American Pain Society
RESEARCH
EDUCATION
TREATMENT
ADVOCACY
PUBLISHED BY ELSEVIER

The Journal of Pain, Vol 11, No 7 (July), 2010: pp 644-651
Available online at www.sciencedirect.com

The Predetermined Sites of Examination for Tender Points in Fibromyalgia Syndrome Are Frequently Associated With Myofascial Trigger Points

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Abstract: **The aim of this present study is to test the hypotheses that the 18 predetermined sites of examination for tender points (TP sites) in fibromyalgia syndrome (FMS) are myofascial trigger points (MTrPs), and that the induced pain from active MTrPs at TP sites may mimic fibromyalgia pain. Each TP site was evaluated with manual palpation followed by intramuscular electromyographic (EMG) registration of spontaneous electrical activity to confirm or refute the existence of an MTrP in 30 FMS patients. Overall spontaneous pain intensity and pain pattern were recorded before manual identification of MTrPs. Local and referred pain pattern from active MTrPs were drawn following manual palpation at TP sites.**

Results: **showed that most of the TP sites are MTrPs. Local and referred pain from active MTrPs reproduced partly the overall spontaneous pain pattern. The total number of active MTrPs ($r = .78$, $P < .0001$), but not latent MTrPs ($r = -.001$, $P = .99$), was positively correlated with spontaneous pain intensity in FMS. The current study provides first evidence that pain from active MTrPs at TP sites mimics fibromyalgia pain. MTrPs may relate to generalized increased sensitivity in FMS due to central sensitization.**

Perspective: ***This article underlies the importance of active MTrPs in FMS patients. Most of the TP sites in FMS are MTrPs. Active MTrPs may serve as a peripheral generator of fibromyalgia pain and inactivation of active MTrPs may thus be an alternative for the treatment of FMS.***

Key words: *Fibromyalgia, intramuscular needle electromyography, manual palpation, referred pain, spontaneous electrical activity.*

A cardinal feature of FMS is the diffuse musculoskeletal pain, though there are other problems including fatigue, cognitive impairment, sleep disturbance, and morning stiffness.[2] There are presently no diagnostic tests for fibromyalgia. Rather, The American College of Rheumatology (ACR) criteria[31] require that spontaneous pain be present for over 3 months' duration along the spine and in all 4 quadrants of the body, and pain upon digital palpation must be elicited at 11 out of 18 tender points. The ACR criteria have been used for standardizing research into FMS, but one of the limitations with the term of tender points is that FMS patients show generalized tenderness all over the body areas even at the so-called control points.[17,33] Another limitation is that tender-point palpation only assesses deep-tissue hypersensitivity and has failed as a reliable indicator of clinical pain intensity in FMS.[27] On the contrary, the number of painful body areas obtained by body-pain diagrams is a better predictor of clinical pain intensity than tender points in FMS[27] and local pain parameters predicted most of the variance of overall clinical FMS pain.[28] Local pain may come from myofascial trigger points (MTrPs). These 18 predetermined sites of examination for tender points (predetermined

Received June 2, 2009; Revised September 25, 2009; Accepted October 2, 2009.
This research was supported by The American Fibromyalgia Syndrome Association, Inc. The Oak Foundation is acknowledged for financial support to the Parker Institute. The authors have no conflicts of interest to report.
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1526-5900/$36.00

doi:10.1016/j.jpain.2009.10.006

TP sites) in FMS may be MTrPs, which may give rise to pain in FMS. In fact, the importance of MTrPs in FMS has been suggested.[5,23] MTrPs have been found in patients with FMS in previous studies.[1,32] In 1 study,[1] more than half of the FMS patients had more than 10 active trigger points. In another study,[32] active MTrPs were found in about 18% of examinations of the predetermined TP sites in patients with FMS. However, in these previous studies, the importance of MTrPs in fibromyalgia pain has not been determined. Adding to the underestimation of the value of active MTrPs in FMS is the striking differences in the ability to find the MTrPs between rheumatologist and MTrPs experts.[32] Therefore, a critical evaluation of the occurrence of MTrPs at the predetermined TP sites in FMS with electrophysiological method is needed to solve these disputes.

