Myofascial Trigger Points and Myofascial Pain Syndrome: A Critical Review of Recent Literature An Introduction by the Editor-in-Chief

Rather than providing the customary few pages with abstracts of the current literature, for this special topic issue of *JMMT* on myofascial pain syndrome we have been able to enlist the expertise of Dr. David Simons and Jan Dommerholt to share with us their critical review of what they consider some of the more relevant recent literature on this topic. As the co-author of the most authoritative textbooks and countless articles in the peer-reviewed literature on the topic of myofascial pain syndrome, Dr. Simons is clearly the pre-eminent pioneer in this area and he remains so by his frequent contributions to the literature including those in this issue of *JMMT*. Jan Dommerholt is a valued member of the Editorial Board of the Journal and is a prolific writer, researcher, and gifted physical therapy clinician and teacher in the area of myofascial pain. By way of this introduction, the Journal would also like to recognize Jan for being the main driving force behind this special topic issue.

Some of the reviews in this section of the Journal have appeared in earlier or will appear in future issues of the *Journal of Musculoskeletal Pain*, a specialized, peer-reviewed and referenced, quarterly journal published by The Haworth Press on the topic of diagnosis and management of patients with fibromyalgia syndrome, myofascial pain syndrome, and other soft tissue pain syndromes. The *Journal of Musculoskeletal Pain* is accessible online at http://www.haworthpress.com. We would like to thank Dr. I. Jon Russell, MD, PhD, the Editor-in-Chief of this Journal, and Mr. Bill Cohen, Publisher and Editor-in-Chief for The Haworth Press, for their kind permission to include these reviews in this special topic issue of *JMMT*.

This review of relevant literature provides the readers with the unique opportunity to more closely review many of the studies referenced in the various articles that make up this issue of the Journal. It also provides readers perhaps not familiar with this area of orthopaedic manual therapy with a bibliography for further study and allows for critical evaluation of the state-of-the art of research in this area and claims made as to the evidence base. Some of the articles reviewed here discuss interventions that may not necessarily be included in the scope of practice of all readers. At times, interventions such as acupuncture, magnetic field stimulation, dry needling, and infiltrations will seem far removed from the familiar terrain of orthopaedic manual therapy. However, it benefits all of our patients if we are familiar with the interventions available and, perhaps more importantly, the –at times limited-- research basis supporting claims for their efficacy.

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Myofascial Trigger Points and Myofascial Pain Syndrome: A Critical Review of Recent Literature

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Hsieh CYJ, Adams AH, Tobias J, Hong CZ, Danielson C, Platt K, Hoehler F, Reinsch S, Rubel A. Effectiveness of four conservative treatments for subacute low back pain. *Spine* 2002;27:1142-1148.

Summary

Two-hundred subjects with low back pain (LBP) lasting between 3 weeks and 6 months were recruited by advertisements for payment and randomly received one of four treatments: 1) three weeks of back school education and training for a home stretching and walking program (this education and training was forbidden in the other three groups), 2) three times a week for three weeks of treatment by physical therapists specifically designed to inactivate myofascial trigger points, 3) three times a week for three weeks of lumbar and/or sacroiliac region chiropractic joint manipulations as deemed appropriate, without flexion distraction or mobilization, and 4) combination of #2 and #3 treatment programs. Blinded independent examinations before, 3 months after, and 6 months after treatment included a visual analog pain rating by patient, the Roland-Morris Disability Questionnaire for LBP, the Short-Form Health Survey, the 71-item Minnesota Multiphasic Personality Inventory, the Confidence Score, and palpation for myofascial trigger points (MTrPs) defined as a tender point with characteristic referred pain in the quadratus lumborum, gluteus maximus, gluteus medius, gluteus minimus, and piriformis muscles. Tenderness over the spinous processes and facets of the lumbar spine and of sacroiliac regions medial to the posterosuperior iliac spines identified articular dysfunction. All data were analyzed regardless of patient compliance. All 4 groups showed significant reduction in pain and activity scores at 3 weeks with no further change at 6 months. Back school and combined therapy were consistently the best and the mean visual analogue scores were significantly better for combined therapy than for only myofascial therapy. Otherwise there were no significant differences in outcome among therapies when compared to baseline. The marked effectiveness of back school was surprising since it was originally included as placebo treatment. When queried, participants were so satisfied because they joined the study to learn the cause of their problem, to discover how to avoid future bouts of LBP, and how to better control the pain if LBP recurred. Combined therapy was consistently but not statistically significantly better than myofascial therapy alone.

Comments

The methods section indicates that this was a study of the results of treatment of MTrPs that were not clearly identified as active or latent. The muscles selected for examination and treatment may not have included ones that had MTrPs contributing significantly to the patient's pain. For pain relief, it is important to concentrate on treating the active MTrPs when they are the cause of the pain. The noteworthy efficacy of back school with a targeted stretch program is consistent with the result reported by Hanten et al[1]. The design of this study does not help to identify how much more effective the treatment programs might have been if they had included the back school program also. In addition, the results suggest that a study is needed in which the initial examinations for MTrPs and articular dysfunctions are related to the relative efficacy of the chiropractic and specific MTrP therapies for those patients who have either one or both of the diagnoses. The critical need is for competent scientific studies like this to address the cause of the pain, and to begin to identify which therapy or combination of therapeutic approaches is most effective for the specific causes. Specifically we need to know more about the relationship between MTrPs and articular dysfunctions as causes of LBP and how they interact [DGS].

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Cummings M. Referred knee pain treated with electroacupuncture to iliopsoas. *Acupunct Med* 2003;21:32-35.

Summary

This case report describes a 33-year old female patient with an eight-year history of deep left knee pain. The pain

started after a period of prolonged standing. Initial knee examinations did not reveal any abnormalities. Further studies revealed a dysplastic left hip with osteoarthritis. The patient's symptoms were managed conservatively for several years, after which she underwent several surgical procedures, including a periacetabular osteotomy, a left femoral osteotomy, and a lateral shaft grafting procedure with bone harvested from the left anterior iliac crest. Eventually, the patient underwent a left total hip replacement that temporarily relieved her knee pain. Three months later, the patient experienced a relapse of knee pain, which she managed pharmacologically. A few months later, she experienced another exacerbation at which point she presented to an acupuncture clinic. Again, no abnormalities were observed in the left knee. However, the patient's knee pain was provoked by left hip flexion combined with adduction or internal rotation. Pressure over an MTrP in the left iliopsoas muscle also provoked the patient's pain complaint. The patient was treated with deep dry needling of the MTrP. The needling did not provoke the patient's usual left knee pain and a decision was made to treat the MTrP subsequently with percutaneous electrical stimulation/electroacupuncuture with a stimulation frequency of 2 Hz for 15 minutes. After only two treatments, the patient had no further complaints of knee pain.

Comments

MTrPs are commonly involved in orthopedic injuries and joint pains, yet frequently overlooked. In 2001, Bajaj et al already described MTrPs associated with lower extremity osteoarthritis[2]. This case report is significant for several reasons. First, the author used Simons, Travell and Simons criteria for a MTrP, which makes comparison to other reports and studies possible[3]. Second, the author realized that the patient's recognition of the pain is an important parameter in determining whether a MTrP is clinically relevant[3,4]. Third, referred pain from the iliopsoas muscle to the knee has not been described previously. Fourth, even though the patient had experienced recurrent knee pain for eight years, after proper identification and treatment of the responsible MTrP, the pain complaint disappeared after only two treatments. Unfortunately, the case report did not include any longer-term outcome measures [JD].

Testa M, Barbero M, Gherlone E. Trigger points: Update of the clinical aspects. *Eur Med Phys* 2003;39:37-43.

Summary

The awareness of myofascial pain syndrome (MPS) and its hallmark feature, the MTrP is growing not only across different disciplines, but also across different continents. From Italy comes this comprehensive meta-analysis of the literature on the clinical aspects, diagnostic tools, and pathophysiology of MTrPs. The authors independently analyzed controlled trials and review articles included in Medline (from 1966 to December 2002) and Embase (from 1988 to December 2002). The clinical signs of a MTrP, including the taut band, jump sign, reproduction of the patient's pain, local twitch response, referred pain, restricted range of motion, muscle weakness, and associated phenomena, are well described with multiple up-to-date references. The authors include an overview of the various interrater reliability studies of the diagnostic process and conclude that a reliable clinical assessment of MTrPs can be achieved with adequate training. The minimal criteria to identify a MTrP are the presence of a taut band in the muscle, a very tender point in the taut band, and the patient's recognition of the pain. The authors state correctly that referred pain and local twitch responses are confirmatory findings.

Comments

It cannot be emphasized enough that the identification of MTrPs requires training. The interrater reliability study by Gerwin et al demonstrated that satisfactory reproducibility can be achieved after training[4]. Other medical procedures, for example, auscultation or review of cranial nerves, require many hours of practice and are included in the medical training of all doctors. Few clinicians receive training in the accurate identification of MTrPs [JD].

Jarrell J, Robert M. Myofascial dysfunction and pelvic pain. *Can J CME* 2003;Feb:107-116.

Summary

The authors present a brief review of the contributions of MTrPs to various pelvis pain problems through five short case descriptions and a concise summary of the nature, diagnosis and treatment of MTrPs. One case report illustrates how visceral disease can present as a MTrP in the abdominal wall, while others describe referred pain patterns from MTrPs in the abdominal wall to the vagina, the impact of stressful conditions on MTrPs, and the need to examine patients for the presence of MTrPs in the intra-pelvic muscles, including the levator ani and obturator internus.

Comments

This article may assist gynecologists and other clinicians in recognizing the implications of MTrPs in the pelvic region [JD].

Edwards J, Knowles N. Superficial dry needling and active stretching in the treatment of myofascial pain: A randomised controlled trial. *Acupunct Med* 2003;21:80-86.

Summary

Forty patients out of a total of 66 with musculoskeletal pain referred to physical therapy met the inclusion criteria and were included in this randomized prospective study of superficial dry needling combined with active stretching. Inclusion criteria were age 18 and over, presence of active MTrPs, identified by spot tenderness in a taut band, subject recognition of elicited pain on palpation, and painful limitation of full range of motion, no other treatment during the trial, and ability to comply with the trial. The presence of a local twitch response and pain in an expected distribution were not considered essential for inclusion, but were used to confirm the diagnosis of MPS consistent with the criteria defined by Simons, Travell and Simons[3]. Fourteen patients were assigned to a group receiving superficial dry needling using acupuncture needles with a needle penetration depth of approximately 4 mm combined with active stretching exercises; 13 subjects received stretching exercises alone and another 13 subjects were no treatment controls. A physical therapist trained in the identification of MTrPs examined all subjects to determine whether they had clinically relevant MTrPs. A total of 6 MTrPs in each subject were recorded. Subjects in the intervention groups received 3 weeks of intervention followed by 3 weeks of home exercises only. Outcomes were assessed with the Short Form McGill Pain Questionnaire (SFMPQ) and pressure pain thresholds of the primary MTrP. Most measurements were conducted by two blinded and trained observers. When the observers were not available, the primary investigator conducted the measurements for a total of 24% of the outcome measurements. Interestingly, there were no statistically significant differences between the 3 groups after 3 weeks. However, after another 3 weeks, the group receiving superficial dry needling and active stretching scored significantly better on the SFMPQ compared to the no-intervention group and significantly better in the pressure thresholds compared to the active stretching only group. The authors suggested that stretching alone may have adverse effects on MTrP sensitivity. They also emphasized that significant numbers of patients with musculoskeletal pain appear to suffer from MTrPs.

Comments

The introduction to this article suggests that the authors are very familiar with the current thinking about MPS and MTrPs. The diagnostic criteria were appropriate and clearly identified. They emphasized that patients with multiple clinically relevant MTrPs are very common in clinical practice: 61% of the patients referred to physical therapy with musculoskeletal pain by general practitioners suffered from MPS. Successful treatment may require multiple treatment sessions. The study protocol reflected their insights and considered the effects of superficial dry needling over a 3 week period. Superficial dry needling has been promoted by Baldry, but there are only few clinical outcome studies[5]. Superficial dry needling combined with an active stretching program was superior to stretching alone and to no-intervention. Although the researchers used the pressure threshold of the primary MTrP in their outcomes, they did not indicate how they determined which MTrP was the so-called primary MTrP. Simons, Travell, and Simons defined a primary MTrP as "a central MTrP that was apparently activated directly by acute or chronic overload, or repetitive overuse of the muscle in which it occurs and was not activated as a result of trigger-point activity in another muscle"[3]. In clinical practice, it is not always easy to determine which MTrPs qualify as primary. Regrettably not all outcome measures were blinded, which may have introduced some bias. Yet, the study supports that superficial dry needling over MTrPs is an effective treatment modality. Other well-designed studies are needed that compare the efficacy of superficial dry needling to deep dry needling and to manual therapy techniques such as contract-relax techniques or MTrP pressure release. The authors suggested that physical therapists and general practitioners practicing acupuncture are well placed to use dry needling techniques in their respective practices. In several countries physical therapists are now authorized to use dry needling techniques, including the UK, Switzerland, South Africa, and Spain among others. In the US, state boards of physical therapy in Maryland, Virginia, New Hampshire, New Mexico, Colorado, South Carolina, Kentucky, and Georgia have already ruled that dry needling falls within the scope of physical therapy practice in those states [JD].

Cummings M. Myofascial pain from pectoralis major following trans-axillary surgery. *Acupunct Med* 2003;21:105-107.

Summary

A 28-year old female presented to an acupuncture teaching clinic with complaints of pain in the left arm and chest. Eighteen months earlier, the patient had a trans-axillary resection of the left first rib because of a left axillary vein thrombosis. Two months after the surgery the patient required a venoplasty. Initially, the patient described left-sided chest pain at a drain site, which eventually developed into a permanent heavy aching with sharp and burning exacerbations involving not only the chest, but also the medial aspect of the left arm, forearm and hand. The patient experienced a "pinching" sensation in the pectoralis major and a "pulling" in the fourth web space of her left hand. Her medical team offered her four

possible causes of her constant pain, including traction on the intercostobrachial nerve, rotator cuff atrophy, Raynaud's phenomenon, and possible scarring around the C8/T1 nerve root. Approximately seven months after the onset of the permanent pain, the patient consulted the acupuncture clinic. An MTrP was observed in the left pectoralis major muscle at the drain site. The MTrP was treated with two gentle and brief needle insertions of 10 seconds each. The patient was instructed to stretch the muscle at home. Two weeks later, she reported that the paresthesia in the arm had resolved with improvement of the "pinching" feeling. The "pulling" in the hand had increased. Two additional needle insertions in the pectoralis MTrP using a dry needling technique completely resolved the symptoms within two hours following the second treatment.

Comments

MTrPs are commonly seen after trauma, irrespective of the nature of the traumatic insult. Cummings described an interesting case of MPS at a drain site following a surgical procedure. Several aspects of this case report are relevant as they illustrate broader issues. MPS was not considered in the differential diagnosis by the patient's medical consultants. The symptoms caused by MTrPs mimicked other pathologies, which indeed had to be considered. However, by excluding MPS as a possible option, the patient was deprived from effective management and suffered needlessly for many months. The author had considered that the "pulling" sensation in the hand could be due to a satellite MTrP. It is rarely possible to distinguish a satellite MTrP from a primary or key MTrP by examination alone. As Simons, Travell and Simons described, the relation usually is confirmed by simultaneous inactivation of the satellite, when the key MTrP is inactivated[3]. The report illustrates that in some chronic cases, a single MTrP can be responsible for a multitude of symptoms. The author did report examining other muscles of the functional muscle unit, but did not find any other clinically relevant MTrPs. The author did not indicate whether the patient remained symptom-free several weeks or months after the treatments [JD].

Mascia P, Brown BR, Friedman S. Toothache of nonodontogenic origin: A case report. *J Endod* 2003; 29:608-610.

Summary

A 25-year old female presented to a postgraduate endodontics university clinic with complaints of spontaneous pain on the left side of her face that began several hours earlier and radiated to her ear and temporal region. Taking 650 mg of acetaminophen had provided no relief. Tooth #18 exhibited symptoms of pericementitis, but anesthetizing he tooth had no effect on her symptoms and no other dental source of the pain could be identified. Since no dental source of the pain could be found the patient was examined for an MTrP cause. An MTrP was located in the left masseter muscle that when compressed referred pain to the mouth, effectively duplicating the patient's chief complain. Injecting it with Carbocaine without epinephrine and a fan-like pattern of dry needling produced immediate pain relief that had continued at the 12-month follow-up examination.

Comments

This is another example of referred pain from a masticatory muscle that was confusingly similar to pain that can originating in the teeth. The authors are to be congratulated on considering MTrPs in the differential diagnosis. The prompt elimination of the MTrP source of the pain was easily accomplished just a few hours after onset and before substantial central nervous system plasticity changes converted the acute episode into a chronic pain condition that is much harder and more expensive to treat. Although the authors did not mention a trial of manual therapy techniques before turning to injection, in acute cases like this, they are usually also promptly effective [DGS].

Hong CZ. Myofascial trigger points: Pathophysiology and correlation with acupuncture points. *Acupunct Med* 2000;18:41-47.

Summary

Hong summarized the clinical features of MTrPs, and extensively described the research reports including animal studies that clearly describe a credible pathophysiology of MTrPs. Hong is a native of Taiwan who was initially trained in acupuncture. He reached two conclusions when he started comparing acupuncture points and MTrPs. First, the Ah-Shi points (Oh Yes! Points) of acupuncture correspond to MTrPs and that the mechanism for pain relief by needling MTrPs may be similar to relief by acupuncture of Ah-Shi points. Second, he believes that the de-chi response is a sensation produced by the acupuncture needle that is comparable to the local twitch response and that in both cases the best therapeutic results are related to these responses. Hong emphasizes the strong relation of these points to central nervous system function.

Comments

This author is particularly well qualified to address this issue and is in agreement with Birch and Audette and Blinder also reviewed in this issue. We agree that the original Melzack article relating acupuncture points and MTrPs is highly flawed in a number of ways, not the least of which was the way that the location of MTrPs was determined. There are many more locations for MTrPs in muscles. We also agree that one class of acupuncture points correlate highly with MTrPs. A number of clinicians have observed noteworthy better responses by MTrPs to treatment that incorporates both acupuncture and MTrP principles. This is an approach that deserves serious research investigation [DGS].

Birch S. Trigger point-acupuncture point correlations revisited. *J Altern Compliment Med* 2003;9:91-103.

Summary

In 1977, Melzack et al published a literature-based review examining the possible correspondence of acupuncture points and MTrPs for the treatment of pain[6]. They reported that all of the 56 examined MTrPs were within 3 cm of an acupuncture point. Forty of these MTrPs (71%) were reported to have the same pain indications as the corresponding acupuncture points. Melzack et al concluded that there was a 71% correlation and that MTrPs and acupuncture points "represent the same phenomenon." As Birch summarized, this study had a profound impact particularly on the further development of the theoretical foundations of acupuncture, but also on the treatment of MTrPs[5]. Melzack's study provided evidence for many researchers and clinicians that acupuncture had an established physiologic basis and that acupuncture practice could be based on the reported correlations with MTrPs. Birch concluded that the 1977 study was based on several "poorly conceived aspects" and "questionable" assumptions, including the notion that all acupuncture points must exhibit pressure pain; that the 40 correlated acupuncture points are normally used in the treatment of pain conditions and are among the more commonly used acupuncture points; and that only the local pain indications of acupuncture points are sufficient to establish a correlation. Birch conducted an extensive study of the current literature on acupuncture practice, some of which was either not available or included in the mid-1970s review. He found that only approximately 18%-19% of acupuncture points examined in the 1977 study could possibly correlate with MTrPs. According to Birch, "acupuncture points and MTrPs do not show any meaningful correlation." At the same time, Birch suggested that there may a relevant correlation between the so-called Ah Shi points and MTrPs. He explained that in the acupuncture literature, the Ah Shi points belong to one of three major classes of acupuncture points. There are 361 primary acupuncture points referred to as "channel" points. There are hundreds of secondary class acupuncture points, known as "extra" or "non-channel" points. The third class of acupuncture points is referred to as "Ah Shi" points. By definition, Ah Shi points must have pressure pain. They are used primarily for pain and spasm conditions. Melzack et al did not consider these Ah Shi points in their study, but focused exclusively on the channel points and extra points.

Comments

Birch's argument that the primary acupuncture points and MTrPs do not have any meaningful correlation is a radical turn from the conclusions drawn by Melzack et al 26 years ago. Yet, the rational he has developed to reject the previous conclusions is quite convincing. Birch is a world-renowned acupuncturist and author of several books and articles on acupuncture[7-9]. In his writings as in this study he displays an in-depth understanding of acupuncture and the different classes and applications of acupuncture points. Birch has incorporated more recent findings from the acupuncture literature into the current study design. We agree with Birch, that the Ah Shi acupuncture points may indeed be MTrPs. An acupuncturist identifying Ah Shi points may not be familiar with the literature on MTrPs and thus not identify them as such. One additional difficulty with the 1977 study is that it assumed that MTrPs were in rather fixed anatomical locations making comparisons with acupuncture point maps of primary acupuncture points feasible. Although the trigger point maps suggest that there may be certain fixed locations, clinicians and researchers should be aware that MTrPs could occur in various locations within a muscle. Melzack et al used a somewhat arbitrary 3 cm criterion and found that all examined MTrPs corresponded to an acupuncture point. But to quote Birch: "it is probable that there is some overlap in the location of acupuncture points and trigger points, but it is unlikely to be more than chance, and such similarity of location does not imply a correlation." Classical acupuncture points and MTrPs may after all not necessarily represent the same phenomena [JD].

Audette JF, Blinder RA. Acupuncture in the management of myofascial pain and headache. *Curr Pain Headache Rep* 2003;7:395-401.

Summary

The authors provide an extensive review of the basic principles of various schools of acupuncture. They explain some of the difficulties researchers encounter when trying to study the mechanisms and effects of acupuncture. Considering the conclusions of Melzack et al that there is a 71% overlap between acupuncture points and MTrPs and the description of so-called "Ah Shi" points, the authors suggest that acupuncture should be considered in the treatment of MTrPs, especially for those patients who do not experience complete relief from allopathic treatment or who have a preference for alternative approaches to their health care. According to the theory of Ah Shi points, an Ah Shi acupuncture point can be found whenever there is local soreness or pressure in the body, irrespective of the classical acupuncture meridians. The authors suggest that unknowingly acupuncturists may already treat MTrPs, whenever they treat Ah Shi points. The efficacy of acupuncture in myofascial pain conditions has been not studied over time.

Comments

The article by Birch reviewed above offers support for the notion to consider the treatment of Ah Shi points, but rejects the findings of the Melzack et al study [JD].

Mense S. The pathogenesis of muscle pain. *Curr Pain Headache Rep* 2003;7:419-425.

Summary

In this review article, Dr. Mense provided an overview of several peripheral and central mechanisms of muscle pain. He focused on the neurobiology of muscle nociceptors, including the various receptor molecules, their neuropeptide content, and especially the sensitization of peripheral nociceptors leading to tenderness and hyperalgesia. Animal research has shown that different types of nociceptors are present in muscle, including a nociceptor that is sensitive to ischemic contractions. In another section of the article, Mense reviewed much of his and other researchers' findings on mechanisms of muscle pain at the spinal level, including expansion of receptive fields, hyperexcitability, and central sensitization, which can account for referred pain from MTrPs. Due to neuroplasticity, the functional reorganization of the spinal dorsal horn may outlast the initiating peripheral lesion. In addition, inhibitory interneurons may become dysfunctional causing nociceptive neurons to be chronically disinhibited and hyperactive. In Mense's words: "this tells us to abolish the muscle pain as early and effectively as possible to prevent central nervous alterations. If a patient already has developed alterations, treatment will be difficult and long-lasting because alterations need time to disappear."

