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Research Article

Effectiveness of active release technique and muscle energy technique in adhesive capsulitis

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ABSTRACT

Adhesive capsulitis, describes the common shoulder condition characterized by painful and limited active and passive range of motion (ROM). The purpose of this study is to find out the effectiveness of active release technique and muscle energy technique on subscapularis trigger points in adhesive capsulitis. 60 subjects were assessed according to inclusion criteria and randomly divided into three groups; Group A (n=20) received active release technique and conventional therapy, Group B (n=20) received muscle energy technique and conventional therapy, Group C (n=20) received only conventional therapy. VAS (visual analog scale), Goniometer, SPADI (shoulder pain and disability index) were measured pre and post treatment. Significant difference was seen in all the three groups but there was more improvement in Group A and B subjects than C. when Group A and B are compared there was immediate improvement in Group A subjects than B. The study concluded that there was immediate improvement in group A subjects than B and C groups in treating subscapularis trigger points in adhesive capsulitis.

Keywords: Frozen shoulder; Shoulder pain and disability index; Subscapularis; Triggers points.

INTRODUCTION

Frozen shoulder is also known as adhesive capsulitis (AC) with uncertain etiology which is characterized by restriction of both active and passive range of motion in shoulder (Sarah Russell *et al.*, 2014). It is the most common cause of the shoulder pain which effects between 2% to 5% of general population and 10% to 20% population with diabetes (Haytham M. Elhafez *et al.*, 2016). AC is more commonly seen in women's than in males between 40-60 years of age group, in 20-30% of cases it can be bilateral (Robert Donatelli *et al.*, 2014). It is also identified that sleeping on affected side is difficult because of severe pain and stiffness. Capsular contractures limit the range of motion and produce capsular end feel. The pathology of frozen shoulder is unclear; it affects the glenohumeral capsular tissue and is particularly localized to coraco-humeral ligament in the rotator cuff interval. Tissue analysis of this has shown inflammatory changes, fibrosis and proliferative myofibroblastic (C.R Hand *et al.* 2007). AC is divided into two types primary and secondary adhesive capsulitis, where primary adhesive capsulitis is charac-

terized by idiopathic fibrosis of the joint capsule, and secondary adhesive capsulitis is due to any external factors like rotator cuff pathology, cervical radiculopathy, fractures around shoulder joint, etc (Hacer Dogru *et al.*, 2008).

Duration of AC is divided into three stages: painful freezing phase (10-36 weeks), adhesive phase (4-12 months), and resolution phase (12-42 months), Later by Neviser, AC is divided into four stages: pre adhesive stage (0-3 months) pain with both active and passive movements, freezing stage (3-9 months) high level of pain near end range of movements, frozen stage (9-15 months) there is minimum pain but only extremes ranges limitation in all shoulder movements is important, and thawing stage (15-24 months) presents with gradual and spontaneous recovery and shoulder mobility and function (Hector Joaquin Gutierrez Espinoza *et al.*, 2015).

Kelley *et al.*, 2013 has proposed a classification based on patients irritability level. Low irritability, according to visual analog scale (VAS) <3/10 neither nocturnal pain nor at rest and final pain sensation is tolerable; active movement limitation is similar to passive movement and both present low levels of disability.

These patients complain about morning stiffness rather than pain. High irritability patients show > 7/10 in VAS mainly with passive movement's nocturnal pain and rest they report high levels of disability these patients complain about pain rather than stiffness.

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Myofascial trigger points are described as “highly irritable bands that are associated with a hyper sensitive palpable nodule in the taught band” (Jandommerholt *et al.*, 2006). When they are compressed it produces referred pain, tenderness and motor dysfunction. Trigger points are classified into active and latent trigger points. Active trigger points are painful with spontaneous onset, it is always tender and prevent full lengthening of the muscle, weakness of the muscle and when it is compressed it produce the referred pain pattern (Carel bron *et al.*, 2011). Latent trigger points are painful only when they are palpated and they don't produce any referred pain when they are compressed. Common cause of muscle pain (myofascial pain) is due to myofascial trigger points (MTrPs), if these are present in shoulder muscles it may produce similar pain in shoulder pain syndrome including pain at rest and during movement. Presence of subscapularis trigger points plays an important role in developing AC. Active triggers in this muscle restrict abduction (ABD) and external rotation (ER), it also restricts the ROM of shoulder girdle muscles (Michael S. Thurner 2013). The pain referred from this muscle is focused on the back of the shoulder and frequently includes a band of pain and tenderness around the wrist (D.Jankovic *et al.*, 2006).

