

The Role of G D Maitland and Laser in Adhesive Capsulitis

Zaki Anwer, Suraj Kumar

Abstract— Background: Adhesive Capsulitis(AC) is a shoulder condition known for gradual and painful loss of both active and passive range of motion (ROM) in all planes of gleno-humeral joint[1]. Many treatments have shown for AC: rest, analgesia, active and passive mobilization, physiotherapy, oral and injected Corticosteroids, capsular distention, manipulation under anesthesia. The Authors present with role of randomized control study to show effects of G D Maitland mobilization as compared to laser therapy in Adhesive Capsulitis. Method: 20 subjects, 10 in each group suffering from AC were randomized into two treatment groups. Group A participants were given hotpack and Maitland mobilization with exercises and Group B with Laser therapy and supervised exercises followed by home based exercises during the data recording intervals. Patients were assessed using VAS, SPADI for assessment of pain and disability in both group scores. Result: It has been seen that variable scores for all the variables improved significantly in both groups namely Maitland therapy group as well as laser therapy group. These were evaluated after the variables score were taken at “0 day versus 30 days”, “30 days versus 90 days” as well as on “0 day versus 90 days” the improvement was seen higher in Maitland group than laser group. Conclusion: Thus we can conclude that the G D Maitland mobilization is better improvement as compared to laser therapy. Maitland mobilization is more effective in reducing pain intensity and reducing functional disability in adhesive capsulitis.

Index Terms— Adhesive capsulitis(AC), Laser therapy, Maitland.

I. INTRODUCTION

Adhesive Capsulitis is one of the condition related to arm and shoulder where it is difficult to treat and prolonged for weeks. Adhesive Capsulitis (AC) is a shoulder condition known for gradual and painful loss of both active and passive range of motion (ROM) in all planes of gleno-humeral joint[1]. Many treatments have shown for AC: rest, analgesia, active and passive mobilization, physiotherapy, oral and injected Corticosteroids, capsular distention, manipulation under anesthesia [2]. Adhesive capsulitis is caused by tightening of the joint capsule and results in stiffness and pain[3]. The incidences of adhesive capsulitis are 3% to 5% in the common population and upto 20% in person with diabetes[4]. The following possible etiologies of frozen shoulder into subcategories: rotator cuff contracture, biceps tenosynovitis, Subscapularis trigger points, auto immune response and autonomic reflex dysfunction[5]. The prevalence of frozen shoulder is slightly greater than 2% in the common population affecting persons older than 2% in the common population affecting persons older than 40

years[6]. Intrinsic factors implicated in the causation of secondary adhesive capsulitis include rotator cuff tears, bursitis and tendonitis whereas extrinsic factors generally having problem associated with trauma[7]. Physiotherapy like stretching, and other rehabilitation programs are more effective in patients presenting with stage 2 or higher adhesive capsulitis due to stage I patients often observe physiotherapy tough due to inflammation and pain. The role is to stretch the capsule sufficiently to allow restoration of normal gleno-humeral biomechanics. Physiotherapy for patients who have stage 3 adhesive capsulitis is designed to treat significant loss of motion by increasing range of motion help of vigorous stretching [7]. Funk and associates reported significant gains in hamstring flexibility using a 20 minute treatment with moist heat alone and no stretch. Henricson and associates

