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Hydrodilatation Vs Intra- Articular Corticosteroid Injection – The Better Modality for Pain Relief, To Increase the Range of Motion and To Improve Functional Outcomes in Patients with Adhesive Capsulitis – A Prospective Study Done in a Tertiary Care Hospital

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Abstract

Background: Adhesive capsulitis, commonly known as frozen shoulder, is characterized by pain and restricted shoulder movement. Hydrodilatation and corticosteroid injections are two widely used non-surgical interventions. **Objective:** This study aims to compare the efficacy of hydrodilatation versus corticosteroid injections in improving pain relief, range of motion, and functional outcomes in patients with adhesive capsulitis. **Methodology:** A comparative study was conducted on patients diagnosed with adhesive capsulitis. Participants were randomly assigned to two groups: Group H received hydrodilatation, while Group C received corticosteroid injections. The functional outcomes were evaluated using the CONSTANT score and ASES score at immediate, 1 month, 3 months, 6 months & 1 year. **Results:** Both groups showed significant improvement after the intervention. The post-operative ASSES & CONSTANT scores were better than the preoperative scores. On comparing Group H and Group C, the patients who received hydrodilation had better range of movements and function than the patients who had received corticosteroids. We found statistically significant at 1 month (0.0403), 6 months (0.0410) and 1 year (0.0471) on evaluation with ASES score and with CONSTANT score at 6 months (0.0138) and 1 year (0.0300). **Conclusion:** Hydrodilatation is more effective than corticosteroid injections in enhancing the range of motion in patients with adhesive capsulitis, while both treatments provide comparable pain relief and functional recovery. Hydrodilatation can be considered a preferred non-surgical option for improving shoulder mobility in adhesive capsulitis. Further studies with long-term follow-up are recommended to validate these findings.
Keywords: Hydrodilation, Corticosteroid injection and Adhesive capsulitis

Introduction

The term "frozen shoulder" is frequently used to describe Adhesive Capsulitis (AC). AC is an inflammatory condition that is distinguished by a substantial reduction in passive range of motion, discomfort, and shoulder stiffness. 10 to 20% of patients have been reported to have long-term disability, and 30 to 60% have persistent symptoms. In the general community, AC affects between 2% & 5% of people. Females have a somewhat higher prevalence than males [1.4:1] (1,2).

The glenohumeral joint capsule is the main area affected, resulting in persistent stiffness & functional impairment that frequently interferes with everyday activities & has major adverse impact on patients' quality of life. There are 2 distinct forms of adhesive capsulitis: primary and secondary. Typically, primary AC is idiopathic that is frequently associated with underlying conditions, including dyslipidemia, thyroid disorders, diabetes mellitus(DM), autoimmune

disorders, and cervical spondylosis. Secondary AC may be triggered by shoulder trauma, injuries that include rotator cuff tears, fractures, surgery, or protracted immobilization (3,4). Glenohumeral joint capsule's early inflammation results in pain, while adhesions and capsular fibrosis limit the range of motions (5,6). The most common symptom of AC is pain, which is a dull aching that gets worse with time, particularly when the shoulder is moved. The shoulder stiffens up, making it hard to move arm. The range of motion in the shoulder is greatly diminished, especially in the areas of abduction, external as well as internal rotation, forward flexion, with shoulder discomfort. AC frequently occurs in three stages: freezing, frozen, and thawing (7).

Further diagnostic tests, including an X-ray, CT scan, MRI, or musculoskeletal ultrasound, are occasionally utilized for identifying AC of the shoulder in addition to a physical examination and patient history to confirm diagnosis and rule out alternative causes (8). Numerous treatment modalities, including intra-articular corticosteroid injections, nonsteroidal anti-inflammatory drugs, hydrodilatation, acupuncture, short-term oral corticosteroids, and physiotherapy, have been examined in reducing symptoms along with enhancing shoulder mobility in patients with AC (8,9).

Injections of corticosteroids and hydrodilatation are two of the more widely used techniques. To improve movement, hydrodilatation, sometimes referred to asdistension arthrography, entails injecting saline or other fluids into joint capsule to physically stretch and break down adhesions. However, by reducing the body's inflammatory reaction within the afflicted joint, corticosteroid injections are used to reduce inflammation, ease pain, and speed up recovery (10). With this background we aimed to Evaluate and compare corticosteroid injections and hydrodilatation in patients with adhesive capsulitis. By examining patient results in terms of pain relief, range of motion, and overall shoulder function, this study seeks to provide significant insights into the optimal treatment strategy for this challenging issue.

Materials and Methods

Study design

This present study was conducted as a hospital based, Comparative study in a Tertiary Care hospital in Chengalpattu district, Tamil Nadu.

Study Setting

The study was conducted at the Department of Orthopaedics, Chettinad Hospital and Research Institute, Kelambakkam, Chengalpattu district.

Study duration

The duration of the study was over 2 years, from January 2023 to January 2025. The table below shows the sequence of completion of the study (Table 1)

Table 1: Timeline for the conduct of the study

January 2023	**Formulation of research hypothesis**
February 2023 to April 2023	Writing protocol and institutional ethical committee submission
May 2023	Institutional Ethical Committee approval
May 2023 to June 2023	Pilot testing
June 2023 to January 2024	Data collection and entry
February 2024 to June 2024	Data analysis
July to October 2024	Write up

November 2024	Final review
December 2024 to March 2025	Finalising writes up, review and revision of the draft
April 2025	Thesis submission

Study population

Patients who are Aged between 18 to 80 years with Primary Adhesive Capsulitis (Frozen Shoulder) presenting to the department of Orthopedics at Chettinad Hospital and Research Institute.

Inclusion criteria

- Patients who are Aged between 18 to 80 years
- Patients with Primary Adhesive Capsulitis (Frozen Shoulder)
- Patients with / without a history of diabetes on medication (controlled / uncontrolled blood sugar levels) along with / without limited range of motion.
- Patients with a Limitation of passive movement of the glenohumeral joint compared with the unaffected side, more than 10 degrees in any movements: flexion, Extension, Abduction, Abduction, External rotation & Internal rotation.
- Both the sex (Male & Female)
- Patients who are interested to take part in the study

Exclusion criteria

- Patients who are Aged under 18 years
- Patients who are aged over 80 years
- Patients who are Allergic to injection material
- Patients who have Rheumatoid arthritis
- Patients who have Infections in and around the shoulder joint.
- Patients who have Associated fractures in the shoulder
- Patients who have sub acromion bursitis
- Patients who have Rotator cuff injuries
- Patients who have sprains
- Patients who have strains
- Patients who refuse to take part in the study
- Patients who refused to give informed consent to participate in the study

Sample Size

The total sample size was 72 which was calculated from the previous study. With this, the patients were randomly divided into two equal groups of 36.

Group H – 36

Group C – 36

Sampling method

Patients were selected based on the criteria sampling method (36 patients in each group who fulfilled the inclusion and exclusion criteria were enrolled in the study).

Study tool

In this study, a pretested, validated, semi-structured questionnaire was used as the research tool. This questionnaire was developed in regional language (Tamil) & English. The first segment contains Socio – demographic characteristics like the patient's name, age, gender, occupation, side of the shoulder and comorbidities of the patients. Patient's occupation was classified based

on Modified Kuppusamy's socioeconomic status scale. The second segment contains the Pre-injection Active and Passive range of movements (Flexion, Extension, Abduction, Adduction, Internal rotation & External rotation).

The third segment contains ASES Score (AMERICAN SHOULDER ELBOW SOCIETY SCORE) which were done before and after the procedure. The fourth segment contains CONSTANT MURLEY scores which were done pre-operative and post-operative.

- The Constant-Murley score (CMS) is a 100-points scale composed of a number of individual parameters.
- These parameters define the level of pain and the ability to carry out the normal daily activities of the patient.
- The Constant-Murley score was introduced to determine the functionality after the treatment of a shoulder injury.

