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Effect of Spencer Muscle Energy Technique on Pain in Diabetic Stiff Shoulder

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ABSTRACT

Background: Diabetes mellitus (DM) and shoulder stiffness (SS) are related. Pain and limitations in both active and passive ROM are its defining characteristics. SS is caused by a fibrotic process, just like other diabetic problems (such as arterial stiffness, pancreatic or renal fibrosis). One of the most popular osteopathic manual treatment techniques for shoulder issues is the Spencer muscular energy technique (MET).

Objective: This research assessed the impact of Spencer MET on stiff shoulder in diabetic patients.

Patients and Methods: 30 female diabetic frozen shoulder (FS) patients, equally split into two groups; group (A) received Spencer MET along with conventional treatment, while group (B) received conventional treatment only. Patients were recruited from Agouza Police Hospital outpatient clinics. Pain and shoulder range of motion were assessed for all participants, outcomes included pain using numeric pain rating scale (NPRS), pain pressure threshold (PPT) while shoulder range of motion assessed by using standardised manual goniometer and shoulder pain and disability index (SPADI).

Results: Post 8 weeks of intervention, group A had a significant lowering in NPRS by 1.73±0.25 contrasted to the control group 4.13±0.92 and increase PPT by 8.73±0.96 contrasted to the control group 7.07±0.8. The study group had a significant reduction in SPADI score by 32.07±5.36 points compared to the control group by 45.93±6 points. Furthermore, the study group showed a significantly increase in Shoulder flexion ROM by 156.33±11.87 points than the control group by 128.67±10.36 points, Shoulder abduction ROM by 127.33±11.6 points than the control group by 104±11.54 points, Shoulder external rotation ROM by 68.33±6.17 points than the control group by 55.33±4.42 points.

Conclusion: The Spencer MET along with conventional treatment is more effective decreasing pain and increasing functional ability in patients with stiff shoulder as compared to conventional treatment alone.

Keywords: Spencer's MET, Conventional treatment, Shoulder stiffness, ROM, Frozen shoulder.

INTRODUCTION

Stiff shoulder is A disorder characterized by limited active and passive glenohumeral range of motion (ROM), can be divided into primary or idiopathic forms, (also known as "frozen shoulder") and secondary (which result from a recognized cause, such as trauma, surgery, or joint immobilization) [1].

Two types of stiff shoulders have been identified by the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS) Upper Limb Committee: primary idiopathic stiff shoulder (frozen shoulder) and secondary stiff shoulder[2].

A stiff shoulder that appears without any particular trauma or underlying disease process is referred to as FS or primary idiopathic stiff shoulder. The patient may have a disease like diabetes or thyroid issues that is known to be linked to stiffness. SS with a known underlying cause, such as trauma, infection, or inflammatory disease, is referred to as secondary stiffness. According to estimates, between 2 and 5% of people have FS [1,2]. FS often occurs between the ages of 50 years and 60 years and seldom presents before 40 years[3]. Women (58%) are more prone to get FS than men (42%)[4].

Certain musculoskeletal stiffening disorders, including Dupuytren's contracture, SS, carpal tunnel syndrome, and tenosynovitis, can occur in patients with DM. Compared to patients without DM, they experience SS more frequently [5]. Patients with FS have a tenfold greater frequency of DM, and the development of FS is linked to a higher HbA1C in patients with poorly managed diabetes [6].

The initial phase of FS's clinical appearance is the freezing stage, which lasts for two to nine months which characterized by shoulder pain and increasingly rigid. The frozen phase, which lasts for four to twelve months and is marked by considerable stiffness and decreased pain, comes next. Lastly, the thawing stage, which lasts for five to twenty-four months and gradually improves shoulder mobility [7].

The majority of the symptoms resolve with conservative treatment. Physiotherapy, Non-Steroidal Anti-Inflammatory Drug's [NSAID'S], intra-articular corticosteroid injection, and hydrodilatation are examples of conservative treatments. Cryotherapy, transcutaneous electrical nerve stimulation, ultrasound, Codman's exercises, stretching, and mobilization techniques are among the several physiotherapy procedures. Surgical procedures are used for patients who have seen no improvement in their symptoms and cannot tolerate discomfort even after 6 to 12 weeks of conservative treatment. Arthroscopic capsular release and repair, as well as manipulation under anesthesia, are surgical therapeutic options[8].

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Since FS frequently causes pain, decreased ROM, and inflammation, it is essential to employ MET to treat these symptoms [9]. The reason MET works so well for chronic capsulitis is that it helps with pain relief, ROM incretions, and the development of functional activities. It does this by allowing muscles to contract precisely and in a monitored position over resistance, which helps to improve joint range by increasing joint flexibility. For all joints with restricted ROM, this modality is advised [10].

