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Myofascial Trigger Points

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A myofascial trigger point is a hyperirritable point in skeletal muscle that is associated with a hypersensitive palpable nodule [1]. Approximately 23 million Americans have chronic disorders of the musculoskeletal system [2]. Painful conditions of the musculoskeletal system, including myofascial pain syndrome, constitute some of the most important chronic problems that are encountered in a clinical practice.

Definitions

Myofascial pain syndrome is defined as sensory, motor, and autonomic symptoms that are caused by myofascial trigger points. The sensory disturbances that are produced are dysesthesias, hyperalgesia, and referred pain. Coryza, lacrimation, salivation, changes in skin temperature, sweating, piloerection, proprioceptive disturbances, and erythema of the overlying skin are autonomic manifestations of myofascial pain.

Travell and Simons [1] defined the myofascial trigger point as "a hyperirritable spot, usually within a taut band of skeletal muscle or in the muscle fascia which is painful on compression and can give rise to characteristic referred pain, motor dysfunction, and autonomic phenomena" [1]. When the trigger point is pressed, pain is caused and produces effects at a target, the zone of reference, or referral zone [3,4]. This area of referred pain is the feature that differentiates myofascial pain syndrome from fibromyalgia. This pain is reproduced reliably on palpation of the trigger point, despite the

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fact that it is remote from its source of origin. This referred pain rarely coincides with dermatologic or neuronal distributions, but follows a consistent pattern [5].

Etiology

Trigger points may develop after an initial injury to muscle fibers. This injury may include a noticeable traumatic event or repetitive microtrauma to the muscles. The trigger point causes pain and stress in the muscle or muscle fiber. As the stress increases, the muscles become fatigued and more susceptible to activation of additional trigger points. When predisposing factors combine with a triggering stress event, activation of a trigger point occurs. This theory is known as the "injury pool theory" [1].

Pathophysiology

There is no pathologic or laboratory test for identifying trigger points. Therefore, much of the pathophysiologic research on trigger points has been directed toward verifying common theories of their formation. Fig. 1 provides an example of the theory behind the formation of myofascial trigger points.

The local twitch response (LTR) has been described as a characteristic response of myofascial trigger points. LTR is a brisk contraction of the muscle fibers in and around the taut band elicited by snapping palpation or rapid

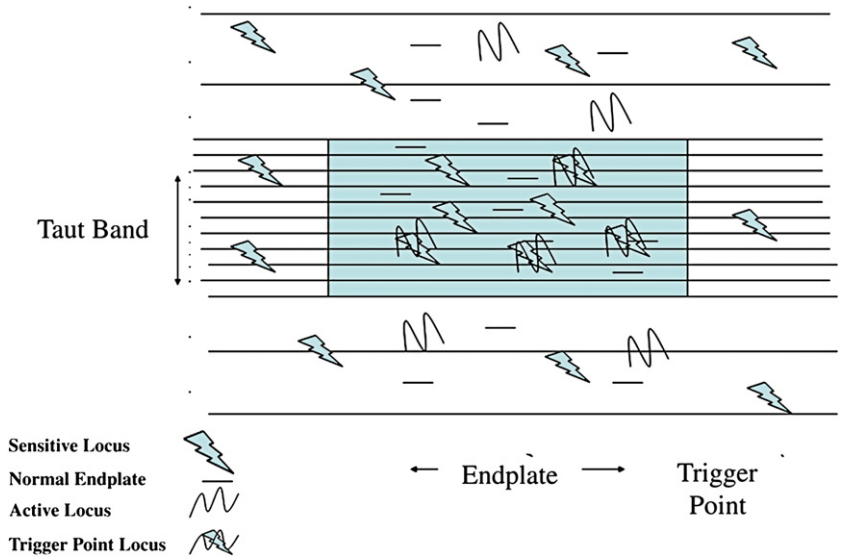

Fig. 1. Myofascial trigger point loci.

insertion of a needle into the myofascial trigger point [6]. The sensitive site where an LTR is found has been termed the ''sensitive locus.'' Based on observations during successful trigger point injections, a model with multiple sensitive loci in a trigger point region was proposed [6]. In a recent histologic study, the sensitive loci correlated with sensory receptors [7,8].