Comments

Mense has published an excellent up-to-date review article on muscle pain that in many cases can apply to MTrPs. Although he warned that applying animal research data to human conditions is at best speculative, he did indicate that several pain syndromes might involve peripheral muscle nociceptors. Nociceptors sensitive to ischemic contractures are likely involved in patients with tension type headaches, MPS, or fibromyalgia. Persistent pain referred from MTrPs is likely due to neuroplastic changes and central sensitization that are likely to persist long after the initiating event has been resolved. Clinically, it is important to prevent the onset of central nervous system alterations. Evaluating acute and subacute patients for the presence of MTrPs is critical. By treating MTrPs early on, patients may be spared from becoming chronic pain patients, even though not all patients with muscle lesions become chronic pain patients. If a patient has developed chronic pain, the recovery is much slower, as the central nervous system alterations can take much time to reverse and disappear [JD].

Lucas KR, Polus BI, Rich PA. Latent myofascial trigger points: Their effect on muscle activation and movement efficiency. *J Bodywork Movement Ther* 2004;8:160-166.

Summary

This study examined the effects of latent MTrPs on muscle activation patterns (MAP) in the shoulder region. During the first phase of the study, subjects with latent MTrPs were compared to healthy control subjects. MTrPs were identified in the trapezius, serratus anterior, rhomboids, levator scapulae, and pectoralis minor muscles. Together with the scapula, these scapular positioning muscles form the segment that links the trunk to the upper limb. Normal scapular movement requires that these muscles are recruited in an optimal MAP. The intra-examiner reliability to assess MTrPs was established. Identified MTrPs were subsequently examined in a randomized fashion with algometry to determine pressure pain thresholds. Using the normative data developed by Fischer, MTrPs were classified as either active or latent[10]. Only subjects with latent MTrPs were included in this study. Surface electromyography (sEMG) was used to determine the time of onset of muscle activity of the upper and lower trapezius, the serratus anterior, the infraspinatus, and middle deltoid muscles. During the second phase, the subjects with latent MTrPs were randomized into a treatment group and a placebo group. The latent MTrP treatment group received dry needling followed by passive stretch to remove the latent MTrPs. The placebo group received sham ultrasound, so that latent MTrPs remained. Both groups repeated the sEMG protocol to investigate whether inactivating latent MTrPs would alter the MAP. The control group was found to have a stable and sequential MAP. The latent MTrP group showed significant differences, inconsistencies, and variability. However, after dry needling and stretching, the MAP of the treated subjects normalized and showed no more significant differences with the control group. The placebo treatment group did not change before and after the sham treatment.

Comments

This important study contributes significantly to the understanding of the impact of latent MTrPs on muscle coordination and balance. Lucas et al have demonstrated not only that latent MTrPs alter normal muscle activation patterns; they also provided support for inactivating latent MTrPs using dry needling techniques combined with muscle stretches. As the authors indicate, the presence of latent MTrPs negatively impacts motor control prior to the presence of pain. Inactivation of MTrPs resulted in an immediate return to normal muscle activation patterns. These findings are especially relevant for training optimal movement efficiency required for sports participation, musical performance, and other motor tasks. For example, it is conceivable that athletes and musicians with latent MTrPs in the shoulder muscles may have altered movement activation patterns in the upper extremity that may interfere with athletic and musical performance. Inactivating latent MTrPs may be indicated to assure optimum motor performance. The authors also suggest that latent MTrPs may contribute to the development of shoulder impingement syndromes when activated by rotator cuff overuse [JD].

Majlesi J, Ynalan H. High-power pain threshold ultrasound technique in the treatment of active myofascial trigger points: a randomized, double-blind, case-control study. *Arch Phys Med Rehabil* 2004;85:833-836.

Summary

Turkish researchers Majlesi and Ynalan compared the effects of high-power, pain threshold static ultrasound (US) with conventional dynamic US in the treatment of MTrPs. Seventy-two subjects meeting the inclusion criteria were randomly assigned to one of two groups. The inclusion criteria included the presence of at least one MTrP in the upper trapezius muscle; symptoms lasting from 0 to 2 weeks; age between 18 and 60; primary MPS; and no other physical therapy intervention or medication. A trained and blinded physiatrist identified active MTrPs, subjective pain ratings, and cervical range of motion. The US treatments for both groups were applied by the same physical therapist, who obviously was not blinded to the treatment intervention. After each treatment the physiatrist re-evaluated each subject without knowledge of the treatment intervention. With conventional US, the applicator was moved over the skin with overlapping sweeps or circles at rates of a few centimeters per seconds over a small area. In this study the intensity was 1.5 W/cm^2 with a duration of 5 minutes. With the high-power pain-threshold static technique, the applicator was placed directly over an MTrP and held motionless with a gradual increase of the intensity until the subject's pain tolerance was reached. It was kept at that level for 4 to 5 seconds and then reduced to the half-intensity for another 15 seconds. The procedure was repeated three times. All subjects in both groups actively stretched the trapezius muscle following the treatment. Follow-up assessments were performed via telephone interviews. Several subjects dropped out of the study leaving a total of 31 subjects in the high-power US group and 29 in the conventional US group. At the end of the study no statistically significant differences were found in range of motion. However, it took only 5 treatments with high-power pain-threshold US to reach the same increase in range of motion as in 16 treatments of conventional US. The reported pain levels were significantly lower in the high-power US group. Scores on a visual analog scale were reduced from an initial 8.32 to 3.32 for the high-power US group and from 8.48 to 7.72 for the conventional US group. Again, the mean number of sessions in the high-power US group was less than three vs. nearly twelve in the conventional US group.

Comments

High-power pain-threshold static ultrasound is a creative application of an old modality, commonly used in physical therapy and chiropractic. This study demonstrates that high-power pain-threshold static US was clearly more effective in reducing pain from MTrPs than conventional US, even though in the end there were no significant differences in range of motion. The decreases in pain levels and increases in range of motion were achieved in far fewer sessions in the high-power US group. A previous study of ultrasound used in the treatment of MTrPs showed no significant differences between conventional US and MTrP injections[11]. In future studies, it would be interesting to compare high-power pain-threshold US to MTrP injection or dry needling. Many physical therapists and chiropractic physicians are legally not allowed to use injection therapy or dry needling. High-power threshold US appears to offer a cost-effective, viable non-invasive alternative to quickly reduce patients' pain from MTrPs. Clinicians need to be aware that high-power static US should not be used over bony or neural structures as this may lead to the formation of very painful "hot spots". The authors do not recommend this technique in facial or paraspinal muscles, or for muscles adjacent to nerve and bone structures.

McMakin CR. Microcurrent therapy: A novel treatment method for chronic low back myofascial pain. *J Bodywork Movement Ther* 2004;8:143-153.

Summary

In this case review, Dr. McMakin describes her extensive experience with frequency-specific micro-current electrotherapy for patients with chronic LBP in which MTrPs were thought to be major contributing factors. The treatment techniques are based on published lists of frequencies that were promoted in the early 1900s, which subsequently have been further refined for MTrP applications based on clinical experience of "thousands of patient visits involving treatment of more than 300 patients." McMakin has developed specific sequences of treatment parameters that empirically are reported to produce immediate results, including pain relief. She speculates that signal patterns generated by specific frequencies may cause alterations in cell membrane configuration and its electromagnetic qualities. Thermodynamic theory suggests that when organic tissues have been treated with frequency-specific micro-current electrotherapy, they remain in a stable configuration. Indeed, clinical experience suggests that the immediate changes in tissue tension and pain levels are maintained. McMakin describes several case series with excellent results, where other treatments including drug therapy, chiropractic manipulation, physical therapy, and acupuncture had failed. Twenty-two patients with chronic LBP and MTrPs of 8.8 years average duration experienced a statistically significant 3.8 fold reduction in pain intensity using a visual analog scale over an average treatment period of nearly six weeks. Overall the treatment approach has few transient side effects including slight to moderate nausea, flu-like aching, and occasionally increased pain, which McMakin attributes to a "post-treatment detoxification reaction."

Comments

Case reports are an important contribution to the scientific literature and may stimulate further research. As with most new therapies, the theoretical foundations and clinical applications need to be further developed and subjected to scientific study. McMakin is cautious not to overstate the underlying mechanisms. The therapeutic effects of frequency-specific microcurrent electrotherapy may be explained by its effects on cell membrane-linked signal transduction mechanisms[12,13]. Oshman described two physiological processes that permit small amounts of power, as used in frequency-specific micro-current electrotherapy, to have large effects on specific tissues, namely cellular amplification and stochastic resonance[14]. At the same time, the empirical results seem to justify randomized controlled clinical trials. Frequency-specific micro-current electrotherapy appears a very promising new therapeutic modality available in the treatment of persons with myofascial pain syndrome. This retrospective case review includes many interesting observations. However, subjects were not randomized. There was no control group and subjects were treated with a variety of other modalities [DGS].

Qerama E, Fuglsang-Frederiksen A, Kasch H, Bach FW, Jensen TS. Evoked pain in the motor endplate region of the brachial biceps muscle: An experimental study. *Muscle Nerve* 2004;29:393-400.

Summary

Motor endplate activity identified electromyographically by spontaneous low-amplitude noise-like [seashell noise] activity sometimes with biphasic or triphasic negative-first action potentials has been identified with MTrPs. The authors induced pain in the brachial biceps muscles of 21 healthy, non-medical subjects by injecting on separate occasions capsaicin and hypertonic NaCl solution in the motor endplate region and at an electrically silent site. Needle and evoked pain were measured by a visual analogue scale [VAS] [0-10] and by the short form McGill Pain Questionnaire. Needle pain in a motor endplate region [activity present] was observed in 83% of sites were spontaneous electrical activity compared to 34% of sites without activity [$P < 0.001$]. No difference appeared in VAS reports between responses to capsaicin and hypertonic saline. VAS scores were higher at sites with activity than at sites without activity [$P < 0.001$]. Pain was described more frequently as throbbing, shooting, stabbing, and cramping at electrically active sites compared to tender and sharp pain at inactive sites. Peak pain was higher in response to hypertonic saline, but the total pain [area under the VAS curve] was greater for capsaicin because it lasted longer. Before injection, tenderness by algometry was greater [lower algometer readings] at active sites than at control sites [$P < 0.001$] and was significantly increased at both sites following both injections, and capsaicin produced a greater increase in sensitivity at control sites than did normal saline. The authors concluded that the motor endplate region might be an important site for eliciting muscle pain.

Comments

This landmark study is the first research paper on the subject of MTrPs to be accepted by this prestigious, authoritative journal. The results are consistent with what is known of MTrPs. Since the subjects were non-medical [not seeking health care] most if not all of the MTrPs would have been latent, not active. Of 21 subjects examined, one exhibited no MTrPs, which is consistent with the DeKalb Medical Center unpublished data that a few normal subjects have few or no latent MTrPs, a few have them in most muscles, and nearly everyone has some latent MTrPs. Since the presence of endplate noise and spikes is indicative of a motor endplate exhibiting MTrP dysfunction and MTrPs are characterized by spot tenderness, it fits that sites exhibiting spontaneous electrical activity were much more sensitive and had a different quality of pain than other sites[15]. The observation that the cramping, throbbing type pain rather than sharp pain was characteristic of sites of electrical activity and was more likely to be referred, fits the pain usually associated with MTrPs and emphasizes that the difference may be due to different kinds of nociceptors or due to the agents that have sensitized the nociceptors in the MTrP. It should be no surprise that nociceptors are in close proximity to motor endplates. The motor nerve terminal supplying it branches from a neurovascular bundle that includes motor nerves, sensory nerves, and blood vessels with their accompanying autonomic nerves[16]. The differences in the responses elicited by hypertonic saline and capsaicin is noteworthy and deserves further investigation. It is hoped that this pioneering study will stimulate further research along these lines [DGS].

Itoh K, Okada K, Kawakita K. A proposed experimental model of myofascial trigger points in human muscle after slow eccentric exercise. *Acupunct Med* 2004;22:2-12.

Summary

This is a somewhat complicated but interesting study comparing the localized tenderness of experimentally induced muscle pain to known characteristics of MTrPs. Fifteen healthy volunteers were assigned to one of two groups. Group 1 consisted of 5 males and 2 females; group 2 consisted of 8 females. Group 1 participated in three different experiments, spaced at least six months apart. During the first experiment, pain thresholds were measured without exercise. During the second experiment, pain thresholds were measured after exercise. During the third experiment, the distribution of pain thresholds was measured after exercise. Group 2 underwent a single series of EMG readings daily after exercise using both indwelling and surface electrodes. Throughout the study, subjects were seated with one forearm supported. A 475 g weight was placed on the middle finger of one hand with the initial position determined by the ability of each subject to hold the finger in a horizontal position for at least ten seconds. Subjects were asked to maintain the finger in a horizontal position. Each time the finger bent 20 degrees downward at the metacarpophalangeal joint, the finger was manually reset to the original horizontal position by the experimenter. The exercise was repeated until exhaustion of the extensor muscle for a total of three sets. During the exercise, EMG measurements were taken to determine when other muscles were being recruited. Pressure and electrical pain thresholds were measured. On the second day after exercise, the forearm extensor muscles were examined by an experienced clinician for the presence of a palpable taut band. If present, the pattern of referred pain was determined following manual pressure on the most tender region of the palpable band. The study revealed significantly decreased pressure thresholds by the second day, which recovered seven days after the experiment. On the second day after exercise, a "clear ropy palpable band" could be detected in all subjects. The taut bands softened in subsequent days and could not be detected by day 7. Referred pain patterns were easiest established with application of pressure over the most tender part of the taut band. Referred pain patterns were felt mostly in the hand and in a line over the dorsum of the wrist and forearm. EMG revealed sustained activity when the recording needle was placed close to the fascia at the tender locus of the taut band. Local twitch responses were frequently observed during the insertion of the needle electrode. The electrical threshold was significantly lower for fascia only; no differences were seen in electrical thresholds of the skin and muscle.

Comments

The similarities between pain following eccentric exercise and pain associated with MTrPs are an interesting area of research. Eccentric exercise is associated with muscle damage and delayed onset of muscle soreness (DOMS). The authors documented the formation of palpable taut bands following eccentric exercise. Repeated eccentric exercise has been shown to lead to segmental disruption of muscle fibers, a loss of cellular integrity, and an increase in fiber size caused by segmental hyper-contractures of muscle fibers associated with very short sarcomere lengths[17]. Following eccentric exercise the muscle fiber cytoskeleton is disrupted, Z-band streaming occurs and the A-band is disorganized[17]. Histological studies of MTrPs have shown similar findings[18]. It is questionable whether the subjects performed eccentric contractions throughout the experiment. The subjects were instructed to keep their finger horizontally, which requires an isometric contraction. They had to eccentrically contract their muscles only after fatigue set in and they were no longer able to maintain the finger horizontally. By definition, an eccentric contraction is a contraction of a lengthening muscle. The authors raised the possibility that a palpable taut band after eccentric exercise is due to localized edema in deep tissues. Eccentric exercise produces local muscle fiber damage with an increase of intra-tissue pressure, which "may be detected as a taut band." While the presence of local edema is certain possible, it is unlikely that taut bands associated with MTrPs are due to edema. In clinical practice, needling of a taut band frequently results in local twitch responses. Although the authors quoted recent EMG research of MTrPs, which supports that MTrPs are associated with abnormal motor endplate activity, they contributed the finding of sustained EMG activity to nociceptive input produced by the insertion of the EMG needle into the painful region of the muscle and its fascia. White and Cummings, editors of Acupuncture in Medicine at the time this article was published, prepared an accompanying editorial in which they questioned whether it is possible to differentiate taut bands from post-exercise swelling. They also wondered whether the clinical picture of DOMS is similar enough to the symptoms associated with MTrPs. DOMS is thought to affect the entire muscle, while MTrPs are localized painful loci. On the other hand, it is likely that following eccentric exercise the normal balance between the release of acetylcholine and its subsequent breakdown by acetylcholinesterase is disturbed. Eccentric exercise leads to hypoperfusion of the muscle caused by contraction-induced capillary constriction. The resultant ischemia and hypoxia leads to a local acidic pH, and the release of nociceptive substances, such as bradykinin, substance P and calcitonin gene-related peptide, which can alter the activity of the motor endplate due to increased acetylcholine release, and a simultaneous inhibition of acetylcholinesterase and up-regulation of acetylcholine receptors. Hypothetically eccentric exercise could indeed lead to the development of persistent muscle fiber contractures as seen with MTrPs.

Audette JF, Wang F, Smith H. Bilateral activation of motor unit potentials with unilateral needle stimulation of active myofascial trigger points. *Am J Phys Med Rehabil* 2004;83:368-374.

Summary

Following the clinical observation that during injections or dry needling of myofascial trigger points (MTrP) muscles on the opposite site of the body would react and exhibit a local twitch response (LTR), the authors hypothesized that the perpetuation of pain and dysfunction associated with active MTrPs may be due to changes in the central nervous system. Thirteen subjects with myofascial neck pain were included in this prospective controlled study with eight subjects functioning as a control group. Inclusion criteria included age between 18 and 75 years, unilateral neck pain for more than six months, and active MTrPs, characterized by unilateral neck pain at rest, reproduction and recognition of pain with palpation of taut bands in either the trapezius or levator scapulae muscle, a LTR with manual, snapping palpation of that taut band, and restricted side bending to the opposite side. The healthy control subjects were found to have taut bands in the trapezius or levator scapulae muscles with mild to moderate pain on deep palpation, but no pain at rest, and restricted side bending to the opposite side, indicating a latent MTrP. After locating an active MTrP in either trapezius of levator scapulae muscle, an EMG needle was inserted into a point at exactly the same location, but on the opposite side of the body. A second EMG needle was inserted in the ipsilateral muscle but 3 cm away from the MTrP to avoid recording movement artifacts. In the control group, a point of maximum palpatory tenderness was identified and EMG needles placed as described for the experimental group. Next, local twitch responses were elicited using a 30 mm long, 0.20 mm in diameter acupuncture needle in the active MTrP (experimental group) or in the most tender spot (control group). Motor unit potentials were observed on the ipsilateral side in all subjects. Interestingly, the researchers were able to identify motor unit potentials on the contralateral side in 61.5% of the active MTrP group, but never in the control group with latent MTrPs.

Comments

Audette et al have documented for the first time, that needling of active MTrPs can elicit motor unit potentials on the contralateral side of the body. As they suggested, active MTrPs may be associated with a central nervous system abnormality, involving segmental changes. Since latent MTrPs did not feature contralateral motor unit potentials, the question arises whether the difference between active and latent MTrPs is partially characterized by the degree of a loss of central inhibition of both nociceptive input and heterosynaptic sensory-motor connections to the contralateral side of the spinal cord. Thirty-eight percent of active MTrPs did not feature contralateral motor unit potentials, offering further support that there may be degrees of central sensitization, perhaps dependent upon chronicity and maybe even the degree of neural plasticity. The authors speculate that selective glia activation may be responsible for the contralateral spread[19]. Considering the previously reviewed study by Lucas et al it may be necessary to treat both active and latent MTrPs in the clinic[20]. This study demonstrates another recordable pathophysiological distinction that emphasizes the validity and importance of the clinical distinction between active and latent MTrPs.

Mense S. Neurobiological basis for the use of botulinum toxin in pain therapy. *J Neurol* 2004;251(Suppl 1);1/1-1/7.

Summary

Mense provides a focused review of the mechanisms of action of botulinum toxin and its application in the treatment of MTrPs, spasm, and dystonia. According to the “integrated trigger point hypothesis”, the formation of a MTrP starts with a muscle lesion that results in excessive release of acetylcholine into the cleft of the neuromuscular junction. Botulinum toxin interferes with the release of acetylcholine from cholinergic nerve endings, which suggests that a botulinum toxin injection is in fact a treatment of the cause of the pain, not just the symptom. Pain in chronically contracted muscles appears to result from ischemia due to compression of the muscle’s blood vessels. Several factors play a role in ischemic muscle pain, such as the release of bradykinin, excitation of vanilloid receptors (subtype VR 1) by protons due to a lowering of the pH, and finally, activation of purinergic receptors by ATP. The article concludes with a brief review of possible mechanisms of the immediate pain relief experienced by some patients before the onset of muscle relaxation. Mense suggests that botulinum toxin may prevent the release of other chemicals in addition to acetylcholine, such as substance P and calcitonin gene-related peptide. Other possible mechanisms may involve the ability of botulinum toxin to reduce neurogenic inflammation, or the effect on the postganglionic sympathetic nerve by blocking the release of norepinephrine and ATP.

Comments

This is one of the most succinct and knowledgeable reviews of the various applications of botulinum toxin and the possible mechanisms of pain in chronically contracted muscles. The possible mechanisms of pain relief by botulinum toxin are clinically relevant and require further study.

Reilich P, Fheodoroff K, Kern U, Mense S, Seddigh S, Wissel J, Pongratz D. Consensus statement: Botulinum toxin in myofascial pain. *J Neurol* 2004;251(Suppl 1);1/36-1/38.

Summary

The authors of this consensus statement are experienced clinicians and researchers, who have contributed much to the current understanding of MTrPs. After briefly reviewing the integrated trigger point hypothesis, they concluded that botulinum toxin should be considered in the management of patients with MPS who have demonstrated poor clinical outcomes after at least a month of physical therapy, including dry needling, and oral pharmacotherapy. Botulinum toxin may prevent the development of maladaptive neuroplastic changes associated with chronic pain syndromes. Two techniques are described: the so-called "near by" technique and the "into" technique. With the "near by" technique, the injection needle is placed as close as possible near a MTrP after careful palpation. The needle placement should elicit both a local twitch response and a referred pain pattern. With the "into" technique, the needle is placed directly into an MTrP using EMG and ultrasonography guidance. The authors included guidelines for dosage. They concluded that there is no consensus as to the question if simultaneous injection of local anesthetic is recommended.

Comments

Botulinum toxin has a distinct place in the management of persons with MPS and persistent MTrPs. The authors emphasized that the injections should only be performed by experienced clinicians in both the identification and management of MTrPs and utilization of botulinum toxin. We agree that botulinum toxin injections should always be integrated into a multimodal therapeutic management strategy, including medical management, physical therapy, relaxation exercises, and functional exercise training.

Huguenin LK. Myofascial trigger points: The current evidence. *Phys Ther Sport* 2004;5:2-12.

Summary

The article reviews current definitions and theories of MTrPs, and addresses some of the different opinions in the literature. Simons' integrated trigger point hypothesis is well explained as is Gunn's radiculopathic model for myofascial pain[15,21]. Arguments in favor of or against various research findings are discussed in detail. The final section on trigger point therapy includes subheadings on stretching, TENS, ultrasound, laser, and invasive therapies.

Comments

Myofascial trigger points are not commonly discussed in the international physical therapy literature. Therefore, this scholarly review is a welcome contribution. At times, the author used references and drew conclusions about MTrPs, when the actual references related to fibromyalgia tender points. In a section on muscle pain, the author stated that substance P and calcitonin gene-related peptide are not relevant as algesic compounds in muscle. However, recent preliminary data by Shah and colleagues suggest that these substances are in fact present in the micro-milieu of active MTrPs[22]. The author concludes with "regardless of the treatment chosen, it is imperative to remember that trigger points are rarely an isolated phenomenon, and the key to successful long-term outcomes of any treatment regime is addressing the precipitating and predisposing factors for each particular patient." We agree.

Sharpe HT. Myofascial pain syndrome of the abdominal wall for the busy clinician. *Clin Obstet Gynecol* 2003;46:783-788.

Summary

The American College of Obstetrics and Gynecology recommends an assessment of the musculoskeletal system prior to surgical interventions for chronic pelvic pain. In spite of this, most obstetricians and gynecologists have not received any training in the evaluation and management of musculoskeletal pain. This article aims to enable the clinician to differentiate between MPS of the abdominal wall and intra-abdominal causes for chronic pelvic pain. Sharpe provides a brief overview of the characteristics of MPS and MTrPs. He suggests that the evaluation of the anterior abdominal wall for MTrPs is a relatively simple procedure and suggests primarily trigger point injections and a home stretching program.

Comments

Unfortunately, the article does not mention any other muscles and MTrPs that can cause or contribute to chronic pelvic pain, such as the adductor magnus, the quadratus lumborum, the levator ani, and the gluteal muscles, among others[23].

Dommerholt J. Dry needling in orthopedic physical therapy. *Orthop Phys Ther Pract* 2004;16(3):15-20.

