Pharmacological & Non-Pharmacological Treatments Available for Myofascial Pain Syndrome – A Scoping Review

Mohit Gulati[1*], Dr Navita Gupta[2], Dr Gowrishankar Potturi[3], Dr. Sadbhawna Dadia[4]

[1*]Research Scholar, Chitkara School of Health Sciences, Chitkara University, Punjab
[2]Associate Professor, Department of Allied Health Sciences, Chitkara School of Health Sciences, Chitkara University, Rajpura, Punjab
[3]Lecturer and HOD, Department of physiotherapy, UPUMS, Saifai, UP
[4]Principal, College of physiotherapy, Dayanand Medical College & Hospital, Ludhiana, Punjab.

Abstract:
Myofascial Pain Syndrome (MPS) is a major source of musculoskeletal pain which is often diagnosed by pain specialists and general practitioners. This review article aims to provide a comprehensive overview of current treatment options for Myofascial Trigger Points (MTrPs) which has been proven a key factor of MPS, which affects people of all ages and genders. This study explored various treatment modalities, including manual therapies, pharmacological interventions, physical therapy techniques, and complementary approaches.
Pharmacological interventions are evaluated such as injections on trigger points with local anaesthetics or botulinum toxin in managing pain associated with trigger points is assessed in terms of both immediate and long-term outcomes. Oral and injections of Glucocorticoid have also been assessed for their efficacy in treating trigger points at various muscles. Other anti-inflammatory drugs have also been used to treat MTrPs. The review emphasizes the importance of considering potential side effects and patient-specific factors in choosing pharmacological treatments.
Physical therapy techniques encompass a broad spectrum of treatments, like stretching, manual therapy, electrotherapy, exercises and postural correction. Exploring the evidence supporting these approaches and their role in preventing MTrP recurrence. The therapeutic treatments also include Dry needling, myofascial release with Heating or Cooling modalities.
The manual therapies section discusses the effectiveness of trigger point release techniques such as dry needling, manual trigger point compression, Deep Friction massages and instrument-assisted soft tissue mobilization. It highlights the role of skilled practitioners in locating and treating MTrPs to alleviate pain and restore function.
Electrotherapy encompasses various modalities such as Ultrasound, TENS, IFT, Shockwave, and Iontophoresis, each Utilising distinct mechanisms of action. These therapeutic modalities have been evaluated both as standalone treatments and in combination with other modalities, manual therapy, and exercise interventions.
Other complimentary interventions include acupuncture, vacuum therapy and prolotherapy are also assessed for their potential benefits in MTrP management.
Through a thorough examination of the current literature, This review aims to provide clinicians and researchers with an extensive approach to understand various MTrP treatment options, their mechanisms of action and their respective levels of empirical support. By examining the multifaceted nature of MTrPs and exploring diverse treatment approaches, this review aims to enhance clinicians' decision-making for individuals suffering from MPS, aligning these decisions more closely with research evidence.

Keywords: Myofascial Pain Syndrome; Myofascial Trigger Point; Treatment; Musculoskeletal pain; Physiotherapy treatment; Medical Management

INTRODUCTION

Musculoskeletal pain syndrome (MPS) is one of the commonest problem faced by any individual all around the world. Sometimes this is not taken seriously as it does not affect everyday activities. However, this pain can lead to serious problems later and can be called as chronic musculoskeletal pain.
MPS is one of the major prevalent health issue around the world. Sometimes they may be associated with various physiological to psychological conditions like anxiety, stress or depression. MPS demands visiting healthcare professionals regularly for reducing its effects which hampers its daily activities. There are various treatments available from pharmacological, non-pharmacological, manual, psychological, yoga, etc. to get relieved from its symptoms.
Treatment of MPS is not only time consuming but in fact it also demands capital to get treated. This economic burden can also sometimes be a cause of person with MPS not taking treatment on time or cannot get treated at all. According to data by Dieleman et al., they revealed that people in USA spent third highest amount after cancer and heart disorders for the treatment of MPS like lower back and neck pain[1]. They also revealed that the frequency of the need of the treatment of MPS is increased second fastest after Diabetes from 1996 to

2013. As per the results from the researcher there is a need to find an efficient treatment which should be cost effective and also awareness campaign are needed to find symptoms of MPS and get it treated early.
While reading about MPS, a research has been found by, Travell and Rinzler in 1952, has played an important role in establishing the link between MPS with myofascial trigger points (MTrPs). Because of this research work orthopaedic and pain clinics have started diagnosing and treating the MTrPs[2]. Various sets of trigger points with pattern of referred pain from different muscle groups throughout the body had been mapped by Simons and Travel. According to the current literature it can also be depicted that MPS has been one of the leading problems diagnosed in pain clinics[3,4].
MTrPs can provide symptoms that can be the combination of both neurocutaneous and neuropathic elements. The symptoms of MTrPs may vary every individual like quality or pattern of pain depending upon individuals' perception and pain threshold. As discussed MTrPs can compress or irritate peripheral nerve endings which will induce referred pain patterns. MPS is often associated with MTrPs[5].
These MTrPs create regions of pain that are often described as dull, aching, boring, and burning pain. Active (ATrP) and Latent (LTrPs) are the two types of MTrPs depending upon its clinical manifestations provided while assessment and palpation.
A wide range of treatment modalities are present for the treatment of MPS. It can be treated from easily available anti-inflammatory drugs (over the counter) and some may need more sophisticated interventions like surgical procedures[6]. The primary objective of the treatment options is to alleviate the pain symptoms and treat the underlying issues associated with the problem. These treatment would also help in improving quality of life for the individuals suffering from MPS.
Most of the pain clinics or general practitioners are prescribing opioids to manage chronic musculoskeletal pain. However, prolong use of opioids has a potential for abuse, overdose, addiction, other systemic side effects and may also cause overdose deaths[6]. Due to this concern, there has been a growing emphasis on exploring alternative pain management strategies that are efficient and safe in the long term for MPS treatment.

