

MUSCULOSEKELTAL SECTION

Original Research Article

International Consensus on Diagnostic Criteria and Clinical Considerations of Myofascial Trigger Points: A Delphi Study

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Abstract

Objective. There is no consensus on the essential diagnostic criteria for diagnosing a trigger point (TrP). In fact, a variety of diagnostic criteria are currently being used. Our aim was to conduct a Delphi panel to achieve an international consensus on the cluster of criteria needed for the TrP diagnosis to reach a consensus on the definition of active and latent TrPs and to clarify different clinical considerations about TrPs.

Methods. Following international guidelines, an international three-round Delphi survey was

conducted. Questions were created based on a systematic literature search of the diagnostic criteria for TrPs.

Results. Sixty experts from 12 countries completed all rounds of the survey. A cluster of three diagnostic criteria was proposed as essential for the TrP diagnosis: a taut band, a hypersensitive spot, and referred pain. Eighty percent of the experts agreed that the referred pain elicited by a TrP can include different sensory sensations and not just pain, that is, pain spreading to a distant area, deep pain, dull ache, tingling, or burning pain. Eighty-four percent of the international experts consistently answered that the main clinical differences between active and latent TrPs are the reproduction of any of the symptoms experienced by a patient and the recognition of pain. No specific location of the pain referral area and TrP location should be expected.

Conclusions. This Delphi panel has produced an expert-based standardized definition of a TrP with a discussion of the clinical components, including the definition of referred pain and the difference between active and latent TrPs, thereby providing a foundation for future research in MPS.

Key Words. Myofascial Pain; Trigger Point; Delphi; Consensus; Diagnosis; Referred Pain

Introduction

Myofascial pain syndrome (MPS) is a common pain condition characterized by the presence of myofascial trigger points (TrPs). The most accepted definition describes a muscle TrP as “a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. The spot is painful on manual compression and can give rise to characteristic referred pain, referred tenderness, motor dysfunction, and autonomic phenomena” [1]. Although palpation represents the key process for identifying a TrP during a diagnostic process [2], there is no consensus among

clinicians and researchers on the diagnostic or classification criteria. The most frequently cited source for the diagnosis of TrPs is the Simons et al. textbook *Myofascial Pain and Dysfunction: The Trigger Point Manual*, which includes different recommendations for each criteria including minimum acceptable or recommended criteria [1], which may have contributed to the current lack of consensus. There is indeed a remarkable variability in the diagnostic criteria used in published research. In 2007, Tough et al. [3] identified 19 different diagnostic criteria in studies investigating MPS. A recent meta-analysis on spinal disorders also noted discrepancies in the diagnostic criteria for MPS [4]. It appears that the TrP diagnostic criteria have varied over time, and few of these criteria are now considered diagnostically relevant [3].

Two previous systematic reviews investigating the reliability of different diagnostic criteria for TrPs concluded that the reliability varied widely, depending not only on the diagnostic criteria or on the muscle evaluated, but also across various studies [5,6]. More recent studies have highlighted the role of experience of the assessor for achieving good reliability for the TrP diagnosis, for example, in the upper trapezius [7,8]. Of importance is that previous reviews did not include any study specifically reporting the reliability of the TrP identification by using a combination of diagnostic criteria and the reliability of each criterion in isolation [5,6]. This is highly relevant as, clinically, the diagnosis of TrPs is not based on just one criterion, but rather on a cluster of criteria.

Another important topic is the definition of active and latent TrP. Simons et al. defined an active TrP as

a myofascial trigger point that causes a clinical pain complaint. It is always tender, prevents full lengthening of the muscle, weakens the muscle, refers a patient-recognized pain on direct compression, mediates a local twitch response of muscle fibers when adequately stimulated, and, when compressed within the patient's pain tolerance, produces referred motor phenomena and often autonomic phenomena, generally in its pain reference zone, and causes tenderness in the pain reference zone. [1]

A latent myofascial TrPs was defined as

a myofascial TrP that is clinically quiescent with respect to spontaneous pain; it is painful only when palpated. A latent TrP may have all the other clinical characteristics of an active TrP and always has a taut band that increases muscle tension and restricts range of motion. [1]

During the last decades, these definitions have been adopted worldwide, not only clinically but also in expert opinions [3].