Summary

This is the first report in the American physical therapy literature that highlights dry needling within physical therapy practice. Realizing that it may be a bit unusual to review one's own article, this article provides pertinent background information and emphasizes that dry needling by physical therapists is gaining ground in several countries. In the US, physical therapy state boards of Maryland, New Hampshire, New Mexico, South Carolina, Kentucky, and Virginia have already determined that dry needling of myofascial trigger points (MTrPs) falls within the scope of practice of physical therapists. The article includes an overview of three different schools of dry needling, the MTrP, radiculopathy, and spinal segmental sensitization models. In addition to examining possible mechanisms of dry needling, the article features a review of statutory considerations for different states.

Jarrell J. Myofascial dysfunction in the pelvis. *Curr Pain Headache Rep* 2004; 8:452-456.

Summary

Puzzled by the finding that between 25% and 40% of all cases of laparoscopy done for pelvic pain do not demonstrate an identifiable visceral cause for the pain, Jarrell became interested in the contributions of MTrPs to chronic pelvic pain syndromes. According to Jarrell, pelvic pain cannot only be due to MTrPs, MTrPs may also be a sign of underlying organic disease, which was the focus of this study. Fifty-five consecutive patients with pelvic pain were evaluated in a cross-sectional design. Subjects had to present with chronic pelvic pain and be found to have, as a component of their condition, evidence of myofascial dysfunction in one or more areas of the abdomen and pelvis. The specific objective was to describe the subjects with myofascial dysfunction and pelvic pain more carefully in terms of the number of trigger points and their relationship to age, parity, treatment, and underlying visceral disease. Subjects were considered to have evidence of visceral disease if they had been treated for a surgically confirmed visceral cause of pain in the past or had documented evidence of current visceral disease. The only variable that Jarrell found to have a correlation with visceral disease was the presence of an abdominal wall MTrP, which predicted evidence of visceral disease in 90% of subjects. If an MTrP was not present, it was associated with no visceral disease in 64% of the subjects. Presence of trigger points in the perineum or the intrapelvic muscles was not associated with previous or existing visceral disease. The author emphasizes that, because of a strict patient selection bias, these correlations would not necessarily be observed in a more general group of subjects with chronic pelvic pain.

Comments

As Jarrell mentions, the presence of abdominal MTrPs in patients with chronic pelvic pain may be indicative of an underlying visceral disease process, or may have resulted from previous visceral disease. By limiting the medical approach to treating the MTrPs only, the underlying diagnosis could potentially be missed. This study does not suggest that abdominal muscles are the only muscles to consider when examining patients with chronic pelvic pain. We recommend examining the gluteals, quadratus lumborum, levator ani, hip adductors, obturators, and piriformis muscles as well[23] [JD].

Doggweiler-Wiygul R. Urologic myofascial pain syndromes. *Curr Pain Headache Rep* 2004;8:445-451.

Summary

The author is a practicing urologist associated with the University of Tennessee. In this paper, she describes that painful bladder syndrome/interstitial cystitis, chronic prostatitis, and irritable bowel syndrome (IBS) are often associated with abdominal wall and pelvic floor MTrPs. Both visceral pain from pelvic organs and myofascial pain from MTrPs generally are diffuse and poorly localized. Peripheral and central sensitization with resultant hypersensitivity and allodynia are common in both conditions. Referred pain can be from visceral organs to the muscles or from MTrPs to visceral organs and both syndromes can trigger each other. Dr. Doggweiler summarizes several common referred pain patterns from MTrPs in the low back, abdominal, and pelvic region. She emphasizes that visceral disease may increase MTrP activity as seen for example with herpes viruses and urinary tract infections. She continues with an overview of the components of a comprehensive urologic examination, including an assessment of bladder function, voiding diary, vaginal or rectal pelvic examination assessing tenderness, contraction, strength, and coordination of the pelvic floor muscles, assessment of perpetuating factors, a musculoskeletal evaluation, that includes gait and posture, and manual examination of MTrPs. The author concludes that his article should not be interpreted as saying that painful bladder syndrome/interstitial cystitis, chronic prostatitis, and IBS are always caused by MTrPs but the possibility needs to be considered before planning more invasive approaches. MTrPs can be the only or concomitant cause of many debilitating pain syndromes.

Comments

This article complements the paper by Jarrell reviewed above. It is another excellent example that the training in the identification of MTrPs needs to extend to many different medical disciplines. It is remarkable that after Drs. Doggweiler, Jarrell, and Teachey (also reviewed in this issue) have been trained to properly identify MTrPs, they each have applied the newly gained knowledge into their respective practices. Each physician found that in many cases common diagnoses within their disciplines could be attributed to MTrPs. It makes us wonder how many patients with interstitial cystitis, chronic prostatitis, or other visceral disease could be managed so much better if their clinician had been trained in the identification of MTrPs [JD].

Gur A, Sarac AJ, Cevik R, Altindag O, Sarac S. Efficacy of 904 nm Gallium Arsenide low level laser therapy in the management of chronic myofascial pain in the neck: A double-blind and randomize-controlled trial. *Lasers Surg Med* 2004; 35:229-235.

Summary

Low-level laser therapy is gaining much ground as a valid treatment tool for MTrPs. Several previous studies were inconclusive because of methodological errors and misconceptions[24,25]. The current paper does not suffer from such errors. The study is a prospective, double blind, randomized, and controlled study of the effects of infrared low level 904 nm Gallium-Arsenide (Ga-As) laser therapy (LLLT) on MTrPs. Sixty subjects with a history of chronic myofascial neck pain were randomly assigned to two treatment groups. Group 1 received actual laser therapy, while group 2 received sham laser. All subjects were seen daily for two weeks except weekends. Outcome measures included pain at rest, pain at movement, number of trigger points (TP), the Neck Pain and Disability Visual Analog Scale (NPAD), Beck depression Inventory (BDI), and the Nottingham Health Profile (NHP). Measurements were taken at baseline, and at 2, 3, and 12 weeks. Inclusion criteria were 1.) age 17–55 years; 2.) pain from the neck and shoulder-girdle lasting at least 1 year, affecting the quality of work or daily living; 3.) between one and ten tender points in the shoulder-girdle, tender points that on palpation induced reproduction of the reported symptoms [note: even though the authors used the term "tender point", from the study it is clear that they used Simons, Travell and Simons criteria for MTrPs[3] – JD]. The researchers excluded nearly all other possible pathologies and conditions. The study showed significant improvements in the laser group in all studied parameters, including levels of pain, number of MTrPs, depression scores, and functional and quality of life measures. In addition, subjects in the treatment group scored significantly higher on a test for self-assessed improvement of pain (63% vs. 19%). The authors conclude that LLLT can be an important adjunct in the treatment of patients with MTrPs.

Comments

Even though the exact mechanisms of LLLT are not known, this study eloquently illustrates that LLLT should be considered in the treatment of MTrPs. It is likely that the effects of LLLT are due to a combination of anti-nociceptive, anti-inflammatory, collagen proliferation, and circulatory effects. LLLT is an excellent choice of treatment, especially for those patients with adverse effects to medications or needling procedures. The treatment is painless and has very few, if any, negative side effects [JD].

Simons DG. Review of enigmatic MTrPs as a common cause of enigmatic musculoskeletal pain and dysfunction. *J Electro Kinesiol* 2004;14:95-107.

Summary

In this review article, Simons explores the impact of MTrPs on work-related musculoskeletal pain. After a comprehensive historical overview dating back to the early 1900's, the author reviews the clinical features of MTrPs, comments on various treatment options, and most importantly, provides a critical and reflective analysis of the Integrated Hypothesis. In taking a patient's history, common features suggesting the presence of clinically relevant MTrPs include a complaint of regional pain, onset of pain wither following sudden muscle overload, sustained muscular contraction, or repetitive activity. Acceptance of the concept of MTrPs is hampered by at least five reasons: 1. MTrPs lack a generally recognized etiology; 2. there is no diagnostic gold standard; 3. MTrPs are underexamined by research investigators; 4. MTrPs are complex, interactive, and often coexist with other conditions; and 5. relatively few practitioners have received adequate training to diagnose MTrPs. The second half of the paper reviews various aspects of the Integrated Trigger Point Hypothesis and points to several areas of future research to validate the underlying assumptions. For example, Simons expresses that "a study is needed that examines the prevalence of MTrPs at sites identified as endplate noise during routine electromyography," or "biopsies including longitudinal sections of human MTrPs are urgently needed." The paper concludes that MTrPs are indeed a likely source of musculoskeletal disorders, especially in the workplace.

Comments

It is always refreshing when an author is able to question his own work. In this paper, Simons reviews with much clarity and honesty what is and what is not known about the pathophysiology of MTrPs. Many peer-reviewed research studies on MTrPs are difficult to obtain, as the journals that have published them are not necessarily included in the database of the National Library of Medicine (Medline, PubMed and Gateway). In spite of these often-excellent publications, there is a tremendous shortage of research that incorporates the clinical experience of practitioners worldwide familiar with the identification and management of MTrPs. Further studies are needed that explore the pathophysiologic mechanisms underlying MTrPs. The articles by Gerwin et al and McPartland[26,27] may signal a significant step in that direction and combined with this article form a solid basis for future research efforts [JD].

Gerwin RD, Dommerholt J, Shah JP. An expansion of Simons' Integrated Hypothesis of trigger point formation. *Curr Pain Headache Rep* 2004;8:468-475.

Summary

Based on new experimental data and established muscle pathophysiology, the authors propose an expansion of Simons' Integrated Hypothesis[3] as to the etiology of MTrPs. They consider the event that activates an MTrP to be an acute or repeated muscle overload such as eccentric or strong concentric contraction with the contractile forces distributed irregularly through hypoperfused muscle. Focal areas of muscle injury and ischemia cause low tissue pH and hypoxia. These in turn induce local histochemical changes that release substances that stimulate muscle nociceptors that cause pain. The histochemical changes also facilitate resting acetylcholine (ACh) release at the myoneural junction, inhibit ACh breakdown, and inhibit removal of ACh from its receptor. As these changes wind up and become self-sustaining they induce local muscle contracture. This increased muscle-fiber tension is responsible for the palpable taut band characteristic of MTrPs. Normally, the nerve terminal releases quantal (packets of) ACh by exostosis into the synaptic cleft, at various rates continuously, and in large quantities in response to a motor nerve action potential that originates in the motor neuron. In addition, the nerve terminal can spontaneously release quanta occasionally or leak ACh continuously at various rates as non-quantal ACh. The acetylcholine esterase (AChE) in the synaptic cleft limits ACh passage to the acetylcholine receptors (AChR) in the postjunctional membrane of the muscle cell and also helps to terminate ACh activation of the receptor. These functions of the esterase are inhibited by the acidic milieu observed in the region of an active endplates[22]. Activation of many of these ACh receptors due to the simultaneous arrival of a large number of quanta induces an action potential that eventually causes a muscle contraction (twitch). Following muscle overload, sufficient (abnormal) continuing steady activation of individual receptors due to spontaneous ACh release from the motor nerve terminal depolarizes the postjunctional membrane and produces endplate noise, but rarely induces a propagated action potential. Such occasional threshold responses are identified as spontaneous endplate spikes. A key feature of the hypothesis is this increased effectiveness of ACh with resulting endplate noise and occasional endplate spikes. The initial injury-induced muscle fiber ischemic hypoxia and tissue acidity induces release of adenosine triphosphate (ATP), substance P (SP), calcitonin gene related peptide (CGRP), bradykinin, cytokines, and other substances that sensitize and activate muscle nociceptors[16,22]. These substances are well known to cause local edema and pain and can produce central neuroplastic changes that lead to allodynia, hyperalgesia, and enlargement of the pool of activated dorsal-horn nociceptive neurons[16]. CGRP 1 (type 1) is produced in the anterior horn motor neuron body and goes by axoplasmic flow to the nerve terminal. Its production is upregulated by neuronal blockade. CGRP increases the effectiveness of ACh by enhancing spontaneous release of ACh from the nerve terminal; by down-regulating all forms of ACh esterase and their activity at the synapse; and up-regulating ACh receptors in the postjunctional membrane by increasing their phosphorylation; by increasing the rate of AChR desensitization; by prolonging the mean open time of AChR channels; and by increasing the concentration of ACh receptors on the post-synaptic membrane. In addition to the nociceptor sensitizing substances identified by Shah et al[22] in the region of involved endplates, the presence of an acidic pH alone strongly initiates and perpetuates muscle pain in rat muscle without damaging muscle tissue. This rat model demonstrates that secondary mechanical hyperalgesia is maintained by neuroplastic changes in the central nervous system. Mechanical hyperalgesia is characteristic of MTrPs. The authors conclude that these new findings support the main thesis of the Integrated Hypothesis and point to areas needing further investigation.

Comments

This tour de-force of the histochemical and activity changes that can occur in motor endplate regions within an MTrP fit beautifully the clinical characteristics of

MTrPs and strongly reinforces the Integrated Trigger Point Hypothesis. The addition of CGRP effects to our thinking is of fundamental importance for a better understanding MTrPs. The remarkable study by Shah et al[22] establishes clearly that the substances described so fully in this paper are present and active in MTrPs. Together they open a new chapter in the MTrP saga. The article discussed below by McPartland[27] that is also reviewed in this issue approaches this same subject from the genetic point of view and makes a number of additional valuable contributions to our understanding of this hypothesis. Together, these reports open the road to additional research that can further refine the hypothesis [DGS].

McPartland JM. Travell trigger point: Molecular and osteopathic perspectives. *J Am Osteopath Assoc* 2004;104;244-249.

Summary

McPartland effectively summarizes how the Integrated Hypothesis added substantially to our understanding of the pathophysiology of MTrPs. The hypothesis, first published in the 1999 *Trigger Point Manual*[3], identifies the core dysfunction with the effect of increased release of acetylcholine (ACh) in involved myoneural junctions (endplates) of skeletal muscle. McPartland presents in detail how genetic effects producing presynaptic, synaptic, postsynaptic, and acquired dysfunctions could do this. The genetic effects involve defects in the L-type and N-type voltage-gated Ca^{2+} channels. With regard to presynaptic mechanisms internet sources list 695 reports of L-type and 57 reports of N-type Ca^{2+} channel mutations that would increase release of ACh from the nerve terminal. With regard to synaptic mechanisms known genetic defect can impair cholinesterase inactivation of ACh within the synaptic cleft. With regard to postsynaptic mechanisms, the 5 subunits of nicotinic ACh receptors depend on at least 16 gene codes that combine in a variety of ways that can produce gain-of-function defects, making them particularly susceptible to genetic defects. With regard to acquired mechanisms, dysregulated expression of the 16 gene codes for nicotinic ACh receptors can substitute the CNS form (activated by nicotine) for the muscle form that is not responsive to nicotine (may be important to smokers); single genes expressing splice variants; and by simple upregulation of L-type and N-type Ca^{2+} channel receptors by psychological, physiological, and chemical stressors. The author then describes how these effects interact with and reinforce other features of the Integrated Hypothesis including segmental central nervous system effects (somatic dysfunctions of Korr) and with biomechanical factors like postural disorders. He details how the most recent clinical treatments of the *Trigger Point Manual* relate closely to osteopathic manual techniques and emphasizes the common interactions between MTrPs and articular dysfunctions. McPartland presents a detailed review of how Quotane, capsaicin, dry needling, Botulinum toxin injection, quinidine, diltiazem hydrochloride, and herbal medicines that are used to treat MTrPs affect Ca^{2+} or Na^{+} channel function. He concludes that with a better understanding of its molecular basis, the MTrP approach will continue to co-evolve with osteopathic concepts.

Comments

The appearance of this article and that of Gerwin et al[26], which is also reviewed in this issue, indicate that the Integrated Hypothesis has stimulated further research and integrative thinking in support of the Hypothesis as the most credible concept of the etiology of MTrPs. This paper is a gold mine of support for that hypothesis and shows a remarkable depth of understanding of the hypothesis and current knowledge of genetic effects. Especially propitious is the enthusiasm for this concept and clinical approach shown by an osteopathic physician. The osteopathic literature has had few reviewed articles on MTrPs for many years. Hopefully this is a breakthrough that will quickly gather momentum [DGS].

Fernández-de-las-Peñas C, Campo MS, Carnero JF, Page JCM. Manual therapies in myofascial trigger point treatment: A systematic review. *J Bodywork Movement Ther* 2005;9:27-14.

Summary

The seven studies that were included in this review of results of manual therapy treatment of MTrPs were found by searching seven databases and were evaluated for quality on a 10-point scale. Two blinded reviewers examined each article for inclusion and exclusion criteria, design, randomization, description of dropouts, blinding, outcome measures, details of the intervention used, and results. Two studies rated 6 points, two 5 points, and one each 3, 2, and 1 point. The results of this examination were tabulated for each article. Treatment was aimed at reducing pain and restoring normal function and most treatments were targeted at deactivating MTrPs. Treatments that were reported included spray and stretch, soft tissue massage, and pressure release [misnamed ischemic compression] in two studies each. Occipital release, active head retraction and retraction/extension [per McKenzie], strain/counterstrain, and myofascial release were studied in one study each. Only two studies examined efficacy beyond placebo and found no difference. The authors reported finding: 1. that few randomized controlled trials analyzed manual therapy of MTrPs; 2. that neither retraction/extension exercises nor ultrasound with massage and exercise were better than placebo; 3. an urgent need for research that establishes efficacy of treatment beyond placebo; and 4. that "no reported treatment had been more efficacious than control intervention", and that some [3] trials confirmed that "MTrP treatment is effective in reducing the pressure pain threshold and visual analog scale [VAS] scores". They noted the established value of outcome measures including pressure pain threshold measures by algometry, VAS measures, and range of motion, since MTrPs characteristically restrict range. The authors expressed serious concern about the lack of general agreement as to appropriate diagnostic criteria for identifying MTrPs by examination and quoted five studies that questioned the reliability of all of the examinations that have been commonly recommended. They concluded that efficacy of manual therapy beyond placebo has been neither established nor refuted and that it is effective in reducing pressure pain sensitivity [of MTrPs].

Comments

This thoughtful review of carefully selected literature provides valuable insight into where we now stand and what is most urgently needed. There are just two points that may need some clarification. The authors' tabulated results of the Gam et al[28] study indicated that treatments caused significantly less tenderness than no treatment in controls. More specifically, the authors of that study concluded that massage of the MTrPs and a home stretching program was effective in reducing the number and intensity of treated MTrPs, whereas ultrasound treatment made no difference. The fact that this effect on MTrPs did not result in significant reduction in clinical pain complaint [VAS scores] may be at least partly due to the fact that over half of the treated patients had more than the 5 active MTrPs [could be 10] that were selected for treatment in this study. The remaining untreated MTrPs would be likely to be aggravated and cause more pain because of the absence of the treated MTrPs. This would obscure the clinical benefits of treatment. Clinical experience generally is that when the MTrPs that are causing the pain become less tender the pain complaint decreases. If research studies do not substantiate this, it is important to determine why. The other point concerns reliability of examination of MTrPs. The author's tabulated results of 4 studies clearly indicate that some examinations are consistently more reliable than others. Some of the studies cited had significant weaknesses that would account for much of their poor results. The tabulated results of the Gerwin et al study[4] make it clear that the three examinations they recommended were highly reliable with high kappa scores of: palpable taut band-0.85, tender spot in taut band-0.84, pain recognition-0.88. They specifically did not recommend the local twitch response-0.44 as a diagnostic criterion. The other outstanding study, not included in that table, was Sciotti et al[29] with even better results under more demanding conditions. Evaluation of all of the studies published and clinical training experience indicate that it takes innate ability with adequate training and practice to develop a high degree of reliability in the examination of MTrPs and that some muscles are consistently more reliably examined than others [DGS].

Teachey WS. Otolaryngic myofascial pain syndromes. *Curr Pain Headache Rep* 2004;8:457-462.

Summary

The author of this paper is an otolaryngologist, who has integrated the diagnosis and treatment of MTrPs in his practice. He describes that over a period of five months, in 106 of 257 consecutive new patients (41%) with complaints of pain, headaches, or ear, nose, and throat symptoms, the chief complaint was attributed to MTrPs. Many of these patients had already received multiple ineffective treatments over a long period of time by a variety of medical disciplines. The worst cases included multiple dental extractions, multiple varying types of dental splints, dental occlusal therapy, or temporomandibular joint adjustments. Teachey reviews many diagnoses commonly seen in any otolaryngic practice. In his experience, sinusitis unresponsive to antibiotics is frequently due to MTrPs in the masseter, pterygoids, zygomaticus, or sternocleidomastoid muscles. Patients with ear aches, a foreign body sensation in their ear, "blocked" ears, hyperacusis, hypoacusis, hearing loss, tinnitus, or dizziness with normal otolaryngic and audiometric studies often have active MTrPs in the pterygoids, masseters, or the clavicular division of the sternocleidomastoid muscle. Teachey includes a long list of several other common diagnoses such as headaches, nasal pain or congestion, pain or pressure in or behind the eyes, blurred vision, reddening of the conjunctiva, chronic/recurrent "tonsillitis," dysphagia, odynophagia, burning sensation, throat "congestion"; throat "drainage," voice irregularities, chronic and recurrent pain in the area of the parotid or submaxillary glands, parotitis, and submaxillary sialadenitis, among others. The paper includes five pertinent case studies that further illustrate the importance of considering MTrPs in the differential diagnosis. Teachey warns that in spite of the impressive number of patients with myofascial dysfunction, true disorders suggesting ear, nose, throat, and sinus pathology must first be considered.

Comments

To the best of our knowledge, this is the first paper that describes in detail how common clinically relevant MTrPs are seen in an otolaryngic practice. Based on personal communication with the author, his practice has changed considerably since he has included MTrPs in his list of common diagnoses. After completing extensive training in the diagnosis and treatment of myofascial pain, Teachey uses a multidisciplinary approach as described in this important paper [JD].

Graff-Radford SB. Myofascial pain: Diagnosis and management. *Curr Pain Headache Rep* 2004;8:463-467.

Summary

This article succinctly reviews the pathogenesis of myofascial pain with emphasis on both central mechanisms with peripheral clinical manifestations. The author includes a description of an integrated 6-week management approach that involves stimulating central inhibitory mechanisms through pharmacology and behavioral techniques and simultaneously reducing peripheral inputs through physical therapies including exercises and trigger point-specific therapy. Patients experienced a 90% reduction in pain and a 90% reduction in their analgesic use [JD].

Itoh K, Katsumi Y, Kitakoji H.Trigger point acupuncture treatment of chronic low back pain in elderly patients: A blinded RCT. *Acupunct Med* 2004;22(4):170-177.

Summary

This randomized controlled clinical study compared the efficacy of standard acupuncture, superficial and deep dry needling in the treatment of elderly patients with chronic LBP. Thirty-five consecutive patients were randomly assigned to one of three intervention groups. After eight subjects dropped out, nine subjects participated in each group. All subjects were over 65 years of age, had a history of lumbar or lumbosacral low back pain for at least six months without radiation of pain, a normal neurological examination, and no previous treatment with acupuncture for low back pain. Subjects with a history of major trauma, systemic disease, or with conflicting treatments were excluded. Subjects and an independent assessor were blinded to the kind of treatment that was offered. Each group received one weekly 30-minute treatment during two 3-week periods with 3 weeks in between the two periods. The standard acupuncture group received treatment at traditional acupuncture points, including BL23, 25, 40, 60, GB30, 34, and up to four ah shi points of greatest tenderness. Disposable stainless needles (0.2 mm x 40 mm) were inserted into the muscle to a depth of 20mm and a standard "sparrow pecking" technique was applied. The sparrow pecking method involves alternate pushing and pulling of the needle. After the subject felt dull pain or de *de qi* acupuncture sensation, the needle was left in place for 10 minutes. The dry needling groups received treatment at MTrPs in taut bands of several low back muscles, including the quadratus lumborum, iliopsoas, piriformis, and gluteus maximus, among others. Standard acupuncture (0.2 mm x 50 mm) needles were inserted into the skin over MTrPs. In the superficial needling group the needle was advanced to a depth of approximately 3 mm. Once a subject would report dull pain or de *de qi* sensation, the needle was kept in place for 10 more minutes. In the deep dry needling group the needle was advanced an additional 20 mm. Using the described sparrow pecking technique, the needle was again kept in place for an additional 10 minutes, once a local twitch response was elicited. Outcome measures included a Visual Analog Scale (VAS) for pain intensity and the Roland Morris Questionnaire (RMQ). The VAS was assessed immediately before the first treatment and one, two, three, six, seven, eight, nine, and twelve weeks after the first treatment. The RMQ was assessed before the first treatment and three, six, nine, and twelve weeks after the first treatment. The group that received deep dry needling reported less pain intensity and improved quality of life after the first treatment series compared to the other two groups, although statistically significance was not reached. There was a significant reduction in pain intensity between the first treatment series and the start of the second treatment series for the deep dry needling group, but not for the standard acupuncture and superficial dry needling groups. The authors concluded that deep dry needling might be more effective in the treatment of LBP in elderly patients than either standard acupuncture of superficial trigger point dry needling.