METHODS

This study is based on review with an extensive literature search of peer-reviewed articles, clinical trials, systematic reviews, metanalysis and RCTs. The databases used for the search included Google Scholar, PubMed and ResearchGate from 2015 to 2023. Keywords employed in the search included the combination of "Myofascial Pain Syndrome," or "MPS" "Myofascial trigger points" or "Trigger Points" "MTrP" with "Treatment" or "Medical Management".

PREVALENCE

As described earlier MPS is most commonly termed as chronic but can be seen as an acute condition as well. MPS is highly prevalent within the general population, with lifetime rates reaching up to 85%, although the prevalence can vary between males and females[7]. It's important to note that reported prevalence rates can vary substantially among different patient populations. Pain clinics may receive patient more than 90% whereas general physician may report this around 21%. These findings have been seen mostly among women.
MPS is a prominent contributor to prolong history of mechanical and regional pain, such as Lumbago, tension-type headaches, facial pain and shoulder joint dysfunction[8]. Its widespread occurrence highlights the need for effective diagnostic and treatment strategies to alleviate the burden of this condition on individuals and the healthcare system.

ETIOLOGY

The exact cause of MTrP related to MPS is not fully understood. However, these trigger points can be developed due to various expected reasons which are as follows.
1. Muscle Overuse: Trigger points can develop because of muscle overuse. Overtraining can induce repetitive stress could be the most common cause of overuse injury. Wear and tear of the muscle is a physiological response but when the proper recovery of the muscles reduces due to excessive stress or improper rest to muscles which may cause oxygen deficit thus causes an overuse injury. Examples of overuse injury can include any daily activities like driving, sewing, writing, frequent lifting, improper use of equipment, prolong sitting or standing or even running. Improper preparation of muscles for properly performing these daily activities which may cause muscle deconditioning due bad posture, improper use of equipment, poor ergonomics, and muscle fatigue can all play a role in the formation of MTrP and thus MPS[9,10]. Furthermore, any other psychological kind of stress or even sleep deprivation add severity to these symptoms[11].
2. Anatomical & Physiological factor: Various anatomical abnormalities may be one of the key factor in the formation of MTrPs. These conditions could be inborn or adaptive structural defect like scoliosis, or due to ageing process osteoarthritis, cervical spondylosis or some other systemic disorders like rheumatoid arthritis or cancer. Any anatomical abnormality can place additional stress on muscles and fascia which may enhance the formation of trigger points[9,12].

3. Systemic Factors: Various systematic factors can also have an impact on developing MPS. Conditions like hypothyroidism, Vitamin deficiencies like vitamin B & D, and iron deficiency, etc. can contribute to the development of MPS. These nutrient deficit or hormone irregularity can affect muscle health and function which may further exaggerate pain experience[13].
There are many other factors along with these mentioned above can lead to development of MTrPs, hence the healthcare providers treating MPS must consider these factors rather just treating the symptoms.

PATHOPHYSIOLOGY

The pathophysiology of both MPS and fibromyalgia is multifaceted and has given rise to various hypotheses, encompassing factors such as pain beliefs, traumatic events, and musculature[14]. Bio-psychosocial conditions like body structure, gender, emotional, cognitive, contextual or society, etc., can influence the pain perception of individual related to MPS[15].
Debates have arisen regarding the development and progression of musculoskeletal pain from acute to subacute stages is a complex process, which can be influenced by various pain mechanisms. It is difficult to predict the transitioning period of MPS from acute to chronic pain. Although, a substantial portion of population with MPS is thought to involve central sensitization, which represents altered central pain modulation[16]. Due to this altered central pain there is a dysregulation of the central nervous system (CNS) happens which causes non-neuropathic and non-nociceptive pain. This dysregulation results in neuronal hyperexcitability which overstimulates the somatosensory system to either painful or non-painful stimuli or both. Because of this impairment within the CNS lead to decreased inhibition of nociceptive and enhanced facilitatory pathways, ultimately increasing nociceptive transmission[17].
The study by S L Thorp et al., has shown correlations between functional connectivity through MRI of the brain and pain symptoms among low back ache, complex regional pain syndrome , fibromyalgia and diabetic neuropathy[18]. Additionally, this research also has highlighted the influence of social differences like culture, race and their behaviour to manage pain replated to disease or chronic pain symptoms[19].
According to a research in women it has been found that disorders associated with chronic whiplash injury can significantly change the brain structure due to chronic pain symptoms. The result of the study implied decrease in regional Gray matter volume related to cognitive and pain processing[20]. Vitamin D deficiency has also been identified among individuals suffering from chronic MPS[21]. The researchers also noticed that conservative treatment of chronic MPS could affect positive structural and functional changes in prefrontal regions of brain. These conservative treatment includes Cognitive Behavioural Therapy (CBT) and various type of Exercise Therapies[22].
In the case of MPS, it is postulated to excess amount of production of acetylcholine (ACh) at motor endplate nerve terminals, leading to constriction of muscle fibres which results in ischemic changes at the site of muscle fibre causing taut bands of muscle fibres and pain[23]. This complex interplay of various factors underscores the intricate nature of the pathogenesis of musculoskeletal pain.
MTrPs are the taut band present within muscles or fascia or both produces painful symptoms when palpated[24]. Local Twitch response (LTR) can be triggered by pressure or insertion of needle over an MTrP, this sudden release of twitch mimics the pain sesation[10].
Numerous mechanical and electrophysiological studies have been done to theorize the mechanism of pain related to MTrPs[24]. The researchers explained that every MTrP contains consists of both an active (motor) and a sensory hub. While using Botulinum for the treatment of MTrP, the researchers suggested that the MTrPs are present at the motor end plate as per the recording of spread of electrical signals in muscles and pain relief[23]. Prolong stimulation of MTrP at the primary muscle site irritates the nociceptive receptors, which may produce pain either locally or referred and both[23].
Spontaneous electrical activity (SEA) initiating from various trigger points have been noted in few studies, in response to this few researchers also pointed out that SEA is only analysed at an active MTrP but not over non-MTrP sites[25]. Furthermore, electromyography (EMG) can be used as an active tool to diagnose the MTrP through LTRs after passing electric current through surface or needle electrode . These findings showcase the experience of pain and complex neurophysiological process in individuals with MPS[26].

