Hemiparetic Shoulder Pain Syndrome Treated with Deep Dry Needling During Early Rehabilitation: A Prospective, Open-Label, Randomized Investigation

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ABSTRACT. Objectives: The purpose of the trial was to evaluate the efficacy of dry needling of myofascial pain syndrome trigger points to relieve the hemiparetic shoulder pain resulting from a cerebrovascular accident [CVA, stroke].

Methods: A prospective, randomized, comparison cohort investigation was performed in the setting of a large inpatient rehabilitation unit with 400 admissions [mainly CVA or head injury] annually. Potential study subjects, who complained of shoulder pain on the hemiparetic side, were enrolled and randomly assigned to standard rehabilitation treatment plus deep dry needling [Group 1] or to standard rehabilitation treatment alone [Group 2]. The Rivermead Motricity Index was used to assess the motility on admission and discharge, and to calculate the percentage of potential improvement achieved during rehabilitation [effectiveness and efficiency]. A Pain Visual Analog Scale was used to serially assess pain. At the end of the trial, a self-report questionnaire evaluated whether patients could rest for a longer period of time in a wheelchair and sleep better in bed than they could before treatment.

Results: One hundred and one CVA survivor patients entered the study. Those receiving dry needling, in addition to standard rehabilitation therapy, reported significantly less pain during sleep and physiotherapy. Their sleep was also more restful than that of the non-needled control subjects. The patients treated with dry needling reported a significant reduction in the frequency and intensity of pain and a reduction of pain during daytime and rehabilitation exercises in comparison to the standard therapy alone control group. A statistically significant inverse correlation was found between shoulder pain and mobility.

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Conclusions: The results indicate that combining dry needling of trigger points with standard rehabilitative therapy may improve the outcome of hemiparetic shoulder pain syndrome. It decreased the severity and frequency of the perceived pain, reduced the use of analgesic medications, restored more normal sleep patterns, and increased compliance with the rehabilitation program.

KEYWORDS. Myofascial pain syndrome, shoulder pain, deep dry needling, cerebrovascular accident, rehabilitation

INTRODUCTION

Shoulder pain is a very common clinical problem. A recent study suggests that the prevalence of hemiparetic shoulder pain syndrome following a cerebrovascular accident [CVA] varies from 16 percent to 72 percent (1). Patients who are admitted to rehabilitation unit for this condition exhibit an increased risk of developing chronic pain. In the acute rehabilitative phase, this problem causes considerable distress, reduces activity, and markedly hinders rehabilitation progress (2).

The core symptoms are chronic widespread muscle pain at rest and following muscular exertion, feeling of muscle stiffness, sleep disturbance, and fatigue. Its course is often unpredictable and several pain mechanisms may be involved. A number of studies have shown benefit from several therapies but further systematic evaluation of the effectiveness of physical and non-physical therapeutic approaches is needed. An important challenge is the multifactorial nature of this long-term disability, often involving a complex of psychological, physiological, and social factors.

There are many potential causes for the pain. These could include: thalamic pain, primary or secondary joint dislocation, worsening of previous rotator cuff tears, gravitational overstretching of the whole paretic joint, increased pyramidal overtone, and the complex regional pain syndromes (3). Long-term disability and chronic pain has an immense impact for these patients, and early interventions to prevent the development of long-term problems have been needed. A number of studies have suggested that the ideal management of the syndrome be mainly based upon prevention. The acute phase is likely to be the phase in which the pain is most amenable to preventive treatment (2-4). However, preventing long-term shoulder pain resulting from hemiparesis has been difficult, and there is no consensus about what intervention strategies should be used.

Several approaches to the treatment of hemiparetic shoulder pain have been attempted but they have exhibited no definitive effect on relieving symptoms. Management involves both nonpharmacologic [e.g., physical reconditioning] and pharmacologic interventions. The patients are typically treated with psychotropic drugs, such as amitriptyline or nonsteroidal anti-inflammatory drugs, in an attempt to relieve the pain and possibly to improve their mood, sleep, and cooperation during physiotherapy. The multidisciplinary team, including patients and caregivers, should avoid injuries to the affected limb. Foam supports or shoulder strapping may be used to prevent pain. Over-arm slings should be avoided even if there is still not a widespread consensus about its usefulness or eventual uselessness. The management program usually consists of the following components: a. external support for the affected upper limb when the patient is seated; b. careful positioning in bed; c. daily static positional stretches and kinesis; and d. occasionally constraining the scapula to maintain postural symmetry.

