Evaluation and Treatment of Deformational Plagiocephaly & Other Head Shape Deformities

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The “Epidemic” of Deformational Plagiocephaly

The Back to Sleep Program is regarded as one of the most successful programs ever initiated by the American Academy of Pediatrics. The rate of sudden infant death in the United States has decreased over 40% since the program’s inception in 1992, saving thousands of infants’ lives. Supine positioning for sleep, keeping the child cool at night, discontinuing smoking at home, eliminating shared bed sleeping and using a pacifier for naps and nighttime sleeping have been found to reduce the incidence of sudden infant death. However, an unintended consequence of the program is the increase in the number of infants who acquire skull deformities secondary to extensive time spent on their backs at night coupled with an inappropriate amount of time supine when the babies are awake. Fortunately, parents are now encouraged to reduce the time in infant positioning devices and to place their babies prone as much as possible when awake to prevent head shape deformities and to encourage normal development.

Parents are naturally concerned if they observe asymmetry or unusual flat spots on their baby’s head, and often seek advice from their pediatrician. This guide is designed to provide information about the causes, signs, and treatment strategies for managing head shape deformities in infants. Treatment interventions include repositioning, a developmental home program, physical therapy, and/or the use of a cranial remolding orthosis, such as the STARband®, to improve symmetry and normal proportion.
Why are the Skulls of Infants Subject to Deformation?

- The plasticity of the newborn’s skull makes it susceptible to external pressures in the womb, during the birth process, and after birth.
- The immobility of newborns and any positional neck preference can predispose infants to extrinsic skull deformities.
- Intrinsic abnormalities can be caused by craniosynostosis or through genetic transmission.
- Deformational forces most frequently affect the occiput, although the frontal bones and the face may be affected in severe cases.
- About 24%* of babies have some type of noticeable skull deformity at birth, reducing to about 20%† by 4 months of age.
- The abnormal shape may persist if the baby spends most of the day on the back against the hard surface of infant carriers and holding devices.

†Hutchison BL, Hutchison AD. Plagiocephaly and Brachycephaly in the First Two Years of Life: A Prospective Cohort Study. Pediatrics: 114;970. 2004
What are Contributing Risk Factors for Deformational Plagiocephaly?

- Prolonged supine positioning.
- Lack of time on the tummy when the baby is awake.
- Congenital Muscular Torticollis, neck weakness or restricted neck range of motion.
- Males more frequently develop deformational plagiocephaly at a rate of 2:1.
- Slower motor development particularly in gross motor skills.
- Breech or transverse presentation in utero.
- Multiple birth infants.
- Visual field deficits.
- Bony abnormality in the cervical spine.

(Pictured above: torticollis and supine position are risk factors.)
What are the Types of Deformational Head Shapes?

DEFORMATIONAL PLAGIOCEPHALY

• The most common type of skull deformity in infants.
• Normally noticed by caregivers at about 6 to 10 weeks of age.
• Characterized by an asymmetrical skull shape.
• Unilateral occipital flattening.
• Ear is positioned more anterior on the side of the occipital flattening.
• Forehead may be asymmetrical and is positioned more anterior on the side of the occipital flattening.
• Facial asymmetry may be present.
• May be accompanied by torticollis, limited neck range of motion, weakness and preferential head positioning.
DEFORMATIONAL BRACHYCEPHALY

- Central occipital flattening.
- Increased cranial vault height posteriorly. The head is excessively wide for its length.
- May be accompanied by a prominent, bossed forehead.

DEFORMATIONAL BRACHYCEPHALY WITH ASYMMETRY

- Combination of brachycephalic and plagiocephalic characteristics.
- The shape is disproportionally wide for its length and is also asymmetrical.
- May or may not include asymmetries to the forehead and facial structure.
DEFORMATIONAL SCAPHOCEPHALY

- Very elongated head shape that is excessively long for its width.
- May be accompanied by a prominent, bossed forehead.
- Deformational Scaphocephaly caused by extrinsic forces is uncommon although it is sometimes seen in premature infants who are often positioned side lying, such as NICU infants.
- Scaphocephaly caused by extrinsic positioning may be confused with sagittal synostosis, a more serious deformity that usually requires surgery to correct.
What is Craniosynostosis?