DIAGNOSIS

Diagnosing MPS typically involves a thorough evaluation, including a detailed history of past trauma or daily activities with physical and medical examinations. There is an available mapping for the palpation of MTrPs thoroughly even though diagnostic criteria still lacks clarity. Location of MTrPs elicits symptoms when palpated may cause characteristic pattern of referred pain associated is the main contributor of diagnosing MPS. The LTRs through pricking and palpation which reproduces pain symptoms are clinically evident for MPS through MTrPs[27].
MTrPs are categorized as primary or secondary. Primary MTrPs are located in the muscles directly affected and may be felt as a knot under the muscle. Whereas the secondary MTrPs can be found either in synergistic

or antagonist or both of the primary MTrP muscles fibres[24]. Similarly, it can be scientifically classified as an active and latent MTrP. The active one provides pain symptoms without palpation whereas a latent MTrP produces pain symptoms only with an external physical pressure applied on it. The ATrPs have a set of defined referral pattern which is not at all associated with LTrPs. The taut bands are predominantly present in postural muscles of the body like Gastrocnemius, neck and shoulder girdle muscles like trapezius, rhomboids, infraspinatus[28]. The main symptoms of these taut bands are reduced function due to muscle weakness thus impacting extremity movement range.

As there could be multiple cause could be associated with MPS and development of MTrP a thorough history with other diagnostic procedures must be included. Physiological, radiological, and pathological tests must be given preference as per the history of the illness may lead to eliminate alternative sources of pain[29].

A group of researchers employed MRE to assess the physical properties of MTrPs demonstrated a strong correlation between band stiffness parameters and predictions made through gel replica experiments. Unlike the subjective assessment by a practitioner's touch, MRE offers a quantitative and consistent method for characterizing MTrPs[30].

Similarly, another group of researchers concluded that chronic pain could lead to reduced inhibition of central nervous system (CNS) neurons, rendering them hyperexcitable[31]. They intensifies the relation between pain in MPS and brain activity inside cortex with the help of transcranial magnetic stimulation (TMS).

These diagnostic and assessment methods contribute to our understanding of MPS and help guide effective management and treatment strategies for individuals experiencing this condition.

MANAGEMENTS OF MYOFASCIAL TRIGGER POINTS & MPS

1. PHARMACOLOGICAL TREATMENT

There are many different types of medications from various families have been tried to manage the MPS. Some of the medications which are most commonly used are discussed below with its effects as per available literatures.

I.Anti-inflammatory Drugs : Nonsteroidal anti-inflammatory drugs (NSAIDs)

NSAIDs are the non-inflammatory drug, which is also used as most common analgesics, available as over the counter drugs. However, NSAIDs are not mostly prescribed for chronic pain disorders and prolong use as it has severe side effects to gastro-intestinal tract like indigestion, bleeding, ulcers and kidney like peripheral oedema and renal failure[31].

This drug works by inhibiting the cyclooxygenase (COX) enzyme, which, in turn, inhibits prostaglandin synthesis. This inhibition helps reduce the sensitization and excitation of peripheral nociceptors, ultimately leading to pain relief[32].

Utilisation of oral NSAIDs for the management of MPS has a limited supporting evidence. In contrast, topically administered NSAIDs have shown effectiveness in managing MPS. An RCT by Hsieh et al. explained that administration of topical diclofenac sodium patch was better than menthol patch in alleviating pain symptoms with improvement in neck mobility in patients with MTrPs on the upper trapezius[33].

These findings also suggests that topically applied NSAIDs may be a valuable treatment option than oral which targets the localised area of MTrPs. This method also reduces the side effects of oral medication while receiving pain relief.

