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Myofascial Trigger Points of the Shoulder

Shoulder problems are common, with a 1-year prevalence ranging from 4.7% to 46.7% and a lifetime prevalence of 6.7% to 66.7%.[1] Many different structures give rise to shoulder pain, including the structures in the subacromial space, such as the subacromial bursa, the rotator cuff, and the long head of biceps,[2,3] and are presented in various lessons. Muscle and specifically myofascial trigger points (MTrPs), have been recognized to refer pain to the shoulder region and may be a source of peripheral nociceptive input that gives rise to sensitization and pain. MTrP referral patterns have been published for the shoulder region.[4-6]

Often, little attention is paid to MTrPs as a primary or secondary pain source. Instead, emphasis is placed only on muscle mechanical properties such as length and strength.[7,8]
The tendency in manual therapy is to consider muscle pain as secondary to joint or nerve dysfunctions. A study of cervical joint dysfunction and MTrPs demonstrated a correlation between the presence of MTrPs in the upper trapezius and C3 and C4 dysfunctions; however, a cause-and-effect relationship was not established.[9] Clinicians should assess both joints and examine muscles for MTrPs and treat accordingly.[9] Interest in MTrPs has increased, as evidenced by a growth in research with more Medline citations in the last decade than in the previous two decades combined.[8] An orthopedic manual therapy text and popular sports medicine texts have included MTrPs in differential diagnosis and management strategies.[8,10,11] A survey of physician members of the American Pain Society showed overwhelming agreement that myofascial pain is a distinct clinical entity.[14]

This lesson focuses on MTrPs, including the philosophical framework, palpation technique, and treatment options with reference to other soft tissue procedures. Selected treatment techniques are presented as examples. Readers are encouraged to seek further information through cited references. Furthermore, in shoulder rehabilitation, a comprehensive orthopedic physical therapy evaluation is imperative. Clinicians should be guided by fundamental physical therapy principles, research, clinical reasoning, and patient goals. The aim of this lesson, and of other lessons, is to assist clinicians in developing a more comprehensive approach to shoulder rehabilitation. Inclusion of MTrPs in the assessment and management of shoulder pain and dysfunction does not necessarily replace other techniques and approaches, but it does add an important dimension to the management plan.

TRIGGER POINTS

A *myofascial trigger point* is defined as a hyperirritable spot in skeletal muscle, which is associated with a hypersensitive palpable nodule in a taut band.[4] When compressed, a MTrP may give rise to characteristic referred pain, tenderness, motor dysfunction, and autonomic phenomena.[4] MTrPs have been described as active or latent. *Active MTrPs* are associated with spontaneous pain complaints, whereas *latent MTrPs* are clinically dormant and are painful only when palpated or needled.[4] Another feature of MTrPs is the *local twitch response* (LTR), which is a sudden contraction of muscle fibers within a taut band elicited by a snapping palpation or with insertion of a needle into the MTrP.[4] The minimum criterion for identification of an active MTrP is exquisite spot tenderness of a nodule in a taut band, which, when adequately palpated, gives rise to the patient's recognition of the current pain complaint. A latent MTrP, due to its lack of relationship to spontaneous pain, is defined as exquisite spot tenderness of a nodule in a taut band (Box 1).[15,16]

Typical referral pain patterns for several shoulder muscles are presented in Figure 1. The "X" indicates only potential MTrP locations and should be considered as a general guideline. Accurate palpation, using the recommended criteria, is the key to identifying MTrPs in an individual muscle, and the examiner must realize that any one muscle may have multiple MTrPs. Often, MTrPs do not lie in their own referral patterns. Commonly, MTrPs will refer distally inferring that often the muscle responsible for the pain will be located proximal to the pain pattern.[17,18]

MTrPs were described as far back as the 16th century by French physician Guillaume de Baillou (1538–1616), who used the term *muscular rheumatism* to describe what is now

BOX 1	Recommended Criteria for the Identification of a Myofascial Trigger Point

- Taut band palpable (where muscle is accessible)
- Exquisite spot tenderness of a nodule in a taut band
- Patient recognition of current pain complaint by pressure on the tender nodule (identifies an active trigger point)

recognized as myofascial pain.[19] Many other clinicians have described trigger points; however, Travell and Simons are considered the authoritative sources.[20] Travell (1901–1997) was initially trained in cardiology and subsequently became interested in referred pain from palpation of taut bands in skeletal muscles.[21] As a side note, Travell became the personal physician to Presidents Kennedy and Johnson and was the first female White House physician.[21] Later in her career, she collaborated with Dr. David Simons (1922–2010), a physiatrist, and they coauthored the widely distributed trigger point manuals.[4,22,23] Several other noted textbooks on myofascial pain and MTrPs have been published.[5,19,24,25]

The prevalence of myofascial pain has been reported in various populations, but the prevalence in the general population is unknown.[4] Investigators reported that between 84% and 93% of patients in pain management centers had myofascial pain.[26,27] Thirty percent of patients presenting with pain in a primary care general medical clinic had myofascial pain, thus making myofascial pain the largest single diagnostic pain group.[28] Furthermore, patients with upper body pain were more likely to have myofascial pain than pain located elsewhere.[28] In older adults with low back pain, MTrPs were identified in 96% of symptomatic subjects versus 10% of controls.[29] MTrPs were identified in 93.9% of patients with migraine compared with 29% of control subjects.[30] Myofascial pain has been described by various clinical specialties in selected patient groups.

With regard to the shoulder, patients with a medical diagnosis of rotator cuff tendinopathy (n = 58) lasting more than 6 weeks and less than 18 months were reported to have MTrPs in the supraspinatus (88%), infraspinatus (62%), teres

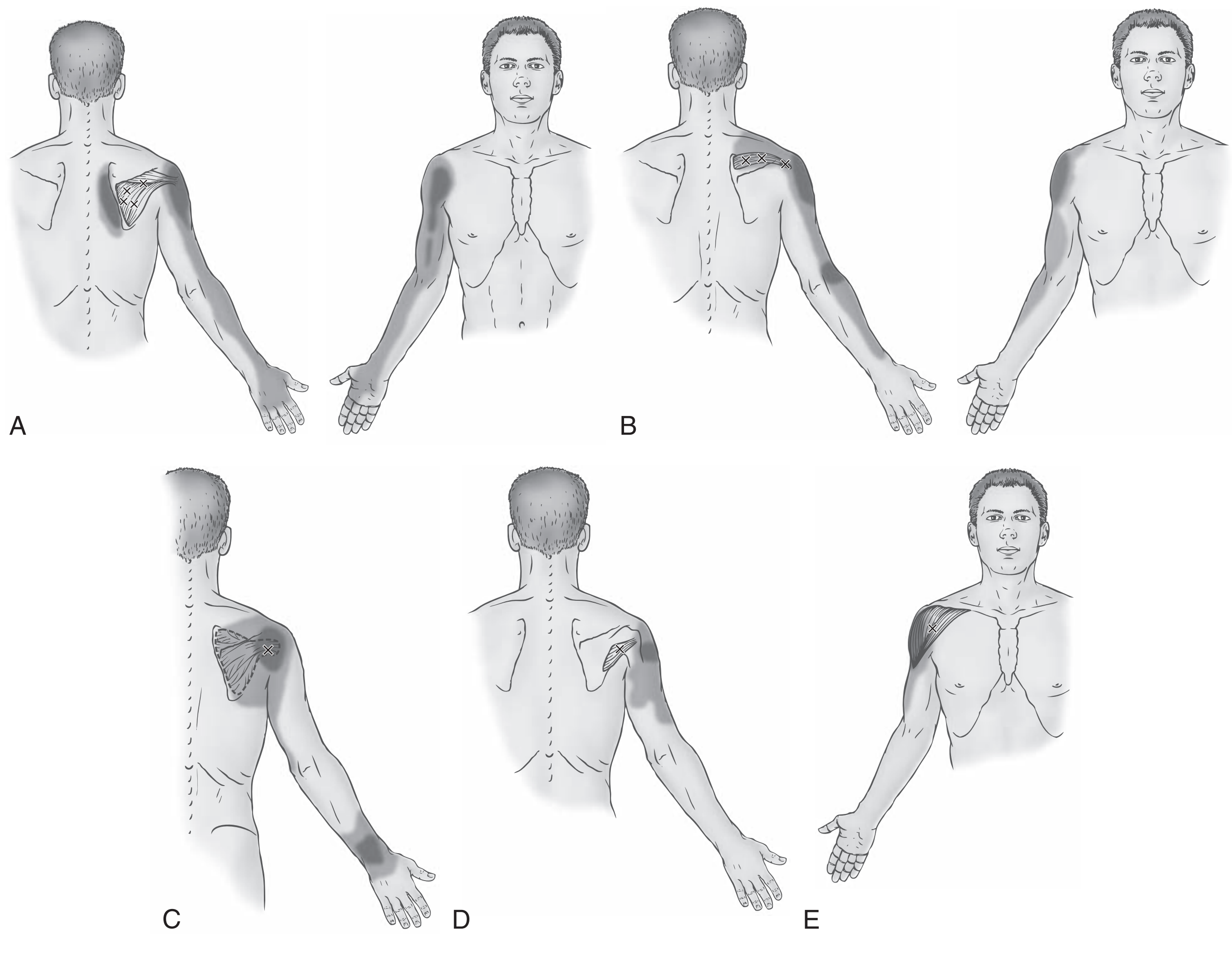

Figure 1 Myofascial trigger points and their corresponding referral zones: **A,** infraspinatus; **B,** supraspinatus; **C,** subscapularis; **D,** teres minor; **E,** anterior deltoid;

(continued)

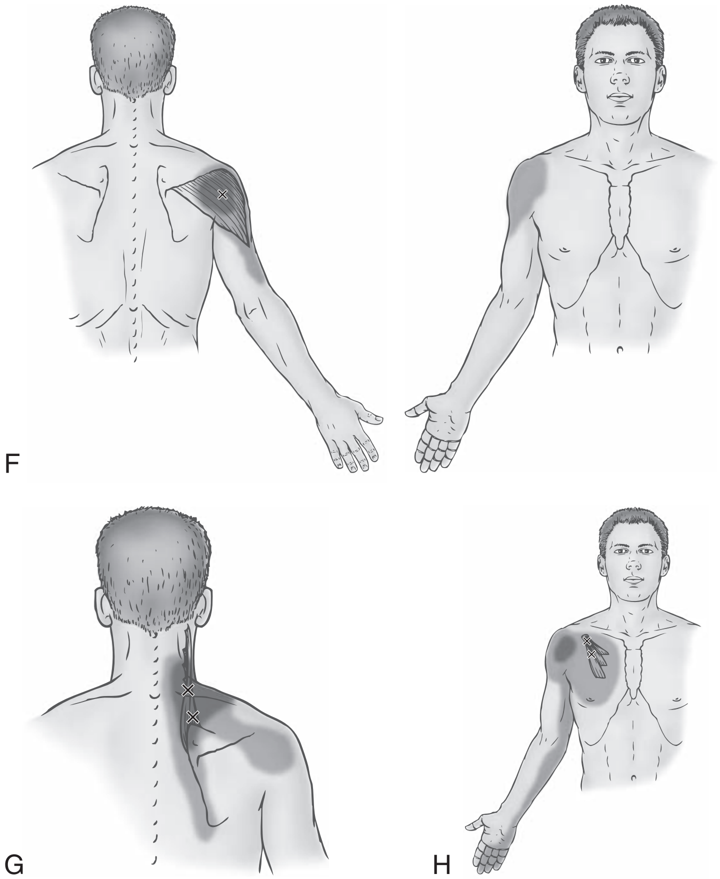

Figure 1 Cont'd F, posterior deltoid; **G,** levator scapulae; **H,** pectoralis minor. (From Muscolino JE: *The muscle and bone palpation manual: with trigger points, referral patterns, and stretching,* St. Louis, 2009, Mosby.)

minor (20.7%), and subscapularis (5.2%) muscles.[31] Patients with shoulder impingement had a greater number of active MTrPs in the supraspinatus (67%), infraspinatus (42%), and subscapularis (42%) when compared with normal control subjects.[32] Patients demonstrated widespread pressure hypersensitivity and the presence of active MTrPs that, when examined, could reproduce the recognized pain complaint.[32] A study of patients with chronic unilateral nontraumatic shoulder pain ($n = 72$), conducted in a Dutch physical therapy practice, identified active MTrPs in all subjects with the following prevalence: infraspinatus (78%); upper trapezius (58%); middle trapezius (43%); anterior, middle, and posterior deltoid (47%, 50%, 44%, respectively); and teres minor (47%) muscles.[33] Brukner and Khan[10] considered MTrPs to be among the most common causes of shoulder pain from a sports medicine perspective and recommended assessing for MTrPs in the clinical setting.

