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Original Research Article

Muscle Trigger Points and Pressure Pain Sensitivity Maps of the Feet in Women with Fibromyalgia Syndrome

Maria C. Tornero-Caballero, PhD,* Jaime Salom-Moreno, PT, PhD,[†,‡] Margarita Cigarán-Méndez, OT, PhD,[§] Matilde Morales-Cabezas, MD, PhD,[†] Pascal Madeleine, PhD, DrScient,[¶] and César Fernández-de-las-Peñas, PT, MSc, PhD, DrScient[†,‡]

*Alumna de Doctorado, Escuela Internacional de Doctorado, Universidad Rey Juan Carlos, Alcorcón, Madrid, Spain; [†]Department of Physical Therapy, Occupational Therapy, Rehabilitation and Physical Medicine, Universidad Rey Juan Carlos, Alcorcón, Madrid, Spain; [‡]Cátedra de Investigación y Docencia en Fisioterapia: Terapia Manual y Punción Seca, Universidad Rey Juan Carlos, Alcorcón, Madrid, Spain; [§]Department of Psychology, Universidad Rey Juan Carlos, Alcorcón, Madrid, Spain; [¶]Physical Activity and Human Performance group, SMI, Department of Health Science and Technology, Aalborg University, Aalborg, Denmark

Correspondence to: César Fernández de las Peñas, Facultad de Ciencias de la Salud, Universidad Rey Juan Carlos, Avenida de Atenas s/n, 28922 Alcorcón, Madrid, Spain. Tel: +34 91 488 88 84; Fax: +34 91 488 89 57; E-mail: cesar.fernandez@urjc.es.

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Abstract

Objective. To investigate the presence of trigger points (TrPs) in feet musculature and topographical pressure sensitivity maps of the feet as well as the relationship between TrPs, pressure pain maps, and clinical variables in women with fibromyalgia (FMS).

Methods. Fifty-one FMS women and 24 comparable healthy women participated. TrPs within the flexor hallucis brevis, adductor hallucis, dorsal interossei, extensor digitorum brevis, and quadratus plantae, as well as external and internal gastrocnemius, were explored. Pressure pain thresholds (PPTs) were assessed in a blind manner over seven locations on each foot. Topographical pressure sensitivity maps of the plantar region were generated using the averaged PPT of each location.

Results. The prevalence rate of foot pain was 63% (n = 32). The number of active TrPs for each FMS woman with foot pain was 5 ± 1.5 without any latent TrPs. Women with FMS without foot pain and healthy controls had only latent TrPs (2.2 ± 0.8 and 1.5 ± 1.3, respectively). Active TrPs in the flexor hallucis brevis and adductor hallucis muscles were the most prevalent. Topographical pressure pain sensitivity maps revealed that FMS women with foot pain had lower PPT than FMS women without pain and healthy controls, and higher PPT on the calcaneus bone ($P < 0.001$).

Conclusions. The presence of foot pain in women with FMS is high. The referred pain elicited by active TrPs in the foot muscles reproduced the symptoms in these patients. FMS women suffering foot pain showed higher pressure hypersensitivity in the plantar region than those FMS women without pain.

Key Words. Fibromyalgia Syndrome; Trigger Points; Pressure Pain; Sensitization; Feet

Introduction

Fibromyalgia syndrome (FMS) is a disabling pain condition mainly featuring widespread pain, fatigue, and cognitive and physical problems, as well as sleep disturbances mainly affecting women [1]. The mean worldwide prevalence of FMS has been estimated to be 2.7% [2], with an overall prevalence of 4.7% in Europe [3] and 5% in United States of America [4].

Although the etiology of FMS is still debated, it is well accepted that patients exhibit hyper-excitability and hyper-responsiveness of the central nervous system. i.e., central sensitization [5,6]. The excitability of the central nervous system plays an important role in sensory symptoms and centrally mediated allodynia seen in FMS [7]. In addition to sensory symptoms, individuals with FMS also exhibit motor disturbances.

Pierrynowski et al. have demonstrated that women with FMS exhibit an altered gait pattern characterized by greater reliance on hip flexors rather than ankle plantar flexors during walking at normal speeds [8]. These authors suggested that this altered gait pattern might be a consequence of the pain from the plantar region of the foot experienced by the subjects. In addition, women with FMS exhibit lower velocity, cadence, and stride length during walking than healthy women [9,10]. It is possible that nociception from foot deep tissue contributes, at least partially, to some aspect of the altered gait pattern. MacPhee et al. have suggested that as no significant differences exist in oxygen consumption or energy expenditure between women with and without FMS during walking, fatigue perceived by individuals with FMS may be related to the increased muscle pain [11].