II.Tri-cyclic Antidepressants (TCA)

TCA an anti-depressive drug have also been used for various pain syndromes. Amitriptyline is commonest TCA used for management of MPS with dose ranging from 20 to 100 mg daily[6].

Blocking the reuptake of serotonin and norepinephrine within the descending spinal pain pathways is the primary mechanism of action for TCAs which provides analgesia. TCA also impacts sodium channels and histamine receptors which contributes to their analgesic effects[6,32]. Cyclobenzaprine is another drug which also exhibits property of muscle relaxants[34].

Numerous studies have investigated the effectiveness of TCAs in managing myofascial pain associated with MTrPs. Haviv et al. showcased significant use of TCA in patients experiencing chronic facial pain and tenderness of regional muscles[35]. Chronic pain due to temporomandibular disorders (TMDs) or tension-type headaches have been successfully managed with drug amitriptyline[36].

Thus, TCA have been proved useful for both depression and MPS, making them valuable therapeutic options for individuals experiencing myofascial pain syndrome and related disorders.

III.Muscle Relaxants (MR)

Various medications like tizanidine, baclofen, benzodiazepines (Clonazepam) & anticholinergics (Orphenadrine) have been used to find out their effectiveness in managing myofascial pain associated with MTrPs.

The benzodiazepines like clonazepam boosts up the GABA-A receptors by binding inhibitory neurotransmitter at GABA receptors, leading to inhibition at both presynaptic and at postsynaptic receptors on spinal cord neurons[37].
Muscle relaxants primarily work by reducing skeletal muscle tone and helps in relieving muscle spasm which is often observed in MPS. However, there are various side effects associated with MRs like drowsiness, dizziness, low blood pressure, unwanted smooth muscle relaxation, and ataxia, etc[37,38].
According to the current available literature, limited source is available which favours the use of muscle relaxants for managing MTrPs directly. Furthermore, benzodiazepines are generally contraindicated due to their potential for misuse, anticholinergic effects and addiction[39].
On the other hand, Tizanidine which is an alpha-2 adrenergic agonist drug, has been advised for managing MPS by few researchers. This drug is also associated with side effects like decrease in blood pressure, heart rate and vision abnormalities[37].
From all these above data, it can be sorted out that only few muscle relaxants are reliable for management of MTrP and hence MPS. Although the prescription of MRs should be given with precautions for various side effects associated with it.

IV.Local Anaesthetics (LA)

The Local Anaesthetics (LAs) primarily functions by blocking the nonspecific sodium channel blocker which helps in disrupting the stability of neuronal cell membranes thus limits nerve impulses. Lidocaine is one of the most common LA which has been used in various forms like injections or patches for management of MPS[39].
Lidocaine injections have been used in several studies to check its efficacy for the treatment of MTrPs. A group of researchers, Xie et al., conducted an observational study on 120 subjects suffering from chronic neck pain associated with MTrPs. They found that lidocaine injection were noticed effectively in reducing neck pain and improve neck function after 6 months of treatment[40].
Lidocaine can also be applied topically through patches in 5% concentration instead of use it as an invasive intervention[39]. Researchers found that Lidocaine patches are less discomforting than Injections while their efficacy of relieving pain is same[41]. A group of researchers examined the efficacy of lidocaine patches in chronic neck pain associated with Myofascial Trigger points as an alternative to Lidocaine injections. They discovered that 5% lidocaine patches were found effective in pain relief[42]. Another team of a researchers compared the efficacy of topical Nimesulide gel against Lidocaine in injection form, in subjects of Migraine with MTrPs at neck region. The study revealed similar level of effectiveness between both treatment groups. However, they have also mentioned that Nimesulide gel showed less discomfort[43]. These researches helps in implication of the use of topical application of treatment by lidocaine patch and Nimesulide gel for MTrPs and MPS, as an alternative to lidocaine injections.
Despite the extensive literature on the effectiveness of interventional techniques in pain management, their usage has been declining and has faced criticism due to possible side effects and various non-invasive treatments are available. Significant discussions continue regarding their medical importance, appropriateness, and uses.

V.Botulinum Toxin

It is commonly known as Botox, the primary function of this medicine is to check on the ACh release at the neuromuscular junction. This action helps inhibit muscle hyperactivity and spasms. Additionally, Botox prevents the release of nociceptive neurotransmitters at sensory neurons, contributing to its potential analgesic effects[36].
However, the use of Botox can be linked with various adverse effects, including such as hypersensitive reaction at injection site, allergic reaction to Botox, muscle weakness of adjacent structures; facial palsy symptoms like drooping of eyelids, watery eyes; headache or flu like symptoms; respiratory and other smooth muscle involvement causing urinary retention and autonomic dysreflexia, etc[44,45].
In summary, Botox may offer promising treatment option for certain conditions, but its use should be carefully considered, weighing the potential benefits against the risks and side effects associated with this pharmacological treatment. Treatment selection should consider individual patient factors and the specific condition being addressed.

VI.Trigger point injections (TPI)

TPIs are another commonly used treatments for managing resistant myofascial pain syndrome. These injections have been employed for years to address MPS with MTrPs. They can be used with Image guiding technologies also like fluoroscopy and ultrasound[46]. This method can be used to administer local anaesthetics, botulinum toxin, or corticosteroids directly over the Trigger Point[46].
Physical assessment plays a key role in finding and performing Trigger point injection sites however, there is a growing interest in using ultrasound-guided techniques for locating MTrPs[46]. Kumbhare et al. delved into the finding the sonoanatomy of trigger points through ultrasound examinations, they also observed MTrPs physical

changes during pain stimulation at MTrP through Ultrasound. The researchers concluded that it is better to analyse the MTrP from imaging as the blind technique through palpation is poor method for locating the MTrP and administering drug into the MTrPs.