The most recent manual treatment technique, Spencer MET, is often utilized in Western practice to treat a variety of shoulder disorders. This method was created and applied by C.H. Spencer in 1916. Since then, it has been applied in several outpatient clinical settings to treat soft tissue injuries that do not require surgery. By slowly stretching the shoulder joint within its ROM, it seeks to increase ROM, reduce discomfort, and enhance function in shoulder problems. Later, it incorporates a number of multistep MET to increase shoulder mobility and flexibility, including post-isometric contraction and relaxation in the rotator cuff and shoulder joint [11].

The Spencer approach uses seven different phases to alleviate shoulder restrictions caused by adhesive capsulitis. This technique releases tensed muscles, ligaments, and capsules by smooth, rhythmic, passive movements. The majority of the force is applied at the end of the ROM. This approach improves lymphatic flow, promotes joint circulation, and extends the tissues, allowing ROM without pain [12]. This research assessed the impact of Spencer MET on stiff shoulder in diabetic patients.

SUBJECTS AND METHODS

This research involved 30 female patients with diabetic FS. They were recruited from outpatient clinics of Agouza Police Hospital. Patients equally split into two groups; group (A) received Spencer MET with conventional treatment, while group (B) received conventional treatment only. Patients completed SPADI and NPRS, PPT using algometer and shoulder ranges (flexion, abduction and external rotation) determined using goniometer.

Inclusion criteria: Women's age between 45 to 55 years old, diagnosed as type 2 DM for at least 5 years, Unilateral FS (at least three months long), No treatment for FS other than topical analgesic including (diclofenac diethylamine or ketoprofen) twice daily.

Exclusion criteria: Patients with rotator cuff rupture or trauma, neurological impairments limiting shoulder mobility, elbow or wrist diseases causing discomfort or limited motion, tendon calcification, osteoarthritis and rheumatoid arthritis, pregnancy, osteoporosis, or skin deformities or cuts.

Procedures:

Evaluation

Using the following resources, every patient in this study has undergone a comprehensive evaluation both before and after the intervention procedure was applied: The NPRS, which has eleven points ranging from zero (no pain) to ten (worst pain), was used to measure shoulder pain [13]. Pain pressure threshold (PPT) assessed by using pressure algometer to determine the pressure and/or force causing a pressure-pain threshold. The rate at which manual force is applied should be consistent to provide the greatest reliability [14]. Near the pectoralis minor muscle's insertion on the coracoid process, PPT was assessed. A standardized manual goniometer, a trustworthy tool for assessing shoulder joint motions in degrees, was used to quantify shoulder ROM (SROM) [15,16]. The ROM examination included shoulder motions such as flexion, abduction, and external rotation.

The SPADI is a valid clinometric (Cronbach-Alpha>0.90) questionnaire that orthopedics and physical therapists use to properly assess shoulder-related pain and disabilities in terms of functional outcomes in patients with various shoulder-related pathologies. A subscale of five questions measures pain, while another subscale of eight items measures disability. It has thirteen items totally and is divided into two domains. A score ranging from Zero (least shoulder impairment) to hundred (most shoulder dysfunction) is calculated by adding each subscale [17,18].

Intervention

Group A (study group): 15 patients got both traditional physiotherapy and the Spencer MET. Spencer technique: The shoulder to be treated is facing the ceiling while the patient is in the lateral recumbent position. To avoid rolling forward, the patient's hip and lower knee are extended, and their back is perpendicular to the surface. The patient's head is held in a midline position by a cushion beneath it, and the therapist faces the patient. Reciprocal inhibition, which involves resistance to attempted extension, flexion, abduction, adduction, external rotation, and internal rotation, has been demonstrated to enhance the impact [19]. The method consists of seven phases of two steps repeated. To create a new barrier, the first stage is to oscillate rhythmically near the end of the range that is accessible. The second step is to do isometric contractions of the antagonist muscle at various ranges. The reciprocal inhibition concept is the basis for this method's operation [20].

Stage 1: Enhance the extension, Stage 2: Enhance the flexion of the shoulders, Stage 3: Circumduction with compression, Stage 4: Circumduction with distraction, Stage 5 involves improving abduction and adduction by external rotation, Stage 6 involves internal rotation, and Stage 7 involves distraction in abduction [20]. Additionally, the

same home program and traditional physiotherapy were used as in the control group.

