Original Research

Therapeutic Effect of Microcurrent Therapy in Infants With Congenital Muscular Torticollis

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Objective: The aim of this study was to determine whether microcurrent therapy is therapeutically effective in infants with torticollis.

Design: Prospective, unblinded, controlled trial.

Setting: Bundang CHA Hospital.

Subjects: Fifteen infants were included in this study who received torticollis treatment from April to July 2008. The control group (CG) included 8 infants (3 male, 5 female) with a mean age of 7.1 months. The experimental group (EG) included 7 infants (6 male, one female) with a mean age of 10 months.

Methods: The CG underwent stretching exercises for 30 minutes after ultrasound therapy and the EG underwent stretching exercises for 2 minutes after microcurrent therapy for 30 minutes. Each group received 3 treatments per week for 2 consecutive weeks.

Main Outcome Measures: Measurements included head tilting angle at supine (TA) and neck rotation range of motion to the affected side (RR) at the first day and the 14th day of treatment. The incidence of crying during therapy also was recorded. The results were assessed by Mann-Whitney *U* and the Fisher exact tests.

Results: In the CG, 4 infants showed TA improvement, one infant showed RR improvement, and 8 infants cried during therapy. In the EG, 6 infants showed TA improvement, 5 infants showed RR improvement, and 3 infants cried during therapy. In the CG, mean TA was 16.3 ± 9.2° at the first day and 13.9 ± 8.2° at the 14th day of treatment. In the EG, mean TA was 15.7 ± 8.2° at the first day and 6.7 ± 4.3° at the 14th day of treatment. TA improvement was greater in the EG ($P < .01$) as compared with the CG. In the CG, mean RR was 65.0 ± 24.6° at the first day and 66.3 ± 25.7° at the 14th day of treatment. In the EG, mean RR was 70.0 ± 11.5° at the first day and 80.7 ± 6.7° at the 14th day of treatment. RR showed greater improvement in the EG ($P < .05$). The incidence of crying during therapy was significantly lower in the EG ($P < .05$).

Conclusion: Microcurrent therapy in infants with torticollis appears more effective in improving TA and RR and shows better therapeutic compliance than traditional therapy.

INTRODUCTION

Congenital muscular torticollis (CMT) is a neck deformity that involves shortening of the sternocleidomastoid (SCM) muscle [1,2]. The main clinical features of torticollis include a characteristic head tilt, limited neck rotation, and/or a palpable mass [3]. The prevalence of CMT varies from 0.3% to 2.0% [4]. Many theories have been proposed, but the true cause of CMT remains unknown. Coventry and Harris [5] reported that 80% of torticollis cases resolved spontaneously without treatment. Canale et al [6] found that if CMT persisted beyond the age of l year, it did not resolve spontaneously. If torticollis persists, craniofacial deformities or plagiocephaly can occur. Therefore, earlier aggressive treatment improves not only head tilt, neck bands, and loss of normal neck contour but also prevents the craniofacial asymmetry that appears to result from restricted growth on the affected side.

The initial therapy for the patient with CMT should consist of physiotherapy with passive and active exercises and massage. If contraction of the SCM muscle persists beyond 1 year of age or craniofacial anomaly develops, surgical treatment is indicated [7]. In the authors' experience, an aggressive stretching program can become challenging because of the extent

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of the tightness of the child's affected SCM and because of the child's resistance to therapy with increasing age.

Recently, the evidence supporting electrical stimulation as a treatment modality for wound healing and soft tissue injury has been evaluated [8]. The principle of electrical stimulation for analgesia, and tissue and wound healing has been adapted into therapies such as electroacupuncture, transcutaneous electrical nerve stimulation therapy and, more recently, microcurrent therapy [9].

Microcurrent therapy is low intensity alternative current (100~200 microamperes). The patient feels no sensation during treatment. The therapeutic mechanism of action is not known but may be related to a reduction in the disturbance of the intracellular Ca^{2+} homeostasis. The latter has been proposed to be the mechanism for taut band formation [10]. Accordingly, the aim of this study was to measure the effectiveness of treatment for CMT with microcurrent therapy as measured by reduction in head tilt, improvement in neck rotation, and infant tolerance of treatment during therapy.