PALPATION RELIABILITY

Currently, no gold standard diagnostic imaging or laboratory test exists for MTrPs, and clinicians must rely on the history and physical examination findings for the diagnosis of myofascial pain.[34] Because of the reliance on physical examination, adequate intrarater and interrater palpation reliability for the identification of MTrPs is important in construct validity.[16]

Nine published studies addressed MTrP palpation interrater[2,15,35-40] and intrarater[31] reliability of various subjects and muscles. Palpation reliability studies were systematically reviewed by McEvoy and Huijbregts,[16] who used the *Data Extraction and Quality Scoring Form for Reliability Studies of Spinal Palpation*.[41] The review concluded that MTrPs can be reliably identified in certain muscles, but a caveat to these findings is that reliability depends on a high level of rater expertise, training, and consensus discussion on technique.[16] Furthermore, location of MTrPs by palpation in the upper trapezius was found to be highly reliable when a three-dimensional infrared camera was used for assessment.[40]

With regard to the shoulder, Bron et al[2] and Gerwin et al[15] examined muscles relating to the shoulder, and interrater reliability was supported in both studies for all muscles tested, including the infraspinatus, posterior deltoid, biceps brachii, trapezius, and latissimus dorsi muscles. Al-Shenqiti and Oldham[31] studied the rotator cuff muscles, infraspinatus, supraspinatus, teres minor, and subscapularis, and intrarater reliability was supported with kappa values of 0.85, 0.86, 0.88, and 0.79, respectively.

PALPATION TECHNIQUE

Palpation is the only currently recommended test for identification of MTrPs (see Box 1), and reliability depends on the expertise and skill level of the clinician. This finding has implications for clinicians and training programs, which should emphasize the development of accurate MTrP palpation skills before instructing students in specific treatment options. Palpation techniques include pincer grip and flat palpation, and they form the basis of the physical examination technique. These techniques are also employed as a mode of treatment for MTrPs.

An in-depth knowledge of anatomy, muscle location and attachments, muscle fiber direction, and muscle layers greatly enhances the accuracy and ability to palpate muscle adequately. Muscles should be palpated with the patient in a relaxed position, with optimum passive tension placed on the muscle to expose the taut band. The degree of required tension or slack depends on the individual patient. In patients with hypermobility, such as Ehlers-Danlos syndrome, the muscle often must be put in a stretched position, whereas in other, less mobile patients, the muscle may need to be placed in a more relaxed position. The optimum position is the position where the clinician can obtain useful information. This statement may be obvious, but attention to positioning is important for clinical efficiency and efficacy.

The clinician palpates perpendicularly to the muscle fiber direction to identify the taut band. During the examination, the muscle is palpated with enough compression to induce local tenderness. Eliciting referred pain is not always necessary, but if that is desired, the MTrP may need to be compressed for at least 15 seconds because it may take some time for the referred pain to arise. Some muscles present palpation challenges, given that these muscles may not be accessible. Consider, for example, the difference between flat palpation of the accessible infraspinatus muscle and limited palpation of the less accessible subscapularis muscle.[4,22,23]

- Flat palpation: Finger or thumb pressure is applied directly to the muscle perpendicular to the muscle fiber direction while the muscle fibers are compressed against the underlying tissue or bone (Fig. 2). An example is palpation of the infraspinatus and teres minor flat against the scapula.
- Pincer palpation: A pincer grip is employed between the clinician's fingers and thumb, essentially again perpendicular to the muscle fiber direction. The muscle fibers are rolled in the grasp to allow examination of the tissues (Fig. 3). For example, the pincer grip palpation is used to palpate MTrPs in the upper trapezius muscle and the axillary portions of the pectoralis major and latissimus dorsi muscles.

Figure 2 Flat palpation. (Courtesy of Myopain Seminars ©2010.)

Figure 3 Pincer palpation. (Courtesy of Myopain Seminars ©2010.)

PATHOGENESIS

The *integrated hypothesis* (IH) of trigger point formation was introduced by Travell and Simons as a theoretical framework for MTrP development.[4,8] The IH is an evidence-informed combination of electrodiagnostic, clinical, and histopathologic studies, and it has been updated several times in light of new research evidence (Fig. 4).[7,34,42-44]

Muscle is the largest collective organ in the human body, and through its synergistic relationship with the nervous system, it executes complex movements of the body. Muscle architecture is made up of fascicles of fibers, which, in turn, are composed of myofibrils.[45,46] The basic unit of the myofibril is the sarcomere, which lies between the Z-lines and is a multiple-protein complex composed of actin and myosin and stabilized by nebulin and titin.[45,46]

The *sliding filament theory* describes the interaction of actin and myosin in molecular cross-bridging, with subsequent shortening of the sarcomere, as a basis for muscle contraction.[45,46] Ultimately, this process is modulated by

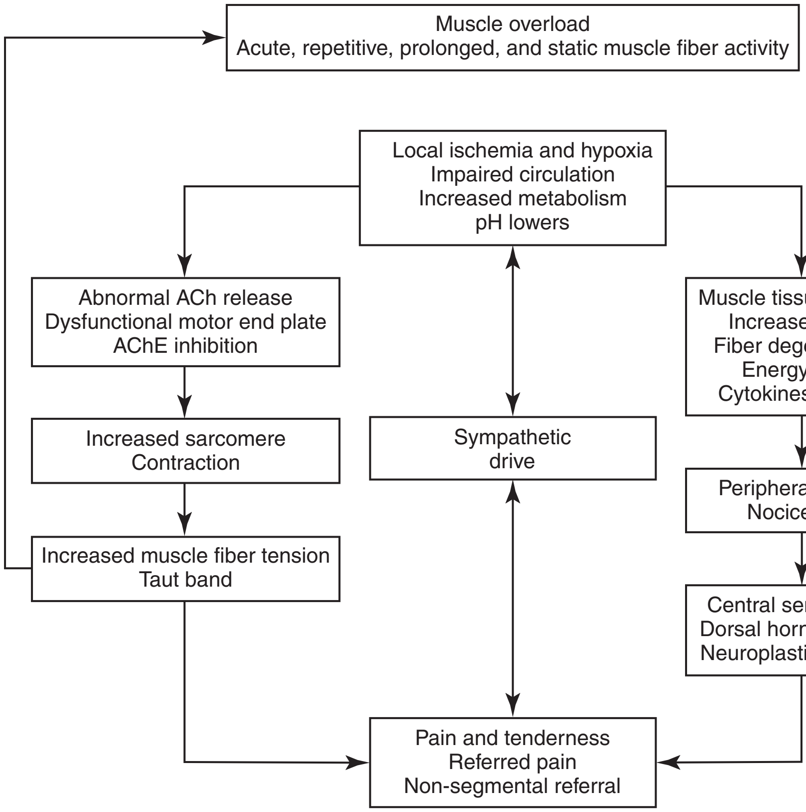

Figure 4 Integrated hypothesis of trigger point formation. (Courtesy of Myopain Seminars ©2010.)

the motor neuron at the neuromuscular junction. When an impulse travels along the motor neuron, it depolarizes the membrane, with subsequent release of acetylcholine (ACh) neurotransmitter from the presynaptic boutons into the synaptic cleft. ACh binds to a postsynaptic receptor with depolarization of the membrane and the rise of a miniature end-plate potential (MEPP). When sufficient MEPPs occur, an action potential is propagated, which travels through the T-tubules and thus releases calcium (Ca^{2+}) from the sarcoplasmic reticulum. This process, in turn, stimulates the molecular cross-bridges and closing of the actin and myosin filaments involved in muscle contraction. At the neuromuscular junction, ACh is hydrolyzed by acetylcholinesterase (AChE) into acetate and choline and is recycled into the nerve terminal. ACh release is modulated by motor nerve activity and by the concentration of AChE. Reduction of AChE would result in excess of ACh in the synaptic cleft, with subsequent up-regulation of postsynaptic MEPPs and maintenance of muscle contraction. In essence, this process is very complex.[8,45-47]

The IH postulates that multiple muscle fiber end plates release, or sustain increased concentration of ACh with resultant continued sarcomere contraction without electrogenic activation of the motor end plate.[34] In support of this, electromyographic (EMG) studies have demonstrated that motor end-plate noise is more prevalent in MTrPs than in areas outside this zone.[48-52] The excess ACh results in increased and sustained localized fiber tension. Multiple contraction knots, with areas of sarcomere shortening, have been visualized under light microscopic examination of canine MTrP biopsies.[53] Microscopic studies of MTrPs in cadavers demonstrated split, ragged, and thickened muscle fibers with type II muscle fiber atrophy.[54,55] Another study, conducted with electron microscopy, reported areas of alternatively shortened and lengthened sarcomeres in biopsies of MTrPs.[56] In a rat study, experimentally increased release of ACh from end plates resulted in muscle fiber damage that may be a precursor for MTrP formation.[57] A more recent study, using stimulated single-fiber EMG, demonstrated neuroaxonal degeneration and neuromuscular transmission disorders in MTrPs.[58] Sarcoplasmic reticulum dysfunction of the calcium pump has also been postulated to play a role in MTrP formation.[34]

An adequate number of dysfunctional motor end plates does produce a palpable taut band.[34] in vivo imaging of MTrPs with magnetic resonance and ultrasound elastography visualized the taut band as an area of increased stiffness.[59-61] Adequately trained clinicians are able to locate taut bands reliably, with accuracy that approaches the physical dimensions of the fingertips.[40] These studies support construct validity for the MTrP taut band phenomena.

Acute, repetitive, or prolonged muscle fiber contraction increases local metabolic demand, which may lead to ischemia and hypoxia.[62,63] Active MTrPs demonstrate a highly resistive vascular bed under Doppler imaging within the stiffened region.[61] Muscle ischemia has been shown to activate muscle nociceptors, with resulting pain.[47,64,65] This tissue distress results in local muscle injury, fiber degeneration, increased Ca^{2+} release, energy depletion, and cytokine release.[47]

A novel study employing microdialysis of active MTrPs reported significantly increased concentrations of bradykinin, calcitonin gene–related peptide, substance P, tumor necrosis factor-α, interleukin-1β, serotonin, norepinephrine, and a lowered pH.[66-68] Many of these substances activate peripheral muscle nociceptors and result in afferent discharge to the dorsal horn of the central nervous system.[69] In turn, the central nervous system can activate the dorsal root reflex, which releases neuropeptides from the peripheral nerve terminal into the peripheral tissue.[47,70-72] Furthermore, release of sensitizing substances may lower muscle pH, which may inhibit AChE and may induce or maintain muscle pain, hyperalgesia, and allodynia.[66,67,73]

Muscle pain has unique neurobiological features (Box 2). Stimulation of muscle nociceptors, as seen in MTrPs, causes a poorly defined aching, cramping pain and is difficult to localize.[47,74] This finding is in contrast to cutaneous pain, which is local, specific, and sharp. Myofascial pain intensity is comparable to, or possibly greater than, pain of other causes, such as arthritis, cystitis, pharyngitis, or angina.[28] Muscle pain activates unique cortical structures,[75] and muscle nociceptors are particularly effective at inducing neuroplastic changes in the dorsal horn.[76] The afferent input from MTrPs can awaken previously silent neurons in the dorsal horn and may be involved in the spread or referral of muscle pain extrasegmentally.[77,78]

Muscle pain can be inhibited strongly by descending pain modulating pathways.[79-81] This finding has implications for management of MTrPs and may explain why muscle pain responds to a broad base of treatments. Furthermore, educating the patient on muscle pain may assist in modulating pain through cognitive pathways.