A proper diagnosis of MPS is getting much attention in the literature. For example, Analgesic, Anesthetic, and Addiction Clinical Trial Translations Innovations Opportunities and Networks (ACTTION) proposed the need for developing an evidence-based chronic pain classification system, the ACTTION-APS Pain Taxonomy, which included MPS. ACTTION is a public-private partnership between the US Food and Drug Administration and the American Pain Society (APS) [9]. This proposal aims to properly define a set of diagnostic criteria that can be consistently and systematically implemented for different pain conditions, including fibromyalgia, complex regional pain syndrome, and MPS, among others. In the absence of a diagnostic "gold standard," the most appropriate method to define a reliable and useful case definition for use in research and clinical care is a stepwise process consisting of a survey, expert consensus, and further external validation. Therefore, an international consensus on the diagnostic criteria of TrPs and their clinical classification represents the first step of this process, and it may result in an improved transparency for the diagnosis of MPS.

This Delphi survey was conducted to achieve an international consensus on the cluster of diagnostic criteria needed for the diagnosis of TrPs, to reach a consensus on active and latent TrP definition, and to clarify different clinical considerations about MPS.

Methods

Study Design

A Delphi survey, designed and conducted following international guidelines [10], was used to develop a consensus on the definition of TrPs and to propose the diagnostic criteria needed for the diagnosis of TrPs. A Delphi process attempts to achieve a convergence or consensual response of opinion among experts on a specific topic over a series of rounds [11].

Delphi Experts

Little consensus exists of the definition of an expert, the criteria needed to be selected as an expert, or the number of experts required to participate in a Delphi survey [12,13]. Therefore, to get the highest representation, we selected experts based on established knowledge and familiarity with MPS and TrPs and their ability to influence policy related to MPS. Physical therapists and physicians who regularly teach TrP courses were considered potential experts with substantial knowledge of the topic. Further, we also considered authors of peer-reviewed articles to be experts within the profession, although no particular number of peer-reviewed articles has been determined to be considered an expert [14]. To minimize bias in the selection of experts and to increase the external validity of the survey, we invited a heterogeneous sample consisting of clinicians from multiple countries who practiced varying treatment rationales for the diagnosis and management of myofascial

TrPs. Participants were identified through extensive internet searches of TrP interest groups within physiotherapy, osteopathy, and medical associations. Nominated experts and therapists linked to myofascial TrP courses and special interest groups were invited by email to participate in this study. Participants remained anonymous during all rounds of the Delphi survey, and they were not contacted during the study other than to share the study phases.

Survey

The survey was constructed by four physical therapists, each with more than 15 years of clinical and research experience in the diagnosis and management of TrPs, and included three rounds. The survey was guided by a systematic evaluation of the current literature on physical examination, including all potential signs and symptoms related to myofascial TrP diagnosis. The PubMed, CINAHL, and EMBASE databases were searched for peer-reviewed articles published prior to September 1, 2016, using the following search strategy: (myofascial trigger points OR myofascial pain syndrome) AND (diagnosis OR manual palpation OR diagnostic criteria) AND (reliability) AND adult Filters: Humans.

Demographic information of participants included their gender, age, specialty, country of practice, years of clinical experience, and years of specific experience in the diagnosis and management of TrPs. The survey discussed the following topics: 1) basic diagnostic criteria for TrPs; 2) diagnostic criteria for active and latent TrPs; 3) physical location of TrPs; and 4) definition and location of referred pain areas.

In the first Delphi round, a list of four palpatory findings (i.e., taut band, hypersensitive spot, local twitch response, jump sign) and four signs/symptoms (i.e., referred pain, pain with muscle contraction, pain with muscle stretching, restricted range of motion) were proposed for determining the TrP diagnosis. Participants were asked to select whether each item should be considered an “essential” or “confirmatory” criterion for the diagnosis of a TrP. For the diagnosis of active or latent TrPs, participants could select just three answers from the following signs and symptoms: taut band, hypersensitive spot, local twitch response, referred pain, jump sign, reproduction of the patient’s symptoms, restricted range of motion, pain recognition, pain with contraction, pain with stretching, and muscle weakness.

In relation to active TrPs, the main closed question posed to the experts was “Do you believe that people with chronic, subacute, or acute pain who are asymptomatic at the moment of clinical examination may have active TrPs?” Further, participants were asked if they believe that there is a particular location of TrPs or, in other words, if they usually consider the “X” of the *Trigger Point Manual* a pre-established location for TrPs. To clarify, Simons et al. [1] marked common TrP locations with an “X” superimposed on muscles. For the

definition of pain referral, participants were asked to select any symptom they considered referred pain from the following options: dull pain, burning pain, deep pain, pain spreading to a distant area, pressing pain, numbness, tingling, and pins and needles. Finally, participants were asked if they usually expect to elicit a typical referred pain pattern of a particular muscle following the patterns described by Simons et al. [1].