Early physical treatment is advocated because earlier treatment leads to better outcomes. One form of physical therapy that is believed to be effective is dry needling of myofascial pain syndrome [MPS] trigger points [TrPs] in the affected muscles (5-7). In this study, we investigated the effects of deep dry needling in

hemiparetic shoulder pain in CVA survivors, as an early intervention in the rehabilitation program. The rationale of the treatment was based on the widely reported success of dry-needling on neuropathic pain, as described in the "neuropathic pain model" (5-8). Woolf (9) described a noteworthy phenomenon named "progressive tactile hypersensitivity." Signals carried by peripheral C-fibers from the hemiparetic shoulder may be perceived as pain. Hemiparetic shoulder pain is reported to occur in 5-84 percent of CVA survivors (10-12), where it is often related to changed functional dynamics due to paresis or weakness (13,14).

The specific aim of our current study was to test the hypothesis that dry needling can prevent hypersensitivity from traducing into neuropathic pain and can thereby reduce the prevalence or severity of post-CVA shoulder pain on the hemiparetic side.

MATERIALS AND METHODS

Setting and Study Design. Santa Lucia Foundation is a Rehabilitation Hospital providing rehabilitation services for inpatients and outpatients. The current study was a prospective, open-label, randomized, parallel treatment trial. All patients with hemiparetic shoulder pain were to receive the clinic's standard rehabilitation therapy regimen for shoulder muscles. In addition, each subject was randomized to receive deep dry needling or to be included in a control group that would not receive dry needling. The goal was to recruit 100 subjects so that there would be about 50 subjects in each treatment group.

Subjects. Sequential male and female, post-CVA subjects of all ages were recruited to participate in this study if they were willing to participate, met the inclusion criteria, and lacked the exclusion criteria for the study. Recruited subjects, without rotator cuff lesions, were experiencing shoulder pain on the post-CVA hemiparetic side resulting from restricted movements due to activation of TrPs.

Recruitment and Consent. Post-CVA patients were identified among our outpatient clinical practice and among those admitted to our rehabilitation ward. Before a post-CVA patient could be enrolled, he or she was required to have undergone at least three weeks of physiotherapy.

Informed consent was obtained from all patients after the objectives and procedures of the study had been explained and their questions had been answered. The study was conducted according to ethical principles and was responsive to all applicable guidelines for good clinical practice.

Inclusion Criteria. The diagnosis of CVA was based on clinical examination and computerised tomography [CT scan] within the first week after the onset of symptoms. Patient selection was based on International Classification of Diseases-10 [infarct cerebri-#433 and hemorragia cerebri-#431]. Subjects were eligible if they were between the fourth and eighth week of their post-CVA period and reported six or higher score on the baseline self-administered 10 cm Pain Visual Analog Scale [PainVAS described below] to evaluate shoulder pain on the affected side.

Exclusion Criteria. Subjects were excluded if any of the following were true: they were suffering pain due to a central CVA caused by a lesion affecting the spinothalamic pathways in the brainstem with sensory deficit; they had primary depression; their hemiparesis was due to neurosurgical procedures, cerebral tumors, head injuries, or congenital cerebral palsy; worsening of pre-existing internal derangement of shoulder ligaments or tendons, adhesive capsulitis, peripheral neuropathy, complex regional pain syndrome-type 1 or 2 (3), shoulder fractures, "neglect" syndrome, or the patient elected not to participate.

Procedures. The standard clinical examination for both intervention groups consisted of a routine shoulder examination and shoulder X-rays, including oblique views for subacromial space. Ultrasonography, computerized tomography, or magnetic resonance imagings were performed only when needed and indicated.

Dry Needling. For about 30 years, dry needling has been used as a pain-relieving procedure (16-20). It is performed without drugs by inserting stainless steel needles into the region of a MPS TrP. The effectiveness of this treatment has always been related to the intensity of the pain produced at the triggered zone, and to the precision with which the needle is di-

rected to the site of maximal tenderness (18-20). The immediate analgesia produced by needling the painful area was defined by Lewit (20) as the "needle effect." While the needling of the painful TrP has appeared to be an effective treatment, opinions still differ regarding whether it is really more effective than placebo (18).

