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Research Article

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Efficacy of dry needling versus traditional manual therapy in the treatment of myofascial pain syndrome in the neck and upper back

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Abstract

Introduction

To treat myofascial pain syndrome in the neck and upper back, it is important to compare the effectiveness of dry needling with that of standard manual therapy, with an emphasis on pain management, functional improvement, and patient satisfaction.

Methods

One hundred patients, aged 18 to 65 years, who were diagnosed with myofascial pain syndrome (MPS) in the neck and upper back and had been in pain for three months or more, were included in this randomised controlled experiment. Individuals who are contraindicated for any therapy, have recent trauma, or have systemic disorders will not be accepted. Random assignments will be made to place participants in one of two groups: the intervention group, which will receive dry needling treatment, or the control group, which will receive standard manual therapy. Each group will consist of fifty patients. The course of therapy will last eight weeks, with two sessions each week. The Neck Impairment Index (NDI), which assesses functional impairment, the visual analogue scale (VAS) for pain severity, and the Patient Satisfaction Questionnaire will be used as assessment instruments. The change in pain intensity as determined by the VAS will be the main outcome measure; improvements in functional impairment as determined by the NDI and patient satisfaction levels will be the secondary outcomes.

Results

The VAS score of the manual treatment group decreased by 35%, whereas that of the dry needling group decreased by 50%. NDI scores increased by 25% in the manual treatment group and 40% in the dry needling group. Compared with 70% of patients in the manual treatment group, 85% of patients in the dry needling group expressed excellent satisfaction.

Conclusion

According to previous studies, dry needling is superior to conventional manual therapy for treating myofascial pain syndrome in the neck and upper back because it reduces pain and enhances functional results. To validate these results, other studies with larger sample sizes and longer follow-up times are advised.

Keywords- Myofascial *pain syndrome (MPS), Dry needling, Traditional manual therapy, Neck pain, Upper back pain, Pain management, Functional outcomes, Patient satisfaction*

INTRODUCTION

CONCEPT OF MYOFASCIAL PAIN SYNDROME (MFPs)

Myofascial pain syndrome (MFPS) is characterised by sensory, motor, and autonomic symptoms caused by trigger points (TrPs). These TrPs are hyperirritable areas in skeletal muscle or fascia associated with a hypersensitive nodule in a taut band. Compression of TrPs can cause pain, referred pain, tenderness, motor dysfunction, and autonomic issues. TrPs are thought to develop after muscle use, particularly due to factors such as submaximal sustained contractions, maximal contractions, and eccentric overload, leading to local ischemia, acidic pH, and inflammatory mediators. However, some medical professionals view the MFPS as controversial and difficult to diagnose or treat. [1-5, 6-8]

Recent research over the last decade has suggested that the formation of taut bands (TBs) and trigger points (TrPs) is linked to altered motor endplate activity or neuromuscular junction dysfunction. According to Travell's "Energy Crisis" theory, local hypoxia at the neuromuscular junction leads to TrPs, causing muscle stiffness and discomfort. [9]

AETIOLOGY FOR TRIGGER POINT DEVELOPMENT

The development of trigger points (TrPs) may be influenced by genetic predispositions, which explains how factors such as stress, repetitive strain injuries, poor posture, and treatments such as massage or injections can exacerbate or alleviate pain. However, the origin of TrPs remains unclear, with conflicting evidence from pathology. Most TrPs share clinical features related to pain patterns and treatment success, often arising in taut muscle bands, which can be latent and symptomless. Common triggers include trauma-induced muscle injury or repetitive strain from prolonged contractions, particularly in type I muscle fibres associated with posture. Stress can activate these bands, leading to muscle soreness from locally produced noxious chemicals, potentially resulting in sensitisation, chronic pain, and other pain-related phenomena. [10-14]

THE PATHOPHYSIOLOGY OF BACK PAIN

Pathophysiology

To effectively treat chronic low back pain (cLBP), which is characterised by its dual impact on the mind and the body, a multidisciplinary approach that is founded on the biopsychosocial paradigm is necessary. Although psychosocial factors are significant, prospective studies have shown that they contribute to only one to three percent of the future occurrence of chronic low back pain for the first time. It does not seem that psychosocial factors are the cause of chronic low back pain (cLBP); rather, it appears that they are the elements that intensify the sense of pain. [15] Despite this, there is still a substantial amount of evidence in the scientific literature that validates the role that physiological and biomechanical factors play in the development of chronic low back pain. For this reason, it is essential to first define these components before beginning investigating the factors that produce pain in patients with chronic low back pain (cLBP). In conclusion, the most common cause of low-level chronic low back pain (cLBP) is microtrauma or spinal injury, which contributes to the gradual deterioration of the spine, joints, and other structures associated with the spine.

These wounds have the potential to induce serious spinal injuries or, more usually, a subfailure injury, which is marked by spinal trauma that falls just short of generating a major injury. Both of these types of injuries are

possible. To be more specific, they can be caused by one of three different factors: (1) tension on muscles or ligaments; (2) degeneration of the intervertebral disc; or (3) degenerative joints. These structural changes have the potential to cause a variety of pain problems, including discogenic pain, facet joint pain, sacroiliac joint pain, myofascial pain, and spinal stenosis. An overview of the etiology of chronic low back pain is provided in Figure 1.

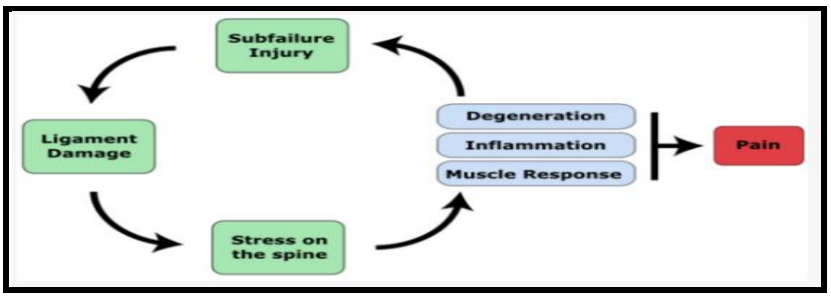


Figure 1. An illustration of cLBP pathogenesis. There is either major trauma or a build-up of microtrauma that harms soft tissue in the ligaments. Ligament damage modifies the spine's stability, increasing the possibility of bad posture or spinal misalignments, which place the spine under unnatural pressures and forces. When the spine is under stress, the discs and joints start to deteriorate. This is followed by disc inflammation, and the muscles need to compensate. Nerves growing into the disc, deteriorated facet joints that excite nerves, and disc herniation or bulging that irritates nerves can all result in pain. These adjustments, when combined with compensatory postures, can exacerbate spine stress and microtrauma, which prolongs discomfort.

The Idea of Ligaments

Abnormal forces that work on the body as a whole and, more specifically, on the facet joints, ligaments, and intervertebral discs are the primary causes of back pain. Soft tissue ligamentous structures are the primary structural feature that maintains alignment and contributes to the passive stabilisation of the spine. There are several examples of these, some of which include intervertebral discs, joint capsules, and ligaments. Damage to these structures puts a person at risk for chronic low back pain (cLBP). [16]

Neurones that innervate the ligament itself can cause pain if they are disrupted by mechanical or chemical stimulation. The vertebrae, disc, and facet joints may experience high and constant axial loads due to a misaligned spine. Because of this misalignment, long-term aberrant stress on ligaments causes degenerative and inflammatory reactions that cause discomfort. [17]

Neural receptors and spinal muscles

Uneven pressures on the muscles of the spine can hasten the degeneration of the discs and facet joints, cause strains on the ligaments, overload the facet joints, and cause inflammation of the neural tissues. Therefore, the cumulative effect of deformed spinal muscles is an increase in the amount of stress placed on the spine. [18]

Inflammatory response and degenerative discs

A lower disc height, DE structuration of the disc structure, increased matrix degeneration, and loss of hydration in the nucleus pulposus proteoglycans are all characteristics of the disease known as intervertebral disc degeneration, which is an irreversible process. Bending strains, which can be induced by ligament damage and misalignment, can possibly result in disc prolapse as well as a series of cell-mediated degenerative modifications. By providing additional pressure to the annulus and endplates of the disc, bending mechanical

stress can result in an outwards bulge or herniation of the disc. Nociceptive neural impulses can cause pain if the herniation or bulging mechanically compresses or distends the nerve root, dorsal root ganglion, or smaller nerves surrounding the disc. [19] This can occur when the nerve root is compressed or distended. In addition to causing calcification of the end plates, internal disc disruption, and cell-mediated loss of water content and disc height, increased mechanical strain is connected to a decrease in the amount of aggrecan and collagen present within the disc. When nerves and blood vessels grow inside the disc as a result of structural and material changes in the disc, painful nerve impulses are created. These nerves and blood vessels are responsible for pain.

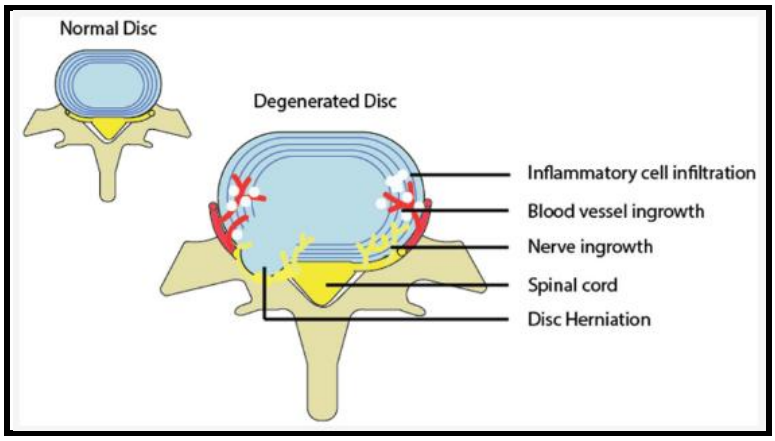


Figure 2. An illustration showing a deteriorated disc that is both normal and exhibits inflammation along with the proliferation of nerves and blood vessels within the disc.

In addition, prolonged transmission of nociceptive signals to the spinal cord leads to the generation of endogenous danger signals as well as increases in the levels of neuronal chemokines, neurotransmitters, and neuromodulators, which in turn activate glial cells. Glial cells that have been stimulated release a wide range of chemicals into the central nervous system. These molecules include nitric oxide, chemokines, prostaglandins, excitatory amino acids, tumor necrosis factor (TNF), and reactive oxygen species. [21] Collectively, these chemicals increase the excitability of neurons. This results in a condition known as central sensitisation, which is characterised by decreased stimulus thresholds and is associated with the activation of neurons in the spinal cord. In addition to causing secondary hyperalgesia, this type of sensitisation is long-lasting and has the potential to induce pain to radiate to sections of the body that have not been initially wounded. [22]

METHODS OF TRIGGER POINT MANAGEMENT THAT ARE-USED OFTEN

Noninvasive methods

1. **For the spray and stretch technique,** it is necessary to spray the vapo-coolant all the way around the muscle that has to be stretched to do this. Utilising this as a distraction while extending the muscle that has been shortened is a possibility.

2. **Ischemic compression and stretch:** Ischemic compression is applied on the trigger point for seven to ten seconds, followed by stretching, which is continued for a period of time until a feeling of release is obtained. Each session is performed three to four times.

3. **Massage and stretch:** Following a session of transverse friction, acupressure, and shiatsu massage that lasts between seven and ten seconds, stretching is performed. In each and every session, 3e4

repetitions are recommended. The myofascial release technique, often known as MRT, is a technique that must be trained to release the trigger point.

Invasive techniques

1. **Dry needling:** Once the trigger point has been carefully found and stabilised between two fingers, an acupuncture needle or a hypodermic needle is inserted into the TrP and repeatedly punctured by pulling it out and replugging it in. This process is performed until the trigger point is satisfied. The individual who is being treated might show signs of the discomfort that they were complaining about, or one might see a twitch reaction.

2. **Trigger point injections:** A hypodermic needle is inserted into the TrPs via the approach described earlier. Normal saline or a local anaesthetic, with or without steroids, is then supplied into and in close proximity to the TrPs and administered.

COMPARING DRY NEEDLING WITH CONVENTIONAL MANUAL THERAPY

Dry Needling

An acupuncture needle or a very small needle is inserted into the skin and muscle during invasive therapy, known as trigger-point dry needling. There are hyperirritable sites in the taut bands of skeletal muscles that are referred to as myofascial trigger points (MTrPs). These areas can be felt as nodules. There are two different tissue layers that can be treated with dry needling with trigger points: superficial and deep.

Pathophysiology of MTrPs

The release of an excessive amount of acetylcholine from specific motor endplates is assumed to be the root cause of trigger points. Latent and active MTrPs are the two broad categories to which they belong.

- Referred or local pain may occur on its own when active MTrPs are present. They result in autonomic symptoms, limited range of motion (ROM), and muscle weakness.

- Until they are triggered, latent MTrPs are painless. They might limit range of motion and change the way muscles are activated.

- In response to applied pressure, both latent and active MTrPs induce hyperalgesia away from the trigger point and allodynia at the trigger point location.

