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The effect of postural control intervention for congenital muscular torticollis: A randomized controlled trial

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Abstract

Objective: To compare the effects of manual stretching and postural control intervention in infants with congenital muscular torticollis and to investigate the factors that predict treatment duration.
Design: Randomized, controlled trial.
Setting: An outpatient rehabilitation clinic in a tertiary university hospital.
Subjects: Infants <6 months of age with congenital muscular torticollis.
Intervention: Group 1 included 38 infants who received postural control intervention. Group 2 included 38 infants who received manual stretching.
Main measures: The thickness of the sternocleidomastoid tumor, rear head and facial asymmetry, and head tilt were variables measured before and after treatment. Additionally, the treatment duration was measured.
Results: The mean treatment duration was 92.53 ± 34.38 days for group 1 and 88.21 ± 37.23 days for group 2. The mean change of thickness of the sternocleidomastoid tumor was 6.88 ± 1.90 mm for group 1 and 6.05 ± 2.85 mm for group 2. There were no statistically significant differences in the mean treatment duration and the mean change of thickness of the sternocleidomastoid tumor between the groups ($P > 0.05$). The first treatment day after birth was associated with the treatment duration. In addition, facial asymmetry, the first treatment day, tumor thickness, and head tilt were associated with the treatment duration ($P < 0.05$). This regression model had a 57.4% explanatory power.
Conclusions: There was no difference between these treatments regarding the treatment duration and the change of thickness of the sternocleidomastoid tumor. Infants with congenital muscular torticollis who were treated earlier had a shorter treatment length.

Keywords

Congenital muscular torticollis, infants, sternocleidomastoid muscle, manual stretching, postural control

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Introduction

In infants, congenital muscular torticollis is one of the most common musculoskeletal abnormalities, generally caused by difficult labor such as breech presentation.[1–3] Congenital muscular torticollis is a result of excessive shortening of the sternocleidomastoid muscle, which leads to an imbalance of muscle function around the neck.

The purposes of intervention for infants with congenital muscular torticollis are to prevent plagiocephaly, achieve symmetrical head position, develop normal range of motion, and balance muscle function around the neck. It is also important to be observant of the infant's motor development. Although early rehabilitative intervention for normal muscle function around the neck is generally recognized to be beneficial in infants with congenital muscular torticollis, it is less clear which type of treatment will result in the best outcome.

Manual stretching is currently the most common treatment for congenital muscular torticollis. Staheli reported that 90% of congenital muscular torticollis cases resolve with stretching exercises, with only 10% requiring surgical intervention. Demirbilek and Atayurt[5] described passive and active stretching of the sternocleidomastoid muscle on the affected side and used firm pressure in both techniques. When therapy was started before 3 months of age, the outcome was excellent. The recommended treatment strategy by Binder et al. is divided about the positioning, handling, and stretching of infants under 3 months of age.[6] In general, however, conservative treatment seems to be beneficial when applied to 2- to 8-month-old infants. For infants older than 3 months of age, the exercises focused on neck and trunk range of motion, equal weight bearing of the trunk, and mid-line activities of the upper extremities. Because passive manipulations provoke discomfort for a child, Taylor and Norton[7] advocated a program to increase active range of motion and positioning to improve passive range of motion and avoiding pain and resistance with good to excellent outcomes in 96% of children.

Although various treatments have been suggested, no randomized clinical trials could be found in the literature to compare the effectiveness of two different treatment approaches for congenital muscular torticollis. The first aim of this study was to compare the effectiveness of manual stretching and postural control in infants with congenital muscular torticollis in a randomized, controlled study. The second aim was to describe how factors, such as the first treatment day after birth, thickness of the impaired sternocleidomastoid muscle, head tilt, facial asymmetry, and rear head asymmetry, affected treatment duration.

Methods

A total of 108 infants less than 6 months of age with a palpable neck mass or tightness, tilted head, and abnormal neck posture were included in this study. They were screened using neck ultrasonography. Patients with congenital anomalies of the cervical spine, ocular anomalies, and benign paroxysmal torticollis were excluded. Additionally, infants with medical complications, including neurological complications that would interfere with the standard stretching program, were excluded. Among the 108 infants, 76 met the inclusion criteria. All legal guardians were informed about the tests and the use of the results and were asked to sign a written statement consenting to the inclusion of their infant in the study.