The Group 1 patients were treated with dry needling at four sittings every five to seven days. On the day following the treatment (H^1-H^3), the shoulder pain was assessed by means of the PainVAS (22). For each shoulder muscle treated, the needles were inserted in the TrPs. In the muscles where such points were not detected, a needle was inserted in the middle of its body. As suggested elsewhere (7), emphasis was placed upon those muscles that showed myalgia or tenderness. The TrPs belonging to the affected myotome were chosen for treatment, ignoring the dermatomal levels. The muscles selected for treatment in the course of this study were: supraspinatus, infraspinatus, upper and lower trapezium, levator scapulae, rhomboids, teres major, subscapularis, latissimus dorsi, triceps, pectoralis, and middle, upper deltoid anterior.

To identify the muscle to be treated by dry needling, we used the "Anatomical Guide for the Electromyographer–The Limb and Trunk" by A. O. Perotto (21), which is our clinic's standard. The acupuncture needles were made of stainless steel and ranged in length from 2 cm to 3 cm. The selection of the needle length was guided by the location of the TrPs to be treated; deeper and thicker muscles required longer needles. The preferred size was 0.34-0.40 mm, while longer and thicker needles were used occasionally in the supraspinous fossa, above the spine of the scapula that divides its dorsal surface in two fossas and where the M. supraspinatus is located quite deeply.

After the deep insertion, the needles were left in-situ for about five minutes and occasionally [i.e., in the presence of sharper myalgic hyperalgesia], they were twirled vigorously to stimulate muscle proprioceptors. During the twirling, the *Deqi* response (7,8,16,17,22) can occur, as evidenced by a perception of soreness, heaviness at the shoulder, and tingling. The Deqi response is believed to involve reflex muscle shortening in which the needle is "grasped" by the muscle. We did not measure the Deqi response during dry needling but we consistently recorded the patients' reports of a "strange sensation" in the shoulder and delayed the procedure for a few minutes or hours until the effect abated. Another infrequent response can be local or regional cutaneous vasodilatation, piloerection, and sweating. Those signs are believed to result from a strong regional sympathetic response to the soft tissue needling stimulation.

Primary Outcome Measures. Measurements of study outcome were obtained at baseline and/or at various times in the course of the study. They included duration [days] of hospitalization, subjective self-assessment of experienced pain, assessment of functional [disability] status, self-assessment of daytime rest, and self-report sleep quality. Pain assessments in the study group were performed on the day after the needling, while the control group was assessed on day 9 [H^1], day 15 [H^2], and day 21 [H^3] after enrolment [Day 1; H^0]. The extent of disability was assessed on admission and at the end of study [day 21]. Finally, the sleep quality was assessed only at the end of study period [day 21].

Pain. The severity of pain following the dry needling procedure was documented by asking the subject to place a mark on a horizontal 10 cm Visual Analog Scale [PainVAS]. The left end of the PainVAS was marked "0" and "No Pain" while the right end was marked "10" and "Severe Pain" (22). On this scale, higher numbers indicate more perceived pain. A baseline PainVAS value of six or more was required for study entry. The PainVAS (22) was assessed on day 1 [before the first treatment], and 24 hours after each subsequent treatment [e.g., on day 6, after the second treatment on day 5; on day 10, after the third treatment on day 9; on day 16, after the fourth treatment on day 15; and on day 22, after the last treatment on day 21].

Disability. The functional ability, or inability, of the study subject was documented by the Rivermead Mobility Index [RMI], a scale of 15 items that evaluates the mobility of patients with a cut-off of 15 for normal subjects (23). The RMI was developed and validated to quantify locomotor disability and evaluate effectiveness of therapy in neurologically im-

paired patients. It has a hierarchy of 15 mobility items valued from least [score = zero] to most mobile [score = 1]. The RMI score correlates with other measures of disability, being reliable and responsive to change in neurologically impaired patients undergoing treatment.

