Round is Good: Cranial Molding Risks, Interventions, and Motor Outcomes

Dana McCarty, PT, DPT
Shannon O’Donnell, PT, DPT

Objectives

1. Identify and describe the types of cranial molding deformities that occur in hospitalized infants and risk factors for each ( plagiocephaly, brachycephaly, and dolichocephaly).
2. Discuss sensitive time periods for development and the short and long term motor consequences linked to early cranial molding deformity.
3. Differentiate and analyze types of interventions for prevention and treatment of various types of cranial molding deformity and their subsequent motor impairments.
4. Plan and consider appropriate treatment, parent education, equipment, and resources for cranial molding deformity prevention and treatment for NICU to EI transition.

Outline

- Back to Sleep ➔ Where are we now?
- Cranial Molding Deformities
  - Plagiocephaly (DP)
  - Brachycephaly
  - Dolichocephaly
- Time sensitive periods of cranial molding deformity (CMD)
- Interventions for CMD – NICU to EI

Cranial Molding is (still) a Hot Topic!

- But it shouldn’t be!
- Back to sleep campaign – 1992

Plagiocephaly: Facts

- “Oblique” or “slanted”
- Most common and widely researched CMD
- Primarily caused by postnatal, external factors (positioning and care) and inversely associated with achievement of motor milestones
**Plagiocephaly: Quantification**

- Cranial Vault Asymmetry Index (CVAI)
- WNL: 1.9
- Mild: 3.7
- Moderate: 5.2
- Severe: 7

\[ \text{CVAI} = \frac{\text{Short diagonal} - \text{Long diagonal}}{\text{Short diagonal}} \times 100 \]

**Plagiocephaly: Risks**

- **Post-delivery**
  - Torticollis (97% co-occurrence)\(^1\), \(^2\)
  - Primiparity\(^4\)
  - Head position when sleeping\(^1\)
  - Position on chest of drawers\(^1\)
  - Bottle feeding\(^1\)

- **At Delivery**
  - Gestational Diabetes\(^2\)
  - Vacuum-assisted delivery\(^2\)
  - Prolonged second stage labor\(^2\)
  - C-section\(^2\)
  - Primiparity\(^4\)

**Brachycephaly: Quantification**

- Cranial Index\(^2\)
- WNL: 79
- Mild: 86
- Moderate: 92
- Severe: 98

**Brachycephaly: Facts**

- "Short"
- Second most commonly researched acquired CMD
- Combined brachy and plagio in ~30%

**Brachycephaly: Risks**

- Long term supine positioning
- Limited head mobility
- Developmental Delay
Dolichocephaly: Facts

- Aka Scaphocephaly, “boat-like”
- Most commonly seen in premature infants
- Can affect 54%-73% of very preterm infants (<32 weeks)

Dolichocephaly: Quantification

- Cranial Index
  - WNL: 79
  - Mild: 77
  - Moderate: 72
  - Severe: 68

Dolichocephaly: Risks

- Prematurity
- Decreased cervical muscle development
- Hypotonia and gravity
- Decreased tolerance for supine
- Low birthweight
- Length of time requiring respiratory support
- Frequent Prone and side-lying

Plagiocephaly and Brachycephaly: Outcomes

- Severe plagiocephaly associated with: (Cabrera-Martos et al)
- Later referral for treatment
- > treatment time
- Use of an orthotic helmet
- Long term cranial molding: (Feijen et al, Roby et al)
  - 1-10% with plagiocephaly in teens
  - 0.1% with brachycephaly in teens

Plagiocephaly and Brachycephaly: Developmental Outcomes

- 3-5 y/o children with hx of DP (Cabrera-Martos et al)
- head postural changes, decreased thoracic mobility and poor balance compared to controls
- ~7 m/o infants with DP on MRI (Collett et al 2012)
  - DIP with asymmetry and flattening of cerebellar vermis and shortening of the corpus callosum
  - Correlated with lower BSID-III
- 36 m/o infants with hx of DP (Collett et al 2013)
  - Largest differences in cognition, language, and parent-reported adaptive behavior
  - Smallest differences in motor development
Plagiocephaly and Brachycephaly: Developmental Outcomes

