International Journal of Kinesiology & Sports Science
ISSN: 2202-946X
www.ijkss.aiac.org.au

Spencer Muscle Energy Technique Versus Conventional Treatment in Frozen Shoulder: A Randomized Controlled Trial

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ARTICLE INFO

Article history
Received: April 24, 2022
Accepted: July 19, 2022
Published: July 31, 2022
Volume: 10 Issue: 3

Conflicts of interest: The authors declare no conflict of interest.
Funding: None

ABSTRACT

Background: The latest osteopathic manual therapy method widely used is the Spencer Muscle Energy Technique (SMET) adopted in western clinical practices to treat various shoulder ailments. **Objective:** The study compares conventional treatment procedures' effects and the SEMT for a frozen shoulder. **Methodology:** A randomized, single-blind observational experiment was carried out from February to May 2019. The study included idiopathic frozen shoulder patients of either sex aged 30 to 70 years, phases 1 and 2, or a stiff joint of an agonizing shoulder for a minimum of 3 months. Among the 60 patients examined, 40 were involved: 20 (50 %) in both groups. The mean age in the control and experimental groups was 49.75±8.52 and 49.10±9.01, respectively, the dissimilarities of the groups in terms of disability and pain were not substantial ($P > 0.05$) at standard, but there was a considerable variance in the assessments of halfway and post-intercession ($p < 0.05$), and similarly was the issue of shoulder Range of Motion (ROM). They comprised 30 (65 %) females and 10 (35 %) males randomly divided into two groups. The first group received SMET, and the second group received the conventional treatment procedure. Numeric Pain Rating Scale (NPRS) was utilized to evaluate Shoulder pain, comprising 11 objects of no pain with a value of 0 and objects of most pain with a value of 10. Standard physical goniometer used to record Shoulder ROM as a consistent device for the analysis of degrees' movement. **Results:** NPRS score values were t = 26.1, p-value of 0.000. The Wilcoxon Sign Rank test was adopted in the control group to discover the significance of the pain intensity treatment. The NPRS score values were W = -4.06, p-value of 0.000. A double-sample t-test was adopted to discover the treatment significance with the experimental and control group. The values for the Disability Index (SPADI) score in the experimental group were t=17.31p-value of 0.000. The values for the SPADI score in the control group were t=18.55 p-value 0.000. **Conclusions:** SMET was more effective in shoulder pain reduction, in which conventional treatment showed more effectiveness in enhancing the shoulder ROM. It can be concluded that SMET can be used or incorporated as an alternative treatment method or combined with other treatment procedures for pain reduction.

Key words: Frozen Shoulder, Bursitis, Manipulation Therapy, Range of Motion, Muscle Stretching Exercises, Spencer Technique

INTRODUCTION

Frozen shoulder is a normal, self-restrictive situation with unclear aetiology to exacerbating pain, difficulty, and advanced range of the shoulder Range of Motion (ROM) equally active and passive with the absence of any pathology of the shoulder (Jivani & Hingarajia, 2021). Due to the substantial uncertainty of the cause of the frozen shoulder, many aspects are associated with frozen shoulder, including a person above 40 years old and of the female gender (Longo et al., 2020). Frozen shoulder is clinically described by the continuing onset of shoulder pain and advanced exacerbation of the shoulder joint leading to exertion in the higher extremity activity, significant disability, and functional restrictions. The most common symptom of a frozen shoulder is night pain, resulting in sleep impediment that leads to one-sided sleep on the uninfected shoulder (Mao et al., 2022). Through each progressive day, frozen shoulder symptoms change. Concerning the physical findings, there is initially tenderness in the anterior and lateral glenohumeral joint line supervened by trigger points and muscle spasms in the pectoral muscle, scapula, trapezius, and deltoid muscles resulting in pain in the neck area and over the shoulder girdle. At a later stage, due to substantial shoulder ROM restrictions, patients grow compensatory scapula-thoracic shoulder movement that alters shoulder alignment (Redler & Dennis, 2019). The frozen shoulder exact protocol of treatment is still not yet well-proven. However, the most exposed frozen shoulder surgical procedure managements are manual therapy under

Published by Australian International Academic Centre PTY.LTD.

http://dx.doi.org/10.7575/aiac.ijkss.v.10n.3p.28

general anesthesia, synovectomy, the arthroscopic capsular release technique, bulging joint merging, and supra-scapula nerve block (Kim et al., 2017).

