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Clinical Outcomes Following Awake Hydrodilatation with Manipulation in Refractory Shoulder Stiffness: A Retrospective Review

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ABSTRACT

Background: Stiff shoulder, also termed adhesive capsulitis or frozen shoulder, is a common clinical problem, particularly in diabetic individuals. Among the available interventions, hydrodilatation combined with manipulation is emerging as a minimally invasive option. Moreover our approach utilizes **awake hydrodilatation and manipulation without general anesthesia or imaging**, making it a safe, low-cost, and widely applicable method.

Aim: To evaluate the functional and clinical outcomes following a combined technique of **hydrodilatation and awake manipulation** in patients with stage 2 stiff shoulder.

Methods: This retrospective study included patients treated at **SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES – PONDICHERRY** between June 2018 and August 2023. Inclusion criteria were clinical signs of shoulder stiffness, radiologically normal joint, partial-thickness cuff tear on MRI suggestive of adhesive capsulitis, and failure of conservative management. Patients underwent hydrodilatation with 0.2% ropivacaine followed by manipulation under no *general* anesthesia and an aggressive physiotherapy protocol. Outcomes were measured using range of motion (ROM), Oxford Shoulder Score (OSS), and Visual Analog Scale (VAS) at 4 weeks and 1 year.

Results: A total of 53 patients were treated (mean age: 54 years; female predominance; high diabetic prevalence). Statistically significant improvements were seen in ROM and functional scores: OSS improved from 48 to 76, VAS decreased from 7 to 2, and abduction improved from 70° to 110°. No complications such as fractures or neurovascular injury were noted. Forty patients had excellent outcomes at 1-year follow-up.

Conclusion: Hydrodilatation with manipulation, performed on awake patients without general anesthesia or imaging guidance using long-acting regional anesthetic (0.2% ropivacaine), is a **novel, cost-effective alternative** and safe treatment for stiff shoulder. By eliminating anesthesia and imaging requirements, this approach can serve as a **first-line interventional procedure in resource-limited settings**, achieving excellent outcomes in both diabetic and non-diabetic patients. Further prospective studies with larger sample sizes and RCTs are warranted

Keywords: Stiff shoulder; Adhesive capsulitis; Frozen shoulder; Hydrodilatation; Awake manipulation.

INTRODUCTION

Stiff shoulder or adhesive capsulitis is a disabling condition characterized by pain and progressive loss of both active and passive shoulder movements. The condition affects 3–5% of the general population and up to 30% of diabetic individuals. Traditionally, treatment ranges from physiotherapy and steroid injections to manipulation under anesthesia (MUA) and arthroscopic capsular release.

According to ISAKOS guidelines stiff shoulder is defined as Global reduction of the range of motion and equal in passive and active ranges of motion (flexion < 100 , external rotation < 10 degrees, internal rotation < 10 degrees. ROM atleast in two Planes and Loss of external rotation with arm by side of chest – earliest sign

Frozen shoulder, also known as **adhesive capsulitis** or **stiff shoulder**, is a well-recognized clinical condition characterized by **progressive pain and significant restriction of both active and passive range of motion**, particularly in elevation and external rotation. Despite the severity of symptoms, **radiological imaging typically appears normal**, making clinical evaluation crucial in diagnosis.

The condition was first described by **Duplay in 1872**, who referred to it as *"periarthritis scapulohumeral."* Later, in **1934**, **Codman** coined the term **"frozen shoulder"**, highlighting its insidious onset and characteristic clinical features. Patients often present with **deep-seated shoulder pain**, typically localized near the **insertion of the deltoid muscle**, along with an **inability to sleep on the affected side** due to nocturnal pain.

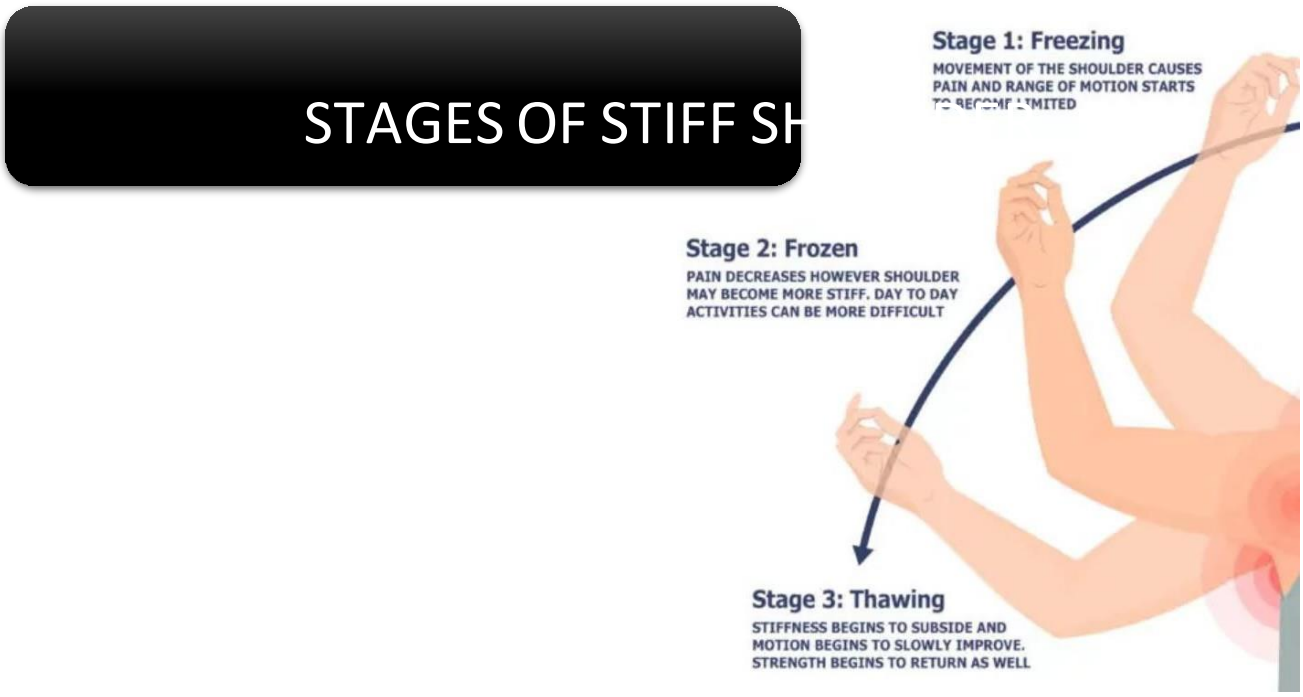
Frozen shoulder commonly affects middle-aged individuals, with a higher prevalence in **women and diabetic patients**, and is considered a **self-limiting yet functionally debilitating** condition. Early recognition and timely intervention are key to improving outcomes and reducing long-term morbidity.