Sleep Questionnaire. This simple questionnaire [digital answers, yes or no] regarding the quality of daytime rest and sleep was developed specifically for this study. It included two questions about the quality of daytime rest in the wheelchair and sleep at night. It was administered only at the last visit, after the study subject had completed the last PainVAS assessment. The wording of the questions was as follows:

Question #1. Did you rest well in wheelchair or bed during the last 2 weeks? Yes__ No __

Question #2. Did you sleep well during the last 7 nights? Yes__ No __

Calculations and Statistical Analysis. As recommended elsewhere (23,26), the parameter "Treatment Effectiveness" was used as a measure of residual disability for both outcome variables [PainVAS, RMI]. Effectiveness at discharge reflected the proportion of total potential improvement actually achieved during hospitalisation. The proportion was calculated according to the following formula:

$$\text{Effectiveness} = [\text{Discharge Scale score} - \text{Initial Scale score}]/[\text{Maximum Scale score} - \text{Initial Scale score}] \times 100$$

According to the formula, the effectiveness was 100 percent when a patient achieved the maximum scale score (26,27).

Moreover, we calculated the efficiency as the "rate of pain improvement" per days [average daily improvement in duration of rehabilitation treatment: efficiency] (25), which was calculated as follows:

$$\text{Efficiency} = [\text{Discharge Scale score} - \text{Initial Scale score}]/[\text{Days of Treatment}]$$

The Sleep Questionnaire results were analyzed using the Chi-squared test.

The RMI (23) was calculated on admission and discharge and the correlation of effectiveness to pain-relief was evaluated according to PainVAS.

With a chosen confidential interval of 95 percent [for all analyses, the criterion alpha level for statistical significance was set at .05; $\alpha = 0.05$], we used the χ^2 test [chi-squared test for p-equality or independence] and analysis of variance for statistical analysis of the data. The Pearson test was used for the linear regression and correlation in Group 1 data to assess the possible correlations between improvement in mobility and pain, and the correlations between final motility and intensity of pain at the end of the trial.

RESULTS

After three weeks of monitored physiotherapy, one hundred and one potential study subjects fulfilled the study criteria and were enrolled. They all continued the indicated rehabilitation therapy which included ongoing shoulder training. All of the patients were taking daily medication at the beginning of the study and continued that therapy with no change in dosages for its duration. At the time of enrolment, the study participants were randomized in two comparison groups: fifty four subjects randomized to Group 1 to receive dry needling for the TrPs of their shoulder muscles (18-20) while 47 subjects randomized to the control Group 2 whose members did not received needling. As shown in Table 1, the two randomization groups were statistically comparable with regard to demographic variables and the duration of time post-CVA.

The muscles treated in the shoulders of patients in Group 1 are summarized in Table 2 along with the frequency with which each muscle was found to contain the painful MPS TrP requiring treatment. Pain from the shoulder and its surrounding tendons was often felt anterolaterally and at the insertion of deltoid and rotator cuff muscle; sometimes it radiated down the arm on the triceps muscle and less frequently down the other shoulder muscle. The rotator cuff is a sheet of conjoint tendons closely applied over the shoulder capsule and

TABLE 1. Demographics of Study Subjects

Variable	All Subjects	Group 1	Group 2	Stats
Number	101	54	47	
Age [years]	66.79	69.56 ± 6.21	67.43 ± 9.05	NS
Age Range [years]	42-86	58-86	42-84	
Gender [Male:Female]	28:73	14:40	14:33	NS
Percent Male [%]	27.7	25.9	29.8	
Ethnicity [Percent Caucasian]	100%	100%	100%	NS
Post-Stroke Duration				
Mean [weeks]	3.53	3.50	3.57	NS
Range [weeks]	3-5	3-5	3-4	NS

Abbreviations: % = percent, NS = not significant, Stats = statistics

TABLE 2. Shoulder Muscles Treated. For Each Shoulder's Muscle, a Needle Was Inserted in the Point of Maximum Tenderness or Where Muscle Taut Bands or Signs of Spasms Were Palpable

Muslce	Frequency*
1. Supraspinatus	54/54
2. Infraspinatus	54/54
3. Trapezium upper & lower	54/54
4. Levator scapulae	54/54
5. Rhomboids	54/54
6. Teres major	10/54
7. Subscapularis	13/54
8. Latissimus dorsi	20/54
9. Triceps	44/54
10. Pectoral	21/54
11. Deltoid anterior, middle, upper	54/54

*Numbers of patients for whom the listed muscle was selected for injection among 54 patients in Group 1.

inserting into the greater tuberosity of the humerus. It is composed of subscapularis in front, supraspinatus above and infraspinatus and teres minor behind: the "rotator muscle," which has an important function in stabilizing the head of the humerus by pulling it firmly into glenoid when the deltoid lifts the arm forwards or sideways. In our subjects, pain on the top of the shoulder suggested a sort of gravitational dysfunction. The entire haemiparetic shoulder was stretched down by its own weight and the top muscles frequently became sites of referred pain and TrPs [see Table 2]. Muscles such as pectoral, triceps, latissimus dorsi, and teres major subordinately hold up the shoulder girdle: according our clinical experience, they appeared to be involved, becoming sites of referred pain, and containing TrPs, when they preserved a sufficient tone, counteracting the gravitational stretching.

