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Outcomes of Fluoroscopic-Guided Hydrodilatation for Frozen Shoulder: A Prospective Study

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Abstract

Background and Aim: Frozen shoulder (adhesive capsulitis) is a disabling condition marked by severe pain and restricted movement in the shoulder joint, often leading to functional impairment. Hydrodilation, a minimally invasive procedure where fluid is injected into the joint under pressure, is a treatment option that aims to improve shoulder mobility and reduce pain. This study aims to evaluate the outcomes of Hydrodilation in terms of pain relief, functional improvement, and psychological impact in patients with frozen shoulder. **Methodology:** In this prospective study, 30 patients diagnosed with primary or secondary frozen shoulder were enrolled and underwent Hydrodilation using a saline solution mixed with local anaesthetic agent (0.5% Bupivacaine 5 ml), performed under fluoroscopic guidance. Clinical assessments were performed at baseline (pre-operative), 1 month and 3 months post-procedure. Outcome measures included the Visual Analog Scale (VAS) for pain, the Disability of the Arm, Shoulder and Hand (DASH) score for functional disability, the Shoulder Pain and Disability Index (SPADI) for pain and disability levels, and the Hospital Anxiety and Depression Scale (HADS) to assess psychological well-being. **Results:** The results demonstrated significant improvements in all assessment scores. The mean VAS score decreased from 7.6 ± 1.2 at baseline to 3.1 ± 1.0 at 3 months ($p < 0.01$). The mean DASH score improved from 70.2 ± 12.6 to 35.3 ± 11.8, and SPADI scores dropped from 74.5 ± 13.4 to 39.2 ± 13.2 (both $p < 0.01$). The HADS scores showed a significant reduction in anxiety and depression symptoms, with the average anxiety score dropping from 10.4 ± 4.1 to 3.2 ± 2.6, and depression scores from 8.3 ± 3.9 to 2.8 ± 2.1 ($p < 0.05$). The procedure was well tolerated, with no major complications reported. **Conclusion:** Hydrodilation is a highly effective treatment for frozen shoulder, yielding significant improvements in pain, shoulder function, and psychological well-being. The procedure offers a minimally in-

vasive alternative to surgery with favourable outcomes in reducing both physical disability and psychological distress.

Keywords

Frozen Shoulder, Hydrodilation, SPADI, VAS, DASH, HADS, Fluroscopy

1. Introduction

Frozen shoulder, or adhesive capsulitis, is a common condition characterized by pain, stiffness, and progressive loss of range of motion (ROM) in the shoulder joint. It affects approximately 2% - 5% of the general population, with a higher prevalence in individuals between 40 and 60 years of age. The condition often results in significant functional impairment and discomfort, limiting daily activities and affecting quality of life [1].

Frozen shoulder typically progresses in three stages: the freezing stage (painful phase), the frozen stage (stiffness phase), and the thawing stage (recovery phase). The exact aetiology remains unclear, although it is commonly associated with diabetes mellitus, thyroid disorders, and trauma. While conservative treatments like physical therapy, nonsteroidal anti-inflammatory drugs (NSAIDs), and corticosteroid injections are often first-line approaches, some patients experience persistent symptoms despite these interventions [2] [3].

Hydro dilation, or distension arthrography, is a minimally invasive procedure that involves injecting saline mixed with local anaesthetic into the glenohumeral joint under fluoroscopic guidance [4]. The technique aims to distend the joint capsule, break adhesions, and restore normal shoulder mobility. In recent years, hydro dilation has been gaining traction as an effective intervention for frozen shoulder, particularly for patients who have not responded to conservative treatments [5]. This study aims to evaluate the outcomes of hydro dilation in the management of frozen shoulder, specifically in terms of pain reduction, functional improvement, and psychological well-being.

2. Aim and Objectives

2.1. Aim

To assess the clinical outcomes of hydro dilation in patients with frozen shoulder, focusing on pain relief, functional improvement, and the reduction of anxiety and depression.