Nociception from muscle tissues, particularly myofascial trigger points (TrPs), are increasingly recognized as a relevant issue related to the development of FMS pain [12,13]. A TrP is defined as a hypersensible spot in a taut band of a skeletal muscle that is sensitive and painful after mechanical stimulation and elicits pain in a referred area [14]. Clinically, active TrPs are considered those for which referred pain reproduces any symptom experienced by the patient. Further, the elicited referred pain is recognized as a familiar or usual nociceptive symptom. On the contrary, latent TrPs are those for which referred pain does not reproduce any symptom experienced by the patient [14]. Clinical distinction between active and latent TrPs is substantiated by biochemical studies where higher levels of chemical mediators, i.e., bradykinin, substance P, or serotonin, have been found in active TrPs as compared with latent TrPs and non-TrPs points [15]. Some studies have reported that the referred pain elicited from active TrPs was able to fully reproduce the overall spontaneous clinical pain area in women with FMS [16,17]. However, no data is yet available related to the presence of deep pain in the feet in this population. Therefore, the aims of the current study were to investigate the presence of TrPs in foot musculature and topographical pressure pain sensitivity maps of the foot as well as the relationship between TrPs, pressure pain maps, and clinical variables in women with FMS.

Methods

Participants

Women diagnosed with FMS following American College of Rheumatology (1990/2010) criteria were recruited from the Department of Rheumatology of four regional urban hospitals in Spain [18,19]. A recent study suggested that a combination of 1990 and 2010 criteria is recommended, as this approach showed the best diagnostic features [20]. Participants were excluded if they presented any of the following criteria: 1) comorbid medical condition (e.g., morbid obesity, inflammatory diseases, irritable bowel syndrome, interstitial cystitis); 2) uncontrolled endocrine disorders (e.g., hyper- or hypothyroidism, diabetes); 3) malignancy; 4) psychiatric illness diagnosis (e.g., substance abuse or schizophrenia); 5) medication usage other than as-needed analgesics (excluding long-term narcotics); 6) previous history of surgery; or 7) previous history of whiplash injury. Patients were not excluded if taking antidepressant medications or analgesics under medical supervision.

Healthy controls recruited from the general population by local announcement were women without history of chronic pain, no pain experience during the previous 6 months, no pain-related diagnoses, and no use of antidepressant medications. The study protocol was approved by local Ethics Committee (URJC 08-30-2014) and conducted following the Helsinki Declaration. All participants signed an informed consent prior to their inclusion.

TrP Examination

TrPs were explored in five pairs of feet muscles, i.e., flexor hallucis brevis, adductor hallucis, dorsal interossei, extensor digitorum brevis, and quadratus plantae; and two pairs of leg muscles, external and internal gastrocnemius, by an assessor with more than 15 years' experience in TrPs diagnosis and who was blinded to the subjects' condition. The order of TrP evaluation was randomized between participants with a 2-minute rest period between muscles. These muscles were chosen because they are commonly affected in patients with plantar heel pain [21].

TrP diagnosis was conducted following the criteria described by Simons et al. [14] and by Gerwin et al. [22]: 1) presence of a painful spot within a palpable taut band of a skeletal muscle; and 2) presence of referred pain in response to compression (Figure 1). A TrP was considered active when the referred pain evoked during manual examination reproduced clinical pain symptoms of the patient, whereas a TrP was considered latent when the elicited referred pain by digital compression did not reproduce any symptoms familiar to the individual [14]. These criteria, when applied by a trained assessor, have shown a good interexaminer reliability (kappa) ranging from 0.64 to 0.88 [22].

TrP examination was done in a blinded fashion as follows. The examiner asked each participant: "When I pressed this muscle, did you feel any pain just locally, and in another area? Please mark on an anatomical chart whether the pain that you feel in the other area reproduced symptoms that you suffered from." Participants were asked to

