



Short-term Effect of Mirror Therapy and Mobilization in Adhesive Capsulitis: A Randomized Controlled Trial

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: Frozen Shoulder, also known as Adhesive Capsulitis is the developing of dense adhesions, joint capsule thickening and capsular restrictions in the joint along with diminished glenoid cavity. Primary adhesive capsulitis most commonly affects individuals between 40 to 60 years of age. A number of treatment techniques exists for the improvement of adhesive capsulitis whereas Mirror Therapy is a recent technique designed to improve adhesive capsulitis.

Objective: To compare the short-term effect of Mirror Therapy and Maitland Mobilization in stage 1 & 2 adhesive capsulitis.

Methodology: The study is a randomized controlled trial which included 34 subjects of the age group 40-60, and were randomly assigned into two groups: Group A (n=17) and Group B (n=17). The Group A was given Mirror Therapy with conventional physical therapy while group B was given Maitland Mobilization with conventional physical therapy. Outcome measure were taken at baseline, and then taken on last day of seventh session by using VAS, ROM, DASH. The treatment was given for 7 sessions over a period of two weeks.

Results: The results show that on comparison of pre and post intervention values within each group, both the groups produced statistically significant difference ($p < 0.05$). On comparison between the groups, ROM shows statistically significant difference ($p < 0.05$) compared to VAS and DASH.

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Conclusion: The current study results shows that Mirror Therapy is better than Maitland Mobilization in terms of relieving pain, improving functional activity and increasing range of motion.
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Keywords: Periarthritic shoulder; frozen shoulder; adhesive capsulitis; mirror therapy; maitland mobilization.

1. INTRODUCTION

Frozen Shoulder, also known as Adhesive Capsulitis is the development of dense adhesions, joint capsule thickening, and capsular restrictions in the joint along with diminished glenoid cavity [1]. It is a painful condition characterized by gradual limitation of active and passive movements [2]. Nevasier et al introduced the "Adhesive Capsulitis" to describe the inflamed and fibrotic condition of capsule ligamentous tissue [3]. Codman coined the term "Frozen Shoulder" in 1943 to describe a painful condition that restricts the shoulder joint motion, especially elevation, and external rotation [4,5].

Adhesive Capsulitis mainly affects 2-5% of the general population and it is mainly seen in women than in men with a preferable age group of 40-60 years [6]. According to Donatelli et al, 20-30% of the frozen shoulder cases can be bilateral. Frozen Shoulder 4 stages:-

Pre Adhesive Stage- [0-3 months] with both active and passive Range of Motion [6], Freezing Stage - [3-9 months] high level of pain near end Range of Motion [6,7], Frozen Stage- [9-15 months] minimum pain, but only extreme Range of Motion is limited in all shoulder movements [6], Thawing Stage – [15-24 months] presents with gradual and spontaneous recovery and shoulder mobility and function [6].

The exact etiology for Adhesive Capsulitis remains unknown. It is proposed that fibrosis is triggered by the release of growth factors such as TGF- β , PDGF & TNF- α , as a result of the stimulation of the shoulder joint by synovitis [4]. Lundberg classified Adhesive Capsulitis into Primary and Secondary frozen shoulder, identifying Primary frozen shoulder as idiopathic & Secondary as due to Diabetes Mellitus, thyroid dysfunction, Autoimmune diseases, Myocardial Infarction, and Cerebrovascular diseases [8].

The medical treatments that are advocated for Adhesive Capsulitis condition that includes Manipulation under Anaesthesia [9,10], or initial conservative measures, anti-inflammatory drugs, intra-articular corticosteroids, capsular distension

injections, and surgical interventions, these include Restriction Arthrographic Distention, Surgical Capsular Release [11,12].

Physiotherapy treatments in the case of Frozen Shoulder focus mainly on Pain reduction, Range of Motion improvements, and Strengthening of the weakened muscle [13,14]. Many physiotherapy treatments are prescribed for Frozen Shoulder including Pendulum exercise, Active and Passive Range of Motion exercise, Shoulder isometrics, Strengthening exercises, and Stretching exercises [15].