2.2. Objectives

1) To evaluate pain reduction using the Visual Analog Scale (VAS) at admission, 1 month, and 3 months post-hydrodilation.

2) To assess functional improvement through the Disabilities of the Arm, Shoulder, and Hand (DASH) score and the Shoulder Pain and Disability Index (SPADI).

3) To evaluate changes in psychological well-being (anxiety and depression) using the Hospital Anxiety and Depression Scale (HADS).

4) To compare the outcomes of hydrodilation with the results of other studies in the literature.

3. Inclusion and Exclusion Criteria

3.1. Inclusion Criteria

- Adults aged 30 - 70 years.
- Diagnosed with idiopathic or secondary frozen shoulder (confirmed clinically and radiologically).
- Symptoms present for at least 6 months.
- Moderate-to-severe pain (VAS ≥ 4 at admission).
- Willing to comply with follow-up visits and rehabilitation protocol.

3.2. Exclusion Criteria

- Previous shoulder surgery or injections within the last 6 months.
- History of shoulder fractures or other joint diseases (e.g., osteoarthritis, rotator cuff tears).
- Active systemic inflammatory diseases such as rheumatoid arthritis.
- Pregnancy or lactation.
- Severe psychiatric or cognitive conditions that may affect the patient's ability to participate in the study.

4. Methodology

This prospective observational study was conducted at BIRRD Hospital, Tirupati from January to June 2024 with follow up of three months. 30 patients with frozen shoulder were enrolled. All the participants underwent hydrodilation. Prior to the procedure, complete hemogram, renal function tests, viral markers and ECG of all the patients were evaluated. The procedure was performed under fluoroscopic guidance. All the patients were analysed for Visual Analog Scale (VAS), Disabilities of the Arm, Shoulder, and Hand (DASH), Shoulder Pain and Disability Index (SPADI) and Hospital Anxiety and Depression Scale (HADS) pre-operatively (baseline), 1 month and 3 months post operatively. The outcomes were hence compared.

4.1. Procedure

The procedure was performed under general anaesthesia to ensure complete patient relaxation, eliminate procedure-related pain, and allow controlled capsular distension without patient guarding. This approach facilitates uniform capsular stretch and effective disruption of adhesions, which may be limited under local anaesthesia or conscious sedation due to discomfort and involuntary muscle contraction.

Under aseptic precautions parts were painted and draped. A 16-gauge needle was inserted in the glenohumeral joint, the intra-articular position was confirmed with 5 ml contrast medium under fluoroscopic guidance (**Figure 1** and **Figure 2**). Hydrodilation was performed by injecting 50 - 70 ml of a mixture consisting of saline solution and 5 ml 0.5% Bupivacaine into the glenohumeral joint (**Figure 3**). The joint was gently distended and manipulated to break any adhesions present. Post-procedure, all patients followed a standardized rehabilitation protocol. Supervised physiotherapy sessions were conducted three times per week for six weeks, focusing initially on passive and active-assisted range-of-motion exercises, including pendulum, cogwheel, forward flexion, and abduction exercises. This was followed by gradual progression to active range-of-motion and strengthening exercises. Patients were also instructed to perform a home-based exercise program twice daily. Compliance was reinforced during follow-up visits.

4.2. Outcome Measures

The following parameters were assessed at baseline (pre-procedure), 1 month, and 3 months after hydro dilation:

1) Pain Score (VAS): A 10-point visual analogue scale was used to measure pain, where 0 = no pain and 10 = worst possible pain [1] [2].

2) DASH Score: The Disabilities of the Arm, Shoulder, and Hand (DASH) score was used to measure functional disability. The score ranges from 0 to 100, with higher scores indicating greater disability [6] [7].

3) SPADI (Shoulder Pain and Disability Index): The SPADI was used to assess pain and disability. It consists of two subscales (pain and disability), each scored from 0 to 100, with higher scores indicating greater pain and disability [8] [9].

