Original Article

Effectiveness of End Range Mobilization and Reverse Distraction Technique in Adhesive Capsulitis: A Comparative Study

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Abstract

Background: Adhesive capsulitis is a common musculoskeletal disorder with spontaneous onset characterized by pain and restricted active and passive range of motion of shoulder.

Objective: This study aims to evaluate the effectiveness of End Range Mobilization and Reverse Distraction Techniques in treating adhesive capsulitis (frozen shoulder).

Methods: A total of 60 subjects diagnosed with adhesive capsulitis were randomly assigned into two groups: Group A (n = 30), receiving End Range Mobilization with conventional therapy and Group B (n = 30), treated with Reverse Distraction Technique with conventional therapy. Pre and post-intervention assessments included passive range of motion in shoulder flexion, abduction, internal rotation and external rotation and The Shoulder Pain and Disability Index score at baseline and end of 4 weeks.

Results: Significant improvements were observed in both groups post-intervention. Group B demonstrated higher passive range of motion and improved function in shoulder.

Conclusion: Both techniques are effective in managing adhesive capsulitis, but Reverse Distraction Technique may offer better results for improving shoulder mobility and function.

Keywords: Adhesive capsulitis, Frozen shoulder, End Range Mobilization, Reverse Distraction Technique.

Introduction

Adhesive capsulitis is a condition characterized by severe shoulder pain and functional restriction of both active and passive shoulder motion in which radiographs of the glenohumeral joint are essentially unremarkable.[1]

The prevalence of adhesive capsulitis in the normal population is 2 to 5 percent and increases in patients with type 1 (10%) and type 2 diabetes (22%). It is generally seen among age groups between 40 and 60 years with more incidence in females.[18]

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The predominant feature of adhesive capsulitis is the contracture of the capsule which can be stretched. There are findings of capsular synovial layer loss, adherence of axillary, humeral and glenoidal capsular parts with general reduction in capsular volume. There is thickened and fibrotic rotator interval particularly in adhesive capsulitis.[2]

There is reduction in the overall ranges of shoulder joint movement with capsular pattern, in ascending order from least affected range flexion, internal rotation, abduction and external rotation.[3]The restriction of motion is in predictable capsular pattern in which there is more limited external rotation than abduction.[4]

The altered kinematics of the scapula in subjects with shoulder stiffness with a three dimensional electromagnetic tracking device during shoulder elevations in different planes and reported early and excessive lateral/upward rotation of scapula with clear disruptive change in the scapulohumeral rhythm.[5]

It is a challenging condition to treat, often leading to significant functional limitations in daily activities. A notably large group of patients receive treatment through non steroidal anti-inflammatory drugs, intra-articular corticosteroid injections, and physical therapy. In resolute cases aggressive interventions are used such as hydrodilation, arthroscopic release, and manipulation under anesthesia.[6]

In physical therapy, a heterogeneity of interventions are used; these include heat, cryotherapy, ultrasound, interferential therapy, transcutaneous electrical nerve stimulation, extracorporeal shock wave therapy, active and passive range-of-motion(ROM) exercises, proprioceptive neuromuscular facilitation techniques, and mobilization techniques.[7]

However, manual therapy techniques such as End Range Mobilization and Reverse Distraction Technique have emerged as promising interventions.[8]End Range Mobilization is the technique incorporated by entering the initial resistance obtained by physiological shoulder elevation and then accessory glides are given respectively for flexion and abduction to the glenohumeral joint maintaining the physiological elevation.[9]

Reverse Distraction is the technique in which the shoulder elevation is achieved till the initial resistance and then with glenohumeral distraction the scapula is mobilized in medial rotation.[10]

Reverse Distraction Technique was used as an adjunct to end range mobilization. Many scapular mobilization techniques were incorporated with mobilization is same plane as that of physiological movement, but the Reverse Distraction Technique is the opposite.[11]

Universal goniometry is the reliable assessment tool to measure the range of motion.[12]The Shoulder Pain and Disability Index (SPADI) score is easy to administer and interpret with understandable translation to assess function of the shoulder joint.[13]

End Range Mobilization is most frequently used mobilization technique in adhesive capsulitis whereas the Reverse Distraction Technique is unconventional and very minimally studied for the fact that only one English study has been found during literature search.[11]

End Range Mobilization is purely a glenohumeral mobilization and Reverse Distraction Technique is purely a scapular mobilization technique.