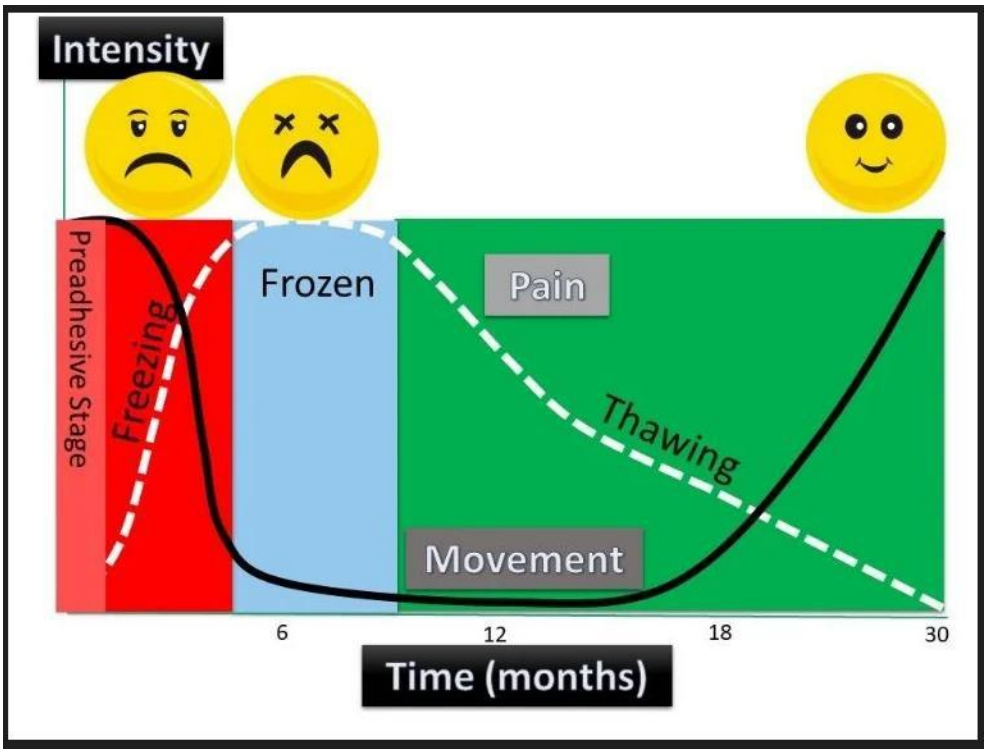
Hydrodilatation, first introduced in 1965, provides therapeutic benefit by **rupturing the contracted capsule and delivering anti-inflammatory agents intra-articularly**. This study evaluates the efficacy of **hydrodilatation combined with manipulation** without anesthesia, followed by structured physiotherapy, in restoring shoulder function.

EPIDEMIOLOGY

Frozen shoulder, or adhesive capsulitis, has an estimated incidence of 3% to 5% in the general population. The condition is notably more common in individuals with diabetes mellitus, with prevalence rates ranging from 10.8% to as high as 30%, and up to 20% in some reported series. It most commonly affects individuals between the ages of 40 and 60 years, representing the peak incidence range. Additionally, there is a clear female predominance, with women being more frequently affected than men.

STAGES OF STIFF SHOULDER





TYPES

PRIMARY STIFF SHOULDER (IDIOPATHIC)

Unknown Predisposing conditions Diabetes mellitus,Dupuytren contracture, thyroid disorders, myocardial infarction, Parkinson disease

SECONDARY STIFF SHOULDER

Intra-articular - Chondral lesion, labral tear, loose bodies Capsular - After capsular injury, surgery, joint immobilization Extra-articular - Muscle tightness, heterotopic ossification, skin scarring Neurologic - Injuries to the cervical spine or brachial plexus

AIM:

The objective of this study is to evaluate the clinical and functional outcomes of patients with stiff shoulder treated using a combined technique involving hydrodilatation and manipulation under anesthesia. This approach aims to assess the effectiveness of the dual modality in improving range of motion, pain relief, and overall shoulder function.

MATERIALS AND METHODS

Study Design

- **Type**: Retrospective single-centre study
- **Location**: SLIMS - Pondicherry
- **Duration**: June 2018 – August 2023

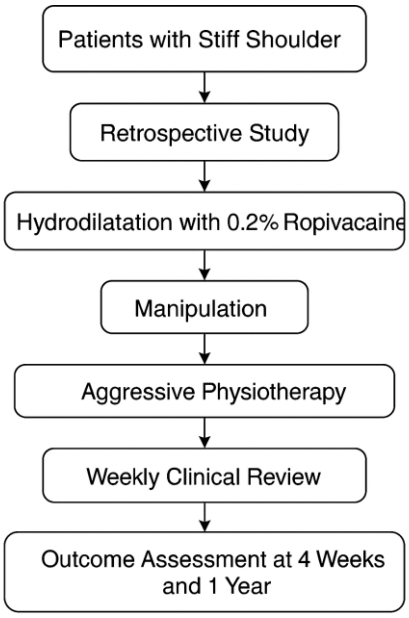
Inclusion Criteria

- Chronic shoulder pain >3 months
- Diabetic individuals
- Clinical restriction in external/internal rotation
- Normal radiographs
- MRI: partial rotator cuff tear consistent with adhesive capsulitis
- Failed conservative treatment