- A taut band within the muscle develops to cause MTrPs. This band is brought on by the motor endplate, which produces an excessive amount of acetylcholine, together with acetylcholine esterase inhibition and nicotinic acetylcholine receptor upregulation.

Manual therapy

There are a wide variety of manual treatment approaches and procedures that are currently in use, and physical therapists have been instrumental in all of them. The practice of manual therapy has been around for a very long time within the field of physical therapy. Throughout history, mechanical explanations have been utilised to explain the working mechanisms of manual therapeutic techniques. A recent study revealed that receiving hands-on inspection and intervention has good psychological implications. [23] Additionally, complex neurophysiologic systems are also involved in this process.

According to the International Federation of Orthopaedic Manipulative Physical Therapists (IFOMPT), manual physical therapy is "a specialised area of physiotherapy/physical therapy for the management of neuro-musculoskeletal conditions, based on clinical reasoning, using highly specific treatment approaches including manual techniques and therapeutic exercises." This definition was provided by the IFOMPT.

Exercising, educating patients, and providing early, regular, and skillful manual physical treatment are the fundamental aspects of an OMPT therapist's field of practice. Advanced examination, communication, and decision-making skills that are founded on the principles of professional and scientific education make it possible to provide treatment that is both effective and efficient. OMPT practitioners are responsible for the treatment of patients, the counselling of other medical professionals about neuromusculoskeletal (NMS) diseases, both simple and complex, as well as the provision of advice and procedures connected to wellbeing."

TREATMENT

MPS patients are typically treated with a variety of complementary therapies, psychological counselling, splints, collars, medication (painkillers, low-dose antidepressants, anti-epileptics), rest (do not use the painful body part for as long as it hurts), physiotherapy (mainly ultrasound, interferential therapy, short wave diathermy, traction, and strengthening), and encouragement to "live with it" and "manage the pain. "However, it does not appear that this method is the most effective one. [24] When a patient with a localised MPS has been studied for years and the issue has not been adequately addressed or treated, it is usually noted that the patient's pain continues to radiate beyond the location where it initially originated. This is a common occurrence. Experiencing acute discomfort that develops over time usually results in the loss of work, disability, and extraordinarily expensive medical expenditures. Half of the patients who seek therapy for pain problems still experience pain five years after they first seek treatment, and up to twenty-five percent of them are permanently incapacitated. The early and accurate identification of posttraumatic stress syndrome (MPS) by specialists in manual musculoskeletal medicine should be prioritised, as should the implementation of rigorous, protocol-based interdisciplinary rehabilitation measures. [25-28]

Mechanisms of Action

In individuals suffering from musculoskeletal disorders, dry needling has been demonstrated to reduce muscular tone, increase the ROM and pressure pain threshold right away, and lessen discomfort. [29] The recommended methods of action include the following:

1. **Local Twitch Response:** An involuntary spinal reaction known as a "local twitch response" can be triggered by dry needling, which causes the targeted muscles to contract locally. A local twitch response can activate mechanoreceptors such as A beta fibres and change the length and tension of muscle fibres.

2. **Effects on Blood Flow:** Localised ischemia and hypoxia may result from prolonged contraction of tense muscular bands at trigger sites. Dry needling dilates tiny blood vessels, which increases oxygenation and blood flow to the muscles.

3. **Neurophysiological effects:** Inducing both peripheral and central nervous system reactions, dry needling can improve trigger point site homeostasis and reduce peripheral and central pain sensitivity.

4. **Remote** effects: Proximal MTrPs can experience analgesic effects from dry needling of distal MTrPs. There is inconsistent evidence in the literature concerning the contralateral effect.

5. **Placebo effect:** Expectations of dry needling have a significant effect on how pain is perceived.

NEED FOR THE STUDY

This study investigates myofascial pain syndrome (MFPS) and chronic low back pain (cLBP) using the biopsychosocial model. It explores how factors like acute overload, repetitive strain, poor posture, and bad ergonomics contribute to trigger points (TrPs). The study compares the effectiveness of dry needling versus traditional manual therapy for pain relief and functional improvement in the neck and upper back. It also examines long-term outcomes, patient satisfaction, and treatment preferences, aiming to provide evidence-based insights for better management of MFPS and individualized patient care.

METHADOLOGY

This study was designed as a single-blinded, randomised controlled, three-arm parallel-group clinical trial. The aim of this study was to assess the effects of local myofascial trigger point dry needling (MTrP-DN), with or without periscapular dry needling (PSDN), on pain, pressure pain threshold (PPT), range of motion (ROM), and disability in participants with adhesive capsulitis (AC). The null hypothesis (H01) stated that MTrP-DN, with or without PSDN, would not improve these outcomes, whereas the alternative hypothesis (Ha1) suggested that it would lead to improvements in the PPT, ROM, discomfort, and disability.

STUDY DESIGN

This study involved a prospective cohort. Eligible participants were invited by two general practitioners who regularly use dry needling (DN) in their clinics. Participation was voluntary, and patients who declined to participate continued to receive DN outside the study. Those who agreed received detailed explanations of the DN procedure and potential side effects and provided informed consent. The Short-Form McGill Pain Questionnaire (SFMPQ) was used to assess pain intensity before, 10 minutes after, and one week after the procedure. The Bait Balev ethical committee (IRB) approved the study, assigned ID 0017–19–BBL, ensuring that all the data remained anonymous.

The dry needling (DN) procedure was conducted by two general practitioners at SRK Hospital, Jaipur, Rajasthan. One was a resident with four years of DN experience and one year at the clinic, while the other was a specialist with three years of DN experience and eight years at the same clinic. Muscles for treatment were selected based on patient complaints and physical examination results. Needles ranged from 30 to 120 mm in length and 0.3 mm in diameter, varying depending on the muscle location. Needle insertion was deep and perpendicular to the skin, except in the back area, where it was angled. Participants were required to be at least 18 years old, speak Hindi, have acute myofascial pain syndrome (MPS) with symptoms starting less than a week ago, and consent to participate. Exclusion criteria included pregnancy, infections, haemophilia, use of anticoagulants, and more. Follow-up interviews were conducted via telephone. Diagnosis of MPS relied on physical examination findings, including the identification of a taut band and pain triggered by pressure, alongside the specialists' clinical judgment.

Variables and Sampling Method

Participants in this study were required to be at least 18 years old, speak Hindi, have acute myofascial pain syndrome (MPS) with symptoms starting within a week, and consent to participate. Exclusion criteria included pregnancy, local infection, hemophilia, anticoagulant use, local mass at the insertion site, contagious diseases (hepatitis B, C, or HIV), orthopedic implants, or lymph node dissection. The primary researcher conducted follow-up interviews by phone. Diagnosis of MPS was based on specific physical examination findings, such

as a taut band and pain triggered by pressure, along with expert clinical opinion. A simple random sampling method was used, with a sample size of 210 participants, divided into three groups of 70 each, determined by a clinical superiority design formula. Inclusion criteria also required participants to be clinically diagnosed with adhesive capsulitis (AC), aged 40-65 years, and experiencing shoulder discomfort for three months or more. The study took place in the physiotherapy department of SRK Hospital, Jaipur, Rajasthan, India.

RESULTS MEASUREMENTS

In this study, several principal outcome indicators were used to assess the effectiveness of interventions in shoulder pain management. The primary measure of shoulder pain was the visual analogue scale (VAS), a self-report tool featuring a 100 mm horizontal line, with 0 representing "no pain" and 100 indicating "worst pain." The participants marked their pain level on this line, and the tool's high validity and reliability were confirmed by an intraclass correlation coefficient (ICC) of 0.97. The shoulder range of motion (ROM) was evaluated via a universal goniometer, which demonstrated satisfactory intrarater reliability, with an ICC of 0.94. For shoulder flexion ROM, patients were positioned supine with their lumbar spine flattened, and the goniometer's movable arm was aligned with the humerus while the stationary arm was aligned with the thoracic midaxillary line. The shoulder extension ROM was assessed with participants in a prone position, and the goniometer was similarly aligned for accurate measurement.

For shoulder abduction, the patients were placed in a supine position, and the goniometer was aligned with the anterior sternum and humerus. Additionally, the pressure pain threshold (PPT) was measured via a pressure algometer, a reliable device that assesses the force required to trigger pain in the muscles surrounding the glenohumeral joint. The participants were briefed on the procedure, and the algometer's steel rod was applied at a right angle to the skin, with compression gradually increasing until pain was reported. The average of three measurements taken 30 seconds apart was used for data analysis, with the results expressed in kilograms per square centimeter. This method has demonstrated high validity and reliability in previous studies. The secondary outcome measures included shoulder disability, which was evaluated via the Shoulder Pain and Disability Index (SPADI), a scale that assesses both functional impairment and pain severity. The SPADI consists of 13 items divided into five pain subscales and eight disability subscales.

It has shown strong internal consistency across diverse patient populations, with Cronbach's alpha values of 0.90 and ICC values exceeding 0.89. The total SPADI score, which combines the pain and disability subscales, ranges from 0 to 100, with higher scores indicating greater disability. The final score was adjusted for any missing items, ensuring a comprehensive assessment of the participants' shoulder function. These outcome measures provided a robust framework for evaluating the effectiveness of the interventions in reducing shoulder pain and improving function in the study population.



Figure 3. A universal goniometer was used to measure the range of motion in the shoulder.



Figure 4. Pressure Algometer Assessment of the Pressure Pain Threshold

STUDY DURATION

In addition to dry needling (DN) therapy, interventions include electrotherapy via shortwave diathermy (SWD), ultrasound therapy (UST), and transcutaneous electrical nerve stimulation (TENS). SWD was applied at 27.12 MHz for 20 minutes via a contra-planner approach, adjusting the intensity for patient comfort. Pulsed ultrasound with a 1:4 pulse ratio and 1.5 W/cm² intensity was administered for 10 minutes to the affected area. TENS involved placing electrodes on the deltoid and trapezius muscles at a frequency of 100 Hz, a duration of 0.05 ms, and 9-volt modulation and was applied for 20 minutes until a tingling sensation was felt, without visible muscle contraction. Joint stimulation included passive rhythmic glides (posteroanterior, anteroposterior, caudal) performed for 30 seconds each at a rate of 2–3 glides per second, with a 30-second rest between sets, which was repeated five times. Muscle stretching was also conducted, with each stretch lasting 30 seconds and a 15-second rest between repetitions, supplemented by five minutes of towel-based physical activities to increase flexibility.

PROCEDURE

The Department of SRK Hospital of Applied Medical Sciences approved the research project, which led to the recruitment of 237 patients via a simple random sampling technique referred to by orthopedic specialists. Of these, 27 were excluded on the basis of medical history, orthopedic tests, and imaging results. Those

meeting the inclusion criteria were informed about the study and provided consent. Preintervention assessments included shoulder pain measured by the visual analogue scale (VAS), pain and disability with the Shoulder Pain and Disability Index (SPADI), range of motion (ROM) with a universal goniometer, and the pressure–pain threshold (PPT) of myofascial trigger points (MTrPs) via a pressure algometer for muscles, including the supraspinatus and infraspinatus. The participants were then randomly assigned to three groups:

1. **Group 1** (70 participants: 33 men, 37 women) received local myofascial trigger point dry needling (local MTrP-DN) for 10 minutes per session over six days, followed by continuous physical therapy (CPT) for twelve days.

2. **Group 2** (70 participants: 35 men, 35 women) underwent both local MTrP-DN and paraspinal dry needling (PSDN), with PSDN administered on alternate days for six days targeting the multifidus muscles around the shoulder joint, combined with local MTrP-DN and CPT for twelve consecutive days.

3. **Group 3** (80 participants: 30 men, 50 women) received conventional physiotherapy, including shortwave diathermy (SWD), therapeutic ultrasound, transcutaneous electrical nerve stimulation (TENS), joint mobilisation, passive stretching, and active exercises, for twelve days.

Postintervention assessments were conducted after twelve days to evaluate outcomes.

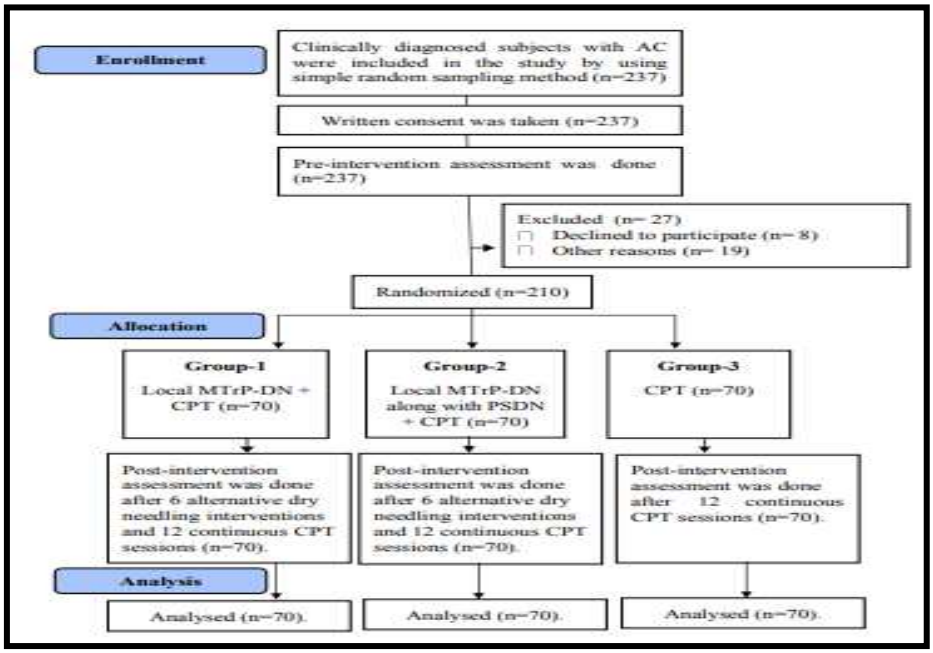


Figure 5. Diagram of a consort flowchart.