Both treatment groups reported a reduction in the intensity of their shoulder pain, according to data collected from day 1 through day 21 [see Table 3 and Figure 1]. Group 1 patients, receiving dry-needling, reported significant improvement from entry through the whole follow-up period. The efficiency data were higher for Group 1 at day five [Group 1 = 0.068, Group 2 = 0.042] and again for Group 1 at the end of treatment [Group 1 = 0.0956, Group 2 = 0.063; see Table 4].

Excellent pain relief was achieved in Group 1 without clinically relevant complications [PainVAS effect = 59.94 percent], these patients having a better improvement on pain during rehabilitation, than the control subjects [PainVAS effectiveness = 37.70 percent, see Table 5]. They reported having less severe pain during sleep and overall more comfort in their wheelchairs, in their beds, and during their physiotherapy. Group 1 subjects also reported a more restful sleep [85.19 percent, p = 0.034, see Table 6] than the control subjects [74.47 percent]. Table 7 shows the data from effectiveness calculations of the RMI data for the treatment comparison groups.

Analysis of the variance [ANOVA] of PainVAS effectiveness [F = 79.93; P = 0.005,

TABLE 3. Pain Visual Analog Scores [PainVAS] by Study Group

Variable	Group 1 Dry Needling*	Group 2 Control*	P Value Statistic**
Number	54	47	
H^0			
Mean ± SD	7.93 ± 0.87	8.02 ± 0.83	0.592
[range]	[6-9]	[6-9]	
H^1			
Mean ± SD	5.56 ± 1.34	6.77 ± 1.46	< 0.001
[range]	[3-8]	[4-9]	
P Value* **	< 0.001	0.05	
	t = 7,4547	t = 1.8534	
H+			
Mean ± SD	5.07 ± 1.21	5.94 ± 1.22	< 0.001
[range]	[3-8]	[3-8]	
P Value* **	0.0005	0.25	
	t = 2.7716	t = 0.085	
H^3			
Mean ± SD	3.15 ± 0.80	4.96 ± 1.12	< 0.001
[range]	[2-5]	[3-7]	
P Value* **	0.05	0.05	
	t = 1.755	t = 1,8556	

* Values are expressed as mean Pain Visual Analog Scale [PainVAS] scores ± standard deviation [SD] and [range] of the observed values.

** P Value for comparisons within group change with time.

*** P Value for comparison across group change with time.

H^0 Baseline PainVAS Score.

H^1-H^3: Following PainVAS assessments.

FIGURE 1. Change in shoulder pain over the course of the study by treatment group. Both treatment groups reported a reduction in the intensity of their shoulder pain, according to data collected from day 1 through day 21.

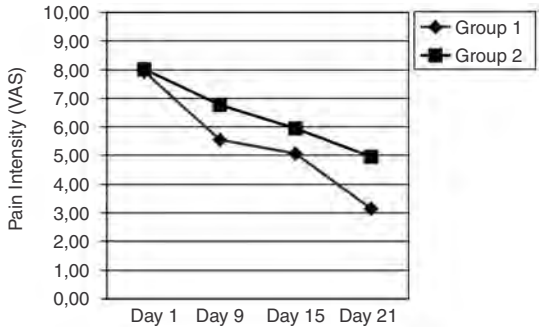

TABLE 4. Reduction in Pain Severity with Treatment as Evidenced by Efficiency* and Effectiveness for the Variable PainVAS

Variables	Group 1 Dry Needling*	Group 2 Control*	ANOVA P Value
Efficiency PainVAS on day 5 [n. 34 ± 1 days]	*0.068* [for 34 days]	*0.042* [for 34 days]	*NS*
Efficiency PainVAS end of treatment [n. 50 ± 2 days]	*0.0956* [for 50 days]	*0.063* [for 50 days]	*NS*
Effectiveness PainVAS end of treatment	Av. 59.94% St. Dev. 11.11 Median 57.14	Av 37.72% St. Dev. 14.82 Median 37.5	*P = 0.005* F = 88.95