4) HADS Score: The Hospital Anxiety and Depression Scale (HADS) was used to assess anxiety and depression levels. It consists of two subscales (anxiety and depression), each scored from 0 to 21, with higher scores indicating greater anxiety and depression [10] [11].

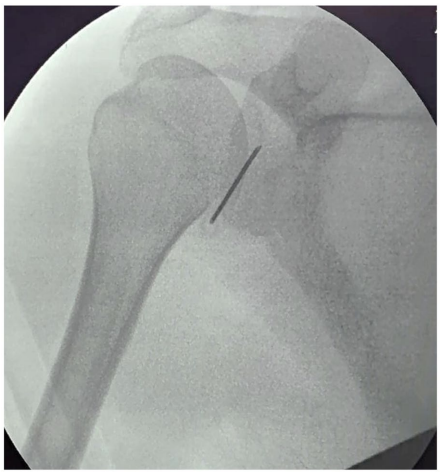

Figure 1. Placement of needle in the joint under fluroscopy.

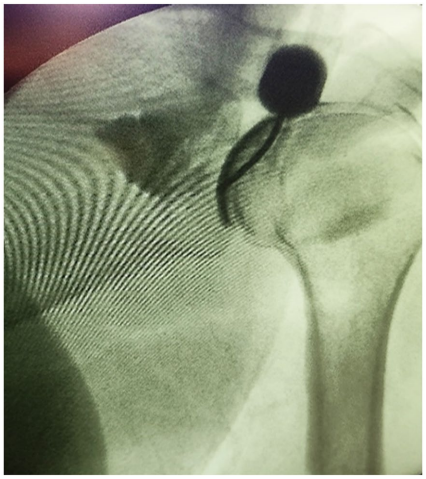

Figure 2. Dye along the rim of glenoid—confirmatory sign of the needle in the joint.

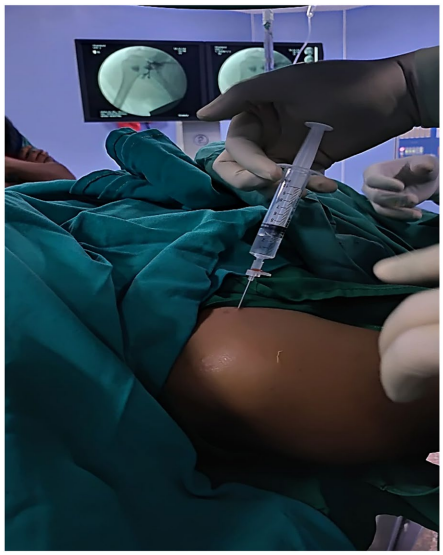

Figure 3. Administration of dye.

4.3. Statistical Analysis

Data was collected and analyzed using paired t-tests to compare the outcomes at different time points (pre-procedure, 1 month, and 3 months). A p value of <0.05 was considered statistically significant. The data were analyzed using SPSS software, version 26.

5. Results

5.1. Demographics

The Mean Age of the patients was 52.3 ± 7.2 years (Table 1). There were predominantly male patients (18, 60%) and the remaining were females. The mean duration of symptoms was 9.2 ± 3.4 months. Pain and stiffness were the major symptoms. Most of the patients had comorbidities like Diabetes—12 (40%), Hypertension—4 (10%) and Thyroid—1 (2.5%).

Table 1. The demographics of the patients enrolled in the study.

Parameters	Value
Mean Age	52.3 ± 7.2 years
Males	18 (60%)
Females	12 (40%)
Duration of Symptoms (Months)	9.2 ± 3.4 months
Co morbidities	17 (56.6%)

Among the study population, 17 patients (56.7%) had secondary frozen shoulder, predominantly associated with diabetes mellitus, while idiopathic frozen shoulder was observed in 13 patients (43.3%) (Table 2).

