Volume : 5 | Issue : 11 | November 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48

EFFICACY OF SCAPULAR MOBILIZATION IN THE TREATMENT OF ADHESIVE CAPSULITIS: A RANDOMIZED CLINICAL TRIAL

ORTHOPAEDIC

KEYWORDS: Scapular mobilization, Adhesive capsulitis, shoulder mobility, shoulder function, shoulder rehabilitation.

Manas Kumar	MPT (Orth), Consultant orthopaedic physiotherapist.
Ujjwal K Debnath	MS (Orth), FRCS, FRCS (Tr & Orth) DM (Orth) University of Nottingham
Manu Goyal	Associate Professor, Maharishi Markandeshwar institute of physiotherapy and rehabilitation(MMIPR)
Debabrata Kumar	D. Ortho, DNB Resident, Apollo Hospital, Bhubaneswar, PhD student, KIIT University, Bhubaneswar
Subhasish Chatterjee	MPT(Neuro), Assistant professor, Maharishi Markandeshwar institute of physiotherapy and rehabilitation(MMIPR)

ABSTRACT

Introduction: Adhesive capsulitis (AC) is a condition of uncertain etiology characterized by pain and stiffness, a progressive loss of both active and passive shoulder motion which leads to progressive shoulder dysfunction and deformity. Present manual therapy treatments for AC are mainly focused on glenohumeral (GH) joint mobilization given end-range or mid-range. Very few studies have been addressed the restriction of scapular mechanics.

OBJECTIVE: The purpose of the study to find out the effects of Scapular mobilization (SM) given in addition to standard care (SC) in patients with AC.

DESIGN: Randomised controlled trial

METHODS: Sixty (60) subjects with unilateral chronic AC were selected and were randomly and equally allocated in two groups (Group A and Group B) for this study. 30 subjects of group A were given SM (elevation, depression, protraction, retraction, downward rotation and upward rotation) in addition to SC and another 30 subjects of group B received only SC. The pre and post treatment outcome measures were taken which included ROM measured using Goniometer, and Shoulder Pain and Disability Index (SPADI). The treatments were given for five consecutive days a week for total of four weeks. The SC included short wave diathermy (SWD), capsular stretching, shoulder wheel/pulley exercises.

ANALYSIS: Pre-and post-treatment scores were analyzed using paired and unpaired t-test at 95% confidence interval in SPSS version 22.0 for Windows.

RESULT: Scapular mobilization group showed significant changes in active flexion (31.66±4.01 degrees), active abduction (31.33±4.18 degrees), active external rotation (16±1.875 degrees) without active internal rotation (3.93±0.28 degrees) and SPADI (22.45±2.519) compare with SC group which were active flexion (20.26±2.26 degrees), active abduction (20.13±1.44 degrees), active external rotation (10.2±1.06 degrees), active internal rotation (3.13±0.23 degrees) and SPADI (13.43±1.533).

CONCLUSION: SM produced significant reductions in pain with improvements in range of motion and shoulder function in AC patients.

IMPLICATIONS: The SM method offers an effective intervention for addressing AC, which is quick and easy to apply and allows for functional use. Thus SM could be further compared with other treatments in future studies.

INTRODUCTION

Adhesive Capsulitis (AC) of the shoulder is the clinical entity affecting 2-5% of the general population and up to 11 – 30% of diabetic patients.[1,2] Women (42%) are more affected than the men (19%) with the involvement of the dominant side more. It affects persons older than 40 years of age more commonly.[3,4]

The condition is characterized by thickening of the synovial capsule and adhesions within the sub acromial or sub deltoid bursa, adhesion to the biceps tendon and or obliteration of the axillary fold secondary to adhesion[5] which results an insidious and progressive loss of active and passive mobility in the glenohumeral (GH) joint due to joint contracture.[6]

Conventional physical therapy (CPT) in the form of stretching, strengthening exercises and the application of electrotherapy modalities mainly interferential currents, short wave diathermy is provided in order to restore function by reducing inflammation and pain and thus allowing the reestablishment of normal shoulder mechanics.[4] The manual therapy in the form of soft tissue and glenohumeral joint mobilization has been used in the management of AC. However, there is a dearth of literature exploring the effect of scapular mobilization in AC patients.