the use of superficial moist heat alone to increase ROM will not produce statistically significant changes[8]. These receptors, are located in the peripheral small nerve endings. For peripheral pain, example, heat can directly inhibit pain. However, when pain is originating from deep tissue, heat stimulates peripheral pain receptors which otherwise change and is termed as gating in the spinal cord and reduce deep pain[9]. Various intervention such as oral oral medications, corticosteroid injections, manipulation and surgery are used. Yet the finding best optimal form of the conservative intervention remains an issue of continuously ongoing research. It has been discussed that the primary treatment for adhesive capsulitis should be based on physical therapy and anti-inflammatory measures [10]. Joint mobilization is a reliable means of treating hypomobility. Mobilization (APG) and inferior glide (IG) are mostly used by physiotherapist to mobilize the shoulder joint to reduce pain, improve mobility and regain normal joint function. The APG procedure, although used as effective technique for improving gleno humeral abduction range despite its common treatment protocol [11]. In 1 of 2 studies comparing the effects of passive mobilization techniques 2 or 3 times per week for 4 weeks, up to grade IV accessory motions according to the Maitland classification system) in adjunct to active exercises with active exercise alone, a positive effect regarding passive abduction was observed after 4 weeks in the mobilization group, with respect to other study no additional effect of passive mobilization technique (once per week for 5-8 weeks, grade III and IV according to the Maitland classification system, without specification of techniques) can be established[12]. Photobiostimulation is the mechanism by which low level laser therapy (LLLT) activates cellular function without causing significant tissue level heating. Karuet al shows that laser radiation is absorbed through mitochondrial chromophores, including complexes I and IV of the respiratory chain [13]. The increased mitochondrial capacity would enhance beneficial changes in the cellular redox state of both the cytoplasm and mitochondria, which

Zaki Anwar, Research Scholar, Monad University, Hapur, U.P
Suraj Kumar, Associate Professor and HOD, Department of
Physiotherapy, UPRIMS, Saifai, UP

may include increasing Krebs cycle turn over, with further production of ATP, and therefore protein synthesis and cell proliferation [14, 15]. LLLT can widely use of reducing inflammation and pain and promoting tissues regeneration in the treatment of soft tissues injuries [16]. Bjordal et al and Tumilty et al have reviewed LLLT for tendinopathy when prescribed dosage are given[17].Serum prostaglandin E2 (PGE2) levels is used as measure in study PGE2 plays an important role in the delineation of nociception in the peripheral nerve system along with the spinal cord[18]. This is a randomized experimental study Maitland mobilization techniques along with supervised exercises and laser therapy with exercises in a group of subjects having adhesive capsulitis of shoulder were studied. The objective of study to evaluate the variable parameters such as pain relief, improve joint function with use of LLLT and Maitland mobilization.

II. METHODOLOGY

This study is randomized controlled in nature where aim of this systemic study is to assess the effects of Maitland and LLLT (Low Level LASER Therapy) in subjects of adhesive capsulitis.

A. Participants

20 subjects were included 10 in each group. The study was conducted at Goodwill Hospital and Research Centre, Noida, UP in department of physiotherapy and subjects were referred by orthopaedic surgeon.

B. Inclusion criteria

Subjects with diagnosed case of grade I & II adhesive capsulitis unilaterally with age group of 40-60 years of painful condition of at least 3 months with 50% restriction in passive shoulder flexion, extension, abduction and external rotation, in sagittal plane compared with opposite side.

C. Exclusion Criteria

Subject had previous manipulation under anesthesia of the affected shoulder or injection with corticosteroids in the affected shoulder in the preceding 4 weeks, history of fracture, neurological deficits affecting shoulder dysfunction in normal daily activities, pain or disorders of the cervical spine, elbow, wrist or hand or any skin lesions/bruises around the shoulder and any other conditions involving the shoulder.(e.g. Rheumatoid arthritis, Osteoarthritis, damage of the glenohumeral cartilage, Hill Sachs lesion osteoporosis or malignancies in the shoulder region).

D. Groups

Group A subjects were given hot pack and Maitland mobilization with exercises and Group Bwith Laser therapy and supervised exercises at department.

E. Procedure

The subjects were randomly allocated equally in each group on the basis of inclusion and exclusion criteria and written consent was taken from the participants. The demographic variables including age, weight, height, sex, gender of the two groups were recorded at baseline. Baseline scores of dependent variables of the study were recorded including pain score on VAS, SPADI (shoulder pain

and disability index) disability and pain index score of shoulder joint.

Material/tools/instruments used were couch, cushion, bed sheet, pillow, Chair, Laser therapy modality with protective goggle, Wall crawler, Shoulder wheel, T-Pulley, moist heat therapy modality with packs, towel to wrap the body when moist heat is used over shoulder, Goniometer.

