

“Comparative Effects of Transcutaneous Electrical Nerve Stimulations and Mobilization With and Without Rotator Cuff Muscles’ Strengthening Exercises on pain, Range of motions and Function in Participants with Adhesive; a randomized clinical trial”

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ABSTRACT:

Background: Adhesive capsulitis (AC disease) is a condition of joint capsule, which becomes inflamed and fibrosed, so a thickening of lining of glenohumeral joint’s capsule brings remarkable stiffness which increases progressively thus limiting all movements at GH joint. Continuous severe pain in the GH joint renders the muscles around the joint to become spastic, muscles when are spastic, becomes less efficient and becomes weak gradually. Therefore it is advised that strengthening of RC muscles must be integrated while treating the AC disease.

Aims and objectives: This study was conducted to find out the effects of TENS and mobilization with and without rotator cuff muscles’ strengthening exercises on function, Range of motions and pain in Adhesive Capsulitis disease.

Materials and Methodology: It was a quasi experimental research. A sample of 40 subjects with AC disease was selected by using convenient sampling technique from public and private hospitals of Faisalabad. We divided the subjects into two groups; one group received GH joint mobilization & TENS, on the other hand, second group was given strengthening exercises of the RC muscles additionally. Total twelve treatment sessions were given for 4 consecutive weeks with administration of three treatment session in one week. A goniometer was used for ROM measurement, VAS for pain measurement and SPADI & PSFS was used for the measurement of pain, disability and functional status. **Data Analysis:** SPSS version 16 was used for data analysis. **Results:** Statistically significant improvement i.e. p -value <0.05 was seen in the group which was given strengthening exercises combined with TENS and mobilizations. **Conclusion:** This study concluded that strengthening exercises combined with mobilization and TENS had a greater impact on ROM and a greater impact on pain on the VAS than using mobilization and TENS alone

Keywords: Adhesive capsulitis, mobilization, frozen shoulder,

Introduction:

Characteristic feature of this ailment is a substantial decrease in ROMs of shoulder, both active & passive. Results of radiographs when performed at GH joint appears to be normal in patients of AC disease. However they can indicate calcific tendonitis or osteopenia. Despite significant investigation, the exact cause of adhesive capsulitis is still unknown; it may be caused by a non-specific, long-lasting inflammatory response of the sub synovial tissue, which thickens the synovium and the capsular tissue, impairing the GH joint's ability to function(Kelley, McClure, & Leggin, 2009) The cause of adhesive capsulitis is still not well understood, and it may be due to a non-specific, long-lasting inflammatory response of the sub synovial tissue that thickens the synovium and the capsular tissue, impairing GH joint's function. AC disease often develops over time and is idiopathic, although it can also manifest suddenly and be linked to a past of minor shoulder joint injuries (Hanchard et al., 2011). Patients of DM (27%) MI patients after surgery (5%) limb immobile (5%) CVA (4%) and inactive persons (4%) are the groups most likely to experience adhesive capsulitis, with an average span of sign and symptoms 3.66 ± 2.36 month. Additionally, this is discovered that two percent of cases involve both shoulders. The left shoulder is more frequently affected (54 percent)(Rauoof, Lone, Bhat, & Habib, 2004). The three stages of adhesive capsulitis are; painful stage, stiffening stage, and thawing stage(Celik, 2010). In painful stage AC disease, the pain starts gradually and remains there for weeks to months. Severe pain has the potential to significantly disrupt sleep (Lin et al., 2009). ROMs of shoulder joint, both passive & active , gradually diminish during the stiffening stage, which can continue up to an year(Escamilla, Yamashiro, Paulos, & Andrews, 2009). During the phase, known to be the "capsular pattern," majority of patients undergo a decrease in ROM of GH joint. Outward rotation decreases first, preceded by a reduction in abduction and then medial rotation. The progressive return of ROM characterizes the last, thawing phase(Lin et al., 2009). The rotator musculo-tendinous cuff is made up of SITS muscles i.e supraspinatus, infraspinatus, teres minor and subscapularis. Because insertion of tendons of each cuff muscle integrate with and strengthen the GH capsule, these muscles are referred to as a "cuff." More importantly, each has action lines that considerably aid in the stabilizing the GH joint's dynamic movement(Reeves, 1975). If it is observed that there is no relief in symptoms despite of having significant shoulder rehabilitation, AC disease may be associated to RC tendonitis, and surgery of RC is advised(Ko & Wang, 2011). In order to maintain shoulder's right biomechanics in the treatment of AC disease, strengthening RC muscles must be integrated as Sahrman claims that RC muscle weakness is frequently observed in cases of adhesive capsulitis. Additionally, RC strengthening exercises must be emphasized in cases of secondary AC disease, which may result from RC weakening after some shoulder trauma or RC tear(Sahrman, Azevedo, & Van Dillen, 2017).