In a study by Hubbard and Berkoff, spontaneous electrical activity was demonstrated at sites in a trigger point region, whereas similar activity was not found at adjacent nontender sites [6]. The site where the spontaneous electrical activity is recorded is termed the ''active locus.'' To elicit and record spontaneous electrical activity, high-sensitivity recording and a gentle insertion technique into the trigger point must be used [6]. The waveforms of the spontaneous electrical activity correspond closely to previously published reports of motor endplate noise [9,10]. Therefore, the spontaneous electrical activity likely is one type of endplate potential, and the active loci probably are related closely to motor endplates.

It was hypothesized that a myofascial trigger point locus is formed when a sensitive locus, the nociceptor, and an active locus—the motor endplate—coincide. It is possible that sensitive loci are distributed widely throughout the entire muscle, but are concentrated in the trigger point region. This explains the finding of elicitation of referred pain when ''normal'' muscle tissue is needled or high pressure is applied (Fig. 2).

Diagnosis

The diagnosis of myofascial pain is best made through a careful analysis of the history of pain along with a consistent physical examination [11]. The diagnosis of myofascial pain syndrome, as defined by Simons and colleagues [12], relies on eight clinical characteristics (Box 1). Identification of the pain distribution is one of the most critical elements in identifying and treating myofascial pain. The physician should ask the patient to identify the most intense area of pain using a single finger. There also is an associated consistent and characteristic referred pain pattern on palpation of this trigger point. Often, this referred pain is not located in the immediate vicinity of the trigger point, but is found commonly in predictable patterns. These patterns are described clearly in *Travell and Simon's Myofascial Pain and Dysfunction: The Trigger Point Manual* [12]. Pain can be projected in a peripheral referral pattern, a central referral pattern, or a local pain pattern (Fig. 3). When a hyperintense area of pain is identified, its area of referred pain should be identified [4].

The palpable band is considered critical in the identification of the trigger point. Three methods have been identified for trigger point palpation: flat palpation, pincer palpation, and deep palpation. Flat palpation refers to sliding a fingertip across the muscle fibers of the affected muscle group. The skin is pushed to one side, and the finger is drawn across the muscle