Inferior shoulder capsule tightness in AC might affect shoulder flexion and abduction, because the scapulo-thoracic (ST) joint is composed of muscles, not like synovial joints. Scapular mobilization (SM) may break up adhesions and release these muscles; hence, scapular movement may be increased. The improvement of shoulder movement might also be related to increased scapular movements.[7]SM is a passive skilled manual therapy technique applied to joints and related soft tissues at varying speed and amplitudes using physiological or accessory motion for therapeutic purposes.[8]

To regain the normal extensibility of the shoulder, SM has been recommended but there is only one study addressing the scapular mechanics in the treatment of AC.[9] The aim of this study was to elucidate the effect of efficacy of combined modality of treatment i.e. SM with CPTand compare this treatment with CPT alone in treating AC.

METHODOLOGY

Sixty (60) patients between age group 35 – 60 years with unilateral chronic AC were recruited by referral from orthopaedics unit at our hospital during the period Aug 2013 to Jul 2014. Random allocation of patients was done using sealed opaque envelope method into two treatment groups by one of author (MK). Treatment allocation was thereby "blinded" for both researcher and patient at the point of inclusion. The patients in the active intervention groups were not informed which treatment option (with or without SM) was carried out. The first group (n= 30) received conventional physical therapy (group A); the second group (n= 30) had SM and CPT treatments (group B). The CPT included capsular stretching, range of motion (ROM), pendulum exercises. Maitland[10] technique of SM included protraction, retraction, depression, elevation and rotation. The intervention period lasted for 5days a week for 4 weeks, with a clinical follow-up after 12weeks. All patients were evaluated at baseline, and during the twelfth week of the study. Ethical approval was taken from the institutional ethical committee.Patients should have reduced passive range of motion (PROM) with a reduction of more than 25 % of all four (4) shoulder movements i.e. flexion (FL), abduction (ABD), internal rotation (IE), external rotation (ER). Patients with diabetes, asthma, pregnant women, acutely inflamed shoulder and injuries were excluded from the study.

Technique of SM

Subjects lay on their sound side on the bed. The clinician stood before the patient's affected shoulder, placing the index finger of one hand under the medial scapular border, the other hand grasping the superior border of the scapula. The scapula was moved superiorly and inferiorly for superior and inferior glide, and then the scapula was rotated upward and downward for scapular rotation. Additionally, the clinician put the ulnar fingers under the medial scapular border and distracted the scapula from the thorax. These patterns were chosen to increase scapular posterior tilt. Ten sets of 10 repetitions were applied, with rest intervals of 30 s between sets.[11]

Outcome measures

Shoulder pain and disability index(SPADI) and Numerical Pain Rating Scale were registered on the first visit, after 4 and 12 weeks.

Sample size

Given α = 0.05, the sample size was calculatedto be 30 in each group to have an 80 % power to detect a difference in mean SPADI score of ≥10. With a 10 % drop out the number of patients required for the study to have the above mentioned power were calculated to be 28 in each group.The mean improvement, % of mean difference, effect size (done by G Power 3.0.10 software), power analysis (done by PASS 13 software) of the AROM, PROM, SPADI score and NPRS scale was measured.

Data analysis

The data was analyzed using SPSS 22.00 for Windows. Chi-square test was used for categorical variables and independent t-test was used for continuous variables. The independent-samples t test was used for between group comparisons of ROM, SPADI and NPRS and the paired- samples t-test was used for within group comparison of ROM, SPADI and NPRS. The results were considered significant if $p< 0.05$.

RESULTS

Patient demographics

The two groups were comparablein their baseline regarding age, gender, mean duration ofshoulder pain and number of affected dominantside. There were no statistically significantdifferences between the two groups regarding AROM, PROM and SPADI (Table 1).