Manual techniques, therapeutic exercise and modalities, are widely integrated in physical therapy for individuals with frozen shoulder. The passive & active stretching, active ROM exercises, wall walks, wheels, Codman's exercise, and rotator cuff and scapular strengthening are among the exercises used to treat AC disease(Kelley et al., 2009). In treating AC disease, strengthening exercises for scapular stabilizers muscles and RC muscles are advised(Page & Labbe, 2010). Adhesive capsulitis disrupts the isokinetic strength of shoulder joint's internal

and external rotators, and its importance for strengthening is underlined(Lin et al., 2009). In one trial, scapular stabilizers exercises were administered for rehabilitation and four wks were offered in another, but information regarding the sort of exercises administered was not provided(Jurgel et al., 2005). No other study that investigated the impact of combining RC muscle training with pain management and mobilization for treatment of AC disease could be reported at the time this one was conducted. Thus, research on the impact of RC strengthening exercises in patients with AC disease was required, and this needed to be contrasted with the mobilization and TENS, which comprises of electrical modalities and mobilization for management of pain. It was predicted that strengthening the RC muscles in patients with adhesive capsulitis would assist to enhance joint function and increase shoulder's ROMs.

Method:

This was a randomized clinical trial where participants were distributed to 2 intervention groups. Group-I; control-mobilization+TENS group and Group 2; experimental group mobilization+ TENS +RC strengthening Exercises. During all this allocation procedure subject is blind i.e. completely unaware of intervention given to her/him. All subjects were treated in OPD of physiotherapy in government and private hospitals of Faisalabad. They were advised to lie supine on a couch which was 4 foot high from the floor. Then a consent form was given to all the subjects to take permission for pursuing the required intervention to respective subjects or group members and filled by them. TENS with same modes of intervention for both group members was applied for 20 minutes. Kaltenborn mobilization was given to the subjects in both groups (grade was decided by the subjects' tolerance). GH joint mobilization & TENS was the treatment that was same for both groups.

Then subjects were randomly allocated into two different groups using lottery method of randomization, for the continuation of research experiment according to criteria of exclusion and inclusion that was already set by the researcher. A questionnaire was also circulated among the subject to collect the basic demographic details about them and baseline information with respect to the pain, restricted movement at shoulder joint and subjects' level of disability, as the aim of study was to manage pain improve range of motion and subjects' shoulder related disability. Specifically for pre and post condition assessment a standard questionnaire named shoulder pain and disability index SPADI(Tveitå, Ekeberg, Juel, & Bautz-Holter, 2008) was used for recording pain and any kind of disability the subject was facing. VAS(Boonstra, Preuper, Reneman, Posthumus, & Stewart, 2008) was used to record subjects' level of pain and patient specific functional scale PSFS Questionnaire was used to record ADL related level of disability the subject was suffering from. These VAS, SPADI and PSFS(Barten, Pisters, Huisman, Takken, & Veenhof, 2012) questionnaires were filled by the subjects in assistance with researcher before starting the intervention i.e. at first day of their visit to the hospital and then filled by them at the end of follow-up i.e. after twelve treatment sessions in four weeks; three treatment sessions weekly. Both pre and post values of shoulder's ROMs i.e. lateral rotation, internal rotation, flexion and abduction, were recorded by using a standard size goniometer(Gajdosik & Bohannon, 1987).

Then through statistical methods and approaches data was analyzed and results were extracted with the help of statistical tests; the unpaired t-test & the paired t-test.

Results:

95% level of confidence and power = 80% was used in order to calculate a sample size of 40 in total. 20 subjects were added to each of the group. SPSS version 16 was used for making data analysis. Pre and post treatment measures were obtained for ROM, function and pain. Paired t-test was conducted to make comparison of pre and post values within group. On the other hand, to make comparison between groups, independent t-test was used.

In subjects of group that underwent RC muscle strengthening exercises as opposed to GH joint mobilization & TENS, changes were observed that were significant statistically in all outcome measures when compared between groups. PSFS; 5.5500 ± 1.23438 Vs 2.4500 ± 1.31689 , VAS; 5.4000 ± 1.04630 Vs 2.1500 ± 1.18210 , SPADI; 48.1500 ± 5.02913 Vs 28.3000 ± 5.04819 and ROMS (External rotation; 79.2500 ± 5.65569 Vs 85.5500 ± 2.81864 , internal rotation; 72.2000 ± 5.01157 Vs 74.3000 ± 3.19704 , abduction; 144.0000 ± 13.92083 Vs 151.0500 ± 8.41349 , flexion; 145.4500 ± 10.45026 Vs 145.4500 ± 8.30647 .