Comments

Dry needling is slowly becoming a common technique in the treatment of MTrPs. For example, in the United States, state boards of physical therapy in eight states have determined that dry needling falls within the scope of physical therapy practice[30]. In the Netherlands, two medical courts have ruled that physical therapists can perform dry needling techniques[31]. In Ireland, the National Training Centre has initiated a National Qualification Examination in Trigger Point Dry Needling. Therefore, this study is a welcome comparison of different needling approaches. While the authors concluded that deep dry needling might be the most effective treatment option, it is important to realize that the protocols used for both superficial and dry needling do not necessarily reflect common clinical practice. When using the superficial dry needling technique, Baldry recommends that the amount of needle stimulation should depend on an individual's responsiveness. In so-called average responders, Baldry recommends leaving the needle in situ for 30-60 seconds. In weak responders, the needle may be left for up to 2 or 3 minutes. The needle is inserted to a depth of 5

– 10 mm[32,33]. In this study the needle was inserted only 3 mm and left for 10 minutes. With deep dry needling, it is common to continue the "sparrow pecking" or "fast in/out" technique until no further local twitch responses can be elicited[30,34]. Commonly, this may involve as many as 10-15 or more attempts. In this study, only one local twitch response was elicited after which the needle was kept in place for an additional 10 minutes. To needle deeper MTrPs in for example the gluteus maximus muscle, clinicians commonly use acupuncture needles with a 0.30 mm diameter instead of the 0.20 mm used in this study. Frequently the needle is inserted much deeper than the 20+ mm in this study. It is not clear whether all MTrPs involved in LBP were treated, which implies that for some subjects the VAS scores may not have changed much as other non-treated MTrPs may have continued to contribute to complaints of pain.The study has a relatively small sample size of only 9 subjects per group. It seems a bit premature to conclude that only deep dry needling results in a reduction of pain. Other studies have demonstrated that acupuncture and superficial dry needling can also be effective in the treatment of individuals with LBP[32,35-38] [JD].

Kamanli A, Kaya A, Ardioglu O, Ozgocmen S, Zengin FO, Bayik Y. Comparison of lidocaine injection, botulinum toxin injection, and dry needling to trigger points in myofascial pain syndrome. *Rheumatol Int* 2005; 25:604-611.

Summary

This prospective single-blind study compared the effects of botulinum toxin type A injections with 0.5% lidocaine injections and with dry needling. Eighty-seven MTrP in 23 female and 6 male subjects were randomly assigned to one of the intervention groups. Subjects with at least one MTrP located in the upper, middle, or lower trapezius, levator scapula, teres minor, supraspinatus, or infraspinatus muscle were included in the study. The problem had to be present for at least 6 months and subjects were not allowed to have had any treatment during the preceding 8 weeks. The contralateral muscles were used as control sites. Exclusion criteria were extensive and included a history of cardiovascular or respiratory disease, allergies, MTrP injections within the last 2 months, cervical or shoulder surgery with the last year, fibromyalgia syndrome, cervical radiculopathy, myelopathy with severe disc or skeletal lesion, pregnancy, poor cooperation, medication regimen that included aminoglycosides or medications preventing neuromuscular transmission. The authors used multiple outcome measurements including cervical range of motion, pressure pain threshold, pain score measurements, visual analog scales for pain, fatigue, and work, the Nottingham Health Profile, and the Hamilton Anxiety and Depression Inventory. All interventions were performed with 1.25 in. long, 25-gauge needles. Active MTrPs were diagnosed using the criteria of Simons, Travell, and Simons[3]. The needle was advanced until the MTrP was reached. In the lidocaine group, 1 ml of 0.5% lidocaine was injected after which the needle was moved backward and forward to needle the same point 8-10 more times. The tip of the needle was withdrawn to the subcutaneous tissue and directed toward the upper and lower parts of the first injection site, reportedly to inactivate satellite MTrPs. The dry needling group received the same procedure but without the injection of lidocaine. The botulinum group underwent the same needle procedure followed by a single injection of 10-20 IU of botulinum toxin type A. For all groups, the intervention was followed by compression of the needle site for 2 minutes, passive stretching, and home exercise programs. A total of 32, 33, and 22 MTrPs were treated in the lidocaine, dry needling, and botulinum toxin groups respectively. All interventions had significant positive effects on cervical range of motion and pressure pain thresholds. Pressure pain threshold were significantly higher in the lidocaine group compared to the dry needling group. The pain scores were lower in the lidocaine group compared to both the dry needling and botulinum toxin groups. The visual analog scales and quality of life scales were significantly improved in the lidocaine and botulinum groups, but not in the dry needling group. Depression and anxiety improved only in the botulinum toxin group. The authors concluded that lidocaine injections are the preferred treatment of choice with botulinum toxin injections reserved for persistent myofascial pain problems.

Comments

It is of great interest that all three treatment groups experienced improvement in several pertinent areas. The authors preferred lidocaine injections realizing that botulinum toxin injections may provide a longer lasting therapeutic effect especially when combined with physical therapy. In a personal communication, one of the study's authors (Dr. Ozgocmen) shared that in his medical practice he rarely uses acupuncture needles for dry needling procedures. Instead, he prefers to use empty syringes with 0.60 X 30 needles. Based on clinical experience and a desire to use the same syringes in all three intervention groups, dry needling with syringes was the preferred choice in this study. This allowed the researchers to determine whether the effects obtained by MTrP injections were related to the pharmaceutical agent. The dry needling procedure in fact became a control group for the lidocaine and botulinum toxin injections. It comes as no surprise that the dry needling procedures using a syringe were found to be more painful. Eighty percent of the patients reported pain during the dry needling procedures compared to 20% of the lidocaine group. In the reviewer's clinical practice, dry needling procedures are always performed with acupuncture needles ranging in size from 0.16 mm x 13 mm for facial muscles to 0.30 mm x 75 mm for larger muscles and deeper MTrPs. Based on empirical experience, it appears that dry needling procedures using thin acupuncture needles is experienced as less painful by most patients than injections with 0.25% lidocaine. A previous study comparing lidocaine injections and dry needling also used syringes for dry needling[34]. It would be interesting to compare 0.25% lidocaine injections with dry needling using acupuncture needles. Using a 0.25% dilution of lidocaine was found to be more effective with less pain from the injection than using a 1% solution [39]. A 0.5% solution is also more painful [JD].

Smania N, Corato E, Fiaschi A, Pietropoli P, Aglioti SM, Tinazzi M. Repetitive magnetic stimulation; A novel therapeutic approach for myofascial pain syndrome. *J Neurol* 2005;252:307-314.

Summary

As a follow-up to a previous study of the efficacy of repetitive magnetic stimulation (rMS) on myofascial pain[40], in this study the authors compared rMS to transcutaneous electrical nerve stimulation (TENS). The authors indicated that the technique of rMS used in this study allows for much greater intensities than traditionally used in magnetic therapy. Magnetic stimulation has been used for at least 70 years to reduce musculoskeletal pain. In this study two different rMS coils were used. A figure-eight-shaped coil induces a more intense and focal stimulation compared to a circular coil, that delivers a less intense and more diffuse effect. Fifty-three subjects with MTrPs in the upper trapezius muscle were randomly assigned to an rMS group, a TENS group, or a placebo group. All subjects were treated daily for 20 minutes, five days a week for two consecutive weeks. Inclusion criteria included the presence of myofascial pain syndrome based on the criteria suggested by Esenyel et al: 1. presence of a tender spot characterized by spontaneous pain or associated with movement of the right or left superior trapezius muscle; 2. reproduction or enhancement of clinical symptoms by compression of the active MTrP; and 3. presence of a palpable taut band peripheral to the MTrP[11]. Exclusion criteria included 1. clinical symptoms of fibromyalgia; 2. age below 18 or above 80; 3. mental retardation; 4. neurological deficits involving the upper limbs; 5. advanced osteopathic or arthropathic disorders of the cervical spine; 6. presence of contraindications for the administered therapies (including subjects with cardiovascular disease, hypertension, coagulopathy, ulcer, recent severe hemorrhage, renal insufficiency, severe hepatic disease, neoplasia, epilepsy, cutaneous pathology, or pain of central origin); 7. metallic implants; 8. pregnancy. The subjects in the rMS group were initially treated with the figure-eight-shaped coil, until the coil reached a temperature of 40EC, after which the circular coil was used. The coils were placed over the most painful MTrP. A total of 4000 pulsed magnetic stimuli were administered in 5-second trains at 20Hz with a 25-second intermission. The stimulation intensity was based on the subjects' pain thresholds. TENS was applied with the negative electrode placed over the most painful MTrP and the positive electrode on the acromial tendon insertional site of the trapezius muscle. TENS treatment parameters included a current frequency of 100 Hz, pulse width of 250 μs, an asymmetrical rectangular biphasic wave form, zero net DC current, and the intensity based on the subjects' comfort levels. The intensity was adjusted when subjects no longer perceived a local sensation. The placebo group received sham ultrasound. Ultrasound gel was placed over the zone of the MTrP. However, the ultrasound device was never turned on. Outcome measures included a 20-item neck pain and disability visual analogue scale (NPDVAS), algometry, manual assessment of the treated MTrP, and cervical spine flexion and rotation. Assessments were determined before and immediately after the treatment, and at one and three months post therapy. The rMS group showed significant improvements in all outcome measures, which remained stable three months after the treatments. The TENS group demonstrated significant improvements in all outcome measures, except for algometry and contralateral bending. All improvements were lost at the one and three month assessments except for the NPDVAS, which was still improved at one month. The placebo group failed to show any progress. The authors concluded with an elegant discussion section in which they suggested that "rMS may be a novel, non-invasive and reliable therapeutic approach…"

Comments

Smania et al have conducted an excellent clinical study of the effects of magnetic stimulation on MTrPs. We agree that rMS appears to be a promising new treatment modality with long-lasting effects especially when compared to TENS or placebo. The authors warn that because of the small sample size definitive conclusions would be premature [JD].

Crotti FM, Carai A, Carai M, Grimoldi N, Sgaramella E, Sias W, Tiberio F. Post-traumatic thoracic outlet syndrome (TOS). *Acta Neurochir* 2005;92(Suppl):13-15.

Summary

The authors present the results of thoracic outlet surgery involving a large population of 280 patients (220 females, 60 males; age range: 27 – 78; 184 patients had right-sided surgery, 96 on the left). Pain was the common factor in the clinical history. Sixty-four cases reported a sudden onset versus 216 with a more gradual onset. In all patients, neurological, vascular, and myofascial pain symptoms were observed prior to surgery. Neurogenic pain was found in all cases and was described as radiating pain in the C8-T1 dermatomes (252 cases) or C5-C6 dermatomes (28 cases). The pain was described as a "shooting" pain. Vascular pain was found in 80% (216) of all patients. It was characterized as "throbbing" pain, variable in intensity, duration and spread, with typical physical changes including rubor, tumor, calor, or pallor to the fingers, the whole hand, limb, neck, breast up to the contralateral hand. Myofascial pain was present in 90% (252) of all cases. The distribution of myofascial pain was reported as being identical in all patients and involved the upper quarter of the body. The authors reported that the pain extended "along the fascias and was commonly perceived on the biceps, triceps, trapezius, scalenes, and pectoralis muscles." Manually tapping of certain tender areas or trigger points elicited the patients' typical referred pain patterns. Myofascial pain was described as "tension ache" or "burning." The authors provided a meticulous description of other features. Paresthesia, avoidance of certain movements or postures, a postural lateral tilt of the head toward the injured side were seen in all patients. Ninety percent of patients presented with an ipsi-lateral tilt of the pelvis and 80% had a scoliosis. In a small minority (20 patients) clear motor deficits (interosseus muscle atrophy) were observed. Twenty-eight patients were diagnosed with bilateral cervical ribs on X-ray. Only one patient out of 88 patients evaluated with Doppler sonography had an impairment of the digital arterial flow. Twenty-eight cases were evaluated with angiography and were found to have a slow-down of the flow of the subclavian vein. In none of the other cases was thoracic outlet syndrome confirmed by any of these more advanced technologies. All patients underwent physical therapy intervention for at least 3 months. Criteria for surgery included persistent symptoms, brachial pain for more than 6 months, dermatomeric hypesthesia, a positive supraclavicular Tinel's sign, positive brachial plexus tension test (Elvey's test), and subjective symptoms severe enough to disturb life style. During surgery the authors found several anatomical or structural anomalies however, they concluded that only the presence of cervical ribs played a role in the pathogenesis of thoracic outlet syndrome. In 244 patients they did not find any immediate evidence of structural compression. In nearly half the patients of this group, the anterior scalene muscle was close to or had merged with the medial scalene muscle, thereby effectively reducing the size of the interscalene triangle. In 200 patients out of the 244, an elevated first rib further compressed the subclavian artery and the C8-T1 trunk. In 88% of all patients there was evidence of neurovascular compression. In all patients they found a fibrillar net bridging the interscalene triangle and compromising the neurovascular bundle. In addition, in all patients the trunks of the plexus were stretched by pulling the scalene muscles. Within the context of this abstracts of current relevant literature with regard to MTrPs and MPS, this study becomes very relevant when viewing the results of surgical intervention. All patients had immediate complete remission of neurogenic pain. Fifty-two patients had immediate relief of vascular pain. After 3-4 weeks all vascular pain had vanished. However, only 20 patients (10%) experienced a complete remission of their myofascial pain immediately after surgery. Eighty-eight patients continued to have myofascial pain for several weeks, while 108 patients continued to have myofascial pain for at least 1 year. The authors emphasized that in thoracic outlet syndrome it is not sufficient to only look for sources of direct compression. In many patients the authors did not find any clear precipitating factors leading to thoracic outlet syndrome. Instead, they concluded that, "trivial stretch or movement on overloaded muscles (e.g. scalene) could activate a latent trigger point and lock some fibers in taut bands." They further suggested that eventually these myofascial restrictions may lead to tethering of the brachial plexus and chronic nerve entrapment, especially when combined with structural (anatomic) abnormalities or longstanding postural deviations. Myofascial pain should, therefore, be considered a primary symptom of thoracic outlet syndrome. Following this study, the authors informally sampled another 240 patients and reported that they again "easily found a large group of fibromyalgia syndrome or myofascial pain syndrome patients more or less bordering thoracic outlet syndrome."

Comments

Although this paper mentions MTrPs only briefly, the findings have far-reaching consequences for clinical practice and the management of thoracic outlet syndrome. Basically, the authors, who are associated with a neurosurgery clinic, recognized two kinds of pain mechanisms evident in thoracic outlet syndrome. The neurogenic-vascular pain loop is treated successfully with surgery. However, the myofascial pain loop continues after surgery and may be responsible for the poor outcomes frequently reported for thoracic outlet syndrome surgery. Myofascial pain is not necessarily altered by surgery. Ninety percent of patients continued to suffer from myofascial pain following surgery, which prompted the authors to recommend that patients must be informed that the same pain symptoms from before surgery may indeed persist after surgery. Myofascial pain may in fact be the primary problem leading eventually to signs and symptoms of thoracic outlet syndrome[3,41]. Prior to surgery all patients were seen for at least 3 months in physical therapy. Brachial plexus entrapments are common with MTrPs in the pectoralis minor, and in the anterior and medial scalenes. It is not clear from this paper, to what extend physical therapy included any specific MTrP work, such as manual trigger point release, dry needling, injection therapy, or even postural corrections. The authors observed significant postural deviations, such as a lateral head tilt, an ipsi-lateral pelvic tilt, and scoliosis. These can all be associated with MTrPs in the scalene muscles, paraspinal muscles, and quadratus lumborum for example. The paper does not include the number of patients who did not require surgery after successful physical therapy intervention, leaving the question whether physical therapy and MTrP work can indeed prevent thoracic outlet surgery in a number of patients[41] [JD].

Furlan AD, Van Tulder M, Cherkin D, Tsukayama H, Lao L, Koes B, Berman B. Acupuncture and Dry-needling for low back pain: An updated systematic review within the framework of the Cochrane Collaboration. *The Cochrane Database of Systematic Reviews* 2005 (Issue 1). Art. No.: CD 001351, pub2.

Summary

This updated Cochrane review aimed to "assess the effects of acupuncture for the treatment of non-specific low back pain and dry needling for myofascial pain syndrome in the low back region." The researchers reviewed the CENTRAL, MEDLINE, EMBASE databases, the Chinese Cochrane Centre database of clinical trials, and Japanese databases from 1996 to February 2003. Only randomized controlled trials (RCT) were included in this review using strict guidelines from the Cochrane Collaboration. Several reviewers judged the papers for adequacy of treatment, after which a six-panel blinded jury reviewed each study once more and classified them as either acupuncture of dry needling. Other reviewers determined the clinical relevance of each study. A total of 35 RCTs were included in this study with the majority covering acupuncture treatments. The article provides a brief overview of the practice of acupuncture, MPS and MTrPs, and dry needling. The selection process, the methodological quality, and results are well defined. Each study is discussed in great detail with summaries, comparative charts, and figures. The paper includes an extensive list of references. The authors were not able to make any recommendations for the use of acupuncture for acute LBP. There were too few RTCs to draw any meaningful conclusions. There was "some evidence of the effects of acupuncture for chronic LBP." The data suggest that acupuncture and dry needling may be useful adjuncts to other therapies for chronic LBP, although the authors warn that "no clear recommendations can be made because of small sample sizes and low methodological quality of the studies."

Comments

According to their website, the "Cochrane Collaboration is an international non-profit and independent organization, dedicated to making up-to-date, accurate information about the effects of healthcare readily available worldwide. It produces and disseminates systematic reviews of healthcare interventions and promotes the search for evidence in the form of clinical trials and other studies of interventions" (http://www.cochrane.org). Cochrane reviews are highly regarded and rigorous reviews of the available evidence of clinical treatments. The reviews become part of the Cochrane Database of Systematic Reviews, which is published quarterly as part of The Cochrane Library. Although in the period from 1996 to February 2003, the authors did not find many high-quality studies, the conclusions are nevertheless very supportive of the use of dry needling for myofascial pain associated with chronic LBP. This 143-page document called for more and better quality studies. It is a bit confusing that acupuncture studies and dry needling studies were grouped together in the paper, although they were clearly defined as different entities in the introductory sections of the report. This is a valuable paper with an extensive review of pertinent studies. This review underscores the need for credible RCT studies of the effects of dry needling [JD].

Facco E, Ceccherelli F. Myofascial pain mimicking radicular syndromes. *Acta Neurochir* 2005;92(Suppl):147-150.

Summary

This review starts with the statement that "myofascial pain is very often underscored and misunderstood in clinical practice." The common medical approach to pain facilitates this. Often, pain is considered a sign of organic disease with a structural cause only. The implications for the suffering patient are poorly appreciated. The location of pain may introduce further bias. For example, muscle pain is often considered with complaints of neck pain however, with pain problems in the lower extremity, the sciatic nerve is usually implicated. Patients with abdominal pain without an obvious structural detectable basis are often considered neurotic. Clinicians are inclined to select the most evident or preferred diagnosis, while skipping others. In patients with a herniated disk and myofascial pain, physicians may rely primarily on a CT or MRI, without considering whether the structural abnormality is causal or merely coincidental. Notwithstanding that checking for structural lesions is an essential step in the diagnostic process, considering other causes of pain, such as MTrPs, is equally important. The article concludes with a brief review of the most common myofascial pain syndromes mimicking radiculopathies caused by MTrPs in the pectoralis minor, scalenes, serratus anterior, gluteus mimimus, and piriformis muscles. The authors emphasize that failure to consider MTrPs may lead to unnecessary reactive depression. A multidisciplinary approach is recommended to avoid "useless and disappointing surgical treatments."

Comments

It is very encouraging to see this kind of article published in a well-known neurosurgery journal. The authors expressed the impressions of many clinicians working with post-surgical patients with myofascial pain. How many neurosurgeons do in fact consider MTrPs in the etiology and differential diagnostic process? How many patients with MTrPs in for example the gluteus minimus muscle and a bulging disc at L5 undergo unnecessary corrective spinal surgery? The importance of bringing MTrPs to the attention of surgeons as a likely source or contributing factor to various radicular pain patterns cannot be overemphasized. Patients should be encouraged to bring a copy of this paper to their surgeons prior to scheduling a date for surgery [JD].

Çimen A, Çelik M, Erdine S. Myofascial pain syndrome in the differential diagnosis of chronic abdominal pain. *Ağri* 2004;16(3):45-47.

Summary

After a succinct introduction to myofascial pain and specifically abdominal pain, the authors describe a case of a 65-year old female with complaints of pain in the left abdominal region for approximately ten years. The pain was described as stabbing and burning with pain intensities ranging from moderate to severe. The pain increased with standing up, sitting down, walking, and cold weather, and decreased with lying down. The patient denied any changes with food. Non-steroidal anti-inflammatories would offer her several hours of relief. Her past medical history included a childhood appendectomy, two cesarean sections, and a minimal scoliosis. She had consulted many physicians, including urologists and gastroenterologists, but no specific etiologic factor was identified. The physical examination revealed a clinically relevant MTrP in the lower left thoracic paraspinal muscles. The patient recognized "her pain" when pressure was applied to this MTrP. She was treated with an MTrP injection with 20 mg triamcinolone acetonide in 3ml 1% lidocaine after which she experienced immediate pain relief. The patient was prescribed amitriptyline hydrochloride 10 mg per day for two months following the MTrP injection and remained pain free for at least six months.

Comments

This brief case report from Turkey illustrates once more that MTrPs should be considered in the differential diagnosis of abdominal pain. One MTrP injection relieved the patient from a 10-year old pain problem. While treatment of a single muscle MTrP in chronic pain conditions may not always have such dramatic results, MTrPs are nevertheless frequently involved in persistent pain problems[42,43]. The patient was treated with a combination of corticosteroids and 1% lidocaine. It should be noted that there is no evidence that adding steroids to a local anesthetic has any additional benefit[44]. As mentioned before, using a 0.25% dilution of lidocaine was found to be more effective with less pain from the injection[39] [JD].

Crotti FM, Carai A, Carai M, Sgaramella E, Sias W. Entrapment of crural branches of the common peroneal nerve. *Acta Neurochir* 2005;92(Suppl):69-70.

Summary

Three patients operated for lumbar disc herniations continued to present with vaguely described pain in the lateral aspect of the lower extremities. The authors found entrapments of the crural branches of the peroneal nerve, which they associated with MPS. They suggested that patients with MPS might be more prone to developing nerve entrapments partially due to the contractures, development of connective tissue hypertrophy, fascial adhesions, and nerve distraction.

Comments

In this brief paper as well as in the above-reviewed paper on thoracic outlet syndrome surgery, the authors presented a similar hypothesis for the development of nerve entrapments in patients with MPS. The possible link between myofascial pain and nerve entrapment has been suggested by others and deserves further study[45-48] [JD].

Shah JP, Phillips TM, Danoff JV, Gerber LH. An in-vivo microanalytical technique for measuring the local biochemical milieu of human skeletal muscle. *J Appl Physiol*, 2005;99:1980-1987.

