

Original Research Article

Functional outcome of fluoroscopy-guided hydrodilatation in adhesive capsulitis of the shoulder

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ABSTRACT

Background: Adhesive capsulitis is characterized by shoulder pain and globally restricted movement. While conservative treatments are standard, fluoroscopy-guided hydrodilatation aims to directly enlarge the contracted joint capsule. This study was performed to evaluate the functional outcome, pain relief, and range of motion (ROM) following fluoroscopy-guided hydrodilatation in patients with adhesive capsulitis.

Methods: This prospective interventional study included 52 patients (aged 18-60) with adhesive capsulitis presenting at a tertiary care hospital. Patients underwent fluoroscopy-guided hydrodilatation using a mixture of normal saline, local anesthetic, and steroid, followed by a structured physiotherapy regimen. Outcomes were assessed using the visual analog scale (VAS) for pain, the Oxford shoulder score (OSS), the shoulder pain and disability index (SPADI), and ROM measurements at baseline, 1, 3, and 6 months post-intervention.

Results: The mean patient age was 47.6 years, with a female predominance (65.4%). Post-intervention, significant progressive improvements were observed across all parameters ($p < 0.001$). The mean VAS score decreased from 7.5 pre-intervention to 1.9 at 6 months. Shoulder ROM improved substantially, with abduction increasing from 94.1 to 143.3, and flexion from 97.0 to 147.6. Mean OSS increased from 22.5 to 42.5, indicating restored function. The total SPADI score significantly decreased from 64.98 to 31.00 at the 6-month follow-up.

Conclusions: Fluoroscopy-guided hydrodilatation, followed by structured physiotherapy, is a highly effective intervention for adhesive capsulitis, yielding significant mid-term pain relief, restoration of shoulder mobility, and enhanced functional outcomes.

Keywords: Adhesive capsulitis, Fluoroscopy, Frozen shoulder, Hydrodilatation, Oxford shoulder score, Range of motion

INTRODUCTION

Adhesive capsulitis, commonly known as frozen shoulder, is an inflammatory condition causing shoulder stiffness and pain. It is distinguished by the development of adhesions, scar tissue, and thickening of the shoulder's capsular tissue.¹ The prevalence of frozen shoulder is estimated to be between 2% and 5% in the general population.² Patients usually arrive with severe pain and

decreased glenohumeral joint passive and active range of motion (ROM).³

Many conservative management options are currently available for patients with frozen shoulder, such as analgesia, corticosteroids, physiotherapy, and hydrodilatation. By injecting a significant volume of normal saline into the shoulder joint, hydrodilatation enlarges the shoulder joint capsule. It causes the capsule to widen, and the intended outcome is the capsule rupturing.⁴

Since this specific component of the intervention has not been exhaustively studied, and there is still uncertainty regarding the efficacy of hydrodilatation as a treatment, further study is necessary. The purpose of this research was to evaluate the effectiveness of fluoroscopy-guided hydrodilatation in adhesive capsulitis of the shoulder by assessing pain relief, functional improvement, and range of motion (ROM) post-intervention.

METHODS

A prospective interventional study was conducted over 18 months in the department of orthopedics at a tertiary care teaching hospital. The calculated sample size was 52 patients.

Eligible patients included those aged 18-60 years, presenting with symptomatic shoulder pain persisting for more than 30 days up to 2 years, with greater than a 30-degree restriction in at least two planes of motion (forward flexion, abduction, external rotation, or internal rotation) compared to the contralateral side. Exclusion criteria included patients with prior use of corticosteroids, previous intra-articular injections within 6 months, history of diabetes mellitus, full-thickness rotator cuff tears, or shoulder arthritis.



Figure 1: The standard supine positioning and sterile draping of the patient's affected shoulder required prior to the intervention.

Fluoroscopy-guided hydrodilatation was performed under aseptic precautions. The patient was positioned supine, and local anesthesia was infiltrated. A 23-gauge spinal needle was inserted, and its position was confirmed using radiopaque contrast under fluoroscopy. Following confirmation, a steroid mixture was injected, and hydrodilatation was achieved using normal saline. Post-procedure, all patients were instructed to perform a structured exercise program (ROM, wall-climbing, and pendulum exercises) thrice daily.

Clinical assessments were performed at baseline and at 1, 3, and 6 months post-intervention. Pain was evaluated using the visual analog scale (VAS). Functional

improvement was measured using the Oxford shoulder score (OSS) and the shoulder pain and disability index (SPADI). Changes in shoulder ROM (flexion, abduction, internal, and external rotation) were recorded using a goniometer.



Figure 2: Intraoperative fluoroscopic imaging taken during the procedure, confirming the precise intra-articular placement of the needle.

