Patients with myofascial pain syndrome (MPS) and trigger points (TP) present to every health care provider. Despite vigorous treatment, patients with progressive MPS often request a referral to a pain specialist. MPS is a common regional pain syndrome associated with chronic soft tissue dysfunction. Patients with MPS suffer from persistent pain and may end up with a decreased range of motion. Frozen shoulder may be caused by MPS and TP involving subscapularis muscle. TP are distinct, focal, hyperirritable spots, and usually can be palpated in a taut band of skeletal muscle. They may cause both local and referred pain. MPS and TP are common pain generators in patients with chronic headache, neck, shoulder, and back pain. Patients with MPS and TP over the gluteus minimus muscle may present with back and radicular leg pain mimicking lumbar disc disease. MPS and TP involving latissimus dorsi muscle should be part of the differential diagnosis of mid-thoracic backache. Skootsky et al. reported that as many as 85% of patients presenting with low back pain to a general internal medicine practice might have myofascial TP as their source of pain. MPS and TP over the upper body was found to be more common in comparison to other region.

PATHOPHYSIOLOGY OF MYOFASCIAL PAIN AND MYOFASCIAL TRIGGER POINTS

Travell and Simons proposed that the principal causes of TP are microtrauma and overload. The size of a single TP was estimated to be between 3 and 6 mm. Gunn originated the concept of neuropathic MPS. He proposed that the clinical presentation of MPS could be attributed to malfunction of the peripheral nervous system, muscle shorting, and autonomic changes. Patients suffer from myofascial pain as a consequence of an underlying neuropathy.

There are multiple electromyographic (EMG) studies on MPS and TP. The consensus is that the abnormal activity might be related to dysfunctional motor endplates and sympathetic modulation. Histological studies reveal contracted sarcomeres in knots that may correlate to the physical findings of myofascial TP. The excessive release of acetylcholine (from dysfunctional motor endplates) may contribute to the spontaneous electrical activity and the progression of many contraction knots associated with myofascial TP.

PHYSICAL EXAMINATION AND DIAGNOSIS

TP can be identified as a bundle or nodule of muscle fiber, which is harder than surrounding muscle. Compression of a trigger point will usually elicit pain directly over the affected area, or referred pain, a twitch response, and the "jump sign." As an example, pyriformis muscle syndrome and TP may have a clinical presentation similar to sciatica. Myofascial TP could be just one component of interconnected causes of muscle pain including muscle spasm, muscle tension, and muscle deficiency.

Myofascial TP should not be considered pathognomonic of MPS. It is prudent to evaluate patients with neck or back pain carefully to rule out underlying facet arthropathy in addition to TP and MPS. Local soft tissue tenderness by palpation could also be referred pain of visceral origin (viscerosomatic convergence). Patients with pancreatic cancer may present with more back pain than abdominal pain.

TREATMENT

Proper diagnosis will ensure effective treatment of TP and MPS. Some TP may respond to a comprehensive physical therapy program. TP injection and needling treatment may be the treatment of choice in chronic TP associated with fibrotic scar formation. TP injection is indicated whenever patients present with active TP causing twitch, "jump sign" and referred pain. The primary TP causing...
the muscle pain must be identified carefully and not confused with the referred pain. A physical therapy program for myofascial pain should address postural and ergonomic adjustments in addition to the proper exercise program. It takes a team effort to coordinate the timing of TP injection treatment followed by a comprehensive physical therapy program.\textsuperscript{5}

Myofascial Trigger Point Needling and Injection Treatment

A detailed description of trigger point injection and needling techniques are beyond the scope of this concise review article. It is a common clinical experience that the duration of pain relief from TP injection frequently outlasts the effect of local anesthetics. Despite frequent injections, the duration of pain relief is only temporary.