Summary

The novel and ingenious micro-analytical system developed and employed by this National Institutes of Health group of clinicians and scientists sampled and measured the in-vitro biochemical milieu within normal muscle and at MTrPs in near real-time at the sub-nanogram level of concentration. The system employed a microdialysis needle capable of continuously collecting microscopic samples (~0.5μl) of physiological saline exposed to the extracellular milieu across a 105-μm thick semi-permeable membrane that permitted diffusion of solutes up to 75 kDa. Nine samples were taken from upper trapezius muscles of 9 subjects in 3 groups: Normal (no neck pain, no MTrPs); latent (no neck pain, latent MTrP present); and active (neck pain, active MTrP present). The needle was inserted near but not into an MTrP (if present) that was identified by a tender spot in a taut band. After 1 minute 4 samples were taken every minute, then 1 sample every 10 seconds, and then the needle was advanced approximately 1.5 cm until the needle elicited a local twitch response. Then a sample was taken every 10 seconds for 4 minutes followed by 5 samples at 1 minute intervals. Local twitches did not occur in normal muscle. Selected analytes were analyzed by immunoaffinity capillary electrophoresis (ICE) and capillary electrochromatography (CEC). Concentrations of protons (H+), bradykinin, calcitonin gene-related peptide (CGRP), substance P (SP), tumor necrosis factor-α [TNF-α], Interleukin-1β [IL-1β], serotonin, and norepinephrine were found to be significantly higher in the Active group than either of the other two groups [$p < 0.01$]. The pH was significantly lower in the active group than in the other two groups ($p < 0.03$). In addition, following the twitch response, peak values of SP and CGRP in active TrPs were significantly higher [active>latent>normal, [$p < 0.02$]. The two substances with the greatest increase in concentration related to the immune system, TNF-α and IL-1β [$p < 0.001$].

Comments

This outstanding, authoritative, and controlled pioneering paper that explores the etiology of MTrPs opens a new chapter in the history of MTrPs. For the first time, this demonstration of high concentrations of effective nociceptive substances specifically and solidly identifies the source of the local and referred pain from MTrPs, validating their clinical existence beyond doubt. In addition, it demonstrated clearly that the purely clinical distinction between latent and active MTrPs that was based on the absence or presence of recognized pain when the MTrP is compressed is associated with a highly significant objective difference in the nociceptive milieu of the two conditions. These two objective findings firmly substantiate the integrated hypothesis. It is no longer appropriate to begin an article on MTrPs with the commonly used statement, "The etiology of MTrPs is unknown." At least, authors should note that there is a credible hypothesis explaining their nature that has substantial experimental verification and deserves serious consideration. It is noteworthy that latent MTrPs commonly cause motor dysfunctions in the same and associated muscles, but only active MTrPs cause clinically symptomatic referred pain. Different parts of the central nervous system mediate these different kinds of effects produced by MTrPs. This emphasizes the importance of identifying both active and latent MTrPs when examining patients with musculoskeletal pain. The motor effects of MTrPs are an investigational frontier that is almost untouched and promises a wealth of valuable clinical insights [DGS].

Hwang M, Kang YK, Kim DH. Referred pain pattern of the pronator quadratus muscle. *Pain* 2005;116:238-242.

Summary

To determine the referred pain pattern of the pronator quadratus [PQ] muscle, these authors injected 35 arms of 35 healthy adults who had no history of neck or arm pain. They used a Teflon coated needle to verify the location of the needle in the PQ by electromyography and then injected 0.2 ml of 6% hypertonic saline. The pain patterns drawn by the patient were processed and combined by computer. Two main patterns appeared: 1. proximal and distal extension of the pain from the injection site broadly along the medial edge of the forearm in the majority of subjects {57%]; 2. a focus of pain over the muscle location on the volar side of the forearm that extended through two phalanges of the 2nd and 3rd fingers, with a less intense but similar pattern on the dorsal side of the forearm and hand. The other 6 subjects had various individual variations including one circumferential pattern of the wrist region. All subjects described the pain as severe (9-10/10), deep, aching, or throbbing and three complained of temporary referred numbness, but none experienced electric shock-like pain that would indicate nerve contact with the needle. These patterns include dermatomes C7-C8 and also ulnar and median nerve distributions. Other muscles referring pain from MTrPs to this region are the deep and superficial flexor digitorum, flexor carpi ulnaris, and abductor digiti minimi muscles. All of these MTrPs should be considered as part of the differential diagnosis when the pain is characteristic of these dermatomes and nerves.

Comments

This remarkably well-designed and documented study fills an important void in the MTrP literature. The authors were understandably unaware that a recent German textbook illustrates the pain pattern of the PQ muscle observed in three patients which corresponds closely to the most intense pain reported in this study in the volar wrist region[49]. This study warns of a much more extensive pain pattern. The authors were perplexed by the differences in referred pain patterns apparently because they were thinking in terms of peripheral innervation correlations. The referred pain is generated in the spinal cord and relates to the wiring and programming of spinal neurons, not peripheral nerves. However, peripheral nerve considerations are essential for making informed differential diagnoses, and the possibility of MTrPs in the brachiialis, supinator, brachoradialis, subclavius, extensor digitorum communis, and scalenus minimus muscles should also be considered. Pain in this region is also commonly attributed to a carpal tunnel syndrome, the cause of which is often enigmatic when MTrPs are not considered [DGS].

Hwang M, Kang YK, Shin JY, Kim DH. Referred pain pattern of the abductor pollicis longus muscle. *Am J Phys Med Rehabil* 2005;84:593-597.

Summary

Fifteen healthy adults received 0.3 ml of 6 % hypertonic saline in the abductor pollicis longus [APL], which was confirmed electromyographically with special care to avoid neurovascular trauma. The referred pain pattern from this muscle has not been published previously. Among the 15 subjects, 21 arms were injected in the central belly deep to the extensor digitorum communis muscle, close to the endplate region and location of central MTrP of the APL. The shaded pain drawing by each patient was transferred to a computerized pain chart system that analyzed the drawings. Nineteen of the 21 arms tested had a basic pattern of local pain at the site of injection and the most intense referred pain to the region overlying the radial styloid process and the anatomical snuffbox. Of those 19 subjects, 7 experienced pain connecting these two regions. In 5 arms, pain was experienced in the dorsal aspect of the proximal segment of the 3rd and 4th fingers in addition to the two isolated regions of pain. Only 3 cases reported only the local injection site pain and the finger pain without wrist pain. The authors described the anatomy of this muscle in detail and noted that the most common pain patterns corresponded to patterns recognized as characteristic of the C6 dermatome, superficial radial nerve territory, and symptoms of de Quervain's tenosynovitis. The less common finger pain overlaps with the C7 and C8 dermatomes. For this reason, patients with suspected involvement of these nerves or de Quervain's tenosynovitis need an examination for APL MTrPs.

Comments

This remarkably well-designed and documented study fills an important void in the MTrP literature. The authors included a thorough discussion of when MTrP examinations are required as an important differential diagnosis. Other muscles that need to be examined for MTrPs in these patients are the brachiialis, supinator, brachioradialis, subclavius, extensor digitorum communis, and scalenus minimus muscles. Pain in this region is also commonly associated with carpal tunnel syndrome, the cause of which is often enigmatic when MTrPs are not considered [DGS].

Fernández-de-las-Peñas C, Cuadrado ML, Gerwin RD, Pareja JA. Referred pain from the trochlear region in tension-type headache: A myofascial trigger point from the superior oblique muscle. *Headache* 2005;45:731-737.

Summary

Fernández-de-las-Peñas et al investigated whether MTrPs in the superior oblique muscle are involved in primary headaches such as chronic tension type headaches [CTTH] and episodic tension type headache [ETTH]. Fifteen subjects with CTTH, fifteen subjects with ETTH, and 15 matched controls were included in this study. The diagnosis of CTTH or ETTH was made according to the criteria of the International Headache Society. Subjects with CTTH had to have headache on at least 15 days per month; ETTH subjects less than 15 days per month. The immediate history was verified with a headache diary for 4 weeks prior to the trochlear examination. Subjects with ETTH were examined on headache-free days; subjects with CTTH were examined on days when their pain intensity was less then 4 out of 10 on a visual analogue scale. The examination of MTrPs in the superior oblique muscle was based on modified criteria from Simons et al and Gerwin[3,4], and divided into four stages. A diagnosis of MTrP was made when there was tenderness in the trochlear area, referred pain with prolonged pressure, and increased referred pain with either contraction or stretching of the superior oblique muscle. An MTrP was classified as active if the subject recognized the referred pain as familiar. All subjects with CTTH had pain with palpation. Eighty-six percent reported familiar referred pain with prolonged pressure outside the trochlear area, which increased with active contractions or stretching, and were classified as having active MTrPs in the superior oblique muscle. The subjects with ETTH also reported pain with palpation. However, only 60% of subjects (9 subjects) reported referred pain that increased with active contractions but not with stretching. Only 2 subjects had active MTrPs and 7 had latent MTrPs. Of the healthy controls, 67% had pain in the trochlear region with palpation. Only 27% reported referred pain with prolonged pressure that increased slightly with contractions, but not with stretching. The authors established that referred pain patterns from the superior oblique muscle are perceived as internal and deep pain located at the retro-orbital region, supra-orbital region, occasionally to the ipsilateral forehead, or deep within the eye. The authors acknowledged that referred pain could also originate in the supraorbital or supratrochlear nerves and suggested that both mechanisms may occur simultaneously.

Comments
A recent report by Yanguela et al, suggested that the pathogenic mechanisms of primary trochlear headaches may include injury or mechanical stress of the supraorbital and supratrochlear nerves[50]. This paper is the first to identify a pain pattern produced by an intraocular muscle. It is an important contribution to the headache literature, and is published in Headache, the premier journal devoted to research and clinical applications of headaches. MTrPs are rarely considered in the headache literature. Yet, the researchers established specific referred pain patterns that are likely to be generated by MTrPs in the superior oblique muscle. Clinicians are encouraged to include the superior oblique muscle in the assessment of patients with chronic and episodic tension type headaches [JD].

Fryer G, Hodgson L. The effect of manual pressure release on myofascial trigger points in the upper trapezius muscle. *J Bodywork Movement Ther* 2005;9:248-255.

Summary
A novel, digital algometer was used to determine if manual pressure-release treatment of latent trapezius MTrPs in 35 subjects reduced the pain pressure threshold [PPT] of the MTrPs during treatment. The MTrPs were identified in student volunteers by the presence of a tender spot in a taut band on which pressure produced referred pain in the head and/or neck. The digital algometer used a circular 0.86 cm^2 capacitance pressure sensor taped to the examiners thumb with a computer display of the pressure applied. The examiner was blinded as to the value displayed. Subjects were randomly allocated to the treatment [manual pressure release] or the control [sham myofascial release] group. The PPTs were significantly higher [$P < 0.001$] following treatment in the treatment group vs. no change in the control group. The maintenance of a constant applied pressure during a 60 sec treatment, starting at a moderate, easily tolerated pain level [7/10] resulted in a progressive reduction in perceived pain and a significant increase in the pressure required to reproduce the original pain level following pressure treatment [$P < 0.001$]. The three blinded repeated PPT measures before and after treatment were highly repeatable [intraclass correlation coefficient = 0.952] using the novel algometer. A Fischer-type spring algometer produced results of similar reliability for MTrPs in superficial muscles, but the finger algometer was clearly superior for MTrPs in deeply placed muscles.

Comments
This randomized, controlled, and blinded study that clearly identifies the MTrP-identification criteria that were used reports two literature innovations: the use of a finger palpometer on MTrPs and measurement of reduction in MTrP sensitivity during application of manual pressure. This is one of the few well-controlled studies that confirm the effectiveness of manual therapy of MTrPs. One common criterion for identifying an MTrP is the presence or absence of a pain response to digital pressure. A convenient digital palpometer that permits measurement of pressure applied to the most tender spot in a taut band, which can be identified only by palpation, would facilitate standardization of the amount of pressure applied. This method should help to improve the reliability of making the diagnosis of an MTrP and deserves further investigation, as suggested by the authors. This reviewer fully agrees that more research is needed to establish the therapeutic mechanism for this treatment. An alternate mechanism considered in the discussion section attributed the response to this type of therapy to reactive hyperemia in the local area due to a counter-irritant effect of a spinal mechanism like that produced reflex relaxation. To this reviewer's knowledge there is no spinal reflex mechanism that causes the increased tension of the taut band to be relaxed. Quite the contrary - motor nerve action potentials are conspicuous for their absence, and there is impressive experimental evidence that the core of the MTrP, where it feels most tense, is ischemic, not hyperemic. It is important that proposed mechanism be consistent with established experimental evidence [DGS].

Al-Shenqiti AM, Oldham JA. Test-retest reliability of myofascial trigger point detection in patients with rotator cuff tendonitis. *Clin Rehabil* 2005;19:482-487.

Summary
This interesting study aimed to investigate the intra-rater reliability of MTrP identification. Fifty-eight subjects with rotator cuff tendonitis of at least 6 weeks duration but less than 18 months were included in this study. Subjects needed to have a painful resisted movement in at least one of the ranges of abduction, external or internal rotation with or without a painful arc. Subjects with arthritis, capsulitis, rotator cuff tears, bicipital tendonitis, cervical syndrome, shoulder pain due to neurological or vascular disorders, and subjects with a history of intra-articular or subacromial steroid injections were excluded. One examiner evaluated the rotator cuff muscles of all subjects for the presence of spot tenderness, a palpable taut band, a jump sign, a local twitch response, pain recognition, and referred pain. The same examiner repeated the process three days later without access to the previous assessment. The researchers used the kappa statistic to describe the degree of agreement between assessments. The analysis revealed perfect agreement with a kappa value of 1.0 for the taut band,

spot tenderness, jump sign, and pain recognition. Kappa values for local twitch response were 1.0 for the teres minor muscle, and 0.75 for the infraspinatus muscle. Kappa values for referred pain ranged from 0.79 for the subscapularis muscle to 0.88 for the teres minor muscle. The authors suggested that the excellent intra-reliability statistics were due to methodological rigor, evidenced by good palpation techniques, standardized positioning, and perhaps even expertise of the examiner. The authors concluded that it is possible to reliably determine the presence of a taut band, spot tenderness, jump sign, and pain recognition.

Comments

Although the authors suggested that the high agreement was due to their methodology, it is not clear from this paper, whether that conclusion indeed can be drawn. The authors already acknowledged that the relatively brief interval between assessment dates might have introduced recall bias from the examiner. The use of the kappa statistic may in itself be problematic. The kappa statistic is a chance-corrected measure of agreement, which considers the proportion of observed agreements and the proportion of agreements expected by chance. In this study, the same examiner made only two observations for each variable. An MTrP characteristic was either present or absent. If the examiner found for example a local twitch response on both occasions, the reliability estimate would automatically be 100%. However, if a local twitch response were found on only one of the assessment dates, the rating for that characteristic would immediately drop to 50%. In other words, the small sample size used in this study can provide misleading results. For example, the authors reported that referred pain in the subscapularis muscle was less reliable. Analysis of their results reveals that referred pain was absent in 55 subjects during the first assessment and in 56 subjects during the second assessment. Referred pain was present in 3 and 2 subjects during the first and second assessment respectively, resulting in a kappa statistic of 0.79. The kappa statistic does not differentiate whether the examiner was actually skilled in determining the presence of each of the MTrP characteristics in each muscle. Subscapularis MTrPs were found in only 3 subjects or 5.2%, which makes this a very small sample size. Another potential problem with the study is that to measure agreement, it is crucial to have enough variance among subjects. In a group with homogeneous characteristics, the percentage of agreements will always be high. The subjects in this study were most likely a rather homogenous group. All subjects had rotator cuff tendonitis with a painful resisted movement and were confirmed by the same examiner who also executed the study. It is thus not clear that the intrarater reliability in this study can be established with the kappa statistic. The authors did not discuss any of these potential problems [JD].

Dommerholt J. Persistent myalgia following whiplash. *Curr Pain Headache Rep* 2005;9,326-330.

Summary

Persistent myalgia following whiplash is commonly attributed to psychosocial factors, illness behavior or poor coping skills. Evidence indicates that peripheral and central sensitizations are largely responsible and that MTrPs often play a critical role. These patients evidence central sensitization characteristic of "wind-up" that is caused by a persistent peripheral pain source that shows evidence of regional specificity. MTrPs are just one of such a source in these patients. One study found clinically relevant MTrPs in every one of 54 consecutive patients. A recent study by Shah et al that is also reviewed in this issue demonstrates the presence of multiple potent nociceptive chemicals in an active MTrP that explain the persistent pain input from them[51]. Treatment of active MTrPs in patients with whiplash is an important part of effective therapy[52] .

Comments

One reason the cause of persistent musculoskeletal pain following whiplash is so enigmatic likely relates to the almost total absence of recognition in the published literature of the MTrP contribution. This review paper eloquently emphasizes the importance of MTrP in this condition. It is fervently hoped other authors concerned with whiplash patients will pick up on this lead and do prospective, controlled, blinded studies that substantiate the MTrP contribution to whiplash symptoms. A novel and remarkably effective therapy, frequency specific microcurrent, has been demonstrated to be effective in similar MTrP conditions such as head, neck, and face pain[53].

Edwards J. The importance of postural habits in perpetuating myofascial trigger point pain. *Acupunct Med* 2005;23:77-82.

Summary

Edwards described five case studies where postural factors were likely to contribute to the persistence of MTrPs. The first case was a chef with intermittent complaints of right-sided suprascapular and posterolateral arm pain. Active MTrPs were found in the right medial scalene muscle, coracobrachialis, and triceps. Aggravating activities involved contractions of the triceps and included motorcycling, mashing potatoes, and bracing of the arms on the knees during sitting. After three sessions of superficial dry needling, muscle stretching exercises, and correction of the sitting posture, the pain resolved. The second case involved a female with longstanding trochanteric pain. Previous interventions had failed. Pain increased with sitting and driving. MTrPs were identified in the right quadratus lumborum and gluteus minimus, which with palpation reproduced the patient's pain. The patient was successfully treated with superficial dry needling and posture corrections. Edwards suggested that sitting with the legs crossed, tucked underneath, or sitting in a side-flexed position may have maintained MTrPs in the quadratus lumborum muscle with referred pain into the trochanteric region. The other cases included several faulty sitting and sleeping postures associated with MTrPs. In all cases, superficial dry needling combined with muscle stretching exercises, and posture correction resolved the problems. Edwards emphasized that identification of poor postural habits is important in patients with MTrPs. By drawing attention to the poor postures, patients are able to break the habit.

Comments

Simons, Travell, and Simons have long recognized the importance of paying attention to mechanical perpetuating factors[3]. These case studies illustrate nicely how relatively simple posture corrections can make significant differences in the outcome of physical therapy, although it is not clear from the case reports what the relative contribution was of each of the interventions (superficial needling procedures, muscle stretching exercises, and posture corrections). In addition to evaluating common faulty sitting, standing, and sleeping postures, it is important to evaluate common and prolonged work postures[54,55]. Keep in mind that posture should not just be viewed from a strict biomechanical perspective, as posture is also a reflection of the person's personality and inner feelings[56] [JD].

Fernández-de-las-Peñas C, Palomeque del Cerro L, Fernández-Carnero J. Manual treatment of post-whiplash injury. *J Bodywork Movement Ther* 2005;9:109-119.

Summary

This paper provides a comprehensive review of an evidenced-based approach to the clinical management of persons with whiplash injuries. The authors reviewed in much detail the whiplash literature and concluded that the treatment of persons suffering from whiplash injuries should always include muscular, fascial and spinal interventions. Spinal manipulations advocated included upper cervical, cervico-thoracic junction, thoracic, thoracolumbar junction, and pelvic girdle manipulations. The authors found that MTrPs are commonly present after whiplash. They promoted MTrP manual therapies, including neuromuscular technique, muscle energy techniques, myofascial release applied to the occipital region, and MTrP deactivation approaches, particularly focused on the trapezius, suboccipital, scalene, and sternocleidomastoid muscles.

Comments

The approach advocated by these Spanish researchers have been shown to be effective and provide a solid starting point for clinical management and future studies of persons suffering from whiplash injuries[52] [JD].

Farina S, Casarotto M, Benelle M, Tinazzi M, Fiaschi A, Goldoni M, Smania N. A randomized controlled study on the effect of two different treatments (FREMS AND TENS) in myofascial pain syndrome. *Eura Medicophys* 2004;40:293-301.

Summary

Forty subjects with upper trapezius myofascial pain were randomly assigned to one of two groups treated with either frequency modulated neural stimulation (FREMS) or transcutaneous electrical nerve stimulation (TENS). Subjects were excluded if they had clinical signs and symptoms of fibromyalgia, were younger than 18 or older than 80, had mental retardation, or neurological deficits involving the upper limbs. Patients with specific medical problems, such as ulcers, hypertension, renal insufficiency, and several others were also excluded from this study. All subjects were examined by the same examiner who was blinded to the treatment. The treatments were performed by another examiner who was blinded to the clinical status of the subjects. Patients in each group received ten 20-minute treatments for two consecutive weeks. Outcome measures included the neck pain and disability visual analogue scale (NPDVAS), pressure pain thresholds with algometry, manual evaluation of myofascial trigger points, and range of motion of the cervical spine. Subjects were examined prior to the study and at one week, one month, and three months following the intervention. The most painful MTrP was treated in those subjects with more than one MTrP in the upper trapezius muscle. The authors concluded that both FREMS and TENS are effective treatment modalities in the treatment of MTrPs. The FREMS treatment did appear to have longer lasting effects when compared to TENS.

Comments

The authors reported that FREMS is a new type of transcutaneous electrical stimulation, characterized by a negative monophasic impulse, high voltage (<300V), low intensity (<10 μA), short duration (10-40 μs), with a spike of short duration (7 ns). This is the first clinical study of FREMS and there are no studies investigating the mechanism of action. Based on this study, FREMS appears to be a useful modality for MTrPs. Previous studies have confirmed the utility of TENS in the treatment of

MTrPs[57]. The authors suggested that TENS is one of the most frequent used treatments for myofascial pain. This reviewer is not aware of any studies that indicate such. The authors list several other therapeutic approaches to treat myofascial pain. Several of these approaches have not been studied specifically for myofascial pain, but as the quoted references indicate were used in studies of either fibromyalgia or low back pain [JD].

Anderson RU. Wise D, Sawyer T, Chan C. Integration of myofascial trigger point release and paradoxical relaxation training treatment of chronic pelvic pain in men. *J Urol* 2005;174:155-160.

Summary

A total of 138 men with chronic prostatitis and/or chronic pelvic pain (CP/CPPS) refractory (median 31 months) to traditional therapy were treated for at least one month with myofascial release therapy/paradoxical relaxation training (MFRT/PRT) by a team of a urologist, physiotherapist, and psychologist. Clinical improvement was identified by a 25% or greater improvement in scores. Global response assessment (GRA) was a 7-point scale ranging from markedly or moderately improved to markedly worse. Each patient was examined in the lithotomy position by the urologist to evaluate prostate, genitalia, external & internal pelvic muscles, and MTrPs. Palpation of MTrPs in the anterior levator ani referred pain to the tip of the penis and the most common intrapelvic location of MTrPs was in the levator ani lateral to the prostate gland. The physiotherapist applied digital treatment to these MTrPs using the left hand for MTrPs on the right side of the pelvis, and the right hand for the left side. Myofascial release therapy included digital pressure applied to a TrP for 60 seconds to release. MTrPs were also treated by voluntary contraction and release, hold-relax, contract-relax, reciprocal inhibition, deep tissue mobilization, stripping massage, strumming of taut bands, skin rolling, and effleurage. Paradoxical release therapy was provided in conjunction with physiotherapy to decrease pelvic muscle tension. This therapy included a progressive relaxation exercise program, training in a specific breathing technique to quiet anxiety, and relaxation training sessions to focus attention on effortless acceptance of tension in various parts of the body. Results include patients who participated in the above protocol even on a limited basis. Approximately half of the patients showed clinical improvement in either the pelvic pain symptom survey or the NIH chronic prostatitis symptom index, and in the global response assessment questionnaire. Pain scores improved ≥ 50% in nearly half (48%) of the patients and ≥ 25% in 69% of them. Of those with initial sexual dysfunction, 69% improved. Global responses of markedly improved was reported by 46% of patients, moderately improved by 26% (72% together). Urinary symptoms were significantly improved ($P = 0.001$) in those reporting marked global improvement.

