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A Comparative Study of Manual Therapy Interventions for Improving Shoulder Pain and Range of Motion in Frozen Shoulder: An Experimental Study

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ABSTRACT

Frozen shoulder or Adhesive capsulitis is characterized by painful, gradual loss of active and passive shoulder motion resulting from fibrosis and contracture of the joint capsule. Joint mobilisation, sometimes referred to as manipulation, is the term for manual therapy methods that target the changed mechanism of the joint, particularly to treat joint impairments that limit the range of motion (ROM) and modulate pain.. This study evaluated the efficacy of different manual therapy interventions in improving pain and ROM in a frozen shoulder. A pre-test and post-test structured experimental study design was conducted using 30 participants who met inclusion and exclusion criteria. Patients were divided into 6 groups 5 in each group. SPADI, NPRS, and ROM of shoulder abduction and shoulder internal range of motion were used as outcome measures pre and post-treatment. 5 sessions for 2 weeks. The result depicted there was a significant reduction in pain and improvement in ROM noted in the patients with frozen shoulders in group B. It was thus concluded that the patients with frozen shoulders showed reduction statistically and clinically in terms of pain and improvement in ROM in group B that is Spencer technique

KEYWORDS: Frozen shoulder, gongs mobilization, Spencer technique, Maitland mobilization, Kaltenborg mobilization, Mulligan mobilization, Graston technique, numerical pain rating scale, shoulder pain and disability index.

LIST OF ABBREVIATION

NPRS- numerical pain rating scale
SPADI-shoulder pain and disability index
ROM- range of motion
ABD-abduction
IR- internal rotation

INTRODUCTION

In 1872, Duplay coined the term "peri arthritis scapulohumeral". Codman first used the term "frozen shoulder" in 1934. He claims that a frozen shoulder is a painful condition of the shoulder that slowly worsens and is characterized by stiffness and difficulty sleeping on the affected side. Codman also

mentioned the commonly reported decline in forward elevation and external rotation due to the condition. Neviaser first used the term "adhesive capsulitis" in 1945 after performing open surgery on the injured shoulders.[1] The formation of dense adhesions, thickening of the joint capsule, and restricted motion, particularly in the lower folds of the capsule, are symptoms of a frozen shoulder. It is not associated with arthritic changes in the bone or cartilage, unlike rheumatoid arthritis or osteoarthritis. It typically emerges between the ages of 40 and 65 and begins gradually. The fundamental origin of a secondary frozen shoulder is unknown, but it can be brought on by RA, OA, trauma, or immobilization. The condition is more likely to develop in people with thyroid issues and diabetes mellitus.[2] Research has indicated that between 7% and 20% of adult Indians have frozen shoulders. Between 2% and 5% of the general population are thought to be affected by the disease, with women being more likely than men to experience it.[3]The stages of frozen shoulder are as follows: The "freezing" phase: During this period, the patient encounters arm-lengthening discomfort and an abrupt onset of pain in their shoulders, which is worse at night and while they perform activities. The typical time frame is 10 to 36 weeks. The shoulder's range of motion is substantially constrained in all planes during this "frozen" stage. There are strict restrictions on daily activity. When the patient approaches the tight capsule's constraint while accomplishing the tasks, a sudden, severe discomfort may begin to develop. This stage ranges from four to twelve months. "Thawing" phase: Over time, the range of motion progressively returns. This stage culminates in five to twenty-six months.[4] Exercises used in the treatment of frozen shoulder frequently include active and active-assisted exercises, pendular exercises, wand exercises, wall and ladder exercises, capsular stretching exercises, and shoulder joint mobilization. Pain relief and tissue hyperthermia are achieved using electrotherapy techniques such as ultrasound, IFT, short-wave diathermy, and LASER.[5] Clinical studies have shown that mobilization strategies are crucial to treating restricted joint movement. The process of making a fixed, ankylosed part mobile is known as mobilization. Mobility improvement for joints and soft tissues is the aim of mobilization. Techniques for mobilization may employ physiological or accessory movements. The glenohumeral joint experiences physiological motions when the humerus moves in any of the cardinal planes, including flexion, extension, abduction, adduction, external rotation, and internal rotation. A therapist can create distractions inside the joint by passively rolling, gliding (or sliding), rotating, and performing other accessory movements.[6] Adhesive capsulitis can be treated using a variety of physical therapy techniques that aid in preserving and enhancing the mobility and stability of the shoulder joint which include:

1. **Maitland mobilization:** Rhythmic oscillatory movements make up the majority of Maitland's mobilization. The Maitland concept is described by the International Maitland Teachers Association (IMTA) as the examination, evaluation, and treatment of neuromusculoskeletal problems using manipulative physiotherapy. The Maitland mobilization techniques, Grades I and II, are generally used to treat painful joints. While Grades III and IV are mainly utilized as stretching movements, these nonstretch actions assist in moving synovial fluid to promote nourishment to the cartilage.[7]
2. **Kaltenborg mobilization:** The Kaltenborn method emphasizes the translatory linear joint, the convex-concave rule, 3-dimensional pre-positioning for joint movement, protecting adjacent joints during procedures, self-treatment, and ergonomic principles.[8]
3. **Mulligan mobilization:** Brain Mulligan developed Mobilisation with Movement (MWM) for the musculoskeletal system. MWM can be applied alone or in conjunction with other manual procedures to improve the efficiency of joint intra-articular gliding, neurodynamic, and the facilitation of appropriate muscle recruitment. By regaining the diminished accessory glide, it is possible to move

without experiencing any pain by combining an active movement with parallel passive accessory mobilizations.[9]

4. **Gong's mobilization:** An efficient method to improve shoulder abduction and internal and external rotation employing an anterior-posterior glide is Gong's mobilization. This mobilization technique is used in a dynamic position at the shoulder's range of motion limit. It involves a correcting glide from anterior to posterior. The technique is then followed by performing the restrained movement and applying a distracting force to the area around the shoulder.[10]
5. **Spencer technique:** The seven distinct treatments of the Spencer approach are utilized to alleviate shoulder limitations brought on by adhesive capsulitis. In this method, constricted muscles, ligaments, and capsules are intended to be stretched through passive, rhythmic motion. Most of the force is applied at the end of the range of motion.[11]
6. **Graston technique:** According to reports, IASTM promotes microcirculation, reorganizes collagen, and stimulates the afferent nervous system. IASTM could enhance regular collagen alignment and increase fibroblast proliferation.[12] Studies have demonstrated the impact of the mobilization approach on enhancing functional capacity and mobility in participants with frozen shoulders. There are many different adhesive capsulitis treatment protocols available, but it is yet undetermined which protocol is the most beneficial. Therefore, the purpose of this study is to compare the effectiveness of manual therapy techniques on reduction of pain and restoration of the functional range of motion of an individual with frozen shoulder.