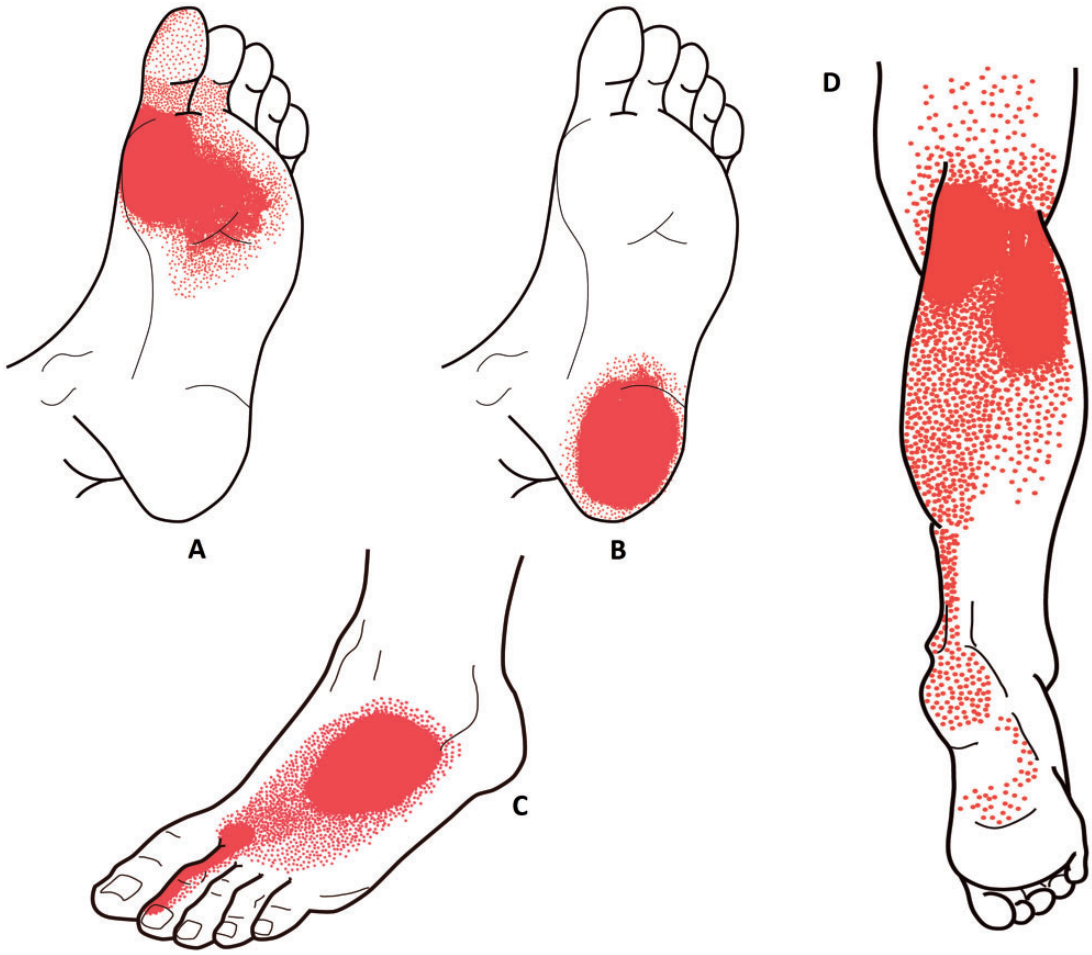

Figure 1 Referred pain from the examined muscles: (A) flexor hallucis brevis and adductor hallucis; (B) quadratus plantae; (C) dorsal interossei and extensor digitorum brevis; (D) external and internal gastrocnemius muscles.

draw the distribution of the elicited pain after palpation of each muscle. Therefore, they should have reported the presence or absence of referred pain to the examiner, but they reflected whether the elicited pain reproduced a usual symptom or not on a paper.

Topographical Pressure Pain Sensitivity Maps

Pressure pain threshold (PPT), defined as the minimal amount of pressure at which a sensation of pressure first changes to pain, was assessed with an electronic algometer (Somedic, Farsta, Sweden). The algometer was calibrated prior to data collection. The pressure was applied perpendicularly to each marked point on the skin at a rate of approximately 30 kPa/s. Participants were instructed to press the "stop button" of the algometer as soon as the pressure resulted in pain. The mean of three trials on each point was calculated and used for the analysis. A 30-second resting period was allowed between each trial. This resting period avoids temporal summation [23]. The reliability of pressure algometry has been found to be high in patients with myofascial pain [24].

Participants were asked to avoid any analgesic or muscle relaxant 24 hours prior to the examination. No change was made to their prophylactic drug treatment. Prior to recordings, they were familiarized with PPT assessment over the wrist extensors. PPT was measured bilaterally over seven locations (Figure 2) on each foot by an assessor blinded to the subjects' condition. Each location was marked with a pencil as follows: first, third and fifth metatarsal head bones (points 1–3); abductor digiti minimi muscle belly (point 4); flexor digitorum brevis muscle belly (point 5); abductor hallucis muscle belly (point 6); and calcaneus bone (point 7). These locations were selected because pain or discomfort is usually reported when wearing shoes. High intrarater reliability (ICC 0.74–0.97) has been reported for PPT measurements on these seven locations [25,26].