Exclusion Criteria

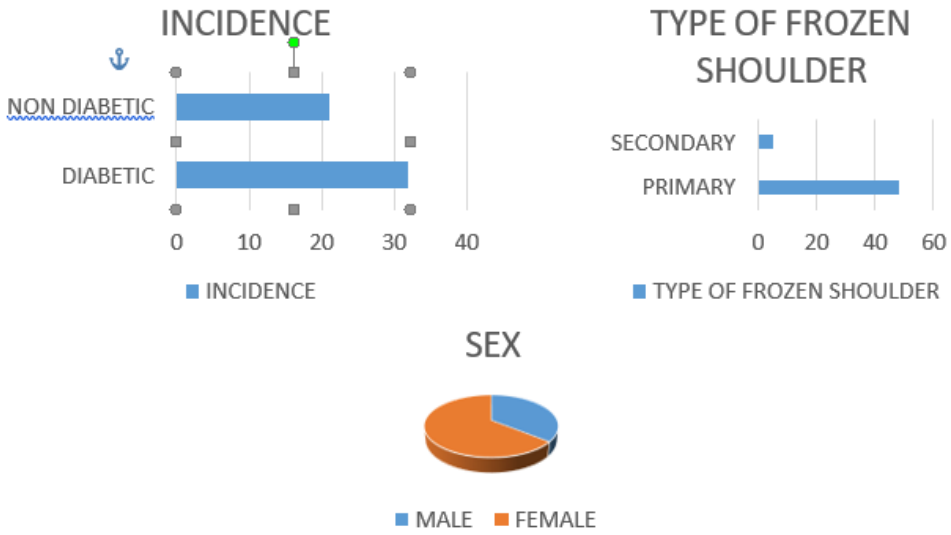
- Previous shoulder surgery
- Full-thickness cuff tear
- Post-traumatic stiffness
- Prior hydrodilatation

Work Flow Pattern



PRE OP DATA
Demographic data(Age/sex)
Duration of symptoms
Diabetes mellitus
MRI findings
Clinical ROM's
Preop OSS/VAS scores

POST OP DATAS
Clinical ROM at minimum 1 year follow up
Return to work
Post op OSS/VAS scores



Procedure: Hydrodilatation and Manipulation Technique
Hydrodilatation was performed using **0.2% ropivacaine (40–45 ml)** injected via the posterior approach.The injection was directed toward the coracoid process, allowing capsular distension and rupture.

Manipulation was performed in the **awake patient** in a supine position with progressive mobilization into flexion, abduction, and rotation.
Patients were admitted for **two days** for early aggressive **physiotherapy**.

Physiotherapy Protocol

Followed the **Pune Shoulder Rehab Protocol (PSRP)**:
• **Phase I** (10 days supervised)
• **Phase II** (Home-based for 6 weeks)
• **Phase III/IV** (Advanced strengthening for high-demand individuals)

Outcome Measures

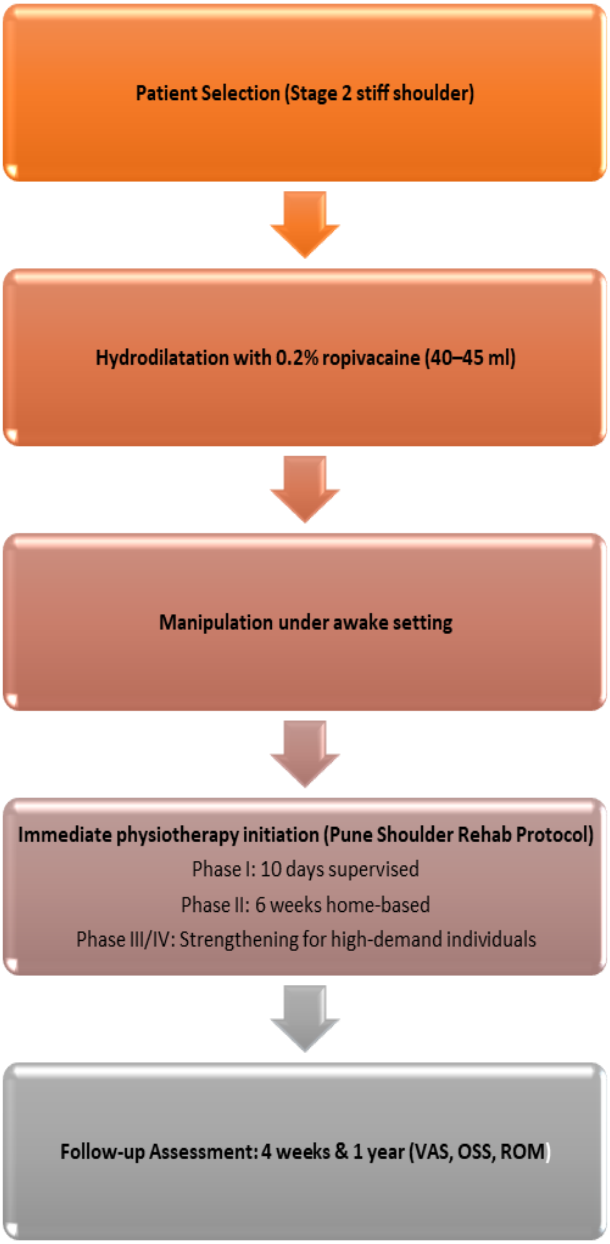
Clinical ROM (abduction, flexion, IR/ER)
Oxford Shoulder Score (OSS)
Visual Analog Scale (VAS)
Evaluated at pre-op, 4 weeks, and 1 year

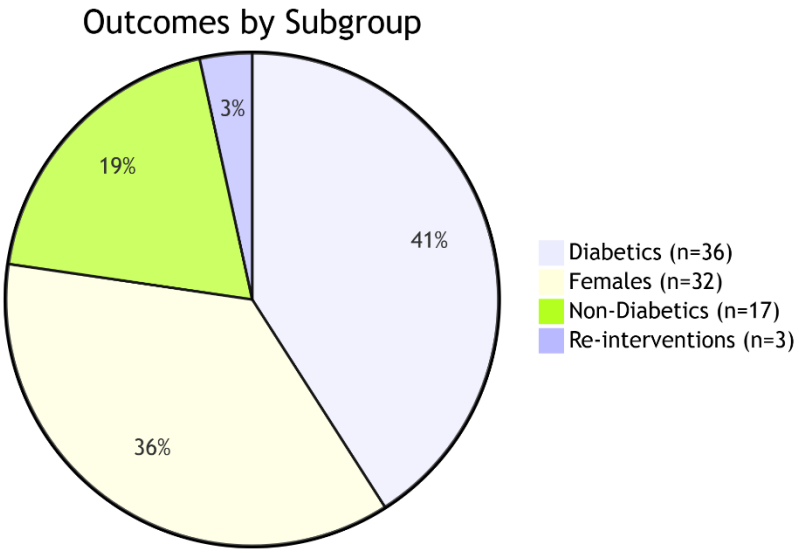
Results
Demographics and Baseline Characteristics