It is essential to note that myofascial trigger point injections, although minimally invasive, may carry potential risks. Adverse effects can include nerve damage, necrotic changes into muscle and other soft tissues, fibrous contractures, pneumothorax, and systemic or regional reactions[46,47]. Utilising ultrasound guidance for these injections significantly resulted in reducing complication rates, number of sessions and improving outcomes.

2. MINIMALLY INVASIVE NON-PHARMACOLOGIC TREATMENT OPTIONS

I.Dry Needling (DN)

Dry needling is a minimally invasive therapeutic technique for MTrPs and MPS. This therapeutic process uses involving the insertion of a thin monofilament needles into MTrPs[11]. These needles are available in various sizes depending upon the muscle girth, location of MTrP in the muscle and patients body type. In contrast to TPI these needles does not have use pharmacological drug to be inserted at the site. In fact, this technique targets the MTrP directly which causes LTR, once achieved LTR it is removed. There are various theory behind its mechanism of action, which is a subject of debate, somehow, most of the researchers believe that it works on pain gate control theory[11,48].

A team of researchers, Liu et al., reviewed 11 randomised controlled trials, comparing dry needling and other physiotherapeutic modalities for low back pain with presence of MTrPs. Dry needling was found better while reducing pain and improving disability in LBA with MTrPs than other alternative treatments[49].

Similar results have been seen other researches like Luis Espejo-Antunez et. al., described in the review that included 15 RCTs. The study findings indicated that dry needling effectively improved quality of life, range of motion (ROM), and helps in reducing pain. However, the researchers also specified that these RCTs did not include any data on medication intake and sleep quality which can be important while treating MPS[50].

However, not all reviews have been uniformly positive like M J N-Santana et al. were more skeptical in their review, the researchers found DN was effective in reducing pain but also citing inconsistencies in results lidocaine and corticosteroid injections over DN[51].

DN has been compared with various pharmacological treatments like Analgesics, Botox, LAs and physiotherapeutic techniques like manual therapy, TENS, etc. These comparisons help healthcare providers and patients choose the most appropriate treatment approach for MPS, considering individual factors and treatment preferences.

II.Acupuncture (AcP)

Acupuncture (AcP) is an ancient technique from China, which in modern days are still in utilisation for managing MPS. Both DN & AcP utilise thin needles that are inserted into precise locations on the body and may be gently manipulated or twirled. These needles can be kept inserted in some specific points on the body for a short duration. In contrast to DN, AcP which is a traditional Chinese medicine practice, believes that it helps in balancing the body's energy, whereas modern medicine experts suggests that mechanism of action and principle of treatment is pain gate control theory[52]. AcP uses always specific patterns or meridians for the treatment whereas in DN which is scientific approach in finding MTrP for insertion of needle[53].

Wang et al. examined 10 research work for their review to assess the effect of manual acupuncture for MTrPs. The review concluded that acupuncture resulted in significant improvements in pain reduction. However, they have also emphasized that the pain reduction achieved only when acupuncture targeted at MTrPs. Traditional acupuncture points did not show the same level of analgesic effects[54].

This suggests that when Utilising acupuncture as a treatment for MPS, it may be more effective when the focus is on specific trigger points rather than traditional acupuncture points. These findings provide valuable insights for healthcare providers and patients considering acupuncture as part of their pain management strategy.

3. MANUAL THERAPIES

Various manual therapy techniques have been tried and tested for the management of MTrPs. These Manual techniques have been shown effective in improving restricted ROM and pain symptoms in subjects with MTrPs. These interventions includes Joint manipulation (osteopathic, chiropractic, etc.); Various soft Tissue Releases like MFR, DTFM; Proprioceptive Neuromuscular Facilitation (PNF); Pressure Release or Ischemic Compression Therapy (ICT), Positional Release Technique (PRT), Muscle Energy Technique (MET) and Stretching.

The mechanisms behind these manual therapies which targets MTrPs are not yet fully described by researchers, but common potential hypotheses have been proposed. For instance, massage and compression, provides such mechanical effect that may lead to regional stretching of a myofascial trigger point. This helps in sarcomere normalisation, hence, improve muscle function. This normalisation of sarcomeres might also

enhance blood supply location causing increased temperature and providing nociceptive and anti-inflammatory effect across the MTrP which helps in facilitating the recovery[55].
Strain–counterstrain technique helps in reducing afferent input by reestablishing the muscle length and its stretch mechanism of damaged tissue. This restoration helps in regulating the length of contractile units of muscle spindle and the muscle tone around MTrPs[55]. The effectiveness of MET in enhancing the ROM may be attributed to the induce relaxation after contraction of muscle isometrically through the inhibition of afferent activity mediated by Golgi tendon organs. Additionally, this is believed that because of this mechanoreceptor stimulation, pain reduction is achieved by pain gate control mechanism at the spinal cord, contributing to the process of descending pain modulation.