Group A (G.D Maitland) - 10 patients of adhesive capsulitis (Grade I & II) were taken on basis of inclusion criteria and exclusion criteria. These patients were given Hot pack for 10-20 minutes and G D Maitland mobilization Grade I & II which included posterior glide, anterior glide and caudal glide thrice a week with 15-20 repetition per session for 6 weeks (18 treatment sessions) along with wall crawling (20 repetition)and T-Pulley (50 repetition) exercises twice a day for three months. The reading were taken at 0 day, 1 month, 3 month (0, 30 days, 90 days).

Home based stretching and strengthening Exercises are also advised including all active range of motion and isometrics 10-20 repetition twice daily.

Group B (Laser Therapy) - Laser with infrared beam (LASERMED 2200 make in Italy) is used with following parameters: - wavelength- 905 nm (single probe), maximum power- 25 watt, peak power value- 25 watt, Pulse Frequency- 5000 Hz, total energy density- 1.50 J/cm², duration 3 min/session on each point and 3 session per week in total of 6 weeks (18 treatment Sessions)

Patients was positioned in supine lying on high end couch with position of ease and shoulder joint is equally relaxed. Marks are made on the skin on four different aspect of shoulder from anterior, lateral and posterior at the tender point on arc of shoulder joint suffering from adhesive capsulitis.

Therapist should stand on the head area of the couch to place probe on the shoulder joint affected. Both therapist and the patient wore protective goggle for eye safety. Contact method is used with appropriate frequency and position of beam is directly incident on the marked point at four different location on shoulder joint.

Exercise Program for Group B included Codman Pendular Exercise 10-15 repetition twice daily and Shoulder Wheel Exercise 10, 20, 50 repetition gradually performed thrice a week for 6 weeks.

Home Exercise program included stretching and strengthening Exercises that are all active range of motion and isometrics 10-20 repetition twice daily.

Reading recorded at interval of 0 day, 1 month and 3 month and evaluation done on VAS, SPADI and ROM measurement of shoulder joint affected from adhesive capsulitis.

F. Data analysis

The design of this study is randomized – controlled trial with the post-intervention follow up to three months. The subjects of this study were equally and randomly allocated in to either of the two groups namely “high grade mobilization techniques or low level laser therapy group or the conventional exercises group using lottery method. Each of the both groups consisted of twenty participants. The demographic characteristics Age, Weight, sex and Height of the both groups were assessed at baseline for making baseline comparison using unrelated t-test. Outcome variables of the study such as VAS (pain), SPADI disability index, SPADI

pain score, were collected by same physiotherapist for the test procedure at base line as well as on day 30 and 90.

Baseline demographic data were compared using unrelated t-test across both treatment groups to assess the adequacy of the randomization and to make baseline comparison. An *a priori* alpha level of 0.05 was used for all analyses. Data obtained was summarized using descriptive statistics of mean and standard deviation. All statistical analyses were performed using SPSS 16.0.

Scores of the dependent variables VAS (pain), SPADI disability index shoulder joint were compared for the three instances in each group at baseline, after 30 days and after 90 days using repeated measures ANOVA and the comparisons were evaluated using Tukey's post-hoc analysis. These comparisons were performed to evaluate the differences in the performance of the variables for between-group as well as with-in group comparisons.

III. RESULTS

The mean age of the G.D. Maitland is 52.50 ± 1.84 standard deviation and the mean age of the Laser group is 53.60 ± 4.94 standard deviation, the mean weight of the G.D. Maitland group is 53.90 ± 2.88 standard deviation, the mean weight of the Laser group is 54.40 ± 2.27 standard deviation, The mean Height of the G.D. Maitland group is 161.50 ± 6.18 standard deviation, the mean Height of the Laser group is 164.50 ± 2.83 standard deviation, The mean duration of onset of the disease of G.D. Maitland group is 5.80 ± 1.54 standard

deviation, the mean onset of the disease of Laser group is 6.40 ± 1.07 standard deviation.

Table 1 depicting the Independent t-test for between group comparison of the baseline data shows that there was no significant difference between the baseline scores of the Age ($p = 0.0704$); weight ($p = 0.3359$); height ($p = 0.090$), symptoms duration ($p=0.1638$).