METHODS AND MATERIAL

1. **STUDY DESIGN**: Experimental
2. **STUDY SETTING**: Department of Physiotherapy, Dr. BR Ambedkar Medical College and Hospital, Bangalore 560045
3. **SAMPLE SIZE**: 30 Participants
4. **SAMPLING METHOD**: Convenient sampling technique.
5. **TREATMENT DURATION**: 5 sessions per week for 2 weeks

INCLUSION CRITERIA:

- Patients diagnosed with Frozen Shoulder. (Stage 2).
- Both male and female diabetics between the age group of 40-60 years.
- Frozen Shoulder patients with painful, stiff shoulders for at least 3 months.
- Frozen Shoulder with at least 25% restricted shoulder range of motion.
- Patients who can comprehend command and willing to participate in the study

EXCLUSION CRITERIA:

- Patients with a recent history of surgery on a particular shoulder.
- Post-traumatic shoulder pain and stiffness.
- Patients with Paresthesia.
- Patients with a previous history of fracture at the shoulder complex.
- Patients with rotator cuff pathology, and tendon calcification.
- Frozen Shoulder secondary to Brachial Plexus Injury, Parkinsonism, Ankylosis, Infection or Arthroplasty

7. **OUTCOME MEASURES**: VAS, SHOULDER ROM, SPADI
8. **MATERAIALS:** Pen, IASTM Tool, Towel, Couch ,Moisturizing lotion , Pillow , Goniometer

PROCEDURE

After obtaining consent, 30 patients with frozen shoulder stage 2 were assessed using the NPRS, SPADI, and Goniometer to determine the pain and shoulder ROM. The patients were randomly assigned into six groups: Group A, Group B, Group C, Group D, Group E, and Group F each consisting of 5 patients. The patients in Group A received gongs mobilization, Group B received the Spencer technique, Group C received Maitland mobilization, Group D received Kaltenborn mobilization, Group E received mulligan mobilization and Group F received the Graston technique.

GONGS MOBILIZATION: For increasing shoulder abduction, The subject sat on a knee-high chair, maintaining a neutral spine position while extending their arms comfortably. The therapist positioned themselves opposite the affected side. gently push the affected scapula from posterior to anterior direction with one hand, humeral head in an anterior to posterior direction parallel to the joint plane with the other hand. Simultaneously, the subject was instructed to perform rapid shoulder abduction with elbow flexion, keeping their palm inward and the back of their hand facing outward. The therapist's hands aligned with the humeral head, following the subject's movements, adding acceleration toward the end of the range, while maintaining slight distraction. This glide continued during slow, pain-free shoulder movements and was released upon returning to the initial position. This procedure consisted of one set of 10 repetitions with a one-minute rest between sets.

GONGS MOBILIZATION: For increasing medial rotation, The subject was in a side-lying position with the affected shoulder joint elevated and abducted to 90 degrees. The therapist held the subject's elbow at a 90-degree angle, positioned their own elbow beneath it, and gently pushed the humeral head from front to back. While maintaining this shoulder abduction and the 90-degree elbow angle, the therapist elevated their own body while slightly pulling on the shoulder joint's articular capsule. This pulling was held for 10-15 seconds, followed by a 5-second relaxation. This procedure lasted about 2-3 minutes. After stretching the capsule, the therapist pressed the shoulder joint from front to back with one hand while supporting the elbow, allowing for shoulder medial rotation. Range of motion was further increased with Maitland grades 3 and 4 oscillations, followed by a 7-second grade 4 sustained stretch.

SPENCER TECHNIQUE: The patient was positioned on the side-lying with the shoulder to be treated uppermost, the therapist stood in front of the patient stabilizing the superior aspect of the shoulder girdle, the fixed shoulder girdle provided a resistant structure against which to stretch the soft tissues around the glenohumeral articulation as the arm was used as a long lever Step 1 – shoulder extension with elbow flexion: The patient's elbow was maintained in a flexed position and the arm was extended until the restricted barrier. Step 2 - shoulder flexion with elbow extension: The patient's flexed elbow was extended and moved anteriorly into shoulder flexion until the restricted barrier. Step 3 – circumduction with compression: grasping the elbow of the patient with his shoulder in 90° abduction, moving the elbow in small clockwise and counterclockwise circles direction with compressive force. Step 4 – circumduction with distraction: The therapist maintained the traction of the patient's shoulder joint in 90° of abduction and held either elbow or wrist-induced small clockwise and counterclockwise circles Step 5 – shoulder

abduction and internal rotation with elbow flexion: the patient was asked to place his hand on the therapist's forearm for support and then the therapist performed abduction and internal rotation of the patient's arm Internal rotation (90°) — therapist placed the dorsum of the patient's hand behind his or her hip and moved the patient's elbow anteriorly Step 6 - shoulder adduction and external rotation with elbow flexion: the patient was asked to place his hand on the therapist's forearm for support and then the therapist took the patient's arm into adduction and external rotation. Step 7 - stretching tissue and pumping fluids with the arm extended: The therapist interlocks his fingertips over the deltoid muscle, the patient's hand is placed over the therapist's shoulder, and the therapist slowly moves the arm away from the shoulder and release it.

MAITLAND MOBILIZATION:

1. **Glenohumeral Caudal Glide** (To increase abduction) Patient Position Supine, with arm in the resting position. Therapist Position and Hand Placement: Stand lateral to the patient's arm being treated and support the forearm between your trunk and elbow. Place one hand in the patient's axilla to provide a grade I distraction. The web space on the other hand is placed just distal to the acromion process.

2. **Glenohumeral Posterior Glide** (to increase internal rotation) Patient Position Supine, with the arm in resting position. Therapist Position and Hand Placement Stand with your back to the patient between the patient's trunk and arm. Support the arm against your trunk, grasping the distal humerus with your Lateral hand. Place the lateral border of your top hand just distal to the anterior margin of the Joints, with your fingers pointing superiorly, this hand gives the mobilizing Force

KALTENBORG MOBILIZATION

SHOULDER CAUDAL GLIDE TO INCREASE ABDUCTION: The patient lies supine with the shoulder in the resting position. Fixate the patient's scapula from the axilla with a pommel or stirrup attached to the treatment surface; if necessary, use an additional fixating strap around the patient's chest. Grip the humerus with both your hands and support it against your body; apply a Grade III traction movement by shifting your body backward.

SHOULDER DORSAL GLIDE (internal rotation) TO INCREASE INTERNAL ROTATION: The patient lies supine; fixate the patient's scapula with a wedge; hold the patient's humerus against your body with both hands; grip with your right hypothenar eminence near the humeral head just distal to the joint space; apply a Grade JU dorsal glide movement to the glenohumeral joint by bending your knees and leaning through your extended right arm; move your hands and body together as one.

