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Original Research

Prevalence of Myofascial Trigger Points in Poststroke Patients With Painful Shoulders: A Cross-Sectional Study

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Abstract

Background: In patients with stroke, hemiplegic shoulder pain can be a major problem. One source of shoulder pain can be myofascial trigger points (MTrPs).
Objective: To determine the prevalence of myofascial trigger points (MTrPs) and the correlation between MTrPs and pain and function in patients presenting with shoulder pain following a stroke.
Design: Cross-sectional study.
Setting: Department of Physical Therapy.
Patients: Fifty patients with stroke with shoulder pain.
Intervention: Not applicable.
Main Outcome Measurements: The prevalence of the MTrPs located in infraspinatus, supraspinatus, teres minor, and upper trapezius was studied, using the diagnosis criteria recommended by Simons et al. The pressure pain threshold was also evaluated. Pain and function were assessed with the Visual Analogue Scale (VAS) and the Disability of the Arm, Shoulder and Hand (DASH) scale, respectively.
Results: The prevalence of latent MTrPs was 68%, 92%, 40%, and 62% for supraspinatus, infraspinatus, teres minor, and upper trapezius muscle, respectively. The prevalence of active MTrPs was 34%, 50%, 12%, and 20% for supraspinatus, infraspinatus, teres minor, and upper trapezius muscle, respectively. Pain was moderately correlated with the prevalence of latent MTrPs ($r = 0.35$; $P = .01$) and active MTrPs ($r = 0.31$; $P = .03$) in the supraspinatus muscle. Disability was measured with the DASH scale and was moderately correlated with latent MTrPs in the infraspinatus ($r = 0.31$; $P = .03$) and active MTrPs of the supraspinatus ($r = 0.32$; $P = .02$).
Conclusions: This study shows that the prevalence of MTrPs is high in patents following a stroke. MTrPs in this population are moderately associated with pain and function.
Level of Evidence: II.

Introduction

In neurologic patients, hemiplegic shoulder pain (HSP) can be a major problem.[1] The incidence of HSP varies from 16% to 84%.[2] Prior studies have documented the negative impact of HSP including obstruction of the rehabilitation process, delay of motor recovery in the upper extremities, decrease in the functional performance of daily activities, and prolongation of hospital stay, and it has been associated with depression and decreased quality of life.[3] One-third of all individuals seeking physician intervention for musculoskeletal pain in the United States are seeking relief for shoulder pain.[4] The causes of the pain can be difficult for clinicians to diagnose due to the complexity of the shoulder anatomy and the wide spectrum of shoulder conditions.[5] Soft tissue injury or degenerative changes of the bone structures may cause painful shoulder conditions.[6,7]

One source of shoulder pain can be myofascial trigger points (MTrPs), which are localized, hyperirritable points

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that are associated with palpable nodules in taut bands (TBs) of muscle fibers.[8] MTrPs can be classified into active and latent.[9] Latent MTrPs demonstrate the same clinical characteristics as active MTrPs but they do not provoke spontaneous pain.[10] Numerous studies have shown that MTrPs are prevalent in patients with chronic nontraumatic neck and shoulder pain.[11-13] A study of 72 patients with shoulder pain showed a high prevalence of active MTrPs in the infraspinatus (78%) and upper trapezius muscles (58%).[11] Persistence of MTrPs in the neck and shoulder muscles for long periods may result in headache, neck and shoulder pain, dizziness or vertigo, limited neck and shoulder range of motion, abnormal sensation, and dysfunction, and disability.[14,15] To the best of our knowledge there are no studies regarding the prevalence of MTrPs in patients after stroke with shoulder pain. Such findings could open up new therapeutic perspectives in this group of patients, as Tang et al have done when they studied the intervention of dry needling to resolve MTrPs in poststroke patients with shoulder pain.[16]

Our hypothesis was that the prevalence of MTrPs may be high in patients with stroke and therefore may be considered as a source of pain and dysfunction. The aim of this study was to determine the prevalence of MTrPs and the correlation between MTrPs and pain and function in patients presenting with shoulder pain following a stroke.