Many treatments are advocated for AC condition, that includes initial conservative measures, anti-inflammatory drugs, intra-articular corticosteroids, capsular distension injections, and surgical interventions (Robert Donatelli, *et al.* 2014). It also includes mobilization and manipulation techniques, for pain free state and normal use of upper extremity (Gokhan Doner, *et al.*, 2013). Many modalities are also suggested for acute pain that includes transcutaneous electrical nerve stimulation, cryotherapy, phonophoresis and iontophoresis (Kedar sule *et al.*, 2015).

Active release technique (ART) is a non invasive, hands-on, soft tissue technique that simultaneously locates and breaks up scar tissue (which is primary cause of pain, stiffness, weakness, numbness, and physical dysfunction that are typically associated with soft tissue injuries), ART combines motions performed by the patient to release the adhesions between the tissue layers, ART was developed and patented by Dr. P. Michael Leahy, DC, CCSP, he began developing and documenting ART in 1985 under the initial name of myofascial release, he used these methods and protocols to treat his patients more effectively and efficiently. ART is used in many syndromes; it can also be used in adhesive capsulitis or frozen shoulder (Dr. Brain Abelson, MD). ART is a collection of treatments for examination, diagnosis, and treatment of soft tissue disorders; it is also used to relieve the nerves from adjacent fascia, muscles, tendon, in order to examine the soft tissue it has four categories, they are (i) tissue texture (ii) tissue tension (iii) tissue movement (iv) tissue function. ART is a manual therapy for the recovery of soft tissue function that involves the removal of the scar tissue which

can cause pain, stiffness, muscle weakness, and abnormal sensation including mechanical dysfunction in the myofascial and soft tissue (J H kim *et al.*, 2015). The effectiveness of ART has been reported in carpal tunnel syndrome, Achilles tendinitis, and tennis elbow all of which involve soft tissue near joints in the distal parts of the body.

Muscle energy technique (METs) is defined as “an isometric contraction in which a muscle or group of muscles, or a joint, or region of the body, is called to upon to contract, or move in a specified direction, and in which that effort is matched by the therapist/subjects effort, so that no movement is allowed to take place”. It has 6 main variations: (1) isometric contraction using reciprocal inhibition, (2) isometric contraction using post isometric relaxation (with stretching), (3) isometric contraction using post isometric relaxation (without stretching), (4) isotonic eccentric contraction (isolytic), (5) isotonic concentric contraction, (6) isokinetic (combined isotonic and isometric contractions). It is a manual technique that is used widely because it is safe and gentle and it is effective in patients with various symptoms (Marzouk A. Ellythy 2012).

Limited studies were present on ART in shoulder muscles; the present study aimed at finding out the effectiveness of ART and METs in adhesive capsulitis subjects.

MATERIALS AND METHODS

PROCEDURE

This experimental study was done on 60 participants in an outpatient department of Susrutha institute of physical medicine and rehabilitation from August 2016 to July 2017 after informed consent and institutional ethical committee approval. All the subjects were randomly selected according to inclusion (age group of 40-50 years, Idiopathic unilateral adhesive capsulitis of more than 3 months of duration with subscapularis muscle trigger points, Movements of the shoulder joint limited below 50% compared to unaffected side) and exclusion criteria (Fractures of upper limb, Cervical radiculopathy, Diabetes mellitus, Thoracic outlet syndrome, Osteo-arthritic changes) and divided into 3 groups (group A, group B, group C) by convenient sampling method. All the subjects were diagnosed with subscapularis trigger points, all participants were actively participated in the study and no drop outs.

- **Group A** : ART and conventional therapy
- **Group B** : METs and conventional therapy
- **Group C** : Conventional therapy (transcutaneous electrical nerve stimulation, pendulum exercises, maitland mobilizations).

The study was carried out for 4 weeks; the base line characteristics were similar in all the groups. visual analog scale (VAS) was used to evaluate pain (0-no

pain;10-severe pain) on 10cm scale; range of motion was measured by universal goniometer and for the functional disability shoulder pain and shoulder disability index (SPADI) is used.

Group A: (treated with ART and conventional treatment)

Technique: The subjects were positioned in supine with the humerus abducted to 45° with elbow externally rotated (20-25°) to a midrange position and flexion to 90°. The muscle was palpated in the axilla to identify areas of myofascial mobility restriction, taught bands or trigger points. The therapist gently places his or her hand into patient's lower axilla between the ribs and bulk of latissimus dorsi muscle laterally. The muscle is compressed while the therapist looks for localized tenderness or trigger points with referred pain elicitation. With the thumb therapist will relieve the trigger point with the other hand he or she holds the subject's elbow while the subject actively moves the shoulder into abduction. In ART the particular muscle is taken from shortened to lengthened position or from lengthened to shortened position. Duration of treatment was 8-15 mins.

Group B: (treated with METs and conventional treatment)

Technique: The subjects were positioned in supine with arm abducted to 90° and the forearm in external rotation and palm facing upwards. The patient raises the forearm slightly against minimal resistance given by therapist for 7-10 seconds followed by relaxation or slight assistance from therapist where it is kept for 30 seconds. The protocol was performed for 3 repetitions per day and thrice a week for 5 weeks.