MULLIGAN MOBILIZATION

TO INCREASE ABDUCTION: patient sitting the therapist Leaning backward, or with the hands, he applies a posterolateral glide to the shoulder joint and then asks the patient to perform the painful/restricted movement of shoulder flexion or abduction, which would be pain-free now

TO INCREASE INTERNAL ROTATION: Patient in a sitting position. For loss of left internal rotation, stand facing the patient's left side. Place your right thumb in the bend of his flexed right elbow. His hand should be as far behind his back as possible. Now, place the web between your finger and thumb of your right hand in the patient's axilla. Now glide the head of the humerus down in the glenoid fossa using your

right thumb while stabilizing up and inwards. While this distraction is taking place have the patient internally rotate his shoulder, while you abduct his upper arm using your abdomen

GRASTON TECHNIQUE:

Iastm tool treatment starts with a good warm-up which prepares a densified area for treatment. this also helps by decreasing sensitivity in the affected area Always apply lubricant to the skin, make sure the skin is not broken, and that there are no obvious protrusions on the skin A stainless-steel tool is then placed on the shoulder region of the trigger points. The tool is designed in a way that it flawlessly follows the length of the muscle and tissue that may have been affected. The tool is placed at 45 degrees at the edge of the skin. start scanning superficially with the shaper side of the tool. Start with light pressure and slow strokes in one direction that is applied to the skin surface increasing as the therapist continues the procedure. The tool enables to detection of the densified area.

DATA ANALYSIS AND RESULT

Table 1: Showing age of the groups

Age	Mean	Std. Deviation
Group A	51.60	10.11
Group B	53.40	6.69
Group C	54.40	4.88
Group D	58.80	3.03
Group E	48.80	8.58
Group F	54.40	6.43

The study shows average age of Group A was 51.60±10.11 years, Group B was 53.40±6.69 years, Group C was 54.40±4.88 years, Group D was 58.80±3.03 years, Group E was 48.80±8.58 years and Group E was 54.40±6.43 years.

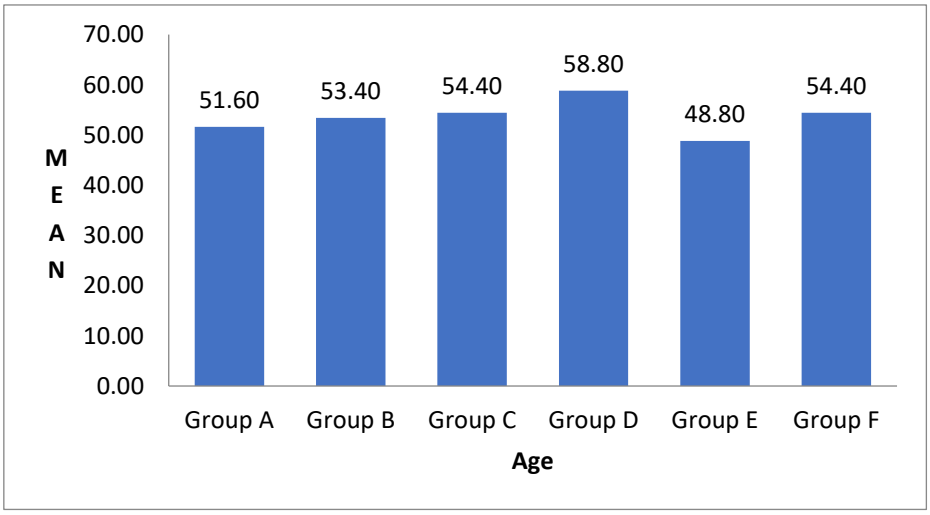


Table 2: Showing distribution of Gender in each group

		Group					
		Group A	Group B	Group C	Group D	Group E	Group F
Gender	FEMALE	3	4	5	3	4	1
		60.0%	80.0%	100.0%	60.0%	80.0%	20.0%
	MALE	2	1	0	2	1	4
		40.0%	20.0%	0.0%	40.0%	20.0%	80.0%
Total		5	5	5	5	5	5
		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Among the 5 patients in each group, Group A had 3(60%) female and 2(40%) male, Group B had 4(80%) female and 1(20%) male, Group C had all 5(100%) female, Group D had 3(60%) female and 2(40%) male, Group E had 4(80%) female and 1(20%) male and Group F had 1(20%) female and 4(80%) male.

Figure 2: Representing gender distribution of the groups

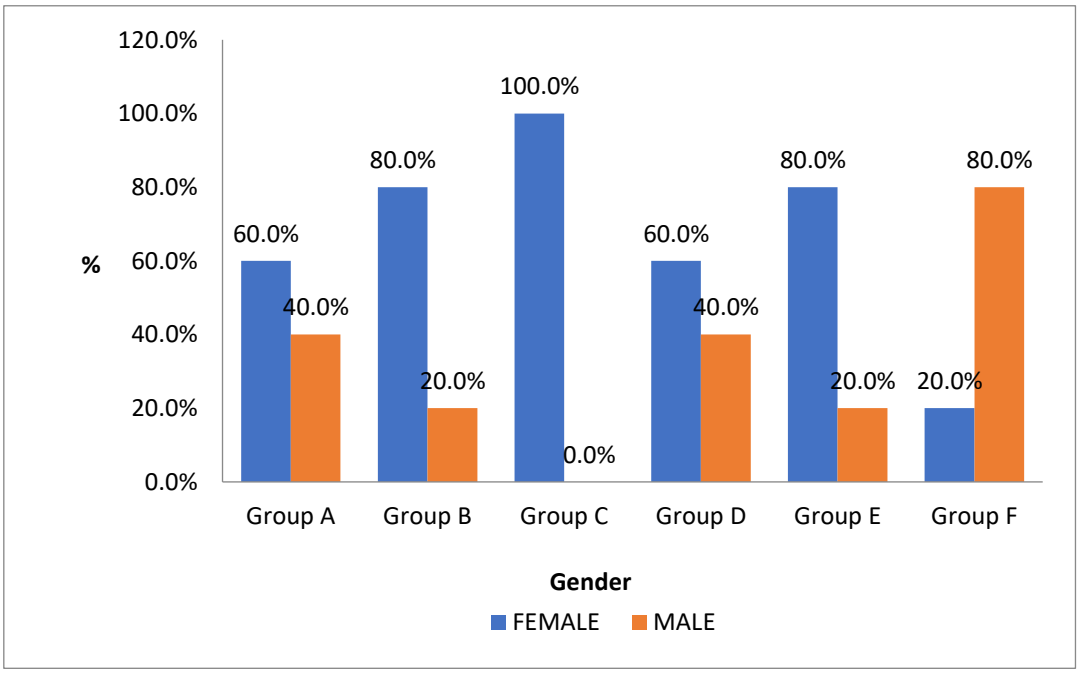


Table 3: Showing pre-post comparison of NPRS in Group A, Group B, Group C, Group D, Group E and Group F

NPRS		Mean	Std. Deviation	Mean difference	t value	p value
Group A	Pre	8.40	0.548	5.40	13.50	0.000 (p<0.001)
	Post	3.00	0.707			
Group B	Pre	9.20	0.837	6.60	16.50	0.000 (p<0.001)
	Post	2.60	0.548			
Group C	Pre	8.80	1.095	6.00	9.12	0.001
	Post	3.80	0.837			
Group D	Pre	8.40	0.548	3.80	10.15	0.001

