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Effect of High Grade Mobilisation Techniques and Scapular Stabilization Exercises in Frozen Shoulder

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Abstract
The aim of this study is to improve ROM and maintain scapula humeral rhythm by High grade mobilisation technique and scapular stabilisation exercises in frozen shoulder. A total of 30 subjects divided into 2 groups included both male and female with unilateral frozen shoulder were selected, Group A was given conventional therapy, Group B was given High Grade mobilisation and scapular stabilization exercises along with conventional therapy. All the participants underwent 4 outcome measures, pre and post intervention which included a Visual Analogue Scale for pain, Shoulder external rotation abduction and flexion range of motion, Disability of Arm Shoulder and Hand scale for functional analysis. The obtained results demonstrated a significant difference exists among the groups after 4th week ($p<0.05$). This study concludes that Scapular stabilization exercises in addition to HGMT is effective in decreasing pain and increasing ROM and functional ability by restoring scapula humeral rhythm in frozen shoulder.

Keywords: HGMT, Scapular stabilisation, frozen shoulder.

1. Introduction
Adhesive capsulitis affects 2% to 5% of the general population [1] and 10% to 20% of people with diabetes at some time or other and ranks as the 3rd most frequent musculoskeletal complaint which results in severe disability [2]. The condition was first described by Duplay in 1872 and referred to as the spontaneous onset of gradually progressive shoulder pain and severe limitation of movement [3].
Currently a large variety of both conservative and surgical interventions exists for treatment of frozen shoulder. Surgical procedures include manipulation and arthroscopic or open capsule release under general anaesthesia [4]. Conservative treatment includes various exercise methods and physical therapy modalities such as TENS and LASER [5, 6]. Exercise program consists of passive and active ROM exercises, stretching exercises guided by a physiotherapist, self-stretching and mobilization techniques, strengthening exercises, patient education, and home exercises.
There were only few exercise programs proven to be effective for impaired scapular movement in the conservative management of frozen shoulder [7]. The aim of this study is to improve ROM and maintain scapula humeral rhythm by High grade mobilisation technique and scapular stabilisation exercises in frozen shoulder.

2. Materials and Methods:
The informed consent was taken from the 30 subjects who met the inclusion criteria and were randomly divided into two groups with each group consisting of 15 patients. After the baseline examination was completed, the subjects were randomized to receive either conventional therapy or high grade mobilisations and scapular stabilisation exercises along with conventional therapy. Group a (conventional therapy) received the exercises like Codman's exercise, finger ladder exercise, stretching and strengthening exercises were given according to the pain tolerance and comfortable position of the subject. Group B (High Grade mobilisation and scapular stabilization exercises).The therapist examined the subject's range of motion to obtain information about the end range position and the end feel of the gleno humeral joint. Then the therapist's hands were placed close to the gleno humeral joint and the humerus was brought into a position of maximal range in different directions. The technique starts with

Warm up of mid-range mobilization with GRADE 1 and 2, after that GRADE 3 and 4 for 10-15 repetitions, varying the plane of elevation or varying the degree of rotation in the end range position. All the participants received treatment five times a week for 4 consecutive weeks. The outcome measures Visual analogue scale (VAS), shoulder external rotation, abduction and flexion range of motion and DASH (Disability of Arm Shoulder and Hand scale) were taken pre and post intervention.

3. Results & Discussion

Paired sample test and Wilcoxon signed rank test was performed to compare the difference within the group's i.e, pre intervention, post 2 weeks and 4 weeks. Independent sample test and Mann-Whitney test was performed to compare the difference in pre, post 2 week and post 4 week values between the groups at the level of significance of value $P < 0.05$.

3.1 Tables and Charts

The below table shows that in Experimental Group there were 15 subjects with mean age 25.47 years and there were 8 males and 7 females were included in the study. In Control Group there were 15 subjects with mean age 26.67 years and there were 6 males and 9 females were included in the study.

