

Original Article

Outcomes of asymmetry in infants with congenital muscular torticollis

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Abstract. [Purpose] The purpose of this study was to assess the outcomes of asymmetry in infants with congenital muscular torticollis (CMT). [Subjects] A total of 102 patients with CMT under the age of 6 months were studied. [Methods] Asymmetry was evaluated by determining the difference in the thicknesses of the two sternocleidomastoid muscles (DTSM) using ultrasonography, head tilt (HT) based on a physical examination, and the torticollis overall assessment (TOA). Patients received ultrasound and massage therapy for 30 minutes, in conjunction with passive stretching exercises, 3 times a week. [Results] The DTSM, HT, and TOA scores were significantly different after treatment. Pretest DTSM, HT, and TOA scores and pre-posttest change scores for DTSM, HT, and TOA scores were correlated with treatment duration in infants with CMT. [Conclusion] The findings of this study suggest that treatment duration is correlated with asymmetry evaluation parameters (DTSM, HT, and TOA) in infants with CMT. We propose that these results will help in reducing the treatment duration, and also in improving communication between doctors and therapists during the diagnosis and evaluation of torticollis.

Key words: Congenital muscular torticollis, Sternocleidomastoid muscle, Ultrasound

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INTRODUCTION

Congenital muscular torticollis (CMT) is characterized by damage to the sternocleidomastoid (SCM) muscle in the neck that results in its shortening or excessive contraction, which curtails the range of motion during both rotation and lateral bending. The head is typically tilted, bending laterally towards the affected muscle and shows rotation toward the unaffected side¹⁾. Plagiocephaly is associated with CMT in 1 out of every 300 newborns, and plagiocephaly may be associated with facial asymmetry, craniovertebral anomalies, and cervical hemivertebra in the neonatal period²⁾. Lee et al.³⁾ reported that patients rotate the head and neck region as an associated movement. Physical therapy for CMT patients aims to resolve the restricted cervical mobility and muscle asymmetry, and to prevent deformities in posture and the craniofacial area⁴⁾.

The evaluation and diagnosis of CMT is very important in treatment planning⁵⁾, and representative methods for evaluating CMT include assessment of the passive range of

cervical motion, visual examination, and torticollis overall assessment (TOA) with an arthrodiagonal goniometer and active range of motion⁶⁾. In addition, ultrasonography is a valuable diagnostic tool, which can also be useful for guiding treatment decisions⁷⁾.

Regardless of the evaluation and diagnostic methods used, most studies have aimed to determine the underlying cause of the SCM muscle lesions⁸⁾. Although some investigators have studied the use of ultrasonography in the management of CMT in children⁷⁾, their studies did not document a correlation between asymmetry and decreased thickness of both SCM muscles. Most studies have focused on the thickness of the SCM muscle on the affected side, and not on the asymmetry between the two sides⁹⁾.

While some studies have evaluated CMT using TOA, few have examined the correlation between the asymmetry evaluation parameters and treatment duration, or whether asymmetry influences treatment duration. Therefore, the purpose of this study was to examine the relationship between asymmetry evaluation parameters and treatment duration, and to determine how certain asymmetry parameters influence the treatment duration in order to identify early prognostic factors and predict positive outcomes for children with CMT.

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SUBJECTS AND METHODS

All infants with clinically suspected CMT who visited the Seoul K Medical Center as outpatients between January 2007 and May 2013 were considered for inclusion in this study. A total of 102 infants (62 boys and 40 girls) met the inclusion criteria, and their parents agreed to a conservative treatment program. The inclusion criteria were: an age of less than 6 months, a palpable neck mass or limited neck motion, and receipt of informed consent from the parents or caregivers. The exclusion criteria were a history of other diseases or disorders, congenital anomalies of the cervical spine, apparent ocular torticollis, or neurologic or auditory problems. The present study was supported by Sahmyook University and approved by the Sahmyook University Institutional Review Board (SYUIRB2014-069).

The parents of each infant were required to provide their written consent to the examination of the patients' medical records as a prerequisite for study inclusion. The clinical characteristics of the participants, including gender, mode of delivery, direction of torticollis, gestation period, birth weight, and presence of lesions such as spinal neurological lesions of the hip joint, were evaluated and recorded. The subjects comprised 62 (59.6%) male and 40 (38.5%) female infants; 81 (77.9%) natural and 21 (20.2%) cesarean deliveries; and 54 (51.9%) cases of right torticollis and 48 (46.4%) cases of left torticollis. Their mean gestation period was 39.3 (1.2) weeks; their mean birth weight was 3.3 (0.5) kg; and their mean treatment duration was 25.9 (11.0) weeks.

