ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

EFFECTIVENESS OF KALTENBORN POSTERIOR GLIDE AND CORACOHUMERAL LIGAMENT POSITIONAL STRETCHING ON EXTERNAL ROTATION RANGE OF MOTION IN PATIENTS WITH ADHESIVE CAPSULITIS.

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ABSTRACT

Background: Adhesive capsulitis is a common and debilitating medical condition which is treated by various surgical and non-surgical treatments but there is no significant method universally. Physical therapists use various shoulder mobilization techniques to improve the ROM. Radiographic and surgical evidence presents tightened CHL to be a prime contributor to inadequate shoulder external rotation in individuals diagnosed with adhesive capsulitis.

Objective: To determine the combined effectiveness of Kaltenborn posterior glide and coracohumeral ligament (CHL) positional stretching on external rotation in patients with adhesive capsulitis.

Methods and Measures: A number of 30 subjects, both Male and Female with a primary diagnosis of shoulder adhesive capsulitis by the physician were recruited. 15 subjects each were randomly assigned to Group-A(Experimental) and Group-B(control). All subjects received 6 therapy sessions consisting of moist heat, shoulder pendular and ROM exercises, Kaltenborn posterior glide and Coracohumeral ligament positional stretching in Group-A. Moist heat, shoulder pendular and ROM exercises in Group-B. Pre-test and post-test were carried out for both the groups and analysed using paired and independent t tests in an SPSS software.

Results: The experimental group(Group-A) mean VAS score had decreased from 6.27 to 3.73, SPADI mean score decreased from 0.534 to 0.380 and also Goniometer (Shoulder external ROM) showed an improvement from 29.2 to 35.33 but when intergroup analysis was done, it resulted in significance only for SPADI where $p < 0.05$. Through this measure, we can state that the treatment protocol for group A had a significant improvement in disability but not much on pain and ROM in patients with adhesive capsulitis.

Conclusion: All the interventions has brought about some improvement in each group post-treatment based on the mean score but its significance vary. So, this study can be concluded that, the treatment protocol, Kaltenborn posterior glide and CHL positional stretching could bring a significant difference with regard to disabilty but not much of difference in pain and ROM in patients with adhesive capsulitis.

Key words: Coracohumeral Ligament, Adhesive capsulitis, Kaltenborn, Positional stretching, CHL.

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ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

INTRODUCTION:

Adhesive capsulitis, is a disease form, of unspecified origin of cause[1] portrayed with a loss of glenohumeral joint motion in all directions, both active and passive movements in an agonizing and steady-rate manner, affecting the external rotation predominantly as a result of progressive fibrosis and contracture of the glenohumeral joint capsule.[2] Various ailments, trauma, muscular disproportion, degenerative changes of the shoulder complex may also lead to adhesive capsulitis but is usually considered as acquired or secondary.[3] AC occurs in 2% to 5% of the population which is more frequent in women aged between 40 and 60 years and in about 20-30% of cases this condition is bilateral. Many pathological disorders can be associated with AC as diabetes mellitus, thyroid dysfunctions, dupuytren contracture, cardio respiratory and autoimmune diseases.[4] It was in the year 1945 in a histological paper published, Neviaser[5] was the first to attempt to convey the adhesive nature of the shoulder capsule as the attribution of the cause in frozen shoulder. And labelled this condition as 'Adhesive capsulitis' subsequently.[5]

