Torticollis and Cranial Deformity in Infants
Interventions and Impacts on Gross Motor Development

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Course Objectives

- Review typical Congenital Muscular Torticollis (CMT) presentation and common cranial deformities (Plagiocephaly, Brachycephaly, Scaphocephaly)
- Understand key points of assessment
- Review Clinical Practice Guidelines for treatment of CMT
- Discuss various treatment strategies and specific interventions
- Identify when to refer out during assessment of an infant with CMT
- Discuss roll of CMT and cranial deformity on gross motor milestones and development
- Explore long term outcomes of untreated CMT and cranial deformity
- Determine prognosis, treatment frequency and discharge criteria
Presenter's Bio - Danielle Rupp, PT, DPT

- Undergraduate: University of Delaware - majoring in Exercise Physiology with concentrations in both Biomedical Engineering and Disabilities Studies
- Graduate: University of Delaware Doctor of Physical Therapy
- Career: Pediatric outpatient physical therapy for 7 years, treating kids from birth to age 21 with a wide variety of diagnoses

Torticollis
Torticollis

In Latin: Tortus = twisted & Collum = neck

- Torticollis describes the tilting of an infant's head to one side with rotation to the opposite side.

Description

- Head tilt to one side & chin points to opposite shoulder
- Limited range of motion makes it difficult for baby to turn head side to side
- Flattening to one side of the face and head may occur
Differential Diagnosis

- Ocular Torticollis
  - Abnormal head position due to ophthalmic conditions
  - Driven by a conscious or unconscious effort to maintain horizontal line of orientation (head righting)
- Neurologic Torticollis
  - Benign Paroxysmal Torticollis – Periodic episodes of torticollis, due to decreased blood flow to the brain, may randomly alternate side to side
- Brachial Plexus Injury
  - Scarring and contracture of SCM causes head to be pulled down and towards affected arm
- Cervical dystonia (Spasmodic torticollis)
  - Constant contraction of muscles force movement of the neck
  - Believed to be a disease of the basal ganglia
- Orthopedic Torticollis
  - Bony and spinal deformities that can cause malalignment of the neck
- Gastro-Intestinal Torticollis: Sandifer’s Syndrome
  - Combination of gastro-esophageal reflux (GERD) disorder along with spastic torticollis and dystonic body movements

Muscular Torticollis

- Two layers of muscle
  - Superficial (long neck muscles)
    - The sternocleidomastoid is the most targeted muscle
    - Bony attachments: sternum (sternum furcula) and clavicle (two-thirds medial) occipital region (two-thirds side of the neckline) and mastoid apophysis
    - Fibers have an obliquely upward and outward direction
  - Deep (paravertebral muscle)
Muscular Torticollis

- SCM Tumor (50%)
  - Hard, immobile, fusiform swelling in the SCM
  - Develops between 7-14 days of life
  - Increases in size for 2-4 weeks and plateaus for 1 month
  - Decreases in size until disappears by 5-8 months
  - Most severe form of muscular torticollis

- Congenital Muscular Torticollis (30%)
  - SCM tightness and passive range of motion limitations

- Postural Torticollis (20%)
  - Mildest form of muscular torticollis
  - Infant’s postural preference
  - Without muscular or passive range of motion restrictions

Congenital Muscular Torticollis (CMT)

- CMT is a congenital musculoskeletal disorder characterized by unilateral tightening and shortening of the SCM, with contralateral weakness and over-lengthening
- Present at birth or develops soon after
  - Usually discovered in the first 6 to 8 weeks of life—when newborn begins to gain head control
- Can persist for a year or longer
- Typically unilateral, but in rare cases can be bilateral
- High occurrence in traumatic childbirth
- During the baby’s first few weeks, a visible, palpable swelling, or soft lump, known as a sternomastoid tumor, may be present
  - Appears in 50% of cases
  - This lump is not painful and gradually goes away, generally before 6 months of age

Incidence

- CMT was considered a rare congenital musculoskeletal disorder
  - 0.3% to 2% of newborn infants or young children
- Recent research studies, however, have noted an incidence **as high as 16%**
- Male to female predominance: 3 to 2 ratio
- Traumatic deliveries = 2%
  - 19.5% forceps, suction 56%
- More than 50% of cases are first pregnancy
- Diagnosis is generally before two months in 50% of cases; parents identify most cases and may correlate with plagiocephaly