Topographical pressure sensitivity maps of the plantar region were generated using the averaged PPT of each foot location [26]. Data was performed using an inverse distance weighted interpolation to obtain a 3D graphical representation of pressure pain distribution [27]. The inverse

distance weighted interpolation consists of computing PPT to unknown locations by using mean scores from the set of known PPT values and locations [28].

Self-Reported Measures

An 11-point numerical point rate scale (NPRS; 0: no pain; 10: maximum pain) was used to determine current level of pain and the worst and lowest levels of foot pain experienced the preceding week [29].

The Fibromyalgia Impact Questionnaire (FIQ) is a disease-specific, widely used, reliable, and valid questionnaire for FMS [30]. This questionnaire consists of 10 subscales assessing physical function, number of days feeling bad, work missed, job ability, pain, fatigue, morning tiredness, stiffness, anxiety, and depression. The sum of all subscales creates a total score, where higher scores indicate negative impact. The valid and reliable Spanish version of the FIQ was used in this study [31].

Statistical Analysis

Data were analyzed with the SPSS statistical package (version 21.0). Results are expressed as mean, standard deviation (SD) or 95% confidence interval (95% CI). The Kolmogorov-Smirnov test was used to analyze the normal distribution of the variables ($P > 0.05$). Quantitative data without a normal distribution (pain history, levels of pain, and number of latent or active TrPs) were analyzed with nonparametric tests, and those data with a normal distribution (PPT) were analyzed with parametric tests. Differences in the number of TrPs (active or latent) among the groups were assessed with the nonparametric Kruskal Wallis test. The advanced chi square (χ^2) test was used to analyze the differences in the size of the distribution of TrPs (active or latent) for each muscle among the three groups. A multilevel (mixed effect) ANOVA was applied to detect differences in PPT with side (dominant/nondominant) and assessed points (from 1 to 7) as within-subject factors and with group (FMS with pain, FMS without pain or controls) as between-subjects variables. Post-hoc comparisons were applying using the Bonferroni test. Finally, the Spearman's rho (r_s) test was used to analyze the association between clinical variables relating to symptoms and disability, PPT, and the number of active TrPs. The statistical analysis was conducted at a 95% confidence level. $P < 0.05$ was considered statistically significant.

Results

Demographic and Clinical Data of the Patients

Thirty-two women with FMS reporting foot pain, 19 women with FMS without foot pain, and 24 comparable healthy women were finally included. Table 1 shows clinical and demographic data of the groups. No significant differences in demographic and clinical variables existed among groups, except for the FIQ ($F = 6.59$; $P = 0.013$): women with FMS suffering from foot pain exhibited higher disability than those without foot pain.