	Post	4.60	0.548			
Group E	Pre	7.60	0.548	4.20	11.22	0.000 (p<0.001)
	Post	3.40	0.548			
Group F	Pre	7.60	0.548	3.20	8.55	0.001
	Post	4.40	0.548			

Figure 3: Representing pre-post comparison of NPRS in Group A, Group B, Group C, Group D, Group E and Group F

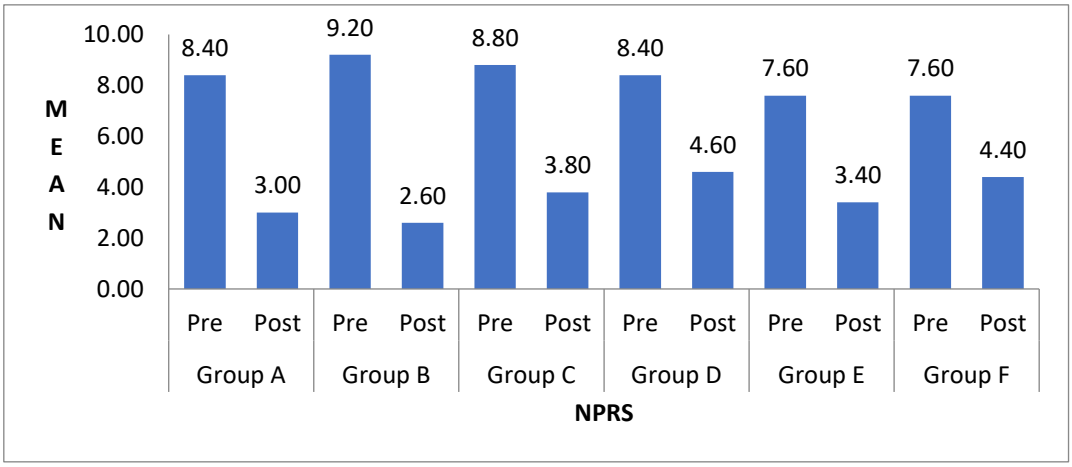


Table 4: Showing pre-post comparison of SPADI in Group A, Group B, Group C, Group D, Group E and Group F

SPADI		Mean	Std. Deviation	Mean difference	t value	p value
Group A	Pre	67.80	5.357	35.10	16.62	0.000 (p<0.001)
	Post	32.70	4.685			
Group B	Pre	74.60	9.529	50.20	12.81	0.000 (p<0.001)
	Post	24.40	2.302			
Group C	Pre	76.00	10.840	44.00	6.64	0.003
	Post	32.00	4.950			
Group D	Pre	72.00	6.928	36.80	23.09	0.000 (p<0.001)
	Post	35.20	4.324			
Group E	Pre	68.20	5.975	40.00	16.60	0.000 (p<0.001)
	Post	28.20	1.643			
Group F	Pre	70.20	5.975	35.00	9.19	0.001
	Post	35.20	4.207			

Figure 4: Representing pre-post omparison of SPADI in Group A, Group B, Group C, Group D, Group E and Group F

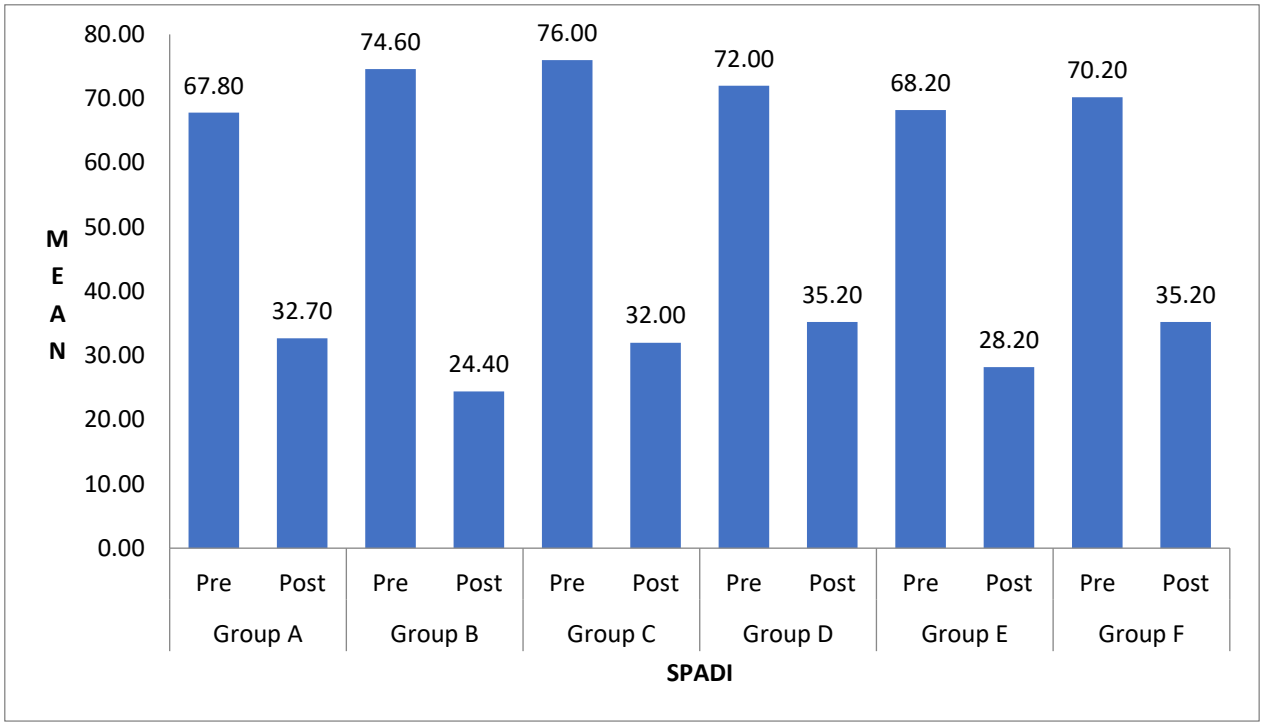


Table 5: Showing pre-post comparison of ABD in Group A, Group B, Group C, Group D, Group E and Group F

ABD		Mean	Std. Deviation	Mean difference	t value	p-value
Group A	Pre	78.00	13.038	100.00	22.36	0.000 (p<0.001)
	Post	178.00	4.472			
Group B	Pre	44.00	27.019	132.00	11.00	0.000 (p<0.001)
	Post	176.00	5.477			
Group C	Pre	44.00	18.166	86.00	7.37	0.002
	Post	130.00	18.708			
Group D	Pre	53.00	12.042	96.00	12.83	0.000 (p<0.001)
	Post	149.00	11.402			
Group E	Pre	40.00	7.906	114.00	19.69	0.000 (p<0.001)
	Post	154.00	11.402			
Group F	Pre	39.00	8.944	101.00	22.04	0.000 (p<0.001)
	Post	140.00	7.071			

Figure 5: Representing pre-post comparison of ABD in Group A, Group B, Group C, Group D, Group E and Group F

