Influence of Spinal Manipulation on Muscle Spasticity and Manual Dexterity in Participants With Cerebral Palsy: Randomized Controlled Trial

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Abstract

Objectives: The aim of this study was to investigate the short-term effects of spinal manipulation (SM) on wrist muscle spasticity and manual dexterity in participants with cerebral palsy (CP).

Methods: After baseline examination, 78 participants with spastic CP (7-18 years) without contractures or hyperkinetic syndrome were randomly allocated into 2 groups. The experimental group underwent SM to the cervical, thoracic, and lumbar spine, and the control group received sham SM. A second evaluation was performed 5 minutes postintervention. Wrist muscle spasticity was measured quantitatively with NeuroFlexor (Aggero MedTech AB, Solna, Sweden), a device assessing resistance to passive movements of different velocities. Between-group difference was calculated using the Mann-Whitney U test. Manual dexterity was evaluated by the Box and Block test.

Results: In the experimental group, muscle spasticity was reduced by 2.18 newton from median 5.53 with interquartile range 8.66 to median 3.35 newton with interquartile range 7.19; the difference was statistically significant (P = .002). In the control group, reduction in spasticity was negligible. The between-group difference in change of muscle spasticity was statistically significant (P = .034). Improvement of manual dexterity was not statistically significant (P = .28).

Conclusions: These findings suggest that SM may, in the short term, help to reduce spasticity in participants with CP. Long-term effects of SM on muscle spasticity have yet to be studied. (J Chiropr Med 2018;xx:1-10)

Key Indexing Terms: *Manipulation, Spinal; Musculoskeletal Manipulations; Muscle Spasticity; Cerebral Palsy*

Introduction

Muscle spasticity is an important clinical syndrome in people with cerebral palsy (CP) and other neurologic diseases resulting from upper motor neuron lesions.[1] It manifests with an increased stretch reflex, which intensifies with movement velocity.[2]

Spasticity affects motor development and functioning of a child, and its reduction is an important therapeutic target for optimizing motor performance. The range of treatments for excess muscle tone is vast: from simple stretching exercises or pharmacotherapy to surgery.[3] However, because of limited effectiveness of conventional treatments, a wide range of complementary and alternative therapies are used for muscle tone management in patients with CP, including spinal manipulation (SM).[4,5]

Resent research indicates possible influence of SM on muscle spasticity. The literature points to the effect of SM on spinal cord neural circuits as a factor that possibly modifies stretch reflexes.[6,7] Neural responses to SM have been reported in studies on animal models.[8,9] There is preliminary evidence that SM is followed by a short-term reduction in local spinal muscle electromyographic activity in hypertonic muscles.[10] Decrease in motoneuron excitability (H-reflex) after sacroiliac joint manipulation was observed in patients with low back pain.[11,12] There are several clinical studies suggesting the influence of SM on spasticity. Decrease of spasticity after SM was noted in post-stroke patients.[13] Reduction in wrist muscle spasticity after SM was also reported in patients with CP.[14,15]

In addition, there is growing body of research on the effects of SM on sensory processing, motor output, and functional performance, including hand function.[8,16] Studies suggest possible changes of muscle strength after a single session of manual therapy (MT).[17] Improvement of manual dexterity after SM was also noted in patients with CP.[18]

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However, there are no studies directly measuring the relationship between SM and reduction of muscle spasticity. Therefore, the primary aim of this study was to evaluate the effect of SM on muscle spasticity in participants with CP. A secondary aim of this study was to test the hypothesis that SM influences manual dexterity in participants with reduced hand function due to CP.

Methods

Study Design

This was a prospective, randomized controlled trial with 2 groups: experimental (receiving SM) and control (receiving sham of SM).

After the baseline examination, participants were randomized into 2 equal arms (1:1): the SM group (experimental) and the sham group (control). We used stratified block randomization with a block size of 4 by the form of CP (unilateral or bilateral) and level of wrist spasticity (low or high). Stratified block randomization helped to achieve balance between the groups on all studied parameters. Both participants and examiners were blinded to group allocation, only the research coordinator allocating participants to groups and the doctor performing MT were aware of which group the participants belonged to. The second evaluation in both groups was carried out 5 minutes after the intervention.

This study was performed on vulnerable populations: both children and people with disabilities. The necessity of their inclusion was approved by the Medical Ethics Commission of the International Clinic of Rehabilitation, located in Truskavets, Ukraine (Protocol Number N- 2016-09-1), after review of all documents, including study protocol and the informed consent forms. Participants and their legal representatives received comprehensive information about the procedures and study design. Written informed consent was obtained from legal representatives. Where appropriate, based on age and cognitive abilities, participants were asked to give verbal assent. The study was registered at clinicaltrials.gov with identifier NCT03005938.

Statistics

Data analysis was performed with SPSS version 23 software (IBM Corp, Armonk, New York). After descriptive analysis, the normal distribution of variables was verified by means of the Kolmogorov-Smirnov test. Normally distributed variables were described with mean and standard deviation (SD), non-normally distributed with median and interquartile range (IQR). Comparison of baseline values between the groups was performed using the $\chi 2$ test for categorical data, independent samples t test for normally distributed continuous data, and the Mann-Whitney U test for non-normally distributed data.

Within-group difference between baseline and postintervention values for non-normally distributed variables was measured with the Wilcoxon signed-ranks test, whereas between-group difference was calculated using the Mann-Whitney U test.

For normally distributed variables, difference between baseline and postintervention within group were measured with the paired samples t test, and difference between experimental and control groups was computed with the independent samples t test, and $P < .05$ was considered significant in all tests.

Sample size was calculated based on data from the preliminary research on the influence of SM on muscle spasticity,[15] with confidence level of 95% and power of 80%. Aimed at detecting the size effect of 1.92 newton in the mild spasticity group, with an SD of 2.92, the estimated sample size was calculated to be at least 37 participants in each group.

Participants

Participants with spastic forms of CP and who were 8 to 18 years of age and admitted to the tertiary care rehabilitation clinic were prescreened during the routine examination and invited to participate in the study. Upon obtaining the informed consent, 85 participants were invited for the baseline assessment. Participants flow is described in the CONSORT 2010 flow Diagram (Fig 1).[19]

The inclusion criteria were spastic forms of CP, age 8 to 18 years, and hand function level I to III according to the Manual Ability Classification System (MACS). The exclusion criteria were dyskinetic or ataxic syndrome, wrist flexion-extension range less than 80° with fingers extended, hyperkinetic movements, startle reflex, Botox injections in hand muscles during the preceding year, antispastic medication during the preceding month, wrist or forearm fracture less than 6 months prior to study, uncooperative behavior, and inability to understand and comply with instructions, in addition to general contraindications to spinal manipulative therapy stated in the World Health Organization guidelines on basic training and safety in chiropractic.[20] In addition, the participants must not have received SM within 3 months prior to the study.

At baseline assessment, 6 participants were excluded because they did not meet the inclusion criteria or because of refusal to participate. Forty participants were randomly allocated to the experimental group, where SM was performed, and 39 were allocated to the control group, which received sham of the manipulation. One participant was excluded from the study, because of noncooperative behavior.

Outcome Measures

The primary outcome measure was muscle spasticity in the wrist muscles measured at baseline and postintervention.