Presenting visual feedback about motor performance to improve the effect of training is widespread in rehabilitation practice. A relatively new way of using visual feedback to help patients is exploited in mirror therapy [16].

Mirror Therapy was first introduced and used by Ramachandran in the year 1993 to treat phantom pain in an amputated extremity [4]. Mirror therapy reorganizes the somatosensory and motor cortex through the use of mirror-mediated visual illusion leads to pain reduction and improved range of motion [4,17]. Studies done based on the Mirror Therapy principle have provided favorable outcomes in complex regional pain syndrome, stroke, musculoskeletal injuries, phantom pain, and hand rehabilitation. A study done by Louw et al states that mirror therapy has proved to provide immediate effects on improving range of motion and reducing pain [15,18].

To regain normal extensibility of the shoulder capsule, passive stretching of the shoulder capsule in all planes of motion through mobilization technique has been recommended [6,19]. Maitland Mobilization is a passive treatment, classified from Grade I-V, with respect to intensity to the shoulder to treat pain and stiffness. Grade I and II of Maitland Mobilization technique is primarily used for treating joints limited by pain. Grade III and IV are mainly used for stretching maneuvers. Grade V is a high-velocity thrust used in manipulation [20,21,22]. A previous study done by Gui Do Moon et al has proved that Maitland Mobilization has proved to

be a standardized physical therapy treatment in reducing pain and improving Adhesive Capsulitis [14].

In shoulder joint conditions, it is a common factor that Range of Motion gets affected. A universal goniometer is a reliable tool for assessing the range of motion of joints more easily and accurately. Thus, a universal goniometer is used to assess the range of motion of the shoulder joint before and after treatment [23,24,25].

Based on these data, the study was designed to compare and evaluate the short-term effect of Mirror Therapy and Maitland Mobilization treatment techniques for improving the Range of Motion and reducing pain in adhesive capsulitis.

2. MATERIALS AND METHODS

Purpose of the study was to evaluate the short-term effect of Mirror therapy and Maitland Mobilization along with conventional physiotherapy in terms of pain, range of motion, and functional activity in adhesive capsulitis.

This is a randomized double-blinded controlled trial conducted in Justice K S Hegde Charitable Hospital, Mangalore, India from May 2020 till May 2021 for 12 months. The sampling technique used is simple random sampling. Participants were recruited from Justice K S Hegde Charitable Hospital and were screened based on inclusion and exclusion criteria. The study was conducted for 7 sessions over 2 weeks.

Inclusion criteria consisted of Male and Female subjects aged between 40 to 60 years, diagnosed with adhesive capsulitis by a physician, subjects with a minimum of 90° of abduction and flexion, and a minimum of 45° of external rotation and shoulder range of motion, subjects with pain and restrictions in the capsular pattern and subjects with stage 1 and 2 adhesive capsulitis.

Subjects with a history of malignancy, tumor in the shoulder region, vascular disease, fracture and dislocations of shoulder and elbow, adhesive capsulitis secondary to neurological conditions, diabetes mellitus, rheumatism, osteoporosis, and degenerative changes of the shoulder and recent history of any shoulder surgery were excluded.

44 participants were assessed from which 10 participants were excluded as they did not meet

the eligibility criteria. Therefore, a total of 34 participants were included in the study and the sample size was calculated based on 5% level of significance, 80% power and effect size of 0.935. This was calculated using G star power sample size software. Participants were divided into two groups; Group A-Mirror therapy and Group B-Maitland mobilization groups consisting of 17 participants in each group. Participants were randomized by block randomization with an opaque sealed envelope method done by a physiotherapist who is not part of the study. This is a double blinded study, because neither participants nor assessor was not aware of the groups they were assigned to.