Neviaser et al.[6] and Hannafin et al.[7] identified this condition to possess 4 stages, which have been stated after a thorough study on the corresponding features between clinical examination and histological findings. The first one is the 'Painful stage', characterised by gradual onset of symptoms that continues for less than 3 months. Second stage is the 'Freezing stage', where symptoms are present from 3-9 months and are marked with nocturnal pain intensified when patient seem to have laid on the affected side, further portrayed with loss of both active and passive ROM. Symptoms persists from 9-14 months with shoulder stiffness primarily and painful end range movement in the 'Frozen stage'. And the last stage is the 'thawing stage', that presents with a minimal pain and a gradual improvement of ROM occuring between 15-24 months.[6,7] The pathophysiology remains unspecified till date. But the most appealing findings considered often is the inflammation that occurs within the joint capsule and synovial fluid leading to pain at the initial stage which is then, followed by reactive fibrosis and adhesions of the synovial lining of the joint resulting in decreased ROM.[8] Fibrosis and hyalinization of connective tissue at the rotator interval including CHL were shown to be one of the pathogenesis of adhesive capsulitis.[9]

Bernard et al. found a thickened CHL of 4mm or more which had a specificity of 95% and a sensitivity of 59% for diagnosis of frozen shoulder along with a thickened capsule in the rotator cuff interval of 7mm or more had a specificity of 86% and sensitivity of 64%.[10] In a study done by Wen Zhao et al., it was concluded that MRI can be used to show characteristic findings in diagnosing AC that includes thickening of the CHL and the capsule at the rotator cuff interval and complete obliteration of the fat triangle under the coracoid process have been the most prominent characteristic in MRI findings seen with AC.[11]

The thickening, contractures and fibroplasia of CHL has been noted where the CHL remain taut in shoulder external rotation. However, quite a number of favourable outcomes have been reported in studies targeting the CHL through surgical release, microadhesiolysis and

ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

stretching.[12] According to the anatomical fibre orientation of CHL, stretching can be applied to improve the extensibility of the tissue.[13] CHL stretching had a positive impact on calcification, which further prevented fibrotic changes and facilitated clinical improvement and also found that including positional stretching in a rehabilitation protocol improved disability outcomes and results in better ROM.[14] Feland et al. classified a stretch known as 'Long-duration' stretch greater than 30 seconds for one repetition and a 'lowintensity' as well according to the patient's perception and found that long-duration and low-intensity stretching increased ROM especially in the elder population with the concept of more the ageing process, more the tautness of the tissues leading to loss of elasticity and poor state of connective tissues thereafter.[15]

The use of ice while stretching or cryostretching provided enhancement in flexibility of the hamstring than with heat or stretching alone.[16] It was stated that the rationale for using cryotherapy along with stretching is based on the concept of cold possessing the capability to contract the tissues in the new lengthened position.[17] A study stating the effects of superficial thermal agents and shoulder stretching exercises in normal subjects concluded that the use of superficial heat in conjunction with low-load prolonged stretching produced more long- lasting changes in the extensibility of soft tissue than did stretching alone.[18]

Grade 3 posterior translation has a great impact in improving range of motion of external rotation of shoulder in patients with adhesive capsulitis by the distraction force on posterior capsule that eases both the pain and increases ROM of external rotation of shoulder. Kaltenborn mobilization has found to have greater evidence in increasing range of motion. Stretching of fibrous tissue allows the tissue to undergo creep which relates to the ability of tissue to change shape over time as a constant load is applied.[19] And joint mobilization along with active exercises were found to be more helpful in hypomobility of shoulder adhesive capsulitis.[20] Andrea J. Johnson et al. portrayed that a posteriorly directed Kaltenborn mobilization was more effective in increasing external ROM in subjects with shoulder adhesive capsulitis.[21] Also, Jose Orlando[22] practiced a positional stretching of CHL and have found to improve the DASH and SPADI scores significantly with improved external rotation and overall mobility and function.[22] But to our knowledge, there are no studies stating the combined effectiveness of Kaltenborn posterior glide and CHL positional stretching. Therefore, this study has been carried out with an aim to find the combined effectiveness of these two manoeuvres in patients with adhesive capsulitis.