Table 1: Demographics and baseline data of patients in both groups

Variable		Group- A	Group-B	p-value
Age (Mean ± SD)		53.8±4.76	54.26±5.99	[a]0.81[b]
Gender	Male[e]	16 (53.3)	18 (60)	[c]0.71[b]
	Female[e]	16 (46.7)	12 (40)	
Side	Non Dominant hand[e]	12 (40)	10 (33.3)	[c]0.27[b]
	Dominant hand[e]	19 (60)	21 (66.7)	
Duration of symptoms (week)		18.267±4.52	18.06±3.73	[a]0.89[b]
AROM	AFLXN[d]	113.93±18.18	120.73±22.88	[a]0.37[b]
	AABD[d]	106.87±11.07	105.67±22.47	[a]0.85[b]
	AER[d]	37.2±14.66	38.6±16.73	[a]0.80[b]
	AIR[d]	41.46±7.61	44.66±8.65	[a]0.29[b]
PROM	PFLX[d]	120.13±17.96	126.47±22.26	[a]0.39[b]
	PABD[d]	112.27±11.37	111.67±22.36	[a]0.92[b]
	PER[d]	42.33±14.65	43±16.73	[a]0.91[b]
	PIR[d]	46.2±7.54	48.73±7.99	[a]0.37[b]
SPADI (Mean± SD)	Total SPADI	44.07±14.36	50.13±15.28	[a]0.27[b]
	PAIN score	34±9.65	43.2±25.31	[a]0.19[b]
	DISABILITY score	50.33±18.55	50.5±12.98	[a]0.97[b]
NPRS[d]		5±1.00	5±1.13	[a]0.99[b]

a:p-value ≤ 0.05 considered as significant.
b: Continuous variable (Independent t-test).
c: Categorical variable (chi-square test).
d: Data are mean±SD.
e: Data are %

Outcome

AROM

The paired t-test reveals that there was statistically significant improvement in both groups with values of active flexion, abduction, external rotation and internal rotation ($p<0.05$) (Graph 1). Unpaired t -test reveals that there was statistically significant improvement of active flexion, abduction, external rotation in group B ($p <0.05$), but no statistically significant improvement in active internal rotation in group B as compared to group A ($p =0.052$). Most improvement was observed in active flexion which was statistically significant in group B (mean difference = 11.40, $p = 0.013$) as compared to group A (Table 2).

Table-2: Comparison of active ROM within and between groups

AROM	Group	Data collection	Within Group			Between Group	
			Mean ± SD(S.E.M)	Mean difference ± S.E.M difference	p value	Mean difference	Pvalue (t value)
FLX	Group A	Pre (Fa)	113.13±18.17(4.694)	Fc(Fa-Fb)=20.26±2.26	0.00[a]	Fc-F/c= 11.40	0.013[a] (2.48)
		Post (Fb)	134.20±16.51(4.263)				
	Group B	Pre (F/a)	120.73±22.88(5.909)	F/c(F/a-F/b)=31.66±4.01	0.00[a]		
		Post (F/b)	152.40±15				
ABD	Group A	Pre (Aa)	106.87±11.08(2.860)	Ac(Aa-Ab)= 20.13±1.44	0.00[a]	Ac-A/c= 11.20	0.017[a] (2.53)
		Post (Ab)	127±10.18 (2.610)				
	Group B	Pre (A/a)	105.67±22.48(5.804)	A/c(A/-A/b)= 31.33±4.18	0.00[a]		
		Post (A/b)	138±14.68 (3.793)				
ER	Group A	Pre (Ea)	37.20±14.67(3.787)	Ec(Ea-Eb)= 10.20±1.06	0.00[a]	Ec-E/c= 5.80	0.012[a] (2.69)
		Post (Eb)	47.40±16.05(4.147)				
	Group B	Pre (E/a)	38.60±16.72(4.320)	E/c(Ea/-Eb/)=16±1.875	0.00[a]		
		Post (E/b)	54.60±13.21(3.411)				
IR	Group A	Pre (Ia)	41.47±7.61(1.966)	Ic(Ia-Ib)= 3.13±0.23	0.00[a]	Ic-I/c= 0.80	0.052[b] (2.03)
		Post (Ib)	44.60±7.51(1.939)				
	Group B	Pre (I/a)	44.67±8.66(2.235)	I/c(I/a-I/b)= 3.93±0.28	0.00[a]		
		Post (I/b)	48.60±8.83(2.280)				