All participants were administered with conventional physiotherapy by the primary investigator consisting of Moist heat for 15 minutes, Shoulder Wheel exercise, Finger Ladder exercise, Wand exercise for 3 sets each consisting of 10 repetitions followed by interventions.

In Group A, Mirror therapy was given. Mirror therapy was first demonstrated by the therapist and then asked the patient to repeat in therapist's supervision, It was performed in front of a standing mirror with the participants reflective side facing the uninvolved side. The affected side was asked to place behind the mirror and the participant was instructed to lean forward gently allowing them to view the complete uninvolved arm in the mirror. Movements performed were active flexion, abduction, and external rotation of the uninvolved arm from resting position to full active range of motion (Figs. 1a,1b and 1c). Each movement was repeated 10 times for 3 sets in each session.

Whereas, in Group B, Maitland Mobilization of Grade 1 and 2 - Anteroposterior oscillation was applied at an intensity that slightly exceeds the restriction point of the range of motion to provoke tissue resistance. First, a maximum abduction of the humerus using one hand is applied while standing beside the subject. Then execution of 90° of flexion of the elbow joint and anteroposterior oscillation was applied to the humeral head (Fig. 2). The duration was one oscillation per second applied for a total of fifteen 30 seconds sets for 10 minutes. A rest period of 10 seconds was given after each set.

Outcome measures used for screening subjects for pain rating was Visual Analogue Scale (VAS) with an ICC value of 0.97, functional activity was

Disability of Arm, Shoulder, and Hand (DASH) with an ICC value of 0.96 & range of motion was Universal Goniometer [26,27,28]. Outcome measures were taken at baseline and on the 7th session by a blinded assessor who was a physiotherapist and not part of the study.

The data collected were analyzed using IBM SPSS software version 26.0. The descriptive

statistics included frequency distribution, mean and standard deviations. The demographic data were analyzed using "independent sample t-test". Independent sample t-test was used to compare pre and post-values of VAS, DASH & ROM between the group, and within-group comparison was done using paired t-test. A significance level of <0.05 was used to determine significant differences by the analysis.



Fig. 1a. Mirror Therapy for External Rotation Range of motion



Fig. 1b. Mirror Therapy for Abduction Range of motion



Fig. 1c. Mirror Therapy for Flexion Range of motion



Fig. 2. Maitland mobilization for shoulder

3. RESULTS

The demographic data (ie. Side affected, Groups and Gender) was analyzed using the Chi-square test and age was analyzed using independent sample t test (Table 1).

The results of within the group were taken after 7 days of intervention where there is a significant change in all the outcome measures. The result showed significant improvement in the Mirror therapy group with respect to VAS, DASH and ROM as well as in the Mobilization group with a p-value of < 0.05 respectively. In the Mirror therapy group, there was a significant impact in VAS and DASH with t value of 12.373 and 13.566 and Mobilization group of 10.043 and 7.097. The ROM of each movement was highly significant within each group (Table 2 & 3), with the ROM for the Mirror therapy group having a t value of -8.316 for flexion active, -7.664 for flexion passive, -7.833 for abduction active, -7.707 for abduction passive, -7.006 for external rotation active and -6.31 for external rotation passive, whereas ROM for Mobilization group has a t value of -5.821 for flexion active, -5.768 for flexion passive, -7.779 for abduction active, -8.986 for abduction passive, -7.475 for external rotation active and -6.194 for external rotation passive.

In the present study, the VAS and DASH shows mean difference in mirror therapy is 3.39±1.13 and 28.76±8.74 whereas in mobilization are 2.90±1.19 and 24.46±14.21 respectively, and the p-value is > 0.05 respectively. So there is no significant difference between the groups.

The mean difference of flexion active and passive ROM of mirror therapy and mobilization groups is (26.94±13.36 and 25.53±13.73) and (13.76±9.75 and 14.47±10.34) respectively, and the p-value is <0.05. So there is a significant difference between the groups.