Table 2. Distribution of frozen shoulder type.

Type	Number (%)
Idiopathic	13 (43.30%)
Secondary	17 (56.70%)

5.2. Pain Score (VAS)

A significant reduction in pain was observed at both 1 month ($p < 0.01$) and 3 months ($p < 0.01$) post-procedure (Table 3).

Table 3. Pain scores (VAS) of the patients recorded.

Time point	Mean VAS Score ± SD	p Value
Pre-Procedure	7.6 ± 1.2	
1 Month	4.2 ± 1.5	$p < 0.01$
3 Months	3.1 ± 1.0	$p < 0.01$

5.3. DASH Score

The improvement in DASH scores was significant at 1 month ($p < 0.01$) and 3 months ($p < 0.01$) (Table 4).

Table 4. The DASH scores of the patients recorded.

Time Point	Mean VAS Score ± SD	p Value
Pre-Procedure	70.2 ± 12.6	
1 Month	47.5 ± 14.3	$p < 0.01$
3 Months	35.3 ± 11.8	$p < 0.01$

5.4. SPADI Score

Significant reductions in SPADI scores were noted at 1 month ($p < 0.01$) and 3 months ($p < 0.01$) (Table 5).

Table 5. The SPADI scores of the participants recorded.

Time Point	Mean VAS Score ± SD	p Value
Pre-Procedure	74.5 ± 13.4	
1 Month	50.7 ± 15.6	$p < 0.01$
3 Months	39.2 ± 13.2	$p < 0.01$

5.5. HADS Score (Anxiety and Depression)

Both anxiety ($p < 0.01$) and depression ($p < 0.01$) scores decreased significantly at 1 month and 3 months post-procedure (Table 6).

Table 6. HADS Score of the patients recorded.

Time Point	Mean HADS Anxiety Score ± SD	p Value	Mean HADS Depression Score ± SD	p Value
Pre-Procedure	10.4 ± 4.1		8.3 ± 3.9	
1 Month	5.1 ± 3.3	<0.0001	4.0 ± 2.7	<0.0001
3 Months	3.2 ± 2.6	<0.0001	2.8 ± 2.1	<0.0001

There was no statistically significant difference in pain reduction or functional improvement between idiopathic and secondary frozen shoulder groups. Hydrodilatation was equally effective in improving VAS, DASH, and SPADI scores irrespective of the underlying etiology (Table 7).

Table 7. Outcome comparison—idiopathic vs secondary.

Parameter	Idiopathic	Secondary	p Value
VAS improvement	4.6 ± 1.1	4.2 ± 1.3	NS
DASH improvement	36.1 ± 9.8	33.4 ± 10.6	NS
SPADI improvement	37.8 ± 10.2	35.1 ± 11.4	NS
VAS improvement	4.6 ± 1.1	4.2 ± 1.3	NS

6. Discussion

The hydrodilation technique has emerged as a non-surgical treatment option for patients suffering from frozen shoulder. It has several advantages over other treatment options, including its minimally invasive nature, quick recovery, and relatively low complication rates. Compared to corticosteroid injections, hydrodilation offers a longer-lasting effect and has been shown to be more effective in improving shoulder function.3. It is also less invasive than shoulder arthroscopy, which carries higher risks and longer recovery times [12].

There was significant improvement in VAS scores in our study which is comparable to other studies. Wang *et al.* in 2021, in a study concluded that hydrodilation resulted in a significant reduction in VAS scores (mean difference: −2.59, 95% CI: −4.56 to −1.87) [13]. The results suggest that hydrodilation effectively allevi-

ates pain compared to conservative treatments like physical therapy and corticosteroid injections. Similarly, another study by Munshi N. *et al.* compared hydrodilation to corticosteroid injections and found that hydrodilation offered superior pain [7].