Active MTrPs have received most attention because of their role in spontaneous pain elicitation; however, interest in latent MTrPs has increased. Activation of latent MTrPs provokes active MTrPs and subsequent pain, under certain circumstances. Subjects with latent MTrPs in the medial gastrocnemius muscle presented with nociceptive hypersensitivity at these latent MTrPs.[82] In another study, muscle cramps were induced in nearly 93% of the subjects following glutamate injections into latent MTrPs, but not in non-MTrP areas, a finding suggesting that appropriately stimulated latent MTrPs could be involved in the development of muscle cramps.[83] Glutamate injections activate small-diameter muscle nociceptive afferents through activation of peripheral excitatory amino acid receptors.[84] Painful stimulation of latent MTrPs leads to muscle cramps, which can contribute to the development of local and referred pain and widespread central sensitization.[85] Reduced skin blood flow response was noted in latent MTrPs compared with non-MTrP areas after painful stimulation with glutamate injection, a finding implying an increased sympathetic vasoconstriction component at latent MTrPs.[86]

An Australian study demonstrated alteration of shoulder muscle activation patterns in subjects with latent trigger points versus control subjects.[87] Dry needling and stretching to the latent MTrPs, when compared with sham ultrasound, led to normalization of the shoulder muscle activation patterns. These studies have implications for patients with myofascial pain because intrinsic stimulation of latent MTrPs (e.g., from fatigue, stressful postures, or certain metabolic conditions) may lead to the development of active pain producing MTrPs. Active MTrPs, in turn, may lead to the wide-ranging effects of peripheral and central sensitization. For a detailed review of muscle pain and central sensitization, the reader is referred to Mense and Gerwin[47] and Sluka.[69]

BOX 2 Muscle Pain Characteristics

- Muscle pain causes a poorly defined, aching, cramping type of pain that is difficult to localize.
- MTrP pain intensity is comparable to pain from other causes.
- Muscle pain stimulates unique cortical structures.
- Muscle nociceptors are particularly effective at inducing neuroplastic changes in the dorsal horn.
- MTrPs may refer pain extrasegmentally.
- Muscle pain can be inhibited significantly by descending pain modulating pathways.

MTrP, myofascial trigger point.

ETIOLOGY AND PERPETUATING FACTORS

MTrPs have several potential causes, including low-level muscle contractions, uneven intramuscular pressure distribution, alterations in blood flow, direct trauma, unaccustomed eccentric contractions, eccentric contractions in unconditioned muscle, and maximal or submaximal concentric contractions.[4,7] Skeletal muscle fatigue can lead to an alteration in normal function of the neuromuscular pathway, with a subsequent increase in concentration of ACh and consequences as outlined by the IH.

From a clinical perspective, several proposed factors are relevant to the development of MTrPs. Simons et al[4] identified mechanical, nutritional, metabolic, and psychological precipitating and perpetuating factors. To develop optimum treatment and a suitable plan of care, physical therapists must become aware of these precipitating, predisposing, and perpetuating factors.[4] Some of these factors may lie outside the direct scope of physical therapy, but awareness helps to direct patients to the appropriate health care provider, including a physician or psychologist.[7] Examples of perpetuating factors include the following:

- Mechanical: postural dysfunctions, including forward head posture, excessive thoracic kyphosis, scoliosis, leg length inequalities, pelvic torsion, joint hypermobility, ergonomic habits, poor body mechanics[4,7,88]
- Physiologic: poor sleep hygiene and non-restorative sleep; fatigue; general fitness, conditioning, and coordination, among others[4,7,88,89]
- Medical: hypothyroidism, systemic lupus erythematosus, Lyme disease, ehrlichiosis, candidiasis, interstitial cystitis,

irritable bowel syndrome, and parasitic disease, among others[4,7,88,89]
- Nutritional and metabolic: deficiencies or insufficiencies of vitamin B_1, B_6, B_{12}, C, and D, folic acid, and ferritin, magnesium, and zinc[4,7,88,89]
- Psychological: stress and tension, emotional state, fear avoidance, psychological disorders, mental illness, genetics, patient beliefs, and addictions, among others[4,7,88,89]

MANAGEMENT STRATEGIES

The development of a suitable plan of care for shoulder pain and dysfunction is based on clinical assessment and includes the patient's history, as well as subjective and objective factors. Clinicians should always remain aware of possible differential diagnoses. Shoulder pain may arise from local or referred phenomena, including orthopedic and visceral structures. In relation to the shoulder, a pain profile should be carried out to include the location of pain, the type of pain, the intensity and frequency, aggravating and relieving factors and irritability, and the behavior of complaint. The use of pain drawings may be helpful for assessment and documentation. The history and development of the presenting complaint are important to review. It is essential to examine the patient's lifestyle, including sports, occupation, and hobbies, among others. Recognizing whether the complaint started insidiously or was precipitated by trauma or overuse assists in the differential diagnosis, such as fracture, rotator cuff derangement, or impingement syndrome, and also helps to identify the mechanism of injury. A medical history, medication usage, and a red flag questionnaire should be routinely obtained, to raise the suspicion of possible visceral somatic disease, such as cardiac disease or Pancoast's tumor, etc. In this regard, red flag questions should be part of the routine assessment.[90] For example, the incidence of shoulder adhesive capsulitis in patients with diabetes mellitus is estimated to be two to four times higher than in the general population; adhesive capsulitis affects approximately 20% of persons with diabetes.[91]

Objectively, the patient should be assessed by an orthopedic physical therapy evaluation, as detailed in other lessons. Attention should be paid to the joints of the shoulder, including the glenohumeral and scapular-thoracic articulations. The neck, thorax, elbow, and hand require screening for differential diagnosis and dysfunction. Key elements of assessment may include the following: observation; static and dynamic postural assessment; and movement testing, including active and passive range of motion and accessory joint mobility. Pain provocation and special tests are essential to the examination process. Of significant importance to muscle and MTrPs are the assessment of muscle length, end feel, and strength and muscle pain provocation tests, including MTrP palpation.

Accessible muscles suspected of harboring MTrPs are skillfully palpated using flat palpation and pincer grip techniques, as previously outlined. These techniques are valuable because they often elicit the patient's pain, a feature of obvious clinical importance. Palpation of muscles for MTrPs usually occurs at the end of the objective orthopedic assessment. This timing reduces the possibility that MTrP palpation-induced pain provocation, or indeed pain relief, will interfere with interpretation of orthopedic tests. Nonetheless, it may be beneficial to treat the MTrP with manual trigger point compression release (TPCR) and to ascertain the effects on the objective findings because the results of the painful arc or impingement tests, for example, often improve. Maitland[92] recommended a test-treat-retest strategy to assess the effects of manual therapy, and this strategy can be adapted to MTrP interventions. From the subjective and objective evaluation, suspicion should be raised about which muscles are potentially involved in the patient's clinical profile.

The most common clinically relevant shoulder muscles that may present with MTrPs are the infraspinatus, supraspinatus, subscapularis, teres minor, trapezius, levator scapulae, latissimus dorsi, and deltoid muscles. Clinicians should not limit themselves to assessing only common muscles, however, but should also remain cognizant of the potential for other muscle involvement (Box 3).

BOX 3 Common Muscles Involved in Anterior and Posterior Shoulder Pain*

Anterior Shoulder Pain	*Posterior Shoulder Pain*
Infraspinatus	Deltoid
Deltoid	Levator scapulae
Scalene	Supraspinatus
Supraspinatus	Teres major
Pectoralis major	Teres minor
Pectoralis minor	Subscapularis
Biceps brachii	Triceps brachii
Latissimus dorsi	Trapezius

*This is not an exhaustive list. Shoulder muscles may cause pain into the upper arm, forearm, and hand. Refer to Simons, Travell, and Simons[4] and Dejung et al[5] for further information.

REVIEW OF TREATMENT OPTIONS

Treatment options for MTrPs include the following: noninvasive manual therapies; invasive needling therapies; modality-based therapies; exercise therapy; and medical, pharmacologic, and psychological therapies (Fig. 5). The main emphases of this section are on TPCR, massage technique, spray and stretch (S&S), invasive needling, modalities, stretch and strengthening, education, and attention to perpetuating factors. This lesson does not cover medical, pharmacologic, injection therapy, or psychological therapies, although the lack of discussion here does not imply that these approaches are not important. Therapeutic options must be considered in relation to the updated IH of trigger point

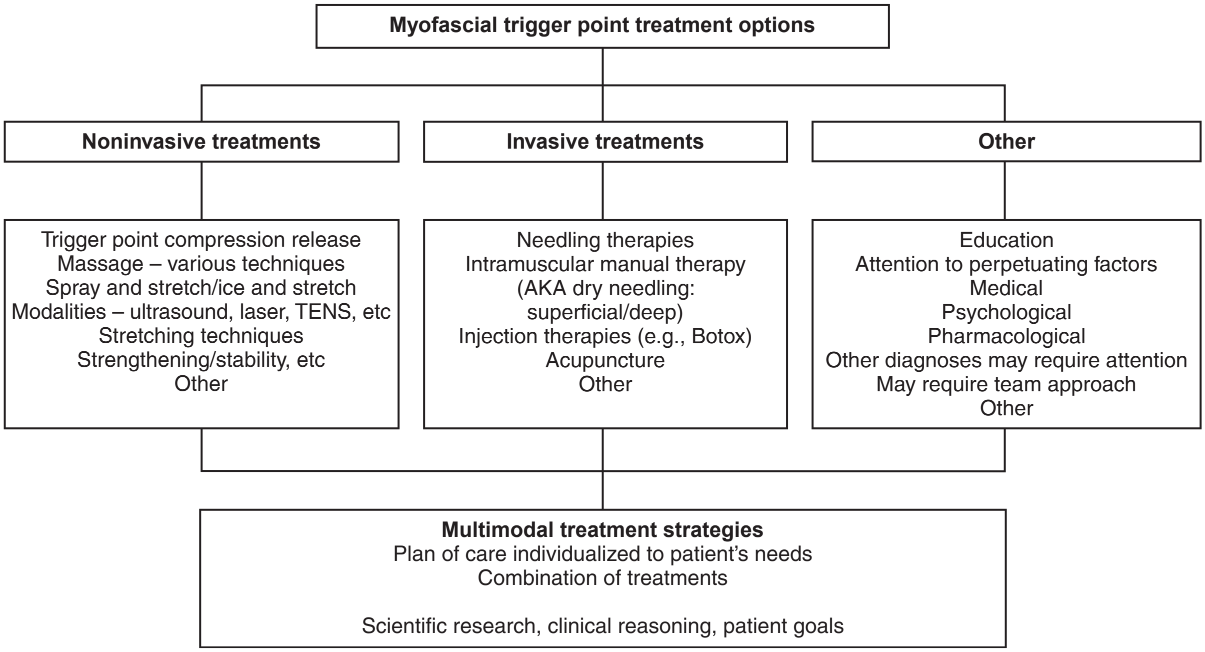

Figure 5 Treatment options for myofascial trigger points. (Courtesy of Myopain Seminars ©2010.)

formation and the way in which an individual treatment may affect the mechanisms that lead to the development of the taut band, pain, and sensitization (see Fig. 4). A systematic review of noninvasive MTrP treatment has been published,[93,94] as has another publication discussing manual therapies and modalities.[8] Several articles have been published on invasive needling therapies and current practice reviews.[95,96]

TREATMENT TECHNIQUES

The techniques included in this section are examples of treatment options. They are not intended to be comprehensive. Clinicians should refer to other lessons for relevant anatomy, biomechanics, pathomechanics, and manual therapy techniques. Further training, including practical skills, may be required, and clinicians should limit themselves to techniques included in their professional scope of practice. Treatment of musculoskeletal pain with soft tissue techniques should be based on appropriate assessment and development of a plan of care. Clinicians should remain cognizant of treatment contraindications, precautions, and safety issues. Therapists should ensure good body mechanics and avoid prolonged repetitive movements, to reduce the risk of occupational injury and overuse.

Noninvasive Manual Therapies

Noninvasive manual therapies include a plethora of techniques, including TPCR,[4,22] massage,[4,97] myofascial release (MFR),[98-100] S&S,[4,22,101] postisometric relaxation,[102-104] muscle energy technique,[105] neuromuscular technique and therapy,[106,107] manual medicine,[108,109] occipital release and retraction extension,[110] strain counterstrain,[111] and a home program of TPCR,[112] and coupled with sustained stretch.[113] A case study employing Kinesio Taping for MTrPs in the anterior and medial deltoid muscle reported improvement in shoulder range of motion, pain, and function, notwithstanding the limitations of a case study.[114] Traditionally, the most common noninvasive methods used in the treatment of myofascial pain are TPCR, massage techniques, and S&S.

