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Original Article

A study on asymmetry in infants with congenital muscular torticollis according to head rotation

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Abstract. [Purpose] The purpose of this study was to research asymmetry in infants with congenital muscular torticollis (CMT) according to head rotation. [Subjects and Methods] 70 infants with CMT were divided into grade I, grade II, and grade III according to the asymmetry of cervical rotation. Patients received ultrasound and massage therapy for 30 minutes, in conjunction with passive stretching exercises, 3 times a week. Repeated measurement results from interventions were presented from baseline, 3 months, and 6 months. Asymmetry was evaluated by head tilt (HT) and the torticollis overall assessment (TOA). [Results] The TOA measured at 3 months and 6 months showed a significant difference in inter group scores and an intra group interaction with grade and rating scale was observed. In contrast, HT was significantly different in intra group comparison, but no significant difference in inter and intra group interaction was observed in the angle and grade. [Conclusion] Conservative physical therapy showed lasting effects according to the intervention period over 3 months and 6 months of repeated measurements over time in TOA and HT. Especially, TOA showed significant differences in asymmetric changes according to the cervical rotation.

Key words: Congenital muscular torticollis, Head rotation, Torticollis overall assessment

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INTRODUCTION

Congenital muscular torticollis (CMT) manifests as an asymmetric head inclination with abnormal cervical mobility due to the imbalance of cervical muscles[1)]. Generally, it is accompanied by a contracture or shortening of the sternocleidomastoid (SCM) due to partial or full fibrosis[2)]. The SCM muscle plays a role in neck rotation and lateral flexion as well as in neck flexion[3)]. Tension on the affected side turns the head toward the unaffected side and inclines the head laterally, resulting in an asymmetric posture[4)]. CMT often occurs with a slight extension in the upper cervical vertebrae[5)]. Aside from the limited range of motion for axial rotation and the lateral curve, plagiocephaly, asymmetry of the cervical vertebrae and head and facial features may also occur[6)]. Therefore, the general goal of physical therapy for CMT is to resolve the limitations of movement and muscle imbalance and prevent postural deformity in the cranium and craniofacial area[7)].

Diagnosis of CMT is based on the clinical assessment of the slope of the cranium and the craniofacial symmetry along with palpability of the hard mass around the anterior two thirds of the Sternocleidomastoid (SCM)[8)]. A general special test can palpate the mass on the SCM but cannot distinguish whether it is a mass, cyst, or other entity[9)]. Therefore, Magnetic Resonance Imaging (MRI) has been mobilized for clear assessment of muscle hypertrophy, fibrosis and brain status in tumor.

Although there is plenty of research studying the change in cervical asymmetry due to intervention, research on the im-

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Table 1. General characteristics of the participants (N=70)

Categories	Type	N (%)/Mean (SD)
Gender	Male	44 (62.9)
	Female	26 (37.1)
Type of delivery	Natural	52 (74.3)
	Cesarean	18 (25.7)
Direction of torticollis (mm)	Right	45 (63.3)
	Left	25 (35.7)
Gestation period (weeks)		39.2 (1.2)
Birth weight (kg)		3.3 (0.5)
Time to starting treatment (days)		50.7 (37.3)

provement of cervical asymmetry from intervention remains insufficient. Therefore, in this study, patients were separated into three groups according to the asymmetry of cervical rotation and conservative physical therapy was conducted to observe the outcome differences based on the intervention period and severity of cervical asymmetry.

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 70 infants (44 boys and 26 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[10]. The present study was approved by the Sahmyook University Institutional Review Board (SYUIRB2014-069).

The parents of each infant were required to provide their written consent for 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 time to starting treatment, were evaluated and recorded. The general characteristics of the participants are shown in Table 1. 70 infants with CMT were separated into grade I (less than 15 degrees of head rotation, 22 people), grade II (15 degrees to 30 degrees of head rotation, 32 people), grade III (more than 30 degrees of head rotation, 16 people) according to the asymmetry of cervical rotation[11, 12].

