

# Treatment of Myofascial Pain Syndrome

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Myofascial pain syndrome (MPS) is caused by myofascial trigger points (MTrPs) located within taut bands of skeletal muscle fibers. Treating the underlying etiologic lesion responsible for MTrP activation is the most important strategy in MPS therapy. If the underlying pathology is not given the appropriate treatment, the MTrP cannot be completely and permanently inactivated. Treatment of active MTrPs may be necessary in situations in which active MTrPs persist even after the underlying etiologic lesion has been treated appropriately. When treating the active MTrPs or their underlying pathology, conservative treatment should be given before aggressive therapy. Effective MTrP therapies include manual therapies, physical therapy modalities, dry needling, or MTrP injection. It is also important to eliminate any perpetuating factors and provide adequate education and home programs to patients so that recurrent or chronic pain can be avoided.

## Introduction

Myofascial pain syndrome is a common clinical problem of muscle pain caused by myofascial trigger points (MTrPs). Based on the following evidence obtained from clinical observations and basic science research, the existence and the nature of MTrPs have now been widely accepted. The evidence shows that 1) compression of the MTrP can reproduce or aggravate a patient's usual complaint (pain recognition), and elimination (or more appropriately, inactivation) of the MTrP can relieve any symptoms of discomfort; 2) similar referred pain patterns can be elicited in different patients by compression of the MTrP in each individual muscle [1,2]; 3) high-pressure stimulation (including deep-pressure massage and needling) to the MTrP can suppress the pain [2–4]; 4) needling to the tiny loci (nociceptors, defined as sensitive loci or local twitch response [LTR] loci [1]) in the MTrP region can induce pain and referred pain, as well as LTR that can be recorded electromyographically [1,5]; 5) immediate relief

of MTrP pain can be achieved if LTRs are elicited during needling of the MTrP [6–8]; 6) all MTrPs are located within the endplate zone [1,9,10,11•], and endplate noise (EPN) can be recorded more frequently at an MTrP region than at a region with normal muscle tissue [12,13,14•]; and 7) electromicroscopic and ultrasonic studies provide morphologic evidence of taut bands and contraction knots in the MTrP region (endplate zone) [2,15].

The MTrP has been defined as a hyperirritable (hypersensitive) spot in a taut band of skeletal muscle fibers [2]. A latent MTrP (tender, but not spontaneously painful) can become an active MTrP (tender and spontaneously painful) secondary to a pathologic lesion [1]. After appropriate treatment of the lesion, the activated MTrP can be suppressed to its inactive state. However, the MTrP never disappears and is only converted from active to latent. Myofascial pain syndrome is a pain phenomenon caused by the activation of latent MTrPs due to certain pathologic conditions, including chronic repetitive minor muscle strain, poor posture, systemic disease, or neuromusculoskeletal lesion (such as strain, sprain, enthesopathy, arthritis, or vertebra disc lesion) [1,7].

## Treating the Underlying Etiologic Lesions— The Most Important Strategy of Myofascial Pain Therapy

In clinical observations, myofascial pain can be easily suppressed by MTrP injection but will frequently recur within a few days to a few weeks if the related pathologic lesion is not eliminated [7,8]. Only when the underlying etiologic lesion is completely eliminated can the active MTrPs be permanently inactivated (barring reinjury) [16••]. The association between active MTrPs and osteoarthritis of the knee [17], cervical disc lesions [18], or cervical facet lesions [19] has also been demonstrated. Chiropractic adjustment of the cervical spine [20] or local injection [21] of a cervical facet joint can effectively relieve the MTrP pain in the rhomboid muscle. It has been suggested that sensory pathways from facet nociceptors and MTrP nociceptors may be connected in the spinal cord or may use the same nociceptive pathway to the higher center [19]. Therefore, MTrP pain can be controlled by suppressing the facet pain and vice versa. If this is the basic mechanism behind the effectiveness of facet therapy (chiropractic manipulation) in controlling MTrP pain, the effect might be only temporary

(pain control, but not elimination of basic pathologic lesion). However, long-term relief of MTrP pain can be observed in clinical practice [21]. Therefore, facet dysfunction may be an important cause of MTrP activation. During physical examinations, compression of the C4-5 facet joint on one side can elicit pain in the MTrP of the ipsilateral rhomboid muscle, but needle stimulation to the rhomboid MTrP cannot induce pain in the ipsilateral C4-5 facet joint. In clinical practice, we have accumulated quite a bit of evidence that active MTrPs are caused by facet joint dysfunction. Treatment of the underlying pathology is the fundamental approach to the management of MTrPs. In many cases, the active MTrPs will automatically inactivate as soon as the underlying pathology heals completely.

