Characteristics of a Newborn Skull

- Highly soft and pliable, with spaces called sutures in between the plates of bones.
- Variable shape due to the inherent plasticity, intrauterine constraint, and journey through the birth canal; also influenced by cranial size, shape, and growth.
- Eight sutures and six fontanels accommodate increased growth of the skull as the brain is growing.

The head shape should assume a normal shape within 6 weeks after birth. An abnormal head shape continuing beyond 6 weeks of age should be evaluated by a physician.

What Are Infant Head Shape Deformities?

- Infant head shape deformities are skull distortions that occur in response to prenatal and postnatal external compression forces.\(^1\)\(^-\)\(^3\)
- Non-synostotic deformities include deformities where the sutures of the skull are open and have not prematurely fused.
- Therapists should differentiate non-synostotic cranial deformities from other causes of abnormal head shapes, including craniosynostosis and craniofacial syndromes.

Infant Head Shape Deformity Statistics

- One in three infants has some degree of skull distortion.\(^3\)\(^-\)\(^5\)
- Male babies are 1.58 to 3 times more likely than female babies to have deformational plagiocephaly.\(^3\)\(^,\)\(^5\)
- The prevalence of plagiocephaly has increased since 1992, following the American Academy of Pediatrics’ “Back to Sleep Campaign,” now called “Safe to Sleep,” which recommends infants sleep in supine to decrease the risk of sudden infant death syndrome (SIDS).\(^6\)\(^-\)\(^8\)

What Are the Causes of Skull Deformation?

Intrauterine and extrauterine factors\(^3\)\(^,\)\(^9\)

- Uterine crowding due to large fetus, multiple fetuses, or oligohydramnios (decreased amniotic fluid)
- Small maternal pelvis
- Left occiput anterior (LOA) position in utero predisposing the fetal head to unilateral pressure.

Neonatal factors (birth and neonatal period)\(^1\)\(^,\)\(^8\)

- First-born infant
- Pressure on the head by a tight birth canal
- Forceps, vacuum, suction used at delivery and prolonged labor
- Macrocephaly, hydrocephalus\(^10\)
- Infants born prematurely or with low birth weight\(^1\)\(^,\)\(^3\)\(^,\)\(^11\)\(^-\)\(^13\)
- Torticollis
• Skull shape deformations that occur after birth or progress
• Hypotonic infants presenting with weak neck muscles\(^{14}\)
• Congenital hip and spine problems\(^{15}\)

**Environmental factors\(^{7}\)**
• Preference to turn head to one side while sleeping due to crib/sleep surface position
• Sleeping and playing in the supine position with very little or no time spent in prone\(^{1,4,14}\)
• Excess time spent in infant carriers, car seats, and strollers\(^{6,16}\)
• Prolonged placement in one position in the neonatal intensive care unit (NICU)\(^{13,17}\)
• Prolonged position secondary to medical and orthopedic treatments (Ex. Feeding tube, ventilation, Pavlik harness)\(^{11,13,17}\)

**What Are the Types of Skull Deformation?**

<table>
<thead>
<tr>
<th>Type</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Craniosynostosis</td>
<td>• Premature closure of one or more sutures of the skull.</td>
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<td>• Clinical presentation of the skull is dependent on the suture(s) involved: sagittal, metopic, coronal, and lambdoid.</td>
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<td>• Lambdoid synostosis is least common(^{18}); mistaken for plagiocephaly.</td>
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<td>• Suspicion of craniosynostosis requires referral back to pediatrician for evaluation by a pediatric neurosurgeon or craniofacial physician.(^{10})</td>
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<td></td>
<td>• Most infants require surgical intervention to open prematurely closed sutures.</td>
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<tr>
<td>Non-synostotic</td>
<td></td>
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<tr>
<td>Plagiocephaly</td>
<td>• Unilateral occipital flattening, anterior progression of the ear on the same side as the flattened occiput, varying degrees of ipsilateral frontal and contralateral posterior parietal bossing (parallelogram shape).</td>
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<td>• Cranial Vault Asymmetry (CVA) is assessed by measuring the longest and shortest diagonals of the skull and subtracting the difference in millimeters.(^{19})</td>
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<td>• Severe cases can involve the eyes, cheeks, and jaw.(^{5})</td>
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<td></td>
<td>• Associated with congenital muscular torticollis, congenital hip dislocation, and congenital scoliosis.(^{15})</td>
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<td></td>
<td>• Right occipital flattening more common than left occipital flattening (2:1).(^{3-5})</td>
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<td>• Severity is determined by the number of skull quadrants involved in the deformity with or without the presence of facial and jaw asymmetry.</td>
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<tr>
<td>Brachycephaly</td>
<td>• Skull is disproportionately wide compared to its length</td>
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<td></td>
<td>• Prominent or bossed forehead</td>
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<td></td>
<td>• Increased height of the cranial vault</td>
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<td></td>
<td>• Central occipital flattening</td>
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<tr>
<td></td>
<td>• Severity is determined by the number of deviations above the mean for Cephalic Index (Cl), increased vertex height, and frontal involvement of the forehead and facial structures.</td>
</tr>
<tr>
<td></td>
<td>▪ <strong>Cl</strong> = (Width/Length) x 100.(^{19})</td>
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<td></td>
<td>▪ <strong>Cl</strong> is higher for infants who sleep supine and spend extended time in supine.</td>
</tr>
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<td></td>
<td>▪ The mean Cl is 79% to 84% depending on age and gender of the infant.(^{19})</td>
</tr>
</tbody>
</table>
How Can Skull Symmetry Be Promoted?\textsuperscript{16}
Early caregiver education, diagnosis, treatment, and counseling are important following the infant’s birth when the skull is most susceptible to deformation.