The test is divided into four subscales:

Pain (15 points),

- Activities of daily living (20 points),
- Strength (25 points) and
- Range of motion: forward elevation, external rotation, abduction and internal rotation of the shoulder (40 points).
- The higher the score, the higher the quality of the function **Study Procedure:**

Identifying the patients for the study

The patients who present to the Chettinad Hospital Research Institute Department of Orthopedics with Primary Adhesive Capsulitis (Frozen Shoulder) were included in the study. Based on the inclusion and Exclusion criteria two hundred patients were selected for the study.

Baseline tests for the study

A thorough medical history was obtained, covering factors such as age, Occupation, side of shoulder and age associated systemic illnesses such as diabetes mellitus, systemic hypertension and Combined diabetes mellitus & systemic hypertension were done. Complete General examinations and Systemic examinations were done. X-ray and range of movements is assessed according to the standardised technique on the affected shoulder. Baseline investigations were done like Complete blood count, fasting blood sugar, Post prandial blood sugar (HbA1c if necessary), Blood pressure, and Serology markers like HIV, HbsAg & HCV and Electro Cardio Gramm (ECG) were done. Patients were divided into two equal groups namely Group H and Group C. For both the group patients were evaluated for both Active & Passive range of movements such as Flexion, Extension, Abduction, Adduction, Internal rotation & External rotation.

Group H – patients in the Group H received hydrodilatation.

Under aseptic precautions, the patient is in a supine or sitting position with a 20-gauge needle of 0.9% Normal Saline (sodium chloride solution) injected directly into the glenoid cavity and rupture the capsule. Manipulation was done under General Anaesthesia

Group C – patients in the Group C received an injection of STEROID - Triamcinolone (KENACORT 80).

Figure 1: Triamcinolone injection

Under aseptic precautions, the patient is in supine or sitting position. C-arm is tilted to the view of the glenoid cavity with a 20 gauge needle Triamcinolone 2 ml (KENACORT 80**)** mixed with lignocaine (2% LOX)

Figure 2: Lignocaine injection 2%

Both the groups were Assessed for pre-injection Scores of ASES & Constant Murley scores and they were followed up immediately post steroid injection or post hydrodilatation procedure and at 1 month, 3 months, 6 months and 1 year.

Figure 3: Spinal needle

Ethical consideration
The study was approved by the Institutional Human Ethical Committee (IHEC) of Chettinad Hospital and Research Institute before data collection. An explicit participant information sheet had been prepared in both Tamil (regional language) and English. This document made the subjects understand all the details of the study before providing consent. The pros and cons of the procedure, its complications were explained clearly to the patients. Written, informed consent was obtained from the participants before the study. Throughout the course of the study, everyone's confidentiality and privacy were upheld.

Data entry
The data was entered into the most recent version of Microsoft Office Excel 2019.

Data analysis
IBM SPSS Statistics Version 21 is used for analysis. The descriptive statistics were shown in frequencies. The unpaired 't' test was used to find an association between the two groups (Group H and Group C).

Data presentation
Tables and graphs were used in the proper areas to describe the results.

Operational definition

Age
"Age is the number of completed years lived by a person" recorded during the data collection for the purpose of the present study participants. (33)

Occupation
"The occupation of the participants was grouped as per the Occupation category in the Modified Kuppusamy's socioeconomic status scale.

Results and Observations

The Table 2 shows the Distribution of age among the participants in Group H and the Mean & Standard Deviation is 48.08 ± 9.44 years. The table 2 shows the Distribution of age among the participants in Group C and the Mean & Standard Deviation is 54.16 ± 10.83 years. The mean age of patients in the Group C are more than the Group H. Among 36 participants in the Group H. Most of the patients are females 55.6 % than the males 44.4 %. Among 36 participants in the Group C. There was an equal number of patients in both the males and females 50 %. The Comorbidities among the participants in Group H were found to be 22.2 % of patients had Diabetes Mellitus and Hypertension, 19.5 % of the patients had Diabetes Mellitus with Hypertension and 36.1 % of the patients had No Comorbidities. The Comorbidities among the participants in Group C were found to be 30.6 % of patients had Diabetes Mellitus, 8.3 % of the patients had Hypertension, 25 % of the patients had Diabetes Mellitus with Hypertension and 36.1 % of the patients had No Comorbidities. The Pre-injection Abduction & Adduction in Active Range of Movements among the participants in Group H were demonstrated in Table 2. In abduction 2.8 % of the patients had 0 – 60, 22.2 % of the patients had 0 – 70, 33.3 % of the patients had 0 – 80, 30.6 % of the patients had 0 – 90 and 11.1 % of the patients had 0 – 110. In Adduction 27.8 % of the patients had 0 – 10 and 72.2 % of the patients had 0 – 20. The Table 2 predicts the Pre-injection Abduction & Adduction in Active Range of Movements among the participants in Group C in abduction 2.8 % of the patients had 0 – 60, 25 % of the patients had 0 – 70, 33.3 % of the patients had 0 – 80, 13.9 % of the patients had 0 – 90 and 25 % of the patients had 0 – 110. In Adduction 2.8 % of the patients had 0 – 10 and 97.2 % of the patients had 0 – 20. Flexion & Extension in Active Range of Movements among the participants in Group H were demonstrated in table 2.

In Flexion 2.8 % of the patients had 0 – 70, 5.6 % of the patients had 0 – 80, 59.3 % of the patients had 0 – 90, 11.1 % of the patients had 0 – 100, 16.7 % of the patients had 0 – 110 and 5.6 % of the patients had 0 – 140. In Extension 19.4 % of the patients had 0 – 10, 38.9 % of the patients had 0 – 20 and 41.7 % of the patients had 0 – 30. Flexion & Extension in Active Range of Movements among the participants in Group C were demonstrated in table 2.

In Flexion 2.8 % of the patients had 0 – 70, 5.6 % of the patients had 0 – 80, 63.9 % of the patients had 0 – 90, 8.3 % of the patients had 0 – 100, 16.7 % of the patients had 0 – 110 and 2.8 % of the patients had 0 – 140. In Extension 2.8 % of the patients had 0 – 10, 27.8 % of the patients had 0 – 20 and 69.4 % of the patients had 0 – 30.

In Table 2 the Pre-injection Internal rotation & External rotation in Active Range of Movements among the participants in Group H was demonstrated 66.7 & of the patients had Restricted Range of movements. 11.1 % of the patients had movement up to the gluteal region, 13.9 % of the patients had movement up to L5 and 8.3% of the patients had movements up to L4. In External rotation 72.2 % of the patients had Extension up to 0 – 10 and 27.8 % of the patients had 0 – 20.

In Table 2 the Pre-injection Internal rotation & External rotation in Active Range of Movements among the participants in Group C was demonstrated 72.2 & of the patients had Restricted Range of movements. 5.6 % of the patients had movement up to the gluteal region, 8.3 % of the patients had movement up to L5, 8.3% of the patients had movements up to L4 and 5.6 % of the patients had Up to D11. In External rotation 72.2 % of the patients had External rotation up to 0 – 10 and 27.8 % of the patients had 0 – 20 in external rotation.

Table 2 depicts Pre-injection Abduction & Adduction in Passive Range of Movements among the participants in Group. Among them 5.6 % of the patients had 60 – 70, 27.8 % of the patients had 70 – 80, 33.3 % of the patients had 80 – 90, 19.4 % of the patients had 90 – 100 and 8.6 % of the patients had 100 – 110 and 5.6 % of the patients had 110 – 120 range of

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movements. In adduction 75 % of the patients had 0 – 20, 13.9 % of the patients had 0 – 30 and 11. 1% of the patients had Restricted movements.