Procedure for dry needling

A thorough physiotherapy examination identified myofascial trigger points (MTrPs), which were treated using Suzhou Tianxie acupuncture needles (0.25 mm gauge, 25-40 mm length). Needle length was based on patient size and targeted muscle. The conical needle was inserted with a fast in/out movement to target sensitive loci and monitor the local twitch response. After 10 minutes, the needle was carefully extracted, maintaining hemostasis, and disposed of in a hazardous materials container.

Technique of dry needling for supraspinatus muscle

During the experiment, every single person was lying down in the prone position. To test the supraspinatus muscle, flat palpation was conducted with the requisite pressure for MTrPs. This was accomplished by using the upper trapezius muscle as the palpation tool. Following the discovery of the MTrPs, the needle was inserted and directed in the direction of the base of the supraspinous fossa. There was no need for any further steps to be taken.

Applying dry needling to the infraspinatus muscle

During the experiment, every single person was lying down in the prone position. MTrP was performed via flat palpation with adequate pressure to obtain access to the infraspinatus muscle for the purpose of performing the procedure. After determining whether MTrPs were present, the needle was inserted and positioned such that it was pointing in the direction of the scapula.

Using dry needling on the Teres minor muscle

The individuals were placed in the prone position, and their upper arms were abducted at a 90-degree angle until they were in the prone position. To access the Teres minor muscle for the purpose of performing MTrP, flat palpation was conducted directly caudal to the shoulder joint. This was done to reach the muscle. Following the localisation of the MTrPs, the needle was inserted and positioned in the direction of the lateral border of the scapula. This was done immediately after the procedures were completed.

Applying dry needling to the subscapularis muscle

During the experiment, the participants were positioned in a supine lying position with their upper arms abducted at a 90-degree angle and rotated 90 degrees to the outside. If you assume this posture, the scapula will be pulled into a more lateral position, which will allow you to reach the muscle in the best possible way. When performing MTrPs, a pincer grip was used directly lateral to the scapula to access the subscapularis muscle. This was done to obtain the desired results. Following the localisation of the MTrPs, the needle was inserted and positioned perpendicular to the scapula and parallel to the ribcage. This manoeuvre was performed immediately after the MTrPs were located.

Applying dry needling to the deltoid muscle

The supine reclining posture was used to examine the anterior fibres of the deltoid muscle, and the individuals were positioned in this position. During the examination of the posterior fibres of the deltoid, the subjects were positioned in the prone lying arrangement. To examine the intermediate fibres of the deltoid muscle, the participants were positioned in the side-lying posture. A cushion was used to provide support for the upper arm in each and every position, and the arm was slightly abducted in a downwards direction. To identify whether MTrPs were present, each fibre of the deltoid muscle was evaluated while the individual held a flat grip. Immediately after the localisation of the MTrPs, the needle was inserted through the skin in a path perpendicular to the direction of the humerus, directly into the band that was contracting against the humerus.

Applying dry needling to the pectoralis major muscle

At the same time that the individuals were lying in the supine position, a little abduction of the arm was performed. There are at least three separate components that can be detected independently on the pectoralis major, and each of these components has its own unique referred pain pattern. Each of these components is referred to as a pain pattern. The clavicular, sternal, and costal heads were each examined independently via flat palpation with sufficient pressure. To hold the pectoralis major muscle in the anterior axillary wall, which

is situated between the muscle and the chest wall, the index and long fingers were used. This was done to separate the muscle from the chest wall after it had been stretched. Next, the needle was inserted and directed towards the shoulder joint. At the same time, the pectoralis major muscle was needled in each of its heads.

Using dry needling on the Teres major muscle

The individuals who took part in the study were positioned in a prone position, with their arms slightly abducted over their heads. A pincer grip was employed between the thumb and the second and third fingers to reach the Teres major muscle to perform the exercise. This was done to perform MTrPs. Following the localisation of the MTrPs, the needle was introduced into the body and directed ventrally and laterally for the duration of the procedure.

Methods for removing the cervical multifidus muscles

During the experiment, every single person was lying down in the prone position. It is not possible to quickly attenuate the cervical multifidus muscles with the use of touch. Approximately one cm lateral to the spinous process, the needle was positioned perpendicular to the skin and parallel to the posterior spinous process. This was done to ensure that the needle would work well.

Table 1. Specifics of dry needling methods, such as the patient's posture and shoulder position, the palpation method, and the direction of needle insertion

Sr.No	Muscle Name	Patient position	Shoulder position	Palpation Technique	The direction of needle insertion
1	Supraspinatus	Prone lying	Neutral	Flat palpation	Longitudinal to the frontal plane
2	Infraspinatus	Prone lying	Neutral	Flat palpation	Directed towards scapula
3	Teres minor	Prone lying	90° Abduction	Flat palpation	Directed towards the lateral border of the scapula
4	Subscapularis	Supine lying	90° abduction & 90° External Rotation	Pincer palpation	Directed parallel to the ribcage
5	Deltoid	Anterior fibre- Supine Middle fibre- Sidelying Posterior fibre- Prone lying	Slight Abduction	Flat palpation	Directed perpendicularly
6	Pectoralis major	Supine lying	Slight Abduction	Flat palpation	Directed towards shoulder
7	Teres major	Prone lying	Slight Abduction	Pincer palpation	The ventral and lateral direction

8	Cervical multifidus	Prone lying	NA	NA	Parallel to the posterior spinous process

DATA ANALYSIS

For the purpose of analysing the data that were acquired, the Statistical Program for Social Sciences (SPSS, version 21) was used. To perform a descriptive analysis of the demographic data, which included age, sex, and body mass index (BMI), the data were considered. The Shapiro–Wilk test, the Z skewness statistic, and the Z kurtosis statistic were used to ascertain whether the data were normally distributed. On the other hand, Levene's test was used to assess the degree to which the data were consistent with one another. A paired t test was determined to be the most appropriate method for comparing the means of shoulder ranges of motion, VAS, SPADI, and PPT among the individuals in the group. A comparison of the means of the shoulder ranges of motion (ROMs), visual analogue scale (VAS), and SPADI and PPT was carried out via analysis of covariance (ANCOVA) to examine the differences between the groups. When performing post hoc comparisons, the Fisher least significant difference (LSD) test was used as the statistical tool of choice. The analysis of variance (ANOVA) developed by Welch was employed for the purpose of comparing the PPT data among groups. Additionally, the Games–Howell test was utilised for post hoc comparisons in instances when the results were statistically significant. For the purpose of statistical analysis, a probability value (p value) that was less than 0.05 was regarded as statistically significant.

STATISTICAL ANALYSIS

To increase the sample size, a power of 90% and a p value of 0.05 were used. This was done on the basis of the assumptions that the pain rating index was 30 prior to the DN and 25 subsequent to the DN (with a standard deviation of 7) and that the VAS score was 6 prior to the DN and 4 subsequent to the DN. For each component of the SF-MPQ, which comprises the pain rating index, current pain intensity, and visual analogue scale (VAS) before, one minute after, and one week after DN, a mean and standard deviation were computed. These calculations were performed to determine statistical significance. Analysis of variance (ANOVA) with Bonferroni correction was used to examine the change at three different time points: ten minutes after compared to the baseline (short-term effect), one week after compared to the baseline (medium-term impact), and one week after compared to ten minutes after. In accordance with the definition of success, a successful result was considered to have occurred when at least two of the three components of the SF-MPQ had improved. In the context of both short-term and medium-term indices, an achievement that was sustained throughout time was considered successful. To establish which elements are associated with success in the short-term, medium-term, and continuous time frames, a logistic regression was carried out via the forward approach. This was done to determine which factors are connected to success. For the purpose of the study, the statistical program version 27 of SPSS Statistics was used.

RESULTS

DEMOGRAPHIC BASED RESULTS

In Table 2, the demographic features of the 210 individuals who were recruited for the study are shown according to their respective categories. Each of the two groups consisted of seventy individuals who participated. With a mean and standard deviation of age of 54.4 ± 5.67 years, height of 5.51 ± 0.31 feet, weight of 67.5 ± 6.69 kg, and body mass index (BMI) of 24.52 ± 1.32 kg/m2, the local MTrP-DN group (Group-1)

included 33 males, accounting for 47.14% of the total, and 37 females, accounting for 52.85% of the remaining participants. The local MTrP-DN group, along with the PSDN group (Group 2), was composed of 35 males and 35 females, with a mean and standard deviation of age of 54.5 and 5.50 years, respectively. The participants' body mass index (BMI) was 24.01 kilograms per square meter, their height was 5.53 feet, and their weight was 67.1 kilograms. The participants' height was 5.53 feet, and their weight was 6.67 kilograms. Among the total number of participants in the CPT group (Group 3), 30 males (42.9% of the total) and 40 females (57.14%) took part. Their height was 5.49 feet, their weight was 67.2 kilograms, and their body mass index (BMI) was 24.38 grams per square meter. The mean and standard deviation ages were 54.5 and 5.64 years, respectively. Their height was 5.49 feet, and their weight was 67.2 kilograms. Considering that none of the demographic variables in the three groups differed significantly from one another ($p > 0.05$), it may be concluded that the three groups are statistically identical to one another.

Table 2. Baseline demographic parameters and research subject homogeneity

Measure	Group – 1 n=70 *M±SD*	Group – 2 n=70 *M±SD*	Group – 3 n=70 *M±SD*	*p value*
Gender	Male= 33 (47.14%) Female = 37 (52.85%)	Male = 35 (50%) Female = 35 (50%)	Male = 30 (42.9%) Female = 40 (57.1%)	
Age (Years)	54.4 ± 5.67	54.5 ± 5.50	54.5 ± 5.64	0.99**
Height (Feet)	5.51 ± 0.31	5.53 ± 0.29	5.49 ± 0.33	0.80**
Weight (kg)	67.5 ± 6.69	67.1 ± 6.67	67.2 ± 6.94	0.70**
BMI (kg/m^2)	24.52 ± 1.32	24.01 ± 1.37	24.38 ± 1.58	0.15**

Notably, Group 1 included the group that received dry needling for the treatment of local myofascial trigger points, Group 2 included the group that received dry needling for local myofascial trigger points in addition to the group that received paraspinal dry needling, and Group 3 included the group that received conventional physiotherapy. **=P>0.05 (representing the homogeneity of all three groups). Abbreviations for the same concept are used to refer to the standard deviation (SD) and the body mass index (BMI).

STATISTICAL TESTS AND INFERENTIAL ANALYSIS

Testing for normality

For the purpose of determining whether the data were normal, the Shapiro–Wilk test was used. Given that the p values for each of the parameters were found to be lower than 0.05, the tests may not support the hypothesis that the data are normally distributed. Additionally, the Z skewness and Z kurtosis statistics were used to

assess the degree to which the data were normal. Given that the p values are all within the range of -1.96--1.96, the data of all the parameters in the three groups suggest that a normal distribution is present.

Table 3. On the basis of the Z kurtosis and Z skewness statistics, the normality test results of the local MTrP-DN group (Group 1)

Measures	Skewness				Kurtosis		
	Motions	*Statistic*	*SE*	*Z Skewness*	*Statistic*	*SE*	*Z Kurtosis*
Shoulder	Flexion	-0.182	0.287	-0.6*	0.655	0.566	1.1*
Range of	Extension	0.000	0.287	0.00*	-0.240	0.566	-0.42*
Motion	Abduction	0.062	0.287	0.21*	-0.580	0.566	1.02*
(Universal	Medial Rotation	-0.432	0.287	-1.50*	-0.239	0.566	-0.42*
Goniometer)	Lateral Rotation	-0.470	0.287	-1.63*	1.08	0.566	1.90*
Pain intensity	VAS	0.058	0.287	0.20*	-0.510	0.566	-0.90*
Disability	SPADI	-0.307	0.287	-1.0*	-0.566	0.566	-1.0*
Pressure Pain	Supraspinatus muscle	-0.496	0.448	-1.10*	1.33	0.872	1.52*
Threshold	Infraspinatus muscle	1.05	0.52	1.92*	1.39	0.935	1.48*
(Pressure	Teres Minor muscle	-1.00	0.512	-1.95*	0.433	0.992	0.43*
Algometer)	Subscapularis muscle	-0.513	0.491	-1.95*	1.58	0.953	1.57*
	Deltoid muscle	-0.855	0.616	-1.38*	1.25	1.19	1.05*
	Pectoralis Major muscle	-0.478	0.564	-0.84*	-0.528	1.09	-0.48*
	Teres Major muscle	0.760	0.687	1.10*	0.922	1.33	0.69*
	Upper Trapezius muscle	-0.89	0.456	1.95*	2.70	0.887	1.42*

Note. In this particular research endeavor, the acronyms that were used were as follows: visual analogue scale (VAS), standard error (SE), shoulder pain and disability index (SPAD), and normal distribution (*).