Potential Causes

- The etiology is unknown
- Theories
  - Ischemia
  - Trauma during childbirth
  - Decreased amniotic fluid volume
  - Uterine compression syndrome.
  - Intrauterine malposition (pelvic position) or space (crowding)
    - Having tighter space in the uterus is more common for first-born children
- No known prevention of congenital muscular torticollis
Cranial Abnormalities & Deformities

Cranial Deformities

- Plagiocephaly
- Brachycephaly
- Scaphocephaly
Plagiocephaly & Back to Sleep Campaign

- When compared to 1996-1999, Plagiocephaly increased
  - 214% in 2000-2003
  - 390% in 2004-2007

Head Shape

Normally, the head is about 1/3 longer than it is wide and rounded at the back.

Credit: Cranial Technologies: https://www.cranialtech.com/plagiocephaly/
Normal Head Shape– 3 month old

Normal Head Shape– 6 month old
**Normal Head Shape – 9 month old**

### Plagiocephaly
- Head is flat on one side
- Head appears skewed to one side from above
- Unilateral facial asymmetries generally involving ear, eye and cheek

### Brachycephaly
- Head is wider than normal
- Back of head is flat rather than curved
- Head may be widest above the ears

### Scaphocephaly
- Head is longer, taller and narrower than normal
Plagiocephaly

Plagiocephaly means “oblique head” (Greek “plagio” = oblique & “cephale” = head)

- Head is flat on one side
- One ear is more forward than the other
- One eye is smaller than the other
- One cheek is fuller than the other
- Top of the head is not level
- Head shape resembles a parallelogram from above
Brachycephaly

Brachycephaly means "short head" (Latin "brachy" = short & "cephaly" = head)

- Head is wider than normal
- Head is abnormally tall
- Back of head is flat rather than curved
- Face appears small relative to the size of the head
- Widest part of the head is just above the ears
- Tips of ears protrude
- Head shape resembles a trapezoid from above

Scaphocephaly

Scaphocephaly, aka Sagittal synostosis or Dolichocephaly meaning "long head" (Greek)

- Premature closure of the sagittal suture of the skull
- The sagittal suture is located on the top of the head running between the parietal bones from the anterior fontanelle (soft spot) and coronal sutures to the lambdoid sutures
- Causes abnormal growth of the skull resulting in a long and narrow head shape
- Fullness (bossing) of the forehead
- Most common form of isolated (non-syndromic) craniosynostosis (about 50% of all cases)
- Male to female ratio 4:1
Craniosynostosis

Craniosynostosis is premature fusion of one or more of the sutures in the skull. True synostosis may limit the size of the cranial vault (skull) and therefore impair brain growth.

- Untreated, build-up of pressure in the baby’s skull can lead to blindness, seizures, or brain damage
- 1 in every 2,500 babies in the US
- Many types require surgery

Many of the problems a baby can have depend on:

- Which sutures closed early
- When the sutures closed
  - before or after birth and at what age
- Whether or not the brain has room to grow

How are CMT and Cranial Deformity related?

- Estimated 87% of babies with CMT also had incidence of plagiocephaly
- CMT impacts the way the baby holds his or her head and ultimately assists in developing bad sleeping and positioning habits
- Once the baby gets into a negative pattern, it almost certain that the soft head of a newborn will receive more pressure in one area and ultimately result in a slight misshapen head

National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention
Clinical Assessment of CMT

Key Points of Assessment

- Birth and Medical History
- Body Systems Review
  - Commonly Impacted Systems: Vision, Hearing, Neurologic, GI, Respiratory, Musculo-skeletal (shoulder, spine, hips and feet), Integumentary
- Palpation
- Muscle Tone
- Positional Preferences and Posture
- Range of Motion
  - Active vs Passive
    - Cervical Lateral Flexion and Rotation
- Strength Assessment
  - Muscle Function Scale
- Physical Assessment
- Gross Motor
  - TIMP or AIMS
Birth and Medical History