A review of needling therapies in the management of myofascial TP by Cummins and White, reported that needling of myofascial TP appears to be an effective treatment for MPS. The authors’ recommendation was to conduct controlled trials to investigate whether needling has an effect beyond placebo on MPS and TP.\textsuperscript{6} Lidocaine 0.25\% provided better efficacy and less injection pain than 1\% lidocaine. There was less injection pain with 0.2 to 0.25\% lidocaine and mepivacaine diluted with water than with saline, or 0.0625\% bupivacaine diluted with water. They recommended lidocaine or mepivacaine diluted to 0.2 to 0.25\% with water for myofascial TP injection. There was no difference in either effectiveness or duration of pain relief from TP injection using water or saline dilution.\textsuperscript{7} Krishnan et al. reported that the pain on intramuscular injection of bupivacaine is significantly more intense than with ropivacaine. The difference in the pain intensity might not be related to the difference in pH. Ropivacaine may be a better choice of long-acting local anesthetic for TP injection on MPS.\textsuperscript{8}

Botulinum Toxin Injection

Botulinum toxins (BTX) are potent neurotoxins produced by Clostridium botulinum that have historically been associated with the severe food-borne illness botulism. BTX blocks acetylcholine release at the neuromuscular junction. In 1989, the FDA approved BTX type A for use in treating strabismus, blepharospasm, and hemifacial spasm. In 2000, BTX type B and type A were approved by the Food and Drug Administration (FDA) in the treatment of cervical dystonia.\textsuperscript{9}

BTX were then studied for the treatment of MPS of the neck, shoulder girdle, and back. The treatment of tension headache, migraine, and cluster headache using BTX is being investigated.

In a double blind, placebo-controlled, cross-over study of 6 patients, BTX type A appears to be an effective treatment for focal MPS involving both cervical paraspinal muscle and shoulder girdle muscles.\textsuperscript{10} Porta studied a total of 40 patients comparing BTX type A and lidocaine/methylprednisolone treatment. These patients suffered from chronic myofascial pain of piriformis, iliopsoas, and scalenus anterior muscles. There was superior efficacy of BTX type A over conventional steroid treatment in these MPS patients who also received ongoing physiotherapy.\textsuperscript{11} Wheeler conducted a randomized, double blind study in 50 patients with chronic neck pain who underwent BTX type A and normal saline injections. Both treatment and control groups showed a significant decline in pain and disability across time. It was concluded that a single dose of BTX type A treatment alone without physical therapy was not effective for chronic neck pain because of MPS.\textsuperscript{12}

BTX is certainly not the first line treatment for TP and MPS. For the time being, BTX treatment for MPS is still an off-label application. There is definitely a rising interest to delineate the mechanism of pain relief. BTX should be considered only in refractory cases of MPS to break the pain, spasm cycle. It may offer a longer duration of pain relief and a window of opportunity to facilitate physical therapy and functional rehabilitation.

Acupuncture and Needling Treatment in MPS

There has been ongoing interest to delineate the mechanism of action of acupuncture as an alternative treatment for MPS and trigger point. Carlsson et al. published a double-blind placebo-controlled study using an independent observer. Chronic back pain patients were randomized to receive manual acupuncture, electroacupuncture, or active placebo (mock transcutaneous electrical nerve stimulation). At the 1-month independent assessment, 16 of the 34 patients in the acupuncture groups and 2 of 16 patients in the placebo group showed improvement ($P < 0.05$). At the 6-month follow-up assessment, 14 of 34 patients in the acupuncture groups, and 2 of 16 patients in the placebo group showed im-
provement \( (P < 0.05) \). There was a significant
decrease in pain scores measured at 1 and 3 months
in the acupuncture groups compared with the pla-
bo group. There was also significant improve-
ment in return to work, quality of sleep, and anal-
gesic intake in subjects treated with acupuncture.\(^{13}\)

Ceccherelli et al. conducted a prospective ran-
domized double-blind study of superficial and deep
acupuncture on 42 patients with lumbar myofascial
pain. At the end of the treatment there was no
evidence of significant statistical difference be-
tween the two treatment groups.\(^{14}\)

Dry needling techniques have also been studied
for myofascial TP treatment. Baldry recommended
the technique of deep dry needling to be consid-
ered in cases where there was severe muscle spasm
because of an underlying radiculopathy; otherwise
apply superficial dry needling or injection of saline
to the myofascial TP.\(^{15}\)

**Intramuscular Stimulation**

Gunn introduced the intramuscular stimulation
(IMS) technique for myofascial pain of radiculo-
pathic origin. Although IMS borrows its needle
techniques from traditional Chinese acupuncture,
Gunn rationalized the treatment on both an ana-
tomical and neurophysiologic basis.