MTrPs may be active or latent. An active MTrP is characterized by spontaneous pain. An active MTrP on a taut muscle band displays local and referred pain and a local twitch response when stimulated manually or with a needle.[4,24] A latent MTrP is clinically quiescent with respect to spontaneous pain; a latent MTrP may have all the other clinical characteristics of an active MTrP, and always has a taut band that increases muscle tension and restricts range of motion.[4,22,24] However, a common characteristic for both active and latent MTrPs is the existence of spontaneous electrical activity (SEA) with intramuscular needle electromyography (EMG) examination when the muscle is at rest.[15] Although the value of SEA in the differentiation of an active or a latent MTrP has not been validated, the registration of SEA at MTrPs is one of the objective electrophysiological methods to document the existence of an MTrP and is independent on the psychophysical responses from the subjects under investigation. On the contrary, manual palpation technique for tender-point examination may be subject to psychophysical biases[13] and sensory aspects associated with MTrPs, such as tenderness and local and referred pain on flat digital palpation, might also be influenced by the generalized mechanical hypersensitivity in FMS. Therefore, in the current study, the intramuscular EMG registration of SEA at the predetermined TP sites in FMS was used to confirm or refute the existence of an MTrP following manual identification at the predetermined TP sites in FMS.

The aims of the current study were thus: 1) todetermine the occurrence of MTrPs at the predetermined TP sites in FMS patients with the methods of manual palpation and intramuscular EMG registration of SEA; and 2) to evaluate whether local and referred pain induced by manual palpation at the predetermined TP sites mimics fibromyalgia pain.

Methods

Participants

The sample consisted of 30 women with fibromyalgia syndrome (mean age: 53.6 ± 2.5 years; mean weight: 68.2 ± 3.5 kg; mean height: 173 ± 29.8 cm). Only women between the ages of 18 and 70 were recruited for the study. Disease duration of FMS was 11.5 ± .6 years. The participants were recruited through local FMS support groups and rheumatology clinics.

The FMS patients were diagnosed by rheumatologists according to The American College of Rheumatology (ACR) criteria for the classification of fibromyalgia,[31] had an average pain rating of 5.3 ± 2.2 cm for the current overall spontaneous pain intensity on the day of experiment on a 0- to 10-cm visual analogue scale (VAS, 0 = no pain; 10 = worst pain imaginable). The patients were not excluded if taking antidepressant medications and/or analgesics. This study was approved by the local Ethics Committee (VN 2008/0018) and conducted in accordance with the Helsinki Declaration and informed consent was obtained from each subject.

Experimental Protocol

Each subject was asked to rate the current overall spontaneous pain intensity and to draw on an anatomical map the pain areas felt on the day of experiment. Measurement of pressure pain threshold (PPT) at 18 predetermined TP sites in FMS[31] was undertaken when subjects took a comfortable sitting position. In the current study, the predetermined TP site of Low Cervical was defined at the midpoint of sternocleidomastoid muscle instead of the scalenus muscle for safety reasons during intramuscular needle insertion. Following PPT measurement, subjects were asked to take a relaxed supine position with a suitable head pillow and both the palms of the hands directed downwards when examining the predetermined TP sites at the midpoint of sternocleidomastoid muscle, 2 to 3 cm distant to the distal edge of the Lateral Epicondyle, and at the Knee. Subjects were asked to take a prone position with a suitable pillow under the chest and both the palms of the hands directed upwards when examining the predetermined TP sites at the Occiput, Trapezius, Supraspinatus, Gluteal, and Great Trochanter.

These positions were used for both manual palpation and needle EMG examination of the predetermined TP sites. In the current study, a predetermined TP site was defined as an area of 2 cm in diameter covering each defined tender point. All the 18 predetermined TP sites were then manually palpated for the existence of a latent or an active MTrP in a randomized manner. Finally, all the 18 predetermined TP sites except the 2 sites bilaterally at Second Rib were examined with intramuscular needle EMG examination. Two sites bilaterally at the Second Rib were not included in the needle EMG examination procedure in order to avoid any complications following needle insertion due to thin muscle layer and its closeness to the thoracic cavity at this site. However, in several patients with a thick muscle mass at Second Rib, this tender point site was also examined.