METHODOLOGY:

An experimental design conducted for a duration of 12 months and a number of 30 subjects, both genders with a primary diagnosis of shoulder adhesive capsulitis by the physician were randomly assigned to Group-A(Experimental) and Group-B(control) after meeting the inclusion criteria. Both males and females of age between 45-65 years with Idiopathic or Primary adhesive capsulitis, painful stiff shoulder for at least 4 months, restricted glenohumeral external rotation when measured at 90° of shoulder abduction without history

ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

of shoulder surgeries to the affected shoulder and manipulation under anaesthesia of the affected shoulder, willingness to perform and complete the treatment regimen as explained and patients who have provided written and verbal informed consent were included. Patients with secondary adhesive capsulitis, history of fracture and dislocation in and around the shoulder joint, inflammatory diseases such as rheumatoid arthritis, sensory impairment, subjects with any cognitive and perceptual disorders, concurrent severe cervical signs and symptoms, any musculoskeletal pathology in the upper limb other than AC, malignancy, subjects under any oral steroidal medication or intra-articular steroid injections and subjects not willing to participate in the study were excluded from the study.The study proposal has been accepted by the ethical committee and the samples were collected from Assam Down Town University OPD and Physiotherapy Department, Down Town Hospital.

OUTCOME MEASURES

VAS, SPADI and Goniometry were used for assessing pain, functional ability and ROM for the shoulder joint.

PROCEDURES

The samples were randomly divided into, Group-A(Experimental) and Group-B(control), each group containing 15 subjects. A pre-test and post-test were conducted by assessing range of motion. The interventions in Group-A included: moist heat, pendular and shoulder ROM exercises, Kaltenborn posterior glide and CHL positional stretching with ice pack. And Group-B received moist heat, pendular and shoulder ROM exercises. Each group received 6 therapy sessions every alternate days.

The tissue is preheated with moist heat for 5mins prior to any intervention as heat is very commonly used before exercise with its advantage of being able to increase tissue metabolism the muscle which is prepared for the metabolic challenge of exercise.[23] This intervention is received by both the groups.

Kaltenborn posterior glide

Initial position for the posterior mobilization. At the end range of abduction and external rotation a lateral humeral distraction in its midrange position is maintained, while the posterior stretch mobilization is performed to its end range. **(Figure 1)**

Progression of the posterior mobilization. At the end range of flexion and external rotation, a lateral distraction in its midrange is maintained, while the posterior stretch mobilization is performed to the end range.**(Figure 2)**

The end range position is held for at least 1 minute. Each stretch repeated so that a total of 15 minutes of sustained stretch is performed. And no oscillatory motions were performed.[21]

ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

Figure 1: Position 1 of Kaltenborn Posterior glide.

Figure 2: Position 2 of Kaltenborn Posterior glide

Coracohumeral Positional stretching

Patient is asked to lie on the unaffected side. 20-22 inches of dowel is made to hold with the affected arm. Forearm supination to encourage external rotation. Extension to 10 degrees and adduct close to the body. Positional CHL stretching is repeated along with a cold pack, building up from 5 minutes at the initial visit and expected to increase upto 15 minutes by the third treatment session. **(Figure 3)**

ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

Figure 3: Coracohumeral ligament positional stretching on patient.

Pendular exercises: The patient used a chair or a table to perform this exercise. Patient leaned forward and firmly grip the chair or table with the non affected hand and slowly bring the affected arm down so it is hanging freely. Once in this position, the patient will slowly swing his affected arm forward, backward, circles and from side to side. These exercises should be done in repetition of 15 times in each direction by the affected hand.

Shoulder ROM exercises: Forward shoulder flexion and extension, where Subject stands with trunk keeping upright, with clasped hands lift both the arms straight up as much as possible in front, letting the unaffected arm assist the affected arm. Followed by Subject standing with trunk keeping upright, push steadily both the arms behind as much as possible and bring back gently. In standing position, lift both the arms at the side of the body and return gently to start intending to perform an abduction and adduction.

Subject in sitting with arms relaxed, gently lift(shrug) both the shoulders up and gently relax. Also, set shoulder blades in neutral position. Keep arm at the side with elbow at 90 degrees, forearm at mid-prone position and wrist in neutral. Rotate the upper arm towards the body and away from the body simultaneously without moving the elbow forward or backwards. Three sets of 15 repetitions of all exercises were performed daily.