Table 4. The PSDN group and local MTrP-DN normality test findings were based on Z skewness and Z kurtosis statistics.

Measures	Skewness	Kurtosis					
	Motions/Tool	*Statistic*	*SE*	*Z Skewness*	*Statistic*	*SE*	*Z Kurtosis*
Shoulder	Flexion	0.031	0.287	0.10*	0.239	0.566	0.42*
Range of	Extension	-0.041	0.287	-1.4*	-0.416	0.566	-0.73*
Motion	Abduction	0.122	0.287	0.42*	-0.646	0.566	1.1*
(Universal	Medial Rotation	-0.433	0.287	1.50*	-0.419	0.566	-0.74*
Goniometer)	Lateral Rotation	-0.148	0.287	-0.51*	-0.453	0.566	-0.80*
Pain intensity	VAS	-0.221	0.287	-0.77*	-0.297	0.566	-0.52*
Disability	SPADI	0.036	0.287	0.12*	-0.659	0.566	-1.16*
Pressure Pain	Supraspinatus muscle	-0.356	0.427	-0.83*	1.17	0.833	1.40*
Threshold	Infraspinatus muscle	0.285	0.491	0.58*	-0.604	0.953	-0.63

(Pressure	Teres Minor muscle	-0.479	0.564	-0.84*	-1.12	1.09	-1.02*
Algometer)	Subscapularis muscle	0.051	0.491	0.10*	-0.823	0.953	-0.86*
	Deltoid muscle	-0.421	0.597	-0.70*	-0.40	1.15	-0.34*
	Pectoralis Major muscle	-0.066	0.564	-0.11*	-0.509	1.09	-0.46*
	Teres Major muscle	-0.282	0.597	-0.47*	-0.646	1.15	-0.56*
	Upper Trapezius muscle	-0.08	0.481	-0.16*	-0.477	0.935	-0.51*

Note. VAS - visual analogue scale, *SE* - standard error, *SPADI* - shoulder pain and disability index, * - normal distribution.

Table 5. Results of the CPT group's (Group 3) normality test on the basis of the statistics for Z skewness and Z kurtosis

Measures	Skewness	Kurtosis					
	Motions/Tool	*Statistic*	*SE*	*Z Skewness*	*Statistic*	*SE*	*Z Kurtosis*
Shoulder	Flexion	0.492	0.287	1.7*	1.09	0.566	1.92*
Range of	Extension	0.073	0.287	0.25*	0.036	0.566	0.063*
Motion	Abduction	0.294	0.287	1.02*	-0.655	0.566	1.15*
(Universal	Medial Rotation	0.069	0.287	0.24*	-1.04	0.566	-1.8*
Goniometer)	Lateral Rotation	-0.476	0.287	1.65*	-1.07	0.566	-1.89
Pain intensity	VAS	-0.139	0.287	-0.48*	-0.094	0.566	-0.16*
Disability	SPADI	0.088	0.287	0.30*	-0.634	0.566	-1.12*
Pressure Pain	Supraspinatus muscle	0.726	0.448	1.62*	-0.231	0.872	-0.26*
Threshold	Infraspinatus muscle	0.749	0.481	1.55*	-0.474	0.935	-0.50*
(Pressure	Teres Minor muscle	0.747	0.491	1.52*	-0.382	0.953	-0.40*
Algometer)	Subscapularis muscle	-0.342	0.524	-0.65*	-1.08	1.01	-1.06*
	Deltoid muscle	-0.037	0.564	-0.06*	-0.761	1.09	-0.69*
	Pectoralis Major muscle	0.804	0.564	1.42*	-0.388	1.09	-0.35*
	Teres Major muscle	-0.916	0.717	1.27*	-0.636	1.40	-0.45*
	Upper Trapezius muscle	0.649	0.456	1.42*	0.503	0.887	0.56*

Note. VAS - visual analogue scale, *SE* - standard error, *Ms* – muscle, *SPADI* - shoulder pain and disability index, * - normal distribution

Impact of dry needling with myofascial trigger points in the local MTrP-DN group (Group 1).

Range of motion in the shoulders

The shoulder ROM scores were significantly different (Figure 6.) for the flexion pretest (M = 108, SD = 14.40) and posttest (M = 154.2, SD = 10.97) readings; t (69) = -33.84, $p \leq 0.05$, extension pretest (M = 22.1, SD =

6.7) and posttest (M = 42.1, SD = 8.1) readings; t (69) = -27.25, $p \leq 0.05$, abduction pretest (M = 110.5, SD = 13.9) and posttest (M = 154.4, SD = 9.4) readings; t (69) = -37.92, $p \leq 0.05$, medial rotation pretest (M = 27.4, SD = 7.1) and posttest (M = 55.8, SD = 9.9) readings; t (69) = -27.59, $p \leq 0.05$, lateral rotation pretest (M = 29.4, SD = 3.3) and posttest (M = 57.7, SD = 7.8) readings. These data suggest that local MTrP-DNs have a significant degree of effectiveness in increasing shoulder ranges of motion in individuals with AC.

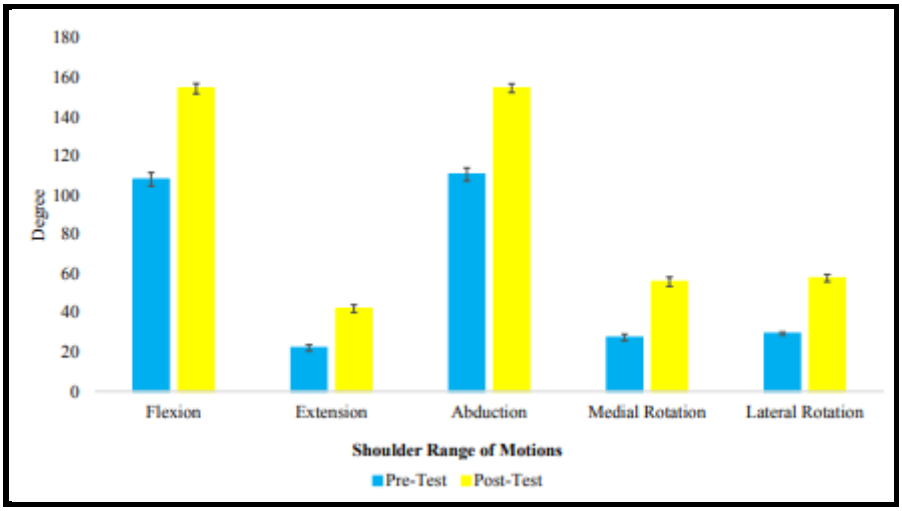


Figure 6. Means and 95% confidence intervals (CIs) of the pre- and posttest measurements of the shoulder flexion range of motion degrees of the local MTrP-DN group (G-1).

Pain in the shoulders

The readings for shoulder discomfort were significantly different between the pretest (mean = 7.9, standard deviation = 0.04) and posttest (mean = 2.8, standard deviation = 0.44) results, as shown in Figure 7. The mean score for the pretest was 7.9, and the standard deviation was 0.04. On the other hand, the p value was either less than or equal to 0.05, and the t value was 80.8 (69). According to the data provided in Table 6., local MTrP-DN is very effective in terms of lowering the degree of shoulder soreness that AC candidates experience.

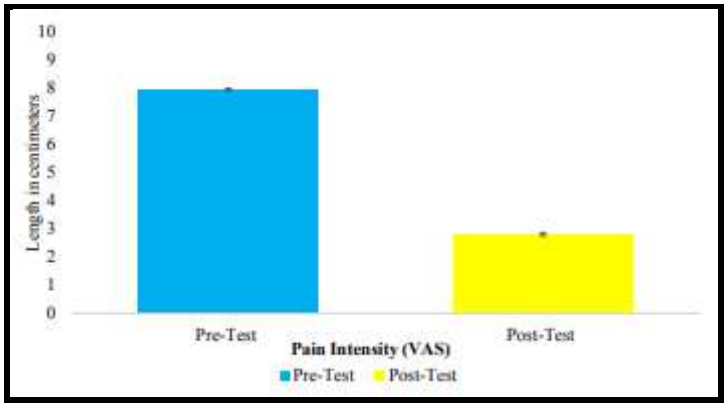


Figure 7. The visual analogue scale was used to measure the means and 95% confidence intervals (CIs) of shoulder pain scores in the local MTrP-DN group (Group 1).

Disability of the Shoulders

A substantial change in the SPADI scores was observed between the pretest readings (mean = 84.7, standard deviation = 0.53) and the posttest readings (mean = 27.52, standard deviation = 3.8), as shown in Figure 8.

The pretest value was 84.7, and the standard deviation was 0.53. The p value was less than or equal to 0.05, and the t value was 89.03, which was the significance level. On the basis of these data, local MTrP-DNs may be of great assistance in lowering shoulder pain and disability in those who have AC (Table 6.).

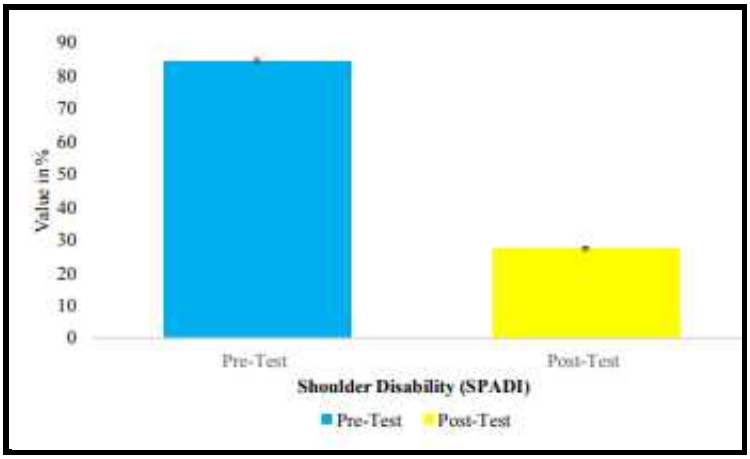


Figure 8. Means and 95% confidence intervals of the pre- and posttest SPADI values for the local MTrP-DN group (Group 1).

Pressure Pain Limit

The PPT scores were significantly different (Figure 4.4) for the supraspinatus pretest (M = 1.46, SD = 0.26) and posttest (M = 3.0, SD = 0.07) readings; t (26) = -19.50, $p \leq 0.05$, infraspinatus pretest (M = 1.40, SD = 0.26) and posttest (M = 2.99, SD = 0.44) readings; t (22) = -25.67, $p \leq 0.05$, teres minor pretest (M = 1.43, SD = 0.25) and posttest (M = 3.0, SD = 0.31) readings; t (18) = -27.13, $p \leq 0.05$, subscapularis pretest (M = 1.46, SD =0.22) and posttest (M = 2.95, SD = 0.40) readings; t (21) = -23.14, $p \leq 0.05$, deltoid pretest (M = 1.40, SD = 0.29) and posttest These data suggest that local MTrP-DNs are very effective in lowering the PPT around the shoulder muscles in those who are suffering from cardiovascular disease (Table 6.).

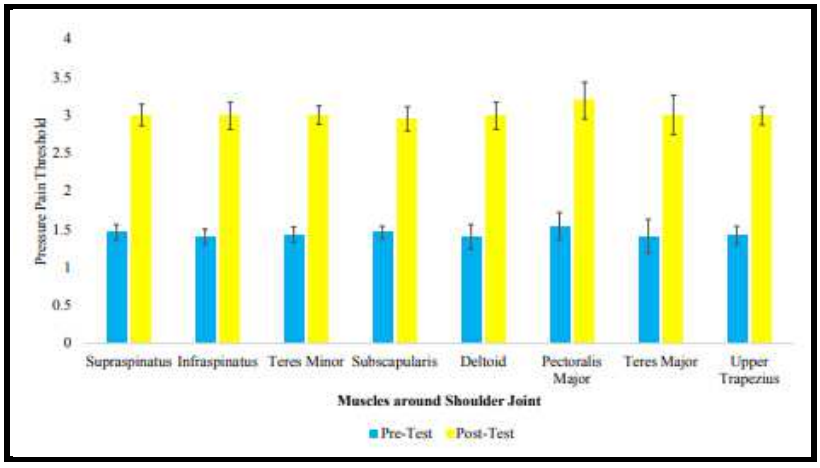


Figure 9. Means and 95% confidence intervals of the pressure pain threshold (PPT) measurements for the local MTrP-DN group (Group 1).