The randomization was performed using opaque, closed envelopes, which the assessor was blinded to. Before commencing the first training session, each parents chose a randomization envelope that contained a message stating whether the patient would be in group 1 (the postural control group) or group 2 (the manual stretching group).

Infants in both groups received each intervention for 30 minutes per day, two times a week. Group 1 received postural control treatment focused on eye tracking, neck righting reaction, and tonic neck reflex. The postural control method proposed by Lee[8] was used and was performed by another well-trained physiotherapist with 10 years of experience. The main principle of postural control treatment was to actively promote strength of the unaffected side of the sternocleidomastoid muscle and to actively elongate the posterior fibers of the affected side of the sternocleidomastoid muscle. Before infants were able to control their neck, under 3 months of age, they were required to move their chin slightly upward and toward their affected side as far as possible in the supine or predominant prone position. We did not passively move the infants' heads but rather waited for them to respond to the suggestion of a new support surface contact by actively moving their head toward their midline. For example, in the supine position, infants initially presented with affected lateral tilt and unaffected rotation of the head, with support surface contact distributed at the affected hemi-occiput most of the time. For a few seconds, we applied gentle loading to the affected hemi-occiput and directed it toward the supporting surface. In side-lying position, we prolonged lengthening of the affected sternocleidomastoid muscle without the stress of passive stretching. Once the infants gained neck control, eye tracking, neck righting reaction, tonic neck reflex, and postural control were used. Infants looked to the affected side (upward or downward), and we exposed them to situations in which they would be interested in looking to the affected side (upward or downward), thus promoting strength of the unaffected side of the sternocleidomastoid muscle and elongating the posterior fibers of the affected side of the sternocleidomastoid muscle. Objects and/or actions to draw their attention were positioned at the affected side to encourage a reach forward towards the affected side, with the affected upper extremity in a prone position. For example, with hand placement at the infants' affected upper arm and the affected side of the back, the direction of force vectors was modified in small increments to induce changes in the support surface contact from the unaffected forearm and the unaffected side of the rib cage to the mid-rib cage. While changing the force distribution at the infants' ischial tuberosities through gentle loading from leaning the body in a supported sitting position, infants gained elongation of the affected side of their neck. Simultaneously, they controlled the unaffected lateral flexion and affected side rotation of the head with an active chin tuck.

Group 2 received passive stretching, soft tissue mobilization, massage of the affected side, strengthening exercises for the unaffected side, and therapeutic ultrasonography on the affected side. Manual stretching proposed by Emery[9] was performed by a well-trained physiotherapist with 10 years of experience. According to recommendations of previous study, we used longstanding stretching with low intensity because this method does not provoke pain is indicated to influence collagen structures and thereby range of motion. Each session consisted of three repetitions of fifteen manual stretches of the tight muscle with a gentle force sustained for 1 second and a rest period of 10 seconds in between. Two people were required to stretch the infant's neck. One person held the infant's shoulders, stabilizing the clavicle, while the other person performed the stretching. Particular attention was paid to hand placement. The infant's chin was rotated upward and toward the affected side and then his/her head was laterally bent downward to the unaffected side. Slight traction to gain relaxation was performed prior to initiating full rotation of the head to the affected side before the end-feel. At the end of the range of motion, the stretch was held. The lateral flexion stretch was also initiated with the application of slight traction followed by slight forward flexion. Finally, the infant's nose was moved laterally upward and toward the affected side. Stretches were held for 10 seconds and were repeated five times each. In our clinical experience, after the infants had gained head control, only the application of manual stretching was lacking. The reason for this is that the neck muscles of infants must be balanced and built up in order for their necks to recover normal function. Another reason is that head control can increase the strength of the affected side. Thus, after the infants had gained control of their neck when it was tilted toward the affected side, lateral head righting on the unaffected side was weak. By having the infants play in a prone position with the neck extended, bilateral sternocleidomastoid muscle elongation was encouraged. Infants strengthened the opposite side of the sternocleidomastoid muscle using the lateral righting response in upright and side-lying activities.