The first-line treatment option for a frozen shoulder is often physical therapy, in which different exercises and modalities of physical therapy help relieve pain, and ROM maintains and causes function restoration (Griggs et al., 2000). Cryotherapy, heating methods, Ultra-Sound (US), Transcutaneous Electrical Nerve Stimulation (TENS), pulsed electromagnetic field treatment, interventional therapy, LASER (light amplification by stimulated emission of radiation), and acupuncture are the majorly commonly used methods for shoulder pain relief and stiffness (Mao et al., 2022). Exercises such as active and passive ROM exercise, capsular release and stretching method, shoulder girdle muscle stretching and strengthening exercise, codman exercise, manipulation and mobilization method and Proprioceptive Neuromuscular Facilitation (PNF), home exercise, and patient education are most often used for the frozen shoulder (Contractor et al., 2016). The commonly used manual therapeutic method to relieve pain is the Muscle Energy Technique (MET), which increases joint ROM through adhesion breaks within joints, releases muscle tone, and stretches tight muscles and fascia. It also assists in improving the strength of the muscle due to its involvement in voluntary isometric shrinkage of the craving muscle against the resistance offered by the therapist. Resistance is provided at a pain-free physiological barrier, and the reduction continues for 7 to 10 seconds in a particular controlled direction (Fryer & Ruszkowski, 2004).

A method of muscle release procedure is used before tightening the craving muscle. It operates based on reciprocal and autogenic inhibition. In autogenic inhibition, the voluntary isometric reduction of the craving muscle within the physiological septum causes post-isometric relaxation via activation of the Golgi tendon organs. The patients in reciprocal inhibition must present a voluntary isometric contraction of the antagonist muscle that offers relaxation against the muscles and muscle spindle activation, resulting in the antagonist muscle contraction reflexivity (Nambi., 2013). The effectiveness of MET found in chronic capsulitis is due to its effect on relieving pain, ensuring ROM incrections, and developing functional activities due to the muscle contraction in a precise direction and in a monitored position over resistance to assist in improving joint range by advancing joint flexibility. This procedure is suggested for all joints with limited ROM (Butt & Tanveer, 2022).

Narayan & Jagga. (2014) conducted a pilot study on patients with frozen shoulder. They used the MET method as a treatment to understand its effects on shoulder functional ability. Some 30 patients of both sexes were divided into the control and experimental groups, built on inclusion and exclusion conditions by an appropriate random sampling method. Conventional therapy combined with MET for shoulder external rotation flexion, and abduction, was applied in the trial group for 15 weeks, three times per week, 1 session per day in 3 recurrences. The conventional treatment was offered to the control group (US, hot packs, codman, pulley exercise, and active assisted exercises). It was found that both sexes displayed substantial differences and advanced shoulder pain and degree of disability after treatment. In contrast, the trial group showed a considerable improvement compared to the control group. It was concluded that MET was far more effective in shoulder improvement functions in patients with adhesive capsulitis.

A pilot study was conducted by Sharma et al. (2016) to discover the efficacy of MET and specific lower capsular enlarging in frozen shoulder patients. They invited 30 patients of both sexes within the age range of 40 to 70 into the trial and control group, with 15 in each group. US and MET, hot pack, and inferior capsular stretching was received by group A, while hot pack, US and MET was received by group B for 4 weeks, at 5 sessions per week. Disability Index (SPADI) shoulder ROM, shoulder pain, and Visual Analogue Scale (VAS) were used as outcome measures and significant improvement was found in both groups. It was concluded that inferior capsular dilation and MET significantly improved VAS, SPADI and shoulder ROM statistically and clinically.

Based on the patients' clinical condition, various forms of MET are available for different joints and muscles. The latest osteopathic manual therapy method widely used is the Spencer Muscle Energy Technique (SMET) adopted in western clinical practices for treating various shoulder ailments. It was recently used for pain reduction and articular ROM increment through breaking-up adhesions within joints, muscle tone release, and stretching tight muscles and fascia (Curcio, 2017).

The technology improves the pain-free range of shoulder joint motion in frozen shoulder patients by increasing blood circulation in the shoulder joint, promoting lymphatic flow and muscle stretching, capsule, and ligaments of the shoulder joint. Many medical healthcare professionals in professional sports have recently adopted this method during training sessions to improve the performance of the athletes in various sports (Iqbal et al., 2020). There are very few studies available concerning SMET. Moreover, there are minimal studies concerning the effect of SMET on ROM, pain, and the disability of the shoulder in patients with frozen shoulders. This research was done to find out how such a technique affected patients with frozen shoulder. The main goal was to determine the effects of SMET on frozen shoulder patients in Libya. The study's objective was to equate the SMET short-term impacts through a conventional treatment procedure in shoulder pain reduction, enhancing shoulder ROM, and shoulder disability reduction in patients with frozen shoulders.