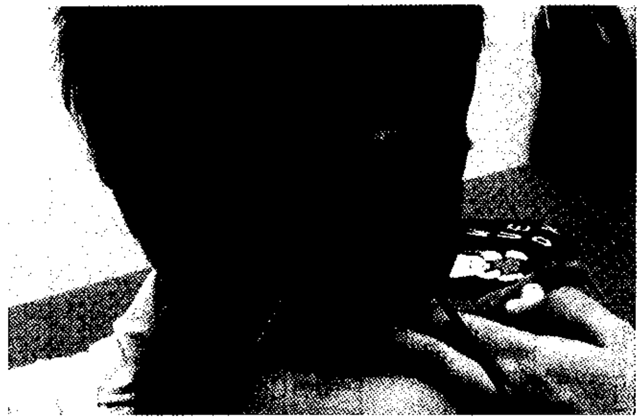

Figure 1. Microcurrent therapy for treatment of torticollis electrode placement on the affected SCM muscle.

MATERIAL AND METHODS

Fifteen infants who received torticollis treatment were recruited at Bundang CHA Hospital from April to July 2008. They did not have developmental dysplastic hips, cervical spine disorder, or neurologic disease. Clinical features, especially facial asymmetry and passive range of motion (ROM) of neck rotation, were evaluated and recorded. Manual stretching and microcurrent therapy were performed by a physiotherapist specifically trained in neuromuscular disorders in pediatric patients with a standardized program session 3 times per week for 2 weeks.

The control group consisted of 8 infants (3 male, 5 female) with a mean age of 7.1 ± 4.9 months. The treatment session consisted of regular physiotherapy for 30 minutes, including ROM exercises, postural training, and gentle stretching. The experimental group comprised 7 infants (6 male, one female) with a mean age of 10 ± 14.3 months. Each treatment session consisted of 30 minutes of microcurrent therapy (EMI, Cosmic Co, Seoul, Korea) followed by stretching for 2 minutes.

Measures included head tilting angle at supine (TA) and neck rotation ROM to the affected side (RR) at the first day and the 14th day. Neck ROM was measured by one physiatrist and physical therapist. The physiatrist and pediatric physiotherapist who were experienced in evaluating infants with CMT using these methods were responsible for performing all the measurements. Neck rotation was measured with an arthrodial protractor. The infant was lying supine on the examination table with the shoulders stabilized. The examiner supported the head and neck in the neutral position, over the edge of the examination table. In this position the neck could be rotated and moved freely in all directions. According to Cheng et al [11], there is an interexaminer reliability correlation coefficient of 0.71 for neck ROM in infants.

The TA was measured with the infant lying in supine on a large protractor with the shoulders stabilized This method was found to have a high intrarater reliability with the interclass correlation coefficient reported as 0.94-0.98. The maximal values for passive ROM in rotation and tilting angle of the cervical spine were recorded; both left and right sides were measured. The infant's mood and willingness to cooperate indicated when to stop. If any infant was tense and uncooperative, the measurements were discontinued.

Muscle function of the lateral flexor muscles of the neck was estimated in the same sample of infants by use of the Muscle Function Scale, a 5-degree scale with scores from 0 to 4. By holding the infant horizontally around the trunk without support for the head, the therapist could estimate the lateral head righting reaction [12]. The same physician and physiatrist performed each individual subject's pre- and post-therapy measurements. In determining quantitative improvement, changes in rotation and tilt were recorded.

After both groups fell asleep with the aid of their mothers, stretching and microcurrent therapy commenced. The number of patients who cried during therapy was measured to determine patient tolerance for treatment. Microcurrent therapies were performed by the same physiatrist or physical therapist. The microcurrent generators were programmed to provide an alternating current. The current intensity was 100 μA, and current frequency was 8 Hz. The current level was significantly below the threshold of sensation of the patient. The muscles selected for treatment were based on the clinical judgment of the muscles' contraction. Electrical probes were attached over each muscle. One assistant was needed to secure the child in a supine or side-lying position. The SCM muscle was isolated by turning the child's head toward the contralateral side, thus allowing the muscle to be easily palpated during the attachment of an electrical probe (Figure 1).

Mann-Whitney *U* tests were used to compare the improvement of TA and RR in both groups. Fisher exact tests were used in both groups for comparison of the incidence of crying during therapy. SPSS for Windows (Release 12.0, SPSS Inc, Chicago, IL) statistical software was used in the analyses.

