J. Phys. Ther. Sci. 33: 505–510, 2021

The Journal of Physical Therapy Science

Case Study

Dry needling for treating spasticity in multiple sclerosis

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Abstract. [Purpose] The aim of the study is to evaluate the efficacy of dry needling (DN) in the treatment of spasticity in patients with multiple sclerosis (MS). [Participants and Methods] Twelve participants (3 males and 9 females) with MS, with no evidence of a relapse in the last four weeks and with an EDSS (Expanded Disability Status Scale) greater than 2.5 points (related with pyramidal score) were recruited. DN was performed in lower limbs for 12 consecutive sessions and evaluated with: PSFS (Penn Spasm Frequency Scale), VAS (visual analogical scale) of spasticity, EDSS (Pyramidal item), Time up and go (TUG), 25 foot, 9hold peg test (9HPT) and the improvement or not in the quality of life (MSQol54) was verified before and after treatment. A follow up visit was carried out to assess improvement. [Results] All patients improved in: VAS scale, EDSS score, quality of life, 9HPT, 25 foot test and TUG and 90% of them showed a decrease in the number of spasms/hour (PSFS). [Conclusion] Dry needling produces positive changes in spasticity in patients with MS and their quality of life, as well as walking capacity and manual dexterity. Therefore, DN should be considered in the treatment of spasticity in patients with MS.
Key words: Dry needling, Spasticity, Multiple sclerosis

(This article was submitted Jan. 13, 2020, and was accepted Apr. 2, 2021)

INTRODUCTION

Multiple sclerosis (MS) is a chronic, autoimmune, inflammatory and demyelinating disease of the central nervous system (CNS), predominantly affecting women between 20 and 40 years of age and is the second highest cause of disability in young adults. The etiology of MS is multifactorial and includes genetic and environmental factors[1)]. Eighty five percent of patients present a relapsing-remitting (RR) phenotype with new or worsening of previous neurological deficits and experience a full or partial recovery that lasts for several days or weeks[2)]. The main symptoms of MS relapses are varied and include: loss of balance, discoordination, weakness, visual loss, tremor; tingling, hypoesthesia and other sensitive deficits, as well as bladder, intestinal, sexual deficits, among others. Fewer patients present progressive symptoms and sequelae from the beginning of the disease[3, 4)]. Spasticity is one of the most frequent signs in MS. It is present over the course of the disease in 40–80% of cases[5)]. Spasticity is defined as a motor disorder with a combination of paralysis, increase in muscle tone with exalted stretch reflexes, hypertonia and a generalized muscle stiffness associated with involuntary muscle spasms[1, 4–6)]. Spasticity occurs as a consequence of injuries to the pyramidal tract and loss of spinal and supraspinal control. This causes a disorder in the signal transmitted by neurons carrying impulses from the brain and spinal cord to the muscles, causing excessive activation.

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The most affected neurons are the alpha motor neurons (responsible for the onset of muscle contraction)[7]. This entails a loss or alteration of interneurons, besides producing cumulative structural damage caused by cytokines, prostaglandins, reactive oxygen species and stress hormones that affect neuronal circuits. The interneuron network response could be altered by facilitation of inhibitions in other ways[8]. Spasticity produces changes in the mechanical properties of the muscle (the endomysium, the perimysium and the epimysium) increasing collagen, type I and III fibers, as well as in its extracellular matrix shortening the muscle[9]. Painful points are generated in the taut bands, similar to trigger points and allowing a nodule to be palpated with or without pain. This symptom evolves towards chronicity and soft tissue properties such as elasticity, plasticity and viscosity are also altered. When this occurs, fibrosis of the muscle and the adjacent structures is generated, resulting in the contracture becoming fixed, and at the same time causes retractions and osteoarticular deformities with pain[10–16]. Spasticity in MS patients is associated with impaired ambulation, fine motor skills, bladder and vesical alterations, pain, development of contractures and sleep disorders worsening their quality of life[11, 17]. Muscle relaxants, antiepileptics and benzodiazepines are frequently used for the treatment of spasticity, but have adverse effects. Botulim toxin administration, blocks nerve with neurolytic agents and intrathecal muscle relaxants are used in patients who suffer from spasticity in a small area of the body or do not respond successfully with oral drugs. Orthotic devices, sports such as swimming and yoga are recommended in many cases[18, 19]. Another therapeutic alternative is surgery, which, due to its aggressive and irreversible nature, is reserved as a last option when all previous measures have failed[20].