Three times a week, the infants with CMT received therapeutic ultrasound, massage therapy, and manual stretching exercises for 30 minutes along with passive stretching exercises. Therapeutic ultrasound was delivered to the infants using a 1 cm² transducer at an intensity of 0.5–1.0 W/cm² for 3 minutes. Massage therapy was performed for 5–7 minutes using the effleurage method with oil to increase muscle stretching and blood flow. The passive stretching program was implemented to increase the range of neck rotation on the affected side and involved lateral neck flexion to the contralateral side, which was held for 10–30 seconds and repeated 10 times¹⁰.

The data of all the subjects were analyzed to determine the difference in the thicknesses of the two sternocleidomastoid muscles (DTSM), head tilt (HT), and torticollis overall assessment (TOA).

Ultrasonography can be used to measure changes in angle, fascicle length, and the thickness of muscles^{11, 12}. DTSM was evaluated using a LOGIQ S8 ultrasound scanner (General Electric, 2012, South Korea) with a 6–12 MHz linear array transducer. Ultrasonography of the SCM muscles was performed by two physicians in order to confirm the existence of a neck mass or hypertrophy of the SCM muscle; the thicknesses of the SCM muscles were measured in longitudinal and transverse views. The infants were examined in the supine position, with slight extension of the neck caused by gentle rotation of the head to the opposite side¹³. SCM muscle thickness was recorded in millimeters (mm), and DTSM measurements were recorded as percentages (%).

Still photography was used to evaluate HT, as suggested by Rahlin¹⁴, and the amount of an infant's habitual lat-

Table 1. Differences in the assessment outcomes of asymmetry (N=102)

Categories	Pretest	Posttest
DTSM (%)	52.8 (1.4)	30.1 (1.7)
HT (angle)	13.6 (7.3)	3.0 (4.5)
TOA (score)	6.1 (3.5)	14.5 (2.4)

Values are presented as mean (SD). DTSM: difference in the thicknesses of the two sternocleidomastoid muscles; HT: head tilt; TOA: torticollis overall assessment

eral flexion in the supine position was recorded as HT. This method involves positioning the infant in a supine state and providing a visual stimulus at the midline, without making any additional effort to place the head in the midline position. To evaluate HT, two lines were drawn on printed photographs, one across the infant's eyes and the other through the superior aspect of the acromion processes (at the top of the lateral third of the shoulder). These lines were extended until they intersected, and the acute angle between the two lines which represents the spontaneous lateral tilt from the midline exhibited by an infant, was measured to the nearest degree with a protractor¹⁴. To minimize measurement error, HT was independently evaluated by three physical therapists with more than 4 years of experience.

TOA was used to evaluate rotation deficits (degrees), side flexion deficits (degrees), craniofacial asymmetry, residual bands (none, lateral, cleido, or sternal), HT (none, mild, moderate, severe), and subjective assessments by parents (cosmetic and functional) to yield an overall score. In the final assessment, the overall results were rated as excellent, good, fair, or poor using a scoring system based on both subjective and objective criteria⁵.

All statistical analyses were performed using SPSS statistical software, version 18.0. Categorical variables are presented as the count with the frequency, and continuous variables are presented as the mean with the standard deviation. The paired t-test was used to determine whether there were significant differences in DTSM, HT, and TOA before and after the intervention. Pearson's correlation coefficient was used to assess the relationships with treatment duration of pretest DTSM, HT, and TOA scores, and pre-posttest change scores (PPCS) of DTSM, HT, and TOA. Results were considered significant for values of $p < 0.05$.

RESULTS

The differences in asymmetric evaluation parameters before and after the treatment are shown in Table 1. DTSM decreased significantly from $52.8 \pm 1.4\%$ before treatment to $30.1 \pm 1.7\%$ after treatment. HT decreased significantly from an angle of $13.6^\circ \pm 7.3^\circ$ before treatment to an angle of $3.0^\circ \pm 4.5^\circ$ after treatment. TOA scores increased significantly from 6.1 ± 3.5 before treatment to 14.5 ± 2.4 after treatment.