Sinha R. *et al.* in 2017 reported that hydrodilation resulted in significant improvement in the qDASH score which reduced to 26.82 ($p = 0.001$) on 4 weeks follow up, indicating improved upper limb function and less disability [6]. Their results are consistent with our study which showed significant improvement in DASH scores 1 month and 3 months post procedure.

Similarly, a study conducted by Munshi N. *et al.* and a meta-analysis by Lee *et al.* found that hydrodilation led to a mean reduction in DASH scores indicating clinically meaningful improvements in shoulder function [7] [14].

The improvement in SPADI scores in our study was comparable to studies conducted earlier by Tveitå E.K. *et al.* [8]. They found that hydrodilation significantly reduced SPADI scores, with scores decreasing from 59 to 20 at 6 weeks, suggesting a substantial improvement in both pain and disability. Other RCT by Huang YH *et al.* concluded similar improvements in SPADI scores with fewer complications and faster recovery [9].

Idiopathic versus Secondary Frozen Shoulder: An important aspect of this study is the comparison between idiopathic and secondary frozen shoulder. Secondary frozen shoulder, particularly when associated with diabetes mellitus, is traditionally associated with a more refractory course and inferior outcomes. In the present study, 56.7% of patients had secondary frozen shoulder, predominantly related to diabetes.

Interestingly, improvements in VAS, DASH, and SPADI scores were comparable between idiopathic and secondary groups, with no statistically significant differences. This finding aligns with previous studies suggesting that hydrodilatation remains effective even in diabetic patients, despite the underlying metabolic and fibrotic tendencies. The ability of hydrodilatation to mechanically disrupt capsular fibrosis may partly overcome the pathological processes seen in secondary frozen shoulder, making it a valuable option in this subgroup.

In terms of psychological outcomes, the present study provides important insights into the mental health benefits of hydrodilatation in patients with frozen shoulder. Chronic pain and functional disability associated with adhesive capsulitis are well known to contribute to increased levels of anxiety and depression. By effectively reducing pain and improving shoulder function, hydrodilatation appears to exert a beneficial effect on patients' psychological well-being. This observation is consistent with previous literature highlighting the positive impact of pain relief on mental health outcomes in patients with chronic musculoskeletal disorders [4] [11] [15].

At baseline, the mean HADS anxiety scores in our cohort fell within the borderline to abnormal range, while depression scores approached the upper limit of the normal range, indicating clinically relevant psychological distress. Following

hydrodilatation, both anxiety and depression scores improved to well within the normal range. These findings suggest that the observed improvements were not only statistically significant but also clinically meaningful, underscoring the broader psychosocial benefits of effective pain reduction and functional restoration in frozen shoulder.

Zhao *et al.* (2017) evaluated the psychological impact of hydrodilatation and reported significant improvements in both anxiety and depression scores following treatment [10]. Similarly, Debeer *et al.* (2021) demonstrated that patients undergoing hydrodilatation experienced lower levels of anxiety and depression, likely secondary to improvements in pain and shoulder function, leading to enhanced overall quality of life [11]. The HADS score improvements observed in the present study are consistent with these findings.

7. Conclusions

Hydrodilation is an effective treatment for frozen shoulder, leading to significant reductions in pain, improvements in shoulder function, and reductions in anxiety and depression. This procedure offers a minimally invasive alternative to more invasive surgical interventions and provides substantial relief for patients who have not responded to conservative treatments. Hence, hydro dilation should be considered an important treatment option for patients with refractory frozen shoulder.

Although the present study lacked a control group, the magnitude of improvement observed in VAS and DASH scores compares favorably with outcomes reported for conservative treatments such as intra-articular corticosteroid injections or physiotherapy alone, which typically demonstrate slower and more modest improvements. Hydrodilatation may therefore provide more rapid and sustained symptomatic and functional recovery in patients with refractory frozen shoulder.

8. Limitations

This study is limited by its small sample size and the lack of a control group. Future studies with larger sample sizes and randomized controlled designs are necessary to validate these findings.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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