Craniosynostosis is the premature closure of one or more cranial sutures. Treatment of craniosynostosis usually requires surgical intervention. Craniosynostosis restricts growth at the involved suture and causes excessive growth perpendicular to the fused suture. Early referral to a specialist is always recommended. There are different types of craniosynostosis, including: sagittal, coronal, metopic, and lambdoid. Infants diagnosed with craniosynostosis usually require surgery and should be referred immediately to a pediatric neurosurgeon or craniofacial specialist for further evaluation and treatment. Early diagnosis is vital. Endoscopic surgeries are often recommended before 3 months of age.

**SAGITTAL SYNOSTOSIS** is the most common type of single suture craniosynostosis and results in a scaphocephalic head shape.

- Sagittal suture is usually ridged.
- Posterior cranial vault slopes inferiorly.
- Frontal and occipital bones have a pinched/boxy shape.
- The skull becomes progressively more abnormal and does not improve with repositioning.
**LAMBDOID SYNOSTOSIS** is the *least common* type of craniosynostosis and can be confused with *plagiocephaly*.

- Significant occipital asymmetry without anterior ear shift or frontal changes.
- Mastoid bossing on the side of occipital flattening.
- Contralateral parietal bossing.

Other types of synostosis include metopic, uni-coronal, bi-coronal and synostoses that are manifested in syndromal disorders like Apert’s and Crouzon’s.

See page 9 to learn more about differentiating lambdoid synostosis and plagiocephaly.
Deformational Plagiocephaly vs. Lambdoid Craniosynostosis

*Deformational plagiocephaly* can be difficult to differentiate from *lambdoid craniosynostosis* because both conditions present with asymmetry. The two deformities are shown below in the vertex view. Refer the infant to a specialist if the diagnosis is unclear.

**DEFORMATIONAL PLAGIOCEPHALY**

- Midline
- Ipsilateral frontal bossing
- Ipsilateral ANTERIOR ear displacement
- Occipital flattening with contralateral bossing

**LAMBDOID CRANIOSYNOSTOSIS**

- Midline
- NO ipsilateral frontal bossing
- Ipsilateral POSTERIOR ear displacement (usually)
- Ipsilateral mastoid bossing
- Significant occipital flattening that worsens over time
**Patient Evaluation**

Examination of the infant skull is essential to differentiate deformational skull shape abnormalities from deformities secondary to craniosynostosis.

<table>
<thead>
<tr>
<th>Clinical Indicators</th>
<th>Normal</th>
<th>Deformational Skull Shape</th>
<th>Craniosynostosis Suspected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fontanelles and Sutures</strong></td>
<td>Normal size for age of child, no depression or bulging, no ridging over sutures.</td>
<td>Normal size for age of child, no depression, bulging, or ridges over sutures.</td>
<td>Abnormal size or other atypical appearance of fontanelle. Suture(s) may be ridged.</td>
</tr>
<tr>
<td><strong>Proportion</strong></td>
<td>Average width of the skull is 76-83% of the length of the skull.</td>
<td>Brachycephaly or Brachycephaly with Asymmetry: Width is &gt;91% of length. Scaphocephaly: Width is &lt;76% of the length.</td>
<td>Coronal Synostosis: Width may be &gt;85% of length. Sagittal Synostosis: Skull is noticeably elongated, and may be &lt;76% of length.</td>
</tr>
<tr>
<td><strong>Occiput and Parietal Bones</strong></td>
<td>Occiput and parietal bones are symmetrical.</td>
<td>Plagiocephaly or Brachycephaly with Asymmetry: Unilateral flattening that may cross midline. Occipital bossing on side opposite flattening.</td>
<td>Unilateral Lambdoid Synostosis: Impressive unilateral occipital flattening, contra-lateral parietal bossing.</td>
</tr>
<tr>
<td><strong>Mastoid</strong></td>
<td>Not prominent.</td>
<td>Plagiocephaly or Brachycephaly with Asymmetry: Mastoid is not prominent.</td>
<td>Unilateral Lambdoid Synostosis: Significant mastoid (not occipital) prominence on side of occipital flattening.</td>
</tr>
</tbody>
</table>
## Patient Evaluation—Continued