Group B (Control group): 15 patients received conventional physicaltherapy treatment. Traditional physicaltherapy treatment involved 5 minutes of 3MHz ultrasound therapy at an intensity of 1.4 w/cm^2. Codman's pendular exercises were part of the exercise treatment regimen. Participants would either stand or lie prone. The afflicted shoulder was suspended parallel to the trunk and swinged the shoulder forward and backward, side to side, or in circles. The participant performed a finger ladder exercise, which involved slowly walking his finger up the wall and lowering his arm; the shoulder joint was stretched, which included the anterior, posterior, and inferior capsules; and a scapular stabilization exercise. Every exercise was performed in three sets of around five repetitions each. Every activity was performed at least twice a day as part of a home workout program [21].

Ethical approval:

This study was authorized by Cairo University's Faculty of Physical Therapy Research Ethical Committee [P.T.REC/012/004908]. A permission form was signed by each participant to take part in the study. The study adhered to the Helsinki Declaration throughout its execution. Clinical trials.gov registered the study (NCT0656728).

Statistical analysis

The statistical software SPSS version 23.0 was used for all computations. To verify the data's normality and evaluate group homogeneity, Shapiro-Wilk and Levene's tests for homogeneity of variances were employed. The variance was homogenous and the data distribution was normal. Quantitative data were presented as mean ± SD. Unpaired t-test was employed to compare groups according to all demographic attributes. Qualitative data were presented as frequency and percentage and were compared by X^2-test. Two-way mixed MANOVA was used to examine the effects of treatment on NPRS, PPT, shoulder flexion, shoulder abduction, shoulder external rotation, and SPADI. Multiple comparisons were carried out using post-hoc testing with the Bonferroni adjustment when the MANOVA revealed significant findings. The significance level for all statistical tests was set at p-value = 0.05.

RESULTS

General characteristic of patients (N=30):

There weren't statistically significant differences regarding patient's general characteristics between both groups (Table 1).

A mixed design multivariate analysis was used to assess the influence of treatment on the measured variables. There was Statistically Significant difference between groups as Wilk's A = 0.25, $F_{(6, 23)}$ = 11.33, P-value < 0.001, Partial Eta Squared ($\eta^{2)}$ = 0.75. Also, there was statistically significant effect on time (pre-post treatment) as Wilk's A = 0.01, $F_{(6, 23)}$ = 368.04, p-value < 0.001, η^2 = 0.99, as well as for the interaction between groups and time as Wilk's A= 0.16, $F_{(6, 23)}$ = 20.46, p-value < 0.001, η^2 = 0.84.

Table (1): General characteristic of patients (N=30)

Characteristics	Study Group (n=30)	Control Group (n=30)	t-value	P Value
Age(years)	49.07±3.24	48.33±2.72	0.67	0.51
Weight(kg)	77±4.17	76.8±6.09	0.11	0.92
Height(cm)	164±4.44	164.67±4.86	-0.39	0.7
BMI (kg/m^2)	28.64±1.34	28.3±1.52	0.65	0.52
Stiffness chronicity (months)	6.2±1.2	6.73±1.58	-0.84	0.41
Diabetic chronicity (years)	7.13 ±1.41	7.07 ±1.39	0.78	0.9
Affected side, n (%)				
Right	13(86.67%)	2 (13.33%)	X^2=0.37	0.54
Left	14(93.33%)	1 (6.67%)		

P-Value < 0.05 indicate statistical significance, $\chi 2$: chi square test.

Between-groups comparison:
At baseline, there weren't significant differences between the two groups in any evaluated variables. After eight weeks of intervention, group A outperformed group B on all evaluated variables (Table 2).

Within-groups comparison
Pre and after intervention findings showed significant differences (p-value < 0.0001) between groups A and B for all outcome measures (Table 2).

Table (2): Within and between group analysis for all measured outcomes (N=30)

Variables	Group A	Group B	MD (95% CI)	p-value (between groups)	η^2
NPRS (cm)					
Pre-treatment	**8.13±1.13**	**8.2±0.94**	-0.07 (0.86 to -0.84)	0.86	
Post-treatment	**1.73±0.25**	**4.13±0.92**	-2.4 (-0.65 to -3.13)	0.001	0.62
p-value (within-group)	0.001	0.001			
Percent of improvement	78.72	49.63			
PPT (kg/cm^2)					
Pre-treatment	**4.53±0.92**	**4.67±0.49**	-0.13(-0.68 to 0.42)	0.62	
Post-treatment	**8.73±0.96**	**7.07±0.8**	1.67 (1 to 2.33)	0.001	0.49
p-value (within-group)	0.001	0.001			
% improvement	92.72	51.39			
Shoulder flexion (degree)					
Pre-treatment	**105.13±12.72**	**106.33±9.34**	-1.2 (-9.55 to 7.15)	0.77	
Post-treatment	**156.33±11.87**	**128.67±10.36**	27.67 (17.98 to 37.35)	0.001	0.55
p-value (within-group)	0.001	0.001			
% improvement	48.7	21			
Shoulder abduction (degree)					
Pre-treatment	**88±5.28**	**88.5±5.61**	-0.5(-0.19 to 0.82)	0.99	
Post-treatment	**127.33±11.6**	**104±11.54**	23.33(8.04 to 38.63)	0.001	0.26
p-value (within-group)	0.001	0.001			
% improvement	44.69	18.1			
Shoulder external rotation (degree)					
Pre-treatment	**44.67±4.41**	**45.33±5.16**	-0.67(-4.26 to 2.93)	0.71	
Post-treatment	**68.33±6.17**	**55.33±4.42**	13(8.99 to 17.01)	0.001	0.61
p-value (within-group)	0.001	0.001			
% improvement	53	22.06			
SPADI (%)					
Pre-treatment	**74±5.98**	**75.47±4.02**	-1.47(-5.28, 2.34)	0.44	
Post-treatment	**32.07±5.36**	**45.93±6**	-13.87(-18.13, -9.61)	0.001	0.61
p-value (within-group)	0.001	0.001			
% improvement	56.66	39.13			