- Age of initial visit
- Age of onset of symptoms
- Pregnancy history
- Delivery history
  - Cephalic vs. breech
  - Vaginal vs. Cesarean
- Use of assistance during pregnancy
  - Forceps
  - Suction
- Family history of torticollis or other congenital/developmental conditions
- Any other known or suspected medical conditions
- Developmental milestones and age reached

Body Systems Review

- Vision
  - Symmetrical eye tracking with emphasis on visual field defects
  - Nystagmus
  - Strabismus
  - Resolution of tilt in supine
- Hearing
- Neurological
- Gastrointestinal
  - History of reflux or constipation
- Cardiorespiratory
  - Symmetrical coloration, rib cage expansion, and clavicle movement
- Musculoskeletal
  - Symmetrical alignment of the shoulder and hip girdles with particular attention to cervical vertebral anomalies, rib cage symmetry and hip dysplasia
  - Symmetrical passive ROM of the neck
- Integumentary
  - Skin fold symmetry of hips and cervical region
Common Comorbidities

- Craniofacial asymmetry (90.1%)
- Plagiocephaly (87%)
- Hip dysplasia (up to 20%)
- History of Reflux
  - Peak at 10-12 months
  - 27% vs 5.4% of normal population

Palpation

- Sternocleidomastoid
  - Perform contralateral rotation, ipsilateral lateral flexion, and flexion of the head.
- Splenius
- Trapezius
- Scalenes
- Quadratus Lumborum
- Rib Cage
- Scapulae
Muscle Tone

- High tone vs Low tone
- Neck and throughout body

Positional Preferences and Posture

- Positioning
  - What is positional preference?
  - What positions does the baby avoid, if any?
  - Recommended: Prone positioning up to 1 hr per day
    - No minimum requirement
    - Shown to offset supine sleeping on motor skill acquisition

- Check Posture
  - Sitting
  - Supine
  - Prone
Range of Motion - Active vs Passive: Cervical Lateral Flexion and Rotation

- **Rotation**
  - Passive:
    - Measured in supine, head in neutral, nose aligned with the 90 degree vertical reference
  - Active:
    - Younger than 3 months: tested in supine
    - Older than 3 months: tested in sitting on the clinician’s lap on a rotating stool with the parent enticing the infant to maintain eye contact while the PT rotates the baby away from the parent

- **Lateral Flexion**
  - Passive:
    - Measured in supine with the shoulders stabilized using an oversized or arthrodial protractor
  - Active:
    - Older than 2 months: the Muscle Function Scale provides an objective strength assessment of active lateral flexion

Credit: Kim Lephart, PT, DPT, MBA, PCS - Treating Torticollis: What's in your toolbox? Evidence-based Assessments & Interventions
Strength Assessment - Muscle Function Scale

- Objective measurement of active lateral flexion
- Used for infants greater than 2 months
- 6-point scale
- Hold infant in front of a mirror and tip horizontally

Muscle Function Scale for Infants

0 = Head below horizontal
1 = Head on horizontal
2 = Head slightly above horizontal
3 = Head high above horizontal < 45°
4 = Head high above horizontal > 45°
5 = Head almost vertical > 75°
Physical Assessment

- Feet check
  - Association between hip dysplasia and clubfoot (one in 54 neonates = 1.9%)
- Pectus excavatum
- Ribs and Pelvis alignment
- Face symmetry
  - Eye and ear size and position, pupils, checks, forehead bossing, jaw symmetry
- Hands to midline/cross body
- Spine – curvature/flattening
- Scapulae & shoulder elevation and symmetry
- Quad/Creep/Crawl
- Transitions: pivot, sit to stand, stand to squat, rolling
- Prone suspension
- Pull to sit – head lag or tilt
- Pull to stand
- Weight Shift & Weight Bearing side preference
- Balance, Righting, Protective responsive

Gross Motor Standardized Assessment Tools

- Test of Infant Motor Performance (TIMP)
  - 34 weeks post-conceptional age to 5 months post-term

- Alberta Infant Motor Scale (AIMS)
  - Infants 0-18 months
TIMP

- Motor outcome measure used to assess posture and selective control of movement needed by infants under four months of age for functional performance in daily life
- The TIMP was developed to
  - 1) identify infants with delayed motor development
  - 2) discriminate among infants with varying degrees of risk for poor motor outcome
  - 3) measure change resulting from intervention
- Age Range
  - Between 34 weeks post-conceptional age to 5 months post-term
- Validity with Alberta Infant Motor scale (AIMS)
  - Correlation between scores on the TIMP and the AIMS was highest
    - TIMP tests at 90 days
    - AIMS testing at 6 months
AIMS

Purpose:
- To measure the motor development for infants at risk for motor delay, focusing on attaining motor milestones and components necessary to attain the milestones.
- The AIMS takes into consideration three criteria related to quality of movement: weight distribution, posture and movement against the force of gravity.