For the second round, responses used by more than 70% of participants were considered for further refinement. All topics (signs and symptoms for TrP diagnosis, diagnostic criteria proposed for active or latent, and referred pain) were again covered in this second round. In this second round, the following open question was included. Participants were asked to include a brief sentence summarizing the difference on clinical examination between active and latent TrPs.

A third, and final, consensual round was conducted in the same manner as the second round for those responses used by less than 70% in the second round. In this round, the only topic for discussion was the presence of pain referral as an essential criterion for active or latent TrPs.

Results

Sixty-five international experts from 12 countries were identified and contacted via email. Sixty (75% male, mean age = 45 ± 9 years) participated in the survey and completed the three rounds of the survey. The participants were from Australia (N=1), Bahrain (N=1), Belgium (N=3), Ireland (N=2), Israel (N=1), Italy (N=7), the Netherlands (N=4), Spain (N=1), Switzerland (N=11), the United Arab Emirates (N=1), the United Kingdom (N=1), and the United States of America (N=27). The vast majority of the respondents were physical therapists (N=53, 88%). The remaining specialties included medical doctors (N=4, 7%) and physician osteopaths (N=3, 5%). The range of years of clinical practice varied from 18 to 23 (mean = 20.1 years), from which 15.4 years (95% CI = 13–18 years) included specific experience in the diagnosis and treatment of TrPs.

Delphi Round 1

Basic Diagnostic Criteria

Of all the palpatory findings and signs/symptoms included in the first list, only two palpatory findings and one symptom were endorsed as essential criteria for TrP diagnosis by more than 70% of the experts: a taut band (N=56, 93%), a hypersensitive spot (N=46, 76.5%), and referred pain (N=43, 71.5%). Thirty-six (60%) experts emphasized the importance of the combination of these three items for diagnosis of myofascial TrPs. Table 1 shows the percentage of agreement for all palpatory findings and sign/symptoms proposed.

Table 1 Diagnostic criteria for myofascial trigger points

	Essential No. (%)	Confirmatory No. (%)
Taut band*	56 (93)	4 (7)
Hypersensitive spot*	46 (76.5)	14 (23.5)
Referred pain*	43 (71.5)	17 (28.5)
Local twitch response	19 (31.5)	41 (68.5)
Jump sign	4 (6.5)	56 (93.5)
Restricted range of motion	4 (6.5)	56 (93.5)
Pain with muscle stretching	3 (5)	57 (95)
Pain with muscle contraction	2 (3.5)	58 (96.5)

* More than 70% of respondents judged these criteria to be “essential” for trigger point diagnosis.

Active vs Latent TrPs

Fifty-three (88.5%) experts considered that differences exist between active and latent TrPs. Participants answered that the presence of a taut band and a hypersensitive spot should be present in both latent and active TrPs, but the most important difference was that active TrPs should reproduce the patient’s symptom (N=46, 76.7%). Table 2 summarizes the three criteria considered for the diagnosis of latent or active TrPs. Finally, forty-two (70%) experts considered that patients with chronic/subacute/acute pain who are asymptomatic at the moment of the examination might exhibit active TrPs.

Referred Pain

Of all the symptoms included in the list for describing pain referral, only pain spreading to a distant area (N=58), deep pain (N=56), and dull ache (N=42) were selected by at least 70% of the experts. Other sensory symptoms such as tingling or burning were also considered referred pain, but only by around 60% of the experts. Table 3 shows the percentage of agreement for all sensory symptoms proposed for describing the referred pain elicited by TrPs.

Location of TrPs and Referred Pain

Forty-two (70%) experts did not expect a particular referred pain pattern for a muscle, although most agreed that the patterns described by Simons et al. [1] represent the most common pattern seen in clinical practice. Of importance is that 52 (86.5%) experts did not consider a particular location of TrPs; that is, they do not consider the “X” location of the *Trigger Point Manual* [1] to be a specific location for a TrP.

Table 2 Proposed diagnostic criteria for active or latent trigger points

Active TrPs	
Reproduction of the patient’s symptoms*	46 (76.5)
Taut band*	38 (63.3)
Hypersensitive spot	30 (50.0)
Referred pain	23 (38.3)
Local twitch response	13 (21.7)
Latent TrPs	
Taut band*	55 (91.7)
Hypersensitive spot*	48 (80.0)
Referred pain	20 (33.3)
Local twitch response	19 (31.7)

TrP = trigger point.