PPT Measurement at Predetermined TP Sites in FMS

Subjects were placed in the sitting position in a chair with back and arm supports during PPT measurement. All the skin areas at the 18 predetermined TP sites in FMS[31] were exposed for PPT measurement. The

predetermined TP location was determined according to a standardized manual tender-point survey procedure.[20] An electronic pressure algometer (Somedic® Algometer type 2, Sollentuna, Sweden) with a 1-cm^2 rubber-tipped plunger mounted on a force transducer was used to measure the PPT. PPT was calculated as the mean of 2 trials with a 10-second interval between repetitions. The pressure was increased at a rate of 30 kPa/s until the subject detected the pain threshold. A 10-minute pause followed after the PPT measurement at all 18 predetermined TP sites.

Manual Identification of MTrPs at 18 Defined Tender Point Sites

Following PPT measurement, the existence of MTrPs at 18 predetermined TP sites were assessed using snapping palpation (first to locate a taut band of muscle and place the fingertip at right angles and then move the thumb tip back and forth to roll the underlying fibers) to induce local twitch response and flat palpation (use the padded aspect of the thumb at a right angle to the muscle fibers and apply pressure against the underlying tissue or bone) to induce local pain and referred pain. Pincer palpation was used only to examine the tender point site at Low Cervical (sternocleidomastoid muscle). The applied pressure to each point was about 4 kg and lasted for 10 seconds. All the predetermined TP sites were randomized for the identification of MTrPs. The presence of an MTrP was determined according to proposed diagnostic criteria of MTrPs:[12,22] an active MTrP has to meet item number 4, and 2 of the first 4 items as follows; 1) presence of a palpable taut band, 2) a tender spot within a taut band, 3) local twitch response by snapping palpation of the taut band, and 4) referred pain evoked by flat palpation of the tender spot which reproduces patient's spontaneous pain complaints. A latent MTrP has to meet 2 of the first 3 items in the criteria for an active MTrP, and/or referred pain evoked by flat palpation of the tender spot which does not reproduce subject's spontaneous pain complaints. In order to determine if local pain and referred pain reproduce patient complaints, the examiner would ask, "Do you feel any change in sensation to any area?" If the subject replied in the affirmative, the examiner asked, "Is the feeling (or pain) just like the one that is a problem to you?" as used in a previous study.[32] The local and referred pain pattern 10 seconds following flat palpation on each point was drawn by the patient on an anatomical map.

Intramuscular EMG Examination at Defined Tender Point Sites for FMS

The area of skin at the predetermined TP sites was then cleaned with isopropyl alcohol. One pair of bipolar surface EMG electrodes (Neuroline 720-01-k, Ølstykke, Denmark; intra-electrode distance of 2 cm) was placed 2 cm away from the each defined predetermined TP site following skin preparation. The surface electrodes were used to ensure that the muscle under investigation was relaxed prior to and during needle EMG examination. During the EMG needle insertion, a thumb palpated the taut band and located the most tender spot on a taut band and applied slightly downward pressure just enough to fix the underlying tissue in place. For the needle EMG examination of Low Cervical, pincer palpation is used to hold the sternocleidomastoid muscle between fingers. The EMG needle electrode was then advanced slowly into the muscle. The needle insertion was redirected twice if 1 insertion failed to find the spontaneous electrical activity (SEA). The purpose of intramuscular EMG examination was to find the existence of SEA, not aimed at finding a point within the sites with the highest amplitude of SEA. A longer intramuscular EMG needle electrode (Neuroline concentric, 75 × .65 mm (3″ × 23 G)) was used to register SEA at the tender point sites of Gluteal (midpoint of gluteal midius muscle) and Greater Trochanter (2 cm medial to the Greater Trochanter, the quadratus femoris muscle). A shorter intramuscular EMG needle electrode (Neuroline concentric, 25 × .45 mm (1″ × 26 G)) was used to register SEA at the other predetermined TP sites (Occiput: 1 cm distal and lateral to the nuchal ridge, suboccipital muscles; Trapezius: midpoint of upper trapezius; Supraspinatus: 1 cm above the medial border of the scapula spine; Epicondyle: 2 cm distal to the lateral epicondyle, the extensor digitorum; Low Cervical: the midpoint of the sternocleidomastoid; Second Rib: 2 cm lateral to manubrium sterni, the pectoris major; Knee: 2 cm above the joint line, vastus medialis) The referred pain and local twitch response following needle insertion were not recorded. When a resting spontaneous electrical activity from an MTrP (Fig 1) was shown on the EMG monitor, then the EMG signals from surface and intramuscular electrodes were recorded for 4 seconds. Standard filter settings (5 Hz-1 kHz), gain (100 uV/div), and sweep speed (20 ms/div) were used on the electromyography system (Keypoint, Dantec Medical, Skovlunde, Denmark). EMG signals was sampled at 2 kHz and stored for offline inspection by another experimenter who was blinded to the results from manual palpation.