Type of Test:
- Performance based, norm-referenced observational measure

Target Population and Ages:
- Infants 0-18 months or until child is able to independently walk

Test Administration

Scoring:

The AIMS consists of 58 items, including 4 positions
- Prone (21 items)
- Supine (9 items)
- Sitting (12 items)
- Standing (16 standing)
Does symmetry of the movements matter?

“In scoring bidirectional motor items, such as rolling, pivoting, and cruising, the examiner should use clinical judgment. If after observing the infant move, the examiner has no concerns about symmetry, the infant may be credited for a bidirectional item, even though it was observed in only one direction. In most instances an infant will move spontaneously in both directions... If, however, the examiner has doubts about the infant’s ability to move symmetrically, the infant should be encouraged to perform the item in both directions. If, in this instance, the examiner is unable to motivate that infant to move in both directions and there is still a concern about symmetry, the item should be scored as ‘not observed’.”
Torticollis Severity Grading
Grading Severity

Grade 1: Early Mild

- Infant presents between 0 and 6 months
- Postural preference or muscle tightness less than 15 degrees of cervical rotation

Grade 2: Early Moderate

- Infant presents between 0 and 6 months
- Muscle tightness of 15-30 degrees of cervical rotation

Grade 3: Early Severe

- Infant presents between 0 and 6 months
- Muscle tightness of more than 30 degrees of cervical rotation or an SCM mass
Grade 4: Late Mild

- Infant presents between 7 and 9 months
- Postural preference or muscle tightness of less than 15 degrees of cervical rotation

Grade 5: Late Moderate

- Infant presents between 10 and 12 months
- Postural preference or muscle tightness of less than 15 degrees cervical rotation

Grade 6: Late Severe:

- Infant presents between 7 and 12 months
- Muscle tightness of more than 15 degrees cervical rotation

Grade 7: Late Extreme:

- Infant presents after 7 months with an SCM mass OR
- Infant presents after 12 months with muscle tightness of more than 30 degrees cervical rotation
Clinical Assessment of Cranial Deformity
Assessment Tools for Head Shape

- **Argenta Classification**
  - A validated and reliable tool for classifying progressive head shape deformities
  - Five ratings for plagiocephaly and three for brachycephaly and scaphocephaly

- **Cranial Anthropometric Measures**
  - Manual cranial measurements using tape measurer or calipers

- **Laser Guided Scans**
  - 3-D laser guided imaging
Cranial Anthropometrics

Measurements

- **Head Circumference**
  - glabella & opisthocranion (g. & op.)

- **Head Length (aka A/P)**
  - glabella to opisthocranion (g. & op.)

- **Head Width (aka M/L)**
  - eurion to eurion (eu & eu)

- **Head Oblique**
  - ipsilateral fronto-temporal point to contralateral lambodial point (ft & l.)

Cephalic Ratio (CR) and Cranial Vault Asymmetry Index (CVAI)

**CR**

- Measures head length vs head width
- CR should be < 90

**CVAI**

- Measures longest and shortest diagonals from forehead to posterior skull
Cranial Vault Asymmetry Index (CVAI)

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

(A-KA Cranial Index (CI))

Cephalic Ratio (CR)

\[ \text{CR} = \frac{(M/L)}{(A/P)} \times \frac{100}{100} \]

Example

Measurements

- Head Circumference = 490mm
- Head Length (A/P) = 310mm
- Head Width (M/L) = 270mm
- Right to Left Head Oblique = 315mm
- Left to Right Head Oblique = 290mm

CR = \[ \frac{270}{310} \times 100 \]

CR = 87

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

\[ \text{CVAI} = \frac{(315 - 290) \times 100}{315} \]

CVAI = 7.9
Laser Guided Scans

Ex: STARscanner
Clinical Practice Guidelines for treatment of CMT

The CPG for PT treatment of infants with CMT is intended as a reference to guide physical therapy practice and to inform the need for continued research

- 16 action statements organized under 4 major headings
Action Statements

Action Statement 1: Identify newborns at risk for torticollis

Action Statement 2: Refer Infants with asymmetries to physician and physical therapist

Action Statement 3: Document Infant History

Action Statement 4: Screen Infants

Action Statement 5: Refer infants from physical therapist to physician if red flags are identified.