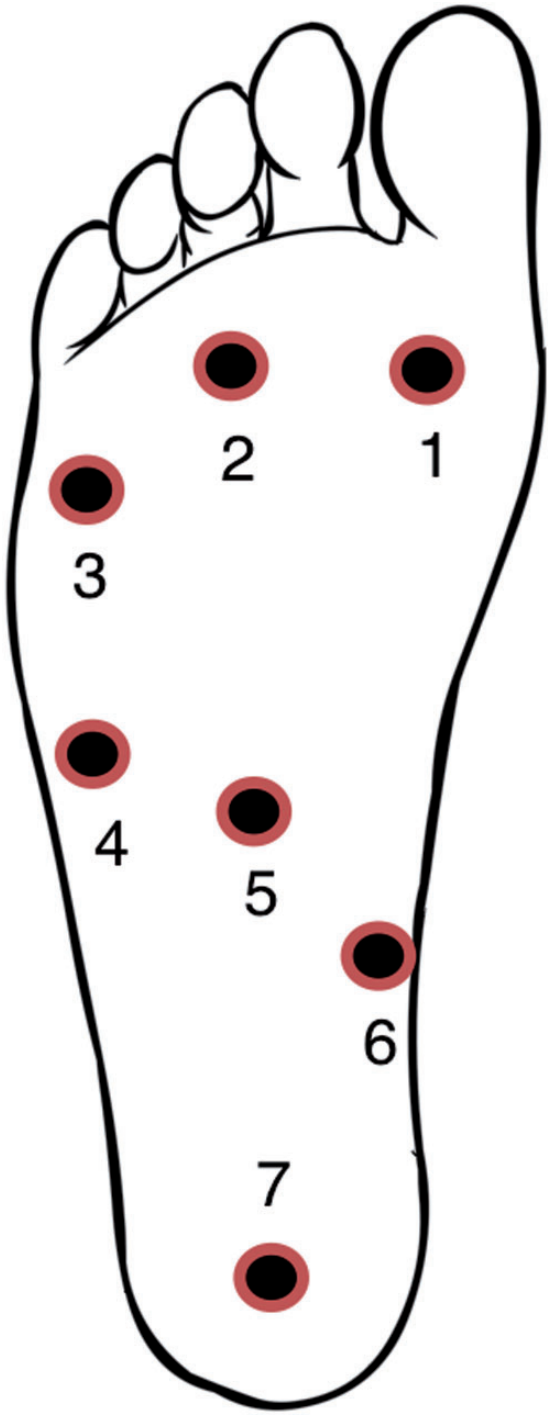

Figure 2 Locations of the assessed pressure pain thresholds on the right foot.

TrPs and Foot Pain in FMS

The mean number of active and latent TrPs for each FMS woman with foot pain were 5 ± 1.5 and 0 ± 0, respectively, on both sides. Women with FMS without foot pain exhibited a mean number of latent TrPs of

Table 1 Demographic and clinical variables of women with Fibromyalgia Syndrome (FMS) and healthy controls

	FMS with pain ($n = 32$)	FMS without pain ($n = 19$)	Healthy controls ($n = 24$)
Age (years)	50 ± 8	50 ± 9	48 ± 8
Height (cm)	160 ± 7	161 ± 6	162 ± 5
Body mass (kg)	69.6 ± 13.2	69.4 ± 12.5	65.6 ± 7.0
Years with FMS diagnosis	9.0 ± 6.5	8.9 ± 6.6	—
FIQ (0–100)*	64.6 ± 12.6	55.3 ± 12.4	—
Years with foot pain	5.9 ± 2.2	—	—
Mean intensity of foot pain (0–10)	5.4 ± 1.7	—	—
Worst intensity of foot pain (0–10)	7.9 ± 0.9	—	—
Least intensity of foot pain (0–10)	4.0 ± 1.3	—	—

FIQ: Fibromyalgia Impact Questionnaire.
*Statistically significant differences between patients with FMS ($P < 0.05$).

2.2 ± 0.8. Two FMS women without foot pain exhibited active TrPs in the gastrocnemius muscles (see Table 2). Similarly, almost all healthy women had latent TrPs (mean: 1.5 ± 1.3), but two of them exhibited active TrPs within the flexor hallucis brevis and adductor hallucis muscles. The number of TrPs between groups was significantly different for active and latent TrPs (both, $P < 0.001$): FMS women with foot pain exhibited a larger number of active TrPs, whereas FMS women without foot pain showed a larger number of latent TrPs than healthy women.

The distribution of TrPs was significantly different among groups for flexor hallucis brevis (right: $\chi^2 = 28.983$, $P < 0.001$; left: $\chi^2 = 19.450$, $P < 0.001$), adductor hallucis (right: $\chi^2 = 37.277$, $P < 0.001$; left: $\chi^2 = 14.324$, $P < 0.01$), dorsal interossei (right: $\chi^2 = 35.565$, $P < 0.001$; left: $\chi^2 = 11.960$, $P = 0.02$), extensor digitorum brevis (right: $\chi^2 = 17.73$, $P = 0.001$; left side: $\chi^2 = 17.854$, $P = 0.007$), quadratus plantae (right: $\chi^2 = 25.215$, $P < 0.001$; left: $\chi^2 = 31.521$, $P < 0.001$), and internal gastrocnemius (right side: $\chi^2 = 17.037$, $P = 0.002$; left: $\chi^2 = 23.812$, $P < 0.001$). No significant differences in TrPs distribution of external (right: $\chi^2 = 8.623$, $P = 0.786$; left: $\chi^2 = 2.880$, $P = 0.578$) gastrocnemius were observed. Active TrPs in the flexor hallucis brevis (n = 22, 68% right side; n = 12, 38% left side) and adductor hallucis (n = 18, 56% right side; n = 14, 44% left side) muscles were the most prevalent in FMS with foot pain. Table 2 summarizes the distribution of TrPs for all muscles in all groups.