Trigger Point Compression Release and Massage

TPCR was previously known as *ischemic compression*. TPCR is usually considered the primary manual therapy technique for MTrPs and has been described for the majority of muscles.[4,5,22,23] TPCR is believed to compress the contractured sarcomeres when perpendicular pressure is applied to the MTrP, thus leading to longitudinal elongation of the sarcomere.[115] No research has been published to support this hypothesis. Also likely is a reflex neural component that may, in part, offer some understanding of the technique.

With regard to the shoulder, the muscle to be treated is positioned for best access and comfort for the patient. The muscle is placed, when appropriate, in a position of optimal resting tension, to expose the taut band for adequate palpation relative to the surrounding muscle tissue. The clinician should be cognizant of the regional practical anatomy, including the muscle attachments, fiber direction, muscle layers, and surrounding anatomic landmarks. Precautions should be noted to avoid inappropriate stretching, compression, or occlusion of neurovascular structures such as the brachial plexus and subclavian artery.

When the patient is appropriately positioned, the MTrP is located by palpating transverse to the muscle fiber direction of the accessible shoulder muscle. Some muscles have challenging accessibility and make palpation difficult. As an example, the clinician should compare the accessibility to palpation of the supraspinatus or subscapularis with that of the infraspinatus or deltoid. Palpating transverse to the muscle fibers allows optimum exposure of the taut band relative to the surrounding muscle fibers and assists in identification of the tender nodule on the taut band. When the MTrP is identified, it is compressed with the clinician's finger or thumb by flat palpation or a pincer grip. The compression intensity can be in the region of 7/10 on the patient's reported pain scale, and this compression is held until a reduction in discomfort is experienced by the patient; this change may take 20 to 60 seconds or longer.[116] This compression may also be delivered either at low pressure below the patient's pain threshold for a prolonged period (90 seconds) or at high pressure for a shorter duration (30 seconds).[117] The immediate reduction in MTrP sensitivity from TPCR is evidenced by an increase in pain pressure threshold (PPT), and it is not caused by a reduction of palpation pressure by the clinician.[116]

Similar effects were noted for TPCR and transverse friction massage, as described by Cyriax, for MTrPs with a similar reduction in Visual Analog Scale (VAS) score and increase in PPT for both treatments.[118] In clinical practice, it would be judicious to titer the treatment to the individual patient's ability to tolerate manual treatments.

Self induced TPCR to the upper back, with a plastic self-release device, was effective in reducing MTrP irritability.[112] Similarly, a home program of TPCR and stretching was effective in diminishing MTrP sensitivity and pain intensity in individuals with neck and upper back pain.[113] Clearly, it is important to consider education on a home program of self-directed treatment.

Trigger Point Compression Release: Infraspinatus and Teres Minor (Fig. 6)

Rationale This technique targets one of the most common muscles in the shoulder region (infraspinatus) that develops MTrPs. The referred pain pattern is expansive and may include the shoulder, forearm, and hand. The infraspinatus muscle is flat, thin, and relatively expansive. To assess the infraspinatus muscle and its neighboring teres minor, the therapist palpates all over the infraspinatus fossa on the posterior scapula.

Figure 6 Trigger point compression release: infraspinatus and teres minor. (Courtesy of Myopain Seminars ©2010.)

Patient Position The patient is sitting, side lying (side up), or prone. The shoulder is positioned to place optimum tension on the muscle for MTrP palpation.

Therapist Position The therapist stands behind the patient.

Procedure The infraspinatus muscle is palpated by flat palpation perpendicular to the muscle fiber direction against the infraspinous fossa. In the upper portion, the fibers run in a direction similar to that of the spine of the scapula and more obliquely in the outer lower portion. The clinician assesses the muscle for taut bands with spot tenderness to identify MTrPs.

The procedure is similar for the teres minor. The muscle is located on the lateral aspect of the infraspinous fossa and runs in an oblique direction to the posterior shoulder inserting into the greater tubercle of the humerus

Trigger Point Compression Release: Supraspinatus (Fig. 7)

Rationale Palpation of supraspinatus is difficult because of its depth and its position under the trapezius. However, the supraspinatus is an important muscle to be able to identify.

Patient Position The patient is sitting or side lying (side up). The shoulder is positioned to place optimum tension on the muscle for MTrP palpation.

Figure 7 Trigger point compression release: supraspinatus. (Courtesy of Myopain Seminars ©2010.)

Therapist Position The therapist stands behind the patient.

Procedure The spine of the scapula and the medial angle are located by palpation; between and below lies the supraspinous fossa. The supraspinatus is palpated through the more superficial trapezius by flat palpation directly into the fossa, by assessing along the length of the muscle. This procedure is challenging, and a taut band is not usually palpable. The clinician assesses for local tenderness and referred pain and for the patient's response to treatment with compression. Caution should be exercised in the lateral portion because of potential, but unlikely, suprascapular nerve compression.

Trigger Point Compression Release: Subscapularis (Fig. 8)

Rationale The subscapularis is an important muscle for stabilization of the shoulder, but because of its subscapular position, it is often ignored in palpation. Patients with weakness seen on Gerber's lift-off test or with restricted external rotation, especially neutral, should be assessed for myofascial pain of the subscapularis muscle.

Patient Position The patient is supine, with the arm abducted and laterally rotated, with a degree of shoulder girdle protraction. The shoulder is positioned to place optimum resting tension on the muscle for MTrP palpation, and support may be given by the clinician's non-palpating hand and arm. This position may vary for each individual, and the clinician should seek to adapt this technique to suit the patient's presentation. Caution should be exercised when treating persons with unstable or hypermobile shoulders.

Figure 8 Trigger point compression release: subscapularis. (Courtesy of Myopain Seminars ©2010.)

Therapist Position The therapist is in front of the treated side.

Procedure The therapist gently places his or her hand into the patient's lower axilla between the ribs and the bulk of the latissimus dorsi laterally. The therapist then advances gently toward the subscapularis muscle lying against the accessible and lateral part of the subscapular fossa. The muscle is compressed while the therapist looks for localized tenderness and potential referred pain elicitation. Testing and treatment are performed along the accessible length of the muscle. The clinician assesses whether compression changes shoulder external rotation or pain and strength as seen on Gerber's lift-off test. Caution needs to be noted with regard to the axillary neurovascular bundle superiorly.

Trigger Point Compression Release: Upper Trapezius (Fig. 9)

Rationale This technique targets the upper trapezius muscle. This is not to say that the lower or middle trapezius is less important, and all parts of the trapezius should be routinely palpated for MTrPs. The trapezius is important for stability of the scapula, and its contribution to shoulder dysfunction should not be underestimated. The upper portion can be palpated using pincer grip, with anterior and posterior access. The middle and lower portions are usually palpated by flat palpation.

Patient Position Sitting and side lying (side up) are the usual preferred positions. The scapula is positioned to place optimum passive tension on the muscle for MTrP palpation.

Therapist Position The therapist is behind the patient.

Procedure The upper trapezius muscle is palpated by pincer grip. The fiber direction runs in an oblique direction upward from the acromion and the spine of the scapula toward the posterior occiput and cervical spine. The clinician assesses the muscle for taut bands with spot tenderness to identify MTrPs along its length from lateral to medial attachments. This muscle is tender to palpation, and the therapist must avoid being aggressive by titrating the palpation pressure.

Figure 9 Trigger point compression release: upper trapezius. (Courtesy of Myopain Seminars ©2010.)

Figure 10 Trigger point compression release: levator scapulae. (Courtesy of Myopain Seminars ©2010.)

Figure 11 Trigger point compression release: pectoralis minor. (Courtesy of Myopain Seminars ©2010.)

Trigger Point Compression Release: Levator Scapulae (Fig. 10)

Rationale The levator scapulae is an important muscle in relation to MTrP referral pain at the angle of the neck and along the medial aspect of the scapula. Often, the levator scapulae is a facilitated muscle with high tone and may predispose the scapula to downward rotation, with a resultant effect on the subacromial space. Therefore, it is an important muscle to assess and treat for scapular thoracic and glenohumeral joint dysfunctions. Often, patients also present with shortness of the pectoralis minor in conjunction with levator scapulae dysfunction.

Patient Position The patient is side lying (side up). A pillow is placed to support the patient's head, to optimize the position and tension on the levator scapulae. The shoulder girdle can be elevated or depressed to optimize passive tension.

Therapist Position The therapist is behind the patient.

Procedure The medial angle and upper medial border of the scapula by are located by palpation, and the scapular attachment of the levator scapulae muscle is identified. The inferior part of the muscle can be palpated under the trapezius muscle, especially if it is placed in optimum tension. The muscle is palpated along its length in a transverse fashion from the scapula toward the transverse processes of C1 to C4. The therapist palpates for tenderness, tension, and referred pain.

Trigger Point Compression Release: Pectoralis Minor (Fig. 11)

Rationale The action of the pectoralis minor in protracting the scapula as part of postural syndromes and the effect of this muscle on the subacromial space make it an important focus for MTrP release. Often, patients also present with shortness of the levator scapulae in conjunction with pectoralis minor dysfunction.

Patient Position The patient is supine. The patient's hand is placed on the abdomen or is positioned in a degree of abduction with the arm supported to ensure that the pectoral muscles are relaxed. The shoulder girdle can be elevated or depressed, to optimize passive tension on the pectoralis minor.

Therapist Position The therapist is in front of the treated side.

Procedure The coracoid process is located by palpation. From here, at an oblique angle, the pectoralis minor descends medially and inferiorly toward its insertions at the third, fourth, and fifth ribs. The clinician palpates the muscle by flat palpation through the overlying pectoralis major. Here the pectoralis minor can be palpated as a thin, firm muscle. The therapist then assesses for tension, tenderness, and elicited referred pain and compresses for treatment. Caution should be noted with regard to the axillary artery and brachial plexus, which lie inferior to the coracoid process and deep to the upper part of the pectoralis minor muscle.

Massage Therapy

Massage therapy, a traditional keystone of physical therapy, evolved in several European countries in the 19th century.[119-121] In relation to MTrPs, different massage techniques have been proposed, and a potential mechanism of action on MTrPs has been offered.[4,115] The main aim of massage can be considered, similar to TPCR, to lengthen the taut band and increase the local circulation. Massage techniques include kneading, rolling, friction, and stripping strokes along or across the taut band.[97,120,122] Massage strokes may be helpful to assess the localized tissue stiffness characteristics and to aid the clinician in honing in on tender nodules and the taut band of MTrPs. In essence, massage therapy can be used as a dynamic assessment and treatment tool.

In a review of massage therapy for chronic nonspecific low back pain, specific manual massage techniques, such as acupressure, outperformed less specific techniques such as Swedish massage.[123] This finding has implications for the choice of techniques employed to treat MTrPs of the shoulder, and it indicates the importance of specific localization in manual techniques. In practical terms, a combination of

TPCR, massage therapy, and myofascial manipulation (MFM) techniques is suggested as a mainstay of manual therapy.

The muscles of the subscapularis, supraspinatus, infraspinatus, and teres minor blend through their fascial and tendon attachments with the glenohumeral capsule and are often implicated in shoulder pain and dysfunction. Cyriax popularized *friction massage,* which is a common treatment option for pain and scar tissue and is also used to stimulate tissue healing, especially for tendons.[124,125] Other techniques include the Graston technique, an instrument-assisted soft tissue mobilization method.[126-128] These techniques aim to influence connective tissue mobility and stimulation by employing forces applied usually across the connective tissue fibers.[129] Clinical evidence for friction massage in tendinitis is limited, and future research is needed.[130-132] However, friction massage remains a popular treatment option, often based on clinical observation. Techniques for the rotator cuff tendons are included later.

Massage Technique: Posterior Scapular Region (Fig. 12)

Rationale Massage techniques may be beneficial for certain pain conditions, especially when these techniques are more specifically directed. Massage is also valuable for assessing the quality and tonal elastic properties of connective tissues and for assessing pain response to pressure. MTrPs can be identified and located for treatment. Areas of restrictions can be identified. Massage is a dynamic process in which assessment and treatment are often carried out simultaneously. The value of massage technique should not be underestimated. Massage can be combined with TPCR or MFM techniques.

Patient Position The patient is supine, with the shoulder maintained in a comfortable position, or the patient can be side lying, with the arm and shoulder supported.

Therapist Position The therapist is on the treated side, maintaining good body mechanics.