Action Statement 6: Request Images and Reports

Action Statement 7: Examine body structures

Action Statement 8: Classify the Level of Severity

Action Statements

Action Statement 9: Examine Activity and Developmental Status

Action Statement 10: Examine Participation Status

Action Statement 11: Determine Prognosis

Action Statement 12: Provide First Choice Interventions

Action Statement 13: Provide Supplemental Interventions

Action Statement 14: Refer for Consult When Outcomes Are Not Fully Achieved

Action Statement 15: Document Outcomes and Discharge Infants From Physical Therapy When Criteria Are Met

Action Statement 16: Provide a Follow-up Screening of the Infant 3-12 Months Post Discharge
Treatment for CMT

Treatment Strategies

First Choice Interventions

- Neck PROM
- Neck and trunk active ROM
- Development of symmetrical movement
- Environmental adaptations
- Parent/caregiver education
Supplemental Interventions

Interventions with Evidence of Efficacy
- Microcurrent
- Myokinetic stretching
- Kinesiotaping
- TAMO approach
- TOT collar
- Soft foam collars
- Custom-fabricated cervical orthosis
- Surgery/Botox
- Helmets

Interventions without Evidence of Efficacy
- Cervical Manipulation
- Soft tissue massage
- Craniosacral therapy
- Total Motion Release
- Feldenkrais Method
- Surgery
  - Approximately 10% of children with CMT require surgery
  - Typically in preschool years.
  - Lengthen the short SCM

Treatment for Cranial Deformity
Treatment - Positioning vs Cranial Remodeling Orthosis

- Sutures generally close by 18 months
  - Need orthosis before this age
- Also need head control generally for helmet, but can use before head control emerges
  - 12 weeks
- One study found toddlers with plagiocephaly continue to exhibit developmental delays compared to toddlers without plagiocephaly, especially in cognition & language
  - IMPORTANT: These findings do not necessarily imply a causal relationship between plagiocephaly and development because children with delays may be more likely to develop plagiocephaly!
- Red Flag: skull shift is opposite of what you’d expect based on torticollis side

Positioning Devices

1. Tortle Beanie
2. Boppy Noggin Nest Head Support
3. Britax Head and Body Support
4. Diono 2 in 1 Head Support
5. Original Baby Elephant Ears Head Support Pillow
6. Babymoov Lovenest Newborn Head Support Pillow
7. Baby Side Sleep Pillow
1. Tortle Beanie

2. Boppy Noggin Nest Head Support

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5. Original Baby Elephant Ears Head Support Pillow

6. Babymoov Lovenest Newborn Head Support Pillow

7. Baby Side Sleep Pillow
Cranial Orthoses, Helmets and Bands

Types:

- **Active**
  - Occasionally referred to as “dynamic” orthotics
  - Most common variety available
  - More snug and form fit to individual’s head

- **Passive**
  - Not as snug as active orthotics

*Primary difference in the two categories is the snugness of the helmet or band’s fit, which affects the overall amount of pressure applied to the baby’s skull at any point

Active Helmets and Bands

STARband
- Comprised of ½ inch of foam below a hard copolymer coating
- Adjustments as needed, checked every two weeks, depending on head growth
- Appropriate for moderate to severe cranial deformities

STARlight Band
- Lightweight, ¼ inch clear plastic
- Can be molded using heat
- Ideal for young infants who are still learning to rotate and lift their heads
- For moderate and mild brachycephaly and plagiocephaly, not best design for use with scaphocephaly

STARband Bi-valve
- Ideal for use with scaphocephaly

STARlight Bi-valve
- Ideal for post-operative scaphocephaly patients

STARlight Cap
- One-piece, clear plastic orthosis
- Lightweight and ideal for younger infants
- Used to treat mild brachycephaly, plagiocephaly and scaphocephaly