DATA ANALYSIS

A paired t test and independent t test were used to analyse the variables pre-intervention and post-intervention in an SPSS software. Level of significance with p value was set at 0.05 less than this is considered as statistically significant difference.

RESULTS

Table 1: Intra – group analysis of Group A and Group B of VAS.

Group	VAS	Mean ± SD	N	t	df	p	Remarks
Group A	Before Treatment (Pre-Test)	6.27 ± .799	15	13.20	14	0.000	S
	After Treatment (Post-Test)	3.73 ± 1.223	15				
Group B	Before Treatment (Pre-Test)	5.47 ± 1.302	15	5.26	14	0.00	S
	After Treatment (Post-Test)	4.33 ± 1.676	15				

*S =Significant

ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

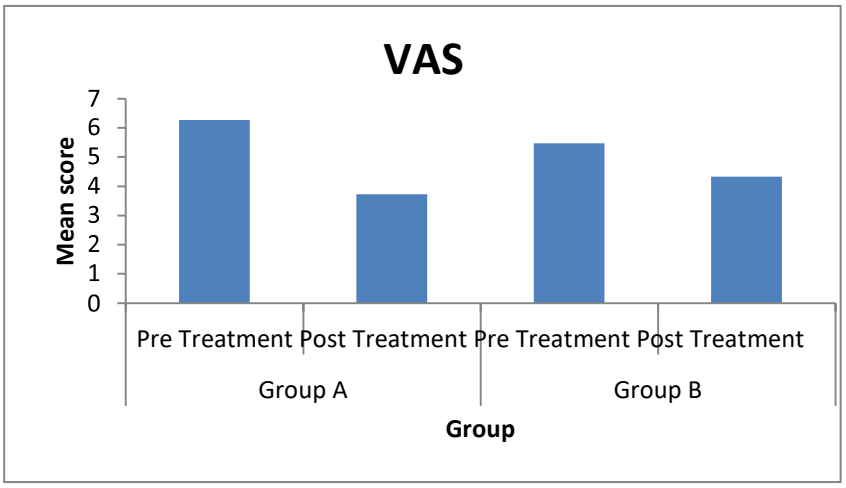

Figure 4: Group wise distribution of VAS score pre and post test.

Table 2 : Intra-Group analysis of Group-A and Group-B of SPADI

Group	SPADI	Mean ± SD	N	t	df	p	Remarks
Group A	Before Treatment (Pre-Test)	0.534 ± 0.17	15	6.83	14	0.000	S
	After Treatment (Post-Test)	0.380 ± 0.167	15				
Group B	Before Treatment (Pre-Test)	0.579 ± 0.148	15	4.37	14	0.00063	S
	After Treatment (Post-Test)	0.523 ± 0.188	15				