Data analysis was performed using SPSS version 20.0. A paired t-test was utilized to compare pre- and post-intervention scores, with a p value of <0.05 considered statistically significant

RESULTS

Table 1 summarizes the baseline demographic and clinical characteristics of the 52 patients enrolled in the study. The mean age of the participants was 47.6 ± 7.17 years. There was a clear female predominance, with women comprising 65.4% (n=34) of the study population compared to 34.6% (n=18) men. Clinically, the right shoulder was more frequently affected (67.3%) than the left (32.7%), and patients presented with a mean symptom duration of 8.07 ± 2.03 months prior to the intervention.

Table 1: Demographic and clinical characteristics of the study population.

Characteristics	Value (%)
Total Patients	52
Age (years) (Mean$\pm$SD)	47.6 ± 7.17
Gender	
Male	18 (34.6)
Female	34 (65.4)
Affected side	
Right	35 (67.3)
Left	17 (32.7)
Duration of symptoms (months) (Mean$\pm$SD)	8.07 ± 2.03

Table 2 illustrates the progressive improvements in both pain and functional scores following the hydrodilatation

intervention over a 6-month period. Patients experienced a highly significant reduction in pain, with the mean visual analog scale (VAS) score dropping from a pre-intervention baseline of 7.5 ± 0.9 down to 1.9 ± 0.8 at 6 months ($p < 0.001$). Concurrently, shoulder function demonstrated marked enhancements; the mean Oxford shoulder score

(OSS) increased steadily from 22.5 ± 4.5 to 42.5 ± 6.9 ($p < 0.001$). Similarly, the total shoulder pain and disability index (SPADI) score decreased substantially from 64.98 ± 14.17 before the intervention to 31.00 ± 19.54 at the final 6-month follow-up ($p < 0.001$), reflecting a profound reduction in overall shoulder disability.

Table 2: Improvement in functional and pain scores following intervention over a 6-month period.

Outcome measure	Before intervention (Mean±SD)	1 month (Mean±SD)	3 months (Mean±SD)	6 months (Mean±SD)	P value
VAS Score	7.5 ± 0.9	6.7 ± 0.8	3.5 ± 0.9	1.9 ± 0.8	<0.001
OSS	22.5 ± 4.5	33.7 ± 4.2	38.2 ± 8.3	42.5 ± 6.9	<0.001
Total SPADI	64.98 ± 14.17	44.73 ± 15.04	39.78 ± 15.77	31.00 ± 19.54	<0.001

Table 3: Improvement in shoulder range of motion (ROM) following intervention over a 6-month period.

Range of motion (degrees)	Before intervention (Mean±SD)	1 month (Mean±SD)	3 months (Mean±SD)	6 months (Mean±SD)	P value
Abduction	94.1 ± 6.5	113.5 ± 12.5	130.2 ± 15.4	143.3 ± 12.1	<0.001
Flexion	97.0 ± 14.6	117.9 ± 12.7	133.8 ± 15.9	147.6 ± 16.5	<0.001
External rotation	29.8 ± 4.2	48.9 ± 15.4	59.5 ± 4.2	65.2 ± 3.6	<0.001
Internal rotation	23.9 ± 2.0	46.5 ± 6.5	68.4 ± 5.9	80.3 ± 8.1	<0.001

Table 3 details the substantial and progressive improvements in shoulder range of motion (ROM) across all assessed planes following the intervention. Statistically significant gains were achieved at each follow-up interval ($p < 0.001$). Specifically, the mean shoulder abduction angle increased from a pre-intervention baseline of 94.1 ± 6.5 degrees to 143.3 ± 12.1 degrees at 6 months. Similarly, flexion improved from 97.0 ± 14.6 degrees to 147.6 ± 16.5 degrees. Rotational mobility also demonstrated marked recovery, with external rotation increasing from 29.8 ± 4.2 degrees to 65.2 ± 3.6 degrees, and internal rotation expanding from 23.9 ± 2.0 degrees to 80.3 ± 8.1 degrees by the final 6-month follow-up.

DISCUSSION

The present study demonstrated that fluoroscopy-guided hydrodilatation, combined with a structured physical therapy regimen, is highly effective in managing adhesive capsulitis, yielding significant mid-term pain relief, restoration of shoulder mobility, and enhanced functional outcomes.