Material and Methods

Participants

We conducted a cross-sectional study in stroke patients between the ages of 30 and 85 years with the diagnosis of unilateral shoulder pain. Written informed consent was obtained from all participants and the procedures were conducted according to the Declaration of Helsinki. This research protocol has been approved by the local ethical committee of "IRCCS Don Carlo Gnocchi Foundation," Italy, on 24 February 2016 and is registered with ClinicalTrials.gov (NCT02701335). Before the experimental procedure, the evaluation protocol was explained to each patient, ensuring that they understood the whole process.

Fifty-five consecutive inpatients with shoulder pain following a stroke were recruited from the department of physical therapy of the IRCCS Don Carlo Gnocchi Foundation. Testing took place between the hours of 9:00 am to noon. The patients were screened and enrolled in the study during 2016. All patients presented with unilateral HSP.

Inclusion and Exclusion Criteria

The data collection method was planned before the physical and palpation tests. A physiatrist reviewed the magnetic resonance imaging (MRI) results and screened the patient's medical history to determine if the patient was eligible for inclusion. Inpatients were included in the study if they were 30- to 85-years-old during the first 3 months after stroke, with shoulder pain, spasticity of Ashworth Scale >2 and without flaccidity. Patients could be ambulatory with or without an assistive device or nonambulatory. Patients with any of the following disorders were excluded: rheumatic inflammatory, diabetes mellitus, fibromyalgia, metabolic syndrome, acute traumatic conditions, postoperative conditions, cervical spine disorders, shoulder and elbow disorders, and receptive or expressive aphasia as determined by the Quick Aphasia Battery (QAB). The following demographic information was gathered: the patients' age, sex, type of stroke, hemiplegic side, characteristics of pain, and any additional problems, medicines, and injections.[17] A detailed physical examination was performed on all patients. All patients were clinically stable and they all underwent subjective and objective physical examination by two physical therapists with experience in management of shoulder conditions. The STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) statement checklist of items of cohort observational studies were fulfilled in this study.[18]

Outcome Measures

Before the start of the evaluation, the clinicians underwent training to standardize the examination techniques and the interpretation of the tests. Each of the two clinicians independently performed a standardized history and physical examination of each patient.

Primary Outcome Measure

Palpation Intervention

The presence of MTrPs in the infraspinatus, supraspinatus, teres minor, and upper trapezius was recorded as the primary outcome variable. The therapist explored the muscle by palpating perpendicular to the direction of the fibers to feel TBs in order to select MTrPs on the muscle. The therapist moved longitudinally to the selected TB to feel for a painful spot or nodule in the TB, and if the painful spot corresponds with the nodule. After an MTrP was diagnosed, a compression test was carried out to classify active or latent MTrPs. The examiner applied compression for 30 seconds and asked the participants if they experienced any referred pain. Patients were asked if the compression test reproduced referred pain that was familiar to them, in which case the MTrPs were considered active.

To perform the palpation of the MTrPs in the infraspinatus, the clinician placed the patient in a seated position with arms relaxed along the sides of the body and then stood behind the patient. Palpation of the supraspinatus and teres minor for MTrPs was performed with the patient's arm relaxed, with the shoulder externally rotated 30°, and the elbow positioned in 90° of flexion.

Table 1
Myofascial trigger point diagnostic criteria

Diagnostic Criteria	Response		
Taut band (TB)	Yes	No	Yes
Palpable nodule (NE)	Yes	No	Yes
Hypersensitive point (HP)	Yes	No	Yes
Referred pain familiar to patient´s pain (RP)	Yes	No	No
Classification of MTrPs	Active	Not Present	Latent

Finally, palpation for upper trapezius MTrPs was done with the patient supine with arms relaxed to the side of the body.

The criteria recommended by Simons et al[10,19] were used to diagnose MTrPs:

1. Is there a taut band (or TB)?
2. Is there a palpable nodule in the taut band (NE)?
3. Is there a hypersensitive point (HP)?
4. Is there referred pain familiar to patient´s pain (RP)?