*S = Significant

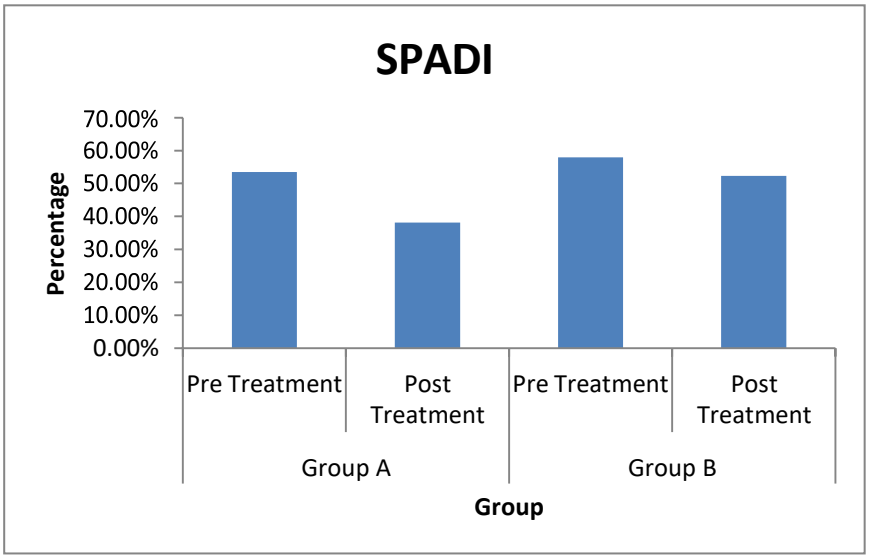

Figure 5: Group wise distribution of SPADI score pre and post test.

ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

Table 3 : Intra-Group analysis of Group A and Group B of Goniometer (Shoulder External ROM)

Group	Goniometer (Shoulder External ROM)	Mean ± SD	N	t	df	p	Remarks
Group A	Before Treatment (Pre-Test)	29.2 ± 18.42	15	-4.97	14	0.0002	S
	After Treatment (Post-Test)	35.33 ± 21.41	15				
Group B	Before Teatment (Pre-Test)	35.33 ± 25.42	15	-4.18	14	0.0009	S
	After Treatment (Post-Test)	36.67 ± 25.65	15				

*S = Significant

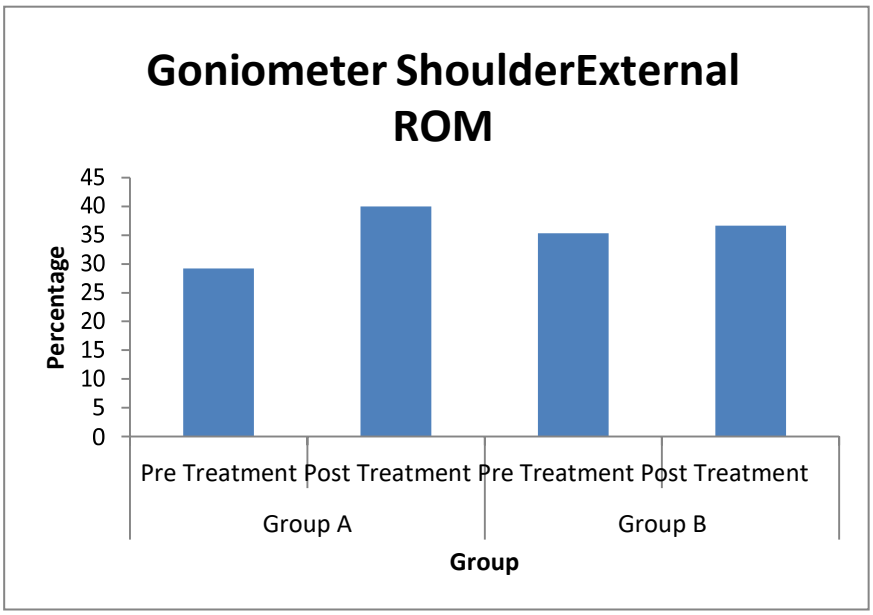

Figure 6: Group wise distribution of Goniometer (Shoulder external ROM) score pre and post test.

ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

Table 4: Inter-group analysis between Group A and Group B to compare and find the effectiveness of interventions on external rotation ROM in patients with adhesive capsulitis

SCALES	GROUP	Mean ± SD	t	df	p	Remarks
VAS	Group A	3.73 ± 1.22	-1.120	28	0.272	NS
	Group B	4.33 ± 1.670				
SPADI	Group A	38.074 ± 16.75	-2.178	28	0.038	S
	Group B	52.25 ± 18.84				
Goniometer-Shoulder External ROM	Group A	40.00 ± 21.414	0.386	28	0.702	NS
	Group B	36.67 ± 25.656				

***S = Significant, *NS = Non Significant

This was a 12 months structured study performed to determine the effects of Kaltenborn posterior glide, CHL positional stretching, moist heat , shoulder ROM and pendular exercises and was received by Group A(Experimental group). Also, a control group, Group B was set at a treatment protocol of moist heat fomentation, shoulder ROM and pendular exercises. Subjects of both the groups were assessed to find the VAS core for pain, SPADI for disability and goniometer for shoulder external ROM specifically. A pre-test and a post-test score of each outcome measures were recorded.