Statistical Analysis

A 2-way (left and right side, different measurement points) analysis of variance (ANOVA) was used to compare the differences in PPT at 18 predetermined TP sites and Dunnett's Method was used for post hoc comparison. Kruskal-Wallis ANOVA by Ranks was used to compare the differences in the occurrence of active and latent MTrPs (dependent variables) at the predetermined TP sites (independent variables). The correlation and possible relationship between overall spontaneous pain intensity and the number of MTrPs (active or latent) were assessed with normal linear regressions. Values in the text and figures are expressed as Mean ± Standard Error (SEM) of the mean. Significance level was set at $P < .05$.

Results

PPT at 18 PREDETERMINED TP Sites

A 2-way ANOVA detected a significant differences in PPT values among 18 predetermined TP sites (F = 36.2,

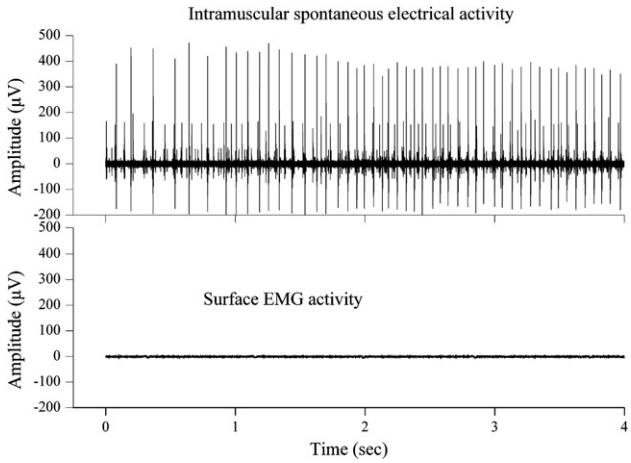

Figure 1. Resting intramuscular and surface electromyographic (EMG) recordings of an active myofascial trigger point (MTrP) in the extensor digitorum. Note that only intramuscular EMG recording (upper trace), but not surface EMG (lower trace), shows spontaneous electrical activity.

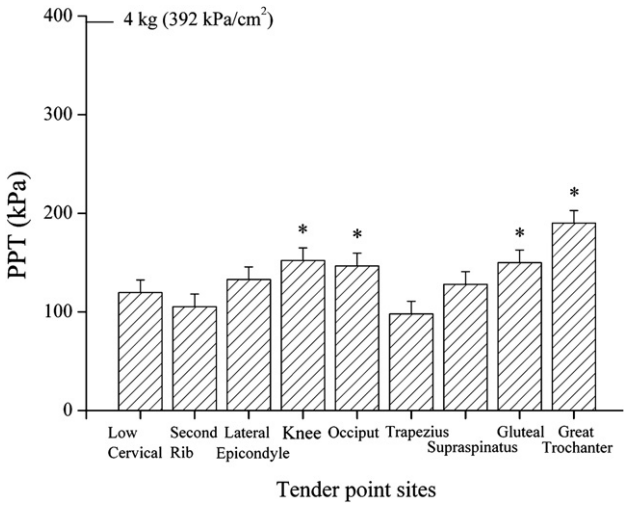

Figure 2. Pressure pain threshold (PPT) at the predetermined tender-point sites in patients with fibromyalgia syndrome. PPT is significantly higher (*) at the tender-point sites of Knee, Occiput, Gluteal, and Greater Trochanter than Trapezius.

$P < .001$), but no differences were found in PPT between left and right sides ($P > .05$, Fig 2). PPT values at all predetermined TP sites were all less than the level of 4 kg (392 kPa/cm^2). All the predetermined TP sites were tender points in this patient group. PPT levels at the sites of Knee, Occiput, Gluteal, and Great Trochanter were higher than Trapezius (all, $P < .05$).