The most common physiotherapeutical techniques used include: sustained muscle stretching and passive mobilization, vibrating mechanical stimulating instruments, night splints and transcutaneous electrical neurogenic stimulation[21–25].

Dry needling is a physiotherapeutical intervention which may be indicated with the aim of reducing hypertonia and spasticity. It is not routinely applied and it may improve the viscoelastic properties of muscles and fascia, spasticity and its complications[26, 27]. Dry needling is a semi-invasive technique that uses acupuncture needles to treat painful points in different muscles, the so-called “trigger points” and decreases stiffness and shortening of the muscle. The needles penetrate the skin pressing and contracting the trigger point to alleviate the pain. The needle produces mechanical stimulation at points of certain muscles and their fascia. It is intended to achieve the normalization of muscle tone. It should be noted that no type of substance is infiltrated in the (DN) process[27]. Once the needle has been inserted, it can be considered a palpation tool as an extension of the physiotherapist’s fingers. The needle enters and leaves the trigger point and oscillations are performed until changes in tissue firmness are seen[26].

Pathophysiological dry needling consists of mechanically interrupting (with a needle) the associated dysfunctional end plate area. As an immediate action, there is rupture of the endomysium and changes in the elongation of actin and myosin fibers. Posteriorly, the inflammatory action allows an improvement in blood flow and oxygen saturation of the stimulated region[28, 29].

There are papers that describe randomized controlled trial protocols where it is proposed to assess the effectiveness of dry needling versus placebo in gait performance, spasticity, electromyographic activity, pain, range of motion and quality of life in patients with multiple sclerosis[30], for what is a field that is in full development and with good prospects of implanting as an alternative treatment for this type of patients. The aim of the present study is to evaluate the efficacy of dry needling in MS patients with spasticity.

PARTICIPANTS AND METHODS

Twelve patients were selected with RRMS for the dry needling intervention (3 males and 9 females, 41.6 ± 5.9 years of age and 12.7 ± 6.4 years of disease duration). All the participants understood the purpose of the study and provided written informed consent prior to their participation in the study in accordance with the ethical standards of the Declaration of Helsinki[31]. The study was approved by the Research Ethics Committee of the Canary University Hospital with the code 2017_100, and was covered by civil liability insurance with policy number 063 0000124.

After evaluating the correct application of ethics in the study, it was decided to use the individual’s baseline data as a control group, because simulating the performance of a dry needling is impossible and a quasi-experimental before-after design was proposed. The purpose was to evaluate the effectiveness in real clinical practice conditions, not randomized, with each patient being their own control. This type of design is based on the measurement and comparison of the response variable before and after the participant’s exposure to the experimental intervention.

The patients were treated for 4 months with 3 dry needling sessions per month. Neurological exploration was performed in the baseline session and 4, 8.12 and (16) sessions and neurological questionnaires were conducted in 0, 8 and 16 sessions. A further examination session and questionnaire were conducted one month after finishing the treatment to verify whether the effect of the therapy lasted over time (Fig. 1). There was a gap of 5 days instead of 7 in two of the sessions due to the availability of the patients. The materials used for the study were: acupuncture needles, stretchers, gauze, alcohol and gloves. The spastic pattern to be punctured was chosen and the puncture was applied to the necessary muscles, which were different for each individual. The muscles to be treated did not compromise any visceral system.

Only dry needling of the lower limbs was performed in all patients (because this was the region most affected by spasticity, although there was also spasticity in upper limbs) In each session, the spastic muscle was chosen to be punctured.