METHODS

Study Design

The randomized trial of single-blind control was carried out at the Tobactos Physiotherapy Centre, Kerzaz Physiotherapy Centre, and Alfa Rehab Centre, Misrata, Libya, starting February until May 2019. All the experimental procedures of study conformed with the Helsinki Declaration and approved by Ethical Committee of the College of Medical

Technology (Reference number PT-318-2019). Written permission was also acquired from the hospitals that partook in this study. Individuals that agreed to partake in this study provided written consent before initiating this study.

Participants and Sample Size Calculation

The G*Power (Version 3.1.6) was used to calculate sample size, and both the alpha level and effect size are 0.05 and 0.23 relatively (Lim et al., 2017; Contractor et al., 2016; Sullivan et al., 2009). In order to achieve 80% power, the requirement was 15 participants per group with a 15% dropout rate, 20 individuals were recruited each group for a total of 40 throughout the two groups. The sample was formed via purposive sampling of non-possibility between patients of both sexes aged 30 to 70 years. In terms of the inclusion criteria, cclinically identified patients with unilateral adhesive capsulitis, frozen shoulder phase 1 or 2, and patients with limited ROM (loss of at least 25% compared to non-involved shoulder in one or more directions) were selected. However, cases with a history of significant shoulder surgery, cervical neuropathy which is one of the illnesses that can be affecting a person's shoulder, neurological changes or paralysis of the afflicted upper limb, fractures or open sores and intra-articular injection pain management history were identified as exclusion criteria. They comprised of 30 (65 %) females and 10 (35 %) males. The mean age in the experimental group and control groups was 49.75±8.52 and 49.10±9.01, respectively. The subjects were divided randomly using a sealed envelope approach into two equal groups. The first group (Group 1) received SMET, and the second group (Group 2) received the conventional treatment procedure.

Assessment Protocol

The Numeric Pain Rating Scale (NPRS) was utilized to evaluate shoulder pain, comprised of 11 objects of no pain with a value of 0 and objects of most pain with a value of 10 (Hawker et al., 2011). Shoulder ROM was recorded with a standard physical goniometer, as a compatible device for analyzing the degrees of the joint shoulder movement (Fieseler et al., 2015; Kolber & Hanney, 2012). In a capsular pattern, passive mobility is also constrained, with external rotation being the most common motion, followed by abduction and internal rotation. In addition, with less is involved in the movements of flexion and internal rotation (Iqbal et al., 2020). An experienced physiotherapist with postgraduate education, more than 20 years of clinical experience, and additional certifications on manual therapy performed the measurements in both groups. On the other hand, the pre- and post-assessments were performed by different physiotherapists who were blinded to the group assignment and treatment protocols.

A fast version of a questionnaire for the disability of the arm, hand, and shoulder has been implemented for of upper extremity disorders' practical assessment. It is an enhanced version, and it appeared to be valid self-assessment and reliable (Cronbach α = 0.92-0.95) instrument (Angst et al., 2011). It provides a measurement of the disability of the shoulder, between 0 % (best) till 100 % (worst), through the aid of 11 inquiries rated on a Likert scale from 0 to 5. Various studies have described different break-off marks to explain symptom extremity (Kennedy, 2011; Gummesson et al., 2006). Also, the SPADI is a valid and reliable clinical scale (Cronbach-α>0.90). There was an adoption of self-directed questionnaires by the physical psychiatrists and orthopedics for the proper shoulder assessment associated diseases. It comprises 13 elements with two spheres. Both subscale evaluates debility evaluates debility evaluates debility within 5 items that process pain, and more 8 items related to another subscale. Separately, the subscales are summed-up and converted to a mark ranging between 0 (minimum shoulder dysfunction) to 100 (high shoulder dysfunction) (Gummesson et al., 2006). Separately, the subscales are summed-up and converted to a mark ranging between 0 (minimum shoulder dysfunction) to 100 (high shoulder dysfunction) (Gummesson et al., 2006).