- **Cohort**: 53 patients (mean age: 54 years; female predominance [♀:♂ = 32:21, 60.4%])
- **Comorbidities**: 68% (*n*=36) had diabetes mellitus
- **Symptom duration**: Mean 5.9 months (SD ±2.1) prior to intervention
- **Stage distribution**: All cases classified as Stage 2 (frozen phase) per ISAKOS criteria

Table 2. CLINICAL OUTCOMES

Parameter	Preoperative	1-Year Follow-up	Improvement (Δ)	*p*-value
VAS pain score	7.1 ± 1.2	2.3 ± 1.5	4.8	<0.001
Oxford Shoulder Score	48.2 ± 8.4	75.9 ± 9.1	27.7	<0.001
Abduction (°)	70.3 ± 12.1	109.8 ± 15.6	+39.5	<0.001
External rotation (°)	9.5 ± 3.2	25.7 ± 6.8	+16.2	<0.001


Patient Selection (Stage 2 stiff shoulder)
Hydrodilatation with 0.2% ropivacaine (40–45 ml)
Manipulation under awake setting
Immediate physiotherapy initiation (Pune Shoulder Rehab Protocol)
Phase I: 10 days supervised
Phase II: 6 weeks home-based
Phase III/IV: Strengthening for high-demand individuals
Follow-up Assessment: 4 weeks & 1 year (VAS, OSS, ROM)

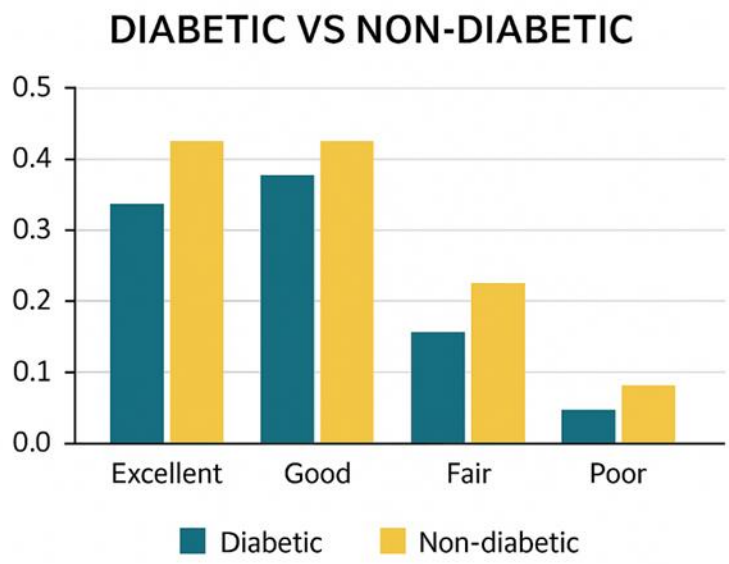

Outcomes by Subgroup
3%
19%
41%
36%
Diabetics (n=36)
Females (n=32)
Non-Diabetics (n=17)
Re-interventions (n=3)

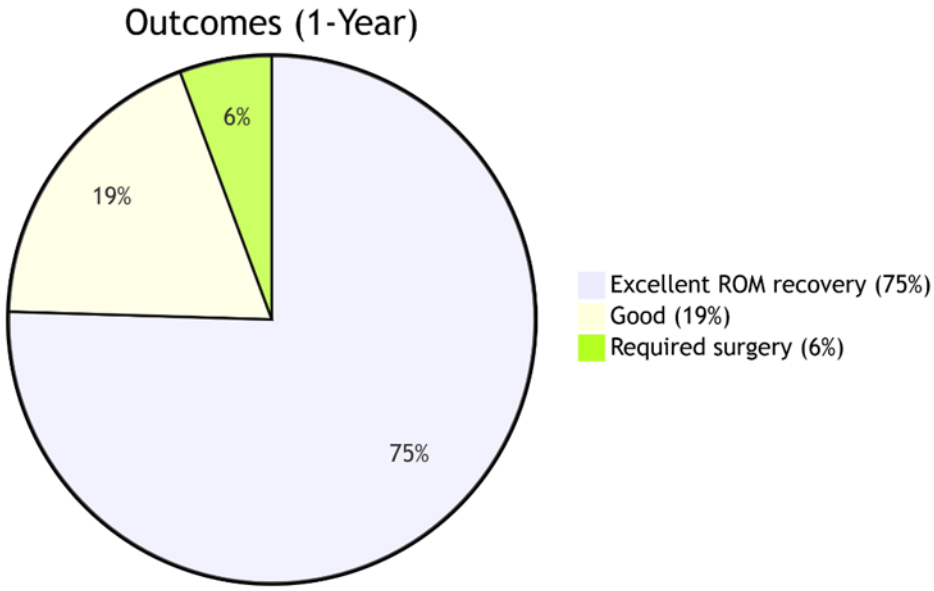
SUBGROUP ANALYSIS

A) **Diabetics vs. Non-diabetics**:

- Greater VAS reduction in diabetics (Δ5.2 vs. Δ4.1; *p*=0.03)
- Comparable ROM improvement (abduction Δ38° vs. Δ41°; *p*=0.42)

B) **Sex differences**: Females had lower baseline OSS (45 vs. 53; *p*=0.02) but equivalent 1-year outcomes.