Active Helmets and Bands

DOC Band
- 6-ounce orthotic that is customized
- Hard plastic shell with a foam liner
- Weekly to bi-weekly follow up visits are required to adjust the band's fit
- First FDA approved post-operative cranial remolding orthotic and the first marketed and approved cranial band

Hanger Cranial Band
- Similar to DOC Band and STARband
- Available only through Hanger’s 670 clinics.
Passive Helmets and Bands

Clarren Helmet
- Appropriate for infants ranging from 6-18 months of age with mild to severe cranial deformations
- Does not have any side or top openings apart from air holes
- Fastened with a chin strap
- Comprised of a 3/8” polypropylene cover with a 1/8”aliplast liner
- Does not require frequent follow-up visits, and only minimal adjustments can be made to the liner
- Can be used in combination with cranial shunts and following surgery due to the loose fit it provides.

Boston Band
- Lightweight, comprised of a flexible plastic outer shell and a foam liner
- Fit is based on a mold or 3D scan
- Acceptable for the treatment of scaphocephaly, plagiocephaly and brachycephaly
- Has both side and top holes, and is a side opening band
- Available only through Boston Brace and their partner programs (NOPCO Clinical Network and other partners)
- Claims to require less time for successful treatment than other available options

Treatment Time
- Ideal onset time for cranial remodeling treatments is 5-6 months of age
  - Treatment can begin at any point before one year of age and still produce decent results
- Orthotics manufacturers provide guidelines for the use of their individual products based on studies that they have conducted and reports from parents and care providers
- Results will vary from child to child and depend on the severity of the condition.
- Most products are designed for 3-4 months of therapy on average
- Average daily wear recommendations are for 23 hours/day
Orthomerica’s STAR Family of Cranial Remolding Orthoses

**STARband**
- Silicone
- Most widely prescribed headband design
- Used in Treating:
  - plagiocephaly
  - brachycephaly
  - post-operative craniostenosis
- Measurements:
  - Custom fabricated from a plaster cast or scan
  - Orthomerica
  - Custom designed and manufactured
- Hypoallergenic, high-quality materials for sensitive skin
- Custom design to fit every nuance of your baby’s head shape for a gentle, yet effective treatment

**STARlight**
- Soft orthosis
- Used for plagiocephaly head shapes
- Measurements:
  - Custom fabricated from a plaster cast or scan
  - Orthomerica
  - Hypoallergenic, high-quality materials for sensitive skin
- Custom design to fit every nuance of your baby’s head shape for a gentle, yet effective treatment

**STARlight PRO**
- Silicone
- For post-operative craniosynostosis
- Measurements:
  - Custom fabricated from a plaster cast or scan
  - Orthomerica
  - Hypoallergenic, high-quality materials for sensitive skin
- Custom design to fit every nuance of your baby’s head shape for a gentle, yet effective treatment

**DOC Band® Difference**
- Exclusively at Cranial Technologies
- Each band is custom manufactured for each infant using state-of-the-art technology
- Typically weighs less than 6 ounces and is 32% lighter than any other device.
- Won’t interfere with your baby’s balance or daily activities.
Clarren Helmet

Boston Band

Gross Motor
Typical Gross Motor Development Outline

2 Months
- Can hold head up and begins to push up when lying on tummy
- Makes smoother movements with arms and legs

4 Months
- Holds head steady, unsupported
- Pushes down on legs when feet are on a hard surface
- May be able to roll over from tummy to back
- Can hold a toy and shake it and swing at dangling toys
- Brings hands to mouth
- When lying on stomach, pushes up to elbows

6 Months
- Rolls over in both directions (front to back, back to front)
- Begins to sit without support
- When standing, supports weight on legs and might bounce
- Rocks back and forth, sometimes crawling backward before moving forward

9 Months
- Stands, holding on
- Can get into sitting position
- Sits without support
- Pulls to stand
- Crawls

12 Months
- Gets to a sitting position without help
- Pulls up to stand, walks holding on to furniture (“cruising”)
- May take a few steps without holding on
- May stand alone

18 Months
- Walks alone
- May walk up steps and run

Roll of CMT and Cranial Deformity on Gross Motor Milestones and Development

- Infants with CMT are shown to have a higher incidence of persisting developmental delay
- If developmental delay is observed remediation of delay should be addressed in plan of care

*Guideline Development Group (GDG) recommends TIMP for infants through 4 months corrected age and AIMS for infants from 4-18 months corrected age
Tummy Time!