Intervention protocols

SMET protocol

Infrared was set for 10 minutes before any SMET was given. Patients were initially offered 7 to 10 minutes of heating pack control treatment, after which the glenohumeral joints were moved via SMET. The afflicted shoulder was elevated as the patient was laying on their side. With the proximal hand, the therapist stabilized the shoulder girdle, and in 7 separate motions, the distal hand applied force into the shoulder's constricted barrier. In 7 distinct movements, the therapist used force on the shoulder's constrictive barrier with the distal hand while supporting the shoulder girdle with the proximal hand. These included glenohumeral pump, distraction, abduction with internal rotation, shoulder extension, circumduction with compression, and shoulder flexion. Following the complete action, patients were encouraged to use their muscles for 3 to 5 seconds against little resistance provided by the therapist. Over the course of three weekly sessions on alternate days for four weeks, the exercise was done 3-5 times with rest periods (Dudkiewicz et al., 2004; Knebl et al., 2002).

Conventional treatment protocol

Conventional treatment was applied for four weeks with rest intervals over three sessions per week (Shah et al., 2021), and it included the following:

Infrared on the shoulder joint for 10 minutes.

Capsular stretching on the shoulder joint included the anterior capsule, posterior capsule, and inferior capsule, and each stretching position was held for 30 sec and repeated three times.

Pendular exercise with a weight cuff increases flexion, extension, and abduction ROM.

To guarantee the quality of reporting, the Consolidated Standards for Reporting of Trials (CONSORT) were followed. (Figure 1).

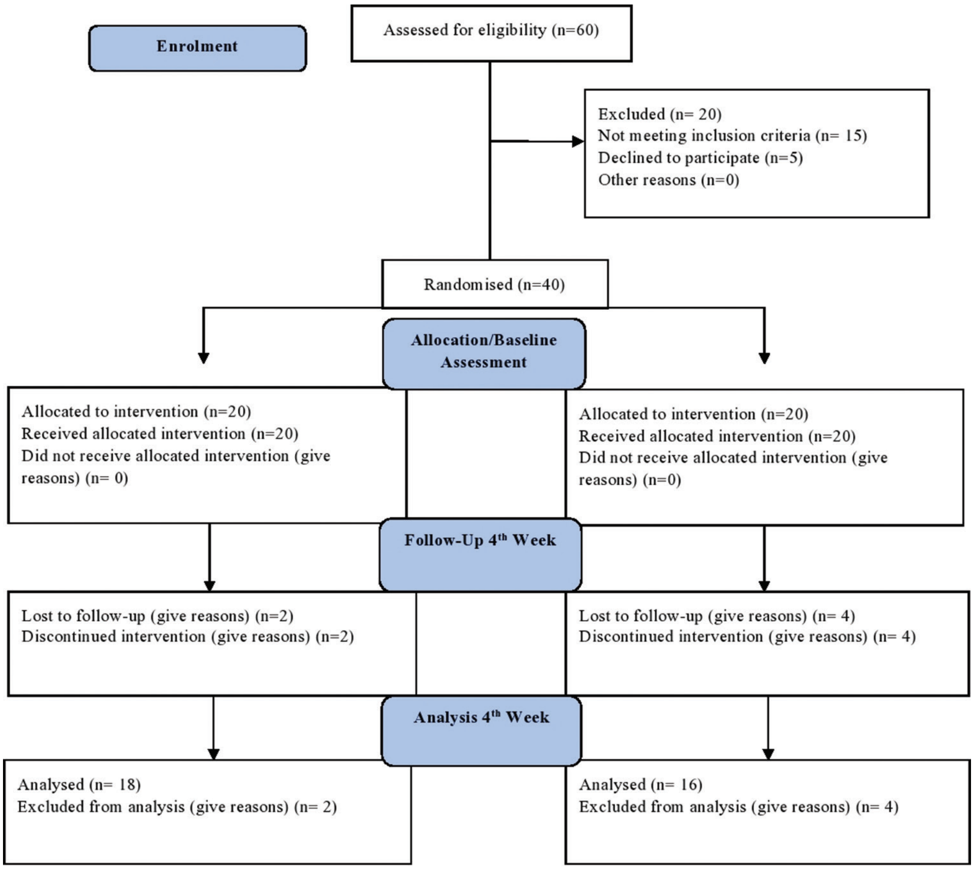

Figure 1. Consolidated Standards for Reporting of Trials (CONSORT) Diagram

Statistical Analysis

The data were analyzed using SPSS Software version 21. The normality of the data was examined using the shapiro-wilk test. Data analysis was achieved by using a paired sample t-test to find the effectiveness or significance of both treatment techniques (SMET and the conventional treatment protocol) within a group for parametric data such as shoulder ROM and SPADI score. A paired sample t-test for the experimental group and the wilcoxon signed ranked test for the control group were employed to find the effectiveness or significance of both treatment techniques for non-parametric data, such as the NPRS score. A two-tailed mann-whitney u-test was employed to compare the effectiveness or significance of treatment technique between groups for non-parametric data such as the NPRS score. The alpha level was set to $P<0.05$.