Table 2 depicts Pre-injection Abduction & Adduction in Passive Range of Movements among the participants in Group. Among them 2.8 % of the patients had 60 – 70, Each 8.3 % of the patients had 70 – 80 & 70 - 90, 47.2 % of the patients had 80 – 90, 8.3 % of the patients had 90 – 100 and 5.6 % of the patients had 100 – 110 and 5.6 % of the patients had 110 – 120 range of movements.
In adduction 13.9 % of the patients had 0 – 10, 77.8 % of the patients had 0 – 20, 2.8 % of the patients had 20 – 30 and 5.6 % of the patients had Restricted movements.

Pre-injection Flexion & Extension in Passive Range of Movements among the participants in Group H showed in table 2. In flexion 2.8 % of patients had 70 – 80, 13.9 % of the patients had 80 – 90, 52.8 % of the patients had 90 – 100 , 11.1 % of the patients had 100 – 110, 13.9 % of the patients had 110 – 120 and 5.6 % of the patients had 140 – 150 as range of movements in flexion. In extension 25 % of the patients had 0 – 10, 27.8 % of the patients had 0 – 20, 44.6 % of the patients had 0 – 30 and 2.8 % of the patients had 20 – 30.

Pre-injection Flexion & Extension in Passive Range of Movements among the participants in Group C showed in table 2. In flexion 2.8 % of patients had 70 – 80, 5.6 % of the patients had 80 – 90, 55.6 % of the patients had 90 – 100 , 5.6 % of the patients had 100 – 110, 16.7 % of the patients had 110 – 120 and 2.8 % of the patients had 140 – 150 as range of movements in flexion. In extension 8.3 % of the patients had 0 – 10, 16.7 % of the patients had 0 – 20, 66.7 % of the patients had 0 – 30, 5.6 % of the patients had 20 – 30 and 2.8 % of the patients had restricted movement.
 In Internal rotation 5.6 % of the patients had Up to the gluteal region, 22.2 % of the patients had Up to L5, 8.3 % of the patients had Up to L4 and 8.3 % of the patients had restricted movements. In External rotation 63.9 % of the patients had 0 – 10 and 36.1 % of the patients had 0 – 20.

Table 2: Distribution of age among the participants in Group H

Distribution of age among the participants in Group H		
Group H	**Mean & Standard Deviation** **(n = 36)**	
Age (years)	48.08 ± 9.44	
Distribution of age among the participants in Group C		
Group C	**Mean & Standard Deviation** **(n = 36)**	
Age (years)	54.16 ± 10.83	
Distribution of Gender among the participants in Group H		
Variables	**Gender**	**Group H** **No of Patients (%)** **(n = 36)**
Gender Distribution	Males	16 (44.4)
	Females	20 (55.6)

Distribution of Gender among the participants in Group C		
Variables	**Gender**	**Group C No of Patients (%) (n = 36)**
Gender Distribution	Males	18 (50)
	Females	18 (50)
Comorbidities among the participants in Group H		
Variable		**Group H No of Patients (%) (n = 36)**
Comorbidities	No Comorbidities	13 (36.1)
	Hypertension	8 (22.2)
	Diabetes Mellitus	8 (22.2)
	Diabetes Mellitus with Hypertension	7 (19.5)
Comorbidities among the participants in Group C		
Variables		**Group C No of Patients (%) (n = 36)**
Comorbidities	No Comorbidities	13 (36.1)
	Hypertension	3 (8.3)
	Diabetes Mellitus	11 (30.6)
	Diabetes Mellitus with Hypertension	9 (25)
Pre-injection Abduction & Adduction in Active Range of Movements among the participants in Group H		
Abduction	0 – 60	1 (2.8)
	0 – 70	8 (22.2)
	0 – 80	12 (33.3)
	0 – 90	11 (30.6)
	0 – 110	4 (11.1)
Adduction	0 – 10	10 (27.8)
	0 – 20	26 (72.2)
Pre-injection Abduction & Adduction in Active Range of Movements among the participants in Group C		
Variable		**Group C No of patients (n = 36) (%)**
Abduction	0 – 60	1 (2.8)
	0 – 70	9 (25)

	0 – 80	12 (33.3)
	0 – 90	5 (13.9)
	0 – 110	9 (25)
Adduction	0 – 10	1 (2.8)
	0 – 20	35 (97.2)

Pre injection Flexion & Extension in Active Range of Movements among the participants in Group H		
Variables		**Group H** **No of patients** **(n = 36) (%)**
Flexion	0 – 70	1 (2.8)
	0 – 80	2 (5.6)
	0 – 90	21 (58.3)
	0 – 100	4 (11.1)
	0 – 110	6 (16.7)
	0 – 140	2 (5.6)
Extension	0 – 10	7 (19.4)
	0 – 20	14 (38.9)
	0 – 30	15 (41.7)

Pre-injection Abduction & Adduction in Active Range of Movements among the participants in Group C		
Variables		**Group C** **No of patients** **(n = 36) (%)**
Flexion	0 – 70	1 (2.8)
	0 – 80	2 (5.6)
	0 – 90	23 (63.9)
	0 – 100	3 (8.3)
	0 – 110	6 (16.7)
	0 – 140	1 (2.8)
Extension	0 – 10	1 (2.8)
	0 – 20	10 (27.8)
	0 – 30	25 (69.4)

Pre-injection Internal rotation & External rotation in Active Range of Movements among the participants in Group H		
Variable		**Group H** **No of patients** **(n = 36) (%)**

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Internal rotation	Restricted	24 (66.7)
	Up to the gluteal region	4 (11.1)
	Up to L5	5 (13.9)
	Up to L4	3 (8.3)
External rotation	0 – 10	26 (72.2)
	0 – 20	10 (27.8)

Pre injection Internal rotation & External rotation in Active Range of Movements among the participants in Group C		
Variable		**Group C** **No of patients** **(n = 36) (%)**
Internal rotation	Restricted	26 (72.2)
	Up to the gluteal region	2 (5.6)
	Up to L5	3 (8.3)
	Up to L4	3 (8.3)
	Up to D11	2 (5.6)
External rotation	0 – 10	26 (72.2)
	0 – 20	10 (27.8)

Pre-injection Abduction & Adduction in Passive Range of Movements among the participants in Group H		
Variable		**Group H** **No of patients** **(n = 36) (%)**
Abduction	60 – 70	2 (5.6)
	70 – 80	10 (27.8)
	80 – 90	12 (33.3)
	90 – 100	7 (19.4)
	100 – 110	3 (8.6)
	110 – 120	2 (5.6)
Adduction	0 – 20	27 (75)
	0 – 30	5 (13.9)
	Restricted	4 (11.1)

Pre-injection Abduction & Adduction in Passive Range of Movements among the participants in Group C		
Variable		**Group C** **No of patients** **(n = 36) (%)**

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Abduction	60 – 70	1 (2.8)
	70 – 80	3 (8.3)
	70 – 90	3 (8.3)
	80 – 90	17 (47.2)
	90 – 100	3 (8.3)
	100 – 110	2 (5.6)
	110 – 120	2 (5.6)
	Restricted	2 (5.6)
Adduction	0 – 10	5 (13.9)
	0 – 20	28 (77.8)
	20 – 30	1 (2.8)
	Restricted	2 (5.6)

Pre injection Flexion & Extension in Passive Range of Movements among the participants in Group H		
Variable		Group H No of patients (n = 36) (%)
Flexion	70 – 80	1 (2.8)
	80 – 90	5 (13.9)
	90 – 100	19 (52.8)
	100 – 110	4 (11.1)
	110 – 120	5 (13.9)
	140 – 150	2 (5.6)
Extension	0 – 10	9 (25)
	0 – 20	10 (27.8)
	0 – 30	16 (44.4)
	20 - 30	1 (2.8)