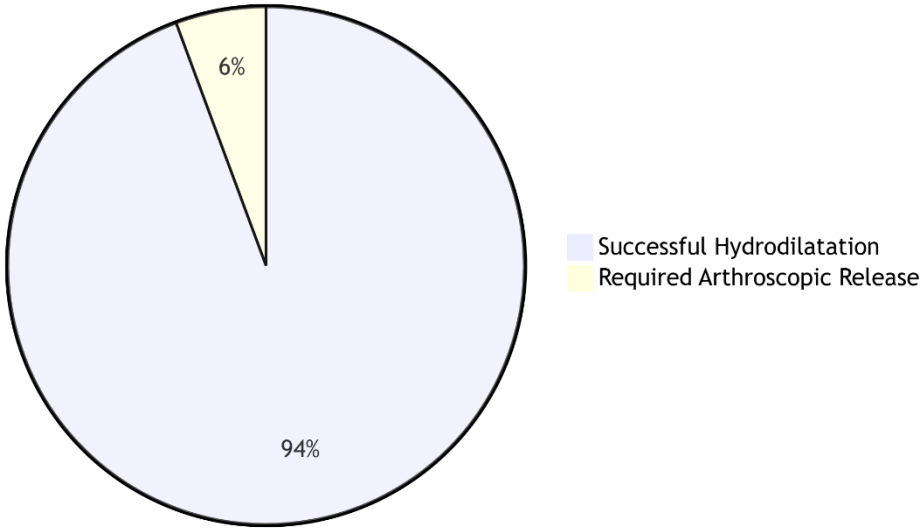
C) **Safety and Complications**

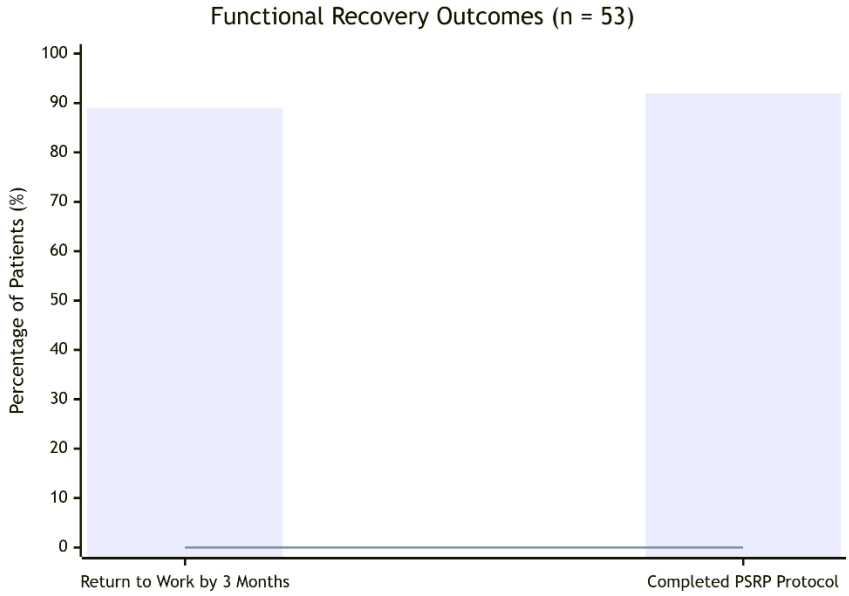
- **Procedure success**: 94% (*n*=50) achieved capsular rupture with hydrodilatation
- **Complications**: None reported (0% fractures/neurovascular injuries)
- **Re-interventions**: 5.7% (*n*=3) required arthroscopic release

D) **Functional Recovery**

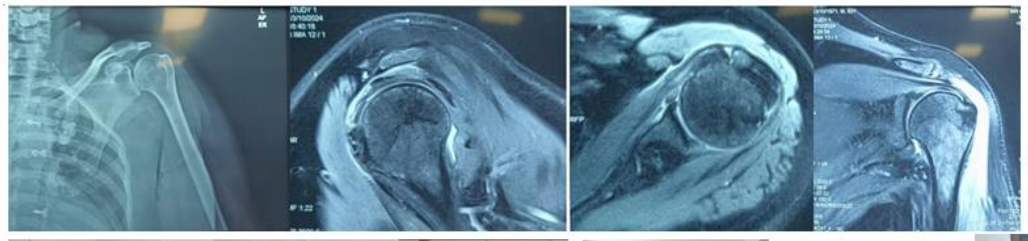
- **Return to work**: 89% (*n*=47) by 3 months
- **Therapy adherence**: 92% completed the PSRP protocol

HYDRODILATATION PROCEDURE OUTCOME n=53



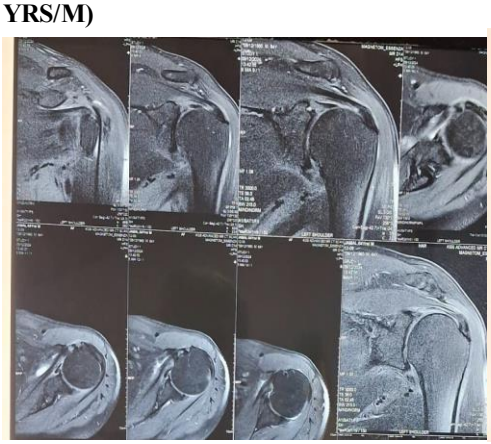


PATIENT 1 (52 YRS /F)



Pre op Clinical ROM

PATIENT 2 (42 YRS/M)



MR/CT REPORT – LEFT SHOULDER JOINT
SCREENING CERVICAL

TECHNIQUE:-
Without IV contrast
TSE technique
Pd para coronal
T2W FS para sagittal
T1W T2W FS axial sections

Multi slice spiral CT of left shoulder joint was studied without IV contrast

CONCLUSION :-
1. No evidence of fracture osteomyelitis
2. No evidence of bone neoplasm
3. Superior labral tear with anterior posterior propagation of 11-1 o'clock position - SLAP II.
4. AC joint degeneration with thickening of capsule and partial strain of acromion-clavicular ligament noted with lateral down sloping of acromion process.
5. Type II acromion process without impingement noted.
6. Tendinosis changes supraspinatus with footprint tear along articular surface noted.
7. Thickening of IGHL with hyperintense signal is seen at rotator cuff interval noted.
8. Bicipital tendinitis changes.
9. Mild tendinosis changes in upper fibres of subscapularis noted