*The rate of pain improvement per days [average daily improvement in duration of rehabilitation treatment] was calculated as follows:

Efficiency for PainVAS score = [Discharge Score − Initial Score]/[Days of Treatment]

Abbreviations: PainVAS = Pain Visual Analog Scale, Av. = average, St. Dev. = standard deviation, % = percent, ANOVA = Analysis of variance

TABLE 5. PainVAs Effectiveness* by Comparison Group

	Group 1	Group 2	ANOVA
	Av. 59.94	*Av. 37.72*	*P = 0.005*
Pain*VAS effectiveness*	*Median 57.14*	*Median 37.50*	F = 79.93
End of treatment	*[33.30-77.70]*	*[0-66.60]*	
	St. Dev. 11.11	St. Dev. 14.82	

*Effectiveness at discharge reflects the proportion of potential maximal improvement achieved during hospitalization. The proportion was calculated according to the following formula:

PainVAS Effectiveness = 100 × [Discharge Scale score − Initial Scale score]/[Maximum Scale score − Initial Scale score].

According to this formula, the PainVAS Effectiveness was 100 percent when a patient achieved the maximum scale score.

Abbreviations: PainVAS = Pain Visual Analog Scale, Av. = average, St. Dev. = standard deviation, ANOVA = Analysis of variance

TABLE 6. Results from the Sleep Questionnaire

	Group 1 Dry Needling*	Group 2 Control*	Chi Square	P Value
Question #1 Yes % [32/47 pts]	85.19%	68.08%	$\chi^2 = 4.518$	*P = 0.034*
Question #2 Yes % [30/47 pts.]	92.59%	74.47%	$\chi^2 = 4.263$	*P = 0.039*

***The Sleep Questionnaire was given after the last PainVAS assessment to determine the quality of daytime rest and sleep at night.**
Question #1. Did you rest well in wheelchair or bed during the last 2 weeks?
Question #2. Did you sleep well during the last 7 nights?

Abbreviations: % = percent

TABLE 7. Rivermead Motricity Index Effectiveness

	Group 1 Dry Needling	Group 2 Control
RMI* Effectiveness**	50.01% ± 15.38%	47.54% ± 17.34%

*The RMI is a 15 item scale that evaluates the mobility of patients with a cut off of 15 for normal subjects.

*Effectiveness at discharge reflects the proportion of potential maximal improvement achieved during hospitalization. The proportion was calculated according to the following formula:

RMI Effectiveness = 100 × [Discharge Scale score − Initial Scale score]/[Maximum Scale score − Initial Scale score].

According to this formula, the RMI Effectiveness was 100 percent when a study subject achieved the maximum scale score.

Abbreviations: RMI = Rivermead Motricity Index, % = percent

see Table 5] and PainVAS end of treatment [F = 88.95; P = 0.005, see Table 4] was made between the two groups.

As proposed in our first hypothesis, there was a statistically significant correlation between the decrease of pain and motor recovery [Pearson t. f.d. = 52; r = −0.270; P = 0.048], and between the improvement in motility [RMI, see Table 8] and the pain score at the end of the treatment [r = −0.395; p = 0.05].

Adverse effects from the dry needling procedure were infrequent and generally benign. During the twirling of the needles, some patients experienced Degi-like soreness, heaviness at the shoulder, and tingling, but local side effects were never so serious as to require discontinuation of the treatment. In a few cases [less the 10 percent] we also observed a local or regional cutaneous vasodilatation, piloerection and sweating consistent with a strong regional sympathetic response to the soft tissue needling stimulation. During the procedure, two patients had a transit fall of blood pressure

TABLE 8. Correlation Between Pain and Motor Recovery in Group 1

PainVAS Score *End of treatment*		**RMI** *End of study*	**Pearson t.**
Mean ± SD [range]	3.15 ± 0.80 [2-5]	*Av. 9.48* *Median 8* *[4-15]* *St. Dev. 3.31*	P = 0.048 fd = 52 r = −0.270
PainVAS Effectiveness* *End of treatment*		**RMI Effectiveness*** *End of study*	**P Value**
Av. 59.94 *Median 57.14* *[33.30-77.70]* St. Dev. 11.11		*50.01% ± 15.38%*	*P = 0.048* *r = −0.270* *f.d. 52*

*Effectiveness at discharge reflects the proportion of potential maximal improvement achieved during hospitalization. The proportion was calculated according to the following formula:

RMI Effectiveness = 100 × [Discharge Scale score − Initial Scale score]/[Maximum Scale score − Initial Scale score].