- ~8 m/o infants with DP compared to controls with BSID-III (Knight et al)
- Weaker motor scores but within normal range
- Cognitive scores within normal range, but none accelerated
- ~ 3 y/o with hx of DP – decreased language development (Korpilahti et al)
- Non-Compliance, Epidemic (Marink et al)
  - Parents aware of DP risk and not following SIDS recs
  - Children with DP and its associated conditions are “clogging up” the health system

Dolichocephaly: Motor Outcomes

- Suggested:
  - Plagiocephaly
  - motor asymmetries
  - delayed reaching skills
  - decreased midline control
  - Myopia
  - shifts in cortical structures in the brain
- At 3 year follow-up – no significant differences in CI or developmental quotient (Elliman et al)

Dolichocephaly: Motor Outcomes

- Infants <32 weeks GA, <1500g (McCarty et al 2016)
- Motor outcomes at Follow-up

<table>
<thead>
<tr>
<th>Factor</th>
<th>At 12-24 wk PMA</th>
<th>24-36 wk PMA</th>
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<tbody>
<tr>
<td>Symmetry</td>
<td>1.5 (0.8, 2.6)</td>
<td>0.5</td>
</tr>
<tr>
<td>Depression cues</td>
<td>1.0 (0.6, 1.5)</td>
<td>0.0</td>
</tr>
<tr>
<td>Delayed head control</td>
<td>1.0 (0.6, 1.5)</td>
<td>0.2</td>
</tr>
<tr>
<td>Decreased gross skills</td>
<td>1.0 (0.6, 1.5)</td>
<td>0.2</td>
</tr>
<tr>
<td>Difficulty orienting</td>
<td>1.0 (0.6, 1.5)</td>
<td>0.2</td>
</tr>
<tr>
<td>Spastic reactivity</td>
<td>1.0 (0.6, 1.5)</td>
<td>0.2</td>
</tr>
<tr>
<td>PT scores at follow-up</td>
<td>1.4 (1.4, 1.5)</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Time Sensitive Periods

- Conservative Treatment: Predictors for poor prognosis of skull deformity and asymmetry (Kordsa et al 2016)
  - PT initiated >3 months of age
  - Presence of skull deformation at time of PT initiation
  - plagiocephaly >/= 104
  - brachycephaly >/= 90
  - Low parental satisfaction score

Time Sensitive Periods

- We have the evidence suggesting lasting impact beyond the period of actual head deformity
  - APTA, Section on Pediatrics
  - FACT SHEET
- Intervention for DP and brachycephaly at 2-4 weeks
- Intervention for dolichocephaly from birth and before 32 weeks GA
Interventions: NICU

- Positioning
- Positioning Aids
- Caregiver Education

Positioning: NICU

- Midline flexion
- Variety of positions
- Obstacles
- Individualized Positioning Needs

Positioning: NICU

Midline flexion

- In utero positioning
- Flexor muscle development
- Gravity-dependent
- Preterm hypotonia

Positioning: NICU

Variety

- Supine

Positioning: NICU

Variety

- Prone

Positioning: NICU

Variety

- Sidelying
Positioning: NICU
Variety

- Upright

Positioning: NICU
Obstacles

- Lines/leads/tubes
- Caregiver dominance
- Infant tolerance
  - Respiratory
  - Reflux

Positioning: NICU
Individualized Positioning Needs

Positioning Aids: NICU
Midliner Positioning System

- Infants <31 weeks GA and <3 weeks chronological age
- N=30
  - 26.0-30.6 weeks PMA at enrollment
- Weekly CI measures
  - Final CI: approximately 4 weeks from enrollment date (between 34.0 and 34.6)

Positioning Aids: NICU
Midliner Positioning System

- Participants
  - 24/30 infants completed study period
  - Positioning plan: recommended time in supine
  - Wear Tortle 100% of time or as much as tolerated
  - 65 infants from previous retrospective study – moldable positioners

