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The Effects of Congenital Muscular Torticollis on Postural Control Among Four to Six - Year - Old Children

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THE EFFECTS OF CONGENITAL MUSCULAR TORTICOLLIS ON POSTURAL CONTROL AMONG FOUR TO SIX-YEAR-OLD CHILDREN

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INTRODUCTION

Congenital Muscular Torticollis (CMT), is a rare musculoskeletal disorder characterized by unilateral shortening of the sternocleidomastoid (SCM) muscle located in the neck.[1] The rate of incidence is estimated at 0.3% to 2% in newborn infants or young children.[1] There are multiple theories about the cause of CMT, but the exact cause is unknown. CMT may be more likely to occur in difficult or complicated births, such as a breech delivery.[3] Other etiologies for CMT are inutero crowding, neurogenic myopathy, mesenchymal precursor cells, and birth trauma.[1,2] Those with CMT generally fall into one of three groups, including those with SCM tumor, those with muscular torticollis, and those with postural torticollis without mass or tightness located in the SCM.[1]

Contributors to Postural Control:

- **Vision[4,5]:** In CMT, visual input is limited, which can lead to maladaptive development of multiple systems that require input from the visual system. Vision is needed for proper head control in space. Without vision, development of balance areas of the cerebral cortex are delayed, which will lengthen the period of instability for the child. Vision provides feedback for integration with other sensory systems, too, such as the vestibular and proprioceptive system.
- **Vestibular[6,7]:** The vestibular system, which consists of internal ear organs, detects linear and angular accelerations by sensing the position of the head in space. Through these mechanisms, the vestibular system is able to determine the body's center of gravity. The vestibular system assists the visual system with gaze stabilization during head movements. When the head position is off center (such as in CMT) the internal ear organs are not providing accurate information about the center of gravity to the vestibular system, thus compromising balance.
- **Somatosensory[8,9]**: The somatosensory system informs the central nervous system about body motion and position in reference to supporting surfaces, contributes to steady state balance by incorporating input from all parts of the body, and provides the primary influence on postural control when the surface is stable.
- **Motor Control[10,11]:** The development of motor control during infancy is key to the acquisition of developmental milestones. Infants with a diagnosis of CMT scored significantly lower than a control group on the Alberta Infant Movement Scale (AIMS) at two and six months of age showing infants diagnosed with CMT are at a higher risk of delay in early motor milestones. Additionally,t 90% of infants with CMT have plagiocephaly, a flat spot on an infant's head. If left untreated, plagiocephaly can lead to neurological, developmental, and psychological deficits.

Purpose:

The purpose of this study was to understand the overall impact of CMT treated during infancy on postural control in children between the ages of four to six years old.

METHODS

PARTICIPANT CRITERIA:

- **Inclusion:**
  - English Speaking
  - Four- to Six-Year-Olds previously treated for CMT in infancy in a Midwestern clinic
- **Exclusion:**
  - Non-English speaking
  - Children with developmental or neuromuscular disorder that may cause balance or coordination deficits
  - Those with upper or lower extremity amputations

TESTS & MEASURES:

- **Functional performance:**
  - *Bruininks-Oseretsky Test for Motor Proficiency, second edition (BOT™-2)[12]:* balance subtest used to assess postural control
- **Orthopedic measures:**
  - Passive/Active ROM: shoulder flexion, extension, abduction, and internal and external rotation; cervical flexion, extension, rotation, and lateral flexion
  - Torticollis Severity Scale: determines severity at admission for treatment

RESULTS

- **SUBJECTS (N=12):**
  - Demographics
    - Males (n=7); females (n=5)
    - Mean Age: 5.8, SD = 0.84 years
    - Severity Classification (Tables 1 & 2):
      - Mild Severity (n=10); Early Severe (n=1); Late Mild (n=1)
    - Sidedness: right (n=10); left (n=2)
- **ANALYSIS (SPSS v.25):**
- **Balance Scores and CMT at infancy vs. typically developing children** (Critical z analysis; Figure 1)
  - No statistically perceivable differences
  - Critical z analysis: -.166
- **Infant Classification Score and Childhood Balance Scores** (Pearson Correlation; Figure 2)
  - No statistically significant relationship
    - P = .505; r = .214
- **Infant AROM and Childhood Balance Scores** (Pearson Correlation)
  - No statistically significant relationship
    - P = .276; r = -.342

Figure 1. Critical z-Score Bell Curve

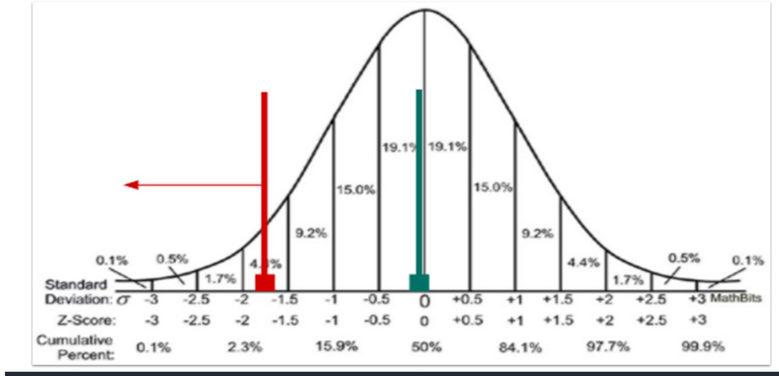

Figure 2. Relationship between BOT-2 Balance Subtest z-scores and Active/Passive Severity Grades