PainVAS Effectiveness = 100 × [Discharge Scale score − Initial Scale score]/[Maximum Scale score − Initial Scale score].

Abbreviations: RMI = Rivermead Motricity Index, % = percent, PainVAS = Pain Visual Analog Scale

followed by loss of consciousness that lasted few seconds.

DISCUSSION

In addition to common symptoms such as sensory deficit and speech disorders, pain is frequently encountered as a consequence of CVA (28,29). Evidence gathered from clinical observation indicates that pain often increases disability and difficulties during rehabilitation of post-CVA patients (12). Shoulder pain is frequently reported and represents an important factor to consider in rehabilitation and care planning of paretic or hemiplegic patients. Unfortunately, different hospitals do not have the same criteria for assessing and treating this syndrome (27-29). Several forms of physical therapy as well as drug therapy have been studied, but no conclusive findings have been reported supporting one approach over the other. Since lessening of pain leads to normalization of sleep patterns and improvement during the rehabilitative process, the primary objective of the present study was to perform a preliminary evaluation of the effectiveness and safety of the dry needling for the hemiparetic painful shoulder. To our knowledge, this is the first randomized controlled trial evaluating the dry needling for CVA periarticular pain and we should like to use this study experience as a further step of discussion of factors to be considered in this type of research.

We are aware that pain represents an emotional response to afferent input. Its perception is influenced by emotion and is dependent on personality and mood. Therefore it is a subjective, problematic, measurement in post-CVA patients. The relative efficacy of TrPs dry needling had previously been well documented (29,30). In a population of patients suffering from back pain, Gunn et al. (4) observed that dry needling of muscle motor TrPs relieved pain significantly more effectively than did the control treatment [$P > 0.005$, $N = 53$]. That finding supported the hypothesis that stimulation of large-diameter fibers contributes to pain relief (18). They also observed that accurate insertion of needles in muscle at the zone of innervation, sometimes mechanically twisted, relieved pain.

In our trial, pain was significantly reduced in both intervention groups, but more so in the dry needling group, where the improvement also occurred more rapidly. The results were statistically significant and seemed to confirm the positive "needle effect" (17) on muscular areas of pain.

The scores showing greater improvement in the dry needling group were not the only observation that let us to be optimistic regarding the use of dry needling of TrPs as a therapeutic approach. The questionnaire showed positive benefits on mood and sleep. We believe this to be highly dependent upon increased emotional tone and reduced performance anxiety.

Our results indicate that dry needling may provide a new therapeutic approach to cope with shoulder pain in CVA survivor patients.

More uncertain is the correlation between pain relief and motor recovery. Since Group 2 [physiotherapy without needling] reported improvement in both PainVAS [effectiveness = 37.70] and RMI scores [effectiveness = 47.54 percent; see Table 6], spontaneous improvement must be considered when one is attempting to understand the correlation between pain relief and motor recovery in Group 1 patients. Although data from Group 1 were statistically significant [$p = 0.048$], a positive correlation between pain and motor recovery was also seen in the patients treated only with physical

therapy [PainVAS effectiveness = 59.94]. In agreement with previous studies, the onset of the pain was early in the post-CVA course and exhibited a consistent trend toward improvement in both groups.

We were strict in our adherence to narrow selection criteria for subject enrolment, but the numbers of subjects enrolled in the study were relatively small and the standard deviation in VAS and RMI scores were relatively large. In addition, this study was not blinded. Therefore, it is recommended that larger randomized and blinded studies be undertaken to confirm these encouraging results.

CONCLUSIONS

As widely reported in the literature (16-19, 29,30), dry needling is an effective method to treat TrPs. When used early in the treatment of shoulder pain syndrome among CVA survivors, it exhibits a widely recognised antalgic action (6,7). Despite the fact that dry needling is more time consuming than administering medications, the former is recommended for treatment of post-CVA hemiplegic shoulder pain during the early rehabilitation phases.

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