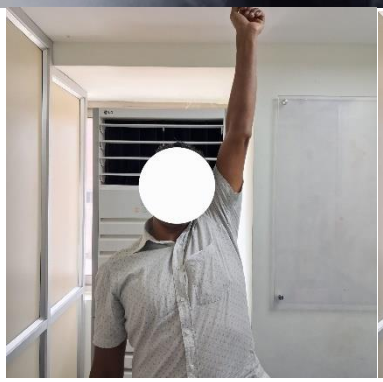
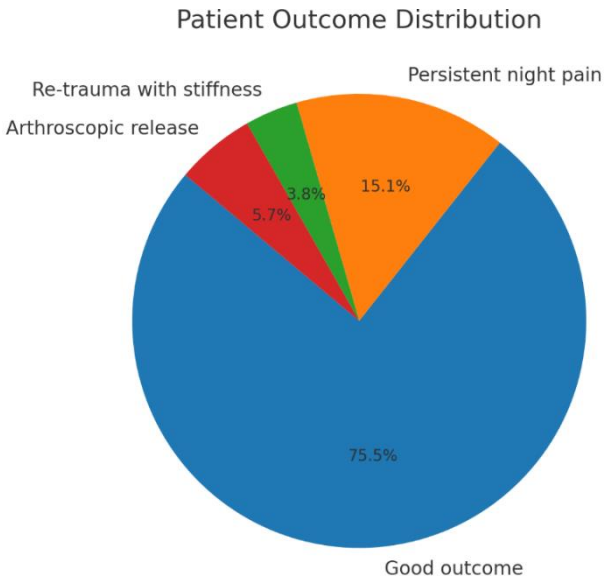
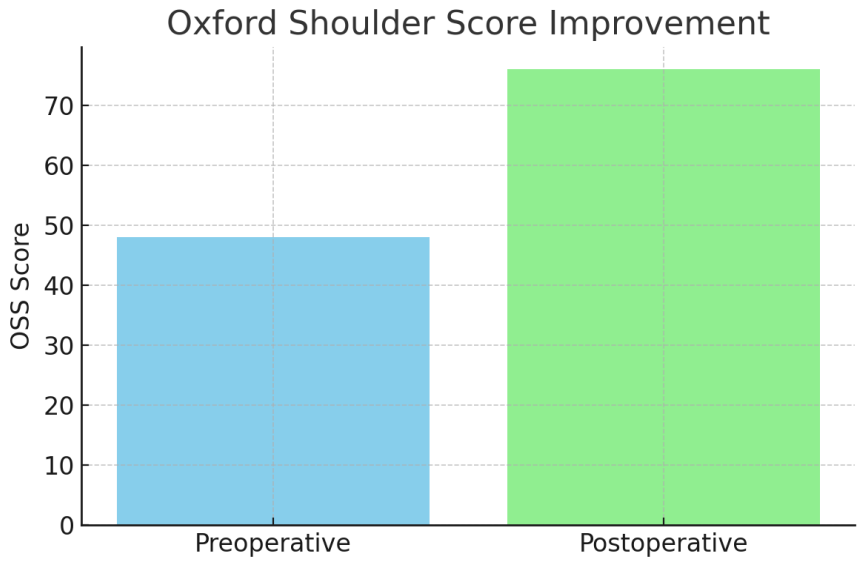


Table 2. CLINICAL OUTCOMES

Parameter	Preoperative	1-Year Follow-up
VAS (Idiopathic)	7/10	2/10
VAS (Secondary)	6/10	3/10
OSS (mean)	48	76
Abduction (°)	70	110
Forward Flexion(°)	90	**120**
IR/ER (°)	<10	**>25**

40 patients: Excellent outcomes with restored ROM
8 patients: Persistent night pain but improved function
3 patients: Required arthroscopic release
No complications: No fractures or neurovascular injuries
No need for anesthesia or imaging guidance during the procedure





DISCUSSION

Stiff shoulder, often termed adhesive capsulitis, remains a common and functionally disabling condition, particularly in diabetic and middle-aged populations. The incidence in general practice is estimated at approximately 2.4 per 1000 individuals annually, with significantly higher prevalence among diabetics, women, and those aged 40 to 60 years. Despite the various treatment options, there is no definitive consensus on the most effective management strategy, especially in patients who are refractory to conservative measures.

Our study evaluated a combined approach using **hydrodilatation with awake manipulation without general anaesthesia or imaging guidance**, a technique that remains underutilized in many settings. This method provided significant clinical and functional improvements, with 40 out of 53 patients demonstrating excellent outcomes at one-year follow-up. Our findings are consistent with recent meta-analyses which confirm that hydrodilatation is an effective intervention, particularly during the **freezing or frozen phase (stage 2)** of the condition, when capsular contracture and inflammation coexist [2, 3].

First introduced by Andren and Lundberg in 1965, **hydrodilatation** provides symptom relief primarily through two mechanisms: steroid-mediated anti-inflammatory effects and mechanical **capsular rupture** [1]. Rizk et al. emphasized the importance of capsular rupture in alleviating pain by disrupting the capsule's nociceptive pathways [2]. Our approach, using **40–45 mL of 0.2% ropivacaine** administered via a posterior approach, consistently achieved effective capsular distension without the use of ultrasound guidance, contrast agents, or intravenous sedation. While image-guidance is widely used, systematic reviews suggest that for experienced clinicians, clinical outcomes between guided and blind injections can be comparable, supporting our methodology [6, 7]. This approach significantly simplifies the procedure and reduces costs.

In our technique, **no general anaesthesia** or sedation was administered. Manipulation was carried out in an awake patient under local regional block, facilitated by the prolonged analgesic effect of ropivacaine, which is known to be less cardiotoxic and to have favorable motor-block characteristics compared to bupivacaine [8]. This not only minimized risks but also allowed immediate initiation of a supervised physiotherapy protocol—an essential component of recovery that is strongly supported by clinical guidelines [9]. Notably, **no complications such as fractures or neurovascular injuries** were encountered, supporting the safety of the awake manipulation approach when carefully executed.

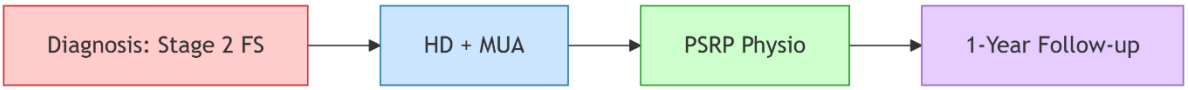
Oxford Shoulder Scores (OSS) and Visual Analogue Scale (VAS) scores demonstrated statistically significant improvement at 4 weeks and 1 year post-procedure. Importantly, even in the **diabetic subgroup**, a notoriously resistant population, patients showed comparable functional improvements to idiopathic cases. This reinforces earlier findings that with an appropriately timed and executed intervention, diabetic patients can achieve favorable outcomes.