After each palpation, the clinician answered these questions with a YES or NO (Table 1). If all the answers were YES, the clinician determined that they had palpated an active MTrP, since it fulfilled all the characteristics described in the literature to locate an MTrP. A "latent" MTrP was determined when all answers were YES except for the last one (it did not produce recognizable pain).[20]

Secondary Outcome Measure

Test and Scales

Before the palpation test, the clinician administered two questionnaires, the Barthel Index and The Disabilities of the Arm, Shoulder and Hand (DASH) score to evaluate the disability of the patient and the specific function of the upper limb, respectively.[10,21,22]

Pain - Visual Analogue Scale (VAS)

Patients were asked about their current pain with a VAS, where 0 was absence of pain and 100 was intense pain. Immediately after this, the clinician examined the shoulder muscles for the presence of MTrPs.

Statistics

Data were analyzed using SPSS for Windows (V.22, IBM, Armonk, NY). Descriptive statistics (mean and SD) were calculated for all patients, as well as for males and females separately. The relationships between the four MTrPs (infraspinatus, supraspinatus, teres minor, and upper trapezius) and pain and function were assessed using Pearson's correlation coefficients. Statistically significant correlation coefficients of <0.30 were considered to be indicative of a poor correlation. A correlation coefficient of ≥0.30 and ≤0.70 was considered to be indicative of moderate correlation, and a correlation coefficient of >0.70 was defined as a strong correlation.

Table 2
Descriptive statistics and functional scores of the cohort

Parameter, all (*n = 50*)	Mean (SD)
Age, y	68.5 ± 10.7
Gender, n	33 men
	17 women
Dominant hand	Right, 96%
Stroke side	Right, 48%
Barthel Index	52.2 ± 27.7
DASH	73.9 ± 18.7
VAS	50.3 ± 22.9

DASH = Disabilities of the Arm, Shoulder and Hand; VAS = Visual Analog Scale; PPT = Pressure Pain Threshold.
Data are mean (SD) unless indicated otherwise.

Sample size calculations were performed based on a priori power calculation with a mean difference of 2 cm minimal detectable change (MDC) on a 10-cm VAS assuming a SD of 2 cm, a 2-tailed test, an alpha level of .05, and a desired power of 80%. A statistical power analysis using ENE 3.0 software (GlaxoSmithKline, Universidad Autónoma, Barcelona) indicated that a minimal sample size of 50 participants was needed.

Results

Clinical Characteristics of the Participants

A total of 33 men and 17 women, age 30 to 85 years (mean 68.5, SD 10.7 years), with poststroke shoulder pain participated in this study. Descriptive statistics for demographics, pain, and functional assessments including mean values of the DASH, Barthel, and VAS scores are presented in Table 2. Regarding the reference values at baseline, the following mean scores were found: 52.2 ± 27.7 for Barthel's Index, 73.9 ± 18.7 for DASH questionnaire, and 50.3 ± 22.9 for shoulder pain measured with the VAS.

Prevalence of MTrPs by Muscle

We combined the performance of clinical tests to determine if it was possible to improve the diagnostic value of the presence of latent and active MTrPs. To confirm a latent MTrP, a positive answer to all of the three first questions (TB, NE, and HP) was necessary, whereas to confirm an active MTrP it was necessary also to reply YES to the fourth question (RP). MTrPs were found in the infraspinatus (n = 46), supraspinatus (n = 34), upper trapezius (n = 31), and teres minor (n = 20) muscles. After classifying them into active or latent according the aforementioned criteria, it was found that the presence of active MTrPs in each muscle was as follows: infraspinatus (n = 25), supraspinatus (n = 17), upper trapezius (n = 10), and teres minor (n = 6). The presence of latent MTrPs was as follows: infraspinatus (n = 21), supraspinatus (n = 17), upper trapezius (n = 21), and teres minor (n = 14) muscles. Figure 1 presents the distribution of active and latent MTrPs per muscle.

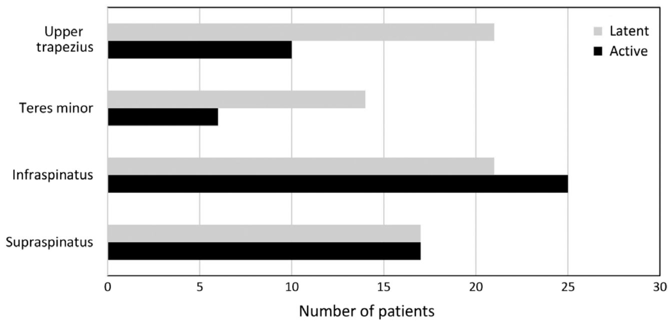

Figure 1. The number of latent (gray bar) and active (black bar) myofascial trigger points (MTrPs) per patient.