P-Value < 0.05 indicate statistical significance.CI: confidence interval.MD: mean difference, η^2 : partial eta square; NPRS: numerical pain rating scale; SPADI: Shoulder pain and disability index.

DISCUSSION

The main goal of this study was to determine how well Spencer MET worked to improve shoulder functioning in FS individuals. Thirty FS patients were randomly assigned to one of two groups for the research. Group A (study group) received both conventional treatment and Spencer MET, whereas Group B (control group) got conventional treatment alone. SPADI was used to quantify shoulder pain and disability, while the NPRS and PPT algometer were used to measure shoulder pain. The universal goniometer measured ROM.

The hypothesis was that Spencer's MET would be significantly effective in treating patients with diabetic FS when added to conventional program compared to conventional program alone.

Following eight weeks of both conventional treatment and Spencer MET, there was a noticeable improvement in shoulder functioning. Pre- and post-test scores improved on all measures. Our research revealed a statistically significant improvement in PPT and pain when compared to the control group. These enhancements might be ascribed to MET's ability to lessen pain and enhance lymphatic and circulatory flow [22].

Our findings concur with an experimental study that was carried out by **Khyathi *et al.*** [23] to compare the efficacy of the Spencer technique and Mulligan's mobilization with movement in improving pain, abduction, external rotation ROM, and functional disability in subjects with FS. Forty individuals with unilateral FS were randomly assigned to two groups, each consisting of twenty individuals: the Mulligan group and the Spencer group. The outcomes demonstrated the effectiveness of the Spencer Technique in reducing shoulder mobility, discomfort, and functional impairment.

In order to compare the effects of Spencer MET versus Maitland's Mobilization technique on pain, ROM, and disability in patients with FS, a study published by **Jivani *et al.*** [24] divided fifty-eight patients into two groups, with twenty-nine patients in each group receiving Spencer MET and conventional physiotherapy and MM and conventional physiotherapy five days a week for a total of four weeks. According to the study's findings, Spencer MET was useful for enhancing ROM, decreasing disability, and alleviating discomfort.

In line with our findings, **Iqbal *et al.*** [25] shown that MET was superior to passive stretching exercises in improving joint ROM and functioning and reducing discomfort in patients with adhesive capsulitis.

Additionally, the study group's shoulder ROM improved significantly, with percentage changes in flexion, abduction, and external rotation of 48.7%, 44.69%, and 53%, respectively. Additionally, the study group exhibited improvements in SPADI, with a change percentage of 56.66%. Stretch perception, ROM, and stretch tolerance may all be affected by these enhancements brought about by high-intensity MET contraction, which may also result in post-synaptic inhibitory processes that reduce cortical and α-motor neuron excitement [26].

These results were consistent with those of **Babu and Putcha** [27] who treated adult outpatients with Stage 2 adhesive capsulitis, predominantly diagnosed in those aged forty to sixty, using Spencer MET and conventional treatment. Following six weeks of both conventional treatment and Spencer MET, there was a noticeable improvement in shoulder functioning.

According to earlier research, Spencer MET improves glenohumeral and scapulothoracic joint mobility by fluid mobilization and soft tissue stretching. In order to increase shoulder complex mobility, the most pain-free movements are treated first, then the most restricted motions [25].

CONCLUSION

In patients with diabetic FS, it was shown that both conventional treatment and Spencer MET significantly improved shoulder functions; however, those who received both conventional treatment and Spencer MET showed more improvement.

We may conclude that for patients with FS, Spencer MET can be employed or included as an alternate treatment approach or coupled with other treatment procedures to reduce shoulder impairment, increase ROM, and reduce discomfort.

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