A comparison of p-values of control and experimental group after administering treatment to both groups is tabulated as follows:

Pre and Post comparison within the group_Paired Sample t-test

Var. Pre Vs Post	A=Control Group p-value	B=Experimental group p-value	Significance (if below p-value < .05)
VAS	.015	.008	Highly Significant
SPADI	.033	.019	Significant
PSFS	.040	.017	Significant
ROM-EXTERNAL-Rot.	.011	.009	Highly Significant
ROM-INTERNAL-Rot.	.033	.010	Significant
ROM-ABDUCTION	.027	.013	Significant
ROM-FLEXION	.010	.007	Highly Significant

It is evident from the results that experimental group showed significant results of all the outcome measures especially those of VAS, external rotation and flexion were highly significant.

And the results indicated that there were differences between effect of treatment protocols given to control group and those given to experimental group, when analyzed through independent t-test, as tabulated below:

Comparison Between the groups _Independent t-test

Variable	p-value
VAS	.012
SPADI	.011
PSFS	.012
ROM EXTERNAL	.025
ROM INTERNAL	.122
ABDUCTION	.040
FLEXION	.007

Internal rotation's p value is not less than .005 so there was no significant difference in internal rotation.

Discussion:

40 out of total patients suffering from adhesive capsulitis were completely tested and screened. All those sufferers were selected and categorized into two groups; one of the class showed GH joint mobilization & TENS. On the contrary the other class come up with TENS, mobilization, and RC strengthening exercises in addition. Figure 1 shows the study's participant flow. Both groups have common demographic features including age, gender, and affected extremity.

The main outcome measures that were compared between the two groups are pain, degree of mobility and function. On the basis of function, both groups shared identical features at baseline. There were distinguished in VAS shoulder flexion and abduction between the both categories. The main resultants distinguished between the two classes were ROM, function, and agony. Both had common basic attributes. There were prominent dissimilarities between both groups in VAS shoulder flexion and abduction. Both groups of members completed all the practices as mentioned. There were zero negative effects found. After 4 to 12 therapy sessions, substantially prominent improvements, in pain, functional level, and all shoulder ROMs excepting those in flexion were noted in subjects of experimental group.

In this experiment, subjects with AC disease were analyzed to differentiate the effectiveness of joint movement, TENS, and the addition of rotator cuff building up exercises. After 12 sessions of intercession, the tests disclosed that RC strengthening exercises had an great part in ROM improvement, pain relief, and functional outcome in persons going through adhesive capsulitis (3 sessions each week for 4 consecutive weeks).

It was proposed that the reason for pain alleviation and an increase in ROM was the use of TENS in conjunction to mobilization. TENS reduces pain by inhibiting both peripheral and central mechanism of pain (Melzack & Wall, 1965). Since less of literature is available supporting the efficacy interferential therapy for treatment of MSK disorders (Fuentes, Armijo Olivo, Magee, & Gross, 2010), we opted the use of TENS over the type of therapy that is frequently utilised in our setup. When combined with other treatments, such as exercises (Maryam, Zahra, Adeleh, & Morteza, 2012) or exercise and mobilization (Carette et al., 2003), TENS has been successfully utilized to treat adhesive capsulitis. TENS was found

to be more effective than interferential therapy in one study, however the regime employed in that research was not same as in our study.(Dewan & Sharma, 2011).

Techniques for mobilizing shoulder joints with adhesive capsulitis are widely used. Patients with AC disease are administered a combination of mobilization with movement, midrange mobilization and end-range mobilization, "high-grade" or "low-grade" Maitland joint mobilization techniques, and it is discovered that these treatments have improved ROM and functional status(Yang, Chang, Chen, Wang, & Lin, 2007). The improvement in both groups may be attributable to the synergistic effects of joint mobilization and pain treatment.

In a study that was identical to our research was conducted by Rawat P. et,al in 2017, the outcome measures of this research showed that in treatment of AC disease, the conjugating a planned RC strengthening exercises Training to GH joint mobilization & TENS led in improving ROM, reducing pain, and increasing function. In the subjects that were given RC muscle strength training as opposite to GH joint mobilization & TENS, with accord to statistics, their outcome measure showed notable differences were when comparison was performed between the groups. SPADI 34.66 6.69 vs 54.29 12.17; PFPS 3.06 0.80 vs 4.70 0.81; VAS 12.76 1.04 vs 4.05 1.32 and range of motion (rotation and elevation; > 70o vs > 48o and > 125o vs > 110 ° respectively)(Rawat, Eapen, & Seema, 2017).