The parents of both groups were taught how to carry out a home program of active positioning and were specifically instructed not do any passive stretching or manipulation. In our clinical experience, the awkward application of manual stretching by parents may cause considerable pain or discomfort to the infant. However, parents usually wish to continue this procedure as a part of their home exercise program. If a home exercise program is not available to the parents, they may have to apply self-manual stretching. Thus, home exercise in both the groups was simple play, such as eye tracking. According to Peitsch's suggestions,[10] the infants of both groups slept, under supervision, in a prone position on the affected side of the sternocleidomastoid muscle, which provided a gentle stretch of the contracted muscle and promoted skull symmetry.

The end-point of the study was defined as the time when the head tilt was normalized or when the deficits in the head tilt were 5° or less.

The enrolled subjects were evaluated before and after treatment. The treatment duration was the time between the first and the last day of standardized physiotherapy. Sex and affected side were collected from the infants' medical records. We measured sternocleidomastoid muscle tumor thickness, rear head and facial asymmetry, and cervical range of motion of the infants. Ultrasonography was performed by physicians with 10 years of experience to confirm the thickness and the presence of a neck mass. Sternocleidomastoid muscle thickness is defined as the distance from the superficial to the deep aponeurosis in the thickest part of the muscle. Head tilt was measured with the degree of head leaning in infants in a supported sitting position. The goniometer was held 10 cm away at the infants' eye level. The stationary arm was maintained horizontal by leveling the carpenter's bubble, and the movable arm was aligned with the lateral corner of the infants' eye. A physician also examined for visible facial and rear head asymmetry According to the level of head tilt, the infants were dichotomized as either having ≤15° or >15°. The assessor was not involved in the study but was experienced and well qualified in the use of the tests.

Statistical analyses were performed using PASW 18.0 for Windows (IBM Inc., Chicago, IL, USA). Univariate and multivariate analyses were used to assess the data. Univariate analysis included the chi-square and independent *t*-test, where appropriate. Univariate regression analysis was also performed to assess the individual effects on the first treatment day, head tilt, tumor thickness, facial or rear head asymmetry, and the extended treatment duration. Stepwise multiple linear regression analysis was performed to select an appropriate model. To avoid multicollinearity, the variance inflation factor was set at <10, and the tolerance was set at <1 in the model. The level of significance was set at 5%.

Results

Figure 1 shows the Consolidated Standards of Reporting Trials (CONSORT) diagram for recruitment. During the treatment period, 6 patients (15.8%) withdrew from group 1. Three infants were transferred to other rehabilitation centers to be closer to their families, and 3 others did not complete their training program. As a result, data from 70 infants were analyzed.

The demographic and clinical features of the two groups are summarized in Table 1. Both groups did not show differences in sex, the mean first treatment day after birth, the mean thickness of the affected sternocleidomastoid muscle, facial asymmetry, and rear head asymmetry. Head tilt in the study was not comparable between both groups.

After intervention, the mean treatment duration was 92.53 ± 34.38 days for group 1 and 88.21 ± 37.23 days for group 2. The mean change of thickness of the sternocleidomastoid tumor was 6.88 ± 1.90 mm for group 1 and 6.05 ± 2.85 mm for group 2. There were no statistically significant differences in the mean treatment duration and the mean change of thickness of the sternocleidomastoid tumor between the groups ($P > 0.05$).

According to univariate regression analysis (Table 2), only the first treatment day was positively associated with the treatment duration ($P < 0.05$). Thus, an infant who started treatment late needed treatment for a longer duration. The most important determinants or predictors of treatment duration, according to the final multiple linear regression model (Table 3), were facial asymmetry (Partial $R^2 = 0.183$), the first treatment day (Partial $R^2 = 0.205$), tumor thickness (Partial $R^2 = 0.065$), and head tilt (Partial $R^2 = 0.121$), all of which were