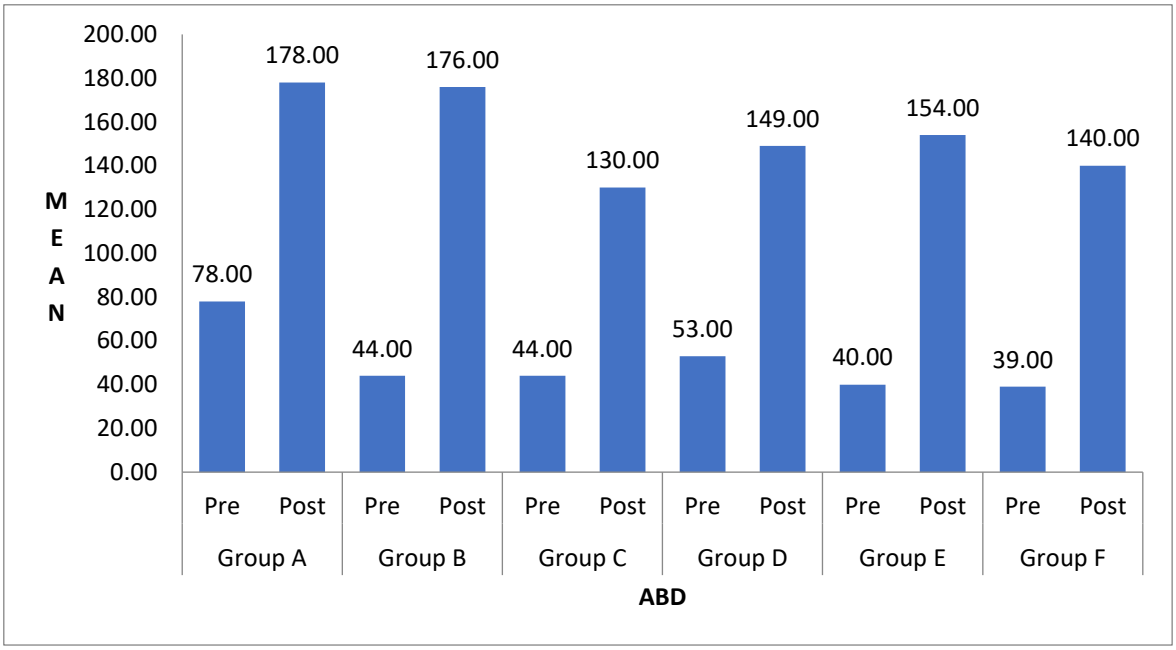


Table 6: Showing pre-post comparison of IR in Group A, Group B, Group C, Group D, Group E and Group F

IR		Mean	Std. Deviation	Mean difference	t value	p-value
Group A	Pre	12.00	2.739	12.00	9.79	0.001
	Post	24.00	4.183			
Group B	Pre	9.00	5.477	65.00	8.76	0.001
	Post	74.00	13.416			
Group C	Pre	16.00	20.736	12.00	1.59	0.186
	Post	28.00	5.701			
Group D	Pre	13.00	4.472	14.00	4.80	0.009
	Post	27.00	2.739			
Group E	Pre	10.00	6.124	32.00	3.03	0.039
	Post	42.00	21.389			
Group F	Pre	12.00	5.701	11.00	11.00	0.000 (p<0.001)
	Post	23.00	4.472			

Figure 5: Representing pre-post comparison of IR in Group A, Group B, Group C, Group D, Group E and Group F

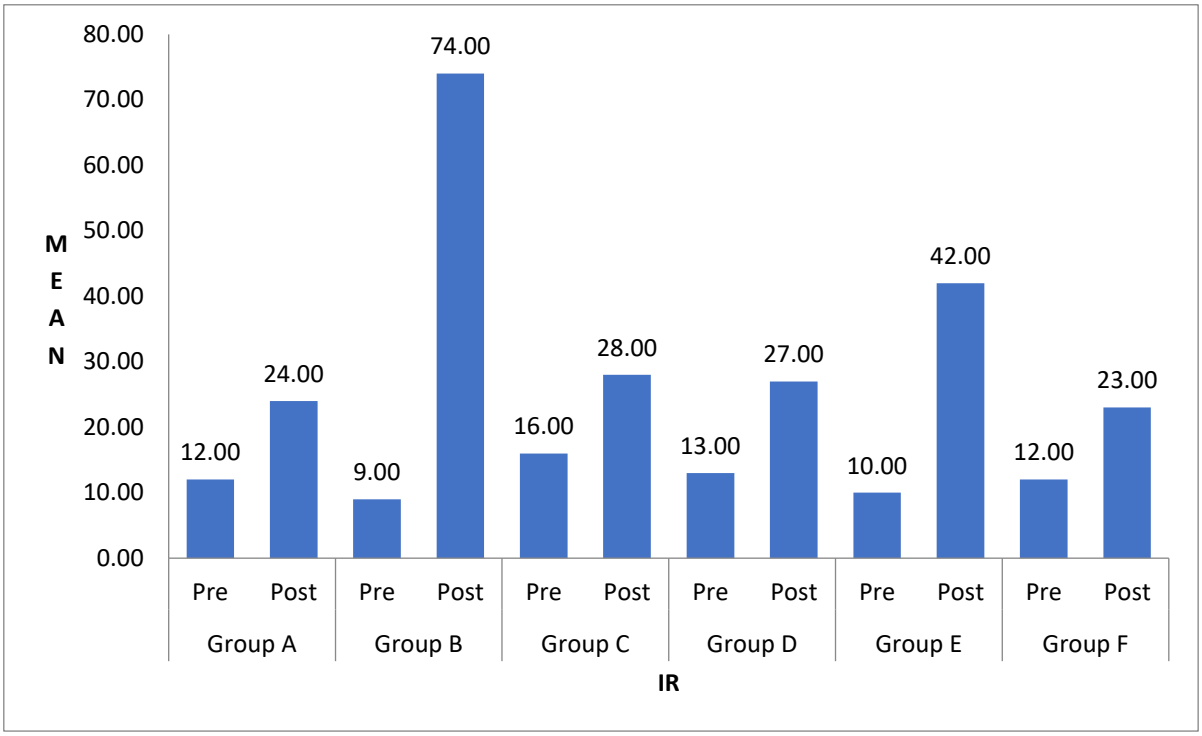


Table 7: ANOVA for comparison of NPRS improvement between the groups 6

NPRS	Mean	Std. Deviation	F value	p-value
Group A	5.40	.894	8.65	0.000 (p<0.001)
Group B	6.60	.894		
Group C	5.00	1.225		
Group D	3.80	.837		
Group E	4.20	.837		
Group F	3.20	.837		

Average changes taking place in NPRS from pre to post in Group A was 5.40±0.894, in Group B was 6.60±0.894, in Group C was 5.00±1.225, in Group D was 3.80±0.837, in Group E was 4.20±0.837 and in Group F was 3.20±0. 837. The analysis shows a statistically significant difference across the groups with p<0.001.