Procedure The therapist can assess the postscapular region by using various massage strokes, including effleurage and kneading parallel and perpendicular to the muscle fiber directions. Therapists should remain cognizant of muscle fiber direction and muscle layers from superficial to deep. Here the therapist can readily assess the latissimus dorsi, trapezius, rhomboids, levator scapulae, infraspinatus, teres minor, teres major, deltoid, triceps, and lateral part of the serratus anterior (usually best access in side lying) muscles. When MTrPs are identified, the direct technique can be applied using TPCR. This treatment can be interspersed with soft tissue massage, such as effleurage and kneading from the center of the trigger point away in both directions. Friction massage can be used to treat MTrPs; however, TPCR may be more tolerable. Friction massage can be introduced to areas of significant restrictions and tenderness as appropriate and titrated to suit the individual patient. Massage is usually well tolerated and should be of an intensity tailored to the patient. Caution should be exercised in patients with allodynia.

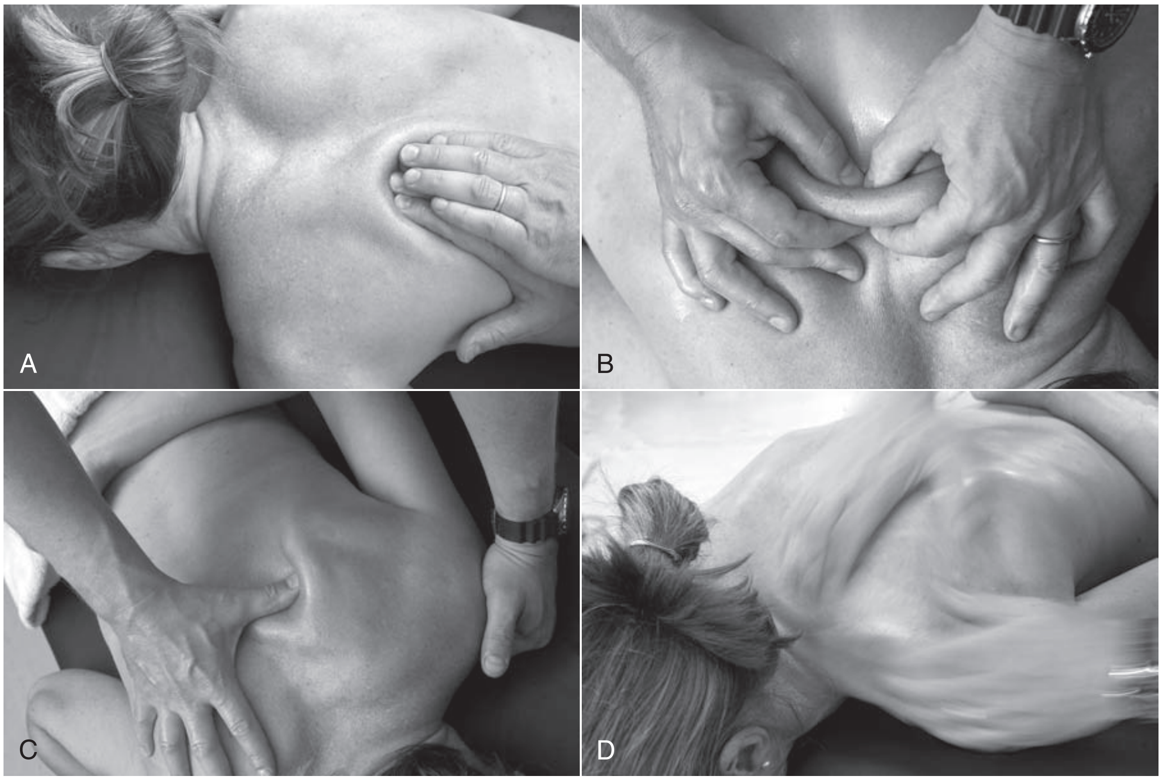

Figure 12 **A** to **D,** Massage technique: posterior scapular region. (Courtesy of Myopain Seminars ©2010.)

Massage techniques can also be applied to the lateral and anterior chest areas to incorporate treatment to muscles such as the pectoralis major, pectoralis minor, anterior deltoid, and biceps. Appropriate draping is important.

Friction Massage: Rotator Cuff (Fig. 13)

Rationale This treatment is used to relieve pain and to stimulate tendon healing.

Patient Position The patient is sitting supported for the subscapularis and supraspinatus muscles and is sitting or prone for the infraspinatus and teres minor muscles.

Therapist Position The therapist stands behind the patient on the treated side. For the friction massage technique, the therapist supports the index finger by crossing the middle finger over it.

Procedure The tendon to be treated is located by functional testing and is positioned to offer best exposure. The therapist contacts the tendon with the reinforced finger and moves transversely across the tendon to ensure that the fingers move with the patient's skin as one, to prevent skin friction burn, blistering, and bruising. No oil is used, and the patient's skin should be dry. Usually, local tissue anesthesia occurs within 2 to 3 minutes, and caution should be exercised if this does not occur or if the treatment appears to aggravate the condition. The friction treatment generally lasts up to 10 minutes or longer, and treatment frequency may vary from one to three times per week. Contraindications include, but

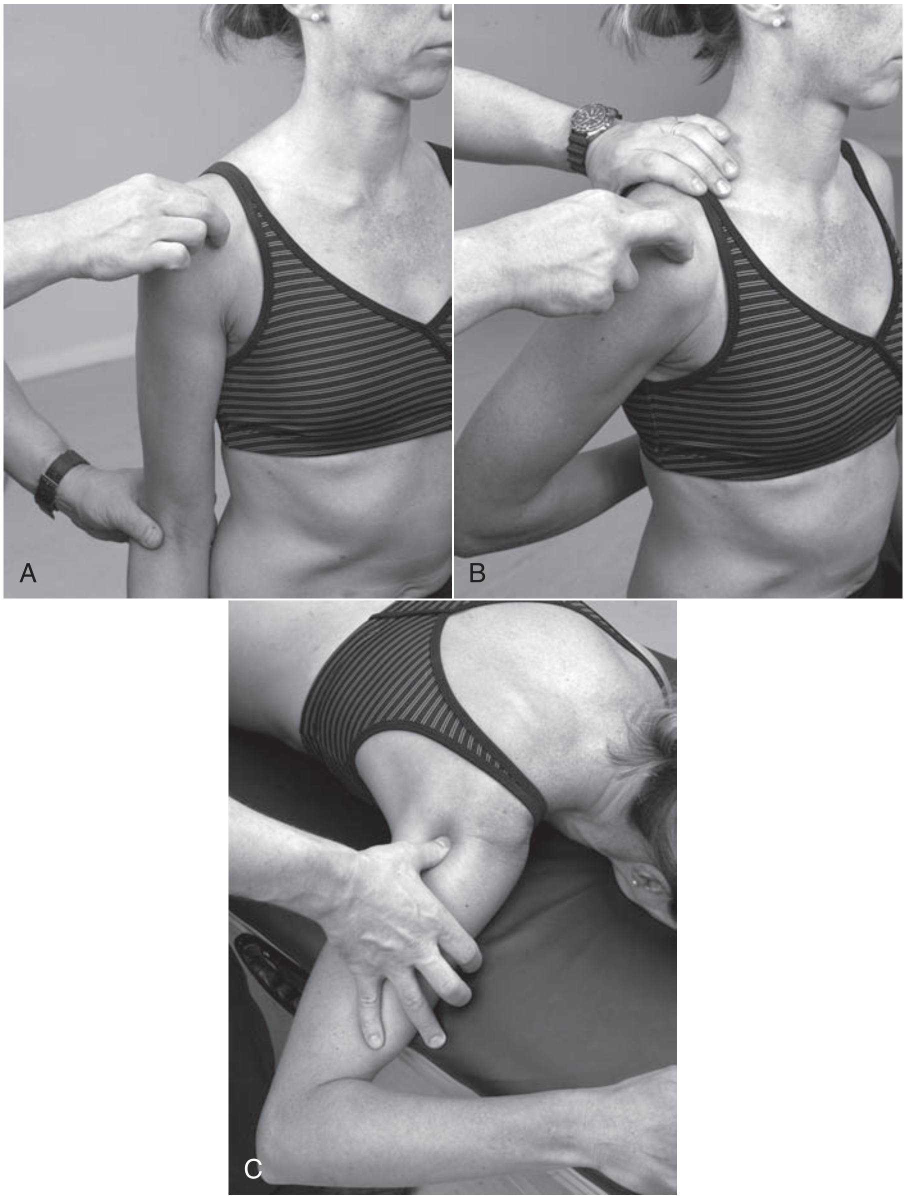

Figure 13 **A** to **C,** Friction massage: rotator cuff. (Courtesy of Myopain Seminars ©2010.)

are not limited to, acute injuries, infections, hematoma, and skin conditions, and special caution is needed in patients with poor circulation or diabetes or in patients who take blood thinning medication.

- Subscapularis: The patient's arm is in neutral, supported with some external rotation to rotate the lesser tubercle laterally to access the tendon. The tendon lies medial to the lesser tubercle and lateral and somewhat inferior to the coracoid process. Friction is carried out in a superior-inferior direction.
- Supraspinatus: The patient's arm is in extension, adduction, and internal rotation. The tendon inserts into the superior aspect of the greater tubercle of the humerus, which is located just inferior to the anterior-lateral acromion. Friction is carried out transversely across the tendon in an inferior-medial–superior-lateral direction.
- Infraspinatus and teres minor: The patient is prone, with the arm off the edge of the bed and supported. The spine of the scapula and the infraspinous fossa are identified from where the infraspinatus muscle arises. From here, the therapist tracks the muscle up to its insertion to the greater tubercle of the humerus at the posterior shoulder. The tendon of the infraspinatus lies superior to that of the teres minor, and both are covered in the posterior shoulder region by the posterior deltoid. Palpation through the relaxed posterior deltoid friction is delivered in an almost superior-inferior direction.

Myofascial Manipulation

The word *fascia* is derived from the Latin word for "band" and refers to sheets of dense fibrous connective tissue that envelop body structures. Fascia plays an essential role in human structure, movement, function, and defense.[133] Connective tissue is made up of specific cells and extracellular matrix (ECM), including fibroblasts, adipocytes, and mesenchymal stem cells, as well as a fluctuating level of defense cells such as macrophages, lymphocytes, neutrophils, eosinophils, and mast cells.[133] Fibroblasts are usually the most abundant cells; they synthesize the majority of the ECM and therefore play an essential role in the maintenance of connective tissue.[133]

Myofibroblasts are specialized contractile fibroblasts that have been reported to function in wound contraction[134] and are present in fascial tissues.[135,136] Fibroblastic activity is influenced by injury, mechanical stress, steroid hormone levels, and dietary content.[133] The ECM consists of the extracellular substances, namely, insoluble protein fibrils, including collagen and elastin, and soluble proteoglycans, and it functions to oppose stresses of movement and gravity while also maintaining structure and shape.[133] The collagen and elastin components of the ECM resist mainly tensile forces, whereas proteoglycans oppose primarily compressive forces.[133]

Fascia is richly innervated by mechanoreceptors with a sympathetic nerve supply.[135-141] Schleip et al[142] proposed that fascia has a neurosensory transducer function and may be in an advantageous position to fulfill this role because of its position farther from the axis of movement compared with joint ligaments. Furthermore, fascia assists in load transfer among the spine, pelvis, legs, and arms and acts as an integrated functional stability system.[143,144] The anatomy of the pectoral and upper limb myofascial complex has been described in detail, and investigators have linked its importance to force transmission between the upper and lower extremities.[145-149] Myofascial expansions show a similarity to MTrP referral patterns, and this is an area for further investigation.[145] This similarity has implications for treatment of the shoulder region and suggests the importance of the interdependence of parts of the kinetic chain. For example, one should consider the interactions among the lower extremity, hip, pelvis spine, trunk, shoulder, and upper limb during javelin throwing or baseball pitching.

Numerous descriptions of soft tissue techniques for the treatment of myofascia,[150] including MFR,[98-100] Rolfing,[151] MFM,[152] fascial manipulation (FM),[148,150] and neuromuscular technique[153] have been published. Fascia is responsive to mechanical load and demonstrates plastic properties.[135,136,140,141,154] The so-called tissue release, felt by the clinician during MFM, MFR, or FM, is purportedly the result of mechanical stress induced by the technique.[141] In addition, stimulation of mechanoreceptors reduces sympathetic tonus and induces changes in local tissue viscosity, which may in part explain the release phenomenon.[141] Such benefits may influence myofascial proprioception and nociception and may assist in addressing postural syndromes, such as protracted shoulders and forward head postures.