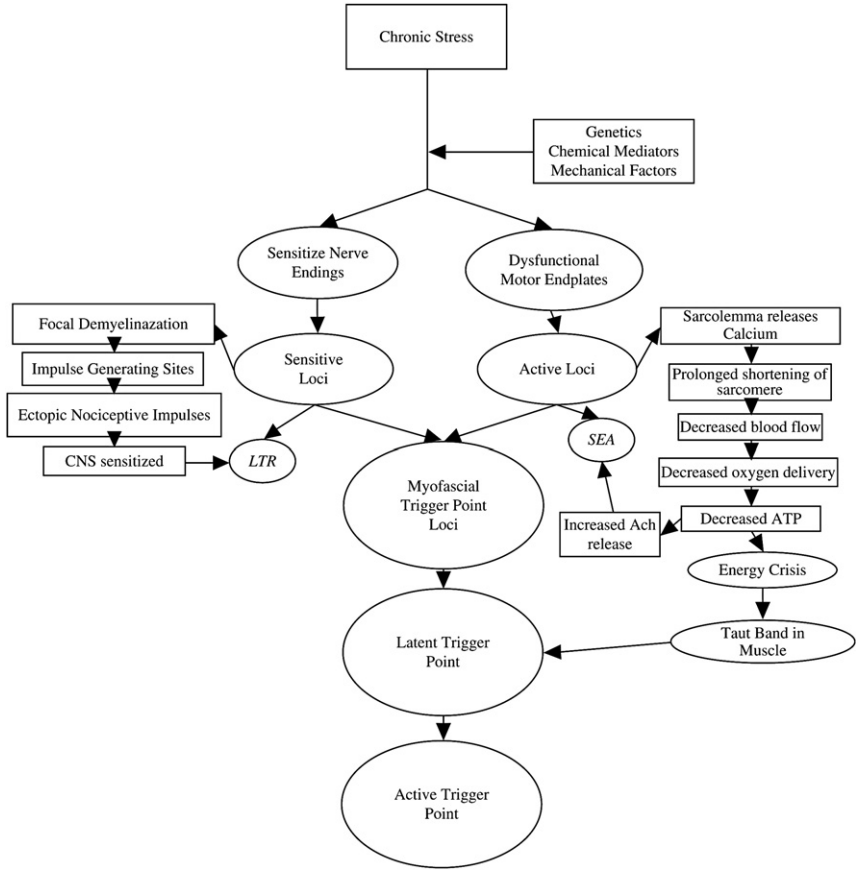

Fig. 2. Pathophysiology of myofascial trigger points. Ach, acetylcholine; CNS, central nervous system; LTR, local twitch response; SEA, spontaneous electrical activity.

fibers. This process is repeated with the skin pushed to the other side. A taut band may be felt passing under the physician's finger. Snapping palpation, like plucking of a violin, is used to identify the specific trigger point. Pincer palpation is a method that involves firmly grasping the muscle between the thumb and forefinger. The fibers are pressed between the fingers in a rolling manner while attempting to locate a taut band. Deep palpation may be used to find a trigger point that is obscured by superficial tissue. The fingertip is placed over the muscle attachment of the area suspected of housing the trigger point. When the patient's symptoms are reproduced by pressing in one specific direction, a trigger point may be presumed to be located [2].

Several devices have been developed to assist in the location of a myofascial trigger point. Fisher [13] developed a pressure threshold measuring gauge to assist in the diagnosis and location of the myofascial trigger point. It is a hand-held device calibrated in kg/cm^2. Pressure is increased gradually

Box 1. Clinical characteristics of myofascial pain syndrome

Onset description and immediate cause of the pain
Pain distribution pattern
Restricted range of motion with increased sensitivity to stretching
Weakened muscle due to pain with no muscular atrophy
Compression causing pain similar to the patient's chief complaint
A palpable taut band of muscle correlating with the patient's trigger point
LTR elicited by snapping palpation or rapid insertion of a needle
Reproduction of the referred pain with mechanical stimulation of the trigger point

and evenly until the patient reports discomfort. The pressure measurement is then recorded. Contralateral pressure measurements are taken to establish relative sensitivity of the point in question; a difference of 2 kg/cm^2 is considered an abnormal reading [14]. An electromyogram (EMG) also may assist in the diagnosis of the trigger point [15,16]. When the active locus is entered, the peak amplitudes often are off the scale of the EMG monitor. Although this method may seem to be useful scientifically, significant clinical results have not been found.

Noninvasive techniques for management

Spray (freeze) and stretch

Travell and Simons [1] advocated passive stretching of the affected muscle after application of sprayed vapocoolant to be the "single most effective

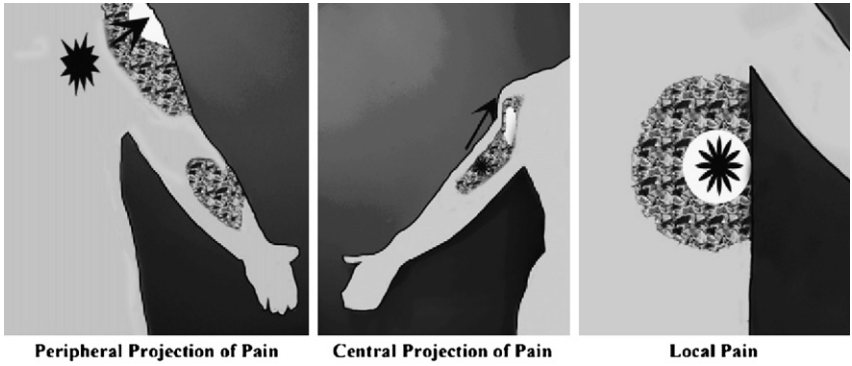

Fig. 3. Trigger points and their reference zones.