Topographical Pressure Pain Sensitivity Maps and FMS

The mixed-model ANOVA detected significant differences in mean PPT among the groups ($F = 8.830$; $P < 0.001$) and between measurement points ($F = 15.724$; $P < 0.001$), but not for sides ($F = 1.306$; $P = 0.274$). No significant interactions between group × sides × points were found ($P > 0.324$). Post-hoc comparisons revealed: 1) lower PPT levels in both FMS groups as compared with healthy controls in all points ($P < 0.001$), 2) FMS women with foot pain exhibited lower PPT at all points than those FMS without foot pain ($P < 0.001$), and 3) higher PPT on the calcaneus bone (point 7) compared with the remaining foot locations (Figure 3). PPTs of each foot point for both sides in all groups are reported in Table 3. Figure 3 depicts pressure pain sensitivity maps of the foot for all the groups.

Associations Between TrP Activity, PPT, and Foot Pain

Within the group of FMS women with foot pain, no significant association between the number of active TrPs with PPT or clinical pain variables was observed (all $P > 0.1$). Interestingly, significant negative correlations between the worst level of foot pain and PPTs were found over point 1 (r_s: –0.454; $P = 0.009$), point 2 (r_s: –0.521; $P = 0.002$), point 3 (r_s: –0.450; $P = 0.010$), and point 7 (r_s: –0.418; $P = 0.017$): the higher the worst foot pain experienced in the last week, the lower the PPTs in these points.

Discussion

The current study found that the prevalence of foot pain in our sample of women with FMS was as high as 60%. In addition, the referred pain elicited by active TrPs in the foot muscles was able to reproduce the foot pain symptoms in these patients. Finally, women with FMS suffering foot pain showed higher pressure pain hyperalgesia in the plantar region than FMS women without pain. Current results provide further evidence in favor of the concept that active TrPs may be important in relation to the extent of pain reported by FMS patients.

TrPs, Foot Pain, and FMS

Our study is the first to investigate the role of TrPs in the foot musculature in women with FMS. We observed that

Table 2 Number (n) of women with Fibromyalgia Syndrome (FMS) and healthy controls with active and latent trigger points (TrPs)

			FMS with pain ($n = 32$)	FMS without pain ($n = 19$)	Healthy controls ($n = 24$)
Flexor hallucis brevis	Right side	Active TrPs	18	0	2
		Latent TrPs	0	0	2
		No TrPs	14	19	20
	Left side	Active TrPs	14	0	2
		Latent TrPs	0	2	2
		No TrPs	18	17	20
Adductor hallucis	Right side	Active TrPs	22	0	2
		Latent TrPs	0	4	4
		No TrPs	10	15	18
	Left side	Active TrPs	12	0	2
		Latent TrPs	0	4	4
		No TrPs	20	15	18
Dorsal interossei	Right side	Active TrPs	15	0	0
		Latent TrPs	0	7	3
		No TrPs	17	12	21
	Left side	Active TrPs	9	0	1
		Latent TrPs	0	4	2
		No TrPs	23	15	21
Extensor digitorum brevis	Right side	Active TrPs	6	0	0
		Latent TrPs	0	5	2
		No TrPs	26	14	22
	Left side	Active TrPs	7	0	0
		Latent TrPs	0	4	1
		No TrPs	25	15	23
Quadratus plantae	Right side	Active TrPs	14	0	0
		Latent TrPs	0	2	2
		No TrPs	18	17	22
	Left side	Active TrPs	18	0	1
		Latent TrPs	0	0	2
		No TrPs	14	19	21
Internal gastrocnemius	Right side	Active TrPs	7	2	0
		Latent TrPs	0	1	7
		No TrPs	25	16	17
	Left side	Active TrPs	13	1	0
		Latent TrPs	0	4	7
		No TrPs	19	14	17
External Gastrocnemius	Right side	Active TrPs	5	1	0
		Latent TrPs	0	0	3
		No TrPs	27	18	21
	Left side	Active TrPs	3	0	0
		Latent TrPs	0	1	1
		No TrPs	29	18	23

the referred pain pattern induced by active TrPs in the foot muscles was able to reproduce the symptoms experienced in this anatomical region in women with FMS. Interestingly, no active TrPs were observed in FMS women not suffering from foot pain. This is highly relevant, as the presence of active TrPs in the foot musculature is not related to FMS diagnosis without the presence of foot pain. In fact, the absence of active TrPs in women with FMS without foot pain would support the assumption that TrPs are not a consequence of central sensitization pain mechanisms associated with FMS, because no active TrPs were observed in absence of foot