The patients were given a booklet to record the number of spasms in one hour during each day (PSFS: Penn Spasm

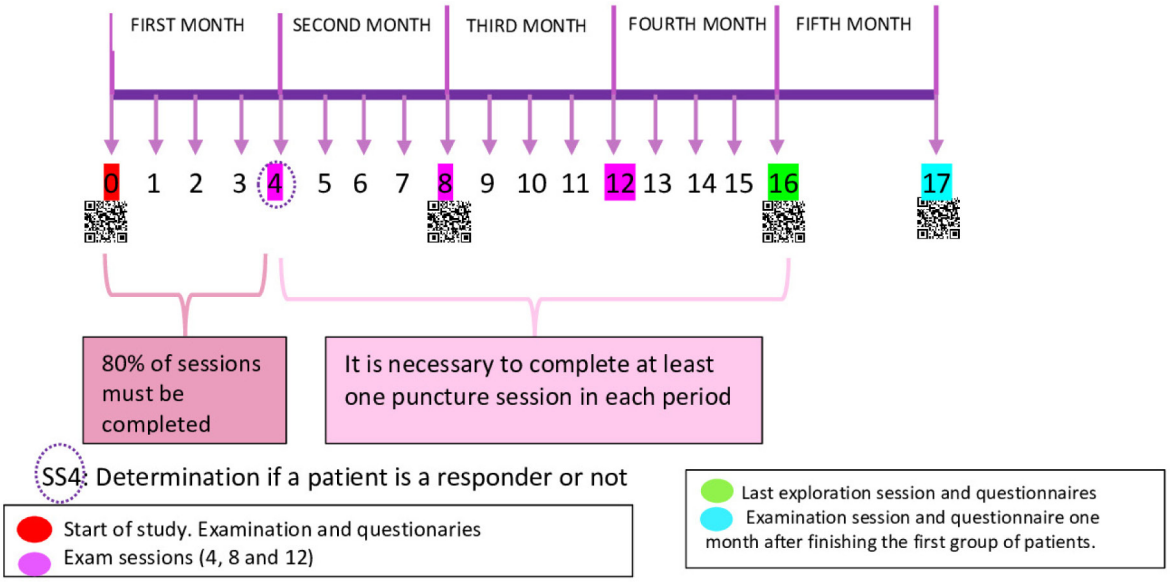

Fig. 1. Study schedule, which shows the dry puncture sessions and the explorations and questionnaires.

Frequency Scale[27]. The questionnaires (all of them free to use and validated in the Spanish language) were conducted in electronic format with an identification number document (ID) assigned to each patient and through a Quick Response (QR) code. The following questionnaires were administrated: Multiple sclerosis Quality of life-54 (MSQol54)[32], questionnaire of 54 items measuring the quality of life of the patient. It can be self-administered or hetero-administered and both physical and mental aspects are measured. Within these there are subscales: among them quality of life in general. Two summary scores, physical health and mental health, can be derived from a weighted combination of scale scores. They range from 0 to 100, where 100 is the highest quality of life (both for physical and mental health)

Visual Analogic Scale (VAS) of spasticity[33], which measures the intensity of pain caused by spasticity described by the patient. The patient is asked to mark the point that indicates the intensity on a line which is expressed in centimeters or millimeters. The evaluation is: 1. Mild pain if the patient scores the pain as less than 3; 2. Moderate pain if the evaluation is between 4 and 7 and 3. Severe pain if the evaluation is equal to or greater than 8.

The exploration session includes 9 hold peg (9HPT)[34]. This consists of placing the pegs in the corresponding holes of the 9 holes in the table in the shortest possible time. Two attempts are made with each hand. Discrimination between dominant and non-dominant hands is recorded and the attempts are timed. From 9HPT two results are obtained (one for the right hand and one for the left hand) this is the average of the attempts for each hand, 25 oot (25WT)[35], (patients must walk a distance of 7.25 meters at the fastest and safest speed for them. It is timed. The test is performed twice. The score is the mean average of the two completed trials.), Time up and go (TUG)[36]. The participants sit in a chair with their backs supported by the back of the chair and their arms resting on the armrests. The participants are asked to get up from the chair and walk a distance of 3 meters, then the patients turn on themselves (360°), walk back to the chair and sit down again. The participants perform the test twice. The result is the mean average of the two attempts. Expanded Disability Status Scale (EDSS) (Pyramidal item)[37], assesses 8 functional systems by means of the following analyses: visual (fundus, scotoma, diopter, etc.) brain stem (nystagmus, dysphagia, dysarthria, etc.) pyramidal (limb strength, reflexes, etc.) cerebellum (ataxias, dysmetria), sensitivity (skin sensitivity, vibratory, deep), vesical/intestinal (dysfunction of urination, intestine, urgency, incontinence, catheterization, etc.) Mental (depression, fatigue, sexual dysfunction, etc.) ambulatory score (the distance the participants were able to move in two minutes was used to homogenize the participants)[38]. Each item is valued individually and a score is given, which will then outline the patient's total EDSS ranging from 0 to 10, for use in the exploration sessions. All scans were carried out by a blind explorer.