The mean vas of the G D Maitland group on the base line day is 7.20 ± 1.13 standard deviation and the mean vas of the Laser group on the base line day is $6.80 \pm .788$ standard deviation, The mean SPADI pain of the G D Maitland group on the base line day is 33.80 ± 2.20 standard deviation, the mean SPADI PAIN of the Laser group on the base line day is 33.80 ± 2.61 stan.deviation, The mean SPADI disability of the GDMaitland group on the base line day is 55.50 ± 3.47 stan.deviation, the mean SPADI disability of the Laser group on the base line day is 55.20 ± 2.34 standard deviation. Using t test for two independent variable the p value of vas G.D Maitland and Laser on the base line day is $P < 0.1861$, The p value SPADI pain of G.D. Maitland and Laser on the Base line day is $P < 0.5$. The p value of the SPADI disability G D Maitland and Laser is $P < 0.4117$.

Base line data in table 1 and table 2 shows that both the groups were homogenous at baseline and there was very little possibility that the any improvement/deterioration in the scores with time could be due to group characteristics.

Table 1. Baseline comparison of the demographic variables of participants.

	GDMaitland group (n=10)	LASER therapy group (n=10)	Level of significance (P value)
Age (years)	52.50 ± 1.84	53.80 ± 4.94	0.0704
Weight (kg)	53.90 ± 2.88	54.40 ± 2.27	0.335
Height (cm)	161.50 ± 6.18	164.50 ± 2.83	0.090
Duration of symptoms (weeks)	5.80 ± 1.54	6.40 ± 1.07	0.1638

Table 2. Baseline comparison of the variables VAS (pain), SPADI disability index of participants at day 0

ROM (variable)	GD Maitland group (n=10)	LASER therapy group (n=10)	Level of significance (P value)
VAS (day 0)	7.20 ± 1.13	$6.80 \pm .788$	0.1861
SPADI PAIN (day 0)	33.80 ± 2.20	33.80 ± 2.61	0.5
SPADI DISABILITY (day 0)	55.50 ± 3.47	55.20 ± 2.34	0.4117

Table 3: ANOVA comparison among the variable scores with time show that, the performance of the G D Maitland group and LASER therapy group shows that for all variables the scores improved significantly with time

PAIN SEVERITY		0 day	30 day	90 day	Level of difference P value
VAS	G.DMaitland group	7.2 ± 1.13	4.8 ± 1.03	1.9 ± 0.56	0.001*
	LASER group	6.8 ± .788	5.20 ± 1.03	3.20 ± 0.78	0.001*
SPADI PAIN	G.DMaitland group	33.8 ± 2.20	25.7±2.66	9.6 ± 0.69	0.001*
	LASER group	33.8 ± 2.61	24.4 ± 1.26	15.1± 1.28	0.001*
SPADI DISABILITY	G.DMaitland group	55.2± 3.47	39.8 ±1.87	22.2 ± 2.25	0.001*
	LASER group	55.20 ± 2.34	42.8±1.13	29.6± 1.95	0.001*

Table 3 shows that the variable scores of the G D Maitland group improved significantly higher while compared to the Laser therapy group. While making the comparison it was found that in “0 versus 30 days” as well as “30 versus 90 days” comparison all the variable significantly improved in the G D Maitland group as well as in the Laser therapy group. However the improvement in the G D Maitland therapy group was much higher than that in the LASER therapy group as VAS score on 90 day in G D Maitland group are found with mean and standard deviation 1.9 ± 0.56 and in Laser therapy 3.20 ± 0.78 whereas SPADI pain in G D Maitland mobilization found to be 9.6 ± 0.69 and in the Laser Therapy 15.1 ± 1.28 respectively. While in GD Maitland mobilization SPADI disability score was 22.2 ± 2.25 and 29.6 ± 1.95 for pain and disability index. The SPADI value in G D Maitland is lower than the Laser group, significantly G D Maitland group is higher than the Laser group and P value is 0.00.