I.Myofascial Release (MFR)

It is a most common manual technique uses by everyone for any injury, which is generally termed as massage. This could be scientifically employed to alleviate pain symptom related to MPS. MFR can be execute either directly or indirectly:

- Direct MFR: This approach includes the application of steady, slow pressure directly onto the affected area of a muscle tissue. This aims to apply appropriate force steadily to stretch the muscle and the surrounding fascia. This techniques helps in breaking the painful adhesions across the muscle and fascia, ultimately improving muscle stiffness[56].
- Indirect MFR: In this technique, practitioners use their hands to gently stretch the for a longer period. They apply minimal force towards the adhesions of fascia directly, stretching the affected muscle tissue and fascia helps in reducing the symptoms by itself. Purpose of both MFR techniques is to reduce pain through breaking internal adhesions around muscle[56].

The potency of MFR has been examined in various studies. Kalichman and Ben David, conducted a review of eight RCTs involving a total of 457 participants. They reported that MFR was significant in alleviating symptoms like pain and ROM associated with MTrPs. However, they also emphasised on short-term follow-up of 2 months, which was only shown in 3 studies as clinically significant in improving symptoms[57].
Another Systematic review published by K Laimi et. al., in 2018 described that present studies does not have a significant evidence on myofascial release therapy in chronic MPS. They included 513 published articles out of which only 8 were found relevant, however out of these most of the articles were found high risk of bias[58].
Many studies which have been conducted on various location of MTrPs in comparison various other Non-pharmacological modalities as well. Some studies are found effective while some are found ineffective in reducing pain symptoms and improving function for MPS patients[59]. The evidence regarding its long-term effectiveness is very limited. Hence, It is important for healthcare workers to consider this therapeutic approach as part of a comprehensive pain management plan, alongside other treatment options.

II.Osteopathic Manipulation Therapy (OMT)

Osteopathic manipulative treatment (OMT) encompasses a diverse set of manual therapy techniques aimed at optimizing function and alleviating pain. Osteopaths commonly address individuals experiencing musculoskeletal pain, with a primary focus on conditions such as back and neck pain. While manual therapy is central to osteopathic management for majority of patients, osteopaths can guide patients in improving posture, work ergonomics and physical activities. This holistic approach is coupled with reassurance and encouragement to foster an active lifestyle[60].
In a recent review of article published by Cesar E Jara Silva et al. suggests OMT offers substantial enhancements for individuals suffering from headaches. These improvements encompass a reduction in the frequency, severity and duration of tension-type headaches and migraines. The application of soft tissue techniques, such as cranial therapies, Myofascial Release and suboccipital inhibition, can not only aids in controlling intensity and frequency migraine or other headache's but also contributes to a decrease in use of medications[61].
Researcher Gary Fryer elucidated the biopsychosocial mechanism of OMT for chronic MPS. He outlined OMT's short-term impact on biological and psychosocial parameters, noting a scarcity of data regarding its long-term effects due to a lack of available literature[60].
In conclusion, Osteopathic Manipulative Treatment (OMT) is an effective approach for musculoskeletal pain, showcasing versatility and positive outcomes, especially in headaches and chronic Myofascial Pain Syndrome. However, the lack of long-term data calls for further research. OMT's manual techniques and holistic care prove beneficial, emphasizing the need for ongoing exploration into its mechanisms and extended effects.

4. ELECTROTHERAPEUTIC MODALITIES

Significant research has been conducted over an extended period on the treatment of myofascial pain, employing diverse electrotherapeutic methods. Commonly Utilised modalities include TENS, IFT, electrical

muscle stimulator (EMS/FEMS), therapeutic ultrasound, LASER and extracorporeal shock wave therapy (ESWT), in addition to various thermotherapy approaches. Despite the widespread use of these modalities in research, there persists a gap in comprehending the most effective strategies for treating various MTrPs among these therapeutic machines.

I.Transcutaneous Electrical Nerve Stimulation

TENS is among the oldest forms of electrotherapeutic device which helps in passing the therapeutic current through electrodes applied to the skin which stimulates the neurogenic tissues of painful areas. TENS is a modality which using alternating current with low to high frequency at different intensity for electrical stimulation. Typical combination is high frequency is paired with low intensity and vice versa. While there are no specific recommendation is provided which specifies the most effective combination of these variables, intensity is generally be considered as the most crucial element. The treatment can be given for prolong duration with strong contraction but it should not produce any painful sensation for beneficial effects[62].

The physiological changes bring by TENS is to be believed as multifaceted, however normalising the ACh concentration at motor end plate through muscle contractions is thought to be the main mechanism of action. This normalization also contributes to the relaxation of taut bands of muscle[62].

The effectiveness of electrical stimulation for MPS still remains uncertain. Research papers conducting the use of TENS at different frequencies suggests that mid to high frequency current 20 to 80 Hz frequency currents are better than 10 and 100 Hz frequency in alleviating the pain. Notably, TENS treatments surging from 15 Hz to 30 Hz also demonstrated alleviating pain symptoms than low and high frequency currents among participants with LBA. Thus, these variety of findings depicts distinct pathophysiological effects associated with different combinations and types of TENS intensities[63].

In another randomised controlled trial (RCT) focusing on neck pain and comparing various types of TENS, it was observed that low-frequency, high-intensity burst transcutaneous electrical nerve stimulation Combined Therapy (burst-TENS-CT) positively impacted in enhancing PPT and ROM values compared to medium-frequency, low-intensity amplitude modulated frequency Combined Therapy (AMF-CT)[62].