One of the purposes of session number 4, when the initial questionnaires were administrated again and the patient reevaluated, is to determine whether the patient has a response or a non-response. The participant is considered to have a response if after undergoing the re-evaluation there are changes in the results (the result varies in two or more tests or questionnaires). A participant is non-response if there are no changes in the results after retesting (results do not vary or by only one point in a single test) and the study would end for that participant. A patient is unclassified if changes are expected in the following evaluations.

Participants will be considered to have complied with the treatment program if they have taken part in at least 80% of arranged sessions. Likewise, as far as possible, an attempt will be made to recuperate the missed session with the aim of

completing 100% of them.

The inclusion criteria were: being a patient diagnosed with multiple sclerosis, being over 18 years of age and less than or equal to 60 years of age, having a score equal to or greater than 2 in the EDSS. They need to have a measurement in the following functional systems: P (pyramidal) >2, CT (brainstem), gait >2 and sphincter >2. They need to present hypertonia or contractures of the muscles selected for the dry needling, the pain expressed by the patients must be a consequence of spastic processes, have hourly availability to receive therapies and not have needle phobias.

The exclusion criteria were: having a disease associated with multiple sclerosis that is incompatible with dry needling, being in relapse, or having suffered it in the thirty days prior to starting the treatment program or taking medications that are contraindicated with the technique applied in the study, (oral anticoagulants.)

All comparisons were made between the participant's baseline status (exploration and questionnaires 0) and the last session of the study immediately after finishing the dry needling.

Statistical analysis was performed with SPSS v. 25.0 (Chicago, IL, USA). P values less than 0.05 are considered statistically significant. Categorical variables are expressed as frequencies and percentages. Continuous variables are expressed as means, standard deviations, medians and ranges (min–max) Wilcoxon test was performed for pre-treatment and post-treatment comparisons.

RESULTS

At the moment of the study there were 9 females and 3 males, demographic and clinical variables are shown in Table 1. 1 female was unable to complete the sessions.

Table 2 shows results of physical exploration and questionnaires before and after dry needling.

Spasticity in the lower limbs improved in the treated muscles and a significant improvement for the right hand (p=0.010) was observed regarding the fine motor skills of the participants' hands in 9HTP test although upper limbs were not treated. The EDSS score improved significantly (p=0.035) but the pyramidal item remained stable. All the participants improved their score in the 25WT (p=0.016). The execution times of TUG decreased in comparison with personal score of the first examination (p=0.016). Subjective perception of spasticity measured with VAS and level of pain measure with PSFS scale improved significantly (p=0.009 and p=0.017, respectively) in all participants. The physical quality of life and the mental quality of life, showed a significant improvement. (p=0.003 and p=0.004, respectively).

Table 1. Clinical and demographic data of patients

	n=12
Gender (females), n (%)	8 (72.7)
Age (years)	41.63 ± 5.92
Disease Duration (years)	12.73 ± 1.95
Type of disease RRMS, n (%)	12 (100)
EDSS	4 (2.5–6.5)
Patients who dropped out of the study	1

RRMS: Relapsing Remitting Multiple Sclerosis; EDSS: Expanded Disability Status Scale.

Table 2. Changes in assessment measures pre-and post-treatment

	Pre-treatment results	Post-treatment results	Progress median	Follow up visit results
9-HPT Rigth	26.51 ± 8.28	23.69 ± 6.47	2.81 ± 2.48*	23.05 ± 6.47
9-HPT Left	25.87 ± 6	23.71 ± 4.2	2.15 ± 3.44	23.94 ± 5.56
QOL54 PHYSICAL	57.19 ± 8.60	69.70 ± 8.88	−12.50 ± 10.12*	64.81 ± 7.71
QOL54 MENTAL	64.97 ± 17.94	83.30 ± 7.01	−18.33 ± 17.64*	79.89 ± 11.48
EDSS	4.45 ± 1.33	3.68 ± 1.34	0.77 ± 1.009*	3.95 ± 1.47
VAS	4 ± 2.72	0.91 ± 1.04	3.09 ± 2.7*	1.64 ± 1.80
25WT	13.15 ± 9.79	10.88 ± 7.09	2.26 ± 3.28*	12.06 ± 8.13
PSFS	25.7 ± 22.05	13 ± 15.71	12.7 ± 13.09*	13.40 ± 18.59
TUG	17.54 ± 10.84	14.29 ± 7.94	3.25 ± 3.66*	16.23 ± 11.57