The effects of prone positioning on the quality and acquisition of developmental milestones in four-month-old infants
Dudek-Shriber et al (2007)

“Specifically, the results of this study also appear to suggest that those infants who spent slightly more than an hour or more in the prone position while awake per day achieved greater success in acquiring certain prone, supine, and sitting milestones that begin developing incrementally at approximately four months of age.”
Motor Function in School-Aged Children With Positional Plagiocephaly or Brachycephaly

Objective:
- To determine whether children with a history of positional plagiocephaly/brachycephaly (PPB) show persistent deficits in motor development.

Methods:
- In a longitudinal cohort study, we completed follow-up assessments with 187 school-aged children with PPB and 149 participants without PPB who were originally enrolled in infancy. Primary outcomes were the Bruininks-Oseretsky Test of Motor Proficiency-Second Edition (BOT-2) composite scores.

Results:
- Children with PPB scored lower than controls on the BOT-2. Stratified analyses indicated that differences were restricted to children who had moderate-severe PPB. No consistent differences were observed in children who had mild PPB.

Conclusion:
- Children who had moderate-severe PPB in infancy show persistent differences in motor function. We suggest close developmental monitoring and early intervention to address motor deficits.

Collett et al (2020)

Do Infant Motor Skills Mediate the Association Between Positional Plagiocephaly/Brachycephaly and Cognition in School-Aged Children?

Objective
- Positional plagiocephaly/brachycephaly (PPB) is associated with lower cognitive scores in school-aged children. This study tested the hypothesis that infant motor skills mediate this association.

Methods
- Children with a history of PPB (cases, n = 187) and without PPB (controls, n = 149) were followed from infancy through approximately 9 years of age. Infant motor skills were assessed using the Bayley Scales of Infant and Toddler Development, 3rd edition (Bayley-3), and cognition was assessed using the Differential Ability Scales, 2nd edition (DAS-2). The Bayley-3 motor composite was examined as a mediator of the association between PPB and DAS-2 general cognitive ability (GCA) scores. In secondary analyses, mediation models were examined for the DAS-2 verbal ability, nonverbal ability, and working memory scores; models using the Bayley-3 fine versus gross motor scores also were examined.

Results
- Cases scored lower than controls on the DAS-GCA ($\beta = -4.6; 95\% \text{ CI} = -7.2 \text{ to } -2.0$), with an indirect (mediated) effect of $\beta = -1.5 (95\% \text{ CI} = -2.6 \text{ to } -0.4)$ and direct effect of $\beta = -3.1 (95\% \text{ CI} = -5.7 \text{ to } -0.5)$. Infant motor skills accounted for approximately 33% of the case–control difference in DAS-2 GCA scores. Results were similar for other DAS-2 outcomes. Evidence of mediation was greater for Bayley-3 gross motor versus fine motor scores.

Conclusion
- Infant motor skills partially mediate the association between PPB and cognition in school-aged children. Monitoring motor development and providing intervention as needed may help offset associated developmental concerns for children with PPB.

Brent et al (2021)
Long Term Outcomes with Gross Motor Delays

- If developmental delay is related to CMT and documented at initial evaluation, treatment can continue under current plan of care.
- If CMT is truly resolved and developmental delay is independent of CMT.
- New prescription required to reflect new diagnosis.
- Re-evaluation required.
- New plan of care established.

Prognosis, Referrals, Home Exercise Programs & Discharge Criteria
Determining Prognosis

Prognosis for full resolution of CMT treated conservatively

- Prior to 3 months of age is 100%
- After 3 months of age is 75%

Estimated length of episode of care

- For infants younger than 3 months: 1.5-3 months
- Infants older than 3 months or infants who initiate treatment several months or more after diagnosis: 3-6 months
- Recommendations for surgery are typically made after conservative PT intervention after a minimum of 3 months of intervention however frequently following 6-12 months of intervention

Duration Based on CMT Severity

<3 months old

- CMT severity of 1-3: <6 months duration
- CMT Severity of 4-7: >6 months duration
Determining Prognosis

- Best Predictor:
  - Severity of ROM restrictions
  - Limitations of cervical rotation >15° or SCM mass
  - Older age at diagnosis – Strongly correlated with surgery

- With proper treatment, 90% to 95% of children improve before the first year of life, and 97% of patients improve if treatment starts before the first six months.