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<tr>
<td><strong>Eyes/Orbits</strong></td>
<td>Eyes symmetrical.</td>
<td>Plagiocephaly or Brachycephaly with Asymmetry: Eye size may be asymmetrical.</td>
<td>Unicoronal Synostosis: Eye on side of flattened frontal bone is positioned higher and more open than opposite side (harlequin sign).</td>
</tr>
<tr>
<td><strong>Ear Position</strong></td>
<td>Ears are symmetrical in height and placement.</td>
<td>Plagiocephaly or Brachycephaly with Asymmetry: Ear on side of occipital flattening is displaced more anterior than contralateral ear.</td>
<td>Unilambdoid Synostosis: Ear on side of occipital flattening is displaced vertically and in a posterior direction toward the closed suture. Unicoronal Synostosis: Ear is displaced vertically toward the fused coronal suture.</td>
</tr>
<tr>
<td><strong>Face</strong></td>
<td>Forehead, eyes, cheeks, mandible and chin are symmetrical.</td>
<td>Plagiocephaly or Brachycephaly with Asymmetry: Forehead, eyes, cheeks, mandible and chin may be asymmetrical. Brachycephaly and Scaphocephaly: Facial features are symmetrical.</td>
<td>Unicoronal Synostosis: Eyes asymmetrical, nasal root displaced toward side of fused coronal suture, chin displaced away from closed coronal suture.</td>
</tr>
</tbody>
</table>
Evaluating Neck Strength and Range of Motion for Torticollis

1. Evaluate active neck strength and range of motion to determine whether torticollis or a positional neck preference is contributing to the abnormal skull shape.

2. Stimulate the infant to visually track an object to each side. Babies with torticollis may compensate for limited range by turning the shoulders at the endpoint of their range or tipping their head back while simultaneously jutting their chin forward.

3. Assess head tilt, skin fold symmetry and occipital hair growth patterns, which may indicate prolonged head/neck positioning.

4. Hold the infant at arm’s length and gently tip to each side. If the baby shows asymmetric head righting ability, neck weakness or limitation may be present.

5. Refer the infant to a physical or occupational therapist if torticollis or neck asymmetry is present, particularly if a home developmental program fails to resolve the problem after 3 months of age.
Can Deformational Plagiocephaly be Prevented?

While not all deformational plagiocephaly cases will correct on their own, there are some efforts that can help prevent or reduce its effects:

- Frequent changes in body and head positions (repositioning strategies) incorporated into a tummy time home program.
- Prone positioning when the infant is awake and supervised.
- Limit time in carriers and positioning devices.
- Prescribe therapy at 3 months or earlier if there is strong positional head/neck preference, torticollis, and/or significant developmental delay.

Visit STARbandkids.com/library to download a FREE copy of Tummy Time Tools! This guide offers a variety of repositioning techniques that families can incorporate into a daily routine to increase the time infants spend off their backs.
## Assessment of Severity and Suggested Action