IV. DISCUSSION

The Aim of this study is to evaluate the effectiveness of Maitland mobilization with exercises Group A and Laser therapy with exercises Group B on VAS and SPADI pain and disability in subjects with adhesive capsulitis of shoulder.

In this study subjects were assessed for shoulder pain and functional disability using shoulder pain and disability index Scale of adhesive capsulitis patients.

While analyzing the outcome measure of this study, it was found that when inter group analysis on (0 day, 30 day and 90 days) the baseline comparison shows that Group A showed significant improvement than Group B in all parameters though both groups have shown in 6 weeks of therapeutic intervention.

In Maitland mobilization group the analysis of pain functional on VAS and SPADI of shoulder within group have shown that there was a statistically highly significant change

in means of total SPADI score (p values <0.000). Rationale behind the improvement in VAS, SPADI score in groups in terms of functional capacity might be due to ease in pain in both dependable variables.

A Maitland mobilization Oscillatory glide reduces pain by stimulating natural pain relieving substances like endorphins. Oscillatory movements stimulate mechano receptors associated with the myelinated alpha beta and alpha delta fibres. The impulse stimulated by mobilization there by block the pain impulse and break the pain cycle by activating the pain gate, which consequently lessened suffering in daily activities, pain with specific tasks, and difficulty in moving arm and lifting actions. When patient pain decreased, it revealed a reduction in SPADI scores.

The similar research has been used by Abhay kumar et al who conducted that Maitland mobilization is effective in improving range of motion and functional ability in subjects with adhesive capsulitis of shoulder showing significant reduction in post treatment SPADI score [19]. And similar another study finding of previous study done by Vermeulen et al who compare the effectiveness of high grade mobilization techniques (HGMT) with that of low grade mobilization techniques (LGMT) in subjects with adhesive capsulitis of the shoulder and HGMTs appear to be more effective in improving glenohumeral joint mobility and reducing disability than LGMTs [12].

R K Minerva et al has done study on 60 subjects of adhesive capsulitis with Maitland and Mulligan treatment thrice a week for 4 weeks has shown significance changes within group with p value 0.00 in group A and p values 0.1 for SPADI score and functional disability score [20].

Saba Aijaz Ali et al (2015) has done study on efficacy of general exercises with or without mobilization on adhesive capsulitis of shoulder for 5 weeks of intervention both groups made significant improvement in all outcome measures (p < 0.001). Intra group analysis showed no significant difference two group (p > 0.05). Mean VAS and SPADI difference was 2.23 and 22 in general exercises and manual therapy grip and 2.33 and 23 in general exercise group [21].

Maricar et al has suggested that manual therapy significantly improve pain and range of movement in adhesive capsulitis[22].

Joint mobilization verses self-exercise done by Tanaka K et al (2010) indicates that the effectiveness of self-exercise depends on the frequency of treatment, and significant improvements seen in the dominant handedness group in which patients use the affected shoulder in everyday life. It is effective for compliance level[23].

Elhafez and Elhafez (2015) Axillary ultrasound and laser with post isometric facilitation study on 59 participants randomly selected for 4 weeks shows significant improvement in laser therapy experimental group after treatment follow up ($p < 0.05$) than control group[24].

Aymann S Soliman et al (2014) concluded that laser and reflexology significantly reduced shoulder pain and increase the range of motion in Type II diabetic patients[25].

Low-level laser therapy is strongly suggested for pain relief and moderately suggested for improving function but not recommended for improving ROM [26].

Yashiro Musha, Takao Kaneko Toshio Shigemitsu et al said that low level laser therapy is effective in pain relief and improve range of motion of shoulder peri-arthritis and serum prostaglandin E2 (PGE2) level decreases and VAS Score for pain decreases (Yashiro et al, 2009).

On the other hand, the biostimulatory effects of LLLT on collagen fibres synthesis may be responsible for the muscle strength improvement of patients with tendinopathy, because Reddy et al.[27] have shown that LLLT can increase collagen production in healing rabbit Achilles tendon. It is a therapeutic dose dependent[28].