Red Flags

- Atypical presentations
  - Tilt and turn to same direction
  - Plagiocephaly and tilt to the same side
- Abnormal tone
- Late-onset torticollis at 6 months or older
- Visual abnormalities
- History of acute onset
When to Refer

- After 4-6 weeks of initial intense intervention in the absence of red flags, little or no reduction in neck asymmetry is noted
- Suspected hip dysplasia
- Asymmetries of the head, neck and trunk are not resolving after 4-6 weeks of initial intense treatment
- After 6 months of treatment with only moderate resolution
- If the infant is older than 12 months on initial examination and either facial asymmetry and/or a 10-15 degree difference persists between Left and Right sides
- The infant is older than 7 month on initial examination and a tight band or SCM mass is present
- If the side of the torticollis changes

FREQUENCY DETERMINATION

<table>
<thead>
<tr>
<th>Age at onset of treatment</th>
<th>Follow frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 4 months</td>
<td>Follow every other week</td>
</tr>
<tr>
<td>4 – 5 months</td>
<td>Follow weekly</td>
</tr>
<tr>
<td>6 – 8 months</td>
<td>Follow weekly</td>
</tr>
<tr>
<td>9 – 12 months</td>
<td>Follow weekly</td>
</tr>
<tr>
<td>12 – 18 months</td>
<td>Follow once every 1-2 weeks until child is an independent ambulator</td>
</tr>
<tr>
<td>18 – 36 months</td>
<td>Initiate treatment, follow once every 1-2 weeks while awaiting specialty consults</td>
</tr>
</tbody>
</table>

Credit: Kim Lephart, PT, DPT, MBA, PCS - Treating Torticollis: What's in your toolbox? Evidence-based Assessments & Interventions
FREQUENCY DETERMINATION

**Decrease** to every other week:
- Good compliance with HEP
- Improving ROM
- Good developmental progression

**Increase** to 2x/week:
- Poor compliance with HEP
- Family needs more hands-on-training

Home Exercise Program

Seattle Children’s Hospital:


Tips:

- Engage the visual system
- Be patient
- Timing during the day and around other activities (eat and sleep)
- Create frequency around already performed tasks
- Modify to increase endurance
**Home Exercise Program - Caution**

Caution:
- Do NOT push!
- Careful around jaw

**Criteria for Discharge**

- Full PROM within 5 degrees of the non-affected side
- Symmetrical active movement patterns throughout the passive range
- Age-appropriate motor development
- No visible head tilt
- The parent/caregiver knows what to monitor as the child grows
Quick Stat Reference

- CMT prevalence was 0.3-2% (1 in 250 = 0.4%), however, as recent as 2014 incidence rates were as high as 16%
- 75% of the time the right side of the neck is affected
- SCM Tumor (50%) Congenital Muscular Torticollis (30%) Postural Torticollis (20%)
- Sternomastoid tumor present in 50% of cases
- Male to female ratio 3:2
- More than 50% of cases of CMT are first pregnancy
- 50% of CMT diagnosed before 2 months
- Approximately 10% of children with CMT require surgery
- 90-95% of babies with CMT improve before first year of life & 97% improve if treatment starts before first 6 months
- Common Comorbidities with CMT: Craniofacial asymmetry (90.1%), Plagiocephaly (87%), Hip dysplasia (up to 20%), Reflux (Peak at 10-12 months with 27% vs 5.4% of normal population)
- Estimated 87% of babies with CMT also had incidence of plagiocephaly
- Plagiocephaly increased 214% in 2000-2003 and 390% in 2004-2007 compared to 1996-1999
- Scaphocephaly is the most common form of isolated (non-syndromic) craniosynostosis (about 50% of all cases), with male to female ratio 4:1
- Ideal onset time for cranial remodeling treatments is 5-6 months of age

Questions?