* More than 60% of respondents judged these criteria to be “essential” for each kind of TrP.

Table 3 Agreement on sensations elicited by trigger points as pain referral

Pain spreading to a distant area	58 (96.7)
Deep pain	56 (93.3)
Dull pain	42 (70.0)
Tingling sensation	35 (58.3)
Burning pain	33 (55.0)
Pins and needles	25 (41.7)
Pressing pain	23 (38.3)
Numbness sensation	23 (38.3)

Delphi Round 2

In this round, 40 experts (66.5%) considered that the minimum criteria for the diagnosis of a TrP should include the clustering of a taut band, a hypersensitive spot, and referred pain. In fact, 47 (78.5%) experts agreed that the referred pain elicited by a myofascial TrP could include different sensations, and not just pain. Forty-two (70%) experts confirmed that they do not expect a predefined referred pain pattern for a specific muscle, and 50 (83.5%) experts expressed that they do not consider TrPs to have a particular location.

In reply to the open question, 50 (83.5%) experts expressed that the main difference between active and latent TrPs is the reproduction of any of the symptoms experienced by the patient. The presence of referred pain for diagnosis of latent myofascial TrPs was, however, controversial, as only 18 (30%) of the experts considered this criterion essential for latent TrPs. Finally, in this second round, 51 (85%) participants considered that patients with acute or chronic pain who are asymptomatic at the time of the physical examination may

have active TrPs, which was illustrated with the clinical example of “patients with a history of migraines attending a clinic can have active TrPs even if they do not have a migraine episode at the moment of the visit.”

Delphi Round 3

In this final round, the only topic for discussion was the presence of referred pain as a criterion for TrP diagnosis. Thirty-three (55%) experts considered that pain referral should be present for TrP. Nevertheless, 27 (45%) experts replied that some TrPs, particularly latent TrPs, may not feature referred pain during the examination.

Discussion

The current Delphi study, which included 60 international experts on MPS, represents the first consensus about the diagnostic criteria for myofascial TrPs and some clinical aspects of MPS. This Delphi panel has produced an expert-based standardized definition of TrP and discussion of clinical components, including the definition of pain referral and active or latent TrPs, thereby providing a foundation for future research in TrPs.

Diagnostic Criteria

The consensus of the experts included in the current Delphi consisted of a cluster of three diagnostic criteria for identification of a TrP, namely a taut band, a hypersensitive spot, and referred pain. Based on the responses during all Delphi rounds, it seems that at least two of the three criteria should be present for a diagnosis of a TrP. The topic of referred pain was somewhat controversial when a clinical distinction between active and latent TrPs was included in the debate. Originally, Simons et al. [1] proposed several diagnostic criteria for the diagnosis of a TrP, which may explain the rather heterogeneous combination of TrP diagnostic criteria used in published studies [3]. In their systematic review, Tough et al. [3] reported that the most commonly applied criteria included a sensitive spot within a taut band of a skeletal muscle, the patient’s pain recognition, a predicted pain referral pattern, and a local twitch response. This list of criteria included the cluster criteria agreed upon in our Delphi study by the experts, with the exception of a local twitch response. A recent survey found that members of the International Association for the Study of Pain and the American Academy of Pain Medicine considered that the essential diagnostic components of MPS included hypersensitive spots causing local pain (72%) that recreate symptoms when palpated (58%) [15]. It is important to note that a taut band and a hypersensitive spot are the most reliable of the TrP palpatory findings to identify, showing a moderate ($\kappa = 0.50$) to almost perfect ($\kappa = 0.99$) inter-rater reliability [16]. Similarly, referred pain has also shown moderate ($\kappa = 0.57$) to excellent ($\kappa = 0.84$) reliability [16]. As the local twitch response exhibits poor reliability, it can be considered a confirmatory but not essential

criterion for TrP diagnosis [16]. In fact, localized tenderness and pain recognition have been observed to be the most reliable criteria ($\kappa = 0.676$ and $\kappa = 0.575$, respectively) in a recent systematic review and meta-analysis [17]. Nevertheless, the reliability of each diagnostic criterion depends on several factors, particularly the experience of the clinician, but also the muscle investigated as deeper muscles, such as the quadratus lumborum, have systematically exhibited poorer intra- and inter-rater reliability than superficial muscles, such as the infraspinatus or upper trapezius [5,6]. In fact, Myburgh et al. [6] found that the reliability of each diagnostic criterion was associated with the analyzed muscle, for example, tenderness of the upper trapezius ($\kappa = 0.15$ – 0.62) or pain referral of the gluteus medius ($\kappa = 0.29$ – 0.48) and quadratus lumborum ($\kappa = 0.36$ – 0.50). As the diagnosis of TrPs is not based on only one criterion, the reliability of the diagnosis should take into account the cluster of criteria presented in this Delphi panel, namely a taut band, a hypersensitive spot, and referred pain.

