Overview

- Review anatomy of fetal skull, attention to areas of potential dysfunction
- Learn common areas of somatic dysfunction in the newborn skull and physiologic implications of dysfunction in that area
- Learn how the forces of delivery can create dysfunction
- Discuss evaluation of newborn for somatic dysfunction, including overriding sutures and strain patterns
- Practice some basic treatment to address common dysfunctions
- Discuss issues in older children, including otitis media, GERD and scoliosis
Fetal Skull

• Vault bones are formed in membrane, squamous in nature
• Bone represents a thickening of the membrane
• Membranes remain continuous through sutures, even after fontanelles “close”

Fetal Skull

• Override is normal and desirable at birth
• Other than the temporal at the squamous suture, parietals should override everything else
• Parietals override frontals at the coronal suture and occipital at the lambdoid suture – most physiologic
• Parietals override each other at the sagittal suture
• If override is asymmetrical, look for SBS strains
• Override is limited by the membranes
Principles of Newborn Osteopathic Treatment

- Balanced ligamentous tension
- Balanced membranous tension
- All techniques should be direct, don’t exaggerate strain patterns
Occipital bone - fetal

- Four parts at birth which surround the foramen magnum: squama, the condylar parts and the base

Occipital bone - adult
Fetal Skull

• Jugular Foramen formed between condylar part of occiput and petrous portion of temporal
• Hypoglossal canal just superior to condylar part of occiput
• Both affected by mechanical strain

Fetal Skull

• Key features:
  – Jugular foramen transmits CN’s:
    • IX (glossopharyngeal)
    • X (vagus)
    • XI (spinal accessory)
  – Hypoglossal canal: transmits CN:
    • XII (hypoglossal)

<table>
<thead>
<tr>
<th>Cranial Nerve</th>
<th>Sensory Function</th>
<th>Somatic Motor Function</th>
<th>Parasympathetic Motor Function</th>
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</thead>
<tbody>
<tr>
<td>CN IX (glossopharyngeal)</td>
<td>Touch &amp; taste to posterior 1/3 of tongue, visceral sensory to carotid bodies.</td>
<td>One pharyngeal muscle (stylopharyngis)</td>
<td>Innervates (increases secretion of) parotid salivary gland</td>
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<tr>
<td>CN X (vagus)</td>
<td>Visceral sensory information from pharynx, larynx, carotid bodies, heart, lungs, most abdominal organs</td>
<td>Most pharyngeal muscles, laryngeal muscles</td>
<td>Innervates smooth muscle and glands of heart, lungs, larynx, trachea, most abdominal organs</td>
</tr>
<tr>
<td>CN XI (spinal accessory)</td>
<td>General sensory information from external auditory canal, ear drum, and pharynx</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>CN XII (hypoglossal)</td>
<td>None</td>
<td>Trapezius muscle, sternocleidomastoid muscle</td>
<td>None</td>
</tr>
</tbody>
</table>

Intrinsic tongue muscles and extrinsic tongue muscles
Clinical Significance

- Glossopharyngeal (IX): Primarily sensory, posterior third of tongue, sensory impairment can affect suck reflex
- Vagus (X): Visceral sensory to pharynx, larynx. Parasympathetic to viscera, poor function can cause decreased peristalsis, reflux
Clinical Significance

- Spinal Accessory (XI): Motor to SCM, trapezius.
  - Unilateral dysfunction can cause torticollis
  - Bilateral dysfunction can cause arching which is frequently seen with reflux
- Hypoglossal (XII): Motor to tongue musculature, involved in suck and swallow reflexes
Sphenoid

- 3 portions at birth
  - Lesser wings with basisphenoid
  - 2 greater wing/pterygoid portions
Sphenoid

Superior orbital fissure
CNs III, IV, V1, VI
Sphenoid

• Superior orbital fissure transmits CN’s:
  – Oculomotor (III)
  – Trochlear (IV)
  – Ophthalmic (V1)
  – Abducent (VI)

Impingement can cause strabismus, may not show up until later

Sphenoid

Superior orbital fissure (III, IV, V1, VI)

Foramen rotundum (V2)

Foramen ovale (V3)

Sphenoid

• Foramen rotundum transmits maxillary nerve (V2): sensory to upper lip, teeth and gums, also palate
• Foramen ovale transmits mandibular (V3): motor to muscles of mastication, can affect ability to suck
Cranial base: Sphenoid and Occiput

• Common strain patterns
  – Torsion
  – Sidebending-rotation
  – Lateral strains
  – Vertical strains

  – Unresolved strains can contribute to plagiocephaly and FLK syndrome

TORSION

• One axis: Antero-superior to Infero-posterior

• Sphenoid and occiput rotate in opposite directions

• Named for superior great wing of sphenoid
SIDEBENDING ROTATION

- Two axes: A-P and bilateral vertical axes
- Occiput and Sphenoid rotate same direction on AP axis; side-bend away from each other on parallel axes.
- Named for convexity
LATERAL STRAIN

- Bilateral vertical axes
- Shearing force at SBS causing Sphenoid and Occiput to rotate same direction on axes
- Named for position of base of sphenoid
- Head appears “parallelogram”
VERTICAL STRAINS

• Sphenoid and Occiput rotate same direction on parallel horizontal axes
• Named for position (superior/inferior) of base of Sphenoid

COMPRESSION
Temporal Bone

- 2 portions at birth (may fuse just prior to birth):
  - Petromastoid portion: contains auditory and vestibular apparatus
  - Squamous portion
  - Eustachian tube forms between the petrous and squamous portions
Frontal bone