During the limited search strategy there is no literature which compared the effectiveness of End Range Mobilization and Reverse Distraction Technique in adhesive capsulitis. Therefore an evoking question arises and the strong need for the study originates.

Methods

Study Design

This is a randomized controlled trial involving 60 subjects diagnosed with adhesive capsulitis.

Sampling procedure

The sample size was calculated using G*Power (version 3.1.0)[23] based on the effect size that is extracted from the fractionate of mean differences and average of standard deviation of two groups with outcomes on passive abduction range of motion

(ROM) of the glenohumeral joint after intervening with End Range Mobilization technique. The mean passive range of motion in degrees measured before and after end range mobilization of glenohumeral joint are 45.65 and 54.95 with standard deviation of 15.62 and 5.24 respectively.[10]

Effect size d - 0.9

Alpha error - 0.05

Power - 0.9

The sample size in each group was determined to be 27. An assumption of 10 percent dropout rate estimates the addition samples of 3 in each group which gives overall sample to be 30 in each group.

Critical t - 2.00

df - 58

Ethical approval was obtained from Institutional Ethics Committee (Ref no. SDMIEC:119:2019 Dated 29.03.2019), SDM college of Medical Sciences and Hospital, Dharwad and informed consent was acquired from all participants.

The intervention was carried out in SDM Hospital Orthopaedic Physiotherapy OPD between time periods of May 2019 to April 2020.

Participants

Participants were randomly divided into two groups by simple randomization.

- **Group A (n = 30):** End range mobilization technique and conventional treatment.
- **Group B (n = 30):** Reverse distraction technique and conventional treatment.

Inclusion criteria included patients with a confirmed diagnosis of adhesive capsulitis, aged 40-65 with limited ROM of a unilateral shoulder joint (ROM losses of 50% or greater compared with the uninvolved shoulderand no previous shoulder surgery). Exclusion criteria included any history of trauma or systemic conditions like rheumatoid arthritis affecting the shoulder.

Intervention

- **End Range Mobilization (Group A):** At the start of each intervention session, the patient's ROM was examined in all directions to obtain information about the end-range position of the glenohumeral joint. A belt was tied across the involved side axilla to the bed to stabilize the scapula. Intervention started with a few minutes of warm up consisting of rhythmic mid-range mobilizations with the patient in a supine position. Thereafter, the therapist's hands were placed close to the glenohumeral joint, and the humerus was brought into a position of maximal flexion and maximal abduction.[9,14]The direction of mobilization has been altered by varying the plane of elevation.10 to 15 oscillations of grade 3 or 4 of Maitland mobilization of 10 sets with 30 seconds of rest was administered.[15]
- **Reverse Distraction Technique (Group B):** At the start of each intervention session, the patient's ROM was examined in all directions to obtain information about the end-range position of the glenohumeral joint. Intervention started with a few minutes of warm up consisting of rhythmic mid-range mobilizations with the patient in a supine position. Patients lie on their unaffected side and in prone position at the edge of a plinth. The cephalad hand of the therapist held on patient's arm for applying glenohumeral distraction at various angles of flexion and abduction, whereas the caudal hand was placed on the lateral border of the scapula for mobilizing it in medial and downward rotation.[9] Mobilization for 10 to 15 repetitions of 10 sets with 30 seconds rest between each set was administered.
- **Conventional therapy:** Both groups received the common treatment of moist heat using a hydro collator pack, Codman's pendular exercise and Theratube exercises for shoulder flexors, extensors, abductors, adductors, internal and external rotators.[9]

- **END RANGE MOBILIZATION** (Figure 1, Figure 2)

Figure 1

Figure 2

- **REVERSE DISTRACTION TECHNIQUE** (Figure 3, Figure 4)

Figure 3

Figure 4

- **Dosage-** Patients were treated for 3 sessions per week for 4 weeks. Assessment for outcome measures was done at baseline and after four weeks.

Outcome Measures

- **Passive Range of Motion (PROM):** Measured using a universal goniometer in shoulder flexion, abduction, external rotation and internal rotation.[12]
- **Functional Assessment:** The Shoulder Pain and Disability Index (SPADI).[13]

Statistical Analysis

All the analysis was performed using Statistical Package for the Social Sciences (SPSS) version 25.0. The tests for normality was done using Kolmogorov-Smirnoff and Shapiro-Wilk test for all the outcome measures which showed that the data in both groups was not normally distributed.