RESULTS

Participants' Characteristics, Adherence, and Attrition

Regarding the 40 participants utilizing a randomized trial with single-blind control, the lost to follow-up was 2 participants for SMET group (n = 2: reluctantly abandoned the sessions), In contrast, the conventional treatment group lost 4 individuals to follow-up (n = 1: due to illness; n = 2: due to family obligations, and n = 1: due to travel). SMET and conventional therapy group attrition rates were 10% and 20%, respectively. 34 people in total participated in the study (Figure 1). Considering the intervention's adherence, the SMET group attended (23.8 ± 0.50) sessions with a percentage of 90%, while the conventional treatment group attended (23.2 ± 1.81) sessions with a percentage of 80%.

Among the 60 patients examined, 40 were involved: 20 (50 %) in both groups. They comprised of 30 (65 %) females and 10 (35 %) males. The mean age in the experimental group and control groups was 49.75±8.52 and 49.10±9.01, respectively, the dissimilarities of the groups in terms of disability and pain were not substantial ($P > 0.05$) at standard, but there was a considerable variance in the assessments of halfway and post-intercession ($p < 0.05$), and similarly was the issue of shoulder ROM.

The NPRS score mean value in the two phases (pre-intervention and post-intervention) in both the control and experimental groups is provided in (Table 1). The wilcoxon sighed-rank test showed that the mean NPRS scores in the experimental group in both stages were 7.2 ± 1.05 and 2.85 ± 0.87, whereby in the control group, 7.3 ± 1.13 and 4.05 ± 0.86, respectively. A double-sample t-test was used in the experimental group to discover the pain intensity treatment. The NPRS score values were t = 26.1, the p-value of 0.000, which shows that the SMET scale was very significant, and the authors admit the alternate hypothesis that there was a huge difference in reduction of shoulder pain intensity over overhead movement after the SMET application in patients with frozen shoulder. The wilcoxon sign rank test was adopted in the control group to discover the significance of the pain intensity treatment. The NPRS score values W = -4.06,

Table 1. Mean difference between pre and post nprs score in experimental and control group (paired sample t-test and wilcoxon sign rank test)

Group	Pre-intervention	Post-intervention	t and w-value	p-value
	Mean SD	Mean SD		
Experimental	7.2 1.05	2.85 0.87	t=26.1	0.000
Control	7.3 1.13	4.05 0.86	w=-4.06	0.000

p-value of 0.000, signified the huge importance of conventional treatment. The authors condone the alternate hypothesis that there was a significant difference in the shoulder pain intensity reduction on overhead movement after traditional treatment application on frozen shoulder patients.

The mean post-intervention NPRS scores in the experimental and control groups are 2.85±0.87 and 4.05±0.86, respectively. The p-value of the mann-whitney u-test is 0.001 and U=82, indicating a significant difference in improvement between groups, and the authors accept the alternate hypothesis. The experimental group receiving SMET improved much more than the control group receiving conventional treatment in relation to pain intensity on the NPRS scale (Table 2).

The shoulder flexion, abduction, and internal and external rotation mean values in both stages (pre and post) for the control and the experimental group are shown in (Table 3). The mean shoulder flexion in the pre-and post-intervention in the experimental group was 120.35 ± 22.4 and 150.1 ± 19.46 while 102.6 ± 18.70 and 150.16 ± 17.81 for the control group, respectively. The mean shoulder abduction for both stages in the experimental group was 98 ± 16.51 and 119.75 ± 15.75, while 95.25 ± 13.53 and 130.05 ± 13.30 in the control group, respectively. The mean internal rotation of the shoulder in the two stages in the experiment group was 50 ± 14.35 and 57.1 ± 13.40, while 30.95 ± 12.03 and 56 ± 10.60 in the control group, respectively. The mean in the external shoulder rotational in both stages in the experimental group was 30.95 ± 12.03 and 45.95 ± 13.03, while 22.9 ± 8.04 and 45.60 ± 9.69 in the control group, respectively. A double-sample t-test was adopted to discover the treatment significance with the control and the experiment groups. The values for shoulder flexion in the experimental groups were t(-14.8), p-value 0.000, for shoulder abduction were t(-14.34), p-value 0.000, for shoulder internal rotation were t(-16.28), p-value 0.000. For shoulder abduction was t(-14.85), p-value 0.000 of the external shoulder rotation, indicating that SMET is very important. The authors condone the alternative hypothesis that there is a considerable difference in the development of shoulder flexion, abduction, and internal and external ROM after SMET application in patients with frozen shoulders. The values for shoulder flexion in the control groups were t(-15.6) p-value 0.000, for shoulder abduction were t(-23.5) p-value 0.000, for shoulder internal rotation were t (-20.85) p-value 0.000, and for external rotation were t (-16.79) p-value 0.000, which showed that the conventional treatment was very significant. The authors condone the alternative hypothesis that there is high difference in the development of shoulder flexion, abduction, and internal and external rotation ROM after adopting conventional treatment in patients with frozen shoulders.