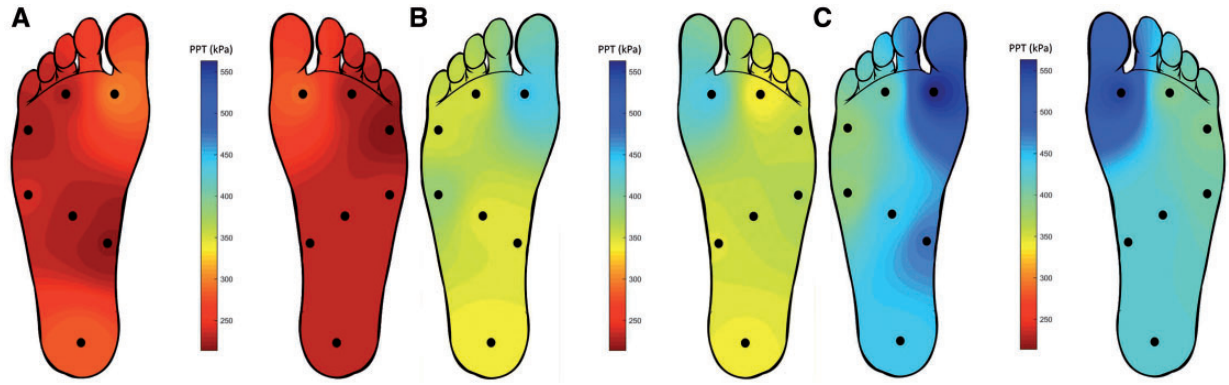

Figure 3 Topographical pressure pain sensitivity maps (kPa) from the plantar region in (A) FMS women with foot pain; (B) FMS women without foot pain; (C) healthy women.

Table 3 Pressure pain thresholds on each assessed point on the foot in women with Fibromyalgia Syndrome (FMS) with and without foot pain and healthy controls

	FMS with pain (n = 32)		FMS without pain (n = 19)		Healthy controls (n = 24)	
Dominant side	Point 1	222.3 (203.1–241.4)	Point 1	341.3 (317.1–365.6)	Point 1	441.0 (386.9–495.1)
Nondominant side		234.5 (214.9–254.1)		344.7 (322.9–366.6)		422.0 (362.8–481.5)
dominant side	Point 2	218.5 (196.4–240.5)	Point 2	350.9 (326.6–375.3)	Point 2	473.6 (413.2–533.9)
Nondominant side		233.9 (212.3–255.5)		350.0 (324.4–375.8)		424.7 (374.3–475.1)
dominant side	Point 3	227.6 (206.9–248.3)	Point 3	348.7 (315.3–382.2)	Point 3	441.6 (388.2–495.1)
Nondominant side		231.4 (210.6–252.1)		359.9 (326.8–393.1)		424.9 (375.2–474.6)
dominant side	Point 4	237.6 (212.8–262.4)	Point 4	383.4 (349.1–417.8)	Point 4	485.4 (427.2–543.4)
Nondominant side		233.1 (212.8–253.3)		367.8 (333.4–402.3)		484.9 (429.3–540.7)
dominant side	Point 5	224.8 (202.2–247.5)	Point 5	352.6 (316.9–388.3)	Point 5	483.9 (429.4–538.5)
Nondominant side		214.5 (192.7–236.3)		358.2 (320.8–395.5)		497.0 (449.4–544.6)
dominant side	Point 6	229.4 (206.8–252.1)	Point 6	349.9 (314.1–385.8)	Point 6	407.9(358.8–457.1)
Nondominant side		226.4 (204.4–248.3)		332.9 (299.7–366.1)		395.6 (342.9–448.3)
dominant side	Point 7	298.1 (279.3–316.9)	Point 7	441.4 (415.3–467.7)	Point 7	563.9 (503.1–624.7)
Nondominant side		286.9 (267.7–306.2)		435.5 (413.6–457.4)		547.5 (485.6–609.4)

Pressure pain thresholds (kPa) are expressed as means (95% confidence interval).

pain. This hypothesis would be slightly supported by the fact that two healthy women had active TrPs, both of these associated with previous experiences of pain.

Therefore, our results further support previous assumptions that regional pain in FMS can be related to active TrPs [16,17]. This can be related to the fact that overall spontaneous FMS pain is not widespread diffuse pain but is located in certain body areas [32]. Current and previous findings would support the hypothesis that interventions aimed at reducing FMS pain should focus on TrPs [33–35]. Some studies have demonstrated that reducing afferent inputs from muscles by TrP injection was effective in reducing hyperalgesia and allodynia in FMS [12,36]. Furthermore, proper treatment of foot pain could be clinically relevant for patients with FMS, as this group reported higher levels of disability, including altered gait pattern [9,10].