a: p<0.05 significant, b: p>0.05 non significant

Volume : 5 | Issue : 11 | November 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48

PROM

The paired t-test reveals that there was statistically significant improvement in group A and group B values of passive flexion, abduction, external rotation and internal rotation at p value<0.05 (graph 2).The unpaired t-test reveals that there was statistically significant improvement of passive flexion, abduction, external rotation and internal rotation in group B as compared to group A (p<0.05). Improvement of passive flexion was statistically significant in group B as compared to group A (mean difference = 11.92, p = 0.011). Improvement of passive internal rotation was observed more in group B (mean difference = 0.867, p = 0.045) as compared to group A (Table 3).

Table 3: Comparison of passive ROM within and between groups

Passive ROM	Group	Data collection	Within Group		Between Group		
			Mean ± SD(S.E.M)	Mean difference	p value	Mean differen	p value (t value)
FLX	Group A	Pre (Fa)	120.13±17.95(4.64)	Fc(Fa-Fb)= 20.12±2.03	0.00[a]	Fc-F′c= 11.92	0.011[a] (2.71)
		Post (Fb)	140.27±15.93(4.11)				
	Group B	Pre (F′a)	126.47±22.26(5.79)	F′c(F′a-F′b)= 32.07±3.91	0.00[a]		
		Post (F′b)	158.53±15.14(4.12)				
ABD	Group A	Pre (Aa)	112.27±14.03(3.61)	Ac(Aa-Ab)= 20.47±2.53	0.00[a]	Ac-A′c= 11.12	0.021[a] (2.44)
		Post (Ab)	132.73±9.95(2.58)				
	Group B	Pre (A′a)	111.67±22.35(5.76)	A′c(A′a-A′b)= 31.60±4.28	0.00[a]		
		Post (A′b)	143.27±15.65(4.03)				
ER	Group A	Pre (Ea)	42.33±14.66(3.77)	Ec(Ea-Eb)= 10.40±1.12	0.00[a]	Ec-E′c= 6.13	0.008[a] (2.85)
		Post (Eb)	52.73±15.87(4.09)				
	Group B	Pre (E′a)	43±16.72(4.31)	E′c(E′a-E′b)= 16.52±1.94	0.00[a]		
		Post (E′b)	59.53±14.27(3.67)				
IR	Group A	Pre (Ia)	46.20±7.53(1.95)	Ic(Ia-Ib)= 3.52±0.25	0.00[a]	Ic-I′c= 0.87	0.045[a] (2.10)
		Post (Ib)	49.73±7.49(1.93)				
	Group B	Pre (I′a)	48.73±7.99(2.06)	I′c(I′a-I′b)= 4.40±0.41	0.00[a]		
		Post (I′b)	53.13±8.46(2.18)				

a: p<0.05 significant

MCID for ROM

Flexion

The active and passive flexion was improved significantly in the experimental group (group B). The mean improvement of active and passive flexion in the experimental group was 31.66° and 32.07° respectively. The MCID values for active and passive flexion were 11 and 9 respectively. The % of mean difference of active and passive flexion was 36.0% and 37.2% respectively. The effect size of active and passive flexion was 0.412 and 0.99 respectively and the power to reject null hypothesis was 70% for active flexion and 78.5% for passive flexion. (Table 5)