### Inactivation of MTrPs

Treatment of active MTrPs may be necessary in certain situations. If the underlying etiologic lesion(s) is treated appropriately, the residual MTrP pain will usually subside soon after. However, if the pain persists, any residual active MTrPs (those that cause persistent pain even after the etiologic lesion has been eliminated) will also need to be treated. Sometimes, the etiologic lesion that causes MTrP activation cannot be identified, but the MTrP pain is severe. In these cases, inactivation of the MTrP will also be necessary. In many situations, release of muscle tightness after inactivation of MTrPs can improve local circulation and subsequently facilitate the healing of the underlying etiologic lesion. Release of muscle tightness can also increase the range of motion and improve the functional status of the muscle.

The commonly used methods for MTrP therapy (inactivation of MTrPs) have been described in previous literature [16••,22]. To inactivate MTrPs, the following principles should be considered.

1. Pain recognition: it is important to confirm that the MTrPs to be treated are the ones causing the usual complaint or discomfort in the patient. Many latent MTrPs surrounding the active MTrP are tender, but they are not the ones responsible for the patient's pain problems.
2. Identification of key MTrP: when an MTrP becomes very active (hyperirritable), other latent MTrPs within the referred zone of the hyperirritable MTrP may also become activated. These newly developed MTrPs are known as satellite MTrPs, or secondary MTrPs, whereas the original one is known as the key or primary MTrP [2,3].
3. Conservative versus aggressive therapy: active MTrPs should be treated conservatively (noninva-

sive treatment, including physical therapy) before the consideration of aggressive therapy (invasive treatment, including injection and surgery). This principle should be similarly applied to the treatment of the underlying etiologic lesions.

4. Acute versus chronic MTrPs: at an acute stage, active MTrPs are usually correlated with the body's defense mechanism protecting an acute traumatic lesion. In most of these cases, the pain from MTrPs only occurs during contraction of the involved muscles. Unless the MTrP pain becomes intolerable, the active MTrPs should not be inactivated at an acute stage. Physical therapy to the acute primary lesion (etiologic lesion) should be provided instead. When the acute lesion is adequately treated, the trauma-induced active MTrPs will usually disappear without any direct treatment to them [7,16••]. Nevertheless, in cases in which pain becomes intolerable, inactivation of MTrPs at an acute stage may be necessary.
5. Mild versus severe MTrPs: sequential MTrP inactivation [23] can be applied to control severe MTrP pain caused by complex regional pain syndrome (type I). In such cases, the underlying etiologic lesion cannot be treated locally because of severe pain and allodynia. Inactivation of satellite MTrPs (located distally) can reduce the sensitivity of key MTrPs (located proximally), which then allows for the key MTrPs to be treated. Consequently, the proximally located etiologic lesion can be treated locally. Chronic or recurrent MTrPs are usually caused by a persistent inflammation in the active etiologic lesion. In some cases, the MTrPs are so widespread that the pain becomes intolerable and begins to interfere with daily life. These hyperactive MTrPs should be controlled even if the underlying etiologic lesion is still uncured or unidentified.
6. Superficial versus deep MTrPs: one of the most effective methods to control MTrP pain is deep pressure massage. This technique can be easily applied on superficial MTrPs, but not deep ones. Deep MTrPs should be treated with stretching or other methods such as ultrasound, laser, acupressure, acupuncture, or local injection.
7. Perpetuation factors: perpetuation factors are those that may cause active MTrPs to persist or aggravate MTrP pain. If treatment of MTrPs is to be optimal, these factors need to be avoided, corrected, or eliminated.