In practical terms, MFM should be directed at primary short and tight myofascial tissues in a slow and melting manner, to induce a parasympathetic state and to avoid myotatic stretch reflexes.[140] Attention should also be given to the antagonistic muscles of the related joint.[140] The techniques may involve manual stretching, by taking up the slack around a restriction, engaging the barrier, and holding until a release is experienced, which may take a few seconds to a half a minute or longer.[99,104] In MFR, sustained hold is in the region of 90 to 120 seconds or longer.[98] FM techniques applied to fascial densities in the low back was shown to halve the pain in a mean time of 3.24 minutes.[129] Techniques may be augmented by limb pulling or trunk rotations.[99] Local manual techniques, such as skin rolling, folding, or pressing, may be employed for local areas of restriction.[104] In essence, MFM is a skilled technique whereby the clinician is assessing and treating interactively during the process. Needle therapies and acupuncture may affect fascia because needle manipulation techniques have been shown to induce extensive fibroblast spreading.[155,156]

Common areas of shoulder restriction include the anterior pectoral myofascial structures, including the pectoralis minor, and the posterior neck region, involving the levator scapulae. Clinicians should consider the shoulder myofascial complex and continuity in relation to the whole kinetic chain.

FM technique apparently restores impeded gliding of collagen and elastic fibers within the ground substance by exploiting heat generated from the friction of deep manipulation.[129] The effectiveness of FM in reducing shoulder pain was shown in a cohort of 28 patients. The FM consisted of deep kneading of muscular fascia at specific points along myofascial sequences.[150] Examples of techniques are presented in this section, and additional techniques for the shoulder complex are offered elsewhere in this book. Donatelli popularized a clinically useful scapular distraction technique .

Traditionally, the main focus of MFM, MFR, and FM has been on the myofascial complex and not directly on MTrPs, and to what extent these techniques benefit patients with MTrPs is unknown.[4] It is possible that MFM, MFR, and FM have both direct and indirect effects on MTrPs. Interest in fascia has increased, as evidenced by the international Fascia Research Congresses. Despite this development, many questions remain unanswered. For example, what is the role of perimysium in the formation of MTrPs, given its role in muscle contractibility? Does MTrP dry needling stimulate connective tissue or muscle fibroblasts, and does that contribute to the immediate reduction in pain following needling procedures.[157]

Myofascial Manipulation: Scapular–Thoracic Soft Tissue Mobilization (Fig. 14)

Rationale This general technique mobilizes the soft tissue components of the scapula-thoracic articulation. The position for this procedure allows a dynamic mobilization technique. The therapist can access passive restrictions in scapular movement and can use the position to mobilize and stretch scapular and thoracic soft tissue.

Patient Position The patient is side lying, treated side upward. The patient's arm should be comfortably positioned on a pillow.

Therapist Position The therapist stands facing the patient. The therapist's upper hand cups the acromion, and the lower hand acts as the dynamic mobilizer.

Procedure The scapula can be moved and dynamically assessed and mobilized in its planes of movement or in combinations of these movements: elevation, depression, protraction, retraction, lateral rotation, medial rotation, upward rotation, downward rotation, and anterior and posterior tipping. This procedure can be very beneficial in improving dynamic mobility around the scapula thoracic joint. It can also help to identify potential restrictions in myofascia and to identify areas for more localized soft tissue therapy such as TPCR or intramuscular manual therapy (IMT).

Myofascial Manipulation: Pectoralis Minor Release (Fig. 15)

Rationale This specific soft tissue technique assists in releasing the pectoralis minor and superficial anterior chest fascia. It is a popular technique for addressing a tight pectoralis minor muscle, as seen in the Janda crossed syndrome of the shoulder girdle. When this muscle is found to be tight, it is important to assess the levator scapulae also.

Patient Position The patient is supine, with the arm by the side and the hand on the chest.

Therapist Position The therapist stands at the head of the patient. One of the therapist's hands is placed on the patient's hand that is resting on the chest. The therapist's other hand isolates the coracoid process.

Procedure A suitable force is applied to distance the clinician's hands, which are near for applying a force along the superficial anterior chest fascia and pectoralis minor. The therapist holds with low force and waits until a release is felt, which may take 30 seconds to several minutes. This technique can be adapted for pectoralis major, clavicular, sternal, and costal sections by applying forces along the fiber direction with a similar technique.

Myofascial Manipulation: Scapular-Cervical Mobilization (Fig. 16)

Rationale The relationship of the cervical spine with the shoulder should not be overlooked. It is always wise to screen the neck for dysfunction. The trapezius and levator scapulae muscles have an important role in elevating the scapula. The levator scapulae may also act as a downward rotator, however, and therefore when facilitated may affect scapular-thoracic and glenohumeral joint motion.

Figure 14 Myofascial manipulation: scapular–thoracic soft tissue mobilization. (Courtesy of Myopain Seminars ©2010.)

Figure 15 Myofascial manipulation: pectoralis minor release. (Courtesy of Myopain Seminars ©2010.)

Figure 16 Myofascial manipulation: scapular-cervical mobilization. (Courtesy of Myopain Seminars ©2010.)

Patient Position The patient is supine, with hands resting on the abdomen.

Therapist Position The therapist is standing or seated directly at the head of the patient. One of the therapist's hands cradles the patient's cervical spine at the occiput, with the patient's head resting on the forearm of the therapist. The therapist's other hand is placed on the superior aspect of the shoulder joint at the acromion.

Procedure The patient relaxes, and the clinician gently and slowly assesses the quality of passive movement of the neck with combinations of side flexion, forward flexion, and rotation. This dynamic procedure assesses for restrictions or tension. At these points, the patient is gently stretched by using both clinician sensitivity and patient feedback. The therapist's opposite hand can depress the acromion. This technique helps to stretch the posterior lateral neck structures, particularly the upper trapezius and levator scapulae. The therapist holds with low force and waits until a release is felt, which may take 30 seconds to several minutes. This maneuver can be combined with TPCR of the upper trapezius and levator scapulae. Caution should be exercised with this technique in patients with suspected or confirmed acute or chronic discogenic, arthrogenic, and neurogenic diagnoses.

Myofascial Manipulation: Anterior Lateral Fascial Elongation (Fig. 17)

Rationale This technique insists in releasing the superficial anterior fascia. This fascia can often be restricted in patients with rounded shoulder, kyphosis, protracted shoulder girdle postures, and a tight sternal-xiphoid-symphyseal line.

Figure 17 Myofascial manipulation: anterior lateral fascial elongation. (Courtesy of Myopain Seminars ©2010.)

Patient Position The patient is supine, with the shoulder elevated to the appropriate angle to engage the restriction.

Therapist Position The therapist is on the treated side and supports the patient's arm while applying gentle traction to the limb. The therapist's opposite hand is placed appropriately on the patient's lower ribs below the breast line.

Procedure The therapist applies a suitable traction force to the patient's arm while applying a simultaneous force caudally on the lower chest in the direction of the palpated restrictions. This dynamic process alters and adjusts forces to meet the changing fascial limitations. The therapist holds with low force and waits until a release is felt, which may take 30 seconds to several minutes. This technique can also be carried out with pelvic rotation, to alter the forces on the anterior fascial slings and muscles.

Spray and Stretch

The S&S technique was a foundation of the Travell and Simons approach to the management of MTrPs,[4,22,23] and it was initially described by Dr. Hans Kraus in 1941.[158] A vapocoolant spray, such as ethyl chloride, fluoromethane, or a combination of pentafluoropropane and tetrafluoroethane, is sprayed directly on the skin over the muscle and referral zone of the MTrP in several sweeps as the muscle is stretched. This procedure is repeated approximately three times; thereafter, the skin should be rewarmed with a hot pack.[4] The technique may produce an afferent sensory barrage, which may inhibit local muscle contraction by affecting the efferent neuromuscular activity and permitting more beneficial stretching of the target muscle.[4] In place of S&S, ice and stretch (I&S) have been employed, in which ice held in an insulated cup is passed over the skin. Vapocoolants can be expensive and hazardous, and they threaten the environment by ozone depletion or greenhouse gas effects. No published research has compared S&S with I&S. In myofascial pain, S&S and I&S are used to reduce pain and to increase range of motion. They may be the most effective noninvasive methods for inactivation of acute MTrPs.[4]

One study supported the use of S&S over stretch alone in increasing hip flexion range of motion.[101] S&S had a positive effect on the VAS score and PPT in patients with neck pain.[159] S&S had immediate positive effects on PPT and was more effective when combined with deep pressure massage than were a hot pack and ultrasound.[160] In a multimodal trial, S&S were more effective when combined with other modalities than a hot pack and active range of motion.[117] A more recent study compared S&S with S&S and skin rewarming with a moist heat pack on MTrPs in the upper trapezius.[161] Adding skin rewarming improved VAS scores and cervical range of motion, but not the PPT of MTrPs.[161] A case study describing S&S for myofascial pain of the posterior shoulder reported significant pain relief with treatment to the subscapularis, among other muscles, coupled with stretching of tight pectoral muscles and attention to posture in a 59-year-old dentist.[162]

S&S can be a valuable technique for treatment of shoulder muscles. Nevertheless, I&S is preferred over S&S for the safety and environmental reasons noted earlier.

Ice and Stretch: Latissimus dorsi in the Side-Lying Position (Fig. 18)

Rationale The bulk of the latissimus dorsi, with its large expanse from the hip to the shoulder, makes it an excellent candidate for I&S.

Patient Position The patient is side lying, with the arm elevated above the head (side up), or the patient is supine, crook lying, with arm elevation.

Therapist Position The therapist stands at the head of the patient and holds the patient's humerus.

Procedure Ice is passed along the skin overlying the latissimus dorsi and along the posterior (medial and lateral) aspect of the arm, in sweeps, as the therapist pushes the humerus down to stretch the latissimus dorsi. To increase the stretch, a foam roll may be placed under the opposite side of the rib-ilium space to augment side flexion and to increase the stretch on the latissimus dorsi. This muscle can also be treated when the patient is supine, and in this position it allows a combination of muscles to be treated, including the pectoralis minor, pectoralis major, and subscapularis, combined with the latissimus dorsi.

Figure 18 Ice & stretch: latissimus dorsi, side-lying position. (Courtesy of Myopain Seminars ©2010.)

Trigger Point Intramuscular Manual Therapy/Dry Needling

Trigger point IMT, also known as trigger point dry needling (TrP-DN), is an invasive therapy in which an acupuncture needle is inserted into the skin, fascia, and muscle to treat MTrPs.[95] Different needling techniques and models are available, including trigger point, radiculopathy, and spinal segmental sensitization models.[21,95,96,163-166] The two main MTrP needling techniques are superficial dry needling (SDN) and deep dry needling (TrP-DN). SDN usually entails inserting a needle into the skin or fascia overlying a trigger point, and was popularized by Dr. Peter Baldry in the early 1980s as a safer approach to needling certain more difficult muscles such as the scalene muscles.[95,166] In contrast, during TrP-DN, the needle is inserted directly into the MTrP, and the main aim is to elicit LTRs, which occur during dynamic needle penetration of the MTrP. The reproduction of LTRs during needling therapy is essential and is associated with improved outcomes; direct needling of MTrPs appears to be an effective treatment for pain.[167,168] Historically, TrP-DN developed from Travell's trigger point injection technique, in which local anesthetic was injected into the MTrP while the hypodermic needle was moved through the muscle to elicit LTRs.[21] Investigators proposed, and later supported, that the therapeutic effect was likely related to the mechanical movement of the needle and the elicitation of LTRs, as opposed to the anesthetic or fluid effect.[21,167-169]

The exact mechanism of action of TrP-DN on myofascial pain is not known, but investigators have reported that TrP-DN reduced nociceptive chemical concentrations in the vicinity of active MTrPs.[66,67] In an animal study, TrP-DN was effective at diminishing spontaneous electrical activity (end-plate noise) when LTRs were elicited.[170] Other modes of action of analgesia have been proposed from experimental animal studies including recovery of circulation[171] and descending pain inhibitory system.[172,173]

A meta-analysis of MTrP needling therapies supported the use of this approach in the treatment of pain, but this analysis could not conclude efficacy beyond placebo, mainly because of the difficulty of placebo needling design.[168] A Cochrane database systematic review supported the use of TrP-DN for chronic low back pain, especially when combined with other treatments.[174] TrP-DN was reported to offer pain relief and improvement in quality of life in older patients with osteoarthritic knee pain,[175] neck pain,[176] and low back pain,[177] when compared with acupuncture.