The baseline data under Mann Whitney U test was performed to check for baseline similarity. The analysis for within group differences for End Range Mobilization group and Reverse Distraction Technique group was done using Wilcoxon Sign Rank test.

To compare between the difference between the end range mobilization group and the reverse distraction technique group Mann Whitney U test was used. The statistical significance was considered as $p<0.05$.

Table 1. Mean and standard deviation of age in Group A and Group B. The mean age of participants in this study was 52.47 years with the standard deviation of 5.92.

Group	Mean Age	SD
A	52.60	6.19
B	52.36	5.69

SD- standard deviation

Table 2. There was equal distribution of Males and Females in Group A and Group B. A total of 15 males (41.5%) and 35 females (58.5%) were present including both the groups.

Group	N (%)	
	Male	Female
A	13 (43)	17 (57)
B	12 (40)	18 (60)

N- Number, %- percentage

Baseline Passive Range of Motion and Function

Table 3. The baseline characteristics analyzed of both groups with the median and interquartile values by using Mann Whitney U test shows that the groups were similar at baseline with p>0.05 for all the outcome measures.

VARIABLE		MEDIAN	LL	UL	p
FLEXION	PRE(A)	89	85	90	0.862
	PRE(B)	88	83.75	90	
ABDUCTION	PRE(A)	80	78.75	85	0.520
	PRE(B)	80	78.75	85	
INTERNAL ROTATION	PRE(A)	45	40	45	0.222
	PRE(B)	42	40	45	
EXTERNAL ROTATION	PRE(A)	40	35	45	0.535
	PRE(B)	35	30	40	
SPADI	PRE(A)	94	92	103	0.335
	PRE(B)	94	90	101	

LL- lower limit, UL- upper limit

Post Intervention Results

Both groups showed significant improvements in PROM and SPADI scores post-intervention (Table 4, Table 5) ($p < 0.05$). Group B (RDT) demonstrated higher gains in shoulder PROM and improvement in pain and function under SPADI scores compared to Group A (ERM) (Table 6) ($p < 0.05$) and (–Z value)

suggesting post treatment improvements are better than pre-treatment within the groups and post treatment improvements between the groups are better in Group B (RDT) than Group A (ERM).

Table 4. Comparison of pre and post treatment passive range of motion and SPADI scores in Group A (ERM) by Wilcoxon Sign Rank test.

VARIABLE		MEDIAN	Z	P
FLEXION	PRE	89	–4.806	0.001*
	POST	150		
ABDUCTION	PRE	80	–4.816	0.001*
	POST	140		
INTERNAL ROTATION	PRE	45	–4.893	0.001*
	POST	65		
EXTERNAL ROTATION	PRE	40	–4.872	0.001*
	POST	55		
SPADI	PRE	94	–5.512	0.001*
	POST	54		

*Significant at 5% level of significance. ($p<0.05$), -Z value= post>pre.

Table 5. Comparison of pre and post treatment passive range of motion and SPADI scores in Group B (RDT) by Wilcoxon Sign Rank test.

VARIABLE		MEDIAN	Z	P
FLEXION	PRE	88	–4.892	0.001*
	POST	167		
ABDUCTION	PRE	80	–4.855	0.001*
	POST	157		
INTERNAL ROTATION	PRE	42	–4.935	0.001*
	POST	79		
EXTERNAL ROTATION	PRE	35	–4.877	0.001*
	POST	65		
SPADI	PRE	94	–5.784	0.001*
	POST	39		

*Significant at 5% level of significance. ($p<0.05$), -Z value = post>pre.

Table 6. Comparison of post treatment passive range of motion and SPADI scores between Group A and Group B by Mann Whitney U test.

VARIABLE		N	U	Z	P
FLEXION	POST(A)	30	30.0	–6.334	0.001*
	POST(B)	30			
ABDUCTION	POST(A)	30	30.0	–6.334	0.001*
	POST(B)	30			
INTERNAL ROTATION	POST(A)	30	0.0	–6.748	0.001*
	POST(B)	30			
EXTERNAL ROTATION	POST(A)	30	31.0	–6.302	0.001*
	POST(B)	30			
SPADI	POST(A)	30	58.5	–5.800	0.001*
	POST(B)	30			

*Significant at 5% level of significance. ($p<0.05$), -Z value= post(B)>post(A).