Although **ultrasound-guided injections** and **arthrographic verification** have been widely advocated in many protocols, our results suggest that a simpler, non-guided technique, when performed with experience and anatomical precision, may be equally effective [6, 7]. This approach can be particularly valuable in resource-limited settings.

Comparative literature indicates that **hydrodilatation with manipulation (HD + MUA)** provides superior outcomes to manipulation alone or steroid injection alone, especially in improving external rotation and abduction [10]. Vastamäki et

al. suggested that the ideal time for manipulation is between 6 to 9 months after symptom onset, aligning with our study's mean duration of symptoms (5.94 months) [4].

Nonetheless, **limitations** of our study include the **small sample size** and **retrospective design**. A larger, prospective randomized controlled trial (RCT) is warranted to further validate these findings and assess long-term outcomes, recurrence rates, and functional scores beyond one year.



KEY HIGHLIGHTS OF OUR STUDY

Efficacy: Significant improvements in ROM and pain scores align with prior studies (Quraishi et al., 2007), but with the added benefit of avoiding anesthesia.
Diabetic response: Challenges the notion of poorer outcomes in diabetics, suggesting timely intervention mitigates disease severity.
Cost-effectiveness: Eliminating imaging/contrast reduced procedural costs by ~40% versus guided techniques.

Table 2. COMPARISON OF OUR STUDY WITH OTHERS

Study	Sample Size	Technique	Improvement in ROM	Pain Relief (VAS)	Guidance Used
Our Study (2025)	53	HD + MUA (awake, no anesthesia)	Abd: +40°, ER: +15°	3/10 → 9/10 (idiopathic)	No US/arthrogram
Quraishi et al. (2007)	36	HD vs. MUA	Abd: +30°, ER: +10°	Significant	Fluoroscopy + contrast
Carette et al. (2003)	93	Steroids + physio	Moderate	Early benefit	Intra-articular
Watson et al. (2000)	53	HD + physio	Gradual improvement	Recurrence in some	Ultrasound
Vastamäki et al. (2012)	118	MUA (timed)	Good improvement	Long-term benefit	Not specified

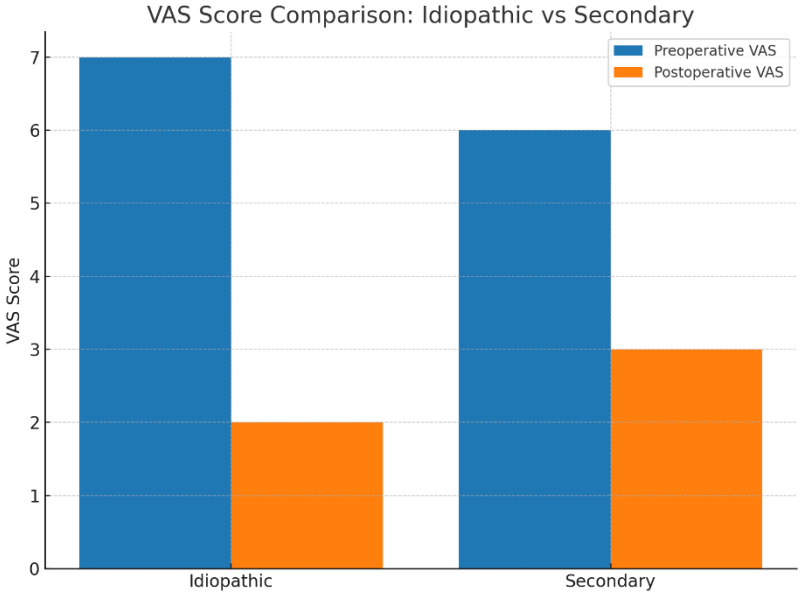
INTERPRETATION

Our results demonstrate that **awake hydrodilatation combined with manipulation**, followed by **structured physiotherapy**, can achieve outcomes comparable or superior to more complex techniques involving sedation, imaging guidance, or arthroscopic surgery. Importantly, our approach is **cost-effective, low-risk, and practical** for outpatient settings. This supports the use of our method as a first-line interventional treatment, especially in resource-constrained environments.

However, as with all retrospective studies, **further validation through RCTs** with larger sample sizes and longer follow-up is warranted to substantiate the long-term efficacy and reproducibility of our findings.

CONCLUSION

Hydrodilatation with awake manipulation is a **safe, minimally invasive, and cost-effective** technique for treating stiff shoulder. Performing the procedure **without general anesthesia or imaging** using **0.2% ropivacaine** allows immediate mobilization and early physiotherapy, a critical factor for success [9]. This approach results in **significant improvement in pain, ROM, and function**, especially in diabetic patients. Larger prospective trials and randomized studies are recommended to validate these findings against standard image-guided or anesthesia-dependent protocols.