treatment'' for trigger point pain. The proper technique depends on patient education, cooperation, compliance, and preparation. The patient should be positioned comfortably, ensuring that the trigger point area is well supported and under minimal tension. Position should place one end of the muscle with the trigger point zone securely anchored. The patient should be marked after careful diagnosis of the trigger point region, and the reference zone should be noted. The skin overlying the trigger point should be anesthetized with a vapocoolant spray (ethyl chloride or dichlorodifluoromethane-trichloromonofluoromethane) over the entire length of the muscle [12]. This spray should be applied from the trigger point toward the reference zone until the entire length of the muscle has been covered. The vapocoolant should be directed at a 30° angle to the skin. Immediately after the first vapocoolant spray pass, passive pressure should be applied to the other end of the muscle, resulting in a stretch. Multiple slow passes of spray over the entire width of the muscle should be performed while maintaining the passive muscle stretch. This procedure is repeated until full range of motion of the muscle group is reached, with a maximum of three repetitions before rewarming the area with moist heat. Care must be taken to avoid prolonged exposure to the vapocoolant spray, assuring that each spray pass lasts less than 6 seconds. Patients must be warned not to overstretch muscles after a therapy session.

Physical therapy

Some of the best measures to relieve cyclic myofascial pain involve the identification of perpetuating factors. Physical therapists assist patients in the determination of predisposing activities. With routine follow-up, they are often able to correct elements of poor posture and body mechanics [1].

Transcutaneous electrical stimulation

Transcutaneous electrical stimulation (TENS) is used commonly as adjuvant therapy in chronic and acute pain management. Placement of the TENS electrode is an empiric process and may involve placement at trigger point sites or along zones of referred pain [17].

Ultrasound

Ultrasound may be used as an adjunctive means of treatment. Ultrasound transmits vibration energy at the molecular level; approximately 50% reaches a depth of 5 mm.

Massage

Massage was advocated by Simons and colleagues [12]. Their technique was described as a ''deep stroking'' or ''stripping'' massage. The patient is

positioned comfortably to allow the muscle group being treated to be lengthened and relaxed as much as possible.

Ischemic compression therapy

The term ''ischemic compression therapy'' refers to the belief that the application of pressure to a trigger point produces ischemia that ablates the trigger point. Pressure is applied to the point with increasing resistance and maintained until the physician feels a relief of tension. The patient may feel mild discomfort, but should not experience profound pain. The process is repeated for each band of taut muscle encountered [12].

Invasive techniques for management

Trigger point injection remains the treatment with the most scientific evidence and investigation for support. Typically, it is advocated for trigger points that have failed noninvasive means for treatment. Injections are highly dependent of the clinician's skill to localize the active trigger point with a small needle.

Various injected substances have been investigated. These include local anesthetics, botulism toxin, sterile water, sterile saline, and dry needling. One common finding with these techniques is that, at least anecdotally, the duration of pain relief following the procedure outlasts the duration of action of the injected medication.

The universal technique for injection

The patient should be positioned in a recumbent position for the prevention of syncope, assistance in patient relaxation, and decreased muscle tension. The trigger point must then be identified correctly. The palpable band is considered critical in the identification of the trigger point. This can be done with any of the three methods described above. The trigger point should be marked clearly. Then, the skin is prepared in a sterile fashion. Various physicians use different skin preparations for their local procedures. One common skin preparation technique is to cleanse the skin with a topical alcohol solution followed by preparation with povidone-iodine [12]. A 22-gauge 1.5-inch needle is recommended for most superficial trigger points. Deeper muscles may be reached using a 21-gauge 2-inch or 2.5-inch needle. The needle should never be inserted to the hub because this is the weakest point on the needle [18].