Abduction

The experimental group (group B) showed more improvement in active and passive abduction. The mean improvement of active and passive abduction was 31.33° and 31.60° respectively. The mean MCID values for active and passive abduction were 16 and 18 respectively. The % of mean difference of active and passive abduction was 36.41% and 35.22% respectively.The effect size of active and passive abduction was 0.419 and 0.889 respectively and the power to reject null hypothesis was 77.63% for active abduction and 73.34% for passive abduction. (Table 5)

External Rotation

The mean improvement of active and passive external rotation in the experimental group (group B) was 16° and 16.52° respectively. The mean MCID values for active and passive external rotation were 14 and 11 respectively. The % of mean difference of active and passive external rotation was 36.25% and 37.04% respectively. The effect size of active and passive external rotation was 0.441 and 0.99 respectively and the power to reject null hypothesis was 76.86% for active external rotation and 77.68% for passive external rotation. (Table 5)

Internal Rotation

The mean improvement of active and passive internal rotation in experimental group (group B) was 3.93° and 4.40° respectively. The MCID values for active and passive internal rotation were 14 and 12 respectively. The % of mean difference of active and passive internal rotation was 20.35% and 20% respectively. The effect size of active internal rotation was 0.375 and passive internal rotation was 0.65 and the power to reject null hypothesis was 50.31% for active internal rotation and 42.9% for passive internal rotation. (Table 5)

SPADI

Both the groups had improvedsignificantly but more improvement was observed in group B. The paired t-test reveals that pain, disability and total SPADI score decreased significantly in both groups(p <0.05).The unpaired t-test between groups A and B suggests that pain score (p=0.02) and disability (p=0.04) and total SPADI (p=0.022) decreased significantly (Table 4). The mean improvement of SPADI in the group B was 22.44. The MCID value was 19.7.The % of mean difference of SPADI was 44.84% for total SPADI score, 45.69% for pain score and 40.93% for disability score. The effect size was 1.11 and the power to reject null hypothesis was 85.98%. (Table 5)

NPRS

The paired t-test reveals that NPRS score was decreased in both group significantly (p <0.05) (Table 4).The unpaired t-test between group A and B reveals that NPRS score decreased more in group B (p=0.03) (Table 4). The mean improvement of NPRS in the experimental group was 3.60 cm. The MCID value was 2.2. The effect size was 0.67 and power to reject null hypothesis was 59.04%. (Table 5)

Table 4: Comparison of SPADI & NPRS within and between groups

		Group	Data collection	Within Group		Between Group		
				Mean± SD(S.E.	Mean differen	p value	Mean differe	p value (t
SPADI	Total SPADI	Group A	Pre (Sa)	44.08±14.36(3.71)	Sc(Sa-Sb)= 13.43±1.533	0.01[a]	Sc-S′c= 9.02	0.022[a] (2.42)
			Post (Sb)	30.63±13.56(3.39)				
		Group B	Pre (S′a)	50.13±15.28(3.94)	S′c(S′a-S′b)= 22.455±2.519	0.01[a]		
			Post (S′b)	27.67±9.97(2.57)				
	Pain	Group A	Pre (Na)	34±9.65(2.49)	Nc (Na-Nb)= 9.733±1.03	0.00[a]	Nc-N′c= 10.00	0.02[a] (2.342)
			Post (A b)	24.26±9.19(2.37)				
		Group B	Pre (N′a)	43.2±25.31(6.53)	N′c(N′a-N′b)= 19.733±3.88	0.00[a]		
			Post (N′b)	23.46±12.59(3.25)				
	Disability	Group A	Pre (Da)	50.33±18.55(4.79)	Dc(Da-Db)= 15.58±2.85	0.00[a]	Dc-D′c= 5.08	0.04[a] (2.13)
			Post (Db)	34.75±18.29(4.72)				