<table>
<thead>
<tr>
<th>Severity</th>
<th>Deformational Plagiocephaly</th>
<th>Brachycephaly</th>
<th>Brachycephaly with Asymmetry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal—Mild</td>
<td>Skull is symmetrical and well proportioned. Some mild asymmetry may be present but it is within normal limits (WNL.)</td>
<td>Skull is well proportioned. It may be wider than normal but is WNL.</td>
<td>Skull may be slightly asymmetrical and wide but is WNL.</td>
</tr>
<tr>
<td><strong>Action:</strong></td>
<td><strong>Monitor.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>The skull has unilateral occipital flattening. The ear on the ipsilateral side may be displaced anteriorly.</td>
<td>The skull has central occipital flattening with compensatory growth laterally.</td>
<td>Skull is abnormally wide. Occipital asymmetry extends past midline. Ipsilateral ear may be displaced forward.</td>
</tr>
<tr>
<td><strong>Action:</strong></td>
<td><strong>Refer for STARband if baby is &gt;3 months and &lt;18 months.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate—Severe</td>
<td>Significant occipital flattening, ear on the ipsilateral side displaced anteriorly, ipsilateral frontal bone is bossed, contralateral frontal bone may appear to be more flat.</td>
<td>Central occipital flattening with compensatory growth laterally creating a very wide head with bilateral frontal bossing.</td>
<td>Occipital flattening extends beyond midline with contralateral occipital bossing. Skull is very wide for its length with significant ear shift, ipsilateral frontal bossing and contralateral frontal flattening.</td>
</tr>
<tr>
<td><strong>Action:</strong></td>
<td><strong>Refer for STARband if baby is &gt;3 months and &lt;18 months.</strong></td>
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<tr>
<td>Severe</td>
<td>Skull shape is very abnormal with unilateral occipital flattening and contralateral occipital bossing. The ipsilateral ear is displaced forward, with significant frontal asymmetry including forehead, orbits, cheeks and mandible.</td>
<td>Occiput is extremely flat, parietal bones are displaced laterally creating a very wide head, high and sloped cranial vault, and significant frontal bossing.</td>
<td>Skull is both asymmetrical and disproportionate with significant frontal changes including ipsilateral frontal bossing and asymmetry of the orbits, cheeks and mandible.</td>
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<td><strong>Action:</strong></td>
<td><strong>Refer for STARband if baby is &gt;3 months and &lt;18 months.</strong></td>
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Treatment of Plagiocephaly with a STARband® Cranial Remolding Orthosis

- Refer for a STARband if the skull deformity is moderate to severe. Mild deformities should be documented and monitored.

- Ideal cranial orthosis treatment results are achieved when infants begin treatment before 6 months of age when the skull is rapidly growing. (Please allow up to 4 weeks from the time of referral to the start of treatment so proper documentation can be submitted to the insurance company for coverage).

- The STARband is best prescribed during the first year of life, but can be used on infants up to 18 months of age.

- Multiple studies have demonstrated that cranial remodeling orthoses are more effective than repositioning in correcting skull deformities.

- Many infants benefit from concurrent physical therapy and orthotic intervention, particularly if the infant has significant neck/torticollis issues.

- The STARband gently molds the infant’s skull into a more symmetrical and well-proportioned shape.

- The STARband has 510k clearance from the FDA. The FDA regulates cranial devices to ensure safety, quality and effectiveness.

(Continued)
• The STARband is worn 23 hours per day for an average of 3-4 months.

• Most infants successfully complete treatment for plagiocephaly with a single STARband.

• Treatment success directly correlates with parental compliance.

Contraindications of Cranial Remolding Orthoses

Infants with head shape asymmetry are not candidates for cranial remolding orthosis treatment if:

• The infant is younger than 3 months.

• The infant is older than 18 months.

• The infant has untreated craniosynostosis.

• The infant has hydrocephalus.
The STARband® Cranial Remolding Orthosis and STARscanner™ Laser Data Acquisition System from Orthomerica have been used by leading physicians, hospitals and treatment centers throughout the world since 2001.

Key Benefits:

- Over 200,000 Infants successfully treated with the STARband and growing exponentially!
- Largest selection of FDA cleared designs for treatment of deformational plagiocephaly and craniosynostosis
- Over 160 STARscanners used in prestigious institutions worldwide
- Scan infant’s head shape in 2 seconds or less eliminating the need for plaster casting
- Capture 3-D Data that can be viewed in multiple planes

Visit www.STARbandkids.com to find a location near you.