Pre-injection Flexion & Extension in Passive Range of Movements among the participants in Group C		
Variable		Group C No of patients (n = 36) (%)
Flexion	70 – 80	1 (2.8)
	80 – 90	2 (5.6)
	90 – 100	20 (55.6)
	100 – 110	2 (5.6)
	110 – 120	6 (16.7)

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	140 – 150	1 (2.8)
Extension	0 – 10	3 (8.3)
	0 – 20	6 (16.7)
	0 – 30	24 (66.7)
	20 - 30	2 (5.6)
	Restricted	1 (2.8)

Pre-injection Internal rotation & External rotation in Passive Range of Movements among the participants in Group H		
	Variable	**Group H No of patients (n = 36) (%)**
Internal rotation	Up to the gluteal region	2 (5.6)
	Up to L5	8 (22.2)
	Up to L4	3 (8.3)
	Restricted	23 (63.9)
External rotation	0 – 10	23 (63.9)
	0 – 20	13 (36.1)

Pre injection Internal rotation & External rotation in Passive Range of Movements among the participants in Group C		
	Variable	**Group C No of patients (n = 36) (%)**
Internal rotation	Up to the gluteal region	1 (2.8)
	Up to L5	3 (8.3)
	Up to L4	3 (8.3)
	Restricted	29 (80.5)
External rotation	0 – 10	13 (36.1)
	0 – 20	6 (16.7)
	Restricted	17 (47.2)

Pre-injection scores among the participants in Group H	
Variable	**Group H (Mean & Standard Deviation) (n = 36)**
ASES	41.45 ± 6.85
Constant murley scoring	44.56 ± 6.33
Pre-injection scores among the participants in Group C	
Variable	**Group C (Mean & Standard Deviation)**

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	(n = 36)		
ASES	42.38 ± 5.61		
Constant murley scoring	44.77 ± 5.55		
Pre-injection Internal rotation & External rotation in Active Range of Movements among the participants in Group H			
Variable			**Group H No of patients (n = 36) (%)**
Internal rotation	Restricted		24 (66.7)
	Up to the gluteal region		4 (11.1)
	Up to L5		5 (13.9)
	Up to L4		3 (8.3)
External rotation	0 – 10		26 (72.2)
	0 – 20		10 (27.8)
Pre injection Internal rotation & External rotation in Active Range of Movements among the participants in Group C			
Variable			**Group C No of patients (n = 36) (%)**
Internal rotation	Restricted		26 (72.2)
	Up to the gluteal region		2 (5.6)
	Up to L5		3 (8.3)
	Up to L4		3 (8.3)
	Up to D11		2 (5.6)
External rotation	0 – 10		26 (72.2)
	0 – 20		10 (27.8)
Pre-injection Abduction & Adduction in Passive Range of Movements among the participants in Group H			
Variables			**Group H No of patients (n = 36) (%)**
Abduction	60 – 70		2 (5.6)
	70 – 80		10 (27.8)
	80 – 90		12 (33.3)
	90 – 100		7 (19.4)
	100 – 110		3 (8.6)
	110 – 120		2 (5.6)

Adduction	0 – 20	27 (75)
	0 – 30	5 (13.9)
	Restricted	4 (11.1)

Pre-injection Abduction & Adduction in Passive Range of Movements among the participants in Group C		
	Variables	Group C No of patients (n = 36) (%)
Abduction	60 – 70	1 (2.8)
	70 – 80	3 (8.3)
	70 – 90	3 (8.3)
	80 – 90	17 (47.2)
	90 – 100	3 (8.3)
	100 – 110	2 (5.6)
	110 – 120	2 (5.6)
	Restricted	2 (5.6)
Adduction	0 – 10	5 (13.9)
	0 – 20	28 (77.8)
	20 – 30	1 (2.8)
	Restricted	2 (5.6)
Pre injection Flexion & Extension in Passive Range of Movements among the participants in Group H		
Variables		Group H No of patients (n = 36) (%)
Flexion	70 – 80	1 (2.8)
	80 – 90	5 (13.9)
	90 – 100	19 (52.8)
	100 – 110	4 (11.1)
	110 – 120	5 (13.9)
	140 – 150	2 (5.6)
Extension	0 – 10	9 (25)
	0 – 20	10 (27.8)
	0 – 30	16 (44.4)
	20 - 30	1 (2.8)
Pre-injection Flexion & Extension in Passive Range of Movements among the participants in Group C		

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Variables		Group H No of patients (n = 36) (%)
Flexion	70 – 80	1 (2.8)
	80 – 90	5 (13.9)
	90 – 100	19 (52.8)
	100 – 110	4 (11.1)
	110 – 120	5 (13.9)
	140 – 150	2 (5.6)
Extension	0 – 10	9 (25)
	0 – 20	10 (27.8)
	0 – 30	16 (44.4)
	20 - 30	1 (2.8)
Pre-injection Internal rotation & External rotation in Passive Range of Movements among the participants in Group H		
Variables		Group H No of patients (n = 36) (%)
Internal rotation	Up to the gluteal region	2 (5.6)
	Up to L5	8 (22.2)
	Up to L4	3 (8.3)
	Restricted	23 (63.9)
External rotation	0 – 10	23 (63.9)
	0 – 20	13 (36.1)
Pre injection Internal rotation & External rotation in Passive Range of Movements among the participants in Group C		
Variables		Group C No of patients (n = 36) (%)
Internal rotation	Up to the gluteal region	1 (2.8)
	Up to L5	3 (8.3)
	Up to L4	3 (8.3)
	Restricted	29 (80.5)
External rotation	0 – 10	13 (36.1)
	0 – 20	6 (16.7)
	Restricted	17 (47.2)
Pre-injection scores among the participants in Group H		

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Variable	Group H (Mean & Standard Deviation) (n = 36)
ASES	41.45 ± 6.85
CONSTANT MURLEY SCORING	44.56 ± 6.33

Pre-injection scores among the participants in Group C

Variable	Group C (Mean & Standard Deviation) (n = 36)
ASES	42.38 ± 5.61
CONSTANT MURLEY SCORING	44.77 ± 5.55

Post-injection Abduction & Adduction in Active Range of Movements among the participants in Group H

	Variable	Group H No of patients (n = 36) (%)
Abduction	0 – 70	5 (13.9)
	0 – 90	4 (11.1)
	0 – 100	7 (19.4)
	0 – 120	12 (33.3)
	0 – 150	4 (11.1)
	0 - 170	4 (11.1)
Adduction	0 – 20	34 (94.4)
	0 – 30	2 (5.6)

Post-injection Abduction & Adduction in Active Range of Movements among the participants in Group C

	Range in degrees	Group C No of patients (n = 36) (%)
Abduction	0 – 70	2 (5.6)
	0 – 100	11 (30.6)
	0 – 120	18 (50)
	0 – 150	2 (5.6)
	0 – 160	2 (5.6)
	0 - 170	1 (2.8)
Adduction	0 – 20	25 (69.4)

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	0 – 30	5 (13.9)
	20 – 30	1 (2.8)
	restricted	5 (13.9)

Post-injection Flexion & Extension in Active Range of Movements among the participants in Group H		
		Group H **No of patients** **(n = 36) (%)**
Flexion	0 – 90	5 (13.9)
	0 – 120	10 (27.8)
	0 – 130	5 (13.9)
	0 – 140	12 (33.3)
	0 – 180	4 (11.1)
Extension	0 – 20	9 (25)
	0 – 30	27 (75)

Post-injection Flexion & Extension in Active Range of Movements among the participants in Group C		
	Range in degrees	**Group C** **No of patients** **(n = 36) (%)**
Flexion	0 – 70	1 (2.8)
	0 – 80	2 (5.6)
	0 – 90	23 (63.9)
	0 – 100	3 (8.3)
	0 – 110	6 (16.7)
	0 – 140	1 (2.8)
Extension	0 – 20	7 (19.4)
	0 – 30	29 (80.6)