Table 8: Showing multiple comparisons for between groups in NPRS

(I) Group		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Group A	Group B	-1.200	0.589	0.791	-3.118	0.718
	Group C	0.400	0.589	1.000	-1.518	2.318

	Group D	1.600	0.589	0.180	-0.318	3.518
	Group E	1.200	0.589	0.791	-0.718	3.118
	Group F	2.20000*	0.589	0.015	0.282	4.118
Group B	Group C	1.600	0.589	0.180	-0.318	3.518
	Group D	2.80000*	0.589	0.001	0.882	4.718
	Group E	2.40000*	0.589	0.007	0.482	4.318
	Group F	3.40000*	0.589	0.000	1.482	5.318
Group C	Group D	1.200	0.589	0.791	-0.718	3.118
	Group E	0.800	0.589	1.000	-1.118	2.718
	Group F	1.800	0.589	0.081	-0.118	3.718
Group D	Group E	-0.400	0.589	1.000	-2.318	1.518
	Group F	0.600	0.589	1.000	-1.318	2.518
Group E	Group F	1.000	0.589	1.000	-0.918	2.918

The comparison shows there is significant difference in the improvement between Group A and Group F, average improvement is significantly higher in Group A. Improvement is significantly more in Group B when compared to Group D, more in Group B when compared to Group E and more in Group B when compared to Group F.

Figure 6: Representing improvement in the groups

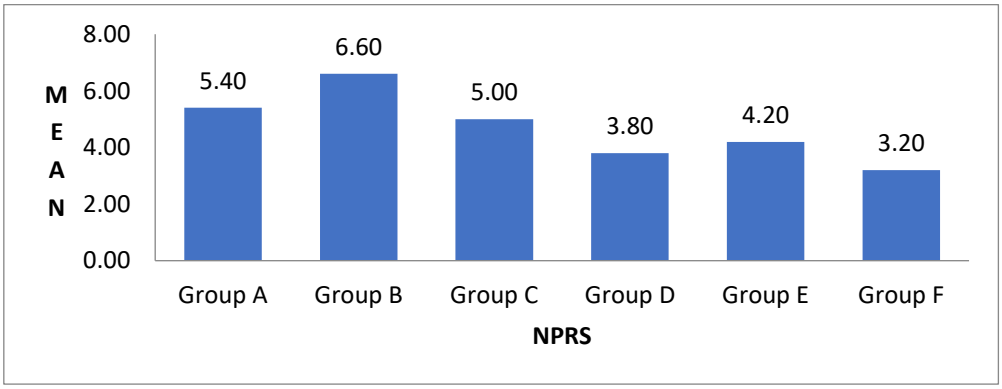


Table 9: Anova for comparison of SPADI between the groups

SPADI	Mean	Std. Deviation	f value	p value
Group A	35.10	4.722	2.48	0.060
Group B	50.20	8.758		
Group C	44.00	14.816		
Group D	36.80	3.564		
Group E	40.00	5.385		
Group F	35.00	8.515		

Average changes taken place in SPADI from pre to post in Group A was 35.10±4.722, in Group B was 50.20±8.758, in Group C was 44.00±14.816, in Group D was 36.80±3.564, in Group E was 40.00±5.385 and in Group F was 35.00±8.515.
The analysis shows no statistically significant difference between the groups with p>0.05.

Figure 7: Representing improvement in the groups

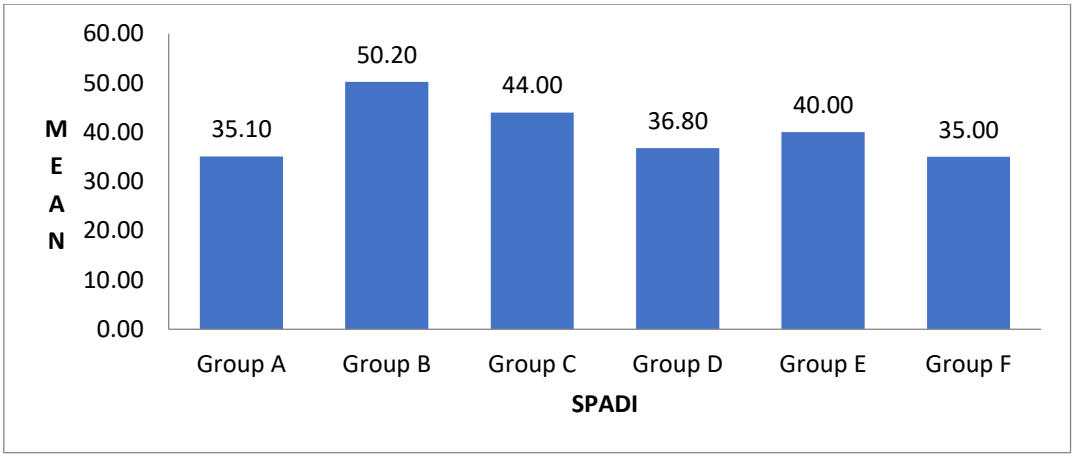


Table 10: ANOVA for comparison of ABD between the groups

ABD	Mean	Std. Deviation	f value	p value
Group A	100.00	10.000	3.77	0.012
Group B	132.00	26.833		
Group C	86.00	26.077		
Group D	96.00	16.733		
Group E	114.00	12.942		
Group F	101.00	10.247		

Average changes taken place in ABD from pre to post in Group A was 100.00±10.000, in Group B was 132.00±26.833, in Group C was 86.00±26.077, in Group D was 96.00±16.733, in Group E was 114.00±12.942 and in Group F was 101.00±10.247.
The analysis shows the statistically significant difference between the groups with p<0.05.

Table 11: Showing multiple comparisons across the groups in ABD

(I) Group		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Group A	Group B	-32.000	11.698	0.173	-70.115	6.115
	Group C	14.000	11.698	1.000	-24.115	52.115
	Group D	4.000	11.698	1.000	-34.115	42.115
	Group E	-14.000	11.698	1.000	-52.115	24.115
	Group F	-1.000	11.698	1.000	-39.115	37.115

Group B	Group C	46.00000*	11.698	0.009	7.885	84.115
	Group D	36.000	11.698	0.077	-2.115	74.115
	Group E	18.000	11.698	1.000	-20.115	56.115
	Group F	31.000	11.698	0.210	-7.115	69.115
Group C	Group D	-10.000	11.698	1.000	-48.115	28.115
	Group E	-28.000	11.698	0.373	-66.115	10.115
	Group F	-15.000	11.698	1.000	-53.115	23.115
Group D	Group E	-18.000	11.698	1.000	-56.115	20.115
	Group F	-5.000	11.698	1.000	-43.115	33.115
Group E	Group F	13.000	11.698	1.000	-25.115	51.115

The comparison shows there is significant difference in the improvement between Group B and Group C, average improvement is significantly higher in Group B.

