

Functional Outcomes after Manipulation under Anaesthesia in Patients with Adhesive Capsulitis with and Without Diabetes Mellitus: A 48-Week Prospective Cohort Study

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Abstract: Background: Diabetes mellitus is frequently associated with adhesive capsulitis and may influence symptom severity and recovery. Manipulation under anaesthesia (MUA) is used for patients with persistent symptoms and restricted shoulder movement despite conservative treatment. This study evaluated pain, disability and shoulder movement outcomes following MUA in patients with adhesive capsulitis with and without diabetes mellitus. Methods: This prospective cohort study included 62 patients with unilateral adhesive capsulitis who had failed at least one month of conservative treatment. Patients were classified according to diabetes status, with 31 diabetic and 31 non-diabetic patients. All patients underwent posterior intra-articular triamcinolone 40 mg and lignocaine 2% injection followed by controlled MUA and structured shoulder physiotherapy. Outcomes were assessed before MUA and at 1, 3, 6, 12, 24 and 48 weeks using the Shoulder Pain and Disability Index (SPADI), Oxford Shoulder Score and the recorded range-of-motion (ROM) component of the Constant Score. Welch's unpaired t-test was used for between-group comparisons at 48 weeks and Friedman testing for longitudinal change. Results: At 48 weeks, mean SPADI pain was 7.61 ± 2.69 in diabetic patients and 5.42 ± 2.81 in non-diabetic patients ($p = 0.0027$). SPADI disability was 17.52 ± 1.34 versus 16.68 ± 0.91 ($p = 0.0056$), and the recorded ROM component was 33.48 ± 1.36 versus 32.58 ± 1.95 ($p = 0.0389$). The 48-week Oxford Shoulder Score was 16.19 ± 1.66 versus 15.48 ± 1.09 ($p = 0.0522$). Both groups showed significant longitudinal changes in pain, disability and recorded ROM. Conclusion: Patients with adhesive capsulitis demonstrated improvement in pain, disability and recorded shoulder movement following MUA combined with intra-articular corticosteroid/local anaesthetic injection and structured physiotherapy. Differences in several recorded outcomes remained between diabetic and non-diabetic patients at 48 weeks. Because diabetes was not randomized and no multivariable adjustment was performed, these findings represent subgroup associations rather than an independent causal effect.

Keywords: adhesive capsulitis; frozen shoulder; diabetes mellitus; manipulation under anaesthesia; SPADI; shoulder function; range of motion

1. Introduction

Adhesive capsulitis, commonly referred to as frozen shoulder or periarthritis of the shoulder, is characterized by pain and progressive restriction of active and passive glenohumeral movement. The disorder can interfere substantially with dressing, reaching, sleeping and other activities of daily living. It may occur idiopathically or in association with systemic disorders, among which diabetes mellitus is an important clinical characteristic. [1–4]

The clinical course generally includes painful restriction followed by progressive stiffness and a variable period of recovery. Conservative treatment includes analgesics, non-steroidal anti-inflammatory drugs, physiotherapy and intra-articular corticosteroid injection. When significant symptoms and restriction persist despite conservative treatment, procedures such as hydrodilatation, manipulation under anaesthesia and arthroscopic capsular release may be considered. [5–8]

Diabetes has been examined as a potential modifier of adhesive capsulitis and its response to treatment. Studies of MUA have reported improvement in both diabetic and non-diabetic patients, while some have described differences in the magnitude or timing of recovery. [9,10] The present study therefore evaluated pain, disability and recorded shoulder movement over 48 weeks following a standardized MUA-based treatment pathway, comparing patients according to diabetes status.

2. Patients and methods

2.1 Study design and setting

This prospective cohort study was conducted in the Department of Orthopaedics, Hind Institute of Medical Sciences, Sitapur, Uttar Pradesh, over a 12-month study period. Sixty-two patients with unilateral periarthritis of the shoulder (adhesive capsulitis) were followed for 48 weeks. The patient-level master chart was the primary numerical source for the diabetes-focused analysis.