Data are mean ± SD. *p<0.05.
9-HPT: Nine Hole Peg test; QOL54: Quality of Life 54; EDSS: Expanded Disability Status Scale; VAS: Visual Analogical Scale; 25WT: 25 Walking Test; PSFS: Penn Spasm Frequency Scale; TUG: Time up and go.

The significant changes disappeared in all tests when data obtained in the questionnaire and examination session one month after finishing the therapy were compared. Therefore, the improvement in spasticity is not maintained over time.

DISCUSSION

Spasticity is one of the most disabling symptoms in patients with MS. Once spasticity appears, the evolutionary course is generally progressive. It affects walking, spasm pain and quality of life, both directly and indirectly, sleep quality and sphincter function, among others. Antispastic therapy often requires a multidisciplinary approach including pharmacology, surgery or botulinum toxin injections and physiotherapy are involved. It also requires multiple combinations due to the low effectiveness of individual therapies

Dry needling is a promising semi-invasive physiotherapy technique for the treatment of spasticity. This technique allows the management of spasticity without increasing muscle weakness or atrophy. It produces few side effects (post-puncture needle) and also has a low economic cost although it requires numerous frequent sessions. Given the novelty of the technique, the optimal frequency of its application is not defined at present. In order not to hinder the daily life of the patients, it was applied once a week in this study based on the minimal time of muscle recuperation[29].

The participants needed to have a certain level of deterioration in pyramidal function, which leads to spasticity.

The study was designed to last for 16 weeks although. In the fourth week, a first analysis was performed to evaluate the participant's response and the viability of working method. All the results show that from the first month of applying the technique (only 3 dry puncture sessions) there is considerable improvement in the scores of all measures. These results began to be statistically significant, even 2 months after receiving therapy. No participant had to be withdrawn from the study due to no response, however one patient left for personal reasons. An improvement of spasticity in upper limbs (9HPT) was observed even though intervention was only performed in lower limbs and they all improved, with statistically significant results, the fine motor skills of the hands. Causes about this are unknown. There are studies where a decrease of spasticity is observed in one hemi-body after application of dry needling with electro-stimulation in the other hemi-body. It is necessary to study the relationship between the application of the technique in the lower limbs and the improvement in the fine motor skills of the subjects in greater depth. Spasticity is not only controlled by the pyramidal pathway, but there are other accessory ways; the function of the pyramidal pathway is to perform voluntary body movements. The extrapyramidal system, on the other hand, is comprised of all the structures that intervene in movement, except the pyramidal bundle. When it is damaged, stiffness occurs. This may be the explanation for the improvement in the fine motor skills of the participants' hands, without the hands having received therapy.

The principal limitation of the study was the small sample size because the main aim was to explore the effectivity of dry needling in spasticity of multiple sclerosis patients. The authors suggest conducting further studies with more patients once the efficacy of this technique is demonstrated.

In order to improve the study, the authors recommend using different evaluation techniques such as ultrasound, functional magnetic resonance imaging and electromyography among others.

In conclusion, dry needling significantly improves the fine motor skills, helps improve the pyramidal functions and contributes to improved neurological disability of patients with MS with spasticity. In addition, it contributes to improving the reaction capacity of MS patients to get up from a chair and to walk at least 7.5 meters. The participants described a reduction in both pain and number of spasms as well as an improvement in physical and mental quality of life.

Dry needling should be considered as a physiotherapeutical technique to treat spasticity in patients with MS. A larger sample would be required to be able to extrapolate the long term results in the MS population and validate the application of the technique.

Conflict of interest

The authors declare no conflicts of interest associated with this manuscript.

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