Once the skin is prepared and the trigger point is identified, the overlying skin is grasped between the thumb and index finger or between the index and middle finger. The needle is inserted approximately 1 to 1.5 cm away from the trigger point to facilitate the advancement of the needle into the trigger point at a 30° angle. The grasping fingers isolate the taut band and prevent it from rolling out of the trajectory of the needle. A ''fast-in,

fast-out'' technique should be used to elicit an LTR. This local twitch was shown to predict the effectiveness of the trigger point injection [19]. After entering the trigger point, the needle should be aspirated to ensure that the lumen of a local blood vessel has not been violated. If the physician chooses to inject an agent, a small volume should be injected at this time. The needle may be withdrawn to the level of the skin without exiting, and it should be redirected to the trigger point repeating the process. The process of entering the trigger point and eliciting LTRs should proceed, attempting to contact as many sensitive loci as possible (Fig. 4).

An integral part of trigger point therapy is postprocedural stretching. After trigger point injection, the muscle group that was injected should undergo a full active stretch.

Complications of trigger point injections

As with the introduction of any foreign body through the skin, the risk for skin or soft tissue infection is a possibility. Injection over an area of infected skin is contraindicated. The physician should never aim the needle at an intercostal space to avoid the complication of a pneumothorax. Hematoma formation following a trigger point injection can be minimized with proper injection technique and holding pressure over the surrounding soft tissue after withdrawal of the needle [12,20].

Medications for injection

Local anesthetics

Local anesthetics are the substances that have been investigated most frequently for the treatment of myofascial trigger points. Local anesthetic

Fig. 4. Injection technique. The trigger point is positioned between two fingers to prevent the sliding of the trigger point during injection. The fingers are pressed downward and apart to maintain pressure and ensure hemostasis.

injections were shown to improve measures on a pain scale, range of motion, and algometry pressure thresholds. The volume of local anesthetic injected also has been investigated, and small volumes are considered the most effective. Typically, less than 1 mL of local agent should be injected in a highly controlled manner. The primary use for a local anesthetic is to prevent local soreness. Procaine is selected often because it is selective for small, unmyelinated fibers that control pain perception rather than motor control. Lidocaine is a common substitute for procaine, but no experimental comparisons are available in the literature [12,21].

Corticosteroids

Local steroid injections offer the potential advantage of control of local inflammatory response; however, the theory that a trigger point is due to a local energy crisis does not support their clinical use. Steroids are used commonly by the orthopedic surgeon and rheumatologist to treat local conditions, such as trigger finger and tennis elbow. They carry the added dangers of local myotoxicity, subcutaneous tissue damage, and skin discoloration [12].

Botulinum toxin

Localized injection of a small amount of commercially prepared botulism toxin A relaxes an overactive muscle by blocking the release of acetylcholine. This essentially denervates the muscle until new synaptic contacts can be established. When injecting botulism toxin, the physician should remember that the toxin does not discriminate between trigger points and normal motor endplates. The physician should be careful to localize the trigger point before injection [22,23].

Dry needling

Dry needling involves multiple advances of a needle into the muscle at the region of the trigger point. Much like any injection technique, the physician should aim to elicit an LTR, reproduction of the patient's symptomatology, and relief of muscle tension [7,24].

Summary

Myofascial pain syndromes are a widely recognized phenomenon among physicians and represent a common pain disorder in the American population. A myofascial trigger point is "a hyperirritable spot, usually within a taut band of skeletal muscle or in the muscle fascia. The spot is painful on compression and can give rise to characteristic referred pain, motor dysfunction, and autonomic phenomena" [1]. Many treatment strategies, both

invasive and noninvasive, have been recognized for myofascial trigger points.

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