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 cm^2 transducer at an intensity of 0.5–1.0 W/cm^2 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 times[13].

The data for all the subjects were analyzed to determine the differences in head tilt (HT) and torticollis overall assessment (TOA). Still photography was used to evaluate HT, as suggested by Rahlin[14], and the amount of each infant's habitual lateral 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 protractor[11]. 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 criteria[8].

All statistical analyses were performed using SPSS statistical software, version 18.0. The general characteristics are presented as averages and standard deviations are also provided. A one-way ANOVA was performed to assess the effect of conservative physical therapy within groups and between groups. Two-way Repeated measures ANOVA was performed to assess the HT and TOA according to the results at baseline, 3 months, and 6 months to determine the change of asymmetry. A post hoc test using Bonferroni method was employed to compare each group, and results were considered significant for values of $p<0.05$.

Table 2. Comparison of TOA and head tilt between groups (N=70)

	Grade I (n=22)	Grade II (n=32)	Grade III (n=16)
Pre TOA (score)	8.6 (2.3)*,†	4.5 (2.0)	2.5 (1.6)
After 3 month TOA (score)	13.9 (1.4)*	11.9 (1.9)	10.4 (3.9)
After 6 month TOA (score)	15.5 (1.3)§,*	14.3 (2.1)§	13.1 (2.8)§
Pre head tilt (angle)	12.1 (5.0)	15.1 (6.7)	18.3 (8.3)*,‡
After 3 month head tilt (angle)	3.8 (4.4)	4.9 (4.9)	6.3 (6.7)
After 6 month head tilt (angle)	2.0 (3.2)§	3.3 (4.7)§	2.8 (5.9)§

Values are means (SD). Grade I: less than 15 degrees of head rotation, Grade II: 15 degrees to 30 degrees of head rotation, Grade III: more than 30 degrees of head rotation, TOA: Torticollis Overall Assessment. *p<0.05: significant difference between groups. §p<0.05: significant difference within group. † mean that 'I' is a significant difference than 'II' and 'II' is a significant difference than 'III' (I>II>III); ‡ mean that 'III' is a significant difference than 'I', and 'II' (III/I,II).

RESULTS

The differences in TOA and head tilt according to the asymmetry of head rotation are shown in Table 2. In the initial TOA of CMT, the average for group I was 8.55, group II scored 4.53, while group III scored 2.50, and there was a considerable difference among the groups (p<0.05). 3 months later, group I's average score was 13.9, group II scored 11.94, group III scored 10.83 and there was a noticeable difference between the three groups (p<0.05). 6 months later, group I scored 15.50, group II scored 14.28, group III scored 13.06 and the significant difference between the groups persisted (p<0.05). After 6 months of intervention, considerable difference was observed among the groups and within the groups (p<0.05). Group I showed the biggest difference, followed by group II and group III in order.

The initial average head tilt angle for group I was 12.05 degrees, that of group II was 15.06 degrees, that of group III was 18.25 and there was a noticeable gap between the groups (p<0.05). 3 months later, group I had an average of 3.82 degrees, group II showed 4.94 degrees, and group III showed 6.31 degrees, with no meaningful difference between the groups. At 6 months, the average head tilt angle for group I was 1.95 degrees, that of group II was 3.31 degrees, and that of group III was 2.75 degrees. There was no specific difference between the groups after 6 months of intervention but there was considerable difference within the groups (p<0.05). Group III showed the biggest difference, whereas the differences in group I and group II were similar.

Table 2 shows the comparison of TOA and head tilt between groups according to treatment period. The TOA of CMT score showed a considerable difference when recorded in the third month and in the sixth month (p<0.05). In this study, a relationship was observed between score and degree (p<0.05). The head tilt showed variations depending on the intervention period (p<0.05), and no relationship was observed between the initial CMT scores and the degree of head tilt.