In patients with bilateral shoulder pain, with active MTrPs in the infraspinatus muscles, TrP-DN of the infraspinatus muscle increased active and passive range-of-shoulder internal rotation and PPT of MTrPs and reduced pain, compared with the control side.[178] In addition, TrP-DN of a primary MTrP (infraspinatus) inhibited the activity in satellite MTrPs (situated in the referral zone of primary MTrP) in the anterior deltoid and extensor carpi radialis longus muscles.[178] In another study, TrP-DN, as part of a rehabilitation program, was reported to be superior to standard rehabilitation alone in the treatment of hemiparetic shoulder pain syndrome.[179] The TrP-DN group demonstrated significant decreases in the severity and frequency of perceived pain, reduced use of analgesic medications, more normal sleep patterns, and increased compliance with the rehabilitation program.[179] TrP-DN of the extensor carpi radialis longus muscle reduced pain intensity, increased the pressure threshold in the ipsilateral trapezius muscle, and increased cervical spine range of motion in patients with active MTrPs in the upper trapezius.[180]

Three case studies of shoulder impingement in tennis and racquetball players who were treated with TrP-DN and stretching to the subscapularis muscle described successful treatment and return to painless function.[181] A more recent case study series described the treatment of four female international volleyball players who received TrP-DN to the infraspinatus (4), teres minor (4), and anterior deltoid (2) muscles, with improvement in verbal pain score and range of motion of the shoulder after treatment.[182] One session of TrP-DN to the supraspinatus evoked short-term segmental antinociceptive effects in the C5 segment when compared with a control group.[183] Latent MTrPs affected muscle activation patterns of the shoulder, as measured by EMG, when compared with control subjects, and TrP-DN and stretching restored the muscle activation to normal.[87] This finding has clinical implications because the aim of shoulder rehabilitation is often to improve and normalize glenohumeral and scapular function.

TrP-DN requires fundamental skills and training for safe and efficient practice. Clinicians should seek suitable training, should ensure that TrP-DN falls within their scope of practice, and should follow local laws and insurance policies.

Trigger Point Intramuscular Manual Therapy/Dry Needling: Infraspinatus (Fig. 19)

Rationale The infraspinatus is one of the most common muscles of the shoulder to harbor active MTrPs. The muscle is easily accessible and responds well to trigger point IMT.

Patient Position The patient is prone or side lying, with the arm positioned optimally to expose the MTrP for palpation.

Figure 19 Trigger point intramuscular manual therapy/dry needling: infraspinatus. (Courtesy of Myopain Seminars ©2010.)

Therapist Position The therapist can stand or sit behind the patient.

Procedure The medial and lateral borders of the scapula and the spine of the scapula are identified by palpation. Next, the infraspinatus muscle is palpated for MTrPs, and the palpating hand locates the taut band. Landmarks are checked again, and the needle is inserted into the MTrP and is moved in and out of the muscle with the aim of eliciting LTRs. During needling, the needle is drawn back to the fascia and is redirected into the muscle at a new angle. Depending on the patient's tolerance, needling is continued until LTRs are reduced or eradicated. The needle is removed and disposed of appropriately, and hemostasis is applied for 30 seconds or as needed. The muscle is then put through gentle stretching or range of motion after needling as appropriate. The main caution here is to protect the lung and prevent pneumothorax.

This procedure is carried out with universal precautions and sterile single-use disposable needles only. Dry needling should be performed only by a licensed health care practitioner who has been adequately trained and who is permitted by local laws to practice dry needling within the state or jurisdiction.

Trigger Point Intramuscular Manual Therapy/Dry Needling: Lateral Subscapularis (Position 1) (Fig. 20)

Rationale The subscapularis muscle is not readily accessible. The IMT technique can allow access to parts of this muscle that are not accessible manually.

Figure 20 Trigger point intramuscular manual therapy/dry needling: lateral subscapularis (position 1). (Courtesy of Myopain Seminars ©2010.)

Patient Position The patient is supine, with the arm abducted and laterally rotated with a degree of shoulder girdle protraction. The shoulder is positioned to place optimum resting tension on the muscle for MTrP palpation, and support may be given by the clinician's non-palpating hand and arm. This position may vary for each individual, and the clinician should seek to adapt this technique to suit the patient's presentation. Caution should be exercised with persons with unstable or hypermobile shoulders.

Therapist Position The therapist sits or stands in front of the treated side.

Procedure The palpating hand is placed flat against the lateral border of the scapula, with fingertips resting against the patient's ribs. The needle is inserted perpendicular to the scapula between the palpating fingers and parallel to the ribs. The needle is not directed toward the ribs. The needle is advanced slowly to elicit LTRs in the subscapularis muscle. Again, treatment is set to the tolerance of the patient, and hemostasis is applied after treatment. The muscle is put through gentle stretching or range of motion after needling as appropriate. The main caution here is to protect the lung and prevent pneumothorax.

Trigger Point Intramuscular Manual Therapy/Dry Needling: Medial Subscapularis, Lateral Aspect of the Rhomboids, and Medial Serratus Anterior (Position 2) (Fig. 21)

Rationale The subscapularis is not readily accessible. The IMT technique can allow access to parts of this muscle that are not accessible manually.

Patient Position The patient is in the prone position, with the hand behind the back in the hammerlock position, with the elbow supported. This position assists to wing the scapula and to raise the medial border to allow access to the subscapularis between the scapula and the thorax.

Figure 21 Trigger point intramuscular manual therapy/dry needling: medial subscapularis, lateral aspect of the rhomboids, and medial serratus anterior (position 2). (Courtesy of Myopain Seminars ©2010.)

Therapist Position The therapist is standing on the treated side.

Procedure The palpating hand raises the medial border of the scapula away from the thorax to accentuate the subscapular-thoracic space. The needle is inserted toward the subscapular fossa, parallel to the ribs. The needle is never directed toward the ribs or lung. From here, the medial subscapularis, the lateral aspect of the rhomboids, and the medial serratus anterior muscle can be accessed. Again, needling is carried out to elicit LTRs within the patient's tolerance. The muscles are put through gentle stretching or range of motion after needling as appropriate. The main caution here is to protect the lung and prevent pneumothorax.

The procedure is carried out with universal precautions and sterile single-use disposable needles only. Dry needling should be performed only by a licensed health care practitioner who has been adequately trained and who is permitted by local laws to practice dry needling within the state or jurisdiction.

Modality-Based Physical Therapies

Many different types of modality-based physical therapies have been recommended in the treatment of MTrPs. These include ultrasound, laser, transcutaneous electrical nerve stimulation (TENS), interferential current (IFC), and shock waves.[4,8,93,94,184]

Ultrasound

Evidence for therapeutic ultrasound in the management of MTrPs is conflicting.[8,93,94] A study exploring the immediate antinociceptive effect of ultrasound on MTrP sensitivity reported a significant but short-term increase in PPT after 5 minutes of 1 W/cm^2, 100% (1 MHz), with no change noted in the control group (5 minutes of 0.1W/cm^2, 100% 1 MHz),[185] a finding suggesting dose specificity. Another study showed that ultrasound to shoulder MTrPs had a short-term neurosegmental antinociceptive effect and, as such, may be beneficial to decrease pain sensitivity temporarily.[186] The clinical applicability is however, limited by the short-term effect. Both phonophoresis and ultrasound were equally effective over placebo in treating neck MTrPs, in reducing pain, and in improving neck disability index scores.[187] A high-power pain threshold (HPPT) static continuous ultrasound technique offered greater pain reduction in active MTrPs of the trapezius over conventional motion-based ultrasound (VAS changes, 8.32 to 3.32 versus 8.48 to 7.72, respectively), with significantly fewer treatment sessions in the HPPT ultrasound group.[188] Clinicians are advised to use caution with this technique, however, because a rapid rise in tissue temperature may cause a burn.

Since 2001, there has been an interest in low-intensity pulsed ultrasound (LIPUS), which comprises the static delivery of very low-dose pulsed ultrasound (e.g., in the range of 30 mW/cm^2 for up to 20 minutes) to soft tissue and bone structures. Initial research was generally encouraging.[189] LIPUS has been reported to influence healing positively in rat tendons during the granulation phase only,[190] mouse muscle laceration,[191] rat articular cartilage,[192] and human bone fractures.[193] Further research on the role of LIPUS in the treatment of MTrPs and soft tissue structures, such as the rotator cuff, is warranted.

Ultrasound therapy may be useful in the treatment of acute MTrP pain and soft tissue structures of the shoulder or as supportive treatment to manual invasive and noninvasive treatments. Further clinical research is needed to ascertain the role of ultrasound and LIPUS in musculoskeletal conditions.

Laser

Several studies reported a positive effect of low-intensity laser for MTrPs when compared with placebo laser treatment.[194-201] Several different types of laser were tested, including gallium arsenide, helium-neon, and infrared diode. Overall, laser therapy is effective for the short-term management of MTrPs,[8,93,94] and it has the advantages of being safe, well tolerated, accessible, and noninvasive.[201,202] Laser is a good choice as a direct treatment for MTrPs; however, clinicians should be able to palpate for MTrPs to ensure correct location of the laser beam.

Transcutaneous Electrical Nerve Stimulation and Interferential Current

TENS is the most commonly researched electrotherapy modality for MTrPs.[117,203-208] Most research has examined the immediate effects of TENS and has concluded that TENS has a short-term effect; one trial reported significant improvement in pain and PPT of MTrPs at 3-month follow-up.[204] High-frequency, high-intensity TENS with 100-Hz and 250-μs stimulation was the most valuable of four tested TENS combinations in attenuating MTrP pain, but it had no effect on MTrP PPT.[206] A multiprotocol study reported that TENS or IFC, in conjunction with other manual or physical treatments, was more effective in reducing MTrP pain.[117] Clinicians should consider TENS or IFC as supportive treatment to manual invasive and noninvasive treatments.

Shock Wave Therapy

A shock wave is a compression wave with a high peak pressure and a short life cycle that, in medicine, is usually generated by electrohydraulic, electromagnetic, or piezoelectric emitter machines.[209] Shock wave therapy (SWT) was originally employed in medicine for the treatment of calcific deposits such as renal stones.[209] Since then, shock waves have been used for various musculoskeletal conditions of tendon, plantar fascia, and bone. SWT has been used in the treatment of shoulder conditions including calcific tendinitis and tendinosis,[210,211] as well as supraspinatus tendon syndrome.[212,213]

More recently, interest has been shown in the use of shock waves for muscle. Research on SWT in the treatment of MTrPs is limited; however, one preliminary study demonstrated that active MTrPs could be identified by causing the familiar referred pain from muscles that are usually difficult to access by palpation.[214] Furthermore, focused extracorporeal SWT to MTrPs in athletes with acute or chronic shoulder pain improved isokinetic force production and overall performance and reduced pain.[215]

SWT may prove particularly beneficial in addressing the peripheral-central sensitization aspects of MTrPs, as proposed in the updated IH of MTrP formation. Animal research concluded that the application of extracorporeal SWT led to a significant decrease in the mean number of neurons immunoreactive for substance P within the dorsal root ganglion of L5 in rabbits exposed to high-energy shock waves to the ventral side of the distal femur, whereas no such change was seen in the contralateral untreated side.[216] Furthermore, selective loss of unmyelinated nerve fibers after extracorporeal shock waves was reported in a rabbit model, a finding that may, in part, explain the reduction in pain by partial denervation of sensory nerves.[217] Research on the role of SWT in MTrPs is warranted, but among the limitations of SWT are availability and cost, which need to be taken into account when comparing SWT with other modalities and treatments.

Radial Shock Wave Therapy: Rotator Cuff (Fig. 22) *Rationale* Radial SWT is used for the treatment of pain, stimulation of tendon, and osteotendinous junction healing or for the treatment of calcific tendinopathy of the shoulder.