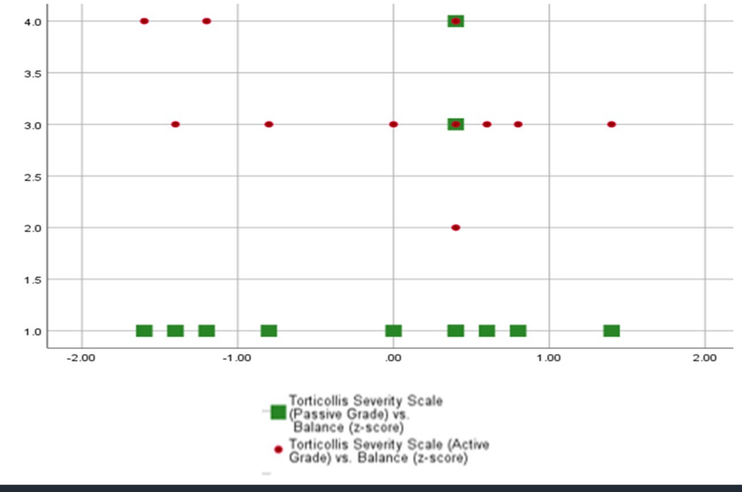

Table 1. Torticollis Severity Scale for PROM[13]

Grade	Classification	Age of Onset	ROM Measurement
Grade 1	Early Mild	0-6 months	PROM greater than 95°
Grade 2	Early Moderate	0-6 months	PROM 80-95°
Grade 3	Early Severe	0-6 months	PROM less than 80°
Grade 4	Late Mild	7-9 months	PROM greater than 95°
Grade 5	Late Moderate	10-12 months	PROM greater than 95°
Grade 6	Late Severe	7-12 months	PROM greater than 80-95°
Grade 7	Late Extreme	After 7 months with SCM mass After 12 months with muscle tightness	PROM less than 80°

Increasing Severity ↓

Table 2. Torticollis Severity Scale for AROM

Grade	ROM Measurement
Grade 1	Chin past shoulder of involved side (~100 degrees AROM)
Grade 2	Chin at shoulder of involved side (~90 degrees AROM)
Grade 3	Chin between nipple and shoulder of involved side/axilla (~70 degrees AROM)
Grade 4	Chin to nipple of involved side (~40 degrees AROM)

Increasing Severity ↓

CONCLUSIONS

The data indicated that no statistically significant relationship between torticollis severity at infancy and balance scores at preschool age were identified. Lack of significance could have resulted from a limited sample size. Further research is needed to understand the relationship between balance in early childhood and increased severity of CMT at infancy.

IMPLICATIONS

Early identification and management of CMT are essential to the maturation of typical motor developmental skills. While the results of the study suggest that pre-school age children with a history of treatment for CMT do not show differences in balance, the risk of developmental delays is documented in the literature. The small sample size and generally low severity should be taken into consideration when interpreting results of this study and the impact of CMT on balance in early childhood.

REFERENCES

1. Nilesh K, Mukherji S. Congenital muscular torticollis. Ann Maxillofac Surg. 2013;3(2):198-200.
2. Townsend, Barry. Static rotational control cervical orthosis for the treatment of congenital muscular torticollis and associated plagiocephaly and hemihypoplasia. http://www.oandplibrary.org/op/1982_01_013.asp
Congenital Muscular Torticollis (Twisted Neck). OrthoInfo. https://orthoinfo.aaos.org/en/diseases--conditions/congenital-muscular-torticollis-twisted-neck. 3.
3. 3. Published October 2018. Accessed January 22, 2019.
4. Prechtl HFR, Cioni G, Einspieler C, Bos AF, Ferrari F. Role of vision on early motor development: Lessons from the blind. Developmental Medicine & Child Neurology. 2001;43(3):198-201. doi:10.1017/S0012162201000378.
5. Bair W-N, Kiemel T, Jeka JJ, Clark JE. Development of multisensory reweighting for posture control in children. Experimental Brain Research. 2007;183(4):435-446. doi:10.1007/s00221-007-1057-2.
6. Rine RM, Wiener-Vacher S. Evaluation and treatment of vestibular dysfunction in children. NeuroRehabilitation. 2013;32(3):507-518. doi:10.3233/NRE-130873.
7. Mergner T, Rosemeier T. Interaction of vestibular, somatosensory and visual signals for postural control and motion perception under terrestrial and microgravity conditions--a conceptual model. Brain Research Reviews. 1998;28(1-2):118-135. doi:10.1016/S0165-0173(98)00032-0
8. Andersson G, Magnusson M. Neck vibration causes short-latency electromyographic activation of lower leg muscles in postural reactions of the standing human. Acta Oto-Laryngologica. 2002;122(3):284-288.
9. Shumway-Cook A, Woollacott, M H. The growth of stability. Journal of Motor Behavior. 1985;17(2), 131-147. doi:10.1080/00222895.1985.10735341
10. Ohman A, Nilsson S, Lagerkvist AL, Beckung E. Are infants with torticollis at risk of a delay in early motor milestones compared with a control group of healthy infants? Developmental Medicine & Child Neurology. 2009;51(7):545-550. doi:10.1111/j.1469-8749.2008.03195.x.
11. Collett BR, Gray KE, Starr JR, Heike CL, Cunnigham ML, Speltz ML. Development at age 36 months in children with deformational plagiocephaly. Pediatrics 2013; 131: e109–15.
12. Bruininks RH, Bruininks BD. *Bruininks-Osteretsky Test of Motor Proficiency.* 2nd edition. Bloomington, MN: NCS Pearson, Inc; 2005:51-72.
13. Kaplan SL, Coulter C, Fetters L. Physical Therapy Management of Congenital Muscular Torticollis. Pediatric Physical Therapy. 2013;25(4):348-394. doi:10.1097/PEP.0b013e3182a778d2.