8. Patient education and home program: the causes, pathophysiology, principle of treatment and prevention, and possible complications of treatment should be explained to patients clearly and carefully before beginning any treatment. Self-care techniques and home programs such as stretching, focal massage, local heat application, and therapeutic exercise should be demonstrated to patients and/or family members.

Manual therapy is an important category of myofascial pain therapy and has been described by various authorities [2,24,25]. A traditional manual therapy for myofascial pain release is the “spray and stretch” (or stretching with intermittent cold application) technique initially described by Simons et al. [2]. Basically, stretching the tight muscle fibers (taut band) can release muscle tension and improve local circulation, thereby breaking the vicious cycle of energy crisis [2]. Another effective technique is “deep pressure massage,” in which compression of the MTrP can provide the effectiveness of counter-irritation [26] and/or inhibition of “MTrP circuit” in the spinal cord [4,16]. Local circulation can be improved using this “milking effect.” A clinical study comparing various therapeutic modalities has suggested that this technique is the most effective method for the immediate relief of MTrP pain [27]. In the United States, chiropractic therapy is another popular technique. Although the mechanism of pain control is still unclear, the significant and immediate relief of MTrP pain after spinal manipulation therapy has been well documented in the literature [20,28,29]. Thus, the effectiveness of manipulation therapy has been widely accepted throughout the world. It is possible that there are connections between the facet nociceptive pathway and MTrP nociceptive pathway in the spinal cord, similar to the connections among different “MTrP circuits” in the spinal cord. If this is true, the therapeutic effectiveness of manipulation would be similar to the MTrP injection via spinal cord reflex mechanism, ie, high-pressure stimulation to the facet nociceptors (facet trigger points) to induce a strong spinal reflex and thus to inhibit the vicious cycle of “MTrP circuits” in the spinal cord. However, the therapeutic effect may be only temporary (similar to MTrP injection), unless the underlying etiologic lesion is appropriately treated. There are other manual techniques described by different authorities. However, some of them still have no adequate scientific basis. Several methods of “voluntary contraction and relaxation” have been recommended for MTrP therapy. Tension and muscle tightness caused by MTrPs can be reduced much more easily after a maximal voluntary contraction. Post-isometric relaxation [30] is also very effective. The patient is asked to contract the involved muscle 10% to 25% of maximum, after which the tight muscle is relaxed then stretched. This method can be reinforced by controlled respiration and directed eye movement [30].

Therapeutic exercise is another important type of physical therapy for pain control. As a home program, patients can be instructed to self-apply post-isometric relaxation. Using this technique, MTrPs in the neck muscles can be effectively released. Conditioning exercise may also be an effective pain control procedure for patients with fibromyalgia [31]. There is evidence that generalized conditioning exercise can activate the endogenous opioid system [32]. For patients with degenerative joint lesions, isometric exercise is recommended to increase muscle strength for joint protection. Dynamic exercise can also improve microcirculation if it is performed carefully. The general principle of dynamic exercise is to avoid heavy, rapid, or prolonged exercise. Strong muscle contraction (heavy exercise) may further injure the degenerative tissues of the tendon and its insertion site (enthesis), the ligaments of the moving joint, the surrounding bursa, or the moving joint itself. Heavy exercise can also cause fatigue to the muscle and cause it to spasm. If muscle spasm is sustained, it can impair local circulation. Additionally, unexpected forces induced by rapid exercise can frequently cause trauma in the soft tissues. Rapid muscle contraction is also much more likely to cause muscle spasm than slow activity. Prolonged muscle contraction cannot only cause direct microdamage to the involved soft tissue, but can also cause muscle spasm and subsequently impair local circulation.