Patient Position For the anterior lateral shoulder, the patient is in the long-sitting position on the treatment table, with the back supported, or is supine. For the posterior shoulder, the side-lying or prone position is preferred.

Therapist Position The therapist sits or stands on the treated side.

Procedure The area to be treated is identified, and it may include the subscapularis, supraspinatus, infraspinatus, and teres minor tendon insertion zones. This area may also include the long head of the biceps. The arm is placed in the optimum position to expose the area to be treated, which may include some degree of external rotation for the subscapularis or extension, adduction, and internal rotation for the supraspinatus. The radial shockwave head is placed on the area to be treated with ultrasound gel. Shock waves are delivered at the required dosage (e.g., 1.6-bar, 10-Hz, 2000 shock waves), as deemed appropriate. The shock wave head is moved to locate the most tender area, based on patient biofeedback. MTrPs can be treated in a similar fashion using radial shock wave.

Stretching and Strengthening

Therapeutic exercise programs are central to the practice of physical therapy and focus on the prevention and rehabilitation of movement dysfunction.[218] The focus here is

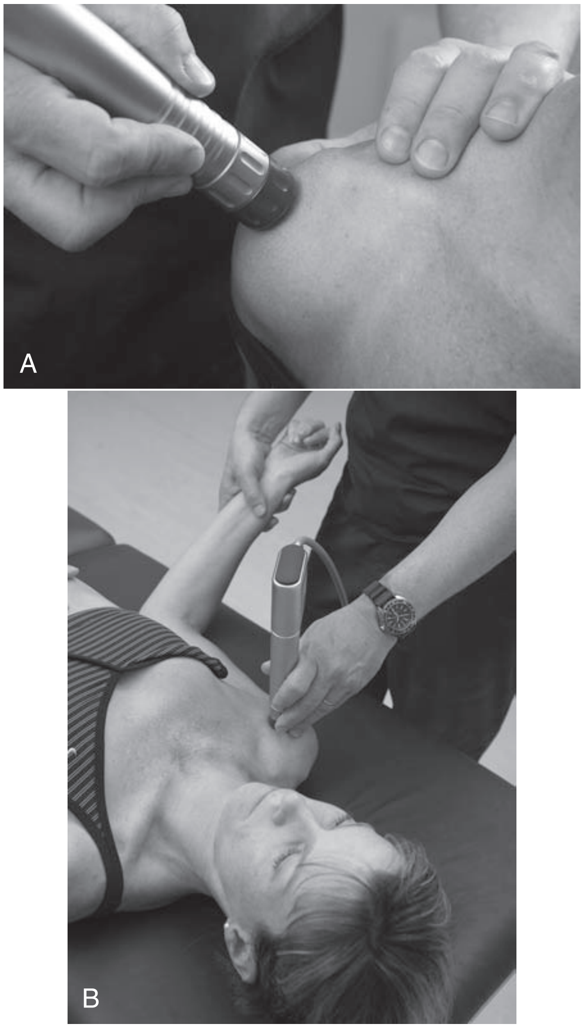

Figure 22 A and **B,** Radial shock wave therapy: rotator cuff. (Courtesy of Myopain Seminars ©2010.)

on stretching and strengthening as related to the treatment of myofascial pain. Patients with chronic pain may benefit from exercise-induced hypoalgesia, which may be mediated by opioid and nonopioid mechanisms.[219]

The IH proposes the taut band to result from contractured sarcomeres, and based on this premise, the main rationales of treatment include stretching and regaining length of the associated muscle.[4] Care should be taken to avoid overzealous, inappropriate, or aggressive stretching because stretching may possibly be a precipitating or perpetuating factor in MTrPs in some patients. Care should be taken with stretching alone because one study suggested that stretching may have an adverse effect on MTrP sensitivity.[220]

A muscle stretching program should be prescriptive and based on the individual needs and assessment of muscles for MTrPs, muscle length, and end feel. Myofascia may manifest with neuromuscular, viscoelastic, or connective tissue alterations.[221,222] Muscle length influences the length-tension relationship, and stretching therefore may have a negative impact on muscle strength and force production.[222,223] This concept should be considered when exercise programs and stretching regimens are designed.

Posture is considered an important influence on MTrPs, and Travell and Simons placed significant emphasis on it.[4] Alterations in shoulder girdle posture may include rounded shoulders, thoracic hyperkyphosis, and forward head posture.[224]

The *Janda upper crossed syndrome* describes a common clinical postural pattern: short muscles are the pectoralis major and minor, latissimus dorsi, levator scapulae, and upper trapezius; long muscles are the serratus anterior and the upper, middle, and lower trapezius.[221] Posture may influence the function of the shoulder and play a role in movement dysfunction, for example, by altering the subacromial space.[225,226]

Patients with episodic tension-type headache have greater forward head posture and numbers of MTrPs in the trapezius, sternocleidomastoid, and temporalis muscles when compared with healthy controls.[227] Similar trends have been shown in patient with unilateral migrane.[228] High visual stress induced during seated computer activity was shown to provoke MTrP sensitivity and changes in EMG.[229] A further study reported MTrP development after 1 hour of continuous typing.[230]

When indicated, static stretching should be carried out with gentle, non-painful action aiming to stretch the target muscles with good form. Recommended static stretching parameters are 15 to 30 seconds with three to five repetitions.[11,223,231] Clinicians should consider a preparatory technique such as TPCR, IMT, moist heat, or stretching as part of the S&S or I&S technique. Stretching can be augmented by methods such as postisometric relaxation, contraction and relaxation, active isolated stretching, or muscle energy technique.[4,102,103,108,221,232] Specific muscle stretches were presented by Travell and Simons.[4,23] Specifically for shoulder mechanics, maintaining internal and external range of shoulder motion appears to be of particular importance; the sleeper stretch for the posterior capsule and a subscapularis and anterior glenohumeral capsular stretch are presented elsewhere in this book.

Special caution should be noted with persons with hypermobility syndrome or a history of joint subluxations or dislocation, to avoid inappropriate stretching.[233] The estimated prevalence of hypermobility in the general population has been reported to be 4% to 7%, it is 9.5% in ballet dancers, and it is 11.7% in high school students; hypermobility is more common in girls and women than in boys and men.[233-236] In a cohort of patients with myofascial neck pain, 18.5% had benign joint hypermobility syndrome.[237] The Beighton score identifies persons with hypermobility and is commonly used in sports medicine, orthopedics, and rheumatology.[233,238]

Little research on strengthening in the treatment of MTrPs has been published. In considering the IH and MTrP research, it is reasonable that zealous strengthening may provoke active MTrPs or may turn latent MTrPs into active MTrPs. Muscles with active MTrPs are under metabolic stress, and further loading may lead to aggravation of the MTrP. Caution should be exercised in the early stage of rehabilitation of persons with MTrPs, and the degree of progression with strengthening should be titrated to suit the individual patient. The demands for a deconditioned, sedentary male smoker vary greatly from the needs of a professional athlete. The treatment strategy should address MTrPs to reduce pain, restore normal muscle length, and ensure proper biomechanical orientation of myofascial elements, followed by stretching and strengthening of the affected muscle.[239] The potential for improvement with strengthening, however, should not be overlooked because muscle weakness may be a predisposing, precipitating, or perpetuating factor in the reactivation of latent MTrPs. Improving fatigue resistance, strength, and stability should be the main aim of treatment. The ability of skeletal muscle to tolerate repeated activity partially depends on individual variation and on the magnitude and repetition of the force.[240] Research into the potential role of eccentric exercise in the treatment of MTrPs is lacking and is an area for future attention. Maintaining adequate strength in the scapular thoracic stabilizing muscles, such as the trapezius, the serratus anterior, and the rotator cuff muscles, is vital. Muscle balance ratios for the shoulder have been presented, including ratios between the internal and external rotators of 66% for both fast and slow isokinetic torque arm speed in normal subjects,[241] as well as for professional baseball pitchers.[242]

CLINICAL IMPLICATIONS FOR THE PHYSICAL THERAPY MANAGEMENT OF MYOFASCIAL TRIGGER POINTS

Considering the multisystemic nature of musculoskeletal pain, evidence supports the greater efficacy of multimodal therapies,[248] and this also applies to the management of MTrPs.[117] In clinical practice, it may be helpful to employ several types of treatment approaches, including manual therapy, TPCR and massage, I&S, stretching, hot packs, electrophysical agents, and dry needling techniques. These treatments are best carried out in a graded progressive manner within the tolerance of the patient. The clinician usually employs several forms of treatment and should keep the IH in mind when choosing treatments combined with the available evidence.

Treatments can be painful and noxious because of MTrP hyperalgesia or allodynia. Clinicians should remain aware of the potential for immediate pain or post-treatment soreness, which can be present for several days. Patients should be warned and educated about the potential for post-treatment soreness. It is important to titer the treatment to suit the individual patient and circumstances. The *peak-end rule*[249] recognizes patients' memories of painful medical treatments may affect their decisions about future treatments. Redelmeier and Kahneman[249] reported that patients' judgments of total pain were strongly correlated with the peak intensity of the pain and with the intensity of pain recorded during the last 3 minutes of the procedure. In a study of patients undergoing colonoscopy in which half of the patients randomly received a less painful end to the procedure, the results demonstrated improved perception and a willingness to undergo future colonoscopy in the patients who received the less painful conclusion.[250] This finding has implications for clinicians treating patients with myofascial pain and suggests that treatments should be designed to control the peak intensity of the pain and to make the final part of the treatment more pleasurable, for instance, by the application of a hot pack. For example, TPCR may be delivered in low pressure, below the patient's pain threshold for a prolonged period of perhaps 90 seconds, as opposed to high pressure for a shorter duration of maybe 30 seconds,[117] thus being cognizant of the peak-end rule.

Furthermore, clinicians should educate patients about myofascial pain because patients may not be as aware of MTrPs when compared with other pain diagnoses such as arthritis, tendinitis, or bursitis. A study examining patients' satisfaction with pain treatment showed that patients with MTrPs appeared to have less accurate beliefs regarding their pain symptoms and expressed more dissatisfaction with physicians' efforts to treat their pain when compared with patients with neurologic or rheumatologic disorders.[251] This finding has implications for the plan of care and treatment design and underpins the importance of patient education. Being able to provoke the patient's pain by skilled palpation is often very valuable in the patient's understanding of MTrPs, no more perhaps than the experience of a positive straight leg raise test.[13]

Additionally, it is important to pay attention to predisposing, precipitating, and perpetuating factors. Success of treatment often lies in the identification and modification of these factors within the framework of the biopsychosocial model. Boyling and Jull[248] proposed consideration of the biopsychosocial model, patient-centered outcomes, including physical impairment and functioning, assessing the responsiveness of treatment, and taking into consideration patient's values, experiences, and opinions of treatments. Evidence-informed practice requires the conversion of scientific evidence into clinical practice with the integration of best available evidence, clinical experience, reasoning, and judgment in a patient goal–oriented manner.[252] Management of patients with MTrPs requires these attributes and a series of skill sets in combination, to achieve a meaningful and often lasting impact on patient's pain and function.

A team approach may be required to develop a multifactorial plan of care, which may include physicians, physical therapists, anesthesiologists, psychologists, and clinical social workers, among others. When patients are not improving, they should be reassessed, and differential diagnoses should be reconsidered with a review by the primary physician or coordinating pain management specialist.

SUMMARY

Myofascial pain of the shoulder is prevalent and is commonly found in patients with shoulder pain and dysfunction. Interest in MTrPs has increased as research has expanded. Myofascial pain is currently best summarized by the updated IH.

Currently, no gold standard clinical test exists for MTrPs. Palpation reliability is supported for certain muscles in adequately skilled and trained clinicians, a finding that stresses the importance of training.

Many shoulder muscles provoke myofascial pain, most commonly the infraspinatus, supraspinatus, subscapularis, teres minor, trapezius, levator scapulae, pectoralis minor and major, latissimus dorsi, and deltoid muscles. Clinicians are encouraged to examine patients routinely for MTrPs as part of the regular shoulder assessment.

Myofascial pain may be subject to recurrence or chronicity as a result of perpetuating factors, including mechanical, physiologic, medical, and psychological issues. Attention to these factors is important in multimodal care. Many treatments have been described for MTrPs, and these include TPCR, massage techniques, S&S, and needling therapies. Multimodal therapy for myofascial pain is likely to yield improved results, especially when it is combined with education and correction of perpetuating factors.

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