LLLT with power densities above 1 W/cm^2 has shown positive effects on reducing exercise induced muscle damage and fatigue in some randomized controlled studies [29].

Stergioulas (2008) done study on low power laser as compared to placebo laser treatment for 8 weeks significant improvement in all outcome measure in laser group[30].

The results of our study have shown better results in palpation sensitivity and significant improvement in pain at VAS and SPADI scale in Maitland group as compared to laser although laser group has performed better in pain perception.

V. CONCLUSION

The findings of this study the improvement in shoulder functional scores and associated disability performance was more efficient in Maitland mobilization group while compared to Laser therapy (LLLT) group. The VAS and SPADI score and maintenance after follow up has more in Maitland group than Laser group as per significance value.

Limitation of Study

The sample size is small where larger population study can be considered.

No radiological assessment or tissue change biopsy method was adopted to explain the tissue change resulting from the intervention in treatment and photo biostimulation along with stretching of capsule by mobilization were further considered in studies.

Ethical Clearance

The protocol was approved by the ethical committee of Monad University, Hapur, UP for PhD curriculum course.

ACKNOWLEDGEMENT

The authors are grateful to the Vice Chancellor of Monad University for considering this research as well as clinical work for betterment to the patients. The authors acknowledge Dr. Javed (Research Head) and Dr. *suhail ahmed* (Deputy Registrar) for their support and guidance. The authors wish to acknowledge patients for their supportive nature and cooperation.

REFERENCES

- [1] Rizk TE, Pinals RS. Frozen Shoulder. Semin Arthritis Rheum. 1982;11:440-452. [PubMed].
- [2] Buchbinder R, Youd JM, Green S et al. Efficacy and cost effectiveness of physiotherapy following gleno humeral joint distension for adhesive capsulitis: a randomized trial. Arthritis Rheum. 2007;57:1027-1037.
- [3] Jacob Isaac Jason, Ganesh Sundaram S et al. Physiotherapy interventions for adhesive capsulitis of shoulder: A systemic review. Int. Journal of Physiotherapy and Research. 2015;3(6):1318-25.
- [4] Henricus M Vermeulen, Rozing PM, Win R Obermann et al. Comparison of High Grade and low grade Mobilization techniques in the management of Adhesive Capsulitis of the Shoulder: Randomized Controlled Trial. Phys Ther. 2006;86:355-368.
- [5] Bulgen D Y, Binder, AI, Hazelman BL, Park jr. Immunological studies in frozen shoulder. J Rheumatol. 1982;9:893-898.
- [6] Lloyd-Robert G, French P. Periarthritis of the shoulder: a study of the disease and its treatment. BMJ 1959;1:1569-74.
- [7] Sheridan Monique A, Hannafin A Jo. Upper extremity: Emphasis on Frozen Shoulder. Orthop Clin N Am. 2006;37:531-539.
- [8] Nicholas A Cosgray, Scott E Lawrance et al. Effect of Heat Modalities on Hamstring length : A Comparison of Pneumatherm Moist Heat Pack and a control. Journal of ortho & sports Physical therapy. 2004;34:377-384.
- [9] Jerrold Petrofsky, Lee Besk, Gurinder Bains et al. Moist Heat or Dry heat for Delayed onset Muscle Soreness. J Clin Med Res. 2013;5(6):416-425.
- [10] Brue S et al. Idiopathic adhesive capsulitis of the Shoulder: A review knee surgery sports traumatology. Arthrosc 2007;15:1048-1058.
- [11] Ar-Tyan Hsu, Lany Ho, Solly Ho et al. Joint position during Anterior Posterior Glide Mobilization: Its Effect on Glenohumeral Abduction Range of motion. Arch Phys Med Rehabil. 2000; (81):210-214.
- [12] Henricus M V, Rozing P M, Obermann W R et al. Comparison of High Grade and Low Grade Mobilization Techniques in the Management of Adhesive Capsulitis of the Shoulder: Randomized Controlled Trial. Phys Ther. 2006;86:355-368.
- [13] Karu T I. Mitochondrial signaling in mammalian cells activated by red and near IR radiation. Photochem Photobiol 2008;84:1091-1099.
- [14] P Douris, V. Southard, R. Ferrigi et al. Effect of Phototherapy on delayed onset muscle soreness. Photomedicine and Laser Surgery. 2006;24:377-382.
- [15] A Bibikova and U Oron. Promotion of muscle regeneration in the toad (*Bufo viridis*) gastrocnemius muscle by low energy Laser irradiation. Anatomical Record. 1993; vol 235(3): 374-380.
- [16] S Tumilty J Munn, S Mc Douough, D A Hurley, J R Basford and G D Baxter. Low Level Laser treatment of tendinopathy: a systematic review with metaanalysis. Photomedicine and Laser Surgery. 2010;28(1):3-16.
- [17] J M Bjordal, C Coupe and A E Ljunggren. Low level laser therapy for tendinopathy. Evidence of a dose response pattern. Physical therapy Reviews. 2001;6(2):91-99.
- [18] Musha Y, Kaneko T, Shigemitsu Toshio et al. The effectiveness of Low Level Laser therapy (LLLT) for shoulder peri-arthritis. Laser Therapy. 2009;18(1):39-43.
- [19] Kumar A, Kumar S, Aggarwal A, Kumar R, Das P. Effectiveness of Maitland Techniques in Idiopathic Shoulder Adhesive Capsulitis. ISRN Rehabilitation. 2012;1-8.
- [20] Minerva R K, Alangini NK, Apparao P, Chaturvedi P. To compare the effectiveness of Maitland versus Mulligan Mobilization in Idiopathic Adhesive Capsulitis of shoulder. IJHSR. 2016;(6):236-244.
- [21] Saba AJ, Khan Muhammad. Comparison for efficacy of general exercises with and without mobilization therapy for the management of adhesive Capsulitis of Shoulder-An International Study. Pak j Med Sci. 2015;31(6):1372-1376.
- [22] Maricar N, Shack lady C, Mc Loughlin L. Effect of Maitland mobilization and exercises for treatment of Shoulder adhesive Capsulitis: A Single-case design. Physiotherapy. 2009;25(3):203-217. doi:10.1080/1095939809027766.
- [23] Tanaka K, Saura R, Takahashi N, Hiura Y, Hashimoto R. Joint mobilization versus self exercises for limited gleno humeral joint mobility:

- Randomized controlled study of management of rehabilitation. Clin Rheumatol.2010;29(12):1439-44.
- [24] Elhafez HM, Elhafiz SM. Axillary ultrasound and laser combined with post isometric facilitation in treatment of shoulder adhesive capsulitis:A randomized clinical trial Physiotherapy.The chartered society of physiotherapy.2015;101(May):e353.
- [25] Soliman AS,Mohmound AM, Serry Z, Dawood F.Therapeutic effects of Low level laser therapy and reflexology on adhesive capsulitis in elderly Type II diabetic patients.Asian J Pharm Clin Res. 2014;7(5):317-21.
- [26] Jain TK and Sharma NK. The effectiveness of physiotherapeutic interventions in treatment of frozen shoulder/ adhesive capsulitis:a systematic review. J Back Musculoskelet Rehabil.2014;27(3):247-73.doi:10.32331BMR-130443.
- [27] ReddyG K, Stehno-Bittel L and Enwemeka C S. Laser photo stimulation of collagen production in healing rabbit Achilles tendons. Lasers in Surgery and Medicine.1998;22(5):281-287.
- [28] Bijordal JM, Coupepe C, and Ljunggren A E. Low level Laser therapy for tendinopathy. Evidence of a dose response patterns. Physical therapy Reviews.2001;6(2):91-99.
- [29] Leal E C P,Lopes- Martins A B, Dalan F et al. Effects of 655 nm Low level Laser therapy on exercise induced Skeletal muscle fatigue in human.Photo medicine and Laser Surgery.2008;26(5):419-424.
- [30] Stergiulas A. Low power Laser treatment in patients with frozen shoulder: Preliminary results. Photomed Laser Surgery. 2008;Apr.26(2):99-105.