It is seen that in group A there is a significant difference between pre-test and post-test since $p < 0.05$ and the protocol (Kaltenborn Posterior glide, CHL positional stretching, Moist heat fomentation, shoulder ROM and pendular exercises) is effective since mean VAS score decreases from 6.27 to 3.73.In group B, there is a significant difference between pre-test and post-test since $p < 0.05$ and the protocol (Moist heat fomentation, shoulder ROM and pendular exercises) is effective since mean VAS score decreases from 5.47 to 4.33**(Table 1).** The analysis has been portrayed in **Figure 4.**

For SPADI, it is seen that in group A there is a significant difference between pre-test and post-test since $p < 0.05$ and the protocol (Kaltenborn Posterior glide, CHL positional stretching, Moist heat fomentation, shoulder ROM and pendular exercises) is effective since mean SPADI score decreases from 0.534 to 0.380.In group B, there is a significant difference between pre-test and post-test since $p < 0.05$ and the protocol (Moist heat fomentation, shoulder ROM and pendular exercises) is effective since mean SPADI score decreases from 0.579 to 0.523**(Table 2).** And the above discussion has been depicted in **Figure 5**.

ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

In group A, a significant difference has been found between pre-test and post-test since $p < 0.05$ and the protocol (Kaltenborn Posterior glide, CHL positional stretching, Moist heat fomentation, shoulder ROM and pendular exercises) is effective since mean Goniometer (Shoulder external ROM) score increases from 29.2 to 35.33.In group B, there is a significant difference between pre-test and post-test since $p < 0.05$ and the protocol (Moist heat fomentation, shoulder ROM and pendular exercises) is effective since mean Goniometer (Shoulder external ROM) score increases from 35.33 to 36.67**(Table 3).** The above explained analysis has been depicted in **Figure 6.**

It is found that the VAS mean score of group A, post treatment (Kaltenborn Posterior glide, CHL positional stretching, Moist heat fomentation, shoulder ROM and pendular exercises) is 3.73 and the mean VAS score of group B post treatment (Moist heat fomentation, Shoulder ROM and pendular exercises) is 4.33. Therefore, group A treatment protocol results better in alleviating the pain according to the overall VAS mean score. But, since $p > 0.05$ it is found to be non significant.**(Table 5)**

The mean SPADI score of group A, post treatment (Kaltenborn Posterior glide, CHL positional stretching, Moist heat fomentation, shoulder ROM and pendular exercises) is 38.074 and the mean SPADI score of group B post treatment (Moist heat fomentation, Shoulder ROM ad pendular exercises) is 52.25. Therefore, based on the overall mean SPADI score, the group A treatment protocol found effective in improving the disability and also significant since $p < 0.05$.**(Table 5)**

It is found that the mean Goniometer (Shoulder external ROM) score of group A, post treatment (Kaltenborn Posterior glide, CHL positional stretching, Moist heat fomentation, shoulder ROM and pendular exercises) is 40.00 and the mean Goniometer (Shoulder external ROM) score of group B post treatment (Moist heat fomentation, Shoulder ROM ad pendular exercises) is 36.67. Therefore, according to the overall Goniometer (Shoulder External ROM) mean score, the group A treatment protocol responded better in increasing the shoulder external ROM. But, since $p > 0.05$ it is found to be non significant.**(Table 5)**

Therefore, we can conclude that based on the inter-group analysis, only the interventions for SPADI is found to be significant. And out of which, the mean SPADI score decreased in group A post treatment (Kaltenborn Posterior glide, CHL positional stretching, Moist heat fomentation, shoulder ROM and pendular exercises). Hence, we can state that the disability is decreased in this protocol but not much of difference in pain and ROM in patients with adhesive capsulitis.

ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

DISCUSSION

Adhesive capsulitis, being known as a debilitating ailment of the shoulder joint commonly, has an unknown origin of cause but there are quite a good number of literature that portrays a good response post physiotherapy treatments. Simultaneously, the difficulty to completely combat the pain and disability through a specific treatment approach in a timeframe is observed even today. And this difficulty was once acknowledged by Codman in 1934: "This is a class of cases which I find it difficult to define, difficult to treat and difficult to explain..."[24(p216)] which exists even today.

This study aimed at determining the combined effectiveness of Kaltenborn posterior glide and CHL positional stretching,moist heat shoulder ROM and pendular exercises(Group A) on external rotation in patients with adhesive capsulitis by measuring VAS for shoulder pain, GONIOMETER for external rotation range of motion and SPADI for shoulder disability. The study also had a control group(Group B) who received a treatment protocol of moist heat fomentation, shoulder ROM and pendular exercises. Each group consisted of 15 subjects which were randomly assigned and every single subject successfully completed their therapy session. Therefore no drop-outs were recorded. Luciano Andrés Rossi et al.,[25] has also discussed a few current concepts in the treatment of adhesive capsulitis of the shoulder wherein, the importance and positive result of physical therapy combined with home based exercises were found to be the mainstay. And other approaches like intra-articular steroid injections provided a significant result in alleviating the pain but only for a short-term.[25]

So, in this study, the experimental group(Group A) mean VAS score had decreased from 6.27 to 3.73, SPADI mean score decreased from 0.534 to 0.380 and also Goniometer (Shoulder external ROM) showed an improvement from 29.2 to 35.33 but when inter-group analysis was done, it resulted in significance only for SPADI where $p < 0.05$. Through this measure, we can state that the treatment protocol for group A had a significant improvement in disability but not much on pain and ROM in patients with adhesive capsulitis.

CONCLUSION

All the interventions has brought about some improvement in each group post-treatment based on the mean score but its significance vary. So, this study can be concluded that, the treatment protocol, Kaltenborn posterior glide and CHL positional stretching could bring a significant difference with regard to disabilty but not much of difference in pain and ROM in patients with adhesive capsulitis.

ISSN: 2278-4632
Vol-10 Issue-7 No. 13 July 2020

LIMITATION

This study consisted of a short course of treatment of 6 therapy sessions, result only showed about short-term effects of the interventions, there was no follow up for the interventions, the sample size was small (Group A, n = 15; Group B, n = 15) and the strength of the shoulder complex musculature were not taken into account.

ACKNOWLEDGEMENT

Humble and heartfelt gratitude to Almighty God for the wisdom, His unending favour and blessing wonderful individuals to guide and encourage throughout this study. My sincere gratitude to Dr. Abhijit Dutta (PT) Sir, Associate Dean, Faculty of Paramedical Sciences, Assam Down Town University, for his constant support and consistent encouragement.

I am indebted and I extend my sincere thanks to my guide Dr. Abhijit Kalita (PT), Assistant Professor, Program of Physiotherapy, Faculty of Paramedical Sciences, Assam Down Town University, for his guidance and without which this work would not have been possible to carry out. Deepest appreciation to Dr. Santosh K. Rajak (PT), Assistant Professor, Program of Physiotherapy, Faculty of Paramedical Sciences, Assam Down Town University, for sharing his knowledge and encouragement. Sincere gratitude to Dr. Kuldeep Deka (PT),Dr. Pranjal Gogoi (PT) and Dr. Dharitri Phukan (PT), Physiotherapists, Down Town Hospital. Heartfelt gratitude to the patients, for the kindness and willingness to be a part of this study. Without whom this study would not have been fruitful.

CONFLICT OF INTEREST: None.

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ISSN: 2278-4632
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