Table 6. Comparison of the shoulder range of motion, discomfort, disability, and PPT of the local MTrP-DN group before and after surgery via a paired t test

	Motion/tools	Pre-Test	Post-Test	t	Cohen's d

		M±SD		SE	M±SD	SE		
Range of Motion	Flexion	108	±14.4	1.72	154.2 ±10.9	1.31	-33.84*	3.64
	Extension	22.1	± 6.7	0.81	42.1 ± 8.1	0.97	-27.25*	2.70
	Abduction	110.5	± 13.9	1.6	154.4 ±9.4	1.1	-37.92*	3.76
	Medial rotation	27.4	± 7.1	0.85	55.8 ± 9.9	1.1	-27.59*	3.34
	Lateral rotation	29.4	± 3.3	0.40	57.7 ± 7.8	0.93	-33.74*	5.09
Pain Intensity	Visual analogue scale	7.94	± 0.39	0.04	2.80 ± 0.44	0.05	80.8*	12.2
Disability	SPADI	84.7	± 4.4	0.53	27.52 ± 3.8	0.46	89.03*	13.9
Pressure pain threshold	Supraspinatus muscle	1.46	± 0.26	0.05	3.0 ± 0.39	0.07	-19.50*	4.73
	Infraspinatus muscle	1.40	± 0.26	0.05	2.99 ± 0.44	0.09	-25.67*	3.31
	Teres Minor muscle	1.43	± 0.25	0.05	3.0 ± 0.31	0.06	-27.13*	5.60
	Subscapularis muscle	1.46 ±0.22		0.04	2.95 ±0.40	0.08	-23.14*	4.80
	Deltoid muscle	1.40	± 0.29	0.08	2.99 ± 0.33	0.09	-17.56*	4.83
	Pectoralis Major muscle	1.54	± 0.37	0.09	3.19 ± 0.48	0.12	-15.90*	3.88
	Teres Major muscle	1.41	± 0.37	0.11	3.0 ± 0.43	0.13	-20.68*	3.97
	Upper Trapezius muscle	1.42	± 0.30	0.06	2.99 ± 0.35	0.06	-27.58*	4.90

Note. M - Mean, SD - Standard deviation, SE - Standard error, SPADI - Shoulder Pain and Disability Index, * = $p \leq 0.05$.

Effectiveness of both paraspinal and local myofascial trigger point dry needling in the local MTrP-DN and PSDN groups (Group 2).

Shoulder Range of Motion

The shoulder ROM scores were significantly different (Figure 4.5) for the flexion pretest (M = 104.5, SD = 13.0) and posttest (M = 151.0, SD = 10.78) readings; t (69) = -42.34, $p \leq 0.05$, extension pretest (M = 20.85, SD = 7.5) and posttest (M = 42.28, SD = 7.6) readings; t (69) = -25.32, $p \leq 0.05$, abduction pretest (M = 107.7, SD = 13.2) and posttest (M= 152.0, SD= 7.9) readings; t (69) = -37.56, $p \leq 0.05$, medial rotation pretest (M = 27.0, SD = 4.6) and posttest (M= 4.4, SD= 9.1) readings; t (69) = -29.63, $p \leq 0.05$, lateral rotation pretest (M = 28.5, SD = 3.5) and posttest (M= 56.4, SD= 4). These data, which are shown in Table 7., indicate that local MTrP-DN in combination with PSDN seems to be significantly beneficial in terms of increasing the shoulder range of motion in persons with AC.

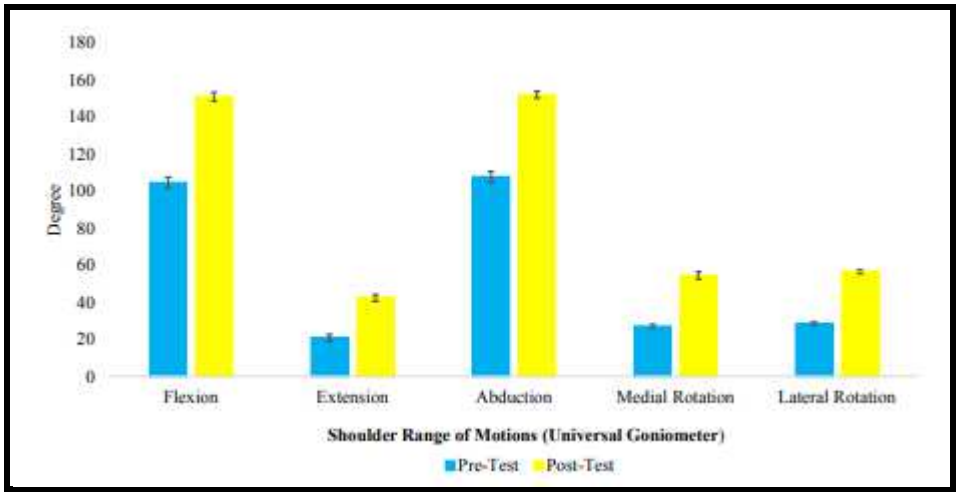


Figure 10. Means and 95% confidence intervals (CIs) of the pre- and posttest measurements of the shoulder flexion range of motion in degrees for the local MTrP-DN group and the PSDN group (Group 2).

Pain in the shoulders

Figure 4.6 illustrates that there was a notable disparity in the ratings of shoulder discomfort between the pretest (mean = 7.9, standard deviation = 0.35) and posttest (mean = 2.7, standard deviation = 0.47) readings. The mean score for the pretest was 7.9, and the standard deviation was 0.35. The t value was 78.40, and the threshold of significance was $p < 0.05$. Taken together, these data suggest that the combination of local MTrP-DN and PSDN is very advantageous in terms of lowering shoulder discomfort in persons who suffer from AC (Table 7.).

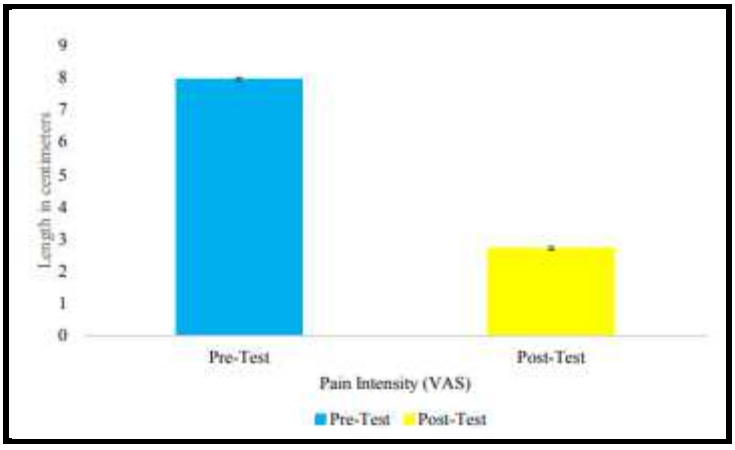


Figure 11. Means and 95% confidence intervals (CIs) for shoulder discomfort on the visual analogue scale before and after testing for the local MTrP-DN group and PSDN group (Group 2).

Disability of the Shoulders

Figure 4.7 shows that there was a statistically significant difference in the SPADI scores between the pretest (mean = 84.6, standard deviation = 4.5) and posttest (mean = 28.1, standard deviation = 3.8) readings. The t value was 80.29, and the p value was less than or equal to 0.05. The mean score on the pretest was 84.6, and the standard deviation was 4.5. These data suggest that local MTrP-DN in combination with PSDN is very effective in terms of lowering shoulder dysfunction in patients who have AC (Table 7.).

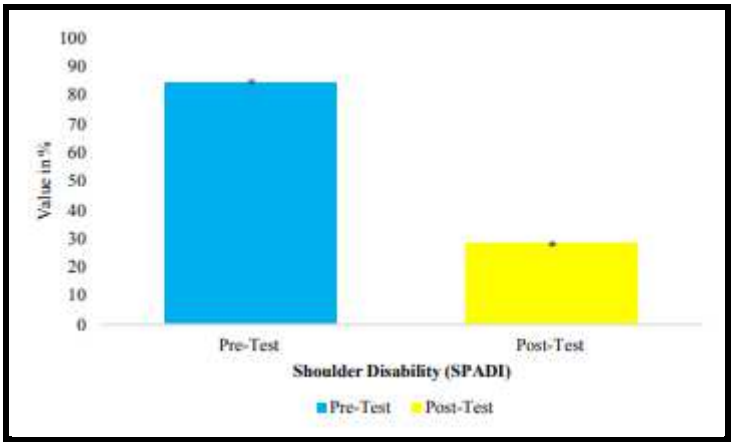


Figure 12. Means and 95% confidence intervals of the Shoulder Pain and Disability Index (SPADI) pre- and posttest results for the local MTrP-DN group and the PSDN group (Group 2).

Pressure Pain Limit

The PPT scores were significantly different (Figure 4.8) for the Supraspinatus pretest (M = 1.39, SD = 0.19) and posttest (M = 2.97, SD = 0.41) readings; t (29) = -17.94, $p \leq 0.05$, infraspinatus pretest (M = 1.36, SD = 0.18) and posttest (M = 3.0, SD = 0.48) readings; t= -19.57, $p \leq 0.05$, teres minor pretest (M = 1.38, SD = 0.21) and posttest (M = 1.05, SD = 3.0, SD = 0.32) readings; t (15) = -25.96, $p \leq 0.05$, subscapularis pretest (M = 1.39, SD = 0.12) and posttest (M = 2.91, SD = 0.31) readings; t (21) = -23.59, $p \leq 0.05$, deltoid pretest (M = 1.36, SD = 0.11) and posttest (M = 3) readings.

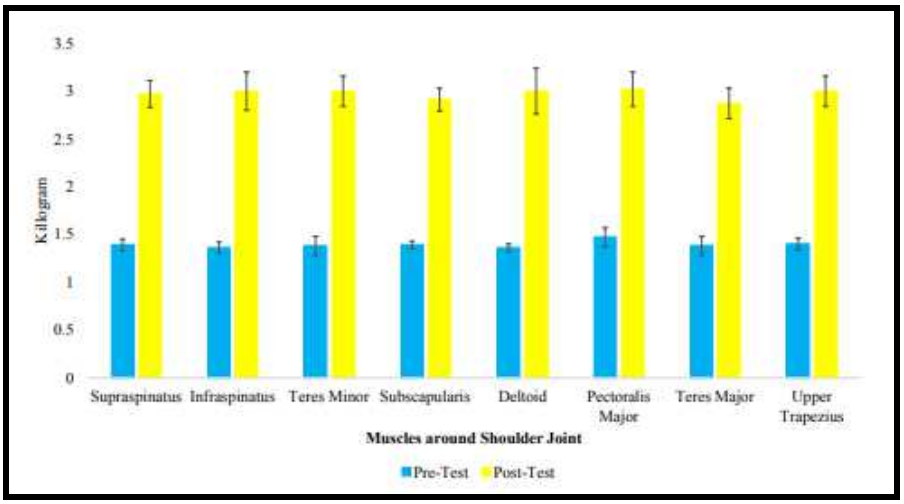


Figure 13. Means and 95% confidence intervals of the pressure pain threshold (PPT) pre- and posttest values for the local MTrP-DN group and the PSDN group (Group 2).

Table 7. Pairing t tests were used to compare shoulder range of motion, pain (VAS), disability (SPADI), and pressure pain thresholds pre- and posttests in the local MTrP-DN group and PSDN group (Group 2).

	Motion/tools	Pre-Test		Post-Test			Cohen's d
		M±SD	SE	M±SD	SE		
Range of Motion	Flexion	104.5 ±13.0	1.5	151 ±10.78	1.2	-42.34*	3.90
	Extension	20.85 ± 7.5	0.90	42.28 ± 7.6	0.91	-25.32*	2.83

	Abduction	107.7 ± 13.2	1.5	152.0 ± 7.9	0.94	-37.56*	4.19
	Medial rotation	27.0± 4.6	0.55	54.4 ± 9.1	1.0	-29.63*	4.00
	Lateral rotation	28.5± 3.5	0.42	56.4 ± 4.8	0.57	-38.12*	6.72
Pain Intensity	Visual Analogue Scale	7.97 ± 0.35	0.04	2.71 ± 0.47	0.05	78.40*	12.68
Disability	SPADI	84.6± 4.5	0.54	28.1 ± 3.8	0.45	80.29*	13.61
Pressure pain threshold	Supraspinatus muscle	1.39 ± 0.19	0.03	2.97 ± 0.41	0.07	-17.94*	5.26
	Infraspinatus muscle	1.36 ± 0.18	0.03	3.0± 0.48	0.10	-19.57*	4.96
	Teres Minor muscle	1.38 ± 0.21	0.05	3.0± 0.32	0.08	-25.96*	6.11
	Subscapularis muscle	1.39 ± 0.12	0.02	2.91 ± 0.31	0.06	-23.59*	7.06
	Deltoid muscle	1.36 ± 0.11	0.02	3.0± 0.45	0.12	-16.16*	5.85
	Pectoralis Major muscle	1.47 ± 0.23	0.05	3.02 ± 0.38	0.09	-17.51*	5.08
	Teres Major muscle	1.38 ± 0.21	0.05	2.87 ± 0.33	0.08	-19.99*	5.51
	Upper Trapezius muscle	1.40 ± 0.16	0.03	3.0± 0.40	0.08	-23.51*	3.33

Note. M - Mean, SD - Standard deviation, SE - Standard error, SPADI - Shoulder Pain and Disability Index, * = $p \leq 0.05$.