Results

Demographic Data

The demographic characteristics of the subjects are presented in Table 1 and 2. There were no significant differences between groups regarding age and gender.

Discussion

The rationale for applying moist heat is to achieve the change in the viscoelastic property of connective tissue, to relax the surrounding muscles and to enhance the effect of stretch mobilization. Studies show that there is a notable reduction in the tensile stress with temperature increase of soft tissues by 3 degree centigrade to 4 degree centigrade.[17] For relaxation of the muscles, to maintain the range of motion and to break down intra-articular adhesions, pendular exercises were performed.[8,16]

The rotator cuff tendons insertions together helps in the reinforcement of the glenohumeral capsule to maintain the static and dynamic stability of the shoulder complex within its range and sufficient force is generated for the stability throughout the complete range for improved function.[16]More than the stability component the gliding at the tissue interface by the muscle contraction to breakdown any inter-tissue adhesions may have been achieved by the theratube exercises which improved function.[18]

Reduction in pain subscale has been attributed by mechanisms such as neurophysiological mechanisms and exercise induced hypoalgesia (EIH).[19]

End Range Mobilization which is used as common mobilization technique aimed to stretch the contracted structures in the periarticular region. The posterior and the postero-inferior part of the capsule is stretched for flexion but the glide is towards posterior till 90 degree and becomes inferior as range increases, anterior and inferior part of capsule is stretched for abduction with glide in inferior direction abiding by the concave -convex rule. These considerations provide specific stretch to the capsule.[9]

One of the effective treatment strategies to improve mobility in the shoulder for patients with adhesive

capsulitis is scapular mobilization. Various technique applications were used such as superior and caudal gliding, upward and downward rotations and scapular distraction from the thorax. But in Reverse Distraction Technique the scapula is moved in medial rotation. The effect may be because of an enhanced scapular motion which was disintegrated and also release of scapulothoracic muscular adhesions.[20]

Contrary to the first technique, in Reverse Distraction Technique to counteract the rotation of the scapula there is no force placed on the acromion. This is because of the hold of the capsule which keeps scapula in place. The distraction of the glenohumeral joint and the movement of scapula medially help to load the capsule effectively and clinically less painful,[10] since it was in varying angles of elevation there is also an effective stretch of the capsule.[21]

So the greater target force on capsule can be applied in Reverse Distraction Technique which can increase glenohumeral mobility easily and efficiently. Moreover the positional correction of scapula is achieved.[21]

Although both the techniques aimed at mobilizing for flexion and abduction the changes in rotations of shoulder can be attributed to the specific stress on different parts of capsule by capsular stretching. Also, the rotations of the shoulder are combination of movements in different planes (Codman's paradox) therefore the increase in range of flexion and abduction has attributed to increase in rotations.

The mechanical changes are attributed to adhesions breaking, collagen realignment, increase gliding of the fibre and the capsular stretch with stress on specific part of capsule causing improvement in function and reduction in pain.[22]

Thus, the results of this study concluded that End Range Mobilization and Reverse Distraction Technique showed increase in range and function in patients with adhesive capsulitis. But when compared with each other the Reverse Distraction Technique showed significant improvement in range of motion and the function in patients with adhesive capsulitis.

Limitations

1. Small sample size.
2. Subjects were recruited from only one hospital.
3. The confounding factors and psycho-social factors have not been considered.
4. Since there is variability and unclear duration of stages, the exact stage of adhesive capsulitis is not mentioned.
5. Absence of a control group or placebo group.

Conclusion

End Range Mobilization and Reverse Distraction Technique provide effective treatment options for patients with adhesive capsulitis. After comparison, the Reverse Distraction Technique showed better improvements than the End Range Mobilization in patients with adhesive capsulitis.

Future scope

1. Large sample size.
2. A multi-centre study should be considered so that the results can be generalized to large population.
3. To find the long term effects of these mobilization techniques.
4. Control group can be added to find whether the outcomes were truly because of the mobilization techniques.
5. The confounding factors and psycho-social factors can be assessed separately and relate with symptoms and outcomes.
6. The range of motion and function in relation with the quality of life can be studied separately.

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Source of Funding: Self

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