Table 1: Basic Characteristics of the subjects studied

Basic Characteristics of the subjects studied		Experimental Group	Control Group	Between the groups Significance[a]
Number of subjects studied (n)		15	15	--
Age in years (Mean± SD)		25.47 ± 4.38 (18-32)	26.67 ± 4.25 (19-32)	p= -0.607 (NS)
Gender	Males	8	6	
	Females	7	9	

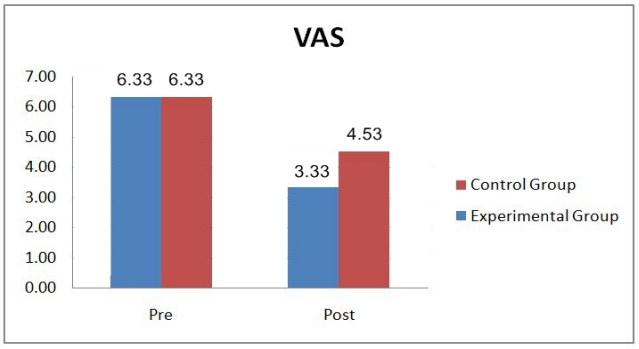
Table 2: VAS scores of Groups A, B, pre, post 4th week

	Group	N	Mean Rank	Sum of Ranks
VAS Pre	Experimental Group	15	15.50	232.50
	Control Group	15	15.50	232.50
	Total	30		
VAS Post	Experimental Group	15	12.20	183.00
	Control Group	15	18.80	282.00
	Total	30		

Table 2.1: comparison of VAS scores

	VAS Pre	VAS Post
Mann-Whitney U	112.500	63.000
Wilcoxon W	232.500	183.000
Z	.000	-2.101
Asymp. Sig. (2-tailed)	1.000	.036
Exact Sig. [2*(1-tailed Sig.)]	1.000[a]	.041[a]

Chart 1: VAS scores of Groups A, B, pre, post 4th week.



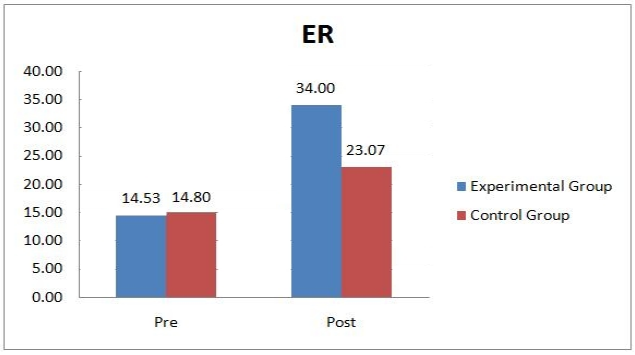
As can be seen from the output, a not significant difference exists Pre of VAS in groups Since Z value is 0.000 and its p-value 1 is greater than 0.05.

As can be seen from the output, a significant difference exists post of VAS in groups Since Z value is -2.101 and its p-value 0.036 is less than 0.05.

Table 3. ER ROM scores of Groups A, B, pre, post 4th week.

		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
ER Pre	Equal variances assumed	-.482	28	.634	-1.33333	2.76601
ER Post	Equal variances assumed	4.496	28	.000	18.00000	4.00397

Chart 2: ER ROM scores of Groups A, B, pre, post 4th week.



As can be seen from the output, a not significant difference exists Pre of ER in groups Since T value is -.482 and its p-value 0.634 is greater than 0.05.

As can be seen from the output, a significant difference exists post of ER in groups Since T value is 4.496 and its p-value 0.00 is less than 0.05.

Table 4: DASH scores of Groups A, B, Pre, post 4th week.

		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
DASH Pre	Equal variances assumed	.000	28	1.000	.00000	1.06607
DASH Post	Equal variances assumed	-6.743	28	.000	-10.00000	1.48303

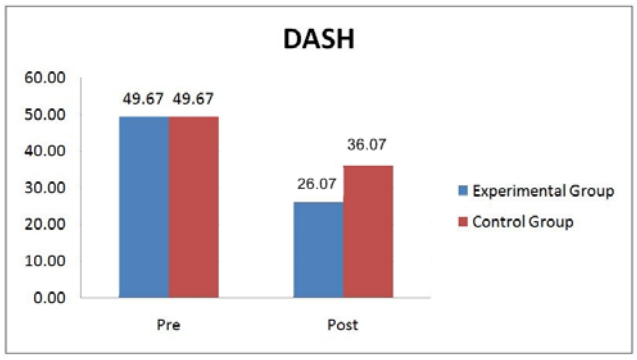


Chart 3: DASH scores of Groups A, B pre and post 4th week

As can be seen from the output, a not significant difference exists Pre of Dash Score in groups Since T value is 0.000 and its p-value 1 is greater than 0.05.
As can be seen from the output, a significant difference exists post of Dash Score in groups Since T value is -6.743 and its p-value 0.000 is less than 0.05.