Standard physical therapy efficacy in the CPT group (Group 3).

Shoulder range of motions The shoulder ROM scores were significantly different (Figure 14.) for the flexion pretest (M 101.1, SD = 11.6) and posttest (M = 143.2, SD = 8.6) readings; t (69) = -39.21, $p \leq 0.05$, extension pretest (M = 22.85, SD = 6.1) and posttest (M = 39.57, SD = 8.9) readings; t (69) = -26.34, $p \leq 0.05$, abduction pretest (M = 100.8, SD = 13.5) and posttest (M = 147.7, SD = 4.8) readings; t (69) = -27.22, $p \leq 0.05$, medial rotation pretest (M = 26.8, SD = 5.5) and posttest (M = 55.4) readings; t (69) = -38.67, $p \leq 0.05$, lateral rotation pretest (M = 29.7, SD = 2.3) and posttest (M = 55.4) readings. On the basis of these data, it seems that CPT is of great assistance in improving shoulder ranges of motion in persons who have AC (Table 8.).

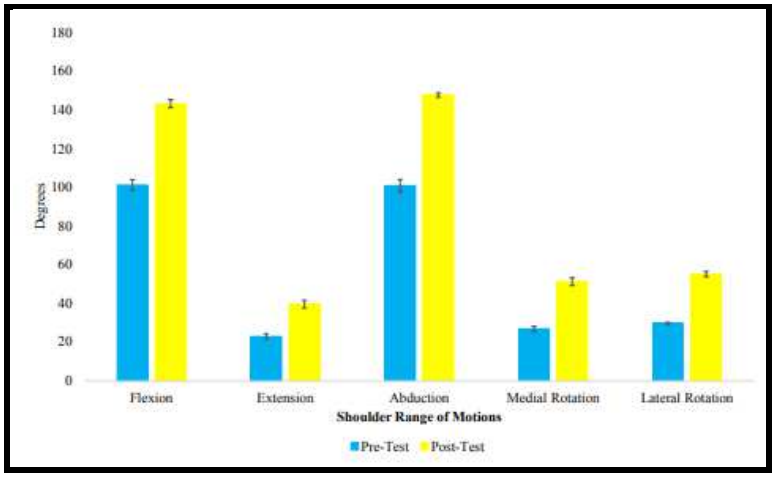


Figure 14. Means and 95% confidence intervals (CIs) of the CPT group's (Group 3) pre- and posttest shoulder range of motion measurements in degrees.

Pain in the shoulders

There was a substantial change in the shoulder pain ratings between the pretest (mean = 7.9, standard deviation = 0.37) and posttest (mean = 3.8, standard deviation = 0.62) readings, as shown in Figure 15. The p value was less than or equal to 0.05, and the t value was 49.80 (69). According to the data shown in Table 8., CPT is very useful in terms of lowering the amount of shoulder pain that persons with AC suffer.

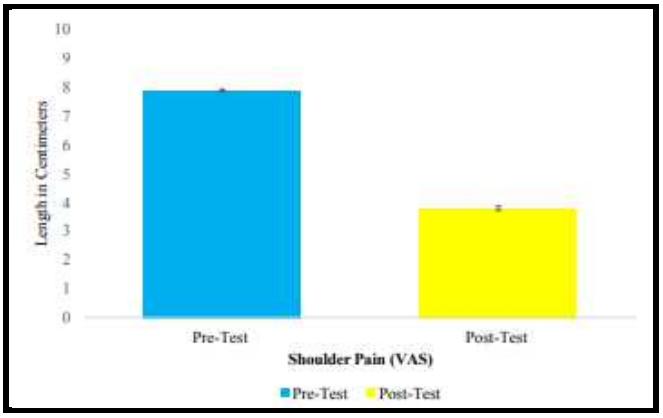


Figure 15. Means and 95% confidence intervals of the visual analogue scale shoulder pain pre- and posttest scores for the CPT group (Group 3).

Disability of the Shoulders

As demonstrated in Figure 16., there was a statistically significant difference in the SPADI scores between the pretest readings (mean = 85.37, standard deviation = 4.4) and the posttest readings (mean = 42.21, standard deviation = 4.1). The p value was less than or equal to 0.05, and the t value was 64.57. All of these values were positive. According to the data shown in Table 8., CPT is very useful in terms of minimising the degree of shoulder dysfunction that persons with AC feel.

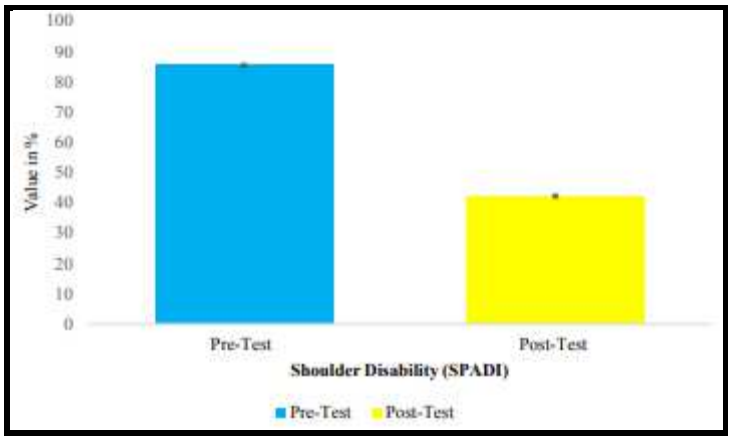


Figure 16. Means and 95% confidence intervals of the Shoulder Pain and Disability Index (SPADI) pre- and posttest values for the CPT group (Group 3).

Pressure Pain Limit

The PPT scores were significantly different (Figure 17.) for the Supraspinatus pretest (M = 1.40, SD = 0.21) and posttest (M = 1.91, SD = 0.80) readings; t (26) = -4.21, $p \leq 0.05$, infraspinatus pretest (M = 1.34, SD = 0.10) and posttest (M = 1.43, SD = 0.12) readings; t (22) = -12.33, $p \leq 0.05$, teres minor pretest (M = 1.39, SD

= 0.23) and posttest (M = 1.48, SD = 0.24) readings; t (21) = -11.23, $p \leq 0.05$, subscapularis pretest (M = 1.45, SD0.38) and posttest (M = 1.57, SD = 0.39) readings; t (18) = -12.87, $p \leq 0.05$, deltoid pretest (M = 1.34, SD = 0.21) and posttest (M = 0.39) readings.

These data suggest that CPT is particularly useful in lowering the PPT around the muscles of the shoulder joint in those who have AC (Table 8.).

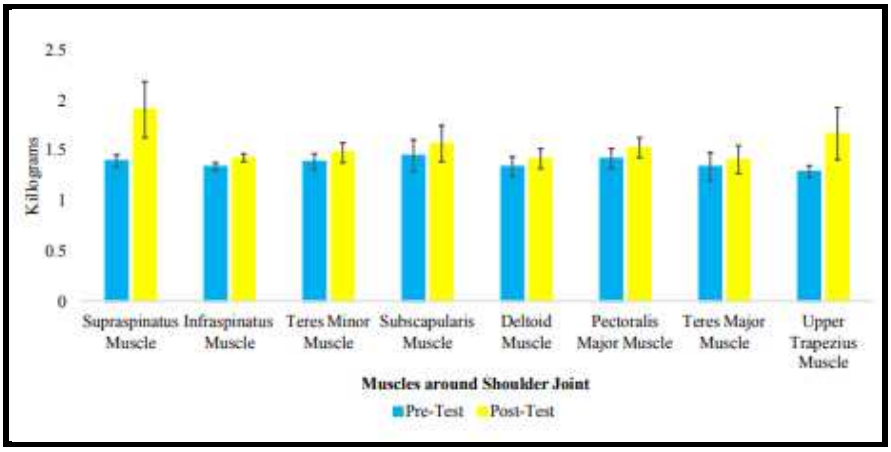


Figure 17. Means and 95% confidence intervals of the pressure pain threshold (PPT) pre- and posttest values for the CPT group (Group 3).

Table 8. Comparison of the pre- and posttest results of the CPT group (Group 3) for shoulder range of motion, pain (VAS), disability (SPADI), and pressure pain threshold via paired t tests.

		Pre-Test		Post-Test		Cohen's	
	Motion/tools	M±SD	SE	M±SD	SE	t	
Range of Motion	Flexion	101.1± 11.6	1.38	143.2 ± 8.6	1.03	-39.21*	4.16
	Extension	22.85 ± 6.1	0.73	39.57 ± 8.9	1.0	-26.34*	2.22
	Abduction	100.8± 13.5	1.6	147.7 ± 4.8	0.58	-27.22*	5.1
	Medial rotation	26.8± 5.5	0.66	51.2 ± 8.4	1.0	-38.67*	3.51
	Lateral rotation	29.7± 2.3	0.28	55.1 ± 5.8	0.69	-40.15*	6.27
Pain Intensity	Visual Analogue Scale	7.9 ± 0.37	0.04	3.8 ± 0.62	0.07	49.80*	8.28
Disability	SPADI	85.37 ± 4.4	0.53	42.21 ± 4.1	0.49	64.57*	10.1
Pressure pain threshold	Supraspinatus Muscle	1.40 ± 0.21	0.03	1.91 ± 0.80	0.14	-4.21*	1.0
	Infraspinatus Muscle	1.34 ± 0.10	0.02	1.43 ±0.12	0.02	-12.33*	0.81
	Teres Minor Muscle	1.39 ± 0.23	0.04	1.48 ± 0.24	0.05	-11.23*	0.39
	Subscapularis Muscle	1.45 ± 0.38	0.08	1.57 ± 0.39	0.09	-12.87*	0.31
	Deltoid Muscle	1.34 ± 0.21	0.05	1.42 ± 0.22	0.05	-11.71*	0.38
	Pectoralis Major Muscle	1.42 ± 0.20	0.05	1.53 ± 0.23	0.05	-10.56*	0.52
	Teres Major Muscle	1.34 ± 0.23	0.07	1.41 ± 0.23	0.07	-11.75*	0.30
	Upper Trapezius Muscle	1.29 ± 0.17	0.03	1.67 ± 0.68	0.13	-3.26*	0.90

M, mean; SD, standard deviation; SE, standard error; SPADI, shoulder pain and disability index.

Impact of paraspinal dry needling (Group 2) and traditional physiotherapy (Group 3) in conjunction with or without local myofascial trigger point dry needling (Group 1).

Range of motion in the shoulders

An analysis of covariance (ANCOVA) was carried out to compare the influence of the DN on the shoulder range of motion (ROM) under local MTrP-DN, local MTrP-DN, PSDN, and CPT conditions. The results of this study are shown in Table 4.8. The influence of the DN on the shoulder range of motion (ROM) was statistically significant at the $p < 0.05$ level for all three scenarios, as illustrated in Figure 4.13. According to the findings of the research, the results for flexion ($F(2, 206) = 18.01$, $p \leq 0.05$), extension ($F(2, 206) = 9.35$, $p \leq 0.05$), and abduction ($F(2, 206) = 5.60$, $p \leq 0.05$) were as follows: [$F(2, 206) = 5.49$, p lower than 0.05] The amount of medial rotation that occurred was reduced. DN did not significantly influence the range of motion (ROM) of the shoulder during lateral rotation [$F(2, 206) = 2.03$, $p > 0.05$]. We did not observe any meaningful effects. According to the findings of post hoc comparisons that were carried out with Fisher's least significant difference (LSD) test, the mean scores for the local MTrP-DN condition and the local MTrP-DN condition together with the PSDN condition were significantly different from those of the CPT condition for flexion, extension, abduction, and medial rotation ranges of motion (ROMs). This was the case for all of the ROMs. For the local MTrP-DN condition, on the other hand, there were no discernible changes between it and either the PSDN condition or the local MTrP-DN environment. Using Fisher's least significant difference (LSD) test, post hoc comparisons were carried out to determine whether there was a significant difference between any of the three treatments in terms of the lateral rotation range of motion. These results revealed that there was no significant difference. In regard to enhancing the shoulder range of motion (ROM) in the areas of flexion, extension, abduction, and medial rotation, both local MTrP-DN and local MTrP-DN in combination with PSDN were equally beneficial. The CPT alone was not as effective as either procedure in enhancing shoulder range of motion in the AC. However, combined therapies are much more effective. With respect to the range of motion (ROM) for lateral rotation, however, there was no significant difference between any of the three situations.

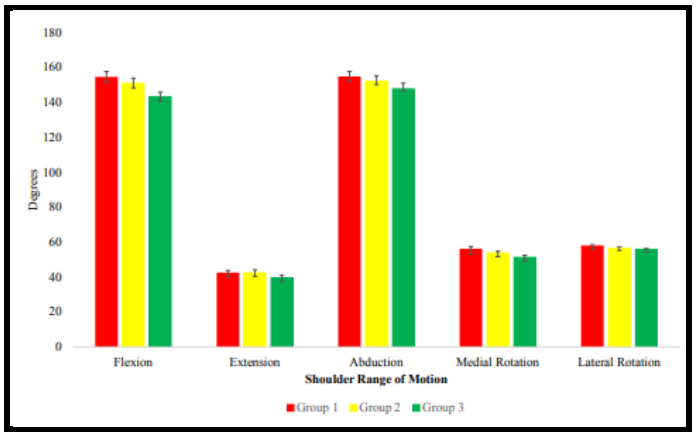


Figure 18. Active range of motion of the shoulders in three distinct groups.