DISCUSSION

Previous studies on cervical rotation asymmetry reported that CMT infants with over 15 degrees of cervical rotation require operational treatment due to a negative prognosis and rotational limitations after treatment[13]. Also, the APFT recently introduced a guidebook for "distinguishing degrees and decision making models" based on existing research[14]. Other studies have also reported that the cervical rotational limitation is a critical factor for prognosis[13, 15]. Therefore, based on the results of existing research, CMT infants less than 6 months old were categorized into three groups according to the TOA of CMT, head tilt, and cervical rotational asymmetry. The TOA of CMT showed considerable improvements after 3 months and 6 months (p<0.05), and conservative treatment showed consistent effectiveness depending on the treatment duration. Conservative treatment including Manual lengthening exercise is well known as an effective technique for face treatment[16]. Manual lengthening exercise is a general technique used to treat CMT[13] and there is no need for special consideration of the intensity and technique when lengthening for the improvement of a passive ROM[14]. Another study observed that the conservative treatment success rate for CMT infants less than 12 months is closely related to age and the time when therapeutic exercises are initiated. Therefore, active and passive lengthening could be a very effective treatment method[17], Cheng et al.[16] conducted manual lengthening by a skilled therapist and reported a high success rate, Therefore, the effectiveness of conservative treatment reported in the previous study was confirmed and it was additionally confirmed that 6 months of treatment was consistently effective based on this result.

The results of the TOA of CMT at 3 months and 6 months after the initiation of treatment showed considerable differences between the groups (p<0.05), Group I showed the biggest difference while group III showed the least. Among groups, a mutual relationship was found between scores and grade (p<0.05). Cheng et al.[18] observed better results from CMT infants when there was less asymmetry of cervical rotation between the sound side and the lesion side, Hsu et al.[19] reported that the

increase in the cervical rotational asymmetry severity grade of torticollis also increases, therefore showing results similar to this study. Recent research on the relationship between treatment duration and cervical rotation asserted that the greater the cervical rotational limitation is, the longer the treatment duration, and early cervical rotational limitation is a very important factor in determining prognosis[20]. According to the cervical rotation asymmetry grade, significant differences were found in the TOA of CMT in this study.

To determine a treatment plan objective, special tests and measurements are needed to precisely assess a patient's status. Thus, in the past, TOA of CMT helped therapists to easily screen for the improvement of severity and treatment through test scores, and through the early stage score, it was possible to predict an indirect prognosis. Based on the results obtained, if CMT infants less than 6 months old are graded on cervical rotational asymmetry and go undergo special assessment, therapists should be aware of the difference between the groups according to the intervention period. This will help them identify a treatment plan that will be much smoother. Additionally, the ability to accurately predict the prognosis of CMT through special tests has enormous clinical value.

Head tilt showed considerable differences in measurements of the cranial slope in the third and sixth months of intervention ($p<0.05$), demonstrating the effectiveness of conservative therapy on head tilt. A recent study reported that normal cervical rotational exercise offers better preconditions to improve cranial symmetry[21]. Thus, this study shows improvements in head tilt symmetry by manual lengthening including cervical rotation exercises.

The groups showed noticeable differences according to treatment duration ($p<0.05$) and there was no mutual relationship between degree and grade within the groups ($p<0.05$). The head tilt assessment used in this study was an active functional assessment[12]. Previous studies indicated that treatment duration affected ROM recovery and symmetric cranial posture recovery[21], reporting differences in motion between active and passive ROM. Asymmetric motions and compensational motions of CMT infants are suspected to be due to hyper-tone and muscle limitations or weakness[12]. Since active ROM is considered along with neck strength as an important balanced development index[22], head tilt assessment that assess active cranial asymmetric movement may be a valuable assessment tool with benefits beyond overall special assessment of CMT. In the future at the time of diagnosis and evaluation of CMT, if torticollis classified by asymmetry of the cervical rotation compared with DRTS and TOA, it is likely that the outcome prediction and intervention plans would establish.

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