

FACT SHEET

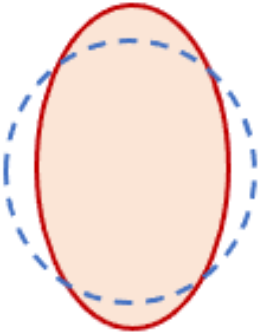
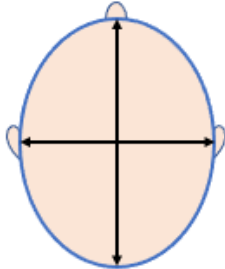
Considerations for Cranial Molding in the Neonatal Intensive Care Unit

Cranial molding deformity, or abnormal skull shape, affects up to three-fourths of infants born in the Neonatal Intensive Care Unit (NICU). The following information can inform the neonatal physical therapist about the prevalence of specific deformities as well as best practices for prevention and treatment.

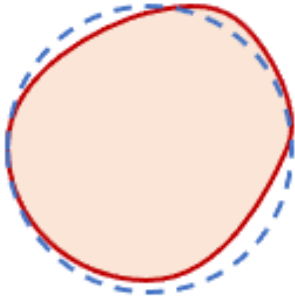
CHARACTERISTICS OF THE NEONATAL SKULL

- Highly soft and pliable, with spaces called sutures in between the plates of bones
- Eight sutures and six fontanelles accommodate increased growth of the skull as the brain is growing.
- Bone mineralization and formation is completed in late gestation; therefore, preterm infant skulls are highly susceptible to external pressures.
- Increased proportion of collagen in neonatal bone compared to mature bone

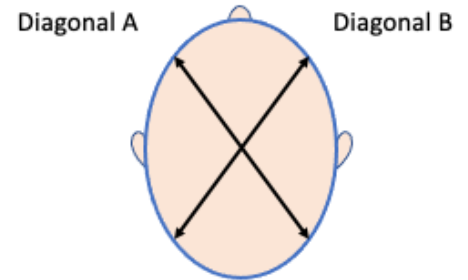
COMMON CRANIAL MOLDING DEFORMITIES IN HOSPITALIZED INFANTS

<p>Dolichocephaly (Scaphocephaly)</p> 	<ul style="list-style-type: none"> • Symmetric, bilateral narrowing of the skull • Seen in 54%-73% of very preterm infants <32 weeks • Associated with frequent sidelying or prone positioning • Can be exacerbated by Continuous Positive Airway Pressure (CPAP) devices • Impacts achievement of midline positioning of head due to significant bossing of the posterior skull • Quantified using the Cranial Index (CI) measure: <ul style="list-style-type: none"> ○ Biparietal diameter (BiPD): Widest transverse diameter of the head ○ Occipitofrontal diameter (OFD): Measured from the external occipital protuberance to the most prominent point of the frontal bone in the midline ○ Cranial Index = (BiPD/OFD) X 100 ○ Can be measured in centimeters or millimeters • Generally, scaphocephaly is determined by a CI less than 76. • CI Severity: <ul style="list-style-type: none"> ○ Within Normal Limits: 76-70 ○ Mild: 73-75 ○ Moderate: 69-72 ○ Severe: <68  <p style="text-align: right;">Cranial Index = (Width/Length) x 100</p>
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Plagiocephaly



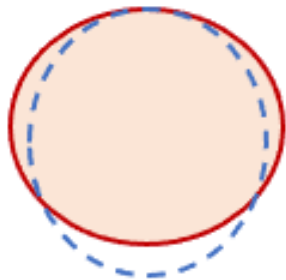
- Unilateral occipital flattening, anterior progression of the ear on the same side as the flattened occiput, varying degrees of ipsilateral frontal and contralateral posterior parietal bossing (parallelogram shape)
- Right occipital flattening is more common than left occipital flattening.
- Is often exacerbated by right-handed caregiving practices and positional tendencies in the intensive care setting
- Quantified using the Cranial Vault Asymmetry Index (CVAI)
- CVAI is determined by measuring the longest and shortest diagonals of the skull and subtracting the difference in millimeters.
- CVAI Severity:
 - Within Normal Limits: 1.9
 - Mild: 3.7
 - Moderate: 5.2
 - Severe: 7



$$\text{CVAI} = \frac{[A-B] \times 100}{A \text{ or } B}$$

(whichever is greater)

Brachycephaly



- Skull is disproportionately wide compared to its length.
- Prominent or bossed forehead
- Increased height of the cranial vault
- Central occipital flattening
- Associated with increased time in the supine position
- Quantified using the Cranial Index (CI) measure
- CI Severity
 - Within Normal Limits: 78-80
 - Mild: 81-86
 - Moderate: 87-92
 - Severe: >92

Asymmetric Brachycephaly is a combination of plagiocephaly and brachycephaly. It is associated with prolonged supine positioning and infant head rotation preference (to the left or right side) and is measured by/using both CI and CVAI measurements.