**Physical and Noninvasive Therapy**\(^{16}\)

1. Electrical Stimulation and Transcutane-
ous Electrical Nerve Stimulation: TENS
may be applied as either a conventional
program or an acupuncture-like stimula-
tion.
2. Physical modalities: ice packs, hot packs,
or deep heat such as ultrasound or inter-
ferential stimulation may be offered.
These modalities provide short-term pain
relief and facilitate exercise or other pain
management programs.
3. Progressive passive and active stretching
exercise: isometric contraction with re-
ciprocal inhibition stretching is recom-
manded.
4. Stretch and spray technique: ethyl chlor-
ide is used to relieve musculoskeletal
pain and joint sprains. This spraying tech-
nique has been applied to inactivate my-
ofascial TP. The theory is that the spray
facilitates the stretching by decreasing the
pain and provoking spinal inhibition and
descending inhibition of TP. Fluori-Meth-
ane is nonflammable, nonexplosive, and
nontoxic as compared to ethyl chloride.
The Fluori-Methane bottle should be held
18 inches away from the patient while
applying the spray at an angle of 30 de-
gress.\(^{17}\)
5. Manual therapy: massage, joint manipu-
lation, spinal manipulation, and other
manual therapy techniques (manipula-
tion-induced analgesia).

**Psychotherapy, Relaxation, Biofeedback, and
Hypnosis**

These modalities may also be considered as part
of the comprehensive pain management plan.
These approaches are indicated especially for pa-
tients with chronic, refractory and recurrent MPS.

**FIBROMYALGIA**

**Introduction**

Patients with fibromyalgia or fibromyalgia syn-
drome (FMS) always present with a chief com-
plaint of chronic extensive musculoskeletal pain.
Patients with FMS often describe constant aching
and stiffness aggravated by any physical activity or
stress. FMS is quite different from the symptoms
and signs of more localized pain and TP in MPS.
There may be multiple associated disorders or co-
morbidities, e.g., fatigue, sleep disturbance, and
irritable bowel syndrome. Although there may be
involvement of psychological factors, FMS should
not be perceived as somatoform pain disorder.

**Prevalence**

Fibromyalgia is a common diagnosis among the
patients visiting the rheumatology service. The
prevalence of fibromyalgia is estimated to be 2-3% in
the general population. The female to male ratio
could be as high as 3-6:1.

**Peripheral and Central Pain Mechanisms in
Fibromyalgia**

Peripheral mechanism: although there has been
no specific muscle pathology associated with FMS,
any peripheral pain generator causing muscle pain
may perpetuate further central pain mechanisms
and result in the extensive pain.
Central mechanism: there is good evidence that central sensitization may be relevant to the chronic pain complaint in FMS patients. The “wind-up” phenomenon, as described at the molecular level via activation of N-methyl-D-aspartate (NMDA) receptors, may contribute to both initiation and maintenance of central sensitization in fibromyalgia. The release of excitatory amino acids such as glutamate and their interaction with receptors are enhanced by neuropeptides such as substance P and nerve growth factor (NGF). This may be relevant to the abnormal sensory processing in FMS. The CSF levels of both substance P and NGF are found to be elevated in patients with FMS.

Physical Examination and Diagnosis

It is always a challenge to evaluate any patient suffering from a chronic widespread pain condition; they are often labeled as having fibromyalgia. The American College of Rheumatology (ACR) diagnostic criteria on fibromyalgia, established in 1990, requires there be chronic widespread pain of over 3 months duration and physical examination must reveal pain induced by 4 kg of palpation pressure at no less than 11 of 18 anatomically defined tender points. These points are: (1, 2) Occiput: suboccipital muscle insertions. (3, 4) Low cervical: anterior aspects of the C5-7 inter-transverse spaces. (5, 6) Trapezius: midpoint of upper borders. (7, 8) Supraspinatus: origins, above the scapular spine, near medial border. (9, 10) 2nd rib: upper lateral surface of second costochondral junction. (11, 12) Lateral epicondyles: 2 cm distal to the epicondyle. (13, 14) Gluteal: upper outer buttock, anterior fold of muscle. (15, 16) Greater trochanters: posterior to trochanteric prominence. (17, 18) Knees: medial fat pad, just proximal to medial condyle. The sensitivity and specificity of the ACR criteria are over 80%. In case a patient presents with diffuse body pain but does not meet the ACR criteria for fibromyalgia, TP should be treated as for myofascial pain.

Laboratory Testing and Imaging

There are no sensitive and specific laboratory tests for establishing the diagnosis of FMS. The CSF level of substance P, an important nociceptive neurotransmitter was demonstrated to increase three-fold in FM patients and nerve growth factor (NGF) was elevated four-fold. There is no imaging study that can contribute to the differential diagnosis in FMS.