Comments

This useful retrospective, uncontrolled, unblinded, multiple case study fully described treatment of pelvic MTrPs, but did not identify the diagnostic criteria employed by the authors. However, it provides valuable guidelines for a more sophisticated study. Considering that many of the subjects received limited treatment, that all of them had failed conventional treatment attempts, and that most patients obtained much relief of symptoms, the results suggest that this treatment protocol, which focused on MTrPs, identified a previously overlooked cause of many of the patients' symptoms. Unfortunately the authors did not identify more specifically how commonly in their opinion the patient's symptoms related primarily to MTrPs, and how commonly to other factors. A comparable study should include the prevalence of MTrPs in the muscles of this patient population. Measurement of pelvic floor tension by pressure measurements and relaxation in terms of surface electromyographic measurements would clarify and help quantify the cause of symptoms. The distinction between active and latent MTrPs in a study of this kind is important because active MTrPs tend to cause pain symptoms, but latent MTrPs disturb motor function and very likely can cause autonomic dysfunction in these pelvic muscles, which are likely important factors in many of these patients [DGS].

Gerwin RD. A review of myofascial pain and fibromyalgia: Factors that promote their persistence. *Acupunct Med* 2005;23:121-134.

Summary

Pain from an MTrP is localized to one region of the body, but often refers to some distance. Myalgias often show no diagnostic laboratory abnormalities. The referred pain is secondary to a primary peripheral source and is mediated at spinal cord level by sensitization phenomena. Both MTrPs and fibromyalgia [FMS] exhibit muscle tenderness but otherwise a distinct entities: FMS is a syndrome of central sensitization and widespread musculoskeletal pain and tenderness, whereas, MTrP pain results from local muscle metabolic stress following muscle overload that produce reproducible characteristic physical findings. Numerous nociceptive substances are present in significant amounts at the MTrP. With multiple MTrPs, clinical symptoms can mimic MTrPs so many cases of MTrPs have been misdiagnosed as FMS due to poor muscle palpation techniques. The two conditions can aggravate each other and comorbidity is common.

Fibromyalgia is a chronic myalgia that is widespread, confirmed with the diagnostic criteria published by the American College of Rheumatology that do not distinguish FMS from the more common MTrPs. FMS is associated with multiple additional systemic symptoms including, sleep disturbance, fatigue, irritable bowel syndrome, interstitial cystitis, dyspareunia, etc. Imaging and laboratory testing is needed to identify comorbid conditions or other causes of the chronic myalgia. The central sensitization with amplification of nociception results in a broad array of stimuli being perceived as more painful than normal. Numerous nociceptive-stimulating substances are identified as increased in many patients with FMS. The long-term prognosis indicates some degree of relief in time. Treatment of FMS includes multiple drug therapies, and progressive exercise with cognitive therapy. MTrPs can produce pain and muscle dysfunction in any part of the body and are identified by a distinctive taut band and pain with tenderness, a distinguishing duality of motor and sensory dysfunction. The taut band, that is reliably identifiable clinically, is also significantly associated with low amplitude endplate noise and high-amplitude endplate spikes, recorded using delicate needle EMG technique. Effective needling an MTrP results in a perceptible twitch of the taut band. The associated endplate noise is reduced 22% by phentolamine infusion, identifying a significant contribution to MTrPs activation by sympathetic nervous system activity. These well-established characteristics of MTrPs are explained by the integrated hypothesis. Inhibition of muscle function by MTrPs results in compensatory overload of other muscles in that functional. This leads in time to propagation and spread of MTrPs throughout the body. Systemic perpetuating factors include nutritional deficiencies, hormonal dysfunctions, and chronic infections. Important and common nutritional deficiencies are vitamin V12 deficiency, Iron deficiency, and vitamin D deficiency, all of which can be corrected with adequate replacement therapy or improved dietary and behavioral habits. Hormonal dysfunctions include hypothyroidism that can also be the result of a chronic or critical illness, the enigmatic role of reverse T3, and growth hormone deficiency. Lyme disease is a treatable chronic infection likely to aggravate MTrPs. When poor response to treatment indicates the presence of a perpetuating factor, appropriate laboratory studies are required to identify the above factors. Effective treatment of MTrPs requires inactivation of MTrPs, restoration of normal muscle length [range of motion] and elimination or correction of initiating and perpetuating factors. Effective treatments include manual therapy release techniques such as TrP compression, gently lengthening the tense muscle, or local stretch of the tense taut band. Release of the fascia associated with the muscle [myofascial release] is helpful. Each technique is muscle specific. Needling the MTrP, either dry or with anesthetic, is effective when a twitch response is elicited. Acupuncture is reported to have some effectiveness. When indicated, ergonomic work factors and psychological stresses must be addressed.

Comments

Overall, this is an authoritative, accurate, concise summary of the nature of MTrPs and FMS. Although referred pain commonly appears in areas innervated by the same spinal segment, the sensitization of spinal sensory neurons responsible for the referred pain phenomenon is not restricted to the same spinal segment, but may involve several other segments as well. As indicated, pain from MTrPs is easily misdiagnosed as FMS, but it is also important to remember that FMS patients frequently also have MTrPs that make a major contribution to their pain and aggravate the FMS. An important identifying feature of FMS is compromised clarity of thinking, intermittent loss of sort term memory, and increased distractibility with loss of capacity for multitasking. MTrPs not only cause the motor abnormality of a taut band through the MTrP, but also even latent MTrPs can cause inhibition and increased motor activity of the same and functionally related muscles—an important but poorly recognized feature of MTrPs. Actually, excessive acetylcholine release at the motor endplate can increase the frequency of endplate noise just 10-100 times, but up to 1,000 times as unequivocally demonstrated in physiological experiments. Many other factors can affect that endplate noise. The extensive discussion of the controversial role of reverse T3 thyroid hormone suggests that it deserves additional research attention.[DGS].

Jarrell JF, Vilos GA, Allaire C, Burgess S, Fortin C, Gerwin R, Lapensee L, Lea RH, Leyland NA, Martyn P, Shenassa H, Taenzer P, Abu-Rafea B. Consensus guidelines for the management of chronic pelvic pain. *Obstet Gynaecol Can* 2005;27:781-826, 869-887.

Summary

This two-part article is a thorough consensus document on the management of chronic pelvic pain (CPP) approved by the Society of Obstetricians and Gynaecologists of Canada. The paper is divided into 14 different chapters including an introductory chapter to various physiological aspects of chronic pain, chapters on definitions, history taking, physical examination, sources of CPP, management of CPP, surgery, and multidisciplinary pain management. Chapter 7 (published in the second half of the paper) is the most relevant chapter in the context of this review as it deals specifically with myofascial dysfunction. The chapter is prepared by Drs. Robert Gerwin, Paul Martyn, and John Jarrell. The chapter reviews in detail the prevalence of myofascial pain in CPP, a review of pathophysiological aspects, and provides specific clinical guidelines for diagnosis and management of myofascial pain in a gynecological setting. The authors determined three levels of muscle examinations, which together cover a comprehensive examination of the abdominal muscles, the hip adductors, the quadratus lumborum, lumbar paraspinal muscles, gluteal muscles, psoas, obturator internus, piriformis, and internal pelvic floor muscles. The authors emphasize that management of CPP involves not only medical management with injection therapy, but requires physical therapy and in many cases a true multidisciplinary pain management approach. In summary, the chapter concludes with the recommendation that health care providers should become more aware of myofascial dysfunction as a cause of CPP and its available treatment options.

Comments

This consensus document endorsed by the Canadian Society of Obstetricians and Gynaecologists is a remarkable step forward in the recognition of myofascial pain and MTrPs in CPP. One of the primary authors, Dr. John Jarrell, has undertaken specific training in the recognition and management of MTrPs. Awareness of the importance of MTrPs in CPP is slowly growing, but there is still a long way ahead before gynecologists, obstetricians, urologists, and other health care providers routinely will consider MTrPs in the diagnosis and management of their (pelvic) pain patients. This paper is a very strong endorsement of the importance of MTrPs by a national medical society [JD].

Treaster D, Marras WS, Burr D, Sheedy JE, Hart D. Myofascial trigger point development from visual and postural stressors during computer work. *J Electromyogr Kinesiol* 2006;16(2):115-124.

Summary

This study explored the development of MTrPs in 16 female computer operators (19-29 years of age, mean 22.8 years). Each subject was asked to type as accurately as possible for 32 minutes using a typing program under four different visual and postural conditions. The four tests were conducted on different days. Prior to the typing task, a clinical specialist examined the subjects' bilateral trapezius muscles for the presence of MTrPs. The skin overlying trapezius MTrPs was marked with ink. Both the examiner and subjects rated the degree of tenderness for each MTrP using a 6-point scale. In addition, the examiner rated the MTrPs based on muscle fiber tautness and the subject's "jump" response to manual pressure or palpation. All MTrPs in the trapezius, rhomboid, levator scapula, sternocleidomastoid, scalene, and deltoid were manually released using a combination of percussion, stretch and relaxation techniques. At the beginning of the test procedures, the subjects had full range of motion and no pain or muscle tightness. The clinical examiner was blinded to the experimental procedure. A pair of surface electrodes was placed around the ink marks. The researchers used cyclic changes in the median frequency to determine the development of MTrPs combined with a re-assessment by the clinical examiner and feedback from the test subjects immediately following the typing task. Changes in median frequency of at least 5 Hz, but less than 30 Hz, followed by a reversal of at least 5 Hz were classified as "cycles." High visual stress conditions resulted in greater MTrP development and sensitivity in the right trapezius muscle. The combination of high visual stress and low postural stress conditions was characterized by significantly fewer cycles in the mean frequency, when compared to low visual and low postural stress or to high visual and high postural stress conditions. Interestingly, the conditions with higher visual stress also corresponded to more MTrP development and greater pain associated with MTrPs. The researchers concluded that MTrPs provide a useful explanation for development of pain following low-level static exertions seen with computer use.

Comments

This is a very interesting study that combines current work-related myalgia research with MTrP research. The authors creatively applied research by McLean et al on the cycling nature of median frequencies[58] and linked the results to a clinical assessment of MTrPs. Median frequency cycles are thought to be related to regulation of motor unit recruitment in an effort to prevent localized muscle fiber fatigue. With low-level static exertions - as seen with computer workers - it is likely that certain muscle fibers are selectively overloaded, consistent with the so-called "Cinderella hypothesis" developed by Hägg[59] . According to Hägg, during low intensity tasks the normal substitution of motor units may not occur, resulting in continued activity, which eventually may lead to damage to these motor units[59,60]. When substitution does not occur, the number of median frequency cycles should decrease[58]. Hägg's Cinderella hypothesis has been confirmed in several studies, but has never before been applied to MTrPs[61-63]. This reviewer postulated a link between the Cinderella hypothesis and MTrPs during the 2005 Focus on Pain conference in Philadelphia, PA. The Cinderella hypothesis provides a seemingly excellent match with the integrated trigger point hypothesis. Sustained contractures may lead to local hypoxia, which according to the integrated trigger point hypothesis would result in the development of MTrPs. MTrPs are usually associated with some degree of muscle overload, which may be acute, sustained, or repetitive[3]. In a recent review, it was postulated that MTrPs may develop with eccentric or sub-maximal concentric contractions[26]. The Cinderella hypothesis offers a likely explanation why MTrPs may develop following relatively low level muscular contractions. The authors of the current study incorporated this rationale into their study design. They made the assumption that frequency cycling is indeed indicative of MTrP development. Muscle contractures at MTrPs sites were assumed to fatigue associated motor neurons and therefore, reduce the number of median frequency cycles. While this is an interesting and intriguing assumption, it may also point to a weakness in the study design. At this point, there is no evidence that median frequency cycling can be linked to the development of MTrPs, and this study supports this assumption only partially. To counter this criticism, the authors incorporated the skills of an expert clinician to manually examine the subjects for the presence of MTrPs. In addition, they solicited the subjects' rating of pain. However, the examiner's subjective rating of muscle fiber tautness and the subject's "jump" response to manual pressure or palpation does not appear to be valid measurement and it is not clear from the study to what extent this rating was applied in the final assessment. The authors found a correlation between median frequency cycling and the development of MTrPs with high visual and low postural conditions, but not with any of the other scenarios. Consequently, this study does not confirm that median frequency cycling is a reliable indicator of MTrP formation. Future studies are needed to explore this fascinating area. The manual examination combined with the subjects' subjective rating did offer support that low-level static exertions may lead to the activation of MTrPs. This is an important finding that should be considered in other ergonomic studies of work-related myalgia [JD].

Cornwall J, Harris AJ, Mercer SR. The lumbar multifidus muscle and patterns of pain. *Man Ther* 2006;11:40-45.

Summary

Fifteen healthy volunteers (11 males, 4 females; 24-45 years of age, mean 32 years) were included in this study of pain patterns of the lumbar multifidus opposite the spinous process of L5. Each subject received two subsequent injections into the L4 band of the multifidus muscle. One injection consisted of 0.3 ml 5% hypertonic saline, while the placebo injection consisted of isotonic saline. The injector and subjects were blinded to the injected substance. The first injection was randomly assigned to one side. The second injection was performed 5 minutes later to the contralateral side. Following each injection, subjects were asked to describe the intensity and location of any sensations. The distribution of pain was mapped out and checked by each subject. None of the subjects reported local or referred pain following injections with placebo isotonic saline. Following hypertonic saline injections, all subjects reported local pain and 13 out of 15 subjects reported referred pain into either the anterior or posterior thigh. The researchers compared the findings with previously established patterns of local and referred lumbar pain and found similarities with patterns from the L3-4 interspinous ligaments, multifidi, zygopophyseal joints, the medical branches of the lumbar dorsal rami, and trigger point referred patterns. They concluded that there were many similarities between described patterns with the exception of MTrP referred pain patterns as reported by Simons, Travell and Simons[3].

Comments

This study confirms that the lumbar multifidi muscles can be a source of local and referred pain. Although the researchers did not determine much overlap between the referred pain patterns found in this study and the MTrP referred pain patterns described by Simons, Travell and Simons, this study does contribute to the current knowledge base and raises questions about the accuracy of referred pain patterns in the *Trigger Point Manual*. Establishing referred pain patterns requires a detailed scientific approach as was used in this and in similar previously published studies[64-69]. Lumbar multifidi muscles cannot be palpated directly and the accuracy of needle placement may be a determining factor. It is not known on how many subjects the MTrP referred pain patterns are based and how accurate Travell was in her needle placement when she established the lumbar multifidus referred pain patterns. It is conceivable that not all multifidi MTrPs and associated referred pain patterns have been captured. To the best of our knowledge, there are no systematic studies of the lumbar multifidus MTrP referred pain patterns. The referred pain illustrations of lumbar multifidus MTrPs in the *Trigger Point Manual* probably only represent a few common examples and do not reflect all possibilities. Swiss authors Dejung, Gröbli, Colla, and Weissmann have described different MTrP referred pain patterns of the lumbar multifidi muscles based on a total of 43 subjects[49]. They determined extensive posterior thigh and leg referred pain patterns, which were very similar to the referred pain patterns in this study. However, these patterns were not derived using a systematic approach either. More studies are needed to establish all muscle referred pain patterns using a scientific methodology [DGS and JD].

Fernández-de-las-Peñas C, Alonso-Blanco C, Fernández-Carnero J, Miangolarra-Page JC. The immediate effect of ischemic compression technique and transverse friction massage on tenderness of active and latent myofascial trigger points: A pilot study. *J Bodywork Movement Ther* 2006;10:3-9.

Summary

This comparison of two manual treatments for MTrPs in

the upper trapezius muscle in two matching randomized groups of 20 subjects was blinded, but there was no control group. Diagnostic criteria for MTrPs were a tender spot in a taut band that responded to snapping palpation with a twitch response and pressure on it reproduced the typical referred pain pattern that was recognized as familiar if the MTrP was active. The ischemic compression treatment involved the application of pressure on the MTrP until the patient felt pressure and pain. That pressure was maintained until the sensation decreased by 50% when pressure was again increased to the pain threshold, and the procedure continued for 90 s. Transverse friction massage was applied slightly painfully across the fiber direction as recommended by Cyriax for three min. Both groups showed statistically significant post-treatment improvement in both decreased visual analog scale pain readings and increase in pain pressure thresholds of MTrP tenderness. The results were very similar and the authors concluded that the two techniques were equally effective in reducing MTrP pain and tenderness. They also noted that follow-up data would be very helpful and that the lack of a control group negates an assumption that a cause and effect relationship exists between the treatments and the statistically favorable results. However, they also cited a study that found that ischemic compression results are superior to sham treatment.

Comments

The authors are to be commended for a well-executed study that unfortunately lacks the critically important control group to warrant unreserved acceptance by discriminating readers. It is very unlikely that the favorable results to both treatments in this study were due to placebo effect, which is usually only 30% effective at most and temporary. Long-term follow-up helps greatly to minimize the mistake of discarding valuable findings because of the possibility of placebo effects. In clinical practice, additional placebo effect is of benefit to the patient, if the basic therapy is also effective. This paper was apparently based on patients who had been receiving appropriate treatment prior to the study. In many studies, the history of multiple ineffective treatments by multiple previous providers establishes that there is no natural healing process involved and that efficacy of the treatment being reported is more than a placebo effect because it should have been evident with the previous ineffective or only temporarily helpful treatments. The common occurrence of untreated chronic MTrPs indicates that one cannot count on a natural healing process. The authors gave equal credibility to the two possible therapeutic mechanisms. One was based on the integrated hypothesis, which is accumulating substantiating research findings[51]. The other was postulated by Hou et al suggesting that pain relief from pressure treatment may result from reactive hyperemia in the MTrP region, or from a spinal reflex mechanism for the relief of muscle spasm[70]. The Hou proposal of reactive hyperemia relieving muscle spasm has two major problems. We avoid the term ischemic compression, because that much pressure is not recommended and is seldom used in current research papers so that the treatments used in this paper should not have caused reactive hyperemia. The proposed relief of muscle spasm is illogical because EMG studies reveal no muscle spasm associated with taut bands and MTrPs[15]. The tension is due to non-electrogenic muscle shortening (physiological contracture) for some reason. Although not cited by the authors, one paper does describe in detail how the pressure applied by either method lengthens shortened sarcomeres that produce the taut-band tension[71]. Rather than cross fiber massage, Hong suggested that massage strokes starting at the MTrP and progressing along the taut band away from it would augment normalization of sarcomere lengths (personal communication). I have found it effective. To my knowledge no one as compared the efficacy of this technique to the other two reported in this paper [DGS].

Fruth S. Differential diagnosis and treatment in a patient with posterior upper thoracic pain. *Phys Ther* 2006;86:254-268.

Summary

A 35-year old youth minister had pain in the posterior upper thoracic region for four months beginning two days after sitting on the bleachers for three hours at an ice hockey game. The pain localized between the right scapula and the spine, increasing during the next 6 weeks. Cyclobenzaprine HCL and naproxene and physical therapy [PT] elsewhere did not help. Two months later, three weeks of different PT treatment that included exercise, modalities, spine mobilization and massage did not help. His physician increased cyclobenzaprine dosage, ordered radiographs of the thoracic and cervical spines and of the right shoulder, and referred patient to the author for another try at physical therapy. Radiographs were negative. The patient complained of constant shoulder-area pain, limited ability to play with and care for his children, participate in softball, and disturbed sleep due to pain when he changed position during the night. Specific daily functions were tested with a comprehensive, simple questionnaire using a 5-point scale for each function: 0-4 (full normal function). Initially rating of functions by the patient included: use your hand with arm at shoulder level 1; dress yourself 2; sleep 0; use arm overhead 1; throw ball overhand 2; perform child care 1; perform normal sport 0; etc. Total score 36 /72. Initial examination revealed that manual muscle testing for strength was not feasible because of limitation by pain. There was painful limited mobility of the right costovertebral and costotransverse joints at ribs 3 through 6, and MTrPs in the right middle trapezius and rhomboid muscles. Subsequent examination identified MTrPs also needing treatment in the right pectoralis major, serratus posterior superior, serratus anterior, and lower trapezius. Treatment began with digital pressure applied to the middle trapezius and rhomboid MTrPs that provided sufficient pain relief that the therapist could then start to release the joint restrictions. After 7 PT sessions in 4 weeks that focused on releasing articular dysfunctions and inactivating all painful and function-inhibiting MTrPs, the patient had return of full function (total function score, 71/72—only sleep was slightly disturbed occasionally) and remained that way through the next 5 years. The author recommended attention to the lack of research on the causes of pain and dysfunction in the thoracic area, on the reliability of detecting MTrPs, and on the efficacy of joint mobilizations and MTrP release.

Comments

This is the first article specifically addressing MTrPs to appear in this PT journal for over 5 years—a most welcome appearance. It is very well and knowledgably written with extensive older references. This case report eloquently demonstrates the critically important interaction between articular dysfunctions and MTrPs and demonstrates how important it is to address each with appropriate diagnostic techniques and treatment. Shoulder pain problems like this commonly involve many of the shoulder-girdle muscles, and usually respond only when all of them are included in the treatment program, as demonstrated in this case. The function evaluation instrument used is novel but looks very practical and effective. It nicely verified the effectiveness of the author's diagnosis and treatment, especially after the history of repeated failure of routine physician and PT approaches to this common but usually overlooked type of musculoskeletal pain and dysfunction. The history of multiple ineffective treatments by multiple previous providers establishes that there is no natural healing process involved and that efficacy of this kind of treatment is more than placebo effect, which if important, should have been evident with the previous treatments. The favorable 5-year follow up confirms the remarkable effectiveness of these treatments compared to the pre-treatment history. The MTrP source reference was the 1983-first edition of volume 1 of the *Trigger Point Manual*, not the much-updated 1999-second edition[3]. As a result, the diagnosis of MTrPs included the jump sign, which is redundant with the tenderness test, and a crude measure of painfulness compared with the well-established visual analog scale measure. I strongly endorse the author's concluding recommendations [DGS].

Samraj GPN, Kuritzky L, Curry RW. Chronic pelvic pain in women; Evaluation and management in primary care. *Comp Ther* 2005; 31(1):28-39.

Summary

In this article, the authors provide an excellent overview of the prevalence and pathophysiology of chronic pelvic pain (CPP). They emphasize that CPP is a syndrome with a complex multi-faceted etiology. Myofascial pain is included in the list of most common pathologies along with endometriosis, interstitial cystitis, irritable bowel disease, and pelvic adhesions. Myofascial pain may present as vulvar vestibulitis, vaginismus, levator ani syndrome, pelvic floor tension myalgia, or pudendal neuralgia, among others. As part of a comprehensive medical history and examination, the authors recommend a detailed physical examination of the low back, spine, abdomen, and groin, as previously outlined by Prendergast and Weiss[72,73] [JD].

Kim ST. Myofascial pain and toothaches. *Aust Endod J* 2005;31(3):106-10.

Summary

The author of this review defined myofascial pain in terms of MTrPs and noted that myofascial pain information is fragmented and poorly understood in dentistry. A major reason for this is the 1992 seminal dentistry article that defined myofascial pain only as tenderness of multiple masticatory muscles and eliminating any palpatory findings of a taut band or related spot tenderness that are distinguishing characteristics of MTrPs[74]. The dental literature has been crippled by this oversight ever since.

Comments

This review from Australia is well written, insightful, and thoughtful, but some critical references are anachronistic. The most serious is the extensive dependence on the 1983 edition of the trigger point manual instead of the 1999-second edition. Clinical features are well described, but the pathophysiology is well described only as of our 1983 understanding of it. The pathophysiology can now be identified by the integrated hypothesis[15] with noteworthy support from basic research[16] and is still debated, but substantiated with impressive research[51]. In this review, diagnosis was well described and illustrated, but management missed all of the effective manual treatment methods covered in subsequent publications. Patients can be taught to use many of these treatments for themselves [DGS].