Figure 8: Representing improvement in the groups

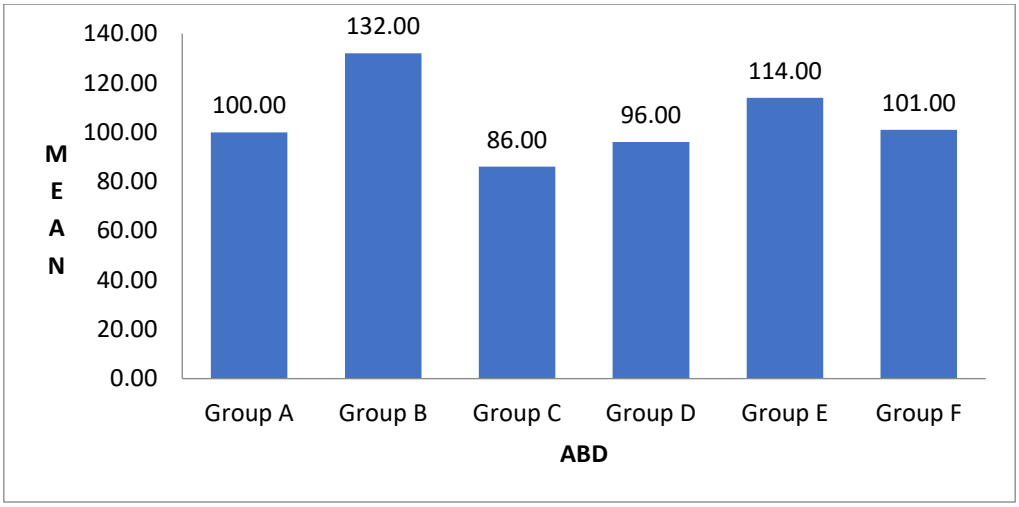


Table 12: ANOVA for comparison of IR between the groups

IR	Mean	Std. Deviation	f-value	p-value
Group A	12.00	2.739	11.80	0.000 (p<0.001)
Group B	65.00	16.583		
Group C	12.00	16.808		
Group D	14.00	6.519		
Group E	32.00	23.611		
Group F	11.00	2.236		

Average changes taking place in IR from pre to post in Group A was 12.00±2.739, in Group B was 65.00±15.583, in Group C was 12.00±16.808, in Group D was 14.00±6.519, in Group E was 32.00±23.611 and in Group F was 11.00±2.236.

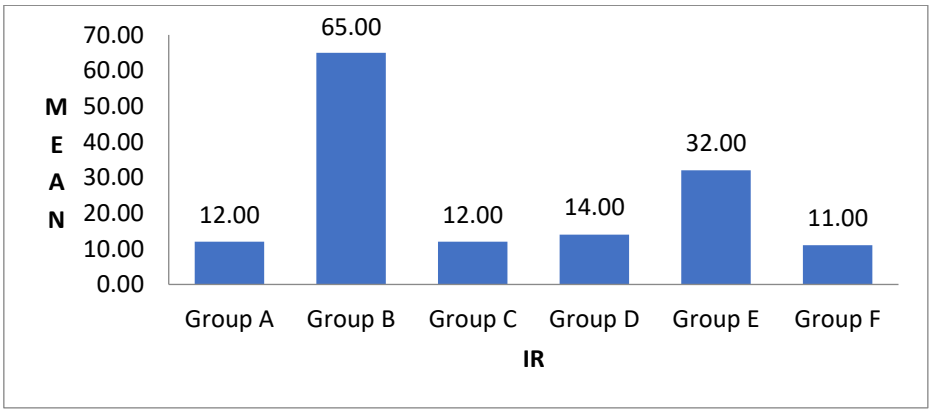
The analysis shows a statistically significant difference between the groups with p<0.

Table 13: Showing multiple comparisons between groups in IR

(I) Group		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Group A	Group B	-53.00000*	8.832	0.000	-81.777	-24.223
	Group C	0.000	8.832	1.000	-28.777	28.777
	Group D	-2.000	8.832	1.000	-30.777	26.777
	Group E	-20.000	8.832	0.493	-48.777	8.777
	Group F	1.000	8.832	1.000	-27.777	29.777
Group B	Group C	53.00000*	8.832	0.000	24.223	81.777
	Group D	51.00000*	8.832	0.000	22.223	79.777
	Group E	33.00000*	8.832	0.015	4.223	61.777
	Group F	54.00000*	8.832	0.000	25.223	82.777
Group C	Group D	-2.000	8.832	1.000	-30.777	26.777
	Group E	-20.000	8.832	0.493	-48.777	8.777
	Group F	1.000	8.832	1.000	-27.777	29.777
Group D	Group E	-18.000	8.832	0.791	-46.777	10.777
	Group F	3.000	8.832	1.000	-25.777	31.777
Group E	Group F	21.000	8.832	0.386	-7.777	49.777

The comparison shows there is a significant difference in the improvement between Group A and Group B, average improvement is significantly higher in Group B. Improvement is significantly more in Group B when compared to Group C, more in Group B when compared to Group D, more in Group B when compared to Group E and more in Group B when compared to Group F.

Figure 9: Representing improvement in the groups



RESULT:

The assessment of NPRS scores unveiled a statistically significant difference between the groups, underlining the effectiveness of the interventions. Group B displayed the most notable improvement, with an average change of 6.60±0.894, closely followed by Group A, which demonstrated a substantial improvement of 5.40±0.894. However, when it comes to SPADI scores, although there were variations in

average changes among the groups, the statistical analysis did not reveal any significant differences. This suggests that the interventions applied had a uniform impact on SPADI scores across all groups. Regarding ABDUCTION ROM, a significant difference was observed, with Group B achieving the most substantial improvement (132.00±26.833), followed by Group A (100.00±10.000). Analysing internal rotation ROM, significant variations were evident among the groups, with Group B achieving the most significant improvement (65.00±15.583), surpassing the other groups. In summary, this research sheds light on the effectiveness of diverse interventions across various health assessment metrics. Group B, particularly in NPRS and internal rotation ROM, emerged as the most effective, with Group A also excelling, notably in ABDUCTION ROM.

DISCUSSION

Frozen shoulder (FS) is a common name for the shoulder movement range limitation associated with different degrees of shoulder rigidity and pain. It is characterised by varying developmental courses, different levels of shoulder movement limitation, and background ambiguity due to the multiplicity of its causative factors. 13

This study was conducted to evaluate the efficacy of different manual therapy interventions in improving pain and ROM. This study consists of six groups of manual therapy interventions, namely: 1. Group A: Gongs Mobilisation

2. Group B: Spencer technique
3. Group C: Maitland mobilisation
4. Group D: Kaltenborg mobilisation
5. Group E: Mulligan mobilisation
6. Group F: Graston technique

All the participants were evaluated with the SPADI questionnaire; NPRS scoring, shoulder abduction, and internal rotation ROM were measured. The assessment is made for the pre-and post-interpretation scores of an individual. In this, the researcher explains to the respondent participants the technique. They are informed to undergo at least 5 weekly treatment sessions for 2 weeks. Later, the reassessment of the patients is done with the SPADI questionnaire, NPRS score, and ROM.