TREATMENT

It is highly recommended that a multidisciplinary team of health care professionals is involved to achieve the best outcomes for FMS patients.

Tender Point Injection and Nerve Block

Tender point injection was documented to be beneficial in the treatment of FMS. In an open study of 41 patients with FMS, a mixture of 0.05 mL 1% lidocaine and 0.25 mL of triamcinolone diacetate was injected into tender points. The average duration of pain relief per injection site was reported to be as long as 13 weeks.

The application of sympathetic blockade in primary fibromyalgia was studied by Bengtsson et al. Twenty-eight patients participated, 20 received placebo, randomly assigned to a saline injection superficial to the stellate ganglion or to IM bupivacaine. Eight patients received a stellate ganglion block with bupivacaine and an intravenous regional sympathetic block with guanethidine 14 days later. Both trigger and tender points were counted, and rest pain in the arm, shoulder, and neck were evaluated at intervals of up to 4 hours after the injection. The guanethidine blockade was evaluated 24 hours after the injection by counting trigger and tender points and by assessment of rest pain in the hand and forearm. Compared to the placebo group, the stellate ganglion blockade markedly reduced the number of tender points and produced a marked decrease in rest pain. The guanethidine blockade reduced the number of trigger and tender points, but had no effect on the baseline level of rest pain. The sympathetic system might play a role in the clinical presentation of fibromyalgia.

Diagnostic epidural opioid blockade in primary fibromyalgia at rest and during exercise was also studied by Bengtsson et al. The 9 patients were studied before, during, and immediately after 4 identical periods of exercise, each performed 30 minutes after injection with saline, or an opioid that was followed by IV naloxone. At the end of the study, epidural lidocaine was injected. Both resting pain and tender points diminished significantly after the epidural opioid injection. Epidural injection of lidocaine also completely abolished
resting pain and tender points. The results supported the hypothesis that fibromyalgia pain may be of either peripheral nociceptive or spinal origin rather than originating in the brain. 24

Sphenopalatine blocks have been used to treat chronic pain. The efficacy of 4% topical lidocaine for sphenopalatine block was tested on 61 patients (42 with fibromyalgia and 19 with MPS). Patients were randomized to receive either 4% lidocaine or sterile water (placebo) 6 times over 3-week period. The authors concluded that 4% lidocaine for sphenopalatine block had no advantage over placebo in any outcome measurement when used for the treatment of chronic muscle pain, either because of MPS or FMS. 25

Systemic Pharmacologic Treatment

A randomized controlled clinical trial was conducted in 31 patients with FMS, before and after intravenous administration of morphine (9 patients), lidocaine (11 patients), and ketamine (11 patients). The patients were classified as placebo-responders, responders (decreased in pain intensity by >50%) and nonresponders. The morphine test did not show any significant changes. The lidocaine test showed a pain intensity decrease during and after the infusion. The ketamine test showed a significant reduction in pain intensity during and after the test period. Tender points also decreased significantly, while muscle strength remained unchanged. The authors concluded that NMDA receptors were involved in pain mechanism in FMS. Central sensitization might be present in FMS and secondary hyperalgesia could explain the presence of tender points. 26

In a double-blind crossover study of three analgesic drugs, 18 FMS patients received intravenous administration of morphine (0.3 mg/kg), lidocaine (5 mg/kg), ketamine (0.3 mg/kg), or saline. Two patients were placebo responders, responding to all 4 infusions. Three patients did not respond to any of the infusions. Seven out of 13 responders had a reduction of pain for 1-5 days. The authors concluded that there were different pain processing mechanisms in FMS patients who had been diagnosed based on the ACR criteria. It was recommended that a pharmacological analysis be conducted before instituting any further therapeutic interventions or clinical research on pain because of fibromyalgia. 27 Although various opioids have been prescribed to treat fibromyalgia patients, there has been no well-controlled clinical study to document the risk and benefit ratio of long term opioid treatment. Tramadol (Ultram) is a centrally acting analgesic with dual mechanisms of weak opioid receptor agonist, and norepinephrine and serotonin reuptake inhibitor. It has been shown to be more effective than placebo.