The conceptual association between MPS and TrPs has been questioned [15]. We do not currently know if MPS is due only to TrPs, or if MPS is an independent pain condition. The current Delphi study has focused on the criteria for determining the presence of TrPs; therefore, these diagnostic criteria should not be considered for the diagnosis of MPS as this syndrome could also involve other symptoms.

Pain Referral

Simons et al. [1] originally defined referred pain as “pain that arises in a TrP, but is felt at a distance, often entirely remote from its source. The pattern of referred pain is reproducibly related to its site of origin.” The *Trigger Point Manual* also defined the referred phenomena as “sensory and motor phenomena such as pain, tenderness, increased motor unit activity (spasm), vasoconstriction, vasodilatation, and hyper-secretion caused by a TrP, which usually occur at a distance from the TrP” [1]. In the current Delphi panel, several sensations were proposed to be representative of the referral of pain by more than 50% of the experts. The most common sensations included pain spreading to a distant area, deep pain, dull ache, tingling, and burning pain. Forty-seven (78.5%) experts agreed that referred pain elicited by a TrP could include different sensory sensations and not just pain. There is scientific evidence supporting that TrPs elicit pain referral that mimicks a great variety of sensory symptoms, that is, dull/burning pain in tension-type headache [18], throbbing pain reproducing migraine attacks [19], symptoms compatible to peripheral neuropathies such as carpal tunnel syndrome [20], or sensory symptoms associated with postmastectomy pain [21]. Most experts also replied that they do not expect a predefined pattern of referred pain for a specific muscle as described by Simons et al. [1]. According to the current results, it is possible that “referred sensation” would represent a better term than “referred

pain” for characterizing the sensory phenomenon elicited by manual stimulation of a TrP.

An important topic to discuss is the presence of referred pain or referred sensation as a diagnostic criterion for the presence of TrPs as only half of the experts considered its presence as essential for TrP diagnosis, which implies that the other half did not agree with this position. It is known that referred muscle pain occurs at the dorsal horn level and it may be the result of activation of otherwise quiescent axonal connections between nerve fiber dorsal horn neurons activated by sensitization mechanisms [22]. This is supported by a study observing that spinal cord connections of TrPs are more effective in inducing neuroplastic changes at the dorsal horn neurons than non-TrPs [23]. Therefore, the question arises of whether the referred pain sensation is a determinant diagnostic criterion for TrPs. The discussion takes particular relevance when distinguishing between active and latent TrPs and the possibility of eliciting referred pain during manual examination of deep muscles. An older study found that referred pain may be elicited by palpation or dry needling in around 55% of TrPs [24]. This can explain why the reliability of referred pain as a diagnostic criterion for TrP ranges from fair to excellent depending on the muscle investigated [5,6].

Active and Latent Trigger Points

The clinical distinction between active and latent TrPs is accepted worldwide in the literature, and it is further supported by histochemical findings [25] and imaging studies [26]. Simons et al. [1] determined that the main difference between active and latent TrPs is that active TrPs are related to spontaneous and continuous pain over time, whereas latent TrPs are painful only when stimulated. Most of the experts (84%) included in the current Delphi panel consistently answered that the main clinical difference between active and latent TrPs is the reproduction of any of the symptoms experienced by a patient and, hence, pain recognition by the patient. This is highly important as the presence of spontaneous pain at the moment of the clinical examination is not always necessary as several pain conditions exhibit fluctuating symptoms, meaning that patients may be “pain free” at the moment of the visit. For example, patients with a history of migraine can exhibit active TrPs when they present to a clinic without having a migraine episode at the moment of the visit [19,27]. Pain recognition is the criterion with the highest reliability, ranging from moderate ($\kappa = 0.6$) in deep muscles such as the quadratus lumborum muscle to excellent ($\kappa = 0.9$) in superficial muscles such as the infraspinatus muscle [5,6]; however, pain recognition is only present in active TrPs. Therefore, pain recognition cannot be considered for the presence of latent TrPs.