In our research, after getting four weeks therapy, when the both groups were compared, subjects in group who were administered RC strengthening exercises displayed improvement comparative to subjects in group who just underwent GH joint mobilization & TENS. So it may be elucidated by the supplementary advantage of strengthening exercises session for the RC muscles. The RC muscles, which are constituent of a "cuff" because RC muscles insert their tendon in such a way that they reinforce the cuff around the GH joint thus ensuring a stronger and stable joint, especially they ensure the dynamic stability at GH joint by producing ample force throughout the ROMs performed at this joint. (Kisner, Colby, & Borstad, 2002).

It is possible that muscular contraction, in addition to stabilizing, support more gliding across tissue interfaces that stretching alone was unable to attain. RC disease has been successfully treated with mobilization and exercise have proved to have good effects in treating the patient with RC disease, but nothing can be said about its effectiveness for AC disease(Green, Buchbinder, & Hetrick, 2003). Adhesive capsulitis is advised to be cured with a variety of excercises(Hanchard et al., 2012). In order to cure adhesive capsulitis, RC strengthening exercises activities are recommended(Page & Labbe, 2010). In a research one group was given RC strengthening exercises but nothing can be surely said that whether the results were improved purely due to RC strengthening exercises beause, in this study RC strengthening was administered combined with electrotherapy and stretching excercises(Sharaf, Ahmed, & Abdel-Aziem, 2013).

Subjects in both groups experienced an improvement in felt pain & function (referred MCID values for VAS and SPADI were 18 points and 1.4 cm, respectively), to a level that is significant not mere statistically but to a level that is significant clinically too. However, in the subjects of experimental group; which were given RC strengthening exercises, it was indicated

by results that an improvement in shoulder ROMs; (referred MCID= 9, 18 & 12 for flexion, abduction and external rotation), was achieved to a level that is significant clinically rather than in the subjects of group which were given GH joint mobilization and TENS, showed a clinically significant increase in the joint's ROM (referred MCID value for shoulder flexion, external rotation, and abduction is 9,12 and 18 respectively), contrarily results indicated that in subjects of control group; GH joint mobilization & TENS group, only flexion and external rotation were improved to a level that is significant clinically. Thus, this study implies that adding RC strengthening exercises to the treatment protocols of AC disease is significant clinically.

Eventually, it can be said that the improvement in RC muscles' strength, and substantial improvements in shoulder ROMs, function and pain, noted after giving the treatment to the subjects of experimental group (who were treated with RC strengthening exercises along with GH joint mobilization & TENS), may be owed to RC strengthening regimes delivered to those patients.

Finally, it can be said that the improvements (noted after treatment sessions) in rotator cuff muscle strength, and substantial improvements in shoulder ROMs, function and pain, found in subjects of experimental group may be due to the specificity of RC muscles' strengthening exercises.

Conclusion:

Finally, this study concludes that mobilization therapies added with mobilization and TENS had resulted a greater influence on ROM and pain on the VAS than mobilization and TENS singly. In the group of participants having adhesive capsulitis, who were treated with strengthening exercises combined with TENS application & shoulder joint's mobilization, they have showed substantial improvement in shoulder ranges of motion (all 4 ROMs that are effected in AC disease), pain (as measured by VAS), and function (as measured through SPADI & PSFS), these improvements were evident by the results to be statistically significant; p-value < 0.05. In addition it was also noted that shoulder ranges of motion were improved not merely to a level that is significant clinically, but to a level that is significant statistically too.

Limitations and recommendations:

In patients with adhesive capsulitis, reinforcement through strengthening exercises of the muscles that are responsible for stabilizing the scapula should also be initiated as soon as it is noted that a plenty of ROM is achieved since the muscles responsible for scapular stabilization help to maintain the scapulo-humeral rhythm, which we know is disturbed in the AC disease. But scapular strengthening was not carried in this experiment. Scapular strengthening can also be the domain of future research. Taking into consideration, the persistent nature of the condition and the truth that sufferers are impressionable to losing inspiration, thus constant proceedings are vital and were not performed in this study.

Future studies may also add the element of strength measurement of RC muscles, after administering strengthening protocols to subjects of experimental group, as we were short of apparatus like dynamometer; an expensive tool for measuring the strength of muscles.

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