Fernández-de-las-Peñas C, Alonso-Blanco C, Cuadrado ML, Gerwin RD, Pareja JA. Trigger points in the suboccipital muscles and forward head posture in tension-type headache. *Headache* 2006;46:454-460.

Summary
Twenty patients with CTTH and 20 matched controls without headache were examined for active and latent MTrPs that were identified by the referred pain produced by palpation and muscle contraction. A blinded assessor made photographic measures of forward head posture and each subject kept a headache diary for four weeks. 65% of the patients had active MTrPs and 35% of them had latent MTrPs in the suboccipital muscles. 30% of control subjects had latent MTrPs there. The difference in latent MTrPs between groups was not statistically significant, but the difference in active MTrPs was, $P < 0.05$. Forward head posture was greater in patients than in controls, both when sitting and standing, $P < 0.01$. The authors concluded that the frequency and duration of CTTH and the degree of forward head posture correlated positively with the presence of active suboccipital MTrPs.

Comments
This blinded, controlled study is a refreshing example of quality MTrP research where it is desperately needed. For too long, the headache literature has been blind to the fact that MTrPs are a major source of headache. This is the second Fernandez/Gerwin paper to start opening that Pandora's box[75]. In the discussion the authors noted that in addition to suboccipital muscles, MTrPs in other posterior cervical, neck, and shoulder muscles could contribute to headaches. One unidentified weakness of this study was the failure to examine these other muscles for active and latent MTrPs. They may help to explain why a considerable number of these headache patients had only latent MTrPs; other active ones causing it may not have been identified. The increased forward head posture with greater headache duration and frequency may be the result of shortening of the suboccipital muscles due to increased muscle tension from the increasingly taut bands of the more active MTrPs. The fact that patients and controls had nearly equal numbers of latent MTrPs in the suboccipital muscles is consistent with, but does not necessarily indicate, that individuals with a genetic tendency to develop latent MTrPs are more likely to develop active MTrPs, and that the additional, active, MTrPs in the headache subjects represent latent MTrPs that were activated and produced headache symptoms. This possibility needs further investigation along with the MTrP origin of other kinds of headache [DGS].

Calandre EP, Hidalgo J, García-Leiva JM, Rico-Villademoros F. Trigger point evaluation in migraine patients: An indication of peripheral sensitization linked to migraine predisposition? *Eur J Neurol* 2006;13:244-249.

Summary
With this paper the authors explore the presence of MTrPs in persons with migraine headaches, the frequency of referred pain, and the correlation between MTrPs and the frequency of migraine attacks, and duration of the illness. Ninety-eight persons with migraine headaches characterized by at least three migraine attacks per month were included. Of that group eight subjects had migraines with aura, and 90 without. Nearly 36% met the International Headache Society's criteria for chronic migraine. The control group consisted of 36 subjects and included 18 subjects with infrequent tension-type headaches defined as less than one attack per month. An examiner trained in the identification of MTrPs palpated all subjects bilaterally in the frontal, temporalis, and trapezius muscles, and in the suboccipital and occipital areas, using no more than 4 kg of pressure force. The authors differentiated between referred pain with myofascial or migrainous characteristics. Migrainous referred pain was defined as pain characteristic of migraine attacks. Twenty-nine percent of the control group reported myofascial referred pain compared to 94% of the migraine subjects reporting migrainous pain. Forty-one percent of the latter also reported myofascial referred pain. In 30% of the migraine group, palpation of MTrPs elicited a "full-blown migraine attack, which required abortive treatment." The number of MTrPs in the control subjects with referred pain ranged from one to five compared to none to fourteen in the migraine subjects. The researchers found a positive relationship between the number of MTrPs and the frequency of migraine attacks and duration of the illness. The location of MTrPs was highly consistent with 43% in the temporal areas, 33% in the suboccipital areas, and 24% elsewhere. The authors determined MTrPs in the anterior temporal and suboccipital areas as typical for migraines and MTrPs in other areas as atypical. The authors proposed that migraine MTrPs are spontaneously hyperactive peripheral nociceptors. As they observed that nearly all initial MTrPs linked to migraines were found in the temporal and suboccipital areas, they suggested that there may be a hierarchy in the recruitment of nociceptors. Therapeutic measures such as dry needling, acupuncture and even botulinum toxin injections may be effective because of their effect on the excitability of myofascial nociceptors. The paper concluded with a brief review of some of the limitations of the study.

Comments

This excellent article highlights the importance of MTrPs in the etiology of migraine headaches. Even though the study was not blinded and the sample was not randomly selected, the consistencies in MTrP location, referred pain patterns, and the correlations between number of MTrPs and frequency of attacks and duration of illness do support the notion that MTrPs may indeed contribute to peripheral and central sensitization in migraine patients. Including the assessment for MTrPs in the examination of persons with migraine headaches is highly recommended [JD].

Fitzgerald MP, Kotarinos R. Rehabilitation of the short pelvic floor. I: Background and patient evaluation. *Int Urogynecol J* 2003;14: 269-275.

Summary

The introductory review identifies a sampling of published identifications of the abdominal–pelvic pain syndromes that include piriformis syndrome, coccygodynia, levator ani spasm syndrome, proctalgia fugax, trigger points, genitourinary pain, prostatodynia, vulvodynia, and interstitial cystitis. Normal function of the lower urinary tract and anorectum depend so highly on proper function of pelvic floor muscles [PFM] that shortness or weakness of those muscles produces more symptoms than if they occurred in limb muscles. Patients with pelvic and bladder complaints characteristically exhibit panniculosis [increased consistency and resistance to skin rolling] with MTrPs in underlying muscle. Since MTrPs cause any muscle to become shortened, to contract slowly, and to relax slowly, MTrPs in the levator ani group will cause it to be short, contract weakly and relax slowly. The result is limitation of this group's ability to inhibit the detrusor during bladder filling, resulting in urinary urgency and frequency. Additional voluntary effort to inhibit detrusor function during filling to suppress urinary urgency causes further PFM pain. These MTrP characteristics can also cause stress incontinence during a cough due to inadequate contribution to reflex urethral closure. Failure of the levator ani group to relax normally during and after defecation can produce voiding dysfunction and constipation. The MTrPs in this muscle group can produce referred symptoms ranging from vague suprapubic or pelvic discomfort to frank pain. The coactivation of abdominal and PFM muscles that is considered necessary for stabilization of the spine and trunk is also disrupted by abdominal wall MTrPs or by tender abdominal wall surgical scars. The extrapelvic musculoskeletal exam includes the usual postural, gait, and anatomical asymmetry considerations. Abnormalities [MTrPs] of the iliopsoas, gluteal, quadratus lumborum, obturator internus [extrapelvic attachment], and piriformis muscles are evaluated because of frequent coexistence of abnormalities in these muscles and in the PFM muscles. Palpation for connective tissue changes in the skin and subcutaneous tissues includes skin rolling, examination of all scars, and non-muscular trigger points for tenderness. These changes are most common in specific areas of the abdominal wall, lower back, buttocks, vulva, and thighs and are commonly observed when there is pelvic floor involvement. Treatment of perineal scars, even if decades old, can contribute relief to pain, dyspareunia, dysfunctional voiding, and constipation. The description of the vaginal examination of intrapelvic muscles is remarkably complete and detailed with much attention paid to minimizing painfulness of the exam. This exam includes the iliococcygeus muscle, ischial spine, coccygeus, piriformis, obturators internus [intrapelvic attachment] muscles, pudendal nerve, and the arcus tendineus fascia of the pelvis. In addition the authors describe testing the normality, symmetry, and strength of pelvic floor voluntary contractions, and evaluate the subsequent relaxation. Common sites of MTrPs in these muscles are well illustrated. The authors note the importance of including examination of abdominal wall muscles for MTrPs and of nerves for neurotension caused by local restriction of normal nerve mobility during stretching by body movements. It includes testing mobility of the sciatic and pudendal nerves. Also, the authors fully describe and illustrate the importance of, technique of, and interpretation of vaginal pressure measurements. Finally the results of a chart review of 49 women with symptoms of urinary urgency frequency and/or pelvic or bladder who were referred for pelvic floor physical therapy evaluation and treatment are tabulated and briefly discussed. This is a most valuable source of past medical history that identifies nine common established medical diagnoses when MTrPs were usually overlooked and identifies 11 common presenting symptoms. The table of 10 major physical findings includes the prevalence of 5 common MTrP locations in these patients. MTrPs were found in the levator ani in 92% of the patients, in suprapubic muscles in 65%, obturator internus in 45% and iliopsoas in 43% of the patients.

Comments

This paper is remarkable for its clarity, completeness, and credibility. The final table presents MTrP data not previously available and gives helpful guidance as to the most important muscles to examine clinically in patients who are suffering any of these pelvic symptoms. The percentages make it abundantly clear that these muscles are a major source of pain and dysfunction in women suffering from pelvic symptoms and that a skillful trigger-point pelvic examination is essential. Fortunately levator ani MTrPs can be detected by external examination of the internal borders of the coccyx for attachment

MTrP trigger point tenderness. Often simply attempting to slip a finger underneath the tail end of the coccyx elicits an unambiguous response [this pearl thanks to Karel Lewit of the Czech Republic]. I know the second author personally. She has dedicated decades of her life to helping female patients suffering from pelvic pain and has developed remarkable competence, obtaining outstanding clinical results that include a member of my family [DGS].

Borg-Stein J. Treatment of fibromyalgia, myofascial pain, and related disorders. *Phys Med Rehabil Clin N Am* 2006;17:491-510.

Summary
Fibromyalgia and myofascial pain are frequently confused in clinical practice. This paper reviews the typical clinical presentations of both syndromes, their pathophysiology, and common treatment options. A section devoted to differential diagnosis is particularly important and includes several diagnostic questions and considerations when making the most likely medical diagnosis. The pathophysiology section is somewhat biased toward myofascial pain and gives a remarkable up-to-date review of current scientific findings, including the biochemical MTrP research by Shah et al[51] and current topics of spinal mechanisms of pain and central sensitization. The treatment section combines pharmacological treatment options for both fibromyalgia and myofascial pain. Non-pharmacological management options include postural, mechanical and ergonomic modifications, stress reduction, acupuncture, exercise, trigger point injections, and dry needling. The author concludes with a brief review of her treatment principles, which include being a sympathetic provider, identifying peripheral pain generators, making an accurate diagnosis, and offering a comprehensive treatment approach.

Comments
The author has managed to synthesize the most pertinent aspects of both fibromyalgia and myofascial pain into a comprehensive review. There is only one issue that keeps showing up in this and similar review articles and that is the statement that "dry needling of the MTrP provides as much pain relief as injection of lidocaine but causes more postinjection soreness." Commonly, as is the case in this article, a paper by Hong et al is quoted[34]. However, Hong et al compared lidocaine injections with dry needling using a syringe and not an acupuncture needle. In clinical practice, dry needling is typically performed with an acupuncture needle and to the best of my knowledge there are no studies that compare dry needling with acupuncture needles to lidocaine injections [JD].

Fitzgerald MP, Kotarinos R. Rehabilitation of the short pelvic floor. II: Treatment of the patient with the short pelvic floor. M.P. *Int Urogynecol J Pelvic Floor Dysfunct* 2003;14:269-75.

Summary
Rehabilitation of a short pelvic floor is usually successful in 10 treatments of 1 hour weekly based on proceeding in the following order, which minimizes the need for transvaginal manipulation. Eliminating activities that usually aggravate the problem require: stopping Kegel-type exercises and abdominal wall strengthening exercises like sit-ups, and avoiding restrictive (tight) slacks, jeans, or panty hose with a seam at the body-thigh interface. Extrapelvic musculoskeletal abnormalities such as lower limb-length inequality, small hemipelvis, and postural misalignments must be addressed. Treatment techniques for connective tissue abnormalities, especially panniculosis, are described fully and well illustrated. Abdominal and perineal scars causing tissue restriction of any degree must be released. Several techniques are described. Closure of any abdominal wall diastasis is necessary and several exercises that carefully avoid any standard abdominal wall strengthening exercises are proposed to facilitate closure, usually in about 6 weeks. Any MTrPs in extrapelvic muscles: iliopsoas, piriformis, quadratus lumborum, and gluteal muscles are released. Any MTrPs remaining in the pelvic floor musculature must now be released using barrier release [MTrP pressure release], contract/relax, post-isometric relaxation, reciprocal inhibition, and proprioceptive neuromuscular facilitation. Each of these is described in detail. If needed, transvaginal injection of the MTrPs is described. For especially sensitive patients and for those requiring release of pudendal nerve tension, a pudendal nerve block by a general obstetrician/gynecologist may be necessary. The home maintenance program includes abdominal wall stretching exercises, knee pushes [illustrated], pelvic drops [lengthening], and manual mobilization of scars. Timed voiding desensitizes urinary frequency by progressive increase in voiding intervals. Knee pushes and/or pelvic drops can help to postpone voiding [DGS].

Prendergast SA, Weiss JM. Screening for musculoskeletal causes of pelvic pain. *Clin Obstet Gynecol* 2003;46:773-782.

Summary
This is a clinically oriented overview of a combined neuromuscular examination of the pelvic structures. The onset of pelvic pain is usually caused by trauma that may have occurred many years earlier. History of urinary infection [but now with repeated negative cultures], childbirth, abdominal surgery, falls on the hip region, sacroiliac dysfunction, a long bike ride, or car accident call for examination of all

potential muscular and visceral sources of pain since they can generate similar referred pain patterns. A shortened quadratus lumborum muscle can lead to MTrPs in the pubo-urethralis and obturator internus muscles producing urinary symptoms. Restricted mobility producing increased tension of peripheral nerves including the iliohypogastric, ilioinguinal, genitofemoral, lateral femoral cutaneous, femoral, pudendal, sciatic, and obturator internus can cause pelvic pain. Sacroiliac joint dysfunction can produce tension and inflammation of the sacrotuberous and sacrospinous ligaments pinching and restricting mobility of the pudendal nerve. This problem is identified by neurodynamic (stretch) testing and palpation of the nerve, which should not be painful procedures. The external muscle exam for trigger points should include the iliopsoas, piriformis, quadratus lumborum, transverse abdominal, rectus abdominis, and the gluteus maximus and medius muscles. The intrapelvic examination for MTrPs should include the sphincter ani, transverse perinei, levator ani, coccygeus, ischiocavernosus, bulbocavernosus, and obturator internus. A table lists the referred patterns of each. Kegel-type exercises are clearly contraindicated when the problem is caused by MTrPs, which it usually is. Palpation of problematic pubourethralis and urethrovaginal sphincter muscles by vaginal examination elicits tenderness and urgency.

Comments

The authors present a knowledgeable review of MTrPs and restrictions of nerve mobility that cause pelvic pain and dysfunction. Unfortunately the key MTrP reference was in error. Volume 2 of the *Trigger Point Manual* that includes the pelvic muscles was published in 1992, not 1983. The 1983 volume 1 reference was badly out of date overlooking the 1999-second edition[3]. The appropriate concluding emphasis on physical therapy manual treatments concentrated on myofascial release, which is often helpful and is intended to stretch-release muscle as whole and its associated fascia. Not mentioned are some more MTrP-specific and very effective manual release techniques commonly used by therapists who are skilled at treating MTrPs. They include pressure release, contract-relax, post-isometric relaxation and reciprocal inhibition [DGS].

Grieve R. Proximal hamstring rupture, restoration of function without surgical intervention: A case study on myofascial trigger point pressure release. *J Bodywork Movement Ther* 2006;10:99-104.

Summary

A 26-year old female tennis player and runner suffered a hyperextension injury of her left knee while water skiing, which resulted in a proximal rupture of the biceps femoris, semimembranosus, and semitendinosus. Although medical consensus dictates that surgical repair is the best treatment for hamstrings ruptures, the patient declined surgical intervention and opted for physical therapy instead. After the first course of physical therapy, which included hydrotherapy, electrotherapy, and exercise, she had regained a 60% improvement in power as assessed isokinetically, but she was not able to return to athletic activities, especially running. She was referred to another physical therapist, who evaluated her for the presence of MTrPs. At that point, she was already 19 months post-injury. Her running capacity was limited to only 4-5 minutes with increased pain during 3-4 days. The patient presented with multiple MTrPs in the left hamstrings and lateral and medial head of the gastrocnemius. The physical therapist used the criteria from Simons, Travell and Simons[3]. The objectives of physical therapy were to restore her pre-injury athletic ability, reduce the sensitivity of the MTrPs, and increase the power of the hamstrings. During the first treatment session, the physical therapist used manual MTrP release and passive stretching, which resulted in an immediate increase in ankle dorsiflexion and hamstrings strength. A week later, the patient reported being able to dance an entire night. There was only one sensitive MTrP left. At the time of the third physical therapy session, she was able to run 6 minutes daily without any post-activity pain. She still had one MTrP in the semimembranosus muscle. She had reached her treatment goals by the fourth session. Long-term follow up at three and six months revealed no further pain and dysfunction.

Comments

This is another excellent example of the importance of assessing patients for the presence of MTrPs even when the medical consensus dictates otherwise. The author presents an eloquent review of the case history and treatment. Of particular interest is the fact that the primary choice of treatment was manual pressure release of MTrPs. It is unfortunate that these kind of treatments are not available to so many patients worldwide. Instead, patients are treated with inadequate interventions and expensive surgeries without ever reaching their functional goals [JD].

Weiner DK, Schmader KE. Postherpetic pain: More than sensory neuralgia? *Pain Med* 2006;7:243-249.

Summary

The authors of this article present five case reports of patients with post-herpetic neuralgia who were successfully treated with MTrP inactivation techniques, including dry needling, percutaneous electrical nerve stimulation, MTrP injections, stretching exercises, physical therapy, and pharmacologic management. The first case involved only three dry needling sessions during which

local twitch responses were elicited. The patient was a 71-year old female with postherpetic neuralgia for 18 months. She had been treated previously with gabapentin, oxycodone, acetaminophen, chiropractic manipulations, and epidural corticosteroids. The second case has a similar overall history characterized by several ineffective interventions. Once MTrPs were identified, the patient was treated with a combination of cervical percutaneous electrical nerve stimulation and dry needling for only four sessions resulting in a dramatic decrease in pain. The introduction and discussion sections of this article bring up many interesting points. While postherpetic neuralgia is generally considered to be a sensory problem, the authors hypothesize that the pain may actually be caused by a combination of the varicella zoster virus and axial spondylosis or degenerative scoliosis, which may trigger not only adaptive muscle shortening and MTrPs, but also lead to the development of peripheral nerve injury and central sensitization. They recommend examining all patients with postherpetic neuralgia for MTrPs. The included case reports strongly support that MTrPs may be contributing to the persistent nature of postherpetic neuralgia.

Comments

This is a rather remarkable series of case reports demanding a shift in the thinking about postherpetic neuralgia. Only one previous report has described the relevance of MTrPs in the symptomatology of this disabling condition[76]. As the authors indicate, the astonishing results of MTrP inactivation suggest that prospective studies of the correlation between MTrPs and postherpetic neuralgia are desperately needed [JD].

Kao MJ, Hsieh YL, Kook FJ, Hong CZ. Electrophysiological assessment of acupuncture points. *Am J Phys Med Rehabil* 2006;85:443-448.

Summary

Physiatrists in Taiwan examined by needle electromyography an acupuncture point and a nearby non-acupuncture control site in a randomly chosen tibialis anterior muscle for the presence of endplate noise characteristic of MTrPs in 10 male and 10 female normal volunteers. Each site was explored for endplate noise by slowly advancing the EMG needle as previously described for MTrPs. Following this, all sites were examined for the following clinical evidence of a MTrP: The most tender spot in a palpable taut band that referred pain to the ankle and foot and responded to snapping palpation with a local twitch. Endplate noise [EPN] was found at acupuncture sites in 25% of both male and female subjects, and in non-acupuncture sites in 6% of male and 1% of female subjects. The difference between the two kinds of sites was statistically significant [$p < 0.001$]. Every time the needle approached one of the 127 acupuncture sites and resulted in the appearance of EPN, the subject reported pain, soreness, or an unpleasant feeling. This experience is comparable to the "Ah Shi" [that's it] effect characteristic of acupuncture sites and was reported in only 7 of the 826 times that the needle did not encounter EPN. Subjects found the sensation when a local twitch response was elicited by the needling an MTrP to be comparable to the "De-Qi" effect of acupuncture.

Comments

The authors are to be highly congratulated for this first controlled well-designed study comparing acupuncture and MTrP sites. This study also for the first time provides an experimental answer to a tricky and controversial question that the authors did not recognize. They do point out how fatally seriously flawed previous studies have been that simply review the literature and are based on false assumptions and they concluded that this study demonstrates that the Stomach-36 acupuncture sites [for treatment of pain] seem to be MTrPs, which supports the concept that some acupuncture points are actually MTrPs based primarily on the strong, significant correlation between the presence of endplate noise and the acupuncture points compared to non-acupuncture points. This conclusion is further supported by the correspondence of the Ah Shi and De Qi experiences at both kinds of sites. The authors also noted that this study strongly supports the association of EPN with MTrPs, which is a basis for the integrated hypothesis explanation of the cause of MTrPs. The fact that several non-acupuncture sites showed EPN can be accounted for by another interpretation. These sites may have been subclinical MTrPs that included a few muscle fibers that had all of the dysfunctions of an MTrP but too few of them were involved to be detected by the limited sensitivity of the clinical examination for MTrPs. Not all MTrP sites are also acupuncture sites, but likely, most pain acupuncture sites are also MTrPs. The data reported help to clarify another controversial issue that was the used as the basis for the rejection by one journal for the research paper that established the close relationship between EPN and MTrPs. Is EPN only the result of needle stimulation of a normal endplate or does it reveal an abnormality of endplate function that was already present? It is not easy to design an experiment to answer this question since the only way you can detect the EPN is by placing the needle close to the endplate and needle pressure increases the amount of EPN. The presence of EPN at acupuncture sites demonstrated that they were in an endplate zone, and the placement of the non-acupuncture sites likely also placed them in the endplate zone. Since exactly the same search procedure was used at both kinds of sites, the needle should have encountered a nearly equal numbers of endplates. The fact that so few of the non-acupuncture [non-TrP] endplate encounters responded to needle approach with EPN is strong evidence that the presence of the needle alone was usually inadequate mechanical stimulus to produce EPN in most normal endplates. Therefore the EPN that was observed was usually preexisting and was caused by the MTrP abnormality, not just by the presence of the needle. If this degree of mechanical stimulation did happen occasionally, or the needle encountered a particularly sensitive endplate, it could account for the occasional presence of EPN at non-acupuncture sites [DGS].

Macgregor J, Graf von Schweinitz D. Needle electromyographic activity of myofascial trigger points and control sites in equine cleidobrachialis muscle: An observational study. *Acupunct Med* 2006;24(2): 61-70.