Group C: Treated with conventional treatment (TENS, Maitland mobilization, pendulum exercises, wand and towel exercises, coracohumeral ligament stretch, capsular stretches, home programme and patient education).

Conventional treatment (TENS): application of TENS with a frequency of 4-8 Hz for a period of 8 minutes

Maitland's mobilization: subject placed in supine position, rhythmic oscillatory movements on glenohumeral joint with grade 2 and 3 mobilization or glides with posteroanterior, anteroposterior and inferior glide was given. Each glide is counted for 2-3 oscillations in a second for about 30 seconds and which is given for 5 minutes.

Instructions were given to the subjects to perform constant daily exercises in home to reduce the symptoms.

STATISTICAL ANALYSIS AND RESULTS

Statistical analysis was performed by using SPSS statistical software (version [64 bit] 20). One way ANOVA test was done to compare between the groups, Independent t-test was done to compare within the groups,

post-hoc test was done for multiple comparisons between the groups.

RESULTS

Base line values for all the groups A,B,C were similar (4 weeks), no significant difference was seen between three groups for age, gender and side ($p > 0.05$). One way ANOVA test is done between groups, it was found that there was a significant difference in VAS measurement ($p < 0.05$), ROM (flexion, abduction, internal rotation, external rotation) ($p < 0.05$) and for SPADI ($p < 0.05$). Independent t-test was done within the groups for pre and post values of VAS, ROM (flexion, abduction, internal rotation and external rotation) and SPADI, there was a significant difference within the groups after 4 weeks ($p < 0.05$). Post-hoc test is done for multiple comparisons between the groups, has shown that there was significant improvement in VAS, ROM (flexion, abduction, internal and external rotations) and SPADI in all groups but with great improvement in group A. when the results were compared with group C there was a significant difference between group A and B than C ($p > 0.05$). Immediate improvement was noted in group A than group B and C.

DISCUSSION

Generally subscapularis trigger points are ignored in shoulder syndromes which play an important role in adhesive capsulitis. In this study, both ART and METs along with conventional therapy were used to treat the adhesive capsulitis with subscapularis trigger points which are common cause to develop shoulder syndromes. Both the techniques showed the equal results in treating AC, but ART has shown immediate improvement in ROM without pain or restriction. Scott D Howitt, et al., 2006, application of deep digital tension at the area of tenderness and patient performing active movement of the tissue from shortened to lengthened position or from lengthened to shortening position resulted in the removal of the adhesions and restoration of normal tissue texture. Sajin Tak et al., 2013, ART recovers movement of all soft tissues, relaxes entrapped nerves, blood vessels and lymph to restore the proper texture and elasticity and function of soft tissue. If the tissues were damaged the healing process will protect it from further damage or infection or inflammation.

ART is a method of treating soft tissue injuries and dysfunction caused by repetitive activity. Leahy has proposed that mechanism known as "cumulative injury cycle" to explain tissue tension or tension. According to this theory, repetitive micro-trauma in tight muscles leads to increase in the friction and tension within the myofascial structures causing a decrease in circulation which is known as "chronic cycle" or "inflammation cycle". Both the cycles lead to accumulation of the adhesions and fibrosis within the tissue and increases the tension in the tissue which in turn makes the tissue stiff. So, the goal of ART is to break the adhesions and

Table 1: comparison of VAS between three groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	47.181	2	23.590	39.108	.000
Within Groups	34.383	57	.603		
Total	81.564	59			

One way ANOVA results of VAS measure shows a significant difference (p<0.05) between the groups.

Table 2: Post-hoc test for multiple comparisons for VAS

(I) VAS	(J) VAS	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
GROUP A	GROUP B	-1.60500*	.24560	.000	-2.0968	-1.1132
	GROUP C	-2.07000*	.24560	.000	-2.5618	-1.5782
GROUP B	GROUP A	1.60500*	.24560	.000	1.1132	2.0968
	GROUP C	-.46500	.24560	.063	-.9568	.0268
GROUP C	GROUP A	2.07000*	.24560	.000	1.5782	2.5618
	GROUP B	.46500	.24560	.063	-.0268	.9568

*. The mean difference is significant at the 0.05 level.

Table 3: comparison of internal rotation ROM between the groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1690.633	2	845.317	84.480	.000
Within Groups	570.350	57	10.006		
Total	2260.983	59			

One way ANOVA results of Internal rotation measure shows a significant difference (p<0.05) between the groups.