The mean difference of abduction active and passive ROM of mirror therapy and mobilization groups is (31.06±16.35 and 27.94±14.95) and (13.18±6.98 and 15.41±7.07) respectively, and the p-value is <0.05. So there is a significant difference between the groups.

The mean difference of external rotation active and passive ROM of mirror therapy and mobilization groups is (11.76±6.92 and 12.76±8.34) and (6.41±3.54 and 6.18±4.11) respectively, and the p-value is <0.05. So there is a significant difference between the groups (Table 4).

In the present study, both the group's ROM has significantly improved but in VAS and DASH, no significant change was observed.

4. DISCUSSION

Frozen shoulder is one of the leading shoulder pathology among old age people. Frozen shoulder is causing various problems and difficulties like pain, functional inability and reduced sleep in old age people. It is the development of adhesions in the shoulder joint capsule leading to capsular restriction [1].

Table 1. Demographic features

(n = 34)		Mirror Therapy		Mobilization		Chi square	p value
		n	%	n	%		
Gender	Male	11	64.71	10	58.82	0.125	0.724
	Female	6	35.29	7	41.18		
Side affected	Left	10	58.82	5	29.41	2.982	0.084
	Right	7	41.18	12	70.59		

Table 2. Comparison of the outcome measures within Mirror Therapy group

(n = 17)	Pre		Post		p value
	Mean	S. D.	Mean	S. D.	
VAS (cm)	7.08	1.47	3.68	1.48	< 0.001*
DASH	45.01	11.71	16.25	5.72	< 0.001*
FLEXION ACTIVE ROM (degree)	106.24	17.12	133.18	17.77	< 0.001*
FLEXION PASSIVE ROM (")	116.06	20.71	141.59	16.74	< 0.001*
ABDUCTION ACTIVE ROM (")	104.65	18.01	135.71	17.43	< 0.001*
ABDUCTION PASSIVE ROM (")	116.35	21.94	144.29	17.54	< 0.001*
EXTERNAL ROTATION ACTIVE ROM (")	53.65	9.49	65.41	7.53	< 0.001*
EXTERNAL ROTATION PASSIVE ROM (")	59.12	10.49	71.88	8.02	< 0.001*

Table 3. Comparison of outcome measures within Mobilization group

(n = 17)	Pre		Post		p value
	Mean	S. D.	Mean	S. D.	
VAS(cm)	6.74	1.16	3.84	1.23	< 0.001*
DASH	45.48	18.04	21.02	8.97	< 0.001*
FLEXION ACTIVE ROM (degree)	113.71	15.40	127.47	13.83	< 0.001*
FLEXION PASSIVE ROM (°)	122.53	15.41	137.00	12.93	< 0.001*
ABDUCTION ACTIVE ROM (°)	106.59	15.71	119.76	14.86	< 0.001*
ABDUCTION PASSIVE ROM (°)	116.47	17.00	131.88	16.13	< 0.001*
EXTERNAL ROTATION ACTIVE ROM (°)	52.29	7.17	58.71	5.68	< 0.001*
EXTERNAL ROTATION PASSIVE ROM (°)	58.47	7.13	64.65	5.44	< 0.001*

Table 4. Comparison of change (Pre-Post) in outcome measures between the groups

(n = 34)	Mirror Therapy		Mobilization		p value
	Mean	S. D.	Mean	S. D.	
VAS(cm)	3.39	1.13	2.90	1.19	0.224
DASH	28.76	8.74	24.46	14.21	0.297
FLEXION ACTIVE ROM (degree)	26.94	13.36	13.76	9.75	0.002*
FLEXION PASSIVE ROM (°)	25.53	13.73	14.47	10.34	0.012*
ABDUCTION ACTIVE ROM (°)	31.06	16.35	13.18	6.98	< 0.001*
ABDUCTION PASSIVE ROM (°)	27.94	14.95	15.41	7.07	0.004*
EXTERNAL ROTATION ACTIVE ROM (°)	11.76	6.92	6.41	3.54	0.008*
EXTERNAL ROTATION PASSIVE ROM (°)	12.76	8.34	6.18	4.11	0.006*

DASH: Disabilities of Arm, Shoulder and Hand; VAS: Visual Analogue Scale; ROM; Range of Motion; P < 0.05

The study compared to evaluate Mirror Therapy and Mobilization with conventional physiotherapy in Adhesive capsulitis with respect to Pain, Range of Motion, and Functional Activity.