We observed that the flexor hallucis brevis and adductor hallucis were the muscles with the highest number of active TrPs in FMS women with foot pain. These muscles were palpated and located in the anterior (adductor hallucis, horizontal portion) and medial (flexor hallucis brevis) arcs of the plantar foot area. It is possible that pain perceived in the anterior arc of the foot due to active TrPs in the hallucis muscles may be related to the altered gait pattern observed in women with FMS, as the anterior and medial arcs are highly important for walking mechanics, but particularly during the unilateral landing phase and direction changes [37,38].

Pressure Pain Foot Maps and FMS

To the best of our knowledge, the pressure sensitivity maps of the plantar area in women with FMS are

reported for the first time. We observed generalized lower PPTs in both FMS groups compared with healthy women, but FMS women with foot pain exhibited a larger extent of pressure pain hyperalgesia than those without foot pain. Our results support the presence of generalized pressure pain hypersensitivity in women with FMS, and revealed that the presence of pain symptoms increases this sensitization process. These findings support the dynamic role of peripheral input in sensitization in FMS [39].

We did not find any linear association between the number of active TrPs in the foot muscles and the PPT values, suggesting that other factors can be more related to foot pain hypersensitivity. For instance, repetitive minor traumas due to inappropriate walking patterns or the use of inappropriate shoes could also be involved. In fact, it has been found that the addition of custom-made foot orthotics to usual care appears to improve functioning in the short term in women with FMS [40].

We also found topographical differences in pressure pain sensitivity in the foot in line with previous studies. In our study, the calcaneus bone had significantly higher PPTs compared with the remaining points in all groups. Our results agree with previous data [25,26]. The forefoot and the central part of the foot are the most loaded regions during walking and direction changes compared with the heel [38]. The lower loading pattern for the heel region would explain the higher PPT level for calcaneus bone. Further, several studies investigating topographical pressure sensitivity maps have observed that nonmuscular locations are generally less sensitive to pressure than muscle locations [26,41,42]. The spatial differences in mechanical sensitivity can be explained by tissue thickness, by various densities of group III and IV nociceptive afferents among muscles, or, in the case of the foot area, by repetitive low-load traumas during locomotion. Independently of the cause of the topographical differences in pressure pain sensitivity, it is interesting to note that no differences were observed among groups, suggesting that sensitization mechanisms accounting in FMS do not alter the spatial distribution of foot sensitivity.

Finally, we found that the worst pain experienced in the foot was associated with higher pressure pain sensitivity in points 1 to 3, those located in the anterior arc of the foot. This would support the hypothesis that foot pain intensity should be considered in women with FMS for controlling pressure pain sensitivity.

Clinical Implications

The results from the current study have several potential clinical implications in relation to walking patterns in FMS women. For instance, walking is recommended as an effective form of exercise/activity for subjects with chronic musculoskeletal pain [43]. In addition, some studies support the use of distance walked in 6 minutes (6MWT) as an element of clinical relevance when planning the assessment, treatment, and monitoring of patients with FMS [44,45]. Therefore, the presence of foot pain, pressure hyperalgesia, and active TrPs as identified in our study may limit walking outcomes by limiting daily life activities in these patients. Proper management of foot pain in women with FMS can lead to improvements in walking patterns. For this purpose, proper foot orthotics can result in increased comfort, lower pain intensity, and increased PPT [26,46]

Limitations

There are some limitations of the current study that should be considered. First, this is a cross-sectional study; so we cannot determine any cause and effect relationship. Second, the purpose of the current study was to determine the presence of TrPs in the foot muscles. When stimulation of one active TrP in a muscle reproduced the patient's pain, no further TrP examination was allowed in that muscle. Third, we only included women with FMS, so we do not currently know if our results would be also similar in a cohort of men. However, gender differences are reported in terms of pain sensitivity that would have resulted in heterogeneous groups. Finally, we included a sample of women with FMS with one ACR diagnosis (1990, 2010). It would be interesting to investigate differences in patients fulfilling either diagnostic criteria or both [47].

Conclusion

This study observed that the referred pain elicited by active TrPs in the foot muscles reproduced the symptoms in women with FMS reporting foot pain (60% of the sample). FMS women with foot pain showed higher pressure pain hyperalgesia in the plantar region than those FMS women without pain. Current results provide further evidence in favor of the concept that active TrPs may be linked to FMS pain.

Key Points

1. This study found that the referred pain elicited by active trigger points (TrPs) in the foot muscles reproduced the foot pain symptoms in women with fibromyalgia syndrome
2. Women with fibromyalgia suffering from foot pain showed higher pressure pain hyperalgesia in the plantar region than those women with fibromyalgia without pain.
3. Topographical pressure pain sensitivity maps of the foot revealed spatial differences in pressure pain sensitivity.

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