		Group B	Pre (D′a)	50.5±12.98(3.35)	D′c(D′a-D′b)= 20.66±3.32	0.00[a]		
			Post (D′b)	29.83±11.96(3.08)				
NPRS		Group A	Pre (Na)	5.00±1.00(0.26)	Nc(Na-Nb)= 2.92±0.21	0.01[a]	Nc-N′c= 0.67	0.033[a] (2.23)
			Post (A b)	2.07±0.54(0.14)				
		Group B	Pre (N′a)	5.00±1.12(0.28)	N′c(N′a-N′b)= 3.60±0.21	0.01[a]		
			Post (N′b)	1.40±0.74(0.19)				

Table 5: Mean improvement and MCID in the experimental group (B)

	Comparison of mean improvement and MCID		Comparison of % of mean improvement		Effect size	Power to reject null hypothesis
	Mean improvement in group B	MCID	Present study	Previous study	Present study	Present study
AFLXN	31.66°	11°	36.0%	32.09%	0.412	70%
PFLXN	32.07°	9°	37.2%	Irem et al	0.99	78.5%
AABD	31.33°	16°	36.41%	38.65%	0.419	77.63%
PABD	31.60°	18°	35.22%	Irem et al	0.889	73.34%
AER	16°	14°	36.25%	29.12%	0.441	76.86%
PER	16.5°	11°	37.04%	Yang et al	0.99	77.68%
AIR	3.93°	14°	20.35%	18.65%	0.375	50.31%
PIR	4.4°	12°	20%	Yang et al	0.65	42.9%
SPADI	22.4	19.7	Total 44.84% Disability 40.93% Pain 45.69%		1.11	85.98%
NPRS	3.60	2.22			0.67	59.04%

AFLXN – active flexion, PFLXN – passive flexion, AABD – active abduction, PABD –passive abduction, AER – active external rotation, PER- passive external rotation, AIR – active internal rotation, PIR- passive internal rotation, SPADI - Shoulder pain and disability index, NPRS – Numeric pain rating scale

DISCUSSION

AC also known as frozen shoulder is a condition characterized by pain and significant loss of both active range of motion (AROM) and passive range of motion (PROM) of the shoulder. The peak age is 56, and the condition occurs slightly more often in women than men.[2,4]

The chronic AC is characterized by an adherent axillary recess and an abnormal scapulohumeral rhythm that hinders humeral head mobility, resulting in diminished mobility of the shoulder.[6]

To regain the normal extensibility of the shoulder capsule and tight soft tissues, passive stretching of the shoulder capsule and soft tissues by means of mobilization techniques has been recommended, but limited data supporting the use of these techniques are available.[12] In the present study, the capsular stretching was used in both the groups. Increasing posterior capsule flexibility supported normal scapula-humeral rhythm and increased range of shoulder motion especially internal rotation. In the current study, similar improvements of internal rotation were observed.

Several studies have shown that scapular lateral rotation is increased and scapular protraction is decreased during arm elevation in the sagittal plane and scapulo-humeral rhythm of the affected shoulder is inversely related to severity of shoulder ROM limitation, which suggests a compensatory pattern in the patients with AC.[13]

Scapular medial rotation and scapular protraction mobilization was used to improve active and passive abduction. Although GH abduction depends on the scapular upward or lateral rotation.[14] Scapular protraction and medial rotation mobilization probably helped to normalized scapular upward or lateral rotation and medial mobility of scapula which leaded to normalize the SHR. Because Vermeulen et al were also able to show that the increased scapular upward rotation was compensatory to maximize overall range of motion overhead in the presence of reduced mobility at the GH joint in frontal plane.[6] Lin et al founded those with anterior GH joint tightness demonstrated greater scapular upward rotation.[15]

To improve active and passive external rotation, we used scapular retraction and protraction scapular mobilization.As decreased protraction with AC during arm elevation in the frontal plane could also be a compensatory mechanism for the severe limitation in external rotation.[13]

The experimental group did not show significant improvement in active and passive internal rotation as compared to the control group. Although GH IR partially depends on the protraction of scapula andthe anterior capsular tightness in AC patients.[14]

SM used in this study was performed according to Maitland's grade III and IV mobilization which mainly consist of rhythmic oscillatory movements. It produces tissue stretch which desensitized the stretch induced pain and also lead to rearrangement of connective tissue, extra cellular matrix and collagenous tissues, so that tissue remodeling occur which can increase the tensile loading,[12] as a result shoulder active and passive ROM (flexion, extension, abduction, external rotation) increased as well as SPADI score and NPRS scale decreased significantly in the SM group than the control group.