Table 2 shows the relationships among treatment duration, and pretest DTSM, HT, and TOA scores. DTSM ($r = 0.316$, $p = 0.001$), HT ($r = 0.351$, $p = 0.001$), and TOA scores ($r = -0.433$, $p = 0.000$) were significantly correlated with

Table 2. Correlation between treatment duration, and pretest DTSM, HT, and TOA (N=102)

Categories	Treatment duration	Pretest DTSM (%)	Pretest HT (angle)	Pretest TOA (score)
Treatment duration	1			
Pretest DTSM (%)	0.316**	1		
Pretest HT (angle)	0.351**	-0.022	1	
Pretest TOA (score)	-0.443***	-0.289**	-0.517***	1

DTSM: difference in the thicknesses of the two sternocleidomastoid muscles; HT: head tilt; TOA: torticollis overall assessment.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3. Correlation between treatment duration, and PPCS of DTSM, HT, and TOA (N=102)

Categories	Treatment duration	PPCS for DTSM (%)	PPCS for HT (angle)	PPCS for TOA (score)
Treatment duration	1			
PPCS for DTSM (%)	-0.263**	1		
PPCS for HT (angle)	0.203*	0.020	1	
PPCS for TOA (score)	-0.276**	0.078	-0.515***	1

PPCS: pre-post test change scores; DTSM: difference in the thicknesses of the two sternocleidomastoid muscles; HT: head tilt; TOA: torticollis overall assessment.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

treatment duration. DTSM ($r = -0.289$, $p = 0.003$) and HT ($r = -0.517$, $p = 0.000$) were significantly correlated with TOA scores.

Table 3 shows the relationships of treatment duration with PPCS of DTSM, HT, and TOA scores. DTSM ($r = -0.263$, $p = 0.007$), HT ($r = 0.203$, $p = 0.040$), and TOA ($r = -0.276$, $p = 0.005$) significantly correlated with treatment duration. HT ($r = -0.515$, $p = 0.000$) significantly correlated with TOA scores.

DISCUSSION

Torticollis is a compound term, originating from the Latin words “torus” and “collum”¹⁵. Infants with CMT usually present with HT, facial asymmetry, and plagiocephaly¹⁶. This study assessed the degree of asymmetry between the SCM muscles using ultrasonography measurements. The head gradient was measured focusing on right-left asymmetry by tilting the head toward the affected side. Rotation deficits, side flexion deficits, craniofacial asymmetry, residual bands, HT, and subjective assessments by parents were evaluated using TOA. Except for subjective assessment by parents, the other five measures evaluate asymmetry in an objective manner. In this study, the influence of head inclination in infants with CMT was verified using still picture photography, which was used to quantify the degree of head inclination asymmetry¹⁴. Head inclination should be assessed with accurate measurement tools, and not subjectively. The head may be held in various stable positions in addition to the supine position, such as the prone and sitting positions, which should be considered in subsequent studies.

Kim et al.¹⁷ reported that SCM muscle thickness did not influence treatment duration. Similarly and Han et al.¹⁸ reported that SCM muscle thickness on the affected side did not greatly affect treatment duration. However,

our study analyzed the difference in the thicknesses of the SCM muscles on both sides. We found that, pretest DTSM, HT, and TOA scores, and PPCS of DTSM, HT, and TOA significantly correlated with treatment duration. Our study suggests that a comparison of SCM muscle thicknesses between the affected and unaffected sides is the best measure pre- and post-treatment comparisons.

TOA is a physical assessment tool, with 6 parameters comprising objective and subjective evaluations. Hsu et al.¹⁹ reported a classifications system with grading from type I to type IV based on the severity of torticollis as assessed by ultrasonography. Higher grades are associated with greater facial asymmetry and restricted cervical rotation. In the present study, pre-test DTSM ($r = -0.289$, $p = 0.003$) and HT ($r = -0.517$, $p = 0.000$) significantly correlated with pretest TOA scores, and a low TOA score corresponded with a big difference in the thicknesses of the two SCM muscles.

Currently, ultrasonography is widely used to diagnose and evaluate CMT. Ultrasonography is a reliable assessment tool for prognosis prediction and for determining an appropriate plan for the management of torticollis in children. However, according to the results of our study, pretest TOA scores ($r = -0.443$) and PPCS of TOA ($r = -0.276$), showed a stronger correlation with treatment duration than pretest DTSM ($r = -0.316$) and PPCS of DTSM ($r = -0.263$). We propose that it is possible to make a more accurate diagnosis by including HT evaluation and DTSM assessment by ultrasonography in the preliminary inspection.

Our study suggests that treatment duration is correlated with the parameters of asymmetry (DTSM, HT, and TOA scores) in infants with CMT. We expect that these results will reduce the treatment duration and will also have a positive impact on communication between doctors, and therapists during the diagnosis and evaluation of torticollis.

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