Although the research on the effectiveness of TENS in the context of MPS and MTrPs is not extensive and the available data suggests that TENS may have modestly favourable effects. As a non-pharmacological approach for alleviating pain symptoms, this modality can be considered as part of an integrated part of management of MTrPs and MPS.

II.Interferential Current Therapy

Interferential Current (IFT) therapy is another non-pharmacological electrotherapeutic treatment modality which involves the effect of low frequency alternating current by using two medium frequency currents, each at different frequency. This therapy is believed to enhance the blood supply at the affected area thus helps in reducing pain. IFT generates an amplitude modulated frequency (AMF), which allows deeper permeation into the muscle tissue, which is a major difference in IFT and TENS[64,65,66].

While IFT has been shown to be effective, it has been demonstrated to be similar in efficacy to TENS[64]. But some studies shown that TENS is better than IFT while treating the Trapezius MTrP for neck pain in improving ROM and decreasing pain intensity[65]. Limited research suggests that IFT may be efficient for the management of MPS, however, further researches are required to establish its overall effectiveness in managing this condition. It is worth considering IFC as an option for pain management in the context of MPS, pending additional research and clinical evidence.

III.Therapeutic Ultrasound (UST)

Utilising both thermal and non-thermal effects, Ultrasound therapy (UST) proves beneficial for cellular remodelling, enhancing the elasticity of collagen fibres, alleviating pain and muscle stiffness and influencing ion permeability through stable cavitation phenomenon. Several factors, such as tissue absorption properties, duration of application, dosage and application can significantly impact the effectiveness of these therapeutic activities. Given the association between chronic pain and depression, the researchers hypothesized that relief from pain may contribute to a reduction in depressive symptoms[67].

UST can be given through various size of probes in two frequencies, 1 & 3 MHz, both of the applicators are depending upon whether the condition is acute or chronic, similarly application can also be continuous or pulsed in various ratios[67]. Researchers demonstrated that continuous UST demonstrates greater efficacy in pain reduction while resting in individuals with MPS compared to pulsed ultrasound therapy[68].

Researchers in a systematic review depicted that current evidence indicates a potential significant impact of UST on pain in patients with MPS although its effect on ROM remains inconclusive due to a high risk of bias[69]. Researchers mostly preferred the UST & TENS as a combination of treatment for MPS, while comparing them individually the therapeutic ultrasound exhibits notable alleviating the pain intensity and improve ROM than TENS[70].

IV.LASER

LASER is an acronym for "light amplification by stimulated emission of radiation". This device produces light through optical amplification via stimulating the emission of electromagnetic radiation. Laser classification is categorized into four main classes, signifying the potential danger of the laser radiation to the human eye[71]. Laser can be mainly divided into two types depending upon its intensity, i.e., High Intensity (HILT) and Low Level (LLLT), Laser Therapies[72].

HILT effectively stimulates and penetrates deeper and wider within the target tissues (muscle and fascia). Importantly, a HILT allows for the transfer of substantially more energy to the tissue when compared to LLLT. The production of chemicals and thermal effect through light of LASER have the potential to simulate collagen production in muscles and tendons, enhances blood supply, increase vascular permeability and exerts an anti-inflammatory effect[71]. Whereas Photo biomodulation (PBM) is a form of LLLT characterized by its photochemical rather than thermal effects. The light initiates biochemical changes within cells, akin to the process of photosynthesis in plants. In this analogy, cellular photoreceptors absorb photons, initiating chemical changes that contribute to the therapeutic effects of PBM[71].

Gang-Zhu Xu et al in a systematic review on TMDs have suggested that LLLT has a significant impact in improving ROM of TMJ and decreasing pain intensity[73]. Another recent study by Umit Dumdar et al., in a RCT evaluated the effectiveness of HILT in female patients with chronic MPS of the trapezius muscle. The researchers depicted that HILT helped in improvement of pain and neck disability[74].

Numerous published articles explore the impact of HILT and LLLT in the treatment of MPS or various muscles and joints. However, there is a shortage of evidence comparing the efficacy of these two methods directly. Researchers are encouraged to assess the efficacy of both types of lasers to determine the optimal option for treating Myofascial Trigger Points (MTrPs).

V.Extracorporeal Shockwave Therapy (ESWT)

ESWT was predominantly employed for bone-related issues, calcific structures, myotendinous and insertion of muscle and tendons with bones. Over the time, ESWT has been employed for the therapy of Myofascial Pain Syndrome (MPS). Numerous researches on ESWT have been published which shows the effectiveness in treating MPS in terms of pain and function, even in the absence of a clear understanding of its pathophysiology[75,76].

The fundamental principle of ESWT is generating mechanical energy through high air pressure. The penetration of this energy deeply into the tissues where it shows its primary therapeutic effect. Concurrently, the additional effects encompass biophysiological response in tissue regeneration and repairing through micro-functional and micro-structural changes[77]. This process aims to induce a pathological reversal in conditions affecting human muscles, bones, internal organs, and other tissues, ultimately achieving therapeutic objectives. ESWT has demonstrated efficacy in delivering effective pain relief for various musculoskeletal conditions, including fracture non-union, calcific tenosynovitis, and plantar fasciitis[75].