The application of low dose tricyclic antidepressants (TCA) in FMS patients has been widely studied. The beneficial effect of amitriptyline (Elavil) has been shown to reduce the level of pain and reduce sleep disturbances. Serotonin reuptake inhibitors, e.g., fluoxetine (Prozac) alone seem to be of little value in FMS. There is evidence that fluoxetine in addition to a TCA may reduce the pain level in FMS. Sertraline (Zoloft) might increase the pain threshold in FMS patients. If patients can tolerate the anticholinergic side effects such as dry mouth, constipation, blurred vision, daytime drowsiness, and weight gain associated with tricyclic antidepressants, amitriptyline may be considered in FMS patients. 28

Nonsteroidal anti-inflammatory drugs (NSAIDs) were not significantly better than placebos in clinical trials on FMS. The combination of NSAIDs and a tricyclic antidepressant may provide synergistic benefit for FMS patients. Prednisone was found to be ineffective compared to placebo treatment in FMS. The hypocortisolism associated with FMS may be of central origin. There may be no significant inflammatory contribution to the clinical presentation in FMS patients. 29

Although muscle pain and spasm are common among fibromyalgia patients, there has not been any significant improvement attributed to muscle relaxants such as carisoprodol.

Alpha-2 adrenergic agonists such as tizanidine have been recommended to provide pain relief, decrease spasm, and help sleep disturbances in FMS patients. Alternative medicine or nutritional supplements such as melatonin have also been recommended to help with sleep disturbances or other comorbidities associated with fibromyalgia.

Nonpharmacological Intervention

Acupuncture, Electroacupuncture, and Electrostimulation

Complementary alternative medicine has been advocated for the treatment of FMS. Deluze et al. have reported the efficacy of electroacupuncture in a double-blind, controlled trial. The 70 patients
were randomized to either electroacupuncture or a sham procedure. There were significant improvements in pain intensity, pain threshold, sleep quality, and physical global assessment with reduction of the number of analgesic tablets used, and regional pain score in the electroacupuncture group as compared to the sham acupuncture group.30°

Sprott et al. also conducted an open study of 29 fibromyalgia patients who were treated with acupuncture over 6 weeks. It was reported that there were decreased pain scores, decreased number of tender points, and an increase of serum serotonin and substance P levels. Acupuncture treatment was recommended for FMS patients based on the outcome of this study.31

Berman et al. extensively reviewed the three randomized controlled trials and 4 cohort studies. They concluded that acupuncture treatment might provide some short-term improvement in the treatment of FMS.32

When compared to MPS patients receiving TP injection, Hong reported that patients with FMS are likely to experience significant, but delayed and attenuated pain relief following similar injection treatments. A higher incidence of post-injection soreness observed in FMS as compared to MPS treatments was noted.33

**Exercise Program**

The options may include cardiovascular fitness, low-intensity endurance, aerobic exercise, pool exercise, and education.

**Physical Therapy Modalities**

Mobilization, massage, stretching, strengthening, heat, ultrasound, electrical stimulation, and ice treatment.

**Manual Medicine and Chiropractic Treatment**

Hains et al. conducted a study of chiropractic treatment with combined ischemic compression and spinal manipulation in patients with FMS. The authors recommended adding chiropractic treatment for FMS patients.34

**EMG**

Biofeedback, hypnotherapy, and cognitive behavioral therapy may be incorporated into the non-pharmacological approach. Ferraccioli et al. published an EMG versus sham biofeedback study. All outcome measures (VAS pain, tender point count, and morning stiffness) in the EMG-biofeedback group had significant improvement whereas only the tender points score improved in the sham biofeedback group.35

**Multidisciplinary Program**

There are multiple clinical trials on interdisciplinary group program in FMS. The successful outcomes were attributed to the teamwork and more efficient interaction with various healthcare providers.36

**CONCLUSION**

Chronic muscle pain such as myofascial pain and fibromyalgia continues to be a challenge for every healthcare provider. The impact of these intractable pain syndromes should not be perceived as “benign” pain in contrast to cancer pain. Patients with MPS or FM often are told that their pain problems are “all in your head.” Ongoing studies have delineated the critical role of the central nervous system in pain modulation. SPECT and FMR imaging techniques have verified the change in brain blood flow and metabolism because of the experience of pain. Molecular pharmacology has shown progress in targeting neurotransmitters and specific receptors. As a pain management physician, I feel optimistic that novel treatments may benefit patients who have been fighting with MPS and FMS.

**REFERENCES**

8. Krishnan SK, Benzon HT, Siddigui T, et al: Pain on intramuscular injection of bupivacaine, ropivacaine, with and