4. Discussion

Scapular stabilization exercises and HGMT decreased scapular external rotation and improved gleno humeral joint ROM. Shoulder ROM, strength, and functional ability were found better in group which received scapular stabilization and HGMT exercises.
In previous studies scapular alterations have been assessed in patients with frozen shoulder but treatment program was mainly focused on pain relief and improvement in ROM. Very few studies included scapular stabilization exercises, according to Nicholson [8] during humeral elevation, increased upper rotation has been reported in patients with frozen shoulder. According to Lin JJ *et al.* [9] there will be trapezius muscle imbalance is seen in frozen shoulder, his study indicate that increased upper trapezius muscle activity may contribute to scapular substitution in compensation for impaired glenohumeral motion in frozen shoulder. The insufficiency of the increased lower trapezius muscle activity should be an important consideration in the rehabilitation of frozen shoulder. Peter J. Rundquist *et al* [10] concluded that humeral ROM deficits relative to the trunk and scapula were present in subjects with frozen shoulder. Fayad F *et al.* [11] in his study of three dimentional scapular kinematics told that scapulohumeral rhythm of the affected shoulder is inversely related to severity of shoulder range of motion, increased scapular rotation is seen in frozen shoulder as a compensatory pattern. The initial 30 degrees of arm abduction are essentially the result of glenohumeral motion. From 30 degrees to full arm abduction, movement occurs at the scapulothoracic and glenohumeral joints. The movement of the scapula is essentially the product of the movement of the sternoclavicular and acromioclavicular joints. The ratio of glenohumeral to scapulothoracic motion is reported as 2:1. Major muscles during early scapular elevation are upper and lower digitations of the serratus anterior muscle, the levator scapulae muscle, the rhomboid major and minor muscles, and the lower fibers of the trapezius muscle. Considering the forces and moments developed about the base of the scapular spine during the early stages of abduction of the arm, a consistent mechanical pattern is seen. The major influence of the upper fibers of the serratus anterior muscle and the abduction force applied to the scapula by the rotator cuff muscles are balanced by the rhomboid, levator scapulae, and lower fibers of the trapezius muscles. This influence stabilizes the root of the spine of the scapula, which is the center of rotation for movement up to 100 degrees of abduction. As rotation of the scapula progresses past this point, the principal source of activity is the lower part of the serratus anterior muscle. The upper part of the trapezius muscle primarily opposes the pull of the deltoid muscle, and it has limited influence on scapular rotation.The serratus anterior muscle is an essential factor in stabilizing the scapula in the early phase of abduction, in addition to upwardly rotating the scapula [12]. In frozen shoulder as we discussed before there will be restriction of glenohumeral ROM due to capsular tightness, this prevents external rotation of humeral head, and the humeral head slides below the acromion during humeral elevation [13]. In this condition throughout humeral elevation, the scap ula reaches to the end of the range earlier than humerus.
According to Carol A. Oatis, action of rotatorcuff muscles in shoulder elevation is indirectly depend upon scapular stabilization because all SITS muscles are origins from scapula only. If there is perfect stabilization at scapulothorasic joint than there will be perfect action of rotatorcuff muscles at GH joint is obtained.
The neurophysiologic effect induced by HGMT is based on the stimulation of peripheral mechanoreceptors and the inhibition of nociceptors. The biomechanical effect manifests itself when forces are directed towards resistance, but within the limits of a subject's tolerance. The mechanical changes may include breaking up of the adhesions, realigning collagen, or increasing fibre glide when specific movements stress the specific parts of the capsular tissue. Furthermore, mobilization techniques are supposed to increase or maintain joint mobility by inducing rheological changes in the synovial fluid, enhanced exchange between the synovial fluid and the cartilage matrix, and increased synovial fluid turnover [14], this is likely the reason that the pain level and ROM were significantly improved.

5. Conclusion

A 4 week intervention of Scapular stabilization exercises in addition to HGMT is effective in decreasing pain and increasing the ROM, strength and functional ability by restoring scapula humeral rhythm in frozen shoulder.

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