Tao Wu et al. in a review study have suggested about ESWT offers the advantage of avoiding the side effects associated with invasive procedures, thereby enhancing patient comfortability. When compared to methods such as dry needling and TPI, etc., ESWT appears to be more beneficial in alleviating nociceptive symptoms in subjects with MPS[77].

Another team of researchers, Qing Zhang et al., depicted in their metanalysis that ESWT seems to provide pain relief in subjects with MTrPs at trapezius muscle. While ESWT may not be considered as an optimal standalone therapeutic approach, it could potentially complement conventional therapies as an adjunct method[78]. Another study by Jun-Il Yoo et al, through their research depicted that ESWT can be a reliable source of management for cervical ache for reducing pain. However, they also implied on that due to extremely low-level evidence due to limited sample size and poor quality of research as well as high risk of bias were involved in most of the researches which they included in their study.

Although the research on the efficacy of ESWT for MPS management is not extensive, but the available data suggests that ESWT may have modestly favourable effects. It offers a great option as a non-pharmacological agent to reduce pain effectively and can be considered as a comprehensive part of treatment plan for MPS.

VI.Iontophoresis

Iontophoresis, also known as Electro Motive Drug Administration (EMDA), is an electrophysiological technique that delivers drugs in ionic form through an electric current. This is a non-invasive pharmacological treatment method that facilitates drug delivery by enhancing transdermal permeation and enabling direct delivery to the target tissue. The principle underlying Iontophoresis is electro-osmosis, where an active ion is electromigrated through this process directly under the skin. Both direct and alternating current types are Utilised in Iontophoresis[79,80].

This method finds application in various medical fields, including cosmetic, ophthalmology, orthopaedics/musculoskeletal, dentistry, etc[81]. Iontophoresis serves diverse therapeutic purposes, including its use as an analgesic and anti-inflammatory agent with opioids and NSAIDs, local anaesthetics, antibacterial, antifungal, antiviral drugs, anticancer drugs, as well as the delivery of fluorides and vitamins[82].
The Musculoskeletal pain syndrome has been treated with various drugs like Dexamethasone, Botulinum Toxin, Lidocaine and Magnesium Sulphate ($MgSO_4$) through iontophoresis[83]. NA Ibrahim et al., have published an RCT in 2021 and concluded that Magnesium Sulphate Iontophoresis was proven to be significant in pain reduction, enhancing neck ROM and its function while treating the trigger points on Trapezius muscle[84].
Kristopher A Brickman et al have published an article that compared Iontophoresis with Lidocaine and Dexamethasone and oral NSAIDs. Iontophoresis can be considered as an effective therapeutic alternative for the management of acute soft tissue injuries in the emergency department. It demonstrated beneficial in reducing the pain and also contributed to a reduced requirement for oral NSAIDs, thereby reducing the potential complications associated with these medications[85].
Another RCT by Tajuddin Chitapure et al., in 2017, assessed the effect of Iontophoresis with 4% Lidocaine against Muscle Energy Technique (MET) for Trapezius Trigger Points. They have found that Iontophoresis with Lidocaine was found effective in reducing pain and improving neck functions with MPS of Trapezius[86].
From numerous researches it has been found that Iontophoresis is found effective in MPS with various drugs like Diclofenac sodium, Lidocaine, Magnesium Sulphate and Dexamethasone, etc. It also helps in reducing oral intake of NSAIDs to reach the target tissue, which could have a several systemic side effects.

5. ADDITIONAL STRATEGIES

There are various alternative therapies are being explored in the healthcare sectors which deals with the challenges related to MTrPs. These modalities does not have strong beneficial evidence as per available literature for MTrPs. However, associated problems with the MTrP can be effectively managed from various techniques like meditation, relaxation techniques[87], taping or bracing, cognitive behavioural/functional therapy[88], biofeedback[89] and tai chi[90], etc. Additionally, some individuals explore the potential benefits of dietary modifications[91], cannabis[92], and probiotics as productive therapies.

CONCLUSIONS

The exploration of contemporary treatments for MTrPs and MPS has revealed a diverse array of therapeutic modalities. It ranges from pharmacological interventions to manual therapies, electrotherapeutic methods, and alternative therapies. These methods are also diverse in terms of application, some need pricking, electric current, or just manual skills to showcase its effective management.
The multifaceted approaches encompass pharmacological interventions from anti-inflammatory to anti-depressant from oral to topical to injectable route to electrical method to transfer medicines in form of ions (iontophoresis). Similarly non-pharmacological interventions include Manual Therapy like OMT, massage and electrotherapeutic methods like Laser Therapy, IFT, TENS and Extracorporeal Shock Wave Therapy, as well as non-pharmacological invasive like dry needling and non-invasive options like biofeedback and dietary modifications.
The therapeutic management skills exhibited by healthcare providers are instrumental in minimising the demand and use of oral medicinal drugs, consequently mitigating their associated side effects. This aspect underscores the importance of personalized and comprehensive care that goes beyond symptomatic relief, aligning with the broader goal of enhancing patients' overall well-being.
In summary, contemporary treatments for MPS and MTrPs offer a range of options, each with its unique advantages. As research continues to evolve, a comprehensive understanding of the most effective and tailored approaches will contribute to enhancing the standard of healthcare and outcomes for subjects suffering from MPS and MTrPs.

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