Table 3
Performance of the combination of three tests for latent and four tests for active MTrPs

	Sensitivity (%)	+ LR (95% CI)
Latent MTrPs (TB + NE + HN)		
Supraspinatus	68	1.96 (1.26-3.07)
Infraspinatus	92	5.92 (2.33-15.08)
Teres minor	40	2.51 (1.86-3.38)
Upper trapezius	62	2.55 (1.70-3.83)
Active MTrPs (TB + NE + HN + RP)		
Supraspinatus	34	2.35 (1.76-3.13)
Infraspinatus	50	2.33 (1.64-3.32)
Teres minor	12	2.14 (1.72-2.65)
Upper trapezius	20	1.31 (0.85-2.04)

LR = likelihood-ratio; CI = confidence interval; MTrPs = myofascial trigger points; TB = taut band; NE = nodule; NH = hypersensitive nodule; RP = referred pain.

Prevalence of Latent and Active MTrPs

The prevalence of latent MTrPs in this population was estimated at 68%, 92%, 40%, and 62% for supraspinatus, infraspinatus, teres minor, and upper trapezius muscles respectively. The prevalence of active MTrPs was estimated at 34%, 50%, 12%, and 20% for the supraspinatus, infraspinatus, teres minor and upper trapezius muscles, respectively (Table 3).

Correlation between MTrPs and Pain and Disability Scores

Pain was measured with the VAS scale and was moderately correlated with the prevalence of latent MTrPs (r = 0.35; *P* = .01) and active MTrPs (r = 0.31; *P* = .03) in the supraspinatus muscle. Disability was measured with the DASH and was moderately correlated with latent MTrPs in infraspinatus (r = 0.31; *P* = .03) and active MTrPs of supraspinatus (r = 0.32; *P* = .02) (Table 4).

Discussion

Shoulder pain following stroke can be caused by impaired motor function (muscle tone changes), rotator cuff and biceps tendon disorders, adhesive capsulitis, and altered peripheral or central nervous system (CNS) activity (complex regional pain syndrome type 1, peripheral nerve entrapment, neglect, sensory impairment, central pain, and central sensitization), or myofascial trigger points.[23,24] Determining the etiology of pain can require a battery of tests including MRI, manual muscle testing, passive range of motion, and palpation.

This study confirmed our hypothesis, that in a specific population of patients following a stroke, MTrPs are prevalent and therefore they should also be specifically examined and treated as in a nonstroke population, as they can be a source of shoulder pain and dysfunction. Active MTrPs in supraspinatus muscle were moderately correlated with both the VAS and DASH scores, thus the evaluation of the presence of MTrPs is key when assessing a patient with HSP. Latent MTrPs in infraspinatus were moderately correlated with the DASH score but not with the VAS score. This may show the importance of the role of MTrPs as a potential source of disability.

To date, there are no published studies of the prevalence of MTrPs in this population. Bron et al studied the prevalence of MTrPs in patients with shoulder pain without neurologic condtions.[11] Compared with Bron et al, we found very similar prevalences rates for the infraspinatus (92% in this study and 93% found by Bron et al) and supraspinatus (68% in this study vs. 60% found by Bron et al[11]). When we compared the prevalence of only active MTrPs with results found by Bron et al, we found the same prevalence in supraspinatus (34% vs 35%), whereas in the infraspinatus the prevalence of active MTrPs was considerably lower despite the finding that the overall prevalence of MTrPs was similar.[11] This may be explained by two hypotheses. The first one is that although the prevalence of MTrPs is similar, they are not primarily

Table 4
The Pearson's correlations between pain severity, disability, and MTrP variables

		Active				Latent			
		Supraspinatus	Infraspinatus	Teres minor	Upper trapezius	Supraspinatus	Infraspinatus	Teres minor	Upper trapezius
VAS	Pearson correlation	0.31*	0.18	0.23	0.05	0.35*	0.17	0.21	0.09
	P value	.03	.21	.12	.74	.01	.24	.15	.52
DASH	Pearson Correlation	0.32*	0.26	0.18	0.05	0.24	0.31*	0.15	0.04
	P value	.02	.07	.21	.72	.10	.03	.29	.80