Post-injection Internal rotation & External rotation in Active Range of Movements among the participants in Group H		
		Group H
Internal rotation	Range in degrees	**No of patients** **(n = 36) (%)**
	Restricted	9 (25)
	Up to the gluteal region	2 (5.6)
	Up to L5	5 (13.9)
	Up to L4	1 (2.8)

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	Up to D12	15 (41.7)
External rotation	Up to D11	4 (11.1)
	0 – 10	10 (27.8)
	0 – 20	26 (72.2)
Post-injection Internal rotation & External rotation in Active Range of Movements among the participants in Group C		
	Range in degrees	**Group C** **No of patients** **(n = 36) (%)**
Internal rotation	Restricted	2 (5.6)
	Up to the gluteal region	5 (13.9)
	Up to L5	2 (5.6)
	Up to L4	1 (2.8)
	Up to D12	22 (61.1)
	Up to D11	4 (11.1)
External rotation	0 – 10	3 (8.3)
	0 – 20	33 (91.7)
Post-injection Abduction & Adduction in Passive Range of Movements among the participants in Group H		
	Range in degrees	**Group H** **No of patients** **(n = 36) (%)**
Abduction	0 – 70	8 (22.2)
	90 – 100	4 (11.1)
	100 – 110	8 (22.2)
	120 – 150	9 (25)
	150 – 170	3 (8.3)
	Restricted	4 (11.1)
Adduction	0 – 20	23 (63.9)
	0 – 30	8 (22.2)
	Restricted	5 (13.9)
Post-injection Abduction & Adduction in Passive Range of Movements among the participants in Group C		
	Range in degrees	**Group C** **No of patients** **(n = 36) (%)**
Abduction	0 – 70	4 (11.1)

-

	100 – 110	6 (16.7)
	100 – 120	4 (11.1)
	120 – 130	1 (2.8)
	120 – 140	1 (2.8)
	120 – 150	1 (2.8)
	150 – 170	1 (2.8)
	160 - 170	3 (8.3)
	Restricted	15 (41.7)
Adduction	0 – 20	32 (88.9)
	0 – 30	4 (11.1)

In Internal rotation 2.8 % of the patients had Up to the gluteal region, 8.3 % of the patients had Up to L5, 8.3 % of the patients had Up to L4 and 80.5 % of the patients had restricted movements.

In External rotation 36.1 % of the patients had 0 – 10, 16.7 % of the patients had 0 – 20 and 47.2 % of the patients had restricted movement.

In the group H (table 2) the mean & Standard deviation of Pre-injection scores of ASES and CONSTANT MURLEY SCORING are 41.45 ± 6.85 and 44.56 ± 6.33.

In the group C (table 2) the mean & Standard deviation of Pre-injection scores of ASES and CONSTANT MURLEY SCORING are 42.38 ± 5.61 and 44.77 ± 5.55. the comparison of pre injection scores were shown in the bar chart

On comparing Pre-injection scores of ASES and CONSTANT MURLEY SCORING among Group H and Group C there was no statistically significant between them. The mean scores were found to be almost same among them.

The table 2 depicts the Post-injection Abduction & Adduction in Active Range of Movements among the participants in Group H. In Abduction 13.9 % of patients had 0 – 70, 11.1 % of the patients had 0 -90, 19.4 % of the patients had 0 – 100, 33.3 % of the patients had 0 – 120 and each 11.1 % of the patients had 0 – 150 & 0 – 170. In adduction 94.4 % of the patients had 0 – 20 and 5.6 % of the patients had 0 – 30.

The table 2 depicts the Post-injection Abduction & Adduction in Active Range of Movements among the participants in Group C. In Abduction 5.6 % of patients had 0 – 70, 30.6 % of the patients had 0 -100, 50 % of the patients had 0 – 120, 2.8 % of the patients had 0 – 160 and each 5.6 % of the patients had 0 – 150 & 0 – 160.

In adduction 69.4 % of the patients had 0 – 20, 13.9 % of the patients had 0 – 30, 2.8 % of the patients had 20 – 30 and 13.9 % of the patients had Restricted adduction movement.

In table 2 Post-injection Flexion & Extension in Active Range of Movements among the participants in Group H was showed. In flexion 13.9 % of the patients had 0 – 90, 27.8% of the patients had 0 – 120, 13.9 % of the patients had 0 – 130, 33.3 % of the patients had 0 140 and 11.1 % of the patients had 0 – 180. In extension 25 % of the patients had 0 – 20 and 75 % of the patients had 0 – 30.

In table 2 Post-injection Flexion & Extension in Active Range of Movements among the participants in Group C was showed. In flexion 2.8 % of the patients had 0 – 70, 5.6 % of the patients had 0 – 80, 63.9 % of the patients had 0 – 90, 8.3% of the patients had 0 – 100, 16.7 % of the patients had 0 – 110 and 2.8 % of the patients had 0 -140. In extension 19.4 % of the patients had 0 – 20 and 80.6 % of the patients had 0 – 30.

The table 2. Depicts the Post-injection Internal rotation & External rotation in Active Range of Movements among the participants in Group H. 25 % of the patients had restricted Range of movements, 5.6 % of them had internal rotation up to the gluteal region, 13.9 % of the patients had up to L5, 2.8 % of the patients had up to L4, 41.7 % of the patients had up to D12, 11.1 % of the patients had D11. In External rotation 27.8 % of the patients had 0 – 10 and the majority of the patients 72.2 % had 0 – 20.

The table 2. Depicts the Post-injection Internal rotation & External rotation in Active Range of Movements among the participants in Group C. 5.6 % of the patients had restricted Range of movements, 13.9 % of them had internal rotation up to the gluteal region, 5.6 % of the patients had up to L5, 2.8 % of the patients had up to L4, 61.1 % of the patients had up to D12, 11.1 % of the patients had D11. In External rotation 8.3 % of the patients had 0 – 10 and the majority of the patients 91.7 % had 0 – 20.

In table 2 Post-injection Abduction & Adduction in Passive Range of Movements among the participants in Group H were demonstrated. In abduction 22.2 % of them had 0 – 70, 11.1 % of the patients had 90 – 100, 22.2 % of the patients had 100 -110, 25 % of the patients had 120 – 150, 8.3 % of the patients had 150 – 170 and 11.1 % of the patients had restricted movement. In adduction 13.9 % of them had restricted movement, 63.9% of them had 0 – 20, and 22.2 % of them had 0 – 30.

In table 2 Post-injection Abduction & Adduction in Passive Range of Movements among the participants in Group C were demonstrated. In abduction 11.1 % of them had 0 – 70, 16.7 % of the patients had 100 – 110, 11.1 % of the patients had 100 -120, Each 2.8 % of the patients had 120 – 130, 120 – 140, 120 – 150 and 120 – 170 range of abduction. 41.7 % of the patients had restricted movement.

In adduction none of them had restricted movement, 88.9% of them had 0 – 20, and 11.1 % of them had 0 – 30.

Table 3: Post-injection Flexion & Extension in Passive Range of Movements among the participants in Group H

Variable		Group H No of patients (n = 36) (%)
Flexion	0 – 90	4 (11.1)
	120 – 130	4 (11.1)
	120 – 140	1 (2.8)
	120 – 150	7 (19.4)
	130 – 160	4 (11.1)
	140 – 150	7 (19.5)
	140 – 160	4 (11.1)
	150 – 160	1 (2.8)
	170 – 180	4 (11.1)
Extension	0 – 10	4 (11.1)
	0 – 20	21 (58.3)
	20 – 30	7 (19.4)
	Restricted	4 (11.1)

In Table .3 Post-injection Flexion & Extension in Passive Range of Movements among the participants in Group H were shown. In flexion Each 11.1 % of the patients had range of flexion at 0 – 90, 120 – 130, 120 – 150, 140 – 160 and 170 – 180. Each 2.8 % of the patients had 120 – 140 and 150 – 160. 19.4 % of the patients had 120 – 150, and 19.5 % of the patients had 140 – 150.