The control group also showed the improvement in all the outcomes but less as compared to the experimental group as evident from the results procured.

Statistical power variation was present in this study because the threat of the internal validity was eliminated by random allocation of the participants in the two groups and a blind observer recorded both the baseline and post intervention data. The threats of external validity were also reduced by a set of strict inclusion criteria and all the participants in the both groups showed similar demographic and baseline characteristics.

The limitations of the study included the inclusion of only primary idiopathic AC, not recording scapular motion, and the absence of the strengthening protocol.

CONCLUSION

Most of the clinical parameters (except internal rotation) had improvement as was observed more in the SM group. The present study provides an evidence of SM effectiveness which addresses the biomechanical alterations and hence improved functional independence in the chronic AC patients.

REFERENCES

1. Shah N, Lewis M. Shoulder adhesive capsulitis: systematic review of randomised trials using multiple corticosteroid injections. Br J Gen Pract. 2007; 57:662-67.
2. Kelley MJ, Mcclure PW, Leggin BG. Frozen Shoulder: Evidence and proposed model guiding rehabilitation. J Orthop Sports Phys Ther.2009; 39:135-48.
3. Simpson J.K. Bulge R. Treatment of frozen shoulder using distension arthrography (Hydrodialation).SA Orthop J.2004; 12:25-35.
4. Ph Laubsher,Rosch TG. Frozen shoulder: A review.SA Orthop J. 2009; 55:144-52.
5. Roubal PJ, Dobritt D, Placzek JD. Glenohumeral gliding manipulation following interscalene brachial plexus block in patients with adhesive capsulitis. J Orthop Sports Phys Ther. 1996; 24:66 –77.
6. Vermeulen HM, Obermann WR, Burger BJ, Kok G, Rozing P. End-range mobilization techniques in adhesive capsulitis of the shoulder joint: a multiple-subject case report. Phys Ther. 2000; 80: 1204–1213.
7. Ahmed M Azzam. Effect of Scapular Mobilization on Improvement of Shoulder Flexion Range in Erb's Palsy Children. J Nov Physiother. 2003; 153: 2 -5.
8. American Physical Therapy Association. Guide to physical therapist practice, 2001 2nd edition.
9. Nath J. Different mobilization technique in management of frozen shoulder. International J of Sceince & Research. 2015; 4(5): 1285- 1290.

10. Maitland GD. Peripheral Manipulation.3rd edition. Butterworth- Heinemann; 1991.
11. Surenkok O, Aytar A, Baltaci G. Acute effects of scapular mobilization in shoulder dysfunction: a double-blind randomized placebo-controlled trial. J Sport Rehabil. 2009 Nov;18(4):493-501.
12. Yang JL, Chang CW, Chen SY, Wang SF, Lin JJ. Mobilization techniques in subjects with frozen shoulder syndrome: randomized multiple treatment trial. Phys Ther. 2007; 87:1307-1315.
13. Fouad F,Roby A, Chadi Y, Sylvain H, Marie M L, Colau D. Vincent G. Three-dimensional scapular kinematics and scapulohumeral rhythm in patients with glenohumeral osteoarthritis or frozen shoulder. J Biomech. 2008; 41: 326–32.
14. Maitland GD. Treatment of the glenohumeral joint by passive movement. Physiotherapy 1983; 69:3–7.
15. Lin JJ, Hanten WP, Olson SL, Roddy TS, Soto DA, Lim HK et al. Functional asctivities characteristics of individuals with shoulder dysfunctions. J ElectromyogrKinesiol. 2005; 15:576-86.