- 2 halves at birth
- Separated by metopic suture
- Remains unfused in 10% of population

Labor and Delivery

- Head engages in pelvis
- Usually left occiput anterior
Forces of Delivery

- Head begins in flexion as vertex is presenting
- Flexion limits ability to rotate, forces move inferiorly
- Can lead to SBS compression

Forces of Delivery

- Head extends as occiput pivots on the pubic symphysis
- Transmits force to atlanto-axial joint, or becomes intra-osseous within the occiput itself

Forces of Delivery

- Rotational component relates to presenting position
- Head returns to neutral upon delivery of head, called restitution
- Strains can also result from in utero positioning
Forces of Delivery

- Moulding should resolve in 2 days
- Crying and suckling help-breastfeeding is better
- Harder to resolve forceps or mityvac deliveries
  - Frequent cause of cephalohematoma and caput succedaneum
- C-sections may also not resolve spontaneously, especially after a trial of labor

Evaluation of Newborn

- Regular physical exam
- Overlapping of sutures
- Cranial base strain patterns
- Cephalohematoma
- Caput succedaneum
- Facial asymmetry, subconjunctival hemorrhage, suck reflex
OCF for Infants

- Torticollis
- Plagiocephaly
- Otitis media

Torticollis

- Sidebending and rotation in opposite directions in the cervical spine that cannot be passively reversed
- Related to intrauterine positioning, CN XI irritation

Plagiocephaly

- Abnormal shape/flattening of the cranium
- Need to distinguish between nonsynostotic (positional) vs. synostotic
Deformational plagiocephaly vs. lambdoid synostosis

Brachiocephaly
Clinical Impact

- Neurodevelopment in Children with Single-Suture Craniosynostosis and Plagiocephaly without Synostosis
  - Showed increased incidence of cognitive and psychomotor development

Clinical Impact

- Auditory ERPs Reveal Brain Dysfunction in Infants With Plagiocephaly
- Balan, Polina PhD*; Kushnerenko, Elena MSc*; Sahlin, Pelle MD, PhD†; Huotilainen, Minna PhD*; Näätänen, Risto PhD*; Hukki, Jyri MD, PhD‡
- Journal of Craniofacial Surgery: July/August 2002 - Volume 13 - Issue 4 - pp 520-525
  - Demonstrated an increased risk of auditory processing disorders

Clinical Impact

- Avoiding the Sequela Associated With Deformational Plagiocephaly
- Habal, Mutaz B. MD, FRCSC; Leimkuehler, Teresa MS; Chambers, Christina MS; Scheuerle, Jane EdD; Guilford, Arthur M. PhD
  - Increased incidence of strabismus
Otitis Media

- 31 million office visits annually
- 90% of children have 1 episode by age 2
- One third of children have 6 or more episodes by age 7
- Major cause of mortality in undeveloped nations

Otitis Media

- Male = Female
- Incidence peaks between 6-18 months
- Recurrence more likely if first episode is diagnosed before 1 year of age

Otitis Media

- Anatomic basis for age differences
- TM’s almost face inferiorly
- Angle of Eustachian tube is more horizontal, moves inferiorly as face lengthens with age
Otitis Media

• Risk Factors
  – Passive smoke exposure
  – Bottle-feeding
  – Group daycare
  – Pacifier use (but may protect against SIDS)
  – Winter/Spring
  – Preceding viral URI

Otitis Media

• Osteopathic Exam
  – Age-dependent
  – Respiratory mechanics
  – Cervical spine: middle for diaphragm innervation & sympathetic ganglion
  – Thoracic spine: upper for sympathetic input to the cranium and mechanical contribution to cranial motion
Otitis Media
• Osteopathic Exam cont’d
  – Visual inspection for cranial asymmetry
  – Cranial base: sphenoid and occiput
  – Temporal bones
  – Jaw

Otitis Media
• Osteopathic techniques
  – Galbreath technique
  – Thoracic lymphatic pumps
  – Diaphragm
  – Balanced ligamentous/membranous tension for the cranium

Research
• Authors
  • Mills, M V; Henley, C E; Barnes, L L B; Carreiro, J E; Degenhardt, B F; Worden, K
• Title
  • Effect of osteopathic manipulative treatment (OMT) on recurrent acute otitis media in children
OM Research
• Multi-center, randomized, non-placebo trial
• Used OMT as adjunctive care to traditional treatment
• Pediatricians were blinded to treatment
• 25 OMT and 32 controls

OM Research
• OMT group received 6-9 treatments over a 6 month period
• Treatment was articulatory, myofascial release, BLT/BMT, facilitated positional release and/or counterstrain
• No HV/LA

OM Research
• Showed significant differences in:
  – Number of episodes of AOM
  – Antibiotic usage
  – Surgical intervention
Other Pediatric Pearls

- Always think about bone age, epiphyseal fusion etc.
- Indirect is always better than direct
- Don’t be intimidated by moving targets. Toys and bubbles help catch their attention

From Pediatric Manual Medicine, Carreiro, 2009, p. 3

Diagnoses that respond well to OMT in kids

- Scoliosis
  - Not usually diagnosed until older, can mostly be treated like adults
  - Home exercise involving postural control
- Sports injuries
- Asthma/bronchiolitis/other respiratory illnesses
- Colic/GERD
- Motor disorder/developmental delays
- Juvenile rheumatoid arthritis
  - Indirect BLT/functional when more acute, joint play when not inflamed