In Extension, 11.1 % of the patients had 0 – 10, 58.3 % of the patients had 0 – 20, 19.4 % of the patients had 20 – 30 and 11.1 % of the patients had restricted movements.

Table 4: Post-injection Flexion & Extension in Passive Range of Movements among the participants in Group C

Variable		Group C No of patients (n = 36) (%)
Flexion	0 – 90	2 (5.6)
	120 – 130	10 (27.8)
	120 – 140	1 (2.8)
	120 – 150	1 (2.8)
	130 – 160	1 (2.8)

	140 – 150	5 (13.9)
	140 – 160	10 (27.8)
	150 – 160	3 (8.3)
	170 – 180	3 (8.3)
Extension	0 – 20	4 (11.1)
	0 – 30	21 (58.3)
	20 – 30	1 (2.8)
	Restricted	10 (27.8)

In Table 4 Post-injection Flexion & Extension in Passive Range of Movements among the participants in Group C were shown. In flexion Each 2.8 % of the patients had a range of flexion at 120 – 140, 120 – 150 and 130 – 160. Each 8.3 % of the patients had 170 – 180 and 150 – 160. 5.6 % of the patients had 0 – 90, 13.9 % of the patients had 140 – 150, and each 27.8 % of the patients had 120 – 130 and 140 – 160.

In extension 11.1% of the patients had 0 – 20, 58.3 % of the patients had 0 – 30, 2.8 % of the patients had 20 – 30 and 27.8 % of the patients had Restricted movement.

Table 5: Post-injection Internal rotation & External rotation in Passive Range of Movements among the participants in Group H

Variable		Group H No of patients (n = 36) (%)
Internal rotation	Restricted	9 (25)
	Up to L5	4 (11.1)
	Up to D12	19 (52.8)
	Up to D11	4 (11.1)
Extension	0 – 10	10 (27.8)
	20 – 30	22 (61.1)
	Restricted	4 (11.1)

In the Table 5 Post-injection Internal rotation & External rotation in Passive Range of Movements among the participants in Group H was showed. In internal rotation 25 % of the patients had restricted internal rotation. 11.1 % of the patienst had internal rotation upto L5, the majority of the 52.8 % patients had internal rotation up to D12, 11.1 % of the patients had movement up to D11. In Extension 11.1 % of the patients had Restricted extension movement. 27.8 % of the patients had 0 – 10, 61.1 % of the patients had 20 – 30.

Table 6: Post-injection Internal rotation & External rotation in Passive Range of Movements among the participants in Group C

Variable		Group C No of patients (n = 36) (%)
Internal rotation	Restricted	7 (19.4)
	Up to Gluteal region	3 (8.3)
	Up to L5	1 (2.8)
	Up to D12	21 (58.3)
	Up to D11	4 (11.1)
Extension	0 – 10	5 (13.9)
	20 – 30	17 (47.2)
	Restricted	14 (38.9)

In the Table 6 Post-injection Internal rotation & External rotation in Passive Range of Movements among the participants in Group C was showed. In internal rotation 19.4 % of the patients had restricted internal rotation. 8.3 % of the patients had internal rotation upto gluteak region. 2.8 % of the patienst had internal rotation upto L5, the majority of the 58.2 % patients had internal rotation up to D12, 11.1 % of the patients had movement up to D11.
In Extension 38.9 % of the patients had Restricted extension movement. 13.9 % of the patients had 0 – 10, 47.2 % of the patients had 20 – 30.

Table 7: Comparison of Post - injection ASES Scores among Group H and Group C

ASES Scores	Group H	Group C	t-value	p-value
Immediate	62.24 ± 9.15	58.39 ± 9.19	1.7813	0.0792
1 month	63.59 ± 9.21	59.75 ± 9.15	1.7747	*0.0403 **
3 months	64.92 ± 9.24	61 ± 9.35	1.7892	0.0779
6 months	66.05 ± 9.18	62.20 ± 9.27	1.7706	*0.0410 **
1 year	67.61 ± 8.47	63.41 ± 9.15	2.0211	*0.0471**

p = < 0.05 considered as significant
In table 7 On comparing Post - injection ASES Scores among Group H and Group C. The mean ASESS scores were significantly increased among the patients in Group H than the Group C. The patients who received hydrodilation had better range of movements than the patients who had received corticosteroids.
In post injection ASESS scores between Group H & Group C we found statistically significant at 1 month (0.0403), 6 months (0.0410) and 1 year (0.0471).
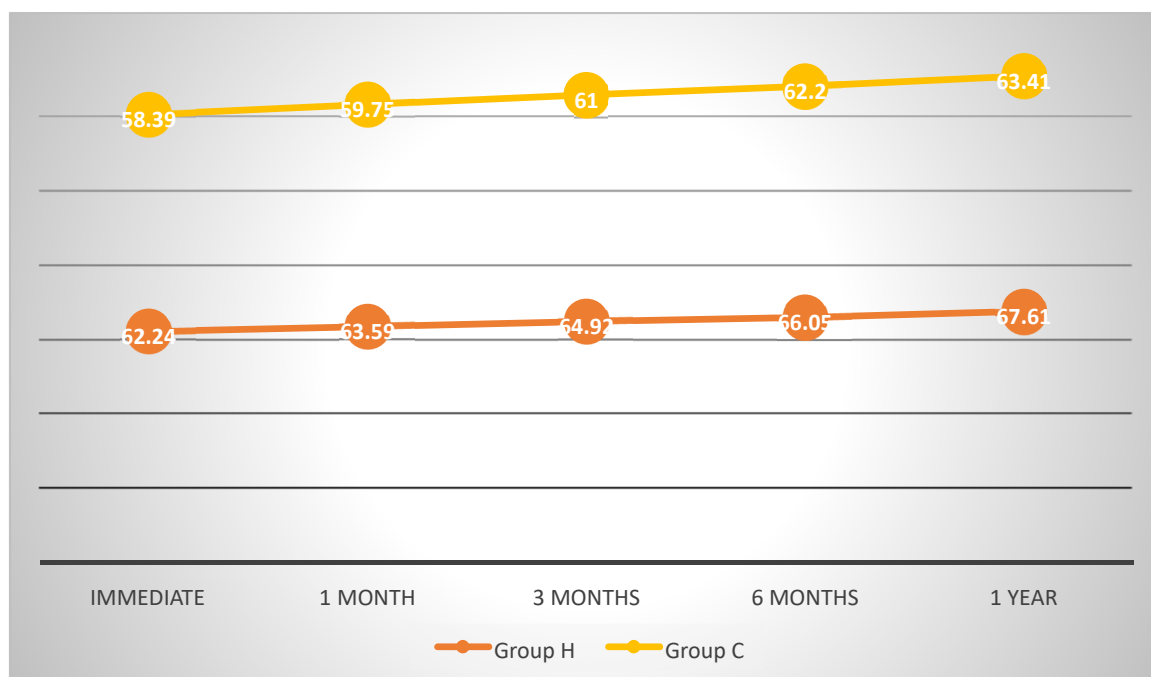
Figure 4: Group H vs Group C on Mean ASES Scores Scores

Table 8: Comparison of Post-injection CONSTANT MURLEY Scores among Group H and Group C

CONSTANT MURLEY Scores	Group H	Group C	t-value	p-value
Immediate	61.78 ± 9.10	58.91 ± 8.24	1.4027	0.1231
1 month	63.15 ± 9.03	60.16 ± 8.13	1.4765	0.1443
3 months	63.93 ± 8.93	61.01 ± 8.05	1.4572	0.1495
6 months	64.99 ± 9.02	61.76 ± 8.07	1.6012	*0.0138 **
1 year	66.05 ± 8.81	62.54 ± 7.93	1.7767	*0.0300 **

*p = < 0.05 considered as significant

In table 8 On comparing Post - injection CONSTANT MURLEY Scores among Group H and Group C. The mean CONSTANT MURLEY scores were significantly increased among the patients in Group H than the Group C. The patients who received hydrodilation had better range of movements than the patients who had received corticosteroids.