The Occurrence of MTrPs at The Predetermined TP Sites in FMS

Since the purpose of the statistical analysis is to assess the occurrence of MTrPs at predetermined TP sites in FMS and not to compare its differences between right and left sides, the statistical analysis was thus done for the predetermined TP sites on the left and on the right sides, separately.

For the predetermined TP sites on the left side of the body, there were significant differences in the occurrence of active (Kruskal-Wallis test: H (7, N = 240) = 40.8, $P < .0001$)) and latent (H (7, N = 240) = 40.8, $P < .0001$)) MTrPs among predetermined TP sites (Table 1). The occurrence of both active and latent MTrPs at the predetermined TP sites ranged from 80 to 100% as confirmed by intramuscular EMG registration of SEA (Table 1).

For the predetermined TP sites on the right side of the body, there were significant differences in the occurrence of active (Kruskal-Wallis test: H (7, N = 240) = 31.2.8, $P = .0001$)) and latent (H (7, N = 240) = 21.4, $P = .003$)) MTrPs among predetermined TP sites (Table 1). The occurrence of both active and latent MTrPs at the predetermined TP sites ranged from 70 to 93.3% as confirmed by intramuscular EMG registration of SEA (Table 1).

There were less than 20 to 30% of the predetermined TP sites which did not show SEA upon intramuscular EMG examination on both sides of the body. Among these predetermined TP sites which did not show SEA, some were tender points where there were no MTrPs, and some were MTrPs identified with manual palpation but did not show SEA upon intramuscular EMG examination. For example, at the predetermined TP site of the right Knee where 8 out of 30 patients did not show SEA, TP sites in 4 patients were tender points where there were no MTrPs and TP sites in 4 patients were latent MTrPs identified with manual palpation but did not show SEA upon intramuscular EMG examination (Table 1).

The occurrence of active MTrPs is illustrated in Fig 3 for each predetermined TP site.

Local and Referred Pain Pattern From Active MTrPs at Predetermined TP Sites in FMS

The overall spontaneous pain pattern in this FMS patient group and the local and referred pain pattern from active MTrPs are illustrated in Fig 3. Referred pain from latent MTrPs, which are not related to spontaneous pain, was not illustrated. The pain pattern from active MTrPs from the predetermined TP sites mimics the fibromyalgia pain but did not fully reproduce the overall spontaneous pain pattern in FMS.

Pain referrals from active MTrPs that mimic fibromyalgia pain at the predetermined TP sites were further summarized in Table 2.

Correlation Between Spontaneous Overall Pain Intensity and the Number of MTrPs

There was a significant correlation between overall spontaneous pain intensity and the total number of active MTrPs at predetermined TP sites in FMS ($r = .78$, $P < .0001$, Fig 4), but no significant correlation was found between overall pain intensity and the total number of latent MTrPs at predetermined TP sites in FMS.

Table 1. The Number of MTrPs at the Predetermined TP Sites in FMS (n = 30)

Side	Tender point sites	MTrP	Taut band	Tenderness	Local twitch response	Referred pain	Intramuscular SEA (number of confirmed MTrPs)	Occurrence of MTrPs at predetermined TP sites
Left	Low Cervical	Active	5	5	5	5	4	93.3%
		Latent§	25	25	24	8	24	
	Second Rib	Active	10	10	0	10	4	100%
		Latent	20	20	1	8	6	
	Epicondyle	Active*	22	22	22	22	22	100%
		Latent	8	8	8	3	8	
	Knee	Active	7	7	7	7	7	80%
		Latent	21	22	18	7	17	
	Occiput	Active	8	8	0	8	8	93.3%
		Latent	22	22	0	8	20	
	Trapezius	Active#	21	21	20	21	21	100%
		Latent	9	9	8	0	9	
	Supraspinatus	Active	16	16	0	15	16	96.7%
		Latent	14	14	0	0	13	
	Gluteal	Active	12	12	11	12	12	96.7%
		Latent	18	18	11	3	17	
	Greater Trochante	Active	12	12	0	12	11	83.3%
		Latent	17	17	0	4	14	
Right	Low Cervical	Active	2	2	2	2	2	86.7%
		Latent‡	26	26	25	7	24	
	Second Rib	Active	7	5	3	6	6	90%
		Latent	20	20	0	7	5	
	Epicondyle	Active	17	17	17	17	17	90%
		Latent	10	10	9	3	10	
	Knee	Active	9	9	9	9	9	70%
		Latent	17	18	12	3	13	
	Occiput	Active	8	8	0	8	8	90%
		Latent	20	20	0	8	19	
	Trapezius	Active†	21	21	20	21	21	93.3%
		Latent	7	7	5	0	7	
	Supraspinatus	Active	16	16	0	16	16	93.3%
		Latent	12	12	1	0	12	
	Gluteal	Active	15	15	14	15	15	93.3%
		Latent	14	14	10	3	13	
	Greater Trochante	Active	11	11	0	11	9	70%
		Latent	16	16	0	4	12	