First Choice Interventions:\textsuperscript{(Infants 0 – 4 months of age without torticollis, developmental concerns, or obvious skull deformities)}

Parent Education, Repositioning, and Exercises\textsuperscript{6,7,16,20}
Goal: Shift infant off flattened areas to encourage a symmetrical head shape and promote typical development.

- Alternate the head position in supine (right cheek on surface one time, left cheek next).
- When awake and supervised, prop the baby onto one side with a foam wedge or a towel rolled lengthwise along the baby’s back.
- Conduct supervised “tummy time” in the waking hours to improve the baby’s muscle strength, development, and keep the pressure baby off the back of the head.
- Watch for “high guard,” “touch down” positioning of the arms and ensure that the infant has opportunities for midline play.
- Limit time in car seats, infant seats, swings, and strollers.
- Frequently change the position of the crib or the orientation of the baby in the crib to reduce the baby’s tendency to look in the same direction.
• Change positions when feeding, carrying, and holding the baby.
• Provide supervised upright play as soon as the baby has upright head control.
• Interact with the baby from different sides, during feeding, changing, and playing.
• Encourage side-lying play opposite the flat side of the head.
• Request referral for physical therapy or cranial remolding orthosis evaluations, if the infant demonstrates resistance to repositioning, neck tightness, movement asymmetries, or if the head shape worsens or does not improve with the repositioning and exercises.

**Second Choice Interventions:**

**Cranial Remolding Treatment**

Goal: Encourage symmetrical and proportionate skull growth through the use of a custom, Cranial Remolding Orthosis (CRO).

- Provide total contact over the abnormally prominent areas of the skull.
- Direct growth into the areas of void within the CRO where growth is desirable.
- Initiate treatment within the first year of life when the skull is rapidly growing.

*All cranial orthoses require FDA clearance; Photos provided courtesy of Orthomerica*

Indications:

- Babies 3-18 months with moderate to severe head shape deformities with symmetrical movements and no torticollis
- No response or poor response to repositioning therapy
- Secondary changes to the skull or frontal facial asymmetries
- Babies with persistent skull deformity after a repositioning program

Contraindications to Cranial Remolding Orthosis:

- Craniosynostosis
- Unresolved hydrocephalus
- Children beyond 18 months of corrected age
- Babies under 3 months of corrected age

Cranial Remolding Treatment Considerations (helmets and bands)**8,16**

- Age at beginning of treatment, type and severity of deformation, and caregiver adherence with the treatment program all affect treatment. Factors include:
  - Average age range for initiating treatment is 4 to 12 months.
  - Overall age range for treatment is 3 to 18 months.
  - Optimum age range for initiating treatment is 4 to 6 months.
  - Cranial remolding orthosis is worn 23 hours per day for a period of 3 to 6 months.
  - Follow up is 1-2 weeks after the initial fit and every 2-3 weeks thereafter.
  - Request referral for Physical Therapy evaluation if torticollis, movement asymmetries or developmental delays are observed.

Revised 6/17/2020
Physical Therapy Treatment

Goals: Resolve range of motion deficits, promote age-appropriate motor skill development, strengthen weak muscle groups, provide a home handling/positioning program, and promote resolution of the head shape deformity as a result of the therapeutic interventions. Request referral for cranial remolding treatment if the head shape does not resolve with physical therapy interventions only.

Indications:
- Restricted neck and shoulder range of motion
- Presence of torticollis
- Delay in gross and fine motor skills
- Lack of head shape improvement after 1 month of caregiver repositioning/handling/tummy time
- Babies 0-12 months with minimal head shape deformities and asymmetrical movement preferences
- Babies 0-4 months with moderate to severe head shape deformities and asymmetrical movement preferences

Cranial Remolding Treatment and Physical Therapy

Since congenital muscular torticollis and non-synostotic cranial deformities often have similar etiology and environmental factors, concurrent treatment of cranial remolding treatment and PT can enhance outcomes.

Goal: Coordination of the infant’s care through collaborative communication between the caregivers, physician(s), and treating clinicians to include:
- Treatment plans
- Infant’s progress
- Caregivers compliance
- Factors that may impact treatments
- Discharge and follow-up planning

Third Choice Interventions:

Surgery for non-synostotic cranial deformities

Indications:
- Rare in in infants with head shape deformities without synostosis
- Used in very severe deformities resistant to non-surgical measures

Cited References:


Revised 6/17/2020


**Supplementary References**


Revised 6/17/2020