RISK FACTORS

Risk factors for all types of cranial molding deformities:

- Restricted uterine environment from multiple births or uterine abnormalities
- Prematurity (especially infants born at extremely low birth weight)
- Trauma at birth
- Lack of bone mineralization
- Torticollis
- Paralysis
- Neurological deficits
- Restricted positioning

Risk factors for Dolichocephaly:

- Prematurity, which is associated with decreased cervical muscle development, hypotonia, gravity-dependent posture, and decreased tolerance for supine
- Low birthweight
- Increased length of time requiring respiratory support
- Frequent prone and side-lying positioning

Risk Factors for Plagiocephaly:

- Positional preference
- Male sex
- Multiple births

Risk Factors for Brachycephaly:

- Prolonged supine positioning
- Limited head mobility
- Developmental delay

PROGNOSIS

Dolichocephaly has been associated with:

- Plagiocephaly
- Motor asymmetries
- Delayed reaching skills
- Decreased midline control
- Myopia
- Shifts in cortical structures in the brain
- The presence of dolichocephaly at 32-34 weeks post-menstrual age is correlated with higher rates of PT referral at 3-4 month NICU follow-up.

Plagiocephaly and Brachycephaly are associated with:

- Torticollis
- Potential need for an orthotic helmet or band
- Reduced motor, language, cognitive, and adaptive behavioral scores at 3 years of age
- Developmental delay
- Delayed psychomotor and auditory processing disorders
- Abnormal dentition with facial feature asymmetries

CRANIAL MOLDING ASSESSMENT RECOMMENDATIONS

Use of objective measures helps to quantify changes in head shape over time. Craniometers or orthopedic calipers can be used at multiple time points during hospitalization beginning at the first indication of any head changes and then weekly or bi-weekly until the cranial deformity resolves. Additionally, the use of objective scales can quantify changes over time. Recommended assessment items include:

- Measure Cranial Index for symmetric deformity (scaphocephaly and brachycephaly).
- Measure Cranial Vault Asymmetric Index for asymmetrical deformity (plagiocephaly and combined plagiocephaly/brachycephaly).
- Objective Scales:
 - Children’s Hospital of Atlanta Plagiocephaly Severity Scale
 - Argenta Scale for Deformational Plagiocephaly
- The Test of Infant Motor Performance (TIMP) and the NICU Network Neurobehavioral Scale (NNNS) both include measures of symmetrical movement and orientation, which is strongly impacted by cranial molding deformity, as a component of neonatal motor assessment.

RECOMMENDATIONS BY AGE

<28 weeks postmenstrual age

- Midline alignment is necessary for at least the first 72 hours of life in this population to prevent intraventricular hemorrhage.
- Optimize midline flexion through the use of positioning aids and mindful positioning of lines/leads/tubes.
- Use positioning aids and strategies to distribute pressure on the head evenly when possible
- Introduce a variety of positions (supine, prone, and sidelying) when physiologically and developmentally appropriate. Periods of midline positioning are best maintained with supine and semi-sidelying positions.
- While on mechanical ventilation, infants need gentle positional variety at each care time. This process might take a 2-3 person assist to maneuver lines, leads, and tubes, ensuring the head is rotated to experience variable pressure.
- For positional changes, use log rolling and whole-body movement without lifting the infant’s legs.
- Encourage skin-to-skin holding with a parent to provide opportunities for positioning outside of the isolette with reduced weight-bearing on the head and to promote overall development.
- Collaborate with nursing and the medical team is needed to develop an individualized positioning plan.

28-32 weeks postmenstrual age

- Continue to provide a variety of positions while optimizing midline with the use of positioning aids and update the individualized positioning plan as appropriate.
- Continue to encourage skin-to-skin and holding as the infant tolerates.
- Increase the proportion of time the infant spends supine as compared to prone and sidelying in order to increase tolerance and provide increased weight-bearing to the posterior head.

>32 weeks postmenstrual age

- Begin the transition to “Back to Sleep” (AAP) as the infant tolerates.
- Continue to encourage skin-to-skin and holding at the bedside.
- Incorporate the use of infant swings and bouncers to provide additional positioning variety as tolerated.

RECOMMENDATIONS BY DEFORMITY

Dolichocephaly

- Use supine, midline positioning to allow weight-bearing on the posterior aspect of the skull.
- Use positioning aids and neck rolls if necessary to prevent hyperflexion of the cervical spine and maintain a neutral position of the neck to protect the infant's airway in supine.
- Ensure symmetry of the infant's body and environment to prevent development of asymmetric head preference.
- For older infants, facilitate postural control interventions that activate and strengthen anterior cervical musculature.

Plagiocephaly

- Alternate head of bed orientation and environmental setup to promote cervical rotation to the opposite side of the preference.
- Increase weight-bearing to the non-preferred side through sidelying and semi-sidelying positioning.

Brachycephaly

- Implement frequent positional changes as tolerated.
- If the infant cannot tolerate major shifts in position, use subtle changes in mattress incline (forward/back, side-to-side) with towel rolls or bed position to vary and distribute weight and pressure.
- Use positioning aids to optimize symmetry and maintain midline alignment of extremities.
- Provide opportunities for free movement when safe and well-tolerated by the infant.

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Developed by expert contributors Dana McCarty, PT, DPT, Board-Certified Pediatric Clinical Specialist & Michele Hyams, PT, DPT, CNT, DCS. Supported by the Fact Sheet Committee of APTA Pediatrics.

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