For the predetermined sites of examination for tender points (predetermined TP sites) in fibromyalgia syndrome (FMS) on the right side of the body, the occurrence of active myofascial trigger points (MTrPs) confirmed with intramuscular spontaneous electrical activity (SEA) is significantly higher at the Epicondyle (*) than at Low Cervical, Knee, and Occiput (Wilcoxon Matched Pairs Test: all, $P < .0001$). The occurrence of active MTrPs is significantly higher at Trapezius (#) than Low Cervical, Knee (Wilcoxon Matched Pairs Test: all, $P < .0001$). The occurrence of latent MTrPs is significantly higher at Low Cervical (§) than Epicondyle and Trapezius (Wilcoxon Matched Pairs Test: all, $P < .0001$). There was a significant difference in the occurrence of active and latent MTrPs at Low Cervical, Trapezius, and Epicondyle (Wilcoxon Matched Pairs Test: $P < .05$).

For the predetermined TP sites in fibromyalgia syndrome on the right side of the body, the occurrence of active myofascial trigger points (MTrPs) is significantly higher at Trapezius (†) than Low Cervical (Wilcoxon Matched Pairs Test: all, $P = .0001$). The occurrence of latent MTrPs is significantly higher at Low Cervical (‡) than Trapezius (Wilcoxon Matched Pairs Test: $P < .005$). At the predetermined TP sites of Trapizius and Low Cervical, the occurrence between active and latent MTrPs is significantly different ($P < .05$). The occurrence of both active and latent MTrPs at each predetermined TP sites on each side of the body is also illustrated. Note that intramuscular EMG examination at Second Rib was done only in a few patients due to technical limitations; the result at Second Rib was therefore expressed according to manual palpation and not included in the statistical analysis.

Discussion

This is the first study to evaluate in detail whether the predetermined TP sites are associated with active and/or latent MTrPs with manual palpation and intramuscular EMG needle examination, and to assess the contribution of induced pain from active MTrPs at the predetermined TP sites to fibromyalgia pain. Most of the predetermined TP sites in FMS are associated with either active or latent MTrPs and the total number of active MTrPs at the predetermined TP sites was positively correlated with overall spontaneous pain intensity in FMS. Further, the induced pain pattern from active MTrPs partly reproduced fibromyalgia pain pattern. Thus, MTrPs may constitute a peripheral pain generator in FMS.

Positive TPs at Predetermined TP Sites in FMS are MTrPs

In the current FMS patient group, low PPT levels were shown at predetermined TP sites. This generalized mechanical pain sensitization is consistent with previous