Table 2. Mean change in nprs score for both the groups after intervention (independent sample t- test)

Group	Mean of post-intervention score	± SD	u-value	p-value
Experimental	2.85	0.87	82	0.001
Control	4.05	0.86		

The mean SPADI in the two phases in the experimental group was 51.80 ± 8.03 and 35.30 ± 5.93, while it was 60.60 ± 9.29 and 43.55 ± 11.19 in the control group, respectively (Table 4). A double-sample t-test was adopted to discover the treatment significance with the experiment and control group. The values for the SPADI score in the experimental group were t(17.31) p-value of 0.000, showing that SMET was of considerable importance and the authors condone the alternative hypothesis that there is a significant difference in shoulder pain reduction and the degree of disability when applying SMET to patients with frozen shoulder. The values for the SPADI score in the control group were t(18.55) p-value 0.000, signifying the importance of conventional treatment and the authors condone the alternative hypothesis that there was a considerable difference in the shoulder pain reduction and degree of disability after applying conventional treatment in patients with frozen shoulder.

DISCUSSION

Invitations were extended to 40 participants who could participate in the study and satisfied the inclusion criteria. The subjects were randomly dispersed into two groups via a wrapped envelope process (experimental and control), each having an equal number (n=20). The conventional treatment procedure was offered to the control group, while the experimental group received SMET. Shoulder ROM, pain, and shoulder disability information were gathered from all 40 subjects before and after the intervention after four sessions.

The SMET was undertaken in a series of MET for shoulder flexion, extension, circumduction traction and compression, abduction with internal and external rotation, and traction of the deltoid and internal rotation. The goal of the current investigation was to determine how SMET affected ROM and pain temporarily and frozen shoulder on the disability of patients and to compare with the conventional treatment procedure. Both treatment groups in this study displayed tremendous improvement in ROM, pain, and disability of the shoulder over four treatment sessions. They also

Table 3. Mean between pre and post shoulder flexion, abduction, internal rotation, and external rotation rom in the control and experimental groups (paired-sample t-test)

Variable	Period	Experimental group Mean SD	Control group Mean SD
Shoulder Flexion	Pre-intervention	120.35 22.42	102.6 18.70
	Post-intervention	150.1 19.46	150.16 17.81
	Paired sample t test	t (-14.8), p-value 0.000	t (-15.6), p-value 0.000
Shoulder Abduction	Pre-intervention	98 16.51	95.25 13.53
	Post-intervention	119.75 15.75	130.05 13.30
	Paired sample t test	t (-14.34), p-value 0.000	t (-23.5), p-value 0.000
Shoulder Internal Rotation	Pre-intervention	50 14.35	34.65 8.88
	Post-intervention	57.1 13.40	56 10.60
	Paired sample t test	t (-16.28), p-value 0.000	t (-20.85), p-value 0.000
Shoulder External Rotation	Pre-intervention	30.95 12.03	22.9 8.04
	Post-intervention	45.95 13.03	45.60 9.69
	Paired sample t test	t (-14.85), p-value 0.000	t (-17.69), p-value 0.000

Table 4. Mean difference between pre and post spadi score in experimental group and control group (paired sample t-test)

Groups	Pre- intervention	Post- intervention	t-value	p-value
	Mean SD	Mean SD		
Experimental	51.8 8.03	35.3 5.93	17.31	0.000
Control	60.60 9.29	43.55 11.19	18.55	0.000

displayed significant statistical results for ROM, pain intensity, and SPADI for patients with frozen shoulder.