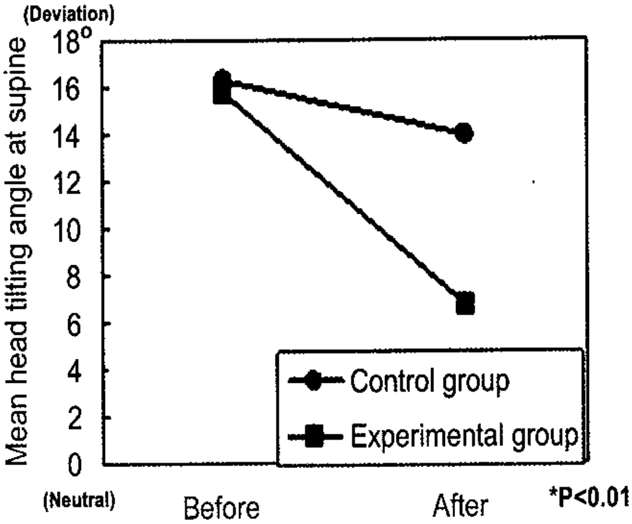

Figure 2. Mean head tilting angle at supine of experimental group and control group. *$P < .01$.

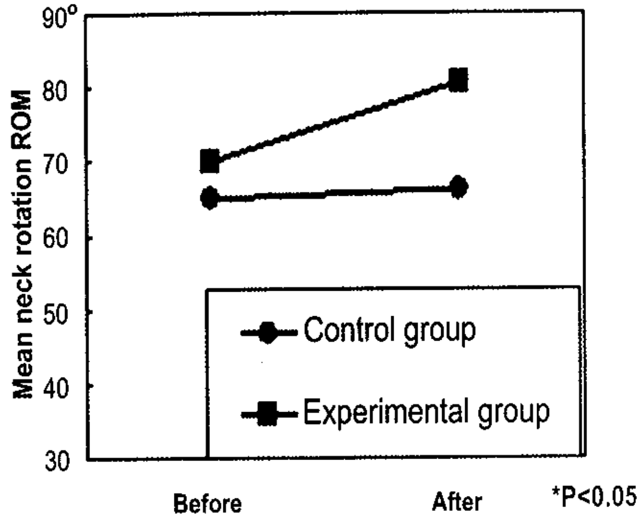

Figure 3. Mean neck rotation ROM to the affected side of experimental group and control group. *$P < .05$.

RESULTS

At baseline, there were no differences between groups with the exception of age. In the control group, 4 infants showed TA improvement, one infant showed RR improvement, and 8 infants cried during therapy. In the experimental group, 6 infants showed TA improvement, 5 infants showed RR improvement, and 3 infants cried during therapy. In the control group, mean TA was 16.3 ± 9.2° on the first day and 13.9 ± 8.2° on the 14th day of treatment. In the experimental group, mean TA was 15.7 ± 8.2° on the first day and 6.7 ± 4.3° on the 14th day of treatment. The improvement in TA was greater in the experimental group ($P < .01$; Figure 2). In the control group, mean RR was 65.0 ± 24.6° on the first day and 66.3 ± 25.7° on the 14th day of treatment. In the experimental group, mean RR was 70.0 ± 11.5° on the first day and 80.7 ± 6.7° on the 14th day. The RR increased more in the experimental group ($P < .05$; Figure 3). The incidence of crying during therapy was significantly lower in the experimental group ($P < .05$; Figure 4).

DISCUSSION

For a child with torticollis who has a shortened and contracted SCM muscle with limited motion but normal ocular, auditory, and physical/neurological examinations, physical therapy should be provided [13]. SCM muscle shortness and/or palpable mass may be related to muscle microtrauma, inflammation, and loss of function. Muscle microtrauma causes transient changes in calcium concentration (essential for muscle excitation-contraction coupling), and sustained increases may result in the activation of calcium-sensitive proteases and phospholipases [14]. This activation is deleterious to cell membrane and sarcoplasmic reticulum integrity, causing a change in membrane permeability [15].