The study included 34 patients with adhesive capsulitis (17 in each group) randomly allocated to Group A (Mirror Therapy) and Group B (Mobilization). Outcomes were taken at baseline and 7th day of the treatment using DASH, VAS, and Goniometer. The patients were treated for 7 sessions over 2 weeks under the supervision of the therapist.

In the current study, the age group was taken in between 40-60 years in both male and female patients. There is a possible explanation for this as the studies conducted by Mehmet Cetin Baskaya, Jason Ramirez and Erkan and Fusan Guler suggest that people in this age group range are more prone to frozen shoulder [4,16,17].

In the current study, there were significant changes in the Range of motion and pain in Mirror therapy after 7 sessions of treatment. These findings correlate with the study conducted by Adriaan Louw et al to determine immediate effects of mirror therapy in patients with shoulder pain and decreased range of motion, where there was a change in Range of motion, pain in patients with frozen shoulder pre

and post-treatment. Even though there is a correlation between both the studies, the outcome used for pain is varied [12,28].

Duenas et al. evaluated a 12-week tailored manual therapy and home stretching program based on the level of irritability and range of motion impairments in patients with primary frozen shoulder contracture syndrome and showed an improvement in pain, functional activity, and range of motion. So this study correlates with my study as it shows significance in improving pain, functional activity, and range of motion in patients with adhesive capsulitis. Even though there is a correlation between both the studies, the outcome measure used for the range of motion is varied [18].

The mechanisms of the two techniques used in the study differ. Mirror Therapy is a component of Guided Motor Imagery. Mirror Therapy's mechanism for reducing pain and improving function is still unknown. There is a lack of coordination between motor commands and visual and proprioceptive feedback, resulting in pain. By providing visual feedback, the mirror may play a specific role in pain reduction and function improvement. When defective or altered sensory feedback is introduced, the representative areas of body parts in the primary somatosensory or motor cortex reorganize. It is believed that reorganizing the somatosensory

and motor cortex through the use of mirror-mediated visual illusion leads to pain reduction and improved range of motion [4,29].

While mobilization reduces pain via neurophysiological effects such as stimulation of type II mechanoreceptors while inhibiting type IV nociceptors.

A passive joint mobilization stimulates Golgi tendon organ activity at the end of the joint mobilization and causes muscle reflex inhibition [10].

As a result, the statistical results show that both interventions, Mirror therapy, and Mobilization, are effective in terms of Range of Motion, but there is no significant difference between the groups in terms of pain and functional activity. However, within the group, there is a significant effect on all three outcomes. According to the findings of this study, both Mirror Therapy and Mobilization approaches are effective in treating Adhesive Capsulitis, but mirror therapy shows better results when compared to Mobilization.

This study is the first to compare Mirror therapy versus Mobilization in Adhesive Capsulitis. Its limitations include small size and a lack of long-term follow-up.

5. CONCLUSION

This study concludes that in short term, Mirror Therapy and Mobilization showed significant improvement in pain, functional activity, and range of motion in patients with adhesive capsulitis. However, more significant improvement was seen in Mirror therapy. Future studies with more sample size and long duration are recommended.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT AND ETHICAL APPROVAL

Ethical committee clearance was obtained from the Institutional Ethics Committee of Nitte Institute of Physiotherapy, Mangalore, and written informed consent was obtained from all participants.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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