Physical therapy modalities may be effective for myofascial pain release. Thermotherapy is not a particularly effective means of controlling myofascial pain. However, it is the most important modality to treat a soft tissue lesion because it can improve focal circulation and facilitate the healing process. Heat application before and after any treatment with manual therapy is suggested. Therapeutic ultrasound may also provide additional mechanical energy directly to the MTrPs. Electrotherapy is also frequently used for pain control. For temporary pain relief, nerve stimulation (such as transcutaneous electronic nerve stimulation) is usually effective. For MTrP therapy, muscle stimulation is recommended, because the muscle contraction caused by the electrical stimulation is similar to focal massage [33]. The therapeutic effectiveness of electrotherapy on MTrPs has been documented [33–35]. Light amplification by stimulated emission of radiation (LASER) therapy can also provide effective myofascial pain release [36]. However, the mechanism of LASER therapy on MTrP is still unclear. It has been suggested that the “laser” is a form of needleless (or painless) acupuncture [37]. The electromagnetic energy from a laser may penetrate and stimulate the MTrP in a manner similar to dry needling. Another study by Snyder-Mackler et al. [36] found an increase in skin resistance after laser therapy and suggested that the effectiveness was sympathetically mediated. Other physical therapy modalities may also be applied for MTrP therapy. However, their actual therapeutic effectiveness has not been well established. In clinical practice, MTrPs are usually treated with a combination

of different methods. A physician can choose any combination based on his/her or the patient's own preferences. Nevertheless, it should be based on a founded scientific wisdom.

Needling of MTrPs (including MTrP injection, dry needling, and acupuncture) is very effective for myofascial pain release if it is performed in an appropriate way [6–9,38]. Before needling, the exact site of the MTrP should be carefully located for needle penetration. It is suggested that the needle tip should encounter the sensitive loci (LTR loci) in the MTrP region to elicit LTR [7,8]. A “fast-in and fast-out” technique is recommended for needle penetration in order to avoid side movement of the needle (which may damage the muscle fiber) and to provide high pressure to elicit LTRs [7]. As many LTRs as possible should be elicited to ensure that all or most sensitive loci are encountered. Many authors have indicated the importance of eliciting LTRs (similar to the “de-qui” or “teh-chi” effect in acupuncture) during needling in order to obtain immediate and complete pain relief [3,6–8,39]. It is possible that the strong pressure stimulation to the MTrP units (nociceptors) can provide very strong neural impulses to the dorsal horn cells in the spinal cord, which can then break the vicious cycle of the “MTrP circuit” [4,16••]. Fischer [40] has recommended infiltrating with local anesthetic into the whole taut band (including the myotendonal junction) during MTrP injection. He has also developed a new technique, “preinjection blocks,” to prevent pain caused by needle penetration of sensitive tissue. In this technique, the sensory nerves supplying the area to be injected are locally anesthetized before MTrP injection. Recently, Chu et al. [41] further modified the dry needling technique by adding electrical stimulation during therapy and renaming it electrical twitch-obtaining intramuscular stimulation. This technique is similar to electrical acupuncture. Baldry [42] has also developed a new technique of superficial dry needling by inserting the needle into the subcutaneous (but not the muscle) tissue. Goddard et al. [43] demonstrated that superficial dry needling (sham acupuncture) has a similar effect on pain relief to intramuscular needling (traditional acupuncture). In a recent review article, Cummings and White [44••] have indicated that needling of MTrPs appears to be an effective treatment. However, in 23 papers reviewed, there were inadequate control trials to test the efficacy of needling beyond placebo for myofascial pain.

Botulinum toxin A can create a presynaptic block of acetylcholine release from the motor nerve endings and subsequently relieve the taut band in the MTrP region. Several authors have demonstrated the therapeutic effectiveness of pain control by MTrP injection with botulinum toxin A [45•,46,47]. In an animal study, EPNs recorded in the MTrP region were suppressed after the injection of botulinum toxin A [45•]. The prevalence of EPNs is related to the intensity of myofascial pain. However, in a recent double-blind, randomized, crossover trial, it was

found that there was no significant difference between botulinum toxin A and 0.5% bupivacaine groups when comparing baseline pain relief, function, satisfaction, or cost of care (cost of injectate excluded) in treating MTrPs [48]. Thus, it appears that MTrP injection with botulinum toxin A is not cost effective. Further study is required to clarify this.

## Conclusions

Myofascial pain syndrome is caused by MTrPs that are usually activated by a soft tissue lesion, rather than the muscle itself. The underlying etiologic lesion should be treated appropriately before the inactivation of active MTrPs. Many procedures may be effective to control myofascial pain. A physician should select appropriate methods for myofascial pain control to avoid the recurrence.

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