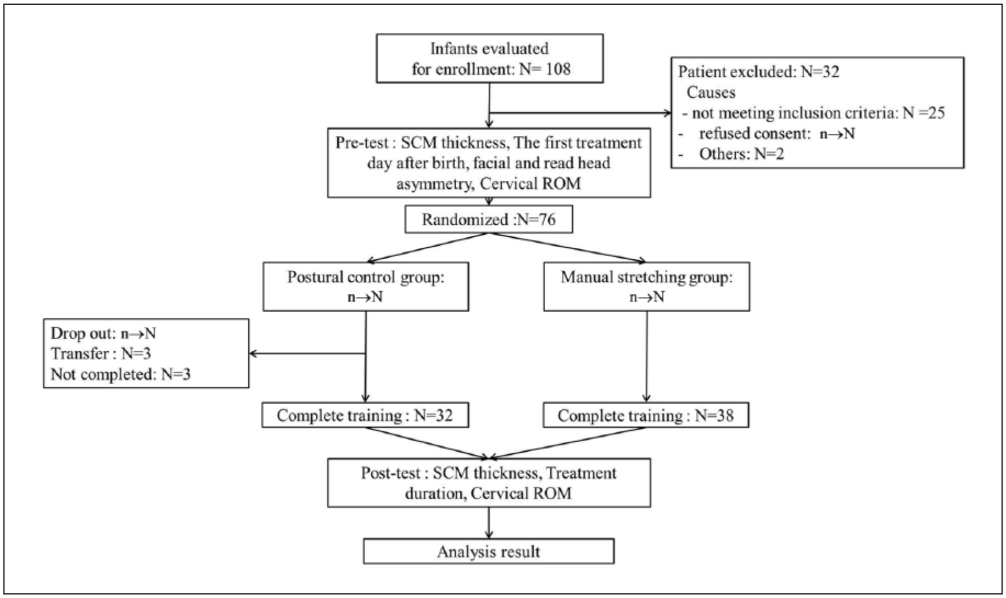

Figure 1. Flow diagram of the study.
Pre-test was performed before the intervention, and post-test was performed after training. ROM: range of motion, SCM: sternocleidomastoid muscle.

Table 1. General characteristics of subjects.

	Postural control group	Manual stretching group	*P* value
Sex (male/female)	15/17	22/16	0.472
The first treatment day after birth	29.19 (13.87)	37.84 (33.14)	0.149
The thickness of impaired SCM tumor (mm)	12.50 (5.70)	12.55 (4.24)	0.965
Head tilt <15° or ≥15°	7/25	19/19	0.025
Facial asymmetry	9/23	16/22	0.317
Rear head asymmetry	5/27	12/26	0.164

Data are expressed as n or means±SD.
SCM: sternocleidomastoid.

significantly associated with the treatment duration ($P < 0.05$). Our final regression model showed a 57.4% explanatory power.

Discussion

The main finding of this study was that the mean treatment duration was not significantly different in the two groups at around 3 months of age. This conclusion is in a line with the Guide to Physical Therapist Practice,[11] which states that 80% of patients classified in pattern 4B including the diagnosis of torticollis, are expected to "achieve the anticipated goals and expected outcomes within 6 to 20 visits during a single continuous episode of care" over a 3- to 6-month period. The mean change of thickness of the sternocleidomastoid tumor was not significantly different between the two groups. Emery[9] reported on a series of 100 patients with congenital muscular torticollis before the age of 2 years, and the patients were treated with a defined home program of stretching and active positioning stimulation. However, trained therapists were not used, making standardization of

Table 2. Association of treatment duration with evaluated items by univariate linear regression analyses.

Variables	β±SE	*P*-value	95% CI
The first treatment day after birth	1.38±0.41	0.002	0.55–2.21
The thickness of impaired SCM tumor (mm)	−2.04±1.25	0.871	−2.73–2.32
Head tilt <15°/≥15°	−22.18±11.92	0.070	−46.21–1.86
Facial asymmetry	23.35±12.68	0.072	−2.20–48.91
Rear head asymmetry	17.80±16.96	0.300	−16.39–51.99

SCM: sternocleidomastoid.

Table 3. Association of treatment duration with evaluated items by multiple linear regression analyses.

Variables	β±SE	Partial R^2	*P* value	95% CI
The first treatment day after birth	1.82±0.33	0.205	0.000	1.16-2.48
The thickness of impaired SCM tumor (mm)	2.60±1.04	0.065	0.017	0.50–4.70
Head tilt <15°/≥15°	−39.61±9.51	0.121	0.000	−58.81–20.41
Facial asymmetry	59.22±10.95	0.183	0.000	37.10–81.34

SCM: sternocleidomastoid.

the technique difficult. The mean treatment duration was about 4–7 months. The current study concluded that the infants' prognosis for recovery was favorable, and they achieved the anticipated goals and expected outcomes of the intervention.