Summary

A veterinary physiotherapist and acupuncturist in the United Kingdom explored the EMG and other characteristics of MTrPs in equine muscle compared to normal muscle. They examined the cleidobarachialis division of the brachiocephalic muscle of four thoroughbred horses that had been retired from active duty and were being seen for treatment of chronic pain signs and impaired performance. The muscle was examined bilaterally at two acupuncture sites for MTrPs. The sites were approved, with the owners' informed consent, for the administration of acupuncture-like treatment with an EMG needle exploring for endplate noise and local twitch responses without equine sedation. Initially, a very tender spot in a palpable taut band in the muscle identified an MTrP. Its precise location was found by the very limited range along the taut band that responded with a maximum twitch response to snapping palpation. Of course, the location of induced pain and its familiarity could not be determined but it is unlikely the horses would fake the local sensitivity, the twitch response is objective evidence, and the musculoskeletal functional disability for which the horses were being seen for treatment was very real to the owners. Needles were inserted only at acupuncture sites that were suitable for treatment, which were LI16 and LI17 using the transpositional acupoints system. LI16 was chosen as the MTrP site in all 4 horses, and for a clinically MTrP-free EMG control site, LI17 was chosen in three horses and ST10 was used in one horse that had an MTrP at LI17. A 50 mm long concentric Teflon coated disposable EMG needle was used to record EMG activity at each test site. Each TrP region and each acupuncture control site was explored for electrical activity by inserting the needle in 5 directions: perpendicularly, and at 45 degrees in 4 quadrants. Each needle insertion was tested for EMG at 5 depths roughly 1 cm apart and was advanced slowly with rotation to minimize insertional activity and twitch responses [instead of endplate noise]. When activity appeared the needle was left in situ to allow the activity to stabilize. The needles in the control and MTrP sites were connected to a two-channel EMG machine and recorded simultaneously. Three items were listed: the appearance of continuous spontaneous electrical activity [endplate noise] of at least 10μV more than control baseline activity [generally 20μV greater], the appearance of irregular spike activity [usually negative first and biphasic] of at least 100μV, and the occurrence of local twitch responses. These three data were combined for all four horses. Differences of $p < 0.05$ between MTrP and control sites were considered statistically significant. Endplate noise sometimes reached 80μV, and endplate spikes, 1,000μV. A typical recording is included. All three phenomena observed were significantly more common at the MTrP sites than at control sites. Although the authors used the outmoded SEA [spontaneous electrical activity] terminology instead of the more specific endplate noise designation for the first item reported, they did recognize from the literature that they were actually dealing with endplate noise. They were not aware of the more recent literature that has adopted the EPN designation and the paper that justifies that change[15,77]. The presence at control sites of EMG recordings typical of TrPs may have been because the horse muscle is large enough that early or small or deep MTrPs may not be clinically identifiable. The surprisingly high level [4 time what has usually been seen in human and rabbit studies] of background noise at control sites may have been because the horses were standing, fully alert, on the legs being tested. The EPN often disappeared if the needle was advanced or withdrawn a few millimeters, consistent with its endplate origin. Although there were only 4 subjects, the results were statistically significant. The authors also noted that blinding of examiners would be desirable.

Comments

This is, to my knowledge, the first research paper ever published on the presence of MTrPs in horses. Dr Janet Travell often described her treatment of MTrPs in her beloved horses. This paper takes a large second step of further EMG substantiation of the strong association of endplate noise with MTrPs. This part of the paper reinforces the basic concept of the integrated hypothesis, which still needs much additional research to fully complete the picture[15]. The descriptions and illustration of EPN and spikes are fully consistent with the extensive experience of Hong, Lois Statham Simons and me, when we were intensively studying TrPs in human and rabbit subjects from 1993 through 1995[78]. We hope the authors will continue this kind of research and make the considerable additional effort required to conduct a controlled blinded study of the effectiveness of acupuncture treatment of MTrPs in their horse patients. It would be another major contribution to the veterinary and MTrP literature [DGS].

Fernández-de-las-Peñas C, Cuadrado ML, Gerwin RD, Pareja JA. Myofascial disorders in the trochlear region in unilateral migraine: A possible initiating or perpetuating factor. *Clin J Pain* 2006;22:548-553.

Summary

This physical therapist from Spain and three neurologists report an unprecedented examination of the superior oblique muscle [SOM] of the eye bilaterally for MTrPs in 20 patients [7 men and 13 women] with unilateral migraine attacks and in 20 age and gender matched healthy control subjects. All subjects were examined by a blinded examiner and patients examined at least one week following a migraine attack to avoid migraine-related allodynia and in a headache-free status. The trochlear region of the eyeball was examined for trochlear region [SOM] tenderness, referred pain evoked by digital pressure maintained for 30 seconds, increased referred pain in response to contraction of the SOM [downward and medial gaze], and increased referred pain due to stretching it [upward and lateral gaze]. A definite MTrP was identified if both contraction and stretching of the SOM increased pain. Response to only one maneuver identified a probable MTrP. Patient recognition of evoked referred pain as familiar during a migraine attack identified an active MTrP, otherwise it was considered latent. Four visual analog scale estimates of pain level were made by subjects on initial trochlear pressure, after 30 seconds of pressure, and in response to contracting or stretching the SOM. All migraine patients had local trochlear-region tenderness, more on the symptomatic side [VAS 4.8] compared to the asymptomatic side [VAS 2.2] [$P < 0.001$]. Sixteen patients [80%] perceived referred pain when pressure was maintained for 30 seconds [VAS 5.2] described as a tightening sensation in the retro-orbital region that sometimes extended to the supraorbital region and even the homolateral forehead. This pain was evoked only from an eye on one side in all patients. 15 patients [75%] had definite MTrPs; 10 of these patients had active MTrPs and 5 had latent MTrPs. In all of these cases, the MTrPs were ipsilateral to the side of the headache. The presence of MTrPs was essentially the same in patients with or without aura. The intensity of local pain responses to testing in controls was significantly lower than patient responses on the symptomatic side [$P < 0.001$], but equal to those on the asymptomatic side. Five control subjects reported local pain on SOM examination that rated them as probable MTrPs that were all latent. Future studies are needed to clarify the cause/effect relationship between the SOM MTrPs and headaches. These studies include treatment effects.

Comments

This outstandingly well-designed, innovative study is a sequel to a previous report of SOM TrPs in patients with tension type headache, that described similar pain patterns[64]. I often wondered why the extraocular muscles didn't have MTrPs that caused referred pain. I just didn't look hard enough. Devin Starlanyl told me how she screens for MTrPs in the other extraocular muscles and occasionally finds them by having the patient gaze in each of the four directions, up, down, left, and right, sequentially for painfully restricted range of motion. Apparently there are very few headaches including migraine that do not have a significant MTrP component[79]. Eighty percent of the patients with migraine had clinical evidence of MTrPs in the SOM [DGS].

Fernández-de-las-Peñas C, Alonso-Blanco C, Cuadrado ML, Pareja JA. Myofascial trigger points in the suboccipital muscles in episodic tension-type headache. *Man Ther* 2006;11:225-230.

Summary

In this study, ten subjects with episodic tension-type headaches [ETTH] and ten healthy age- and sex-matched controls were examined for the presence of MTrPs in the rectus capitis posterior minor, rectus capitis posterior major, and oblique capitis superior by an examiner who was blinded to the subjects' condition using modified criteria by Simons, Travell and Simons, and by Gerwin et al[3,4]. Since these suboccipital muscles are not directly palpable, subjects were asked to extend the neck from a neutral spine position, once the examiner had elicited referred pain by compression in the area between the occiput and the posterior arch of the atlas. The active cervical-occipital extension allowed the examiner to palpate for active contractions. The presence or absence of familiar referred pain similar to pain during headache attacks determined whether MTrPs were classified as active of latent respectively. On the day of the examination, all ETTH subjects received a headache diary to record the daily headache intensity, duration, and the days with headache for a period of 4 weeks. All ETTH subjects had MTrPs in the suboccipital muscles; 6 subjects (60%) had active and 4 subjects (40%) had latent MTrPs. Two control subjects (20%) had latent MTrPs. Differences between groups were significant for the presence of active MTrPs. The headache intensity, frequency, and duration in the ETTH group did not depend on whether MTrPs were active or latent.

Comments

The authors recognized that the limited sample size designates this study basically as a pilot study with limited power. Combined with the many other headache studies by this research group, it appears that suboccipital muscles play a role in the etiology of episodic tension-type headaches. As these muscles are not directly palpable, it is conceivable that other structures in the suboccipital region could also contribute to the perception of referred pain even though the authors attempted to minimize its likelihood. Future studies should be expanded and include other posterior neck muscles, a larger sample size, and other types of headaches [JD].

Fernández-de-las-Peñas C, Alonso-Blanco C, Alguacil-Diego IM, Miangolarra-Page JC. Myofascial trigger points and postero-anterior joint hypomobility in the mid-cervical spine in subjects presenting with mechanical neck pain: A pilot study. *J Manual Manipulative Ther* 2006;14:88-94.

Summary

Thirty patients with mechanical neck pain referred by their primary care physician were included in this study. Mechanical neck pain was defined as "generalized neck and/or shoulder pain with mechanical characteristics including symptoms provoked by maintained neck postures, by neck movement, or by palpation of the cervical muscles." One physical therapist examined each subject for the presence of MTrPs in the upper trapezius, sternocleidomastoid, and levator muscles according to the criteria by Simons, Travell, and Simons, and by Gerwin et al[3,4]. The researchers used an algometer to reproduce familiar referred pain. A second physical therapist, blinded to the findings of the first therapist, examined the cervical spine from C3 to C7 for the presence of posterior-anterior hypomobility as described by Maitland[80]. The mean number of MTrPs was 3.4 (2.3 latent and 1.1 active) with most MTrPs in the sternocleidomastoid muscle (left: 66.6%; right: 83.3%), followed by the trapezius (left: 70%; right: 63.3%), and the levator scapulae (left: 30%; right: 26.6%). Sixteen subjects had right-sided joint hypomobility and 14 presented with left-sided hypomobility with the C3 segment most commonly involved (80%) followed by C4 (20%). The authors could not determine a statistical significant relationship between the number of MTrPs in the examined muscles and the presence of hypomobility at the C3 and C4 vertebrae. In the discussion section the authors addressed several aspects of muscle and joint dysfunction in the cervical spine and reviewed in detail the discrepancies between the current study and a previous study from the same research group reporting a significant relationship between the number of MTrPs in the upper trapezius muscle and C3 and C4 hypomobility[81]. In the previous study, they employed the lateral gliding test and included 150 subjects versus 30 in the current study[81].

Comments

It is encouraging to see that one of the world's leading manual therapy journals published this excellent article on the relationship between MTrPs and cervical hypomobility. Even though this study could not determine statistical significance, the authors emphasized that the mere presence of MTrPs and joint dysfunction dictates that in clinical practice both muscles and joints need to be addressed. It is our impression that until recently, the manual physical therapy community has not focused on MTrPs. The many clinically relevant studies by this Spanish research group certainly will facilitate a re-orientation that can only benefit our patients [JD].

Ge HY, Fernández-de-las-Peñas C, Arendt-Nielsen L. Sympathetic facilitation of hyperalgesia evoked from myofascial tender and trigger points in patients with unilateral shoulder pain. *Clin Neurophysiol* 2006;117:1545-1550.

Summary

Twenty-one female subjects with chronic unilateral shoulder pain were included in this study. To be included in the study, the subjects needed to have an active MTrP in one of the infraspinatus muscles using the criteria of Simons, Travell, and Simons[3]. A tender point in the contralateral infraspinatus muscle was identified. A tender point was defined as a point within a taut band but without referred pain with snapping palpation. A point in the right tibialis anterior muscle was used as a control point. Subjects rated their resting pain on a visual analog scale before any measurements were taken. The researchers determined the pressure pain threshold [PPT] for all three points using an algometer during normal respiration and during induced elevated intrathoracic pressure [EITP], which is described as a maneuver that increases the sympathetic outflow to the skeletal muscle when holding one's breath with the glottis closed. With this maneuver it is possible to determine the effect of increased sympathetic outflow on the mechanical sensitivity of MTrPs. In the second phase of the study, the PPT and the pressure threshold for eliciting referred pain [PTRP] were determined in eleven subjects. Next the local pain and referred pain intensities were measured at the MTrP during normal respiration and during EITP during application of pressure equal to 1.5 x PTRP. After all measures were completed, a local twitch response was elicited in the active MTrP using an acupuncture needle. The authors concluded that increasing sympathetic outflow to the muscle decreases PPT, PTRP, and increased local and referred pain intensities at both tender and trigger points. They offered several conceivable mechanisms for the observed sensitivity, including a change in the local chemical milieu at the tender and trigger points due to increased vasoconstriction, an increased sympathetic release of noradrenaline, or an increased sensitivity to noradrenaline.

Comments

This is an important study that provides for the first time experimental evidence of sympathetic facilitation of mechanical sensitization of MTrPs. Previous studies demonstrated that exposing subjects with active MTrPs in the upper trapezius muscles to stressful tasks consistently increased the electrical activity in MTrPs, while autogenic relaxation was able to reverse the effects[82-85]. The authors offer several possible mechanisms that differ from previous suggestions that the autonomic contributions may be due to muscle spindle activity or activity of adrenoreceptors on the motor nerve terminal[83,86]. The authors' choice of characterizing a tender point in a taut band as a "tender point" is rather confusing, as these points seem to meet the criteria for latent MTrPs as defined by Simons, Travell, and Simons[3]. It gets even more confusing when the authors seem to equate these tender points or latent MTrPs with fibromyalgia tender points in the discussion section of this paper. While it is conceivable that some fibromyalgia tender points may indeed be MTrPs, the mixed use of these terms only contributes to confusion[87]. Notwithstanding the confusing terminology, this study does offer support for autonomic influences on MTrPs [JD].

Kern KU, Martin C, Scheicher S, Mdler H. Auslosung von Phantomschmerzen und -sensationen durch Muskuläre Stumpftriggerpunkte nach Beinamputationen [Referred pain from amputation stump trigger points into the phantom limb]. *Schmerz* 2006;20:300-306.

Summary

Based on their experiences with the treatment of phantom and stump pain using botulinum toxin injections into MTrPs,s the authors completed a systematic analysis of the local and referred pain patterns of stump MTrPs. Thirty subjects with leg amputations (12 transfemoral,18 transtibial) were examined for MTrPs. After determining the five most symptomatic MTrPs, the subjects were asked to localize areas of stump pain, phantom pain, and sensations in the phantom limb. Interestingly, patients were not aware of the presence of the MTrPs. Yet, pain sensations were commonly seen in as many as 20 out of 30 patients with 60 out of 150 MTrPs producing phantom sensations and 17 causing phantom pain. Fourteen MTrPs caused involuntary stump movements and 10 produced stump fasciculations. Phantom phenomena were most commonly seen in the toes (62.8%) and midfoot (17.9%) with the remainder more proximal. Approximately 70% of the MTrPs were in an area 3 to 7 cm from the stump end. The MTrPs that caused toe projections were usually more distal than those with tibial referred pain/sensation patterns. Thirty percent of the MTrPs were located in the dorso-lateral aspect of the stump and 18% were in the medio-ventral part, presumably because of greater muscle mass, but conceivably because of more dorsal nerve distributions in the leg. Ventral MTrP did cause dorsal phantom pain in some instances. The authors concluded that latent MTrPs may contribute to phantom pain and sensations and speculated whether MTrP pain and phantom pain may develop from a shared etiology.

Comments

This and other articles from the same authors are very encouraging and should provide hope for thousands of patients suffering from daily phantom pain. A survey of American veterans revealed that 78% of respondents experienced phantom pain[88]. To the best of our knowledge, this is the first study that systematically examined the role of MTrPs in phantom pain phenomena. While the exact mechanism of action may require further studies, the results of this study justify examining and treating patients with phantom pain with inactivation of MTrPs [JD].

Dorsher P. Trigger Points and acupuncture points: Anatomic and clinical correlations. *Med Acupunct* 2006;17(3): 21-25.

Summary

This article compares the anatomical and clinical relationships between MTrPs described by Travell and Simons and acupuncture points [AcP] described by the Shanghai College of Traditional Medicine and other acupuncture publications. An anatomical correspondence was assumed when a MTrP and AcP were within a 2 cm radius of each other, and the points entered the same muscle. A published cross-sectional anatomic study of AcP was used to determine whether AcPs were in the same muscle as the corresponding MTrPs. Differences in depth were accepted. The author determined whether AcPs with corresponding MTrPs had similar regional pain indications as the MTrPs. In addition, he determined whether there was any overlap between the distributions of acupuncture meridians and MTrP referred pain patterns. The degree of correspondence was graded on a five-point scale ranging from excellent to none. Of the 255 MTrPs, only 8 did not have an anatomic correspondence with AcPs and most of these points were located in the medial pterygoid, psoas, iliacus, subscapularis, and obturator internus muscles, which the author characterized as "not safely accessible by trigger point injections." Fifteen percent of classical AcPs with corresponding MTrPs did not have similar clinical pain indications.

Referred pain patterns and meridian distributions were nearly identical in 76%, partially identical in 14%, and had no correspondence in 10% of comparable points. After the author addressed possible criticisms of this study, he concluded that "the strong correspondence between trigger point therapy and acupuncture should facilitate the increased integration of acupuncture into contemporary clinical pain management."

Comments

Dowsher has undertaken a very detailed and consuming comparison between 255 MTrPs and 386 AcPs. In addition to the current article, he mentioned that he has prepared computer graphic demonstrations of each of the 234 MTrP-AcP anatomic correspondences, and meridian-referred pain correlations. His findings are pretty much in line with Melzack et al's conclusion that there is a 71% overlap between MTrPs and AcPs[6]. Dowsher dismissed Birch's arguments that most AcPs are not used specifically for pain indications[89]. Yet, it remains questionable whether it is possible to assume distinct anatomical locations of MTrPs and use those in comparisons with other points. In part, the *Trigger Point Manuals* are to blame for suggesting that MTrPs have distinct locations[3,23]. Simons, Travell, and Simons have described specific MTrPs in numbered sequences based on their "approximate order of appearance" and may have contributed to the widely accepted impression that indeed MTrPs have distinct anatomical locations[3]. To this reviewer, the detailed numbered descriptions of specific MTrPs in the *Trigger Point Manuals* are not consistent with clinical practice. For example, Simons, Travell, and Simons described seven MTrPs in the trapezius muscle. In clinical practice, one frequently finds more MTrPs in just the upper part of the muscle. The authors have used the terms "trigger regions with distinctive pain patterns" and "TrPs" somewhat interchangeable, which in fact may add to the confusion. The most striking aspect of this study is the correspondence between known referred pain patterns and described courses of meridians. However, the same dilemma arises: Are referred pain patterns MTrP-specific or should they be described for muscles in general or perhaps for certain parts of muscles? Recent studies of experimentally induced referred pain suggest that individual referred pain patterns may be characteristic of muscles rather than of MTrPs[65,66,90,91]. If one of the objectives of this paper is to increase the utilization of acupuncture into pain management practice, it may be preferable to conduct clinical outcome studies of the efficacy of acupuncture in the treatment of persons with pain conditions or investigate the nature of acupuncture points as several researchers have attempted[92-94]. More research is needed to establish whether MTrPs can be categorized with distinctive anatomical locations and whether referred pain patterns are MTrP-specific or muscle-specific, before undertaking more such studies. As a side note, all the muscles the author deemed not safely accessible by trigger point injections are commonly needled in clinical practice [JD].

Rodriguez-Blanco CR, Hernandez J, Algaba C, Fernandez M, De la Quintana M. Changes in active mouth opening following a single treatment of latent myofascial trigger points in the masseter muscle involving post-isometric relaxation or strain/counterstrain. *J Bodywork Movement Ther* 2006:10:197-205.

Summary

This study of 90 subjects (42 men, mean age 25 years) with a latent MTrP in the masseter muscle compared the immediate effect on active mouth opening following a single treatment with either post-isometric relaxation or strain/counterstrain technique. The subjects were healthy college students without any restrictions in mouth opening. MTrPs were identified using the Simons, Travell and Simons criteria[3]. Subjects were excluded if they had no MTrP in the masseter muscle; a history of fibromyalgia, whiplash, surgery in the cranio-cervical region, or temporomandibular disorders; or having undergone myofascial pain therapy within the past month before the study. Subjects were randomly assigned to one of three groups. Groups one and two were treated with post-isometric relaxation and strain/counterstrain respectively, while the third group functioned as the control group that received no treatment. Treatment by post-isometric relaxation began with passive opening of the mouth to the barrier, followed by a gentle isometric voluntary contraction, repeated 3 times. Strain/counterstrain by the therapist involved applying pressure to the masseter MTrP by pincer palpation until the subject felt pressure and some pain. Then the subject was passively positioned into a position of ease that reduced the palpable tension and pain by around 75%, which was usually ipsi-lateral side-flexion of the cervical sine, and a slight mouth opening [5-8 mm]. Blinded evaluations of mouth opening before treatment, and 5 minutes post-treatment found an increase of 2.0 mm after post-isometric relaxation, 0.2 mm after strain/counterstrain, [$p < 0.001$], and 0.1 mm for the control group. Only the group receiving post-isometric relaxation showed a significant improvement in active mouth opening.

Comments

Spain is becoming an important source of high quality MTrP research and this study follows the trend. To our knowledge, this is the first blinded, randomized, controlled study comparing the effectiveness of a manual treatment of MTrPs that is comparable to strain/counterstrain, and the results were more dramatic than expected. The authors acknowledged that the results might not be typical of symptomatic patient populations, as the subjects were asymptomatic before the study. This study had no assessment of follow-up results. Yet, the study does demonstrate that latent MTrPs may be clinically relevant and can cause limitations in range of motion consistent with Lucas et al's findings[20]. Several additional considerations would have been of value in this study. Additional measures of MTrP tenderness [pressure pain threshold] before and after treatment were lacking. The authors did not include MTrP examinations of the temporalis and medial pterygoid muscles, which share functions with the masseter. They may have been more affected by the post-isometric relaxation than by the strain/counterstrain technique. The question remains how actual patients with limited mouth opening would respond to either form of therapy and we hope that this research team will consider this in future studies [DSG and JD].

Huguenin L, Brukner PD, McCrory P, Smith P, Wajswelner H, Bennell K. Effect of dry needling of gluteal muscles on straight leg raise: A randomized, placebo controlled, double blind trial. *Br J Sports Med* 2005;39(2):84-90.

Summary

Fifty-nine athletes with hamstrings pain recruited from Australian Rules football clubs, advertisements, flyers, and private referral were included in this study, which aimed to evaluate the effects of therapeutic and placebo dry needling on hip straight leg raising [SLR], internal rotation [IR], muscle pain, and muscle tightness. The symptoms had to be reproducible with pressure over MTrPs. SLR and IR were measured with standardized methods validated for their reliability before the start of the study. Pain and tightness in the hamstrings and gluteals were assessed on four unmarked 10 cm visual analog scales.The dry needling procedures were performed by the same researcher. MTrPs were identified mostly in the upper outer buttock quadrant with 3-5 MTrPs per subject. Therapeutic needling was performed with 0.30 mm diameter and 25 mm long acupuncture needles. Reproduction of recognizable pain or visualization of a local twitch response were used as indicators of correct needle placement. The needle was partially withdrawn and repeatedly advanced until the pain resolved and no further twitches were observed. Placebo needles were modified acupuncture needles. The tip had been removed and the needle was glued back into the shaft. Placebo needling involved applying the tip of the blunted needle to the skin over MTrPs. The placebo needling had been assessed for reliability in 10 volunteers and found to reliable. There were no significant changes in range of motion in either group. The VAS scores did not change significantly either for any of the resting variables or for gluteal pain. Both groups did have significant improvements in hamstrings tightness, hamstrings pain, and gluteal tightness. Measurements were taken before, immediately after, and again after 24 and 72 hours.

Comments

This study is somewhat difficult to understand and to evaluate. Both the therapeutic and placebo group had similar outcomes. The authors raised the possibility that limited range of motion may not necessarily be associated with symptoms. But there are other, more fundamental problems with this study. Unfortunately, the authors did not indicate which gluteal muscles were included in the assessment or in the interventions. Which particular gluteal MTrP reproduced the hamstrings pain? According to Travell and Simons, only MTrPs in the deeper portion of the gluteus mimimus refer pain to the hamstring[23]. Did the authors provoke the familiar pain by applying pressure on a gluteus minimus MTrPs? If so, it would be impossible to reach this MTrP with a 25 mm long acupuncture needle, especially in well-trained athletes with presumably conditioned gluteal muscles. There may have been other structures contributing to hamstrings pain, such as the sacrotuberous ligament, or sacroiliac joints, even though the latter were excluded based on clinical evidence. At the same time, there are many other muscles that may need to be treated before changes in range of motion would be measurable, including the piriformis and other hip rotators, the abductor magnus, and of course the hamstrings themselves. Hamstrings pain is frequently due to MTrPs in the hamstrings or the adductor magnus, and not from gluteal MTrPs[95]. Another issue is whether the placebo needle really provided a true placebo. The researchers did stimulate the skin overlying MTrPs, which may implicate a-beta fibers, which in turn may have an impact on the observed outcomes. Placebo needling is inherently difficult to accomplish. The authors suggested that the placebo stimulus might have been equivalent to a needle penetration [JD].

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