The main reason behind pain reduction in the trial group could be the tissue and nerve factor because of the SMET and superficial heating effects of the infrared. There was stimulation of low-threshold mechanoreceptors within muscle and joints during the SMET, which resulted in the generation of a sympathetic excitatory stimulus of somatic efferent that assisted in localising the activation of the periaqueductal matter in the midbrain. The nociceptive inhalers then impede nociceptive impulses in the dorsal horn of the spinal cord by blocking the gait. Pain is suppressed or modulated through this pain gait pathway by activation of the mechanoreceptors within the muscles and joints (Leon Chaitow, 2013).

The control group's reason for pain reduction could be the infrared's superficial heating effect, which assisted in vascular dilation and pain threshold alteration through a local tissue heating effect. This dilation of blood vessels helped supply oxygen and nutrients, removed waste products, and metabolites and promoted the inflammatory process (Leung & Cheing, 2008). Exercise within the pain-free ROM aids in the movement of synovial fluid within the joints, and mechanoreceptor stimulation that aids in muscle relation reflex and inflammatory and pain reduction (Leon Chaitow, 2013).

The findings showed that SMET was much more effective than conventional treatment at relieving shoulder discomfort and impairment and improving shoulder ROM. This observation has been supported by literature on a pain-reduction technique developed by SMET ($p<0.001$) through shifting pain circulatory biomarkers, as well as restoring pain-free joint mobility by stretching soft tissue and the capsule of the shoulder (Knebl et al., 2002). Absorption of isometric muscle contraction together with moving the shoulder complex stimulates the mechanoreceptors of muscles and joints that close the pain portal at the spinal cord's dorsal horn stage and stimulate pain descendant modulation by the periaqueductal grey of the midbrain (Zreik et al., 2016).

The finding of the current study are inline with the srudy of Iqbal et al., (2020) that showed the SMET group's NPRS score was lower ($p<0.001$) than that of passive stretching and deep heating. It was revealed by a similar study that there was no substantial result ($p>.05$) of stretching movements compared to the shoulder pain joint mobilization procedure (Shah et al. 2021). In the experimental group, the results concerning the shoulder ROM revealed that there was a significant statistical improvement in shoulder abduction, flexion, and internal as well as external rotation ROM with a p-value of 0.000, for shoulder flexion t= -14.8, the p-value of 0.000, for shoulder abduction t = - 14.34, p-value 0.000, for internal rotation of the shoulder t = -16.28 and p-value 0.000, for external rotational of the shoulder t = -14.84 respectively. The results in the control group revealed that there was a significant statistical improvement in shoulder abduction, flexion, internal and external rotation ROM with a p-value of 0.000, for shoulder flexion, t = -15.6, p-value of 0.000, for shoulder abduction t = -23.5, p-value of 0.000, for internal rotation t = -20.85, p-value of 0.000, for external rotation of the shoulder t = -16.79 respectively on the paired sample t-test. Tissue texture change during SMET and muscle reflex relation was a possible method in improving shoulder ROM.

The Golgi tendon organ played a vital role in reflex relaxation after isometric contraction. In the apparatus of the SMET, muscle contraction over equal resistance stimulated the Golgi tendon organ. The afferent nerve impulse from the Golgi tendon organ touched the dorsal root of the spinal cord, where it interacted with the neurons of the efferent inhibitory motor pathway. They block the release of outgoing motor nerve impulses and inhibit further muscle contraction. Muscle strength decreased, further stimulating muscle lengthening and agonist relaxation. All this resulted in a ROM increase via muscle relaxation after an isometric contraction in a reflexive pattern (Gupta et al., 2008).

Concerning the score SPADI in the trial group, the findings revealed a statistically significant decrease in shoulder pain and disability index with a SPADI value before and after SPADI of 51.80±8.03 and 35.30±5.93 respectively, with a p-value of 0.000, t = 17.31 in the double-sample t-test. The control group's findings revealed a significant statistical reduction in shoulder pain and disability index with a SPADI value before and after SPADI of 60.60 ± 9.29 and 43.55 ± 11.19, respectively with p-value of 0.000, in the double-sample t-test t = 18.55. This result revealed that both treatment procedures (Conventional therapy and SMET) effectively decreased the SPADI within the group analysis.

The study was undertaken by Narayan & Jagga. (2014), supported the current study to discover the effects of MET in patients with adhesive capsulitis in terms of functional capacity. Those authors found that both the conventional and MET treatment group displayed a significant difference and improvement in the score of SPADI after treatment.

