Effect of Dry Needling on Spasticity, Shoulder Range of Motion, and Pressure Pain Sensitivity in Patients With Stroke: A Crossover Study

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Abstract

Objective: The purpose of this study was to determine the effects of the inclusion of deep dry needling (DDN) in spastic shoulder muscles into a rehabilitation program on spasticity, pressure pain sensitivity, and shoulder range of motion in subjects who had experienced a stroke.

Methods: A controlled, repeated-measures, crossover, double-blinded, randomized trial was conducted. Twenty patients who have had a stroke were randomly assigned to receive rehabilitation alone or rehabilitation combined with DDN over the upper trapezius, infraspinatus, subscapularis, and pectoralis mayor muscles on the spastic shoulder. Subjects received both interventions separated at least 15 days apart. Each intervention was applied once per week over 3 weeks. Spasticity (Modified Ashworth Scale), pressure pain thresholds over the deltoid and infraspinatus muscles and C5-C6 zygapophyseal joint, and shoulder range of motion were collected 1 week before and 1 week after each intervention by a blinded assessor.

Results: Reduction in spasticity was similar after both conditions for the upper trapezius, pectoralis major, and subscapularis muscles. A greater number of individuals receiving DDN exhibited decreased spasticity within the infraspinatus muscle. The analysis of covariance showed that all pressure pain thresholds, shoulder abduction, and external rotation of the shoulder increased significantly more after DNN intervention ($P < .05$). Shoulder flexion showed similar changes after both conditions.

Conclusions: Our results suggest that inclusion of DDN into a multimodal rehabilitation program was effective for decreasing localized pressure sensitivity and improving shoulder range of motion in individuals who had experienced stroke; however, we did not observe significant differences in muscle spasticity. (J Manipulative Physiol Ther 2016;39:348-358)

Key Indexing Terms: *Stroke; Muscle Spasticity; Pain Threshold; Range of Motion; Shoulder*

Introduction

Stroke is a disabling condition with an estimated annual incidence ranging from 144 to 148 per 100,000 people[1,2] A systematic review found that men suffered from stroke more frequently than women; however, large variations between populations were observed.[3] Although stroke has dropped from being the third main leading cause of death to the fourth cause,[4] it still remains the main cause of physical disability, particularly due to the presence of spasticity because subjects with spasticity exhibit lower motor activity performance than those without.[5]

Spasticity was defined as "a motor disorder characterized by velocity-dependent increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks, resulting from hyper-excitability of stretch reflexes, as a main component of upper motoneuron syndrome."[6] The prevalence of spasticity reaches 43% at 6 months after a first-ever stroke[7] and 38% at 1 year after stroke.[8] It seems that the

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primary lesion in subjects with spasticity is neural in origin; however, increasing evidence suggests profound secondary changes in the muscles due to muscle contractures occurring secondary to spasticity. In fact, some studies had observed that spastic musculature shows decreased mitochondrial volume fraction, appearance of intracellular amorphous material, reduction in muscle fiber length, and decrease in the number of serial sarcomeres within muscle fibers.[9,10]

Several therapeutic approaches can be proposed for the management of spastic muscles. Intramuscular botulinum toxin A (BTX-A) injection is the most popular tool for the management of spasticity.[11] A meta-analysis found that application of BTX-A in patients who had experienced a stroke was associated with moderate improvements in upper extremity performance.[12] Because some subjects exhibit allergic responses to BTX-A, the use of other needling therapies, such us acupuncture or dry needling, for the management of poststroke spasticity has been proposed. A recent meta-analysis showed that acupuncture significantly decreased wrist, knee, and elbow spasticity in patients who had experienced a stroke.[13]

On the contrary, evidence for the application of dry needling in neurological conditions is still lacking. An old study found that inclusion of dry needling into an early rehabilitation program was effective for improving pain outcomes in hemiparetic shoulder pain.[14] The only randomized clinical trial on dry needling and spasticity found that dry needling was effective for decreasing spasticity in the leg muscles and pressure pain hypersensitivity in individuals with poststroke spasticity.[15] However, evidence on the upper extremity is related to case reports including a patient who had experienced a stroke[16] or a 4-year-old child suffering from spastic tetraparesia.[17]

To our knowledge, no previous study has investigated the effects of deep dry needling (DDN) in patients with poststroke spasticity in the upper extremity. Hence, the purpose of this randomized clinical trial was to determine the effects of the inclusion of DDN in spastic shoulder muscles into a rehabilitation program on spasticity, pressure pain sensitivity, and shoulder range of motion in individuals who had suffered a stroke. We hypothesized that individuals receiving DDN into their rehabilitation program will exhibit greater improvements in spasticity, pressure pain sensitivity, and range of motion than those patients receiving only the rehabilitation program.

Methods

Design

A controlled, repeated -measures, cros-over, double-blinded, randomized study was conducted (registered ClinicalTrials.gov, NCT02377804). The study protocol was approved by the human research committee of the Hospital Beata María Ana, Spain (URJC-HBMA), and all subjects signed an informed consent before participation in the study.

Participants

Consecutive subjects who had experienced a stroke were screened for eligibility criteria from January 2014 to March 2015. To be included, participants must have met the following criteria: (1) first-ever unilateral stroke, (2) hemiplegia resulting from stroke, (3) age between 40 and 65 years old, (4) presence of hypertonicity in the upper extremity, and (5) restricted range of motion of the shoulder. They were excluded if they exhibited any of the following: (1) recurrent stroke; (2) previous treatment with nerve blocks and/or motor point injections with neurolytic agents for spasticity; (3) previous treatment with BTX-A within the 6 months before the study; (4) severe cognitive deficits; (5) progressive or severe neurologic diseases, for example, heart conditions, unstable hypertension, or fracture or implants in the lower extremity; (6) fear of needles; or (70 any contraindication for DDN, e.g., anticoagulants, infections, bleeding, or psychotic.

Spasticity: Modified Modified Ashworth Test

Muscle spasticity was evaluated with the Modified Modified Ashworth Scale (MMAS)[18] in the following muscles: upper trapezius, subescapular, infraspinatus, and pectoralis mayor. The examiner passively moved the upper extremity in the stretching direction of each muscle (ie, shoulder depression, shoulder external rotation, shoulder internal rotation, and shoulder abduction at 90° with external rotation, respectively) back and forth at least 5 times and evaluated the degree of resistance to the movement on a scale from 0 to 4. The MMAS is a modification of the modified Ashworth scale,[19] which is the most commonly scale used for assessing spasticity,[20] where the grade "1+" is omitted and the grade "2" is redefined.

In the MMAS, spasticity is scored on an ordinal scale from 0 to 4 as follows: 0, no increase in muscle tone; 1, slight increase in muscle tone (minimal resistance at the end of the range of motion); 2, marked increase in muscle tone (resistance throughout the range of motion, but some sections are easily moved); 3, considerable increase in muscle tone (passive movement difficult throughout the full range of motion); or 4, affected part(s) rigid. The MMAS has exhibited good intraexaminer (kappa = 0.84)[21] and interexaminer (kappa = 0.74)[22] reliability for assessing spasticity in the upper extremity musculature in patients with a stroke.

Shoulder Range of Motion

A universal goniometer was used to determine the participant's shoulder range of motion. Because patients