The demographic profile of our cohort, characterized by a higher prevalence in females and a middle-aged distribution, is consistent with existing epidemiological literature on frozen shoulder.³

We observed a dramatic and sustained reduction in pain intensity as measured by the VAS, alongside profound improvements in functional indices (OSS and SPADI). The mechanical distension achieved by hydrodilatation likely plays a crucial role in rupturing capsular adhesions,

directly improving glenohumeral mobility, while the intra-articular steroid minimizes the inflammatory process.⁴

Our findings align with several previously published studies evaluating hydrodilatation. The dramatic reduction in the VAS pain score mirrors the results reported by Paruthikunnan et al, who noted similar significant pain relief following capsular distension.⁸

The improvements observed in functional scores (OSS and SPADI) reflect the outcomes described by Ahmad et al and Tveit et al and Paruthikunnan et al all of them concluded that hydrodilatation facilitates rapid functional restoration and reduces overall shoulder disability.⁶⁻⁸

As outlined in Table 4, our improvements in the Oxford Shoulder Score (OSS) closely parallel those documented by Ahmad et al over the same follow-up period.⁷ Similarly, Table 5 illustrates that our baseline and follow-up SPADI scores are highly comparable to the substantial functional gains reported by both Tveit et al and Paruthikunnan et al.^{6,8}

Table 4: Comparison of OSS with other study.

Timepoint	Present study (Mean±SD)	Ahmad et al ⁷ (Mean±SD)
Pre-intervention	22.5 ± 4.5	22.2 ± 4.4
1 month after intervention	33.7 ± 4.2	33.5 ± 4.1
6 months after intervention	42.5 ± 6.9	42.8 ± 6.8

Gam et al previously demonstrated that patients receiving both distension and steroids exhibited superior ROM recovery compared to those receiving steroids alone, a finding strongly supported by the progressive mobility gains recorded across all planes in our study.⁵

Furthermore, our results are in strong agreement with Kumar et al, who reported significant functional outcome improvements following hydrodilatation and intra-articular steroid injections.⁹

Clement evaluated the long-term outcomes of arthrographic distension, noting substantial improvements in shoulder function that align with our mid-term findings.¹⁰

Debeer et al found that hydrodilatation positively influences both physical outcomes and psychological factors like kinesiophobia, supporting the holistic benefit of the procedure.¹¹

Additionally, Subramanyam et al assessed hydrodilatation combined with viscosupplementation, demonstrating it to be an effective day-care procedure for rapid functional recovery, which is highly consistent with our observations.¹²

A key component of this success was the mandatory adherence to a structured post-operative physiotherapy program, emphasizing the synergistic effect of mechanical capsule release followed by guided mobilization to prevent re-adhesion.

The limitations of our study include the lack of a control group and the exclusion of diabetic patients, which limits the generalizability of these outcomes to that specific high-risk subgroup. Nevertheless, the consistent, statistically significant improvements validate fluoroscopy-guided hydrodilatation as a robust and reliable intervention for recalcitrant adhesive capsulitis.

Table 4 provides a comparative analysis of the Oxford shoulder score (OSS) outcomes from the present study against the findings reported by Ahmad et al.⁷ The baseline OSS in our study group (22.5 ± 4.5) was highly comparable to that of Ahmad et al (22.2 ± 4.4).⁷ At both the 1-month and 6-month follow-up intervals, the trajectory of functional recovery closely mirrored their reported results, with our 6-month OSS (42.5 ± 6.9) aligning almost identically with theirs (42.8 ± 6.8). This direct comparison highlights the consistency and predictability of functional restoration following fluoroscopy-guided hydrodilatation.

Table 5: Comparison of SPADI with other study.

Study Group	Tveitå et al (DIL group) ⁶	Tveitå et al (INJ group) ⁶	Paruthikunnan et al ⁸	Present study
Baseline SPADI (Mean±SD)	59±20	63±20	68.6±9.0	64.98±14.17
Follow-up SPADI (Mean±SD)	20±17	26±19	25.7±21.0	31.00 ± 19.54 (at 6 months)

Table 5 compares the shoulder pain and disability index (SPADI) scores from the present study with similar hydrodilatation studies conducted by Tveitå EK et al and Paruthikunnan et al.^{6,8} The baseline SPADI score in our study group (64.98 ± 14.17) was consistent with the baseline disease severities observed in both the DIL (59 ± 20) and INJ (63 ± 20) groups of Tveitå et al, as well as the cohort of Paruthikunnan et al (68.6 ± 9.0).^{6,8} Following the intervention, our 6-month follow-up SPADI score (31.00 ± 19.54) demonstrated substantial functional recovery, maintaining a trajectory of improvement that is highly comparable to the significant reductions in disability reported across these established reference studies.

CONCLUSION

Fluoroscopy-guided hydrodilatation, followed by structured physiotherapy, is a highly effective intervention for adhesive capsulitis, yielding significant mid-term pain relief, restoration of shoulder mobility, and enhanced functional outcomes. By demonstrating rapid and sustained improvements across multiple objective parameters, this study advances the current understanding of minimally invasive management for frozen shoulder,

offering a reliable, time-efficient alternative for alleviating prolonged morbidity.

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