In post injection CONSTANT MURLEY scores between Group H & Group C we found statistically significant at 6 months (0.0138) and 1 year (0.0300).
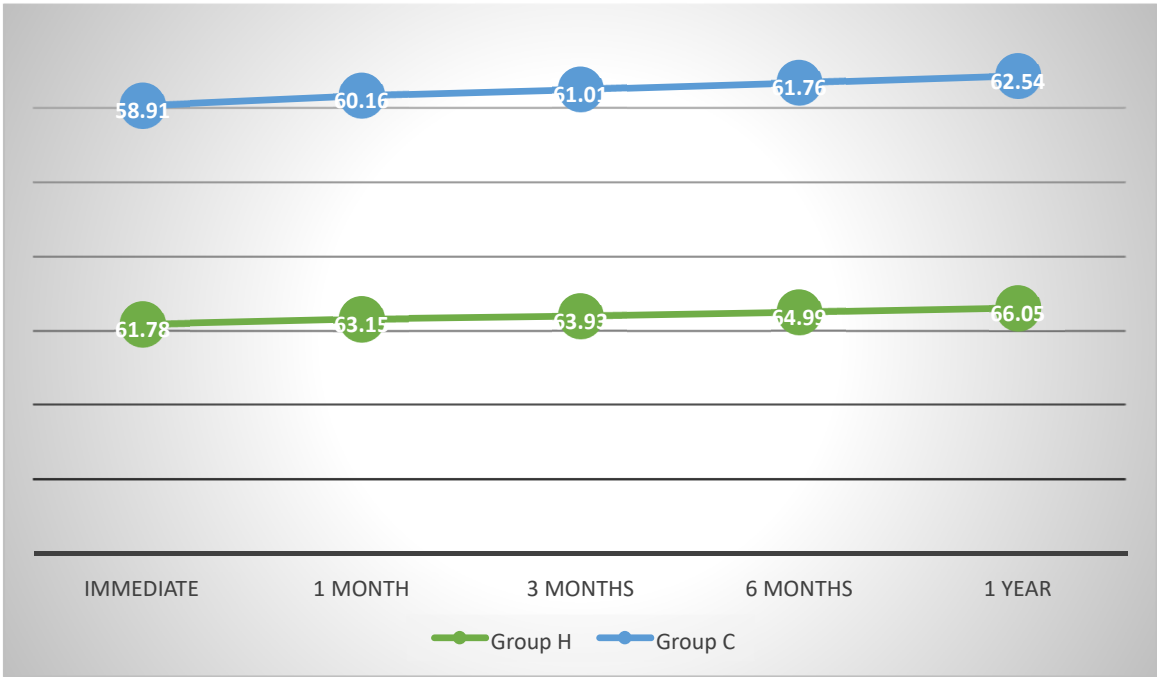
Figure 5: Group H vs Group C on Mean CONSTANT MURLEY Scores

Case Illustrations
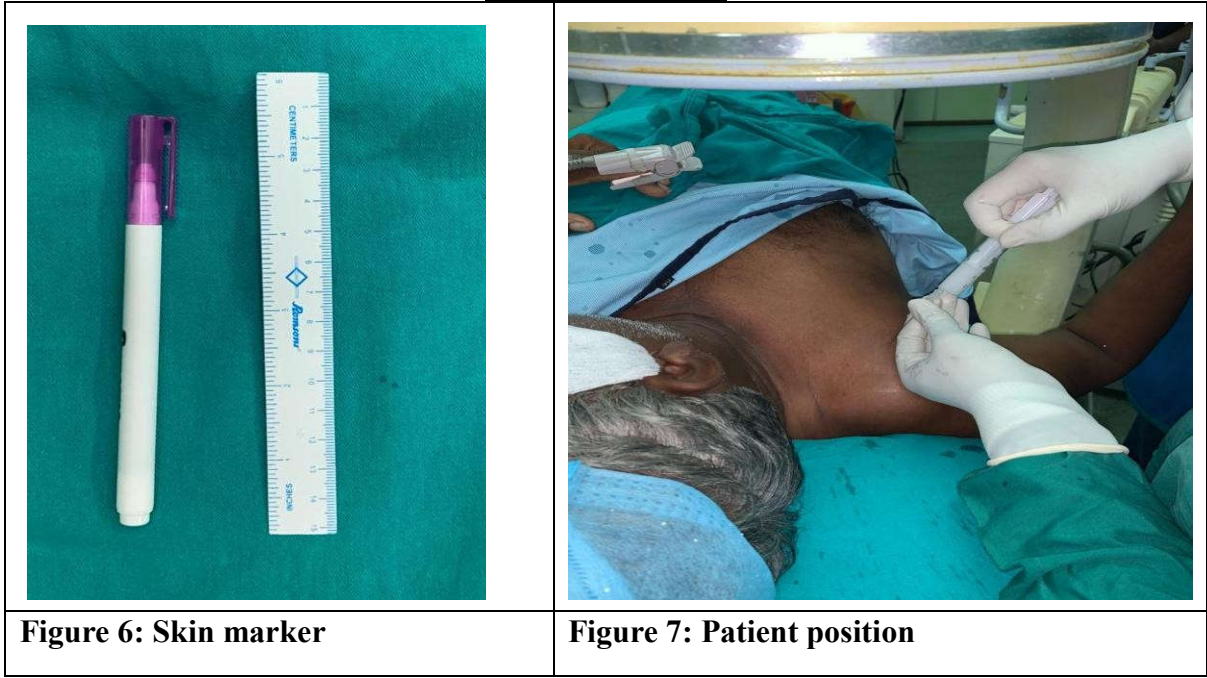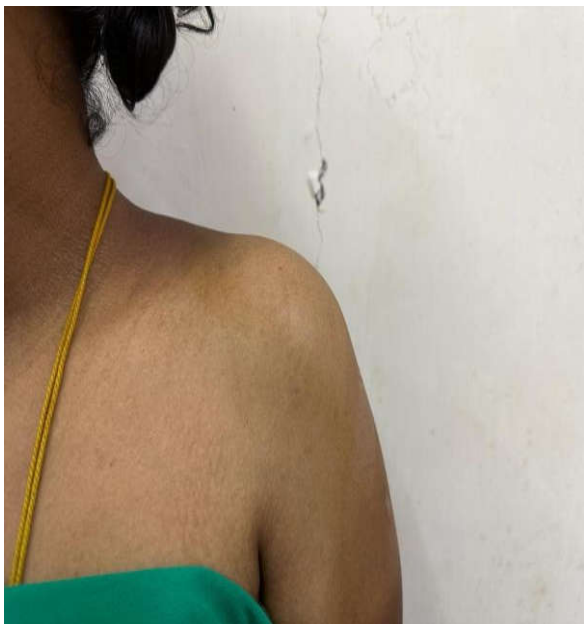
| **Figure 6: Skin marker** | **Figure 7: Patient position** |