Table 4: Post-hoc test for multiple comparisons for internal rotation

(I) IR	(J) IR	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
group A	group B	9.35000*	1.00031	.000	7.3469	11.3531
	group C	12.50000*	1.00031	.000	10.4969	14.5031
group B	group A	-9.35000*	1.00031	.000	-11.3531	-7.3469
	group C	3.15000*	1.00031	.003	1.1469	5.1531
group C	group A	-12.50000*	1.00031	.000	-14.5031	-10.4969
	group B	-3.15000*	1.00031	.003	-5.1531	-1.1469

*. The mean difference is significant at the 0.05 level.

Table 5: comparison for SPADI between the groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3816.230	2	1908.115	231.917	.000
Within Groups	468.971	57	8.228		
Total	4285.202	59			

Results: One way ANOVA results of SPADI measure shows a significant difference (p<0.05) between the groups.

Table 6: Post-hoc test for multiple comparisons for SPADI

(I) SPADI	(J) SPADI	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
group A	group B	-13.52500*	.90706	.000	-15.3414	-11.7086
	group C	-18.97000*	.90706	.000	-20.7864	-17.1536
group B	group A	13.52500*	.90706	.000	11.7086	15.3414
	group C	-5.44500*	.90706	.000	-7.2614	-3.6286
group C	group A	18.97000*	.90706	.000	17.1536	20.7864
	group B	5.44500*	.90706	.000	3.6286	7.2614

*. The mean difference is significant at the 0.05 level.

to stop the cumulative cycle, by taking the affected tissue from shortened to lengthen position or from lengthened to shortened position while the therapist holds the tissue with hand in tension along the tissue fibers. According to Dr. Michael Leahy's "law of repeti-

tive motion", to describe the physical factors involved in a repetitive strain injury (RSI) the formula used is

$$I = \frac{N \times F}{A \times R}$$

where, I = degree of insult to the tissue caused by friction or pressure, N = no. of repetitions of any action, F = force or tension of each repetition as a percentage of the maximum strength, A = amplitude of each repetition, R = relaxation time between repetitions, a time with no pressure or tension on tissue involved (Dr. Brain Abelson, MD).

ART can affectively increase the relaxation time (factor R) by removing the constant pressure and tension that resulting in the formation of adhesions or scar tissue. Muscles that are restricted, tight and adhered cannot be relaxed. By releasing these restrictions, ART can help to achieve better muscle function, and prevent the return or reoccurrence of the repetitive strain injury. Jerome Wong DC *et al.* 2006, ART is designed to accomplish 3 unique functions ie the release of entrapped nerves, vasculature and lymphatic's and to re-establish texture and normal soft tissue functions. Junho Kimet *et al.* 2015 compared two groups of patients with neck pain one group with joint mobilizations and another group with ART, they treated the scar tissue based on the texture of the fiber in longitudinal direction. Soft tissue mobilization was performed in lengthened to shortened position or from shortened to lengthened position during neck movements. The data from the current study identified that there is statistical significance difference present in the participants who were treated with ART, the reasons may be due to the break in the inflammatory cycle and by restoring the normal tissue function by treating the scar tissue and mobilizing it from shortened to lengthened position.

Gopis Mistry *et al.*, 2015, two groups of patients were taken with chronic low back ache, one group was treated with PNF hold relax technique and another group was treated with ART for 10 sessions for 5 times. When both groups were compared with hamstring flexibility, PNF and ART both the groups showed equal results but PNF technique results was superior than ART results. Marzouk A. Ellythy 2012, two groups are selected one group treated with METs and another group treated with strain and counter strain. Both groups has shown equal results in reducing pain and functional disability in chronic low back patients. The data from the current study identified that there is statistical significance present in the participants who treated with METs, the reason may be by using the 3-5 contractions to subscapularis muscle has shown the improvements.

Salameh bweir *et al.* 2014, subscapularis muscle is the most powerful rotator cuff muscle and stability. Restriction of shoulder movement in most cases results from muscle spasm which also restricts the flow of blood, lymph and nerve signals in the area. The subscapularis trigger points are treated with combination of sustained manual pressure and slow deep strokes to the subscapularis myofascia for 7 minutes it was followed by PNF technique for subscapularis muscle and

glenohumeral medial rotation for 7 seconds against the therapist force. Other group is treated with ultrasound for 10 minutes. In present study by using the manual pressure and deep digital strokes in subscapularis muscle has break down the trigger points and helpful in reducing the pain. The results of present study was correlated with the other studies and shown statistical significance ($p < 0.05$). Limitation of this study includes Small sample size, follow up should be done to know the later affects of ART, study can also be done in secondary AC subjects, and other stages of AC can also be included in this ART treatment.

CONCLUSION

The results of the present study concluded that ART and METs has shown the the improvement in VAS, ROM and SPADI in Adhesive capsulitis subjects, but more significant and immediate improvement was observed in the subjects who were treated with ART along with conventional therapy. Patients treated with conventional therapy alone have shown minimal decrease in pain and functional activities.

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