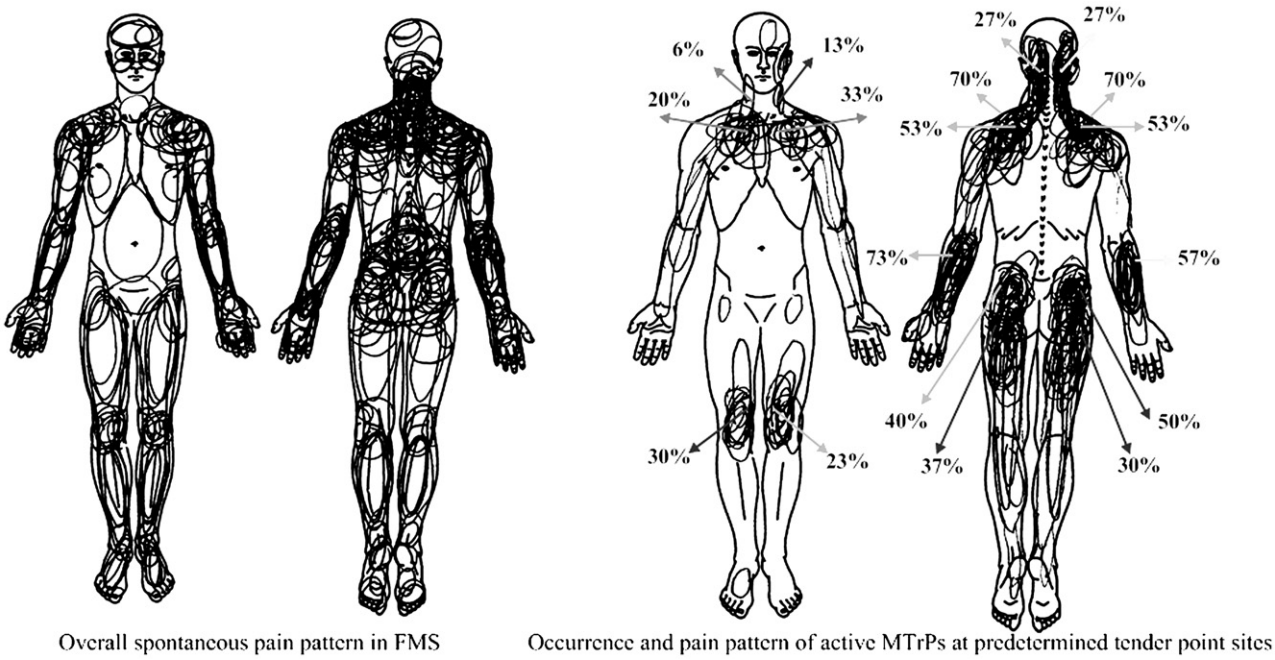

Figure 3. Overall spontaneous pain pattern in patient with fibromyalgia syndrome (FMS) and the induced-pain pattern from active myofascial trigger points (MTrPs) at the predetermined tender-point sites. The occurrence of active MTrPs at each predetermined tender-point site is also illustrated (% of patients). Note that the occurrence of active MTrPs at the Second Rib is calculated according to the results from manual palpation.

studies showing decreased PPT levels in FMS.[16,18,25] However, decreased PPT levels are also associated with the existence of MTrPs.[7,10] In the current study, more than 90% of the predetermined TP sites are MTrPs (Table 1), either active or latent as evaluated by manual palpation and further confirmed by needle EMG registration of SEA. The predetermined TP sites with high occurrence of active MTrPs were Epicondyle (extensor digitorum), Supraspinatus, and Gluteus medius (Fig 3). Active MTrPs in these muscles reproduced in part fibromyalgia pain in the neck shoulder region, in the arm, and in the gluteal region and the back of the thigh. The results in the current study not only confirm the earlier reports of existence of MTrPs in FMS patients at predetermined TP sites[1,32] and support the claims that positive TPs at predetermined TP sites are clinically MTrPs,[3,23] but also extend to show that pain from active MTrPs at predetermined TP sites mimics fibromyalgia pain as shown in Fig 3. Pain pattern induced from active MTrPs at the predetermined TP sites failed, however, to totally reproduce the overall spontaneous pain pattern; this may suggest that active MTrPs in other muscles may contribute to the fibromyalgia pain pattern. It is also important to note that the 18 predetermined TP sites do not represent regions of tender-point occurrence, but rather were selected to standardize testing over 4 quadrants of the body. Therefore, MTrPs identification in FMS should not be restricted to these 18 sites. Further studies may elucidate the role of active MTrPs in fibromyalgia pain in other commonly inflicted muscles such as infraspinatus, quadratus lumborum, and gluteal minimus. Recognition of the importance of active MTrPs in FMS would add

Table 2. Pain Referrals From Active MTrPs at Predetermined TP sites in FMS

Predetermined TP sites	*Pain Referrals*
Low Cervical	Orofacial region
Second Rib	Chest and anterior aspect of the arm
Epicondyle	The dorsum of the forearm and hand
Knee	Knee region
Occiput	Occipital region
Trapezius	Neck-shoulder region
Supraspinatus	Scapular region
Gluteal	Gluteal and posterior aspect of lower limb
Greater Trochanter	Posterior aspect of lower limb

Abbreviations: FMS, fibromyalgia syndrome; MTrPs, myofascial trigger points; TP, tender point.