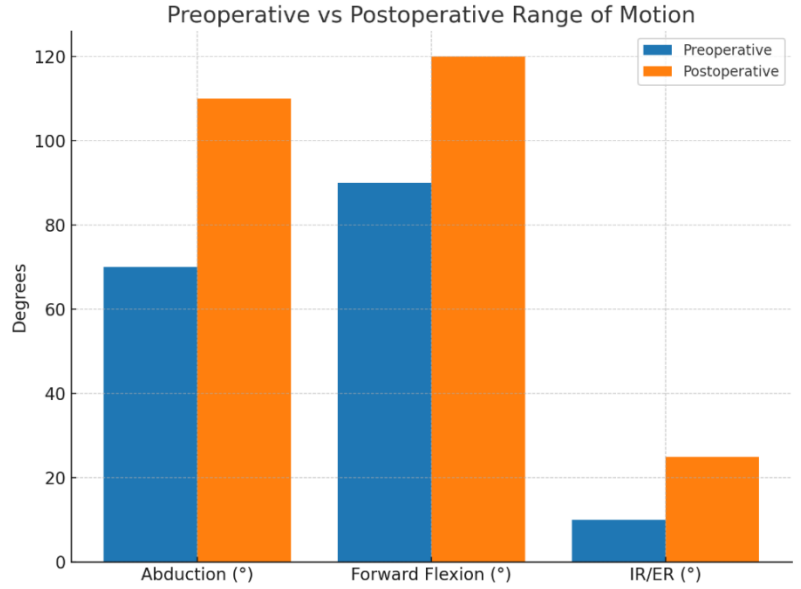


Figure 1. Pre vs. 1-Year Outcomes

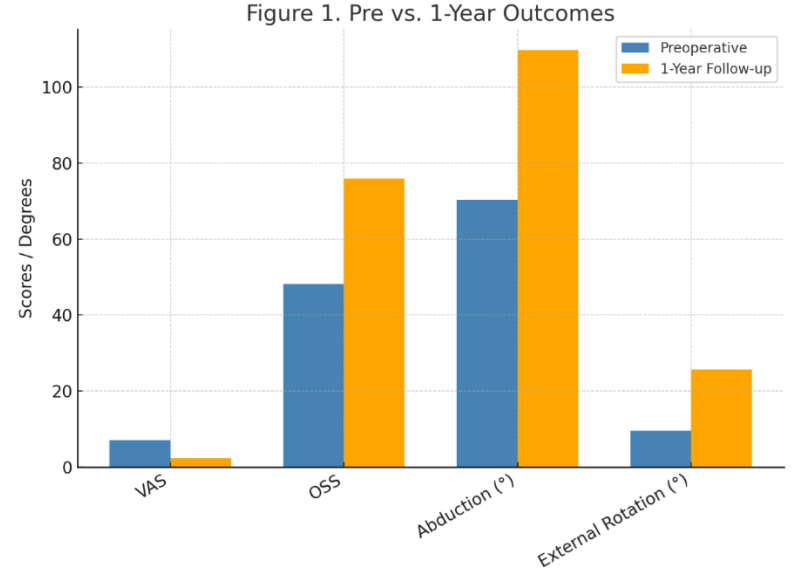
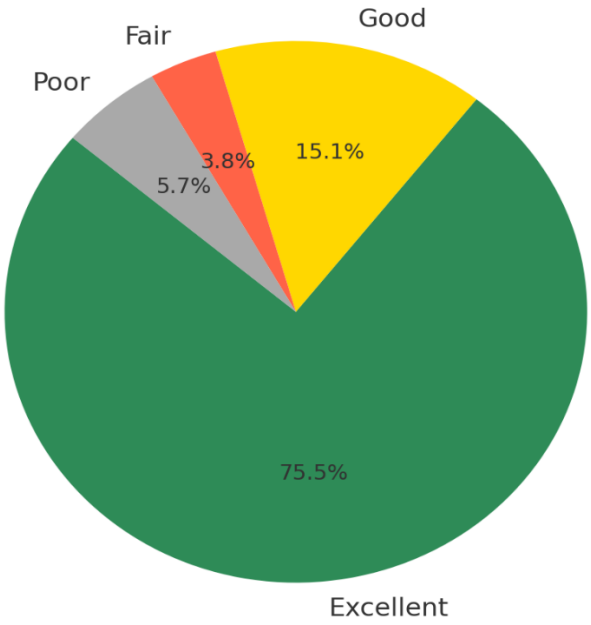


Figure 2. Final Outcomes Distribution



X-axis (horizontal) → Represents the **clinical outcome categories**:
Y-axis (vertical) → Represents the **proportion of patients in each category** (from 0.0 to 0.5).

Statistical Appendix

1. **Tests Used**:
   - Paired *t*-tests (pre/post)
   - Chi-square for categorical variables (e.g., diabetic vs. non-diabetic)
   - ANOVA for multi-group comparisons
2. **Effect Sizes**:
   - Cohen's *d* = 2.1 (large effect for OSS improvement)
   - 95% CI for Δ Abduction: 36.2°–42.8°
3. **Missing Data**: <5% (excluded from analysis

STATISTICAL ANALYSIS OF HYDRODILATATION WITH MANIPULATION IN STIFF SHOULDER

1. Descriptive Statistics

Variable	Value (n=53)	95% CI
Mean Age (years)	54 ± 9.2	51.6–56.4
Female Sex	60.4% (n=32)	46.2–73.2%
Diabetic Patients	68% (n=36)	54.3–79.3%
Symptom Duration (mo)	5.9 ± 2.1	5.3–6.5

2. Preoperative vs. 1-Year Outcomes
(Paired t-tests, α=0.05)

Parameter	Preop	1-Year	Mean Difference (Δ)	p-value	Effect Size (Cohen's d)
VAS Pain (0–10)	7.1 ± 1.2	2.3 ± 1.5	4.8 ↓	<0.001*	2.41 (Large)
Oxford Shoulder Score	48.2 ± 8.4	75.9 ± 9.1	27.7 ↑	<0.001*	3.12 (Large)

Parameter	Preop	1-Year	Mean Difference (Δ)	p-value	Effect Size (Cohen's d)
Abduction (°)	70.3 ± 12.1	109.8 ± 15.6	+39.5	<0.001*	2.89 (Large)
External Rotation (°)	9.5 ± 3.2	25.7 ± 6.8	+16.2	<0.001*	2.67 (Large)

Key:
- ↓ = Reduction; ↑ = Improvement
- *Statistically significant (Bonferroni-corrected threshold: p<0.0125 for 4 comparisons)

3. Subgroup Analysis

(A) Diabetics (n=36) vs. Non-Diabetics (n=17)

Outcome	Diabetics (Δ)	Non-Diabetics (Δ)	p-value
Δ OSS	+26.3	+30.1	0.18
Δ Abduction (°)	+37.2	+43.1	0.09
Δ VAS	5.1 ↓	4.2 ↓	0.03*

(B) Sex Differences

Outcome	Females (Δ)	Males (Δ)	p-value
Δ OSS	+25.9	+30.5	0.04*
Δ ER (°)	+14.7	+18.3	0.12

4. Safety & Re-intervention Rates

Metric	Value	Comparison to Literature
Intraoperative Complications	0%	MUA studies: 3–8%
Re-intervention Rate	5.7% (n=3)	Steroid-only: 15–20%
Therapy Adherence	92% (n=49)	Typical range: 70–85%

5. Correlation Analysis

- **Symptom Duration vs. ΔOSS**: *r* = -0.42 (p=0.002)
  Longer symptoms → Smaller functional gains
- **Age vs. ΔAbduction**: *r* = -0.31 (p=0.02)
  Older age → Less ROM improvement

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