In univariate regression analysis, delay of the first treatment day after birth was indicative of long treatment duration. In our final regression model, the explanatory power of the first treatment day after birth was higher than the thickness of the affected sternocleidomastoid tumor, head tilt <15°, and facial asymmetry. This result is in agreement with previous studies. Tatli et al.[12] subdivided subjects into two groups according to their age at presentation, less than 6 weeks and between 6 and 24 weeks old, and found that patients who presented at less than 6 weeks old had a shorter period of therapy compared to that in those who presented later. Petronic et al.[13] showed that earlier treatment is shorter and more cost-effective.

Many authors reported that passive stretching is a very effective intervention for congenital muscular torticollis.[1,9,14–16] However, in clinical practice, we have observed that infants frequently resist this activity and cry during passive stretching, especially if they are older than 3 or 4 months of age. Karmel-Ross and Lepp[15] reported irritability in patients with torticollis as a response to pain resulting from a perinatal or intrauterine compartment syndrome. Cheng et al.[17] also reported that "snapping" of the sternocleidomastoid muscle during manual stretching, although rare, might signify a partial or complete rupture of this muscle, which can be confirmed by ultrasonography. In the current study, the infants' resistance and crying frequently appeared to make parents feel uncomfortable about using manual stretching. Although long-standing stretching with low intensity does not provoke pain, infants do not like stretching themselves, and repeated discomfort induces crying. In a future study, a diary for recording the infants' crying or a parental questionnaire should be considered to measure pain or discomfort. Whereas, we observed that infants feel much less discomfort and resistance to handling and crying during postural control. During postural control intervention, infants with congenital muscular torticollis also achieved a favorable outcome, normal range of motion, and normal head control ability when comparable to those in infants who underwent manual stretching. Rahlin[16] reported on Tscharnuter Akademie for Movement Organization (also known as TAMO therapy), a therapeutic approach based on the dynamic theories of motor control, which was applied to infants with congenital muscular torticollis. Infants achieved favorable outcomes with unrestricted head rotation to the affected side in the absence of a palpable intramuscular fibrotic mass, without avoiding discomfort, resistance to handling, and crying.

In the present study, infants slept in prone under supervision. Previous studies described that prone sleep is a risk factor for sudden infant death syndrome.[18–20] Although prone sleep was applied under thorough supervision, prone sleep must be carefully performed and required continuous observation.

The present study has limitations that should be considered. First, the location of a mass in the sternocleidomastoid muscle was considered influential to the rehabilitation outcome. Sternocleidomastoid muscle thickness was measured from the site that showed the largest diameter when scanning along the sternocleidomastoid, but the location of the mass was not considered. Cheng et al. adopted a scoring system for evaluating the outcomes of children with congenital muscular torticollis.[21] Among their evaluation categories was the presence of a residual band, scored according to its location in the sternocleidomastoid. Therefore, in a future study, evaluating the location of a mass in the sternocleidomastoid will be helpful in determining the treatment duration. Second, the follow-up evaluation was not performed after rehabilitation intervention; therefore, it is not known whether the effects of treatment were maintained. Third, our study's small sample size lessened its statistical power. A prospective study with a large sample size that represents the general population would be helpful for analyzing prognostic factors for congenital muscular torticollis and increasing statistical power. Fourth, head tilt in our study was not comparable between the groups for the first measurement, and this difference may have affected the results.

Although the study contains some limitations, there were no differences in the effectiveness of postural control and manual stretching in the recovery from congenital muscular torticollis. Regardless of the treatment method, we identified initiation of physical treatment as a reliable prognostic factor for the outcomes of infants with congenital muscular torticollis. Therefore, infants with congenital muscular torticollis who were treated earlier had shorter treatment duration. Additionally, during postural control, the positive correlations between the thicker tumor on the sternocleidomastoid and the appearance of facial asymmetry and treatment duration were confirmed as reliable prognostic factors. The prognosis is favorable even in infants with congenital muscular torticollis who have fewer limitations with their leaned head.

Clinical messages

- Treatment duration for both treatments, postural control intervention and manual stretching, were equal in infants with congenital muscular torticollis.
- Infants with congenital muscular torticollis who were treated earlier had a shorter length of treatment.

Conflict of interest

The author declares that there is no conflict of interest.

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