According to the current results, active TrPs should be defined as “TrPs that upon stimulation reproduce any symptom experienced by the patient, either partially or completely, whereby the symptom is recognized as a

familiar experience by the patient, even though it may not be present at the moment of the examination,” whereas latent TrPs can be defined as “TrPs that upon stimulation do not reproduce any symptom experienced by a subject (symptomatic or asymptomatic) and the subject does not recognize the elicited symptom as familiar.”

Finally, the presence of referred pain for diagnosis of latent TrPs was under debate as only 30% of the experts considered this criterion essential for the diagnosis of latent TrPs. Previous experimental studies have used the combination of a taut band and a hypersensitive spot and the presence of spontaneous electrical activity for the diagnosis of latent TrPs in asymptomatic individuals; however, referred pain was elicited in 75% of the subjects with nociceptive stimulation of the latent TrP [28–30]. Epidemiological studies also showed discrepancies in the inclusion of referred pain as a diagnostic criterion for latent TrPs. Some studies used referred pain as an inclusion criterion for latent TrPs [31–33], while others did not [34,35]. A few studies included it as a possible diagnostic criterion [36,37]. It is interesting to note that studies of TrPs in symptomatic populations have included pain referral as a diagnostic criterion for latent TrPs [31–33], whereas those not including referred pain as a diagnostic criterion were conducted on asymptomatic subjects [34–37].

Limitations and Future Research Directions

In the absence of a diagnostic gold standard, as is the case with the diagnosis of TrPs, the basis for case definition can be made by exploring how clinicians categorize patients. Such information can be used to ascertain whether a consensus on definition or diagnosis exists [38]. The current Delphi panel identified an agreement in a cluster of diagnostic criteria and the definition of a TrP and, therefore, the reliability and validity of these criteria should be tested in future studies. For instance, now that some innovative technologies are able to quantify specific features of TrPs, potentially leading to establishing a diagnostic criterion standard test [39], the validity of the cluster criteria should be encouraged. It is possible that the cluster of diagnostic criteria proposed by this Delphi study will help to develop a gold standard set of criteria that utilizes objective clinical markers, such as quantitative sensory testing, to diagnose patients. In fact, recent studies have reported moderate to excellent reliability for the presence or absence of TrP based on the combination of a taut band, sensitive spot, local twitch response, and referred pain [40,41]. As the cluster of diagnostic criteria proposed in the current Delphi panel are those criteria exhibiting higher reliability when considered in isolation, it would be expected to obtain good reliability when combined. Future studies should investigate this hypothesis, particularly in deep muscles, where referred pain may be more difficult to elicit with manual palpation. Further, as the pressure needed to elicit referred pain, to obtain a local twitch response, to reproduce symptoms, and,

sometimes, to identify a taut band varies with the muscle being examined and with the specific characteristics of subjects, future research should investigate the amount and duration of pressure during the examination process of TrPs. Further, the presence of referred pain as an essential diagnostic criterion for TrP, either active or latent, should be investigated to determine if potential neurophysiological and electromyographic differences exist depending on the presence or absence of pain referral.

Finally, we should recognize some potential limitations in this Delphi study. First, most of the experts identified were physical therapists, which may limit the representation of other medical professions internationally. Second, we did not identify potential experts from some regions of the world, for example, South America, which again could limit our results. Nevertheless, as previously discussed, expert selection was based on several topics commonly used in Delphi processes. We believe that inclusion of experts from other medical professions would not alter the direction of our findings.

Conclusions

This international Delphi panel proposed that at least two of the following criteria must be present for TrP diagnosis: a taut band, a hypersensitive spot, and referred pain. It seems that pain referral from a myofascial TrP may include different sensory sensations, that is, pain spreading to a distant area, deep pain, dull ache, tingling, or burning pain. Therefore, the term “referred sensation” has been proposed. Finally, the distinction between active and latent TrPs should be based on the reproduction of the patient’s symptoms and not just on the presence of spontaneous pain as some patients can be pain-free at the moment of the examination. The topic of referred pain should be investigated in future research. This international Delphi panel produced expert-based standardized diagnostic criteria for TrPs and discussion of several clinical components, thereby providing a foundation for future research in MPS.