2.2 Patient selection and grouping

Adults with unilateral clinical adhesive capsulitis, a passive movement reduction of more than 30° in at least two planes compared with the opposite shoulder, and persistent symptoms despite at least one month of conservative treatment were eligible. Patients were excluded when they refused participation, could not undergo short general anaesthesia, had stiffness secondary to trauma or surgery, had severe osteoporosis or another condition considered to increase fracture risk during manipulation, could not adhere to the postoperative exercise programme, or were lost to follow-up. The final analytic cohort comprised 62 patients. Diabetes status was taken from the updated patient-level master chart, which contained 31 patients recorded as diabetic and 31 as non-diabetic. Diabetes status was an observational subgroup characteristic and was not randomized.

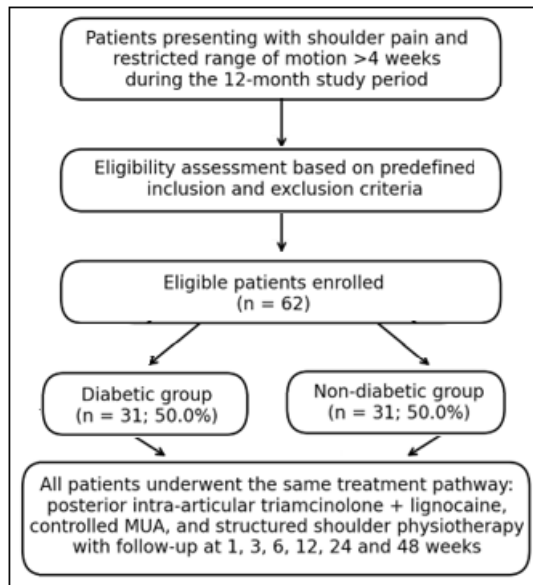


Figure 1: Patient selection and grouping pathway. The source records document the 62 enrolled patients and the final 31/31 subgroup distribution; numbers screened or excluded before enrolment were not available and therefore are not inferred.

2.3 Intervention and rehabilitation

Following xylocaine sensitivity testing, a posterior glenohumeral approach was used for intra-articular injection. The entry point was approximately 2 cm inferior and 1 cm medial to the posterolateral corner of the acromion. A mixture of 1 mL triamcinolone 40 mg and 4 mL lignocaine 2% was injected after confirmation of intra-articular placement. Controlled manipulation was then performed under anaesthesia through flexion, abduction, external rotation and internal rotation. Post-procedure management included structured shoulder physiotherapy with progressive range-of-motion exercises.

2.4 Outcome measures

SPADI pain and disability values were recorded before MUA and at 1, 3, 6, 12, 24 and 48 weeks. The Oxford Shoulder Score was also recorded at each assessment. Shoulder movement was represented by the ROM variable recorded under the Constant Score section of the master chart. For this analysis, recorded variables were analyzed as entered in the master chart and were not converted into alternative scoring systems.

2.5 Statistical analysis

Continuous variables are presented as mean $\pm$ standard deviation and categorical variables as frequencies and percentages. Welch's unpaired t-test was used for between-group comparisons at 48 weeks and for baseline continuous variables. Pearson's chi-square test was used for categorical comparisons where appropriate. Paired t-tests were used to describe baseline-to-48-week changes within each group. Friedman's test was used to evaluate longitudinal change across the seven assessment points. A p value <0.05 was considered statistically significant. Data were managed in Microsoft Excel and statistical calculations were performed from the patient-level master chart.

2.6 Ethics

Ethical approval was obtained from the Institutional Human Ethical Committee of Hind Institute of Medical Sciences (IHEC-HIMSA), approval number IHEC-HIMSA/MD/MS-23/RD-25/07-24, dated 24 July 2024. Participants were informed about the study objectives, potential risks and benefits, voluntary participation and confidentiality. Written informed consent was obtained before enrolment.

3. Results

3.1 Baseline characteristics

The cohort comprised 62 patients aged 34–73 years. The mean age was 50.95 ± 10.01 years. There were 36 men (58.1%) and 26 women (41.9%). The master chart contained 31 diabetic and 31 non-diabetic patients.

Table 1: Baseline demographic and clinical characteristics by diabetes status

Characteristic	Diