired
  - Parietals
  - Temporals
  - Maxillae
  - Zygoma
  - Palatines
  - Nasals
  - Frontal
- Unpaired
  - Occiput
  - Sphenoid
  - Ethmoid
  - Vomer

Motion

- The sphenobasilar synchondrosis
  - Basisphenoid and basiocciput articulation
  - Fuses after the late teens
  - Residual plasticity throughout life
  - Flexion and extension
  - Sphenoid and occiput rotate in opposite directions around a transverse (L/R) axis
  - A component of the cranial rhythmic impulse (more to come).

Sphenobasilar Flexion

- The sphenoid rotates anteriorly
  - the basisphenoid is elevated
  - the pterygoid processes moves inferiorly
- The occiput rotates posteriorly
  - the basiocciput is elevated
  - The squamous portion and condylar parts move inferiorly
- Extension is the opposite
Sphenobasilar Motion

- Flexion
  - Paired bones move into external rotation
  - Unpaired bones move into flexion

- Extension
  - Paired bones move into internal rotation
  - Unpaired bones move into extension

The combination of flexion-extension of the midline unpaired bones and the internal-external rotation of the paired bones is palpable.
**Sphenobasilar Motion**

- **Flexion**
  - Transverse diameter of the skull increases
  - The anteroposterior (AP) diameter decreases
  - The vertex flattens
- **Extension**
  - Transverse diameter decreases
  - AP diameter increases
  - Vertex becomes more prominent

**Meninges**

- Pia, arachnoid, dura
- The external layer of the dura is continuous with the periosteum of the cranium
- The internal layer of the dura has several duplications that separate segments of the brain and encircle the venous sinuses.

**Dura**

- **Dural attachments**
  - Foramen magnum
  - Upper two or three cervical segments
  - Upper segment of the sacrum in the spinal canal (posterior to the center of rotation)
- **Sphenobasilar flexion**
  - Foramen magnum elevates
  - Upward tension of the dura causes the base of the sacrum to move posteriorly

- **Falx Cerebri**
- **Tentorium cerebelli**
- **Falx cerebelli**
Falx Cerebri (Vertical System)

- Attachments
  - Crista galli of the ethmoid
  - Frontal bone
  - Parietals
  - Occipital Squama
- Encloses the superior sagittal sinus and the inferior sagittal sinus
- Separates the two cerebral hemispheres

Tentorium cerebelli (Horizontal System)

- Attachments
  - Anterior Clinoid Process of the Sphenoid
  - Occipital squama
  - Both parietals
  - Both temporals (petrous ridge)
- Encloses the transverse sinus at the sigmoid decent
- Separates the cerebrum and cerebellum
Reciprocal Tension Membrane

Sutherland fulcrum
- At the junction of the falx cerebri and the tentorium cerebelli
- Location of the straight sinus

Primary Respiratory Mechanism – fifth component- The involuntary mobility of the sacrum between the ilia (pelvic bones)
- During flexion, the resultant pull on the falx cerebri reduces the AP diameter of the cranium
- The paired bones move into external rotation. Thus, with the pull on the petrous portions of the temporal bone, these bones externally rotate.
Primary Respiratory Mechanism – fifth component- The involuntary mobility of the sacrum between the ilia (pelvic bones)

- The SBS is drawn upward into flexion with the anterior end of the sphenoid bone moving in a downward nose-dive.
- The resultant pull on the dura lifts the spinal cord upward and due to the dural attachment at the posterior S2 level results in an upward and posterior movement of the sacrum between the ilia.
- During extension, the reverse occurs.

Respiration & the Three Diaphragms

- Inhalation enhances sphenobasilar flexion, and exhalation enhances sphenobasilar extension
- The Tentorium is viewed as a diaphragm
  - Descends and flattens during inhalation similar to the thoracoabdominal and pelvic diaphragm
- In health the three diaphragms should function in synchronous fashion

Cranial Rhythmic Impulse

- The motion perceived in the osseous cranium is termed the “Cranial Rhythmic Impulse”
- Widening and narrowing
- Normal rate 6-10 cycles per minute
- Result of the five components of the primary respiratory mechanism

Primary Respiratory Mechanism

- Inherent mobility of the brain and spinal cord
- Fluctuation of the cerebrospinal fluid
- Motility of the intracranial and intraspinal meninges
- Articular mobility of the cranial bones
- The involuntary mobility of the sacrum between the ilia
Primary Respiratory Mechanism

- Considered to include the innate motility of the CNS, which coordinates with the observable fluctuation of the CSF fluctuation, under the guidance and restraint of the reciprocal tension membranes, to produce motion in the linked craniosacral mechanism, and the two-phase rhythmic cycle throughout the body. This cycle manifests as the cranial rhythmic impulse and represents a dynamic metabolic interchange in every cell, with each phase of action.

Cranial Dysfunction

- Headaches
- Neck pain
- Vertigo
- Temporomandibular Joint Dysfunction
- Manifestations of Concussion/Traumatic Brain Injury

Cranial Osteopathy

- Anatomic studies
  - Sutures stay patent well into the 8th decade of life
- Biomechanical studies
  - Vault bone energy absorption positively correlated with increased sutural interdigitation
- Mobility studies, radiographic studies, palpatory studies
  - The cranium motion is present and palpable with good reliability.
Clinical Applications

- The sphenoid and the apex of the temporal bone
  - Trigeminal ganglion
  - Cavernous sinus
    - CN 3, 4, 6
    - Profound facial and orbital pain

Clinical Application

- Posterior quadrant
  - Occipitomastoid suture
    - Suboccipital muscles
    - C1- C2 referral
  - Parietomastoid suture
  - Petrojugular suture
    - Jugular foramina
      - CN 9, 10, 11
      - Inferior petrosal sinus
      - Transverse sinus

Clinical Application

- Temporal bone
  - Jugular foramen
  - Auditory and vestibular portions of CN 8
  - Facial nerve
    - Bell's palsy

Jugular Foramina & Petro-Jugular Suture
Trigeminal Nerve

- Convergence of Trigeminal and Cervical inputs:
  - The trigemino-cervical neurons store a convergent synaptic input from the trigeminal substantia gelatinosa
  - Nociceptive primary afferents
  - Ipsilateral muscle afferents
  - Trigemino-cervical reflex: The ponto-cerebellar system

- The afferent arrangement may be responsible for all and partly localized quality of head and neck pain.

Trigemino-Cervical Reflex (TCR)

- Reflex interaction between nociceptive trigeminal afferents and both upper and lower cervical spinal cord motoneurons.
- Considered a withdrawal reflex, the TCR is often triggered after trauma, such as whiplash.

Referral Pain – Trigger Points

- Sternocleidomastoid Muscle
  - Head
  - Neck
  - Orbit face
  - Occiput

- Medial and Lateral Pterygoid Muscles
  - Ear
  - Cheek
  - Teeth
Temporal Mandibular Joint with Deceleration Injury

Sensing the CRI
- Vault Hold
- Vault Hold Deconstructed
  - Six-quadrant Diagnosis
    - Posterior
    - Temporal
    - Anterior

Treatment Details and Sequence
- Type II dysfunctions in the upper thoracic spine
  - Upper rib cage motion restrictions
- Cranial motion restrictions
  - Posterior (OM, PM, OA)
  - Temporal bone (SS pivot, PJ)
  - Anterior (Palatine, Zygoma)
  - Monitor for any compressions and paradox’s
- Treat remaining cervical segmental dysfunctions

OCCIPITOMASTOID SUTURE
- The most common articular restrictor in the posterior quadrant.
- A vertical and horizontal limb with a bevel change at the junction.
- Frequently related to occipital condylar compression and atlantooccipital joint dysfunction.
Occipitomastoid Suture

Occipitomastoid Suture

PARIETOMASTOID ARTICULATION (Parietal notch)

- Usually associated with occipito-mastoid dysfunction.
- Diagnosis by bilateral medial compression on parietal, sensing for give and resiliency.
- Goal of treatment is to LIFT the parietal from the horizontal portion of the mastoid process.

Parietal Notch
Parietomastoid Articulation

TEMPORAL BONE
“A walk around the temporal bone.”
“The trouble maker”

TEMPORAL BONE AND CRANIAL NERVES
- The temporal bone has direct relationship to nine cranial nerves:
- III, IV, V, VI, VII, VIII, IX, X, and XI
TEMPORAL BONE

MOTION PALPATION
- With five finger hold sense for inherent internal and external rotation.
  - Asymmetrical motion suggests SS Pivot restriction
  - Paradoxical motion makes diagnosis of petrojugular subluxation.
- With five finger hold lift both temporals toward vertex.
- With five finger hold with one hand and the other holding occiput, look for paradoxical motion and bilateral petrojugular restrictions.

MOTION TESTING
- 5 Finger hold.
PETROJUGULAR SUBLUXATION

- Rare! Occurs with trauma particularly dental extraction.
- Diagnosis made by paradoxical temporal motion relative to the ipsilateral occiput.
- Goal of treatment is to restore temporal bone motion relative to the occiput.

PETROJUGULAR SUTURE

- During exhalation
  - Internally rotate temporal
  - Extend the occiput
- Hold to balance
- During forced inhalation
  - Externally rotate temporal
  - Flex the occiput

PETROBASILAR ARTICULATION

- In line with petro-sphenoid ligamentous articulation. (Get two for one).
- Diagnosis by assessing antero-medial and postero-lateral joint play.
- Goal of treatment is to restore symmetry to postero-lateral glide.
Petrobasilar Articulation

- An L-shaped suture with a vertical and horizontal limb with a bevel change at the junction.
- The most common dysfunction of the temporals.
- Diagnosis assessed by restriction of temporal external rotation inherently.
- Goal of treatment is to externally rotate temporal and lift sphenoid anteriorly and into flexion.

SS Pivot

Sphenosquamous Articulation
PALATINES

- Paired bones that internally and externally rotate.
- With maxillae form the roof of mouth.
- Serve as speed reducers between pterygoid processes of sphenoid and maxillae.
- Articulates with sphenoid, maxillae, ethmoid, vomer, and inferior conchae.
- Most common restrictor in the front quadrant.
ZYGOMA

- Zygomaticofrontal suture.
- Zygomaticosphenoid suture.
- Zygomaticomaxillary suture.
- Zygomaticotemporal suture.

Compressions

- SBS Compressions
  - Sphenoid and occiput moving paradoxically
  - Lessor Wing
  - Frontosphenoid
- Bilateral Petrojugular Compressions
- Sphenoid Ethmoid Vomer Paradox