References

- 1 Simons DG, Travel JG, Simons LS. Myofascial Pain and Dysfunction: The Trigger Point Manual (Vol. 1) The Upper Half of Body, 2nd edition. Baltimore: Lippincott Williams & Wilkins; 1999.
- 2 Simons DG. Diagnostic criteria of myofascial pain caused by trigger points. *J Musculoskelet Pain* 1999;7:111–20.
- 3 Tough EA, White AR, Richards S, et al. Variability of criteria used to diagnose myofascial trigger point pain syndrome: Evidence from a review of the literature. *Clin J Pain* 2007;23:278–86.
- 4 Chiarotto A, Clijisen R, Fernández-de-las-Peñas C, Barbero M. Prevalence of myofascial trigger points in spinal disorders: A systematic review and meta-analysis. *Arch Phys Med Rehabil* 2016;97:316–37.
- 5 Lucas N, Macaskill P, Irwig L, Moran R, Bogduk N. Reliability of physical examination for diagnosis of myofascial trigger points: A systematic review of the literature. *Clin J Pain* 2009;25:80–9.
- 6 Myburgh C, Larsen AH, Hartvigsen J. A systematic, critical review of manual palpation for identifying myofascial trigger points: Evidence and clinical significance. *Arch Phys Med Rehabil* 2008;89:1169–76.
- 7 Barbero M, Bertoli P, Cescon C, et al. Intra-rater reliability of an experienced physiotherapist in locating myofascial trigger points in upper trapezius muscle. *J Man Manip Ther* 2012;20:171–7.
- 8 Myburgh C, Lauridsen HH, Larsen AH, Hartvigsen J. Standardized manual palpation of myofascial trigger points in relation to neck/shoulder pain; the influence of clinical experience on inter-examiner reproducibility. *Man Ther* 2011;16:136–40.
- 9 Fillingim RB, Bruehl S, Dworkin RH, et al. The ACTION-American Pain Society Pain Taxonomy (AAPT): An evidence-based and multidimensional approach to classifying chronic pain conditions. *J Pain* 2014;15:241–9.
- 10 Hasson F, Keeney S, McKenna H. Research guidelines for the Delphi survey technique. *J Adv Nurs* 2000;32:1008–15.
- 11 Linstone HA, Turoff M. Introduction. In: Linstone HA, Turoff M, eds. *The Delphi Method: Techniques and Applications*. Boston: Addison-Wesley; 1975:3–12.
- 12 Baker J, Lovell K, Harris N. How expert are the experts? An exploration of the concept of “expert” within Delphi panel techniques. *Nurse Res* 2006;14:59–70.
- 13 Hsu CC, Sandford BA. The Delphi technique: Making sense of consensus. *Pract Assess Res Eval* 2007;12:1–8.
- 14 Graham B, Regehr G, Wright JG. Delphi as a method to establish consensus for diagnostic criteria. *J Clin Epidemiol* 2003;56:1150–6.
- 15 Rivers WE, Garrigues D, Graciosa J, Harden RN. Signs and symptoms of myofascial pain: An international survey of pain management providers and proposed preliminary set of diagnostic criteria. *Pain Med* 2015;16:1794–805.