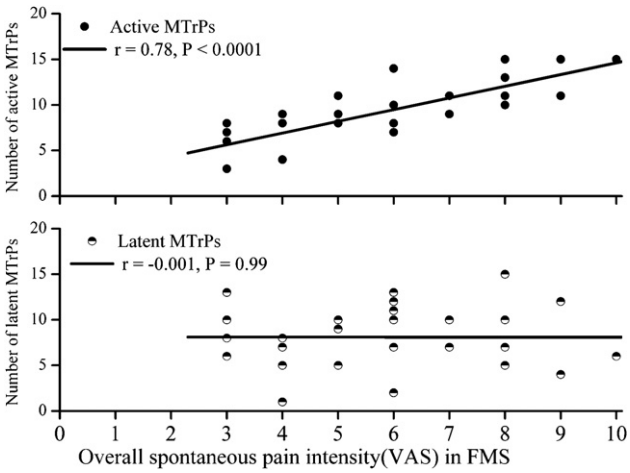

Figure 4. The positive correlation between overall spontaneous pain intensity and the total number of active, but not latent, myofascial trigger points (MTrPs).

significantly to the planning of pain relief strategies in FMS management.

In addition to the higher occurrence of active MTrPs, there are also many latent MTrPs at the predetermined TP sites. Chemical and physical activation of latent MTrPs experimentally have been shown to evoke more pain experiences in healthy subjects.[9,29,34] Factors which may promote persistence of myofascial pain and fibromyalgia pain[6,11] may also activate latent MTrPs leading to clinical pain manifestations. Eliminating perpetuating factors and latent MTrPs may prevent the relapse of fibromyalgia pain.

Role of Active MTrPs in the Pathogenesis and Diagnosis of FMS

An important finding of the current study is that the total number of active, but not latent, MTrPs is positively associated with overall spontaneous pain intensity in FMS. As it is known that active MTrPs are a major cause of local musculoskeletal pain syndromes,[24] the close relationship between the total number of active MTrPs and overall spontaneous pain intensity is in accord with the finding that the number of painful body areas obtained by body pain diagrams is a better predictor of clinical pain intensity than tender points in FMS.[27] It is now evident that active MTrPs provide a strong link connecting the predetermined TP sites in ACR criteria[31] and fibromyalgia pain intensity. The results of this current study suggest a nice overlap of MTrPs at the predetermined TP sites selected to standardize testing over 4 quadrants of the body in FMS. Thus, MTrPs may also have implications in the diagnosis of FMS since MTrPs can be assessed not only by manual palpation but also by intramuscular EMG examination of SEA.

Increasing evidence points towards peripheral tissues as relevant contributors of nociceptive input that might either initiate or maintain central sensitization, or both.[14,26,30] Indeed, nociceptive stimuli from painful foci in muscles are increasingly recognized as being relevant to the development of fibromyalgia.[2,5,30] Active MTrPs show lower PPT[7,10] and higher level of algesic substances[21] than latent MTrPs, intramuscular SEA when muscle is at rest,[15] sympathetic hyperactivity,[8,34] and association of enhanced brain responses of somatosensory and limbic activity with active MTrPs,[19] and these characteristics render active MTrPs as one of the peripheral pain generators driving central sensitization in fibromyalgia.

FMS is a multidimensional disease; the effect of generalized mechanical hyperalgesia contributed from other peripheral pain generators on the occurrence of MTrPs at predetermined TP sites cannot be excluded and needs further evaluation. The healthy control group was not included in the current study due to the fact that active MTrPs are not present in healthy subjects.

In conclusion, results in the current study provide first evidence that positive TPs at predetermined TP sites in FMS are clinically MTrPs, and active MTrPs at predetermined TP sites mimic fibromyalgia pain. Further, the total number of active rather than latent MTrPs are positively associated with the overall spontaneous pain intensity in FMS. Thus, the total number of active MTrPs may serve as a reliable indicator for fibromyalgia pain and active MTrPs may act as a peripheral pain generator driving central sensitization in FMS.

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