*Indicates statistical significance $P < .05$.
VAS = Visual Analog Scale; DASH = Disabilities of the Arm, Shoulder and Hand.

responsible for pain in this population of patients. The second one is that the criteria to classify the MTrPs into active MTrPs (positive criteria of referred pain familiar to the patient) are not reliable for a population with sensory alterations, like those that occur following a stroke. In fact, although active MTrPs were not correlated with pain despite their high prevalence, latent MTrPs in the infraspinatus showed a moderate correlation with DASH. Perhaps the (RP) criteria used to classify MTrPs is the most useful. According to our clinical experience, treating these patients and obtaining good results after specific MTrP therapy, we think that the criteria "referred pain familiar to the patient" has a potential high risk to yield false negatives in this population, so in neurologically impaired patients the specific examination should consider this criteria with caution.

The incidence of MTrPs is very common in general population, and the prevalence in around 30% of pain patients consulting in primary care.[25] Hidalgo-Lozano et al assessed the prevalence of MTrPs in 12 patients with unilateral shoulder impingement syndrome compared to healthy controls and found the point prevalence of active MTrPs was most predominant in supraspinatus (67%), infraspinatus (42%), and subscapularis (42%).[26] In contrast, we found the highest prevalence of active MTrPs in the infraspinatus (50%), followed by the supraspinatus (34%). Fernández-De-Las-Peñas et al analyzed the prevalence of active MTrPs in the head, neck, and arm between manual and office workers with nonspecific neck or shoulder pain.[27] They found a similar number of MTrPs in the upper quadrant musculature, with the most prevalent being upper trapezius, infraspinatus, levator scapulae, and extensor carpi radialis brevis muscles for both groups.[27] We are in agreement with their study as we also found the highest prevalence for both latent and active MTrPs in the infraspinatus muscle. However, we found a higher prevalence of latent MTrPs and they reported there was not a significant difference between active and latent MTrPs in their study.[27]A recent systematic review reported that latent MTrPs did not consistently have a higher prevalence compared to healthy controls.[28]

For future studies, it would be beneficial to assess latent trigger points in patients with stroke without pain. It would also be beneficial to perform several interventional studies treating latent MTrPs after confirming the classification described in this study. These types of studies should be conducted to determine if the presence of MTrPs of the muscles considered are correlated to clinical improvement of the patients despite the fact that they were not considered active MTrPs using the current clinical criteria. This may help analyze if the clinical criteria should be redefined for this specific population.

Study Limitations

The main limitation of the study is the absence of a control group of participants not affected by a neurologic condition but with shoulder pain. However, we aimed to propose some preliminary considerations based on our data and to pose the basis for further analyses in larger groups of patients affected by stroke. We avoided the inclusion of non-neurologically impaired participants because the existing literature provides a reliable and large database about pain parameters in healthy subjects of similar age. Another limitation is that the third criterion that was used in this study to diagnose MTrPs (HP) may not be reliable when patients have impaired sensation. Because of this, we conducted a secondary analysis excluding the HP criteria to diagnose MTrPs, and results were very similar (prevalence increased four points for the supraspinatus and infraspinatus, two points for the teres minor, and no difference was found with the upper trapezius). Therefore when patients have good communication skills, the use of this general criterion may not negatively affect the diagnostic reliability of MTrPs in patients with stroke who have shoulder pain.

Clinical Applications

Prevalence of MTrPs was reasonably correlated with myofascial shoulder pain following a stroke, although our cross-sectional study could not define an association of cause and effect between shoulder pain and MTrPs. Although these findings suggest that palpation is useful for determining MTrPs in patients with hemiplegic shoulder pain, the criteria "referred pain familiar to the patient" should be reconsidered when determining if MTrPs are active.

However clinicians should consider using MTrP-specific assessment and treatment for the management of the hemiplegic shoulder pain.

Conclusion

This study shows that prevalence of MTrPs is high in patents following a stroke. Clinicians should consider using MTrP-specific assessment for the management of hemiplegic shoulder pain.

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