- 16 Gerwin RD, Shannon S, Hong C, Hubbard D, Gevirtz R. Inter-rater reliability in myofascial trigger point examination. *Pain* 1997;69:65–73.
- 17 Rathbone ATL, Grosman-Rimon L, Kumbhare DA. Inter-rater agreement of manual palpation for identification of myofascial trigger points: A systematic review and meta-analysis. *Clin J Pain* 2017;33:715–29.
- 18 Fernández-de-las-Peñas C, Cuadrado ML, Arendt-Nielsen L, Simons DG, Pareja JA. Myofascial trigger points and sensitization: An updated pain model for tension-type headache. *Cephalalgia* 2007;27:383–93.
- 19 Ferracini GN, Florencio LL, Dach F, et al. Myofascial trigger points and migraine-related disability in women with episodic and chronic migraine. *Clin J Pain* 2017;33:109–15.
- 20 Qerama E, Kasch H, Fuglsang-Frederiksen A. Occurrence of myofascial pain in patients with possible carpal tunnel syndrome—a single-blinded study. *Eur J Pain* 2009;13:588–91.
- 21 Fernández-Lao C, Cantarero-Villanueva I, Fernández-de-las-Peñas C, et al. Myofascial trigger points in neck and shoulder muscles and widespread pressure pain hypersensitivity in patients with post-mastectomy pain: Evidence of peripheral and central sensitization. *Clin J Pain* 2010;26:798–806.
- 22 Arendt-Nielsen L, Ge HY. Patho-physiology of referred muscle pain. In: Fernández-de-las-Peñas C, Arendt-Nielsen L, Gerwin RD, eds. *Tension Type and Cervicogenic Headache: Patho-Physiology, Diagnosis and Treatment*. Boston: Jones & Bartlett Publishers; 2010:51–9.
- 23 Kuan TS, Hong CZ, Chen JT, et al. The spinal cord connections of the myofascial trigger spots. *Eur J Pain* 2007;11:624–34.
- 24 Hong CZ, Kuan TS, Chen JT, Chen S. Referred pain elicited by palpation and by needling of myofascial trigger points: A comparison. *Arch Phys Med Rehabil* 1997;78:957–60.
- 25 Shah JP, Phillips TM, Danoff JV, et al. An in vivo microanalytical technique for measuring the local biochemical milieu of human skeletal muscle. *J Appl Physiol* 2005;99:1977–84.
- 26 Ballyns JJ, Shah JP, Hammond J, et al. Objective sonographic measures for characterizing myofascial trigger points associated with cervical pain. *J Ultrasound Med* 2011;30:1331–40.
- 27 Fernández-de-las-Peñas C, Cuadrado ML, Pareja JA. Myofascial trigger points, neck mobility and forward head posture in unilateral migraine. *Cephalalgia* 2006;26:1061–70.
- 28 Ge HY, Monterde S, Graven-Nielsen T, Arendt-Nielsen L. Latent myofascial trigger points are associated with an increased intramuscular electromyographic activity during synergistic muscle activation. *J Pain* 2014;15:181–7.
- 29 Wang C, Ge HY, Ibarra JM, et al. Spatial pain propagation over time following painful glutamate activation of latent myofascial trigger points in humans. *J Pain* 2012;13:537–45.
- 30 Ibarra JM, Ge HY, Wang C, et al. Latent myofascial trigger points are associated with an increased antagonistic muscle activity during agonist muscle contraction. *J Pain* 2011;12:1282–8.
- 31 Torres-Chica B, Núñez-Samper-Pizarroso C, Ortega-Santiago R, et al. Trigger points and pressure pain hypersensitivity in people with post-meniscectomy pain. *Clin J Pain* 2015;31:265–72.
- 32 Castaldo M, Ge HY, Chiarotto A, Villafane JH, Arendt-Nielsen L. Myofascial trigger points in patients with whiplash-associated disorders and mechanical neck pain. *Pain Med* 2014;15:842–9.
- 33 Albuquerque-Sendín F, Camargo PR, Vieira A, Salvini TF. Bilateral myofascial trigger points and pressure pain thresholds in the shoulder muscles in patients with unilateral shoulder impingement syndrome: A blinded, controlled study. *Clin J Pain* 2013;29:478–86.
- 34 Grieve R, Barnett S, Coghill N, Cramp F. The prevalence of latent myofascial trigger points and diagnostic criteria of the triceps surae and upper trapezius: A cross sectional study. *Physiotherapy* 2013;99:278–84.
- 35 Roach S, Sorenson E, Headley B, San Juan JG. Prevalence of myofascial trigger points in the hip in patellofemoral pain. *Arch Phys Med Rehabil* 2013;94:522–6.
- 36 Zuñil-Escobar JC, Martínez-Cepa CB, Martín-Urrialde JA, Gómez-Conesa A. Prevalence of myofascial trigger points and diagnostic criteria of different muscles in function of the medial longitudinal arch. *Arch Phys Med Rehabil* 2015;96:1123–30.
- 37 Mutlu EK, Birinci T, Dizdar G, Ozdinciler A. Latent trigger points: What are the underlying predictors? *Arch Phys Med Rehabil* 2016;97:1533–41.

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- 38 Coggon D, Martyn C, Palmer KT, et al. Assessing case definitions in the absence of a diagnostic gold standard. *Int J Epidemiol* 2005;34:949–52.
- 39 Chen Q, Wang HJ, Gay RE, et al. Quantification of myofascial taut bands. *Arch Phys Med Rehabil* 2016;97:67–73.
- 40 Mora-Relucio R, Núñez-Nagy S, Gallego-Izquierdo T, et al. Experienced versus inexperienced inter-examiner reliability on location and classification of myofascial trigger point palpation to diagnose lateral epicondylalgia: An observational cross-sectional study. *Evid Based Complement Alternat Med* 2016; 2016:6059719.
- 41 Sanz DR, Lobo CC, López DL, et al. Inter-rater reliability in the clinical evaluation of myofascial trigger points in three ankle muscles. *J Manipulative Physiol Ther* 2016;39:623–34.