Group A: The post-intervention mean NPRS score was 3.00, reflecting a significant change from the pre-intervention score with a difference of 5.40, and a t-value of 13.50, indicating the significance of this improvement. The post-intervention mean SPADI score was 32.70, showing a notable change from the pre-intervention score with a difference of 35.10 and a t-value of 16.62, confirming the significant improvement. Additionally, the post-intervention mean ABD ROM was 178.00, marking a substantial difference of 100.00 from the pre-intervention measurement, with a t-value of 22.36 signifying its significance. As for the IR ROM, the postintervention mean was 24.00, with a difference of 12.00 from the pre-intervention measurement and a t-value of 9.79, indicating a positive change in IR ROM.

Group B: The mean NPRS score post-intervention was 2.60, which marked a substantial difference of 6.60 compared to pre-intervention, and this improvement was statistically significant, as evidenced by a t-value of 16.50. Similarly, the mean SPADI score post-intervention was 24.40, with a significant difference of 50.20 from pre-intervention, supported by a t-value of 12.81. the mean ABD ROM postintervention reached 176.00, signifying a substantial improvement of 132.00 from the pre-intervention value, and this enhancement was statistically significant with a tvalue of 11.00. Additionally, the mean IR ROM post-

intervention was 74.00, showing an improvement of 65.00 from the pre-intervention measurement, which was supported by a t-value of 8.76, indicating an increase in IR ROM.

Group C: the mean NPRS score post-intervention was 3.80, with a notable difference of 6.00 compared to pre-intervention, and this improvement was statistically significant, as evidenced by a t-value of 9.12. Similarly, the mean SPADI score postintervention was 32.00, with a significant difference of 44.00 from pre-intervention, 42 supported by a t-value of 6.64. the mean ABD ROM post-intervention was measured at 130.00, indicating a substantial improvement of 86.00 from the pre-intervention value, and this enhancement was statistically significant with a t-value of 7.37. However, when it comes to the mean IR ROM post-intervention, it was 28.00, with a smaller difference of 12.00 from the pre-intervention value, and the t-value of 1.59 indicated that there was no statistically significant improvement in IR ROM.

Group D: The mean NPRS score post-intervention was 4.60, with a significant difference of 3.80 from pre-intervention, supported by a t-value of 10.15, indicating a noteworthy improvement in NPRS post-intervention. Likewise, the mean SPADI score post-intervention was 35.20, with a considerable difference of 36.80 from preintervention, and the t-value of 23.09 confirmed a highly significant improvement. Furthermore, the mean ABD ROM post-intervention reached 149.00, demonstrating a substantial improvement of 96.00 from the pre-intervention value, and this enhancement was statistically significant with a t-value of 12.83. Additionally, the mean IR ROM post-intervention was 27.00, showing an improvement of 14.00 from the pre-intervention measurement, which was supported by a t-value of 4.80, indicating an increase in IR ROM.

Group E: The mean NPRS score post-intervention was 3.40, with a substantial difference of 4.20 from pre-intervention, supported by a t-value of 11.22, indicating a noteworthy improvement in NPRS post-intervention. Likewise, the mean SPADI score post-intervention was 28.20, with a considerable difference of 36.80 from pre-intervention, and the t-value of 23.09 confirmed a highly significant improvement. Furthermore, the mean ABD ROM post-intervention reached 154.00, demonstrating a substantial improvement of 114.00 from the pre-intervention value, and this enhancement was statistically significant with a t-value of 19.69. Additionally, the mean IR ROM post-intervention was 42.00, showing an improvement of 32.00 from the pre-intervention measurement, which was supported by a t-value of 3.03, indicating an increase in IR ROM.

Group F: The mean NPRS score post-intervention was 4.40, with a notable difference of 3.20 compared to pre-intervention, and this improvement was statistically significant, as indicated by a t-value of 8.55. Similarly, the mean SPADI score post-intervention was 35.20, with a substantial difference of 35.00 from pre-intervention, supported by a t-value of 9.19. In addition, the mean ABD ROM post-intervention measured at 140.00, showing a significant improvement of 101.00 from the pre-intervention value, and this enhancement was highly statistically significant with a t-value of 22.04. Furthermore, the mean IR ROM post-intervention was 23.00, reflecting an improvement of 11.00 from the pre-intervention measurement, and the t-value of 11.00 indicated a significant increase in IR ROM.

On comparing Group A, Group B, Group C, Group D, Group E, and Group F:

NPRS: The analysis of the data unveiled a statistically significant difference among the groups, with a p-value below 0.001, indicating that their responses differed significantly. When comparing the average changes in NPRS from pre-assessment to post-assessment, Group B emerged as the most noteworthy, showing an improvement of 6.60±0.894. Group A also demonstrated a substantial improvement of 5.40±0.894, significantly outperforming Group F, which had an improvement of 3.20±0.837. Moreover,

Group B's improvements were significantly greater than those in Group D, as well as Group E. These findings suggest that Group B made the most significant progress in their NPRS scores, while Group A also stood out in comparison to other groups, particularly Group F.

SPADI: The average changes observed in the SPADI scores from pre-treatment to post-treatment were as follows: Group A had an average change of 35.10±4.722, Group B had 50.20±8.758, Group C had 44.00±14.816, Group D had 36.80±3.564, Group E had 40.00±5.385, and Group F had 35.00±8.515. The statistical analysis indicated that there was no significant difference between these groups, with p-values greater than 0.05.

ABDUCTION ROM: The data analysis showed that there were significant variations in the improvements of ABD scores from the pre-treatment to the post-treatment assessments across the different groups. Group A displayed an average improvement of 100.00±10.000, Group B exhibited a more substantial improvement with a value of 132.00±26.833, Group C had an improvement of 86.00±26.077, Group D showed an average change of 96.00±16.733, Group E demonstrated a change of 114.00±12.942, and Group F had an average improvement of 101.00±10.247. The statistical analysis conclusively indicated that there was a significant difference among these groups, with a p-value less than 0.05. This underscores that the improvements in ABD scores were statistically significant across the various groups. Notably, the comparison revealed a significant disparity in the degree of improvement between Group B and Group C. Group B exhibited a significantly greater average improvement, suggesting that the treatment or intervention implemented in Group B had a more pronounced positive effect on ABD scores compared to Group C.

INTERNAL ROTATION ROM: The data analysis showed notable differences in the improvement of IR scores among different groups. Group B displayed the most significant average improvement (65.00±15.583), significantly surpassing Group A, Group C, Group D, Group E, and Group F. The statistical analysis supported these distinctions with a p-value below 0.05, indicating the statistical significance of the IR score improvements. Group B's treatment approach was notably more effective in enhancing IR compared to the other groups.

CONCLUSION

Based on the average values obtained for NPRS, SPADI, and Shoulder ROM measures within and between Groups A, B, C, D, E, and F, this study's findings point to a substantial overall improvement in all of these groups. Notably, when comparing these groups, the Group B Spencer technique demonstrates a marked difference in comparison to the others.

APPENDICES

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