Positioning Aids: NICU
Midliner Positioning System

- Results:
  - Final CI Measures for dolichocephaly:
    - Midliner Group: 12.5%
    - Historical Controls: 39%
  - GA, BW, PMA, time of study, CA, days on CPAP during study period, percentage of time spent supine, or GERD were not significant
Positioning Aids: NICU
Midliner Positioning System

- Controls
  - CI @ 32.6 wks PMA = 77.2
- Midliner
  - CI @ 32 wks PMA = 79.4

Positioning Aids: NICU
Cranial Cup, Z-flo

- DeGrazia et al 2014
  - Pillow=46% @ D/C
  - CC+ Pillow= 19% @ D/C

Positioning Aids: NICU
GELShield, AliGel

- Invictus GELShield
- AliGel Head Positioner Donuts

Caregiver Education: NICU

- ROM
  - Cervical rotation, lateral flexion, extensors
  - Trapezius and rhomboids
- Positioning
- Firm surface for activation
- D/C ed re: SIDS

Interventions: EI

- Positioning
- Positioning Devices
- Non-traditional Interventions
- Caregiver Education

Positioning: EI

- Back to Sleep
  - 50% decrease in SIDS since 1994
  - 48% of infants with plagio or brachy as result
- How do we achieve it?
  - Swaddle – demo/re-demo
  - Sleep surface
  - Problem solving – sensory strategies
Positioning: EI

- Baby equipment
  - Container Baby Syndrome (moveforwardPT.com and Bartlett et al)
  - Gradual progression of incline considering muscle tone
  - Age appropriateness of equipment

Interventions: EI

Positioning Devices

- Cranial Orthoses
- Tortle Air
- Other Commercial Products

Positioning Devices: EI

Cranial Orthoses

- Name Brands: KidCap, Cranial Reshaping Orthosis (CAF), STARband, DOC band
- Indications
  - No response to repositioning therapy
  - Secondary changes of the skull or frontal involvement
- Contraindications
  - Craniosynostosis
  - Unshunted hydrocephalus
  - Children beyond 18 months of corrected age
  - Babies under 3 months of corrected age

- Average age range for initiating treatment is 4-12 months
- Overall age range for treatment is 3-18 months
- Optimum age range for initiating treatment is 4-8 months
- Worn 23 hours per day for a period of 2-6 months
- F/U is 1 week after the initial fit and every 2 weeks thereafter

Flannery et al. 2012

APTA, Section on Pediatrics FACT SHEET
Positioning Devices: EI

Cranial Orthoses

- Time Sensitive Periods:
  - Cranial Orthosis: Predictors for Poor Prognosis (Steinberg et al 2014)
    - Poor compliance
    - Advanced age
  - PT vs. Helmet Therapy
    - Complete cranial correction with PT (77%) and Helmet (94%)
    - Helmet has greater correction of ear/facial asymmetry (Kim et al 2013)

Prevention: Foam Roll is placed behind infant’s ear and switched to opposite side at intervals

Treatment: For mild plagiocephaly - bump is placed over the flattened occipital area (Schumann 2015)

Positioning Devices EI:

Other Commercial Products

- A lot to choose from!
- Not compatible with Safe Sleep Practices
- Supervision!
- Use ears as a guide in car seat

Non-Traditional Interventions: EI

Manual Therapy

- Manual therapy added to standard treatment reduces the treatment duration (~1 month) in infants with severe nonsynostotic plagiocephaly (Cabrera et al 2016)
- Occiput to Sacrum

Group Therapy

- Group PT as effective as individual PT sessions for plagiocephaly and torticollis (Suprenant et al 2014)
- Establish general educational programs for parents in plagiocephaly prevention (Wilbrand et al 2013)

Caregiver Education: EI

- Hands-on Education!
Caregiver Education: EI

- Supine Playtime
  - Progression of activities
  - Soft Boundaries
  - Open play

- Prone Playtime
  - Progression of activities
  - Swaddled upright
  - Semi-reclined on chest
  - Reclined on chest
  - Flat on chest
  - Floor

In Summary

- The earlier, the better
- Variety is key
- Education, education, education!
- Consider the individual and family

References

McCarty O'Donnell_Round is Good_CSM

2017

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