In the end, those authors concluded that the experiment for the MET mobilization receiving group had a better volume (%) improvement than the control group that received convention treatment. Another study by Kumar et al. (2012) was designed to discover the efficacy of MET with mobilization against frozen shoulder mobilisation patients alone, which supported the current study. They found that both MET with mobilization and mobilization alone significantly improved shoulder pain reduction, shoulder ROM, and SPADI index. They further concluded that there was no substantial difference in SPADI index and pain reduction between-group analysis. At the same time, the MET and mobilization group improved significantly better than mobilization alone in terms of shoulder abduction, flexion, extension, internal and external rotation ROM, and the improvement difference was statistically significant.

Adherence and Attrition

The intervention programs responded, with 90% compliance in the SMET group and 80% in the conventional treatment group. Compared to fall prevention intervention regimens, this is greater than the stated average of 75%. (Nyman & Victor, 2011). From baseline to post-test, the median attrition rate for interventions was reported to be between (12.5% and 6.25%) (Sadeghi et al., 2021), which is lower than our attrition rates across groups (range, 10%-20%). Preventive measures were put in place to have as low an attrition rate as possible to increase the study's credibility and have a more accurate outcome. However, some participants were suspected of not adhering to these measures, which is the case of the participants who gave no apparent reason for not attending and reluctantly abandoned their sessions.

Limitations

The participants' daily activities were not observed, which may influence the research. As frozen shoulder patients are unavailable in hospitals, it was necessary to compromise on sampling methods and blinding procedures. The largest described results of SMET may be connected to active muscle energy use. This hypothesis requires to be further explored in future research. Additionally, the current study only lasted a brief time. It would be recommended to have extended-term randomized controlled trials with the aid of huge sample scopes in multiple centers with equal delivery between the gender lines and with the inclusion of age-based subgroups and longer follow-ups. Following this research, it is recommended to conduct further research into SMET with a more significant number of participants over a longtime frame. Strict action and a standardized blinding process would be recommended to improve the research quality. Follow-up data is suggested to discover the actual effect of SMET over the long term. It is best to monitor the activities of daily living during intervention periods that have the potential to influence the outcomes.

Strength and Practical Implication

The study, which compares two hand therapy procedures involving long axis movement and activating joint mechanoreceptors, is the first of its type. The increased effects of SMET that have been documented can be attributed to the use of active muscular energy. Very little research has been done on how SMET affects individuals with frozen shoulder in terms of ROM, discomfort, and impairment. This study adds that the Golgi tendon organ played an important role in reflex relaxation after isometric contraction. To reduce discomfort, enhance ROM, and decrease shoulder impairment in patients with frozen shoulders, physiotherapists can employ the SMET on its own or in conjunction with other therapies.

CONCLUSION

In this study, it was revealed that the SMET effectively decreased shoulder pain, decreased shoulder disability, and enhanced shoulder ROM. Both the conventional treatment and SMET protocol significantly result in pain reduction, improving ROM, and reducing shoulder disability. However, in contrast to its specified efficacy, SMET was more effective in terms of shoulder pain reduction, in conventional treatment showed greater effectiveness in enhancing the shoulder ROM. It can be concluded that SMET can be used or incorporated as an alternative treatment method or combined with other treatment procedures for pain reduction, ROM improvement, and decreasing shoulder disability in patients with frozen shoulders.

Author Contributions

Qais; data curation, Qais and Agiela; formal analysis, Agiela; investigation, Radea and Ahlam; methodology, Hala and Eiman; project administration, Qais; resources, Qais; software, Agiela; supervision, Qais and Agiela; validation, Radea., Ahlamand Eiman; visualization, Qais; writing—original draft, Qais; writing—review and editing, Qais., Agiela., Radea., Ahlam., Hala and Eiman. The published version of the paper has been read and approved by all authors.

Informed Consent Statement

Informed consent was obtained from all participants involved in the study.

Acknowledgments

The authors would like to thank the principals, physiotherapists, and patients at the clinics where this study was conducted for approving and/or participating.

Abbreviations

Shoulder Range of Motion (ROM)
Ultra-Sound (US)
Transcutaneous Electrical Nerve Stimulation (TENS)
Proprioceptive Neuromuscular Facilitation (PNF)
Muscle Energy Technique (MET)
Visual Analogue Scale (VAS)
Disability Index (SPADI)
Spencer Muscle Energy Technique (SMET)
Confidence Interval (CI)
Numeric Pain Rating Scale (NPRS)
Consolidated Standards for Reporting of Trials (CONSORT)
Software Package for Social Science (SPSS).

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