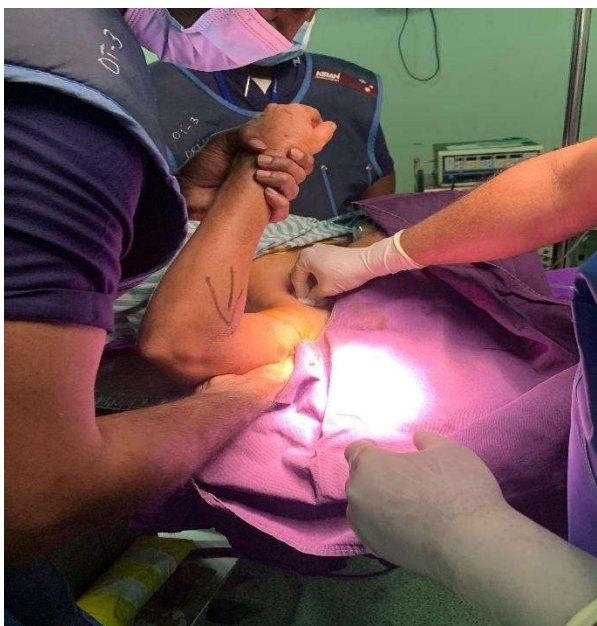| Figure 8: Iohexol dye | Figure 9: Clinical image |

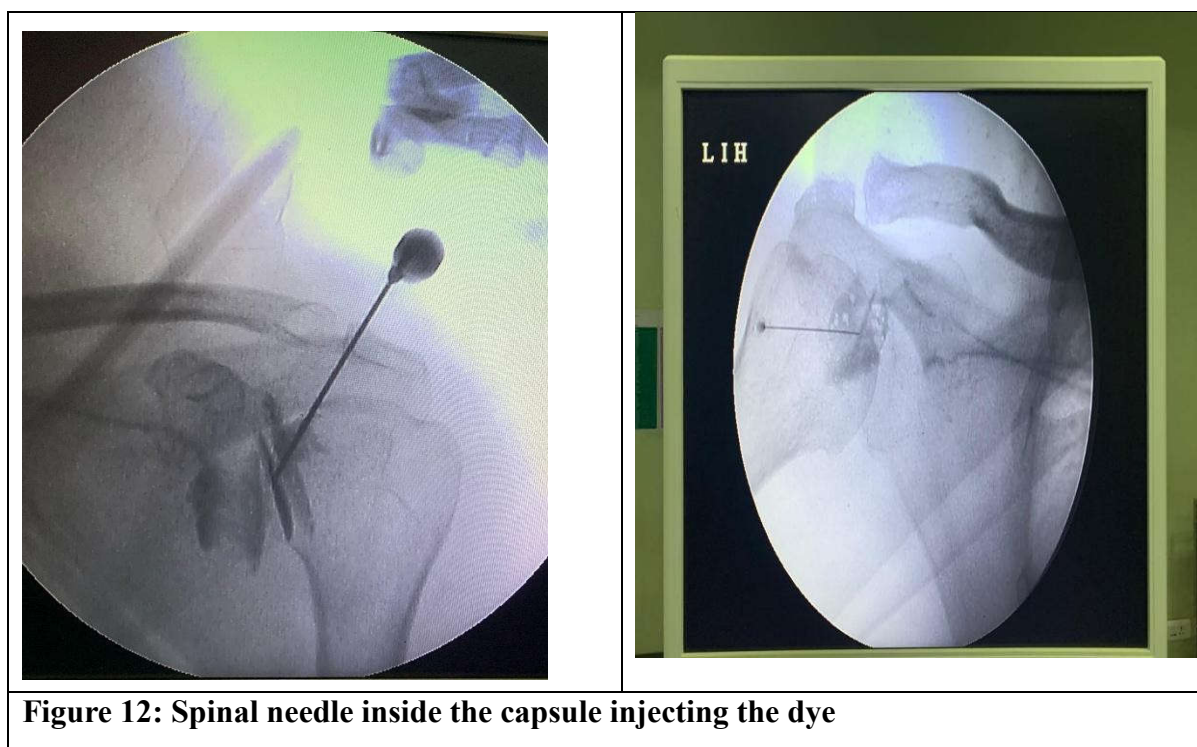| Figure 10: Shoulder ROM | Figure 11: Shoulder C arm |

Figure 12: Spinal needle inside the capsule injecting the dye

Discussion

Current research conducted as Hospital-based, Comparative study in Tertiary Care Hospital in Chengalpattu district, Tamil Nadu. The Patients who presented to the Chettinad Hospital Research Institute Department of Orthopedics with Primary AC (Frozen Shoulder) included in research.

Current research included 72 patients, who had been randomly divided into 2 equal groups of 36, designated as Group H and Group C. Hydrodilatation had been administered to patients in Group H, while patients in Group C received a corticosteroid (triamcinolone) injection.

The pre-injection range of movements flexion, extension, abduction, adduction, internal rotation, and external rotation were ASES in active and passive range of movements and they were found to be almost same in both groups. In group H the mean & Standard deviation of Pre-injection scores of ASES and CMS are 41.45 ± 6.85 and 44.56 ± 6.33. In group C, the mean & Standard deviation of Pre-injection scores of ASES and CMS are 42.38 ± 5.61 and 44.77 ± 5.55. After the procedure, patients were followed up for immediate, 1 month, 3 months, 6 months, and 1 year.

Pre-injection range of movements flexion, extension, abduction, adduction, internal rotation, and external rotation assessed in active and passive modalities. Patients in Group H, that underwent hydrodilatation, exhibited an enhanced range of movements and superior results.

On comparing post-injection ASES Scores among Group H and Group C. The mean ASESS scores were significantly increased among the patients in Group H than the Group C. The patients who received hydrodilation had better range of movements than the patients who had received corticosteroids. In post-injection ASESS scores between Group H & Group C, we found statistically significant at 1 month (0.0403), 6 months (0.0410), and 1 year (0.0471).

On comparing post-injection CMS among Group H and Group C. The mean CMS were significantly increased among the patients in Group H than the Group C. The patients who received hydrodilation had better range of movements than the patients who had received

corticosteroids. In post-injection CMS between Group H & Group C we found statistically significant at 6 months (0.0138) and 1 year (0.0300).

Effectiveness of Hydrodilatation

Hydrodilatation, involving the injection of saline with or without corticosteroids to distend the glenohumeral joint capsule, showed promising results in improving both pain and range of motion (ROM). The mechanism involves mechanical disruption of adhesions, capsular stretching, and possible stimulation of mechanoreceptors to reduce pain. The results suggest that hydrodilatation may provide faster and more sustained improvement in ROM compared to corticosteroids alone. This aligns with prior studies indicating the benefit of addressing both mechanical and inflammatory aspects of adhesive capsulitis.

Efficacy of Corticosteroid Injections

Corticosteroid injections primarily target inflammation within the joint capsule. They demonstrated significant improvement in pain, particularly in the early phases of treatment. However, their effect on ROM was less pronounced compared to hydrodilatation. The findings corroborate existing literature suggesting that corticosteroids are effective in reducing pain but may not address the mechanical restrictions caused by capsular tightness as effectively.

Comparison and Clinical Implications

The study revealed that while both interventions improved pain and function, hydrodilatation had a superior impact on ROM and functional recovery over the medium to long term. This suggests that hydrodilatation may be a better option for patients with significant ROM restrictions who are seeking comprehensive improvement in shoulder function.

Acknowledgments

Conclusion

The effectiveness of corticosteroid injections and hydrodilatation in treating adhesive capsulitis is demonstrated by this comparative study. Range of motion, functional results, and pain alleviation were all markedly improved by both treatments. While corticosteroids provide quicker pain relief during the acute phase, hydrodilatation demonstrated greater advantages in regaining shoulder mobility and long-term functional recovery. According to the results, corticosteroids might be a better choice for people looking for short-term symptom alleviation, whereas hydrodilatation would be a better choice for those who prioritise long-term functional improvement. To maximise clinical results in the management of adhesive capsulitis, a customised strategy that takes into account patient-specific characteristics and treatment objectives is advised. In order to confirm these results and improve treatment procedures, more studies with bigger sample sizes and longer follow-up times are required.

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