Another consequence of a sustained elevation of intracellular Ca^{2+} concentration is the activation of nonlysosomal cysteine proteases, such as calpain [14]. Calpain cleaves a variety of protein substrates, including cytoskeletal and myofibrillar proteins. Calpain-mediated degradation of these proteins is thought to contribute to changes in muscle structure [14]. These morphological changes in the contractile machinery of the muscle may underlie the reduced muscle function of torticollis. Therapeutic mechanisms of action are not known but may be related to a reduction in the disturbance of the intracellular Ca^{2+} homeostasis (which has proposed as an updated hypothetical mechanism of taut band formation) [10]. Achievement of intracellular Ca^{2+} homeostasis is the most important factor for proper muscle

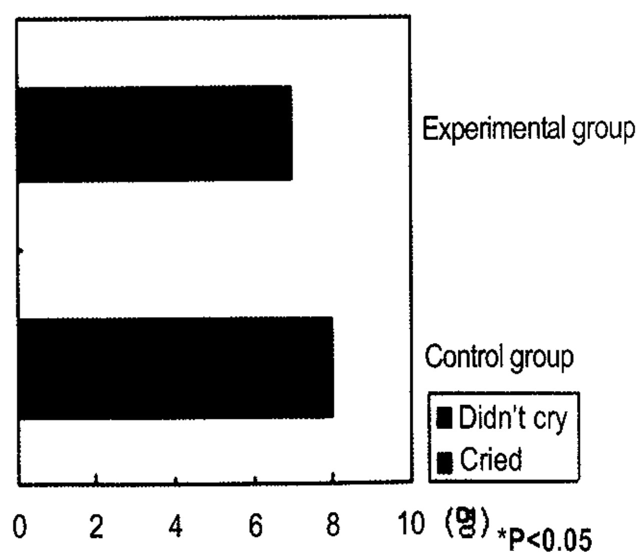

Figure 4. The incidence of crying during therapy of experimental group and control group. *$P < .05$.

excitation-contraction coupling. This present study has shown that microcurrent therapy was an effective method of treatment in torticollis by improvement of TA and RR. That is, microcurrent therapy might adjust the disturbance of the intracellular Ca^{2+} homeostasis.

In the authors' experience, an aggressive stretching program can become challenging because of the degree of tightness of the child's affected SCM and because of the child's resistance to therapy with increasing age. Microcurrent therapy is low-intensity alternating current (100~200 microamperes). The patient feels no sensation during treatment. This study revealed significantly less crying and more cooperation during treatment when used as an adjunct to a stretching and therapeutic exercise program.

Early diagnosis and commencement of physical therapy is critical in the management outcomes of true muscular torticollis. In a study by Demirbilek and Atayurt [16], among 57 children with CMT involved in a therapy program, all children younger than the age of 3 months had excellent results without the need for surgery. However, surgery was required in 25% of the 3- to 6-month-old infants and 70% of the 6- to 18-month-old infants. In that study, as the result of the older age and, hence, more prolonged symptoms, the experimental group was considered more difficult group to treat than the control group. Oleszek et al [17] reported that tightness in the upper trapezius muscle can occur with CMT. They treated the upper trapezius with botulinum toxin type A injections in correlation with documented shoulder elevation on examination.

In this study, because none of the children showed shoulder elevation, only the SCM muscle was selected as target for microcurrent therapy. While the control group was treated with 30 minutes of physiotherapy, the experimental group received 30 minutes of microcurrent therapy followed by 2 minutes of manual stretching. On the assumption that 2 minutes of manual stretching is too short to affect the outcome of therapy, 2 minutes manual stretching was added to the experimental group for the reassurance of patient's mother. The main treatment regimen of the experimental group was 30 minutes microcurrent therapy.

It is important to note the limitations of this study. A longer follow-up of affected SCM muscles can help clinicians in managing and observing changes of CMT. Because of the nature of the treatment technique, double blinding, as well as the blinding of the patient or examiner, was considered not feasible in this study.

It is the authors' opinion that these results provide preliminary comparative data for the management strategies of CMT. However the small number of patients in this study prevents the authors from making definite conclusion about the effect of microcurrent therapy. Further investigation is needed to assess the use of microcurrent therapy as an adjunct treatment for CMT.

CONCLUSION

Microcurrent therapy in infants with torticollis appears more effective in improving TA and RR and shows better therapeutic compliance than traditional therapy.

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