Level of Pain

An analysis of covariance (ANCOVA) was performed to examine the influence of the DN on shoulder pain (VAS) in local MTrP-DN, local MTrP-DN, PSDN, and CPT situations. This was done to understand the differences between these conditions. These findings are shown in Table 9. In each of the three scenarios, as shown in Figure 19., DN had a significant influence on shoulder pain, with a p value that was either less than or equal to 0.05. Post hoc comparisons, which were carried out with the help of Fisher's least significant

difference (LSD) test, revealed that the mean scores for the local MTrP-DN condition (M = 2.80, SD = 0.44) and the local MTrP-DN along with PSDN condition (M = 2.71, SD = 0.47) were significantly different from those for the CPT condition (M = 3.87, SD = 0.62). The comparison of the mean scores of the two conditions was used to arrive at this conclusion. Both the local MTrP-DN condition (M = 2.80, SD0.44) and the PSDN condition (M = 2.71, SD = 0.47) did not significantly differ from one another. However, the local MTrP-DN condition did not significantly differ from the PSDN condition.

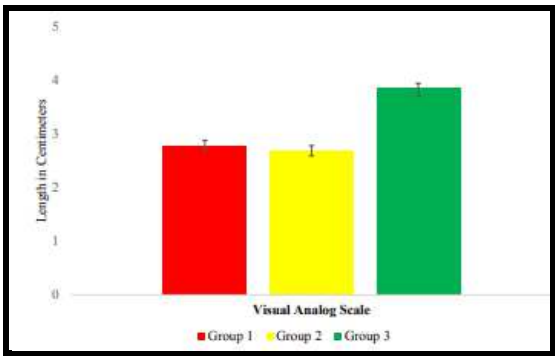


Figure 19. Scores on the visual analogue scale divided into three categories.

Disability of the Shoulders

An analysis of covariance (ANCOVA) was performed to assess the influence of the DN on shoulder pain and disability index (SPADI) in local MTrP-DN, local MTrP-DN, PSDN, and CPT conditions. This was done to determine the degree of similarity between the findings. These findings are shown in Table 4.8. As shown in Figure 20., the presence of the DN had a significant influence on the shoulder pain and disability index (SPADI) for all three disorders. This was evidenced by the fact that the significance threshold was set at $p < 0.05$. Using Fisher's least significant difference (LSD) test, post hoc comparisons revealed that the mean score for the local MTrP-DN condition (M = 27.52, SD = 3.85) and the local MTrP-DN along with PSDN condition (M = 28.12, SD = 3.81) was significantly different from that of the CPT condition (M = 42.21, SD = 4.15). This was the case for both conditions. The comparison of the mean scores of the two conditions was used to arrive at this conclusion. Although the PSDN condition (M = 28.12, SD = 3.81) did not significantly differ from the local MTrP-DN condition (M = 27.52, SD = 3.85), the local MTrP-DN condition did not seem to be significantly different from the PSDN condition.

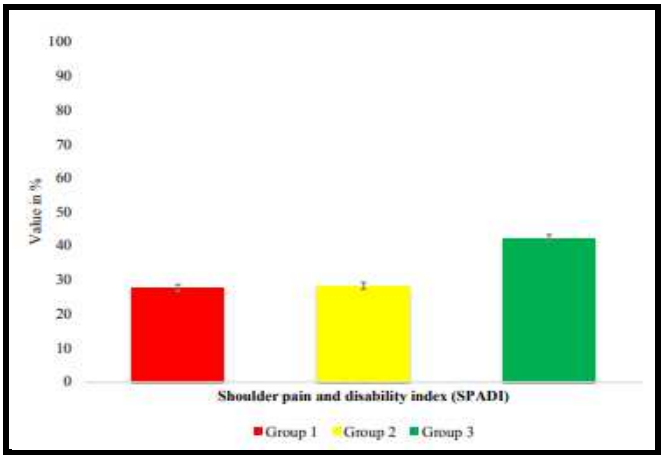


Figure 20. Scores for shoulder pain and disability in three distinct groups.

Pressure Pain Limit

The purpose of performing Welch's analysis of variance was to investigate the influence that the DN has on PPT in the context of local MTrP-DN, local MTrP-DN, PSDN, and CPT scenarios. Table 9. displays the findings of this comparison if you are interested. As shown in Figure 4.16, the presence of DNs had a significant influence on PPT, with a p value that was either less than or equal to 0.05. The F value for the supraspinatus muscle was 38.20, and the p value was either less than or equal to 0.05. The F value for the infraspinatus muscle was 439.5, and the p value was either less than or equal to 0.05 to indicate statistical significance. The F value for the subscapularis muscle was 434.7, and the p value was either less than or equal to 0.05. The F value for the deltoid muscle was 246.0, and the p value was lower than 0.05 since it was less than 0.05. There was a significant difference between the F value of 353.9 and the p value of 0.05 in the pectoralis major muscle. In conclusion, the F value for the upper trapezius muscle was 45.94, and the p value was either less than or equal to 0.05. Post hoc comparisons revealed that the mean scores for the local MTrP-DN and the local MTrP-DN combined with PSDN were significantly different from those of the CPT for each muscle evaluated for the PPT. This was applicable to all of the muscles that were evaluated. However, the local MTrP-DN condition did not significantly differ from either the MTrP-DN condition or the local MTrP-DN condition. This was the case.

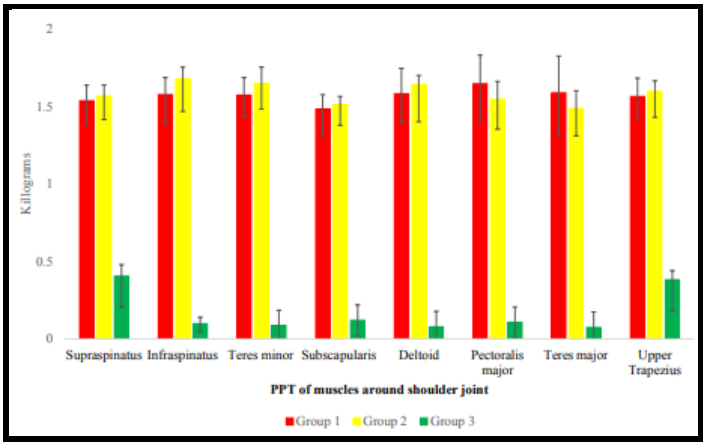


Figure 21. Scores for the pressure pain threshold in three distinct categories.

Table 9. Changes in the shoulder-specific outcome measures throughout the course of a twelve-day dry needling-based intervention are shown via analysis of covariance (ANCOVA) and Welch's ANOVA, along with post hoc analysis.

				Group 1-2			Group 2-3			Group 1-3	
	OM	F	MD	95% CI		MD	95% CI		MD	95% CI	
Range of motion	Flexion	18.01*	1.53	-1.03	4.11	5.97*	3.40	8.54	7.51*	4.89	10.1
	Extension	9.35*	-1.18	-3.22	0.85	4.33*	2.29	6.38	3.15*	1.11	5.18
	Abduction	5.60*	1.57	-0.59	3.74	2.24*	0.03	4.45	3.81*	1.56	6.07
	Medial Rotation	5.49*	1.74	-0.66	4.15	2.29	-0.11	4.70	4.04*	1.62	6.45
	Lateral Rotation	2.03	NA	NA	NA	NA	NA	NA	NA	NA	NA

Pain	Visual Analogue Scale	112.7*	0.10	-0.07	0.27	-1.1*	-1.35	-1.01	-1.0*	-1.25	-0.9
Disability	SPADI	309.1*	-0.60	-1.91	0.70	-14.0*	-15.3	-12.7	-14.6*	-15.9	-13.3
Pressure pain	Supraspinatus	38.20*	-0.03	-0.32	0.24	1.17*	0.82	1.52	1.13*	0.79	1.48
threshold	Infraspinatus	439.5*	-0.10	-0.36	0.15	1.59*	1.37	1.80	1.48*	1.33	1.64
	Teres minor	594.7*	-0.07	-0.28	0.13	1.56*	1.39	1.73	1.48*	1.34	1.63
	Subscapularis	434.7*	-0.02	-0.25	0.19	1.39*	1.23	1.56	1.36*	1.20	1.53
	Deltoid	246.0*	-0.05	-0.39	0.28	1.56*	1.29	1.83	1.50*	1.26	1.74
	Pectoralis major	231.1*	0.09	-0.23	0.43	1.44*	1.21	1.67	1.54*	1.27	1.81
	Teres major	353.9*	0.10	-0.16	0.37	1.41*	1.22	1.61	1.51*	1.30	1.73
	Upper Trapezius	45.94*	-0.03	-0.24	0.18	1.22*	0.89	1.54	1.18*	0.87	1.50

Note. OM - Groups 1--2 represent the differences between the local MTrP-DN group and the PSDN group, Groups 2--3 represent the differences between the local MTrP-DN group and the CPT group, and Groups 1--3 represent the differences between the local MTrP-DN group and the CPT group compared with the PSDN group. CI stands for confidence interval, and MD stands for mean difference. * Indicates that the p value is less than 0.05, whereas NA indicates that the result is not relevant since it is not significant. Both of these notations are possible because the p value is less than 0.05.

RESULTS ON DN PROCEDURES WERE CARRIED OUT ON THE TRAPEZIUS MUSCLE

For the purpose of the research, a total of fifty-five patients were recruited between the months of September 2019 and August 2020 (the supplementary questionnaire included all of the information). Patients who were in the three groups were not included since they were not followed up after one week. Fifty-two percent of the patients were female, and their average age was 37.8 years, with a standard deviation of 12.6 years. Twenty-four percent of the DN procedures were carried out on the trapezius muscle, while twenty-seven-point three percent were carried out on the iliac lumborum muscle, and twelve-point seven percent were carried out on the latissimus dorsi muscle. Each surgery required the insertion of one or more needles (76.9% of the operations involved the use of a single needle, whereas 23.1% involved the use of several needles).

The VAS score was 6.0±2.3 before the execution of DN, increased to 4.1±2.5 ten minutes later, and then decreased to 2.6±2.71 weeks after the treatment. The pain rating index was 17±9.1 before the operation, 10.8±8.5 ten minutes after the procedure, and 5.1±6.5 one week after the procedure to determine the level of pain experienced. Before the DN was performed, the current level of pain intensity was 2.6±1.0, and ten minutes after the DN, it decreased to 1.7±1.0.

Table 10. Features of the patients included in the research

Sociodemographic characteristics	
Age	
mean±SD	37.0±12.2
range	18–62 n (%)
Gender	
female	27 (51.9)
male	25 (48.1)

Birth country	
India	45 (86.5)
Other	7 (13.5)
SES	
1–4 – low	8 (15.4)
5–7 – reference	35 (67.3)
8–10—high	9 (17.3)
Marital status	
Single	35 (67.3)
Married	14 (26.9)
divorced	3 (5.8)
Smoking status	
Smoker	12 (23.1)
Nonsmoker	40 (76.9)
Dry Needling Procedure characteristics	
Physicians	
#1 (specialist)	18 (34.6)
#2 (resident)	34 (65.4)
Needles inserted	
Single	40 (76.9)
multiple	12 (23.1)
Initial VAS	
>5	33 (63.5)
≤5	19 (36.5)

$(P<0.001)$ and 1.1±1.2 1 week later (Table 2, Fig. 1). All comparisons were significant at P<0.05.

MANY-TERM ANALYSIS

The findings of a logistic regression study revealed that there is a connection between two factors and short-term success. The physician who performed the therapy (odds ratio: 10.08, 95% confidence interval: 1.15,88.4) and the single needle that was placed (as opposed to multiple needles) were the variables that contributed to the outcome (odds ratio: 4.55, 95% confidence interval: 1.03,20.11). Becoming a native born (that is, not having moved to India) was associated with medium-term success (improved after one week, compared with baseline) (odds ratio: 8.59, 95% confidence interval: 1.11, 66.28) and having a high degree of early discomfort (odds ratio: 11.22, 95% confidence interval: 1.82, 69.27). A high degree of early discomfort was also associated with medium-term success. Continuous success was associated with the insertion of a single needle, as opposed to the insertion of many needles (odds ratio: 5.00, 95% confidence interval: 0.97, 25.77).

Table 11. ANOVA-based univariate study of variations in pain indices

	Before the intervention (a)	10-min after the intervention (b)	1-week after the intervention (c)	P value
Visual Analogue Scale (VAS)	6.0±2.3	4.1±2.5	2.6±2.71	(a),(b)<0.001 (a),(c)<0.001 (b),(c) 0.009

Pain Rating Index	17±9.1	10.8±8.5	5.1±6.5	(a),(b)<0.001 (a),(c)<0.001 (b),(c) 0.001
Present Pain Intensity	2.6±1.0	1.7±1.0	1.1±1.2	(a),(b)<0.001 (a),(c)<0.001 (b),(c) 0.020

DISCUSSION

This study aimed to determine whether MTrP-DN and PSDN were successful in treating patients who were diagnosed with AC. One of our hypotheses was that MTrP-DN therapy for MTrPs might improve pain, range of motion (ROM), disability, and physical performance (PPT) in individuals who are living with AC. According to the findings of this study, which support the therapeutic applications of MTrP-DNs in participants with AC, pain is generated by the MTrPs of glenohumeral girdle muscles, which could hinder the range of motion and contribute to the impairment associated with AC. This research was conducted to investigate the role of MTrPs in the development of AC. Myofascial dysfunction may cause shoulder capsules that are already inflamed to be even more painful, limit movement, and induce shoulder impairment.

Similarly, compared with those in Group 3, the individuals in Group 1 and Group 2 presented a significant reduction in the degree of shoulder impairment. Following DN, there was an improvement in disability as a result of the decrease in joint restriction and the neutralisation of MTrPs, which are sources of pain. The literature, which matches our findings, demonstrates that DN, when combined with physical activity, has been demonstrated to be beneficial in reducing disability and improving quality of life in those who have suffered from shoulder myofascial pain, chronic rotator cuff tendinopathy, and subacromial pain syndrome. The researchers reported that SPADI significantly improved after receiving medication therapy, which was identified over the course of a case study that was performed to explore the influence of DN on participants who had been diagnosed with AC. Numerous findings indicate that a single session of the DN has the potential to minimise the degree of disability that is present in a golfer's elbow. Although DN, when coupled with other therapies, effectively reduces the degree of impairment experienced by patients who are suffering from low back pain, the clinical superiority of DN is not wholly evident. The results of the present study revealed that the deep DN was more useful than the shallow DN in terms of reducing impairment.

The outcomes of the study indicate that there was no significant difference between the MTrP-DN and PSDN groups in terms of the degree of shoulder pain, range of motion, physical performance, or impairment. This conclusion can be drawn from the observations of researchers. The results of this study indicate that the implementation of PSDN in combination with MTrP-DN does not result in any clinical repercussions that do not have an effect on the outcome measures in individuals who have AC of the shoulder joint. In the context of acute facet joint dysfunction of the neck, myofascial pain syndrome of the upper trapezius, and nonspecific thoracic pain syndrome, a few studies have shown that participants who were treated with PSDN significantly improved both their range of motion and their level of discomfort. These studies were conducted in the context of the neck. Importantly, in some situations, the cause of pain or restraint has a direct anatomical link with the spine; hence, PSDN has improved substantially. This is something that should be brought to your attention. In addition, the second possible reason for the improvement in joint function might be that paraspinal muscle spasms themselves are a source of pain and joint restriction in instances of facet joint dysfunction and myofascial pain syndrome. This is the second possible explanation for the improvement in joint function.

CONCLUSION

The primary purpose of this study was to explore the effectiveness of MTrP-DN, both with and without PSDN, in terms of improving shoulder pain, range of motion, physical performance, and physical impairment in individuals with AC. This was done to determine whether MTrP-DN is effective in addressing these issues. New research, on the other hand, reveals that decreased myofascial kinematics, stiffness in the shoulder girdle muscles, and MTrPs surrounding the shoulder joint, in addition to paraspinal muscular spasm, may further limit the range of motion in the shoulder. According to conventional wisdom, the characteristics that are considered hallmarks of arthritic pain (AC) include persistent inflammation and the tightness of joint capsules. As a consequence, it was hypothesised that MTrP-DN has the ability to effectively resolve MTrPs that are located in the vicinity of the shoulder muscles. Additionally, PSDN has the potential to offer additive benefits that result in a reduction in shoulder pain. Additionally, patients may experience improvements in shoulder range of motion, disability, and physical performance as a consequence of treatment.

According to the findings of this study, there were no significant differences in the clinical outcomes, such as the degree of pain, range of motion (ROM), physical performance (PPT), and disability, between the groups that received local MTrP-DN (Group 1) and the groups that received local MTrP-DN coupled with PSDN (Group 2). The injection of PSDN into the paraspinal muscles did not have any further benefits in terms of relieving the pain associated with AC. On the basis of these findings, PSDN is beneficial only in circumstances in which the muscles impacted by the MTrP have some kind of anatomical connection with the SC.

Compared with the CPT group, both Group 1 and Group 2 had significant improvements in shoulder range of motion (ROM), with the exception of shoulder lateral rotation (G3) from the CPT group. There was no noticeable improvement in the external rotation of the shoulder muscles when the DN was administered to the MTrPs of the shoulder muscles. This finding is likely related to the clinical features of chronic inflammation and subsequent fibrosis of the glenohumeral joint capsule AC, which leads to a restriction in the capacity to rotate externally. This is a possibility. On the other hand, there were no discernible differences between Group 1 and Group 2 in terms of the similarities and differences between their traits. Because PSDN was unable to reduce shoulder discomfort and, as a consequence, did not have any positive influence on the shoulder range of motion, PSDN did not have any further advantages in terms of enhancing the shoulder range of motion (ROM).

After the implementation of local MDN therapy, there was a significant improvement in shoulder range of motion (ROM) (with the exception of shoulder lateral rotation ROM), pain intensity, disability, and physical performance (PPT). This was confirmed by a comparison between the groups. The findings of this study indicate that DN intervention could be useful for people who have AC. Even if this is the case, the PSDN does not have an effect that can be considered cumulative on the outcome measures. The findings of the present study indicate that there was no significant difference between the MTrP-DN and PSDN groups in terms of the severity of shoulder pain, range of motion, physical performance, or disability. This is because there was no significant difference between the two groups. The combination of the PSDN and the MTrP-DN does not have any clinical significance since this is not reflected in the findings of persons who have AC of the shoulder joint. This is the reason why the combination does not have any clinical significance.

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Contributions

Vikas Tiwari: acquired the data, or analysis and interpretation of data, designed and drafted the work and substantively revised it for content Jaishree Tiwari: revised the manuscript, worked on the English, and made the final version. All authors contributed to the article and approved the submitted version.

Conflict of interests

The authors declare no conflict of interests.

Ethical Consideration

The AMCH Institutional Ethical Committee (AMCH-IEC/0017-19) provided ethical approval. Before any data was collected, the participants received a thorough explanation of the study's objectives and methodology. The participants' privacy and confidentiality were guaranteed and upheld. At any point during the data collection process, participants were made aware of their right to withdraw from the study or to refuse to participate. Participants were guaranteed of the anonymity of their answers, and no personal information was recorded. Prior to the collection of data, the participants provided written informed consent.

Reffrences

[1] Ángela Menéndez-Torre (2023) An overview of the incidences and costs of low back pain. *Orthop. Clin. N. Am.* 1991, *22*, 263–271.

[2] Syed Md Akram Kashif G, (2024) Van Oosterwijck, J.; van Ittersum, M.; Meeus, M. How to explain central sensitisation to patients with “unexplained” chronic musculoskeletal pain: Practice guidelines. *Man. Ther.* 2011, *16*, 413–418.

[3] Systematic Review of Outpatient Services for Chronic Pain Control—PubMed. Available online: https://pubmed.ncbi.nlm.nih.gov/9483161/ (accessed on 26 September 2022).
[4] Watson, J.A.; Ryan, C.G.; Cooper, L.; Ellington, D.; Whittle, R.; Lavender, M.; Dixon, J.; Atkinson, G.; Cooper, K.; Martin, D.J. Pain Neuroscience Education for Adults with Chronic Musculoskeletal Pain: A Mixed-Methods Systematic Review and Meta-Analysis. *J. Pain* 2019, *20*, 1140.e1–1140.e22.
[5] Lew, Jennalyn & Kim, Jennifer & Nair, Preeti. (2020) M. The impact of combining pain education strategies with physical therapy interventions for patients with chronic pain: A systematic review and meta-analysis of randomised controlled trials. *Physiother. Theory Pract.* 2021, *37*, 461–472.
[6] Dutton (2004) Preoperative pain management education: A quality improvement project. *J. Perianaesthesia Nurs. Off. J. Am. Soc. PeriAnaesthesia Nurses* 2015, *30*, 221–227.
[7] Fricton J. Masticatory myofascial pain: an explanatory model integrating clinical, epidemiological, and basic science research. Bull Group Int Rech Sci Stomatol Odontol. 1999;41:14e25.
[8] Shah, J, Heimur, J. New frontiers in pathophysiology of myofascial pain. Pain Pract. 2:26e33.
[9] Rocío García-de la-Banda-García, (2023) Myofascial Pain and Dysfunction. The Trigger Point ManualIn: Upper Half of Body. vol. 1. Baltimore: Lippincott Williams &Wilkins; 1999.
[10] Rayegani, Seyed Mansoor & Bayat, Masume , (2013) Myofascial pain syndromes and the fibromyalgia syndrome: a comparative analysis. In: Fricton J, Awad EA, eds. Myofascial Pain and Fibromyalgia. New York: Raven Press; 1990:43e66.
[11] Kato KSP, Evengard B, Pedersen NL. Chronic widespread pain and its comorbidities: a population-based study. Arch Intern Med. 2006;166:1649e1654.
[12] Sendarrubias, Gracia M & Rodriguez, (2020) The effect of cetylated fatty esters and physical therapy on myofascial pain syndrome of the neck. J Bodyw Mov Ther. 2011;15:363e374.
[13] Sharan D, Ajeesh PS. Development of a score for assessing severity, predicting interventions and prognosis of musculoskeletal disorders. Work. 2012;41:6007e6010.
[14] Sharan D, Ajeesh PS, Rameshkumar R, Jose J. Risk factors, clinical features and outcome of treatment of work related musculoskeletal disorders in on-site clinics among IT companies in India. Work. 2012;41:5702e5704.
[15] Travelll J, Simons DG. Myofascial Pain and Dysfunction. The Trigger Point Manual. I ed. 1992.
[16] Schneider MJ. Tennis elbow. In: Ferguson LW, Gerwin R, eds. Clinical Mastery in the Treatment of Myofascial Pain. LWW; 2005:132.
[17] Cummins M. Myofascial pain syndromes. In: Hazleman B, Riley G, Speed C, eds. Soft Tissue Rheumatology. 2004:509e522. Oxford.
[18] Leahy PM, Mock LE. Myofascial release technique and mechanical compromise of peripheral nerves of the upper extremity. Chiro Sports Med. 1992;6:139e150
[19] Huijbregts PA. Manual therapy. InPain Procedures in Clinical Practice 2011 Jan 1 (pp. 573-596). Hanley & Belfus. Available from: https://www.sciencedirect.com/topics/medicine-and-dentistry/manual-therapy (last accessed 21.9.2019)
[20] IFOMPT. OMPT Definition. Available from: https://www.ifompt.org/About+IFOMPT/OMPT+Definition.html (accessed 13 January 2023).
[21] Locher H, Beyer L. Manual medicine, manual therapy. Manuelle Medizin. 2021 Nov;59(4):254-66.
[22] Schulze NB, de Melo Salemi M, de Alencar GG, Moreira MC, de Siqueira GR. Efficacy of manual therapy on pain, impact of disease, and quality of life in the treatment of fibromyalgia: a systematic review. Pain Physician. 2020;23(5):461.
[23] MAJ Guy R Majkowski PT, DSc, OCS, FAAOMPT, Norman W GillIII PT, DSC, Cert MPT, OCS, FAAOMPT, Physical Therapy Modalities The Sports Medicine Resource Manual, 2008 Available

from: https://www.sciencedirect.com/topics/nursing-and-health-professions/physiotherapy (last accessed 21.9.2019)

[24] Javadov A, Ketenci A, Aksoy C. The efficiency of manual therapy and sacroiliac and lumbar exercises in patients with sacroiliac joint dysfunction syndrome. Pain Physician. 2021;24(3):223.

[25] Indahl, A.; Kaigle, A.M.; Reikerås, O.; Holm, S.H. Interaction between the Porcine Lumbar Intervertebral Disc, Zygapophysial Joints, and Paraspinal Muscles. *Spine* **1997**, *22*, 2834–2840.

[26] Solomonow, M.; Zhou, B.-H.; Baratta, R.V.; Burger, E. Biomechanics and electromyography of a cumulative lumbar disorder: Response to static flexion. *Clin. Biomech.* **2003**, *18*, 890–898.

[27] Williams, M.; Solomonow, M.; Zhou, B.H.; Baratta, R.V.; Harris, M. Multifidus Spasms Elicited by Prolonged Lumbar Flexion. *Spine* **2000**, *25*, 2916–2924.

[28] Roberts, S.; Eisenstein, S.M.; Menage, J.; Evans, E.H.; Ashton, I.K. Mechanoreceptors in intervertebral discs. Morphology, distribution, and neuropeptides. *Spine* **1995**, *20*, 2645–2651

[29] McLain, R.F.; Pickar, J.G. Mechanoreceptor Endings in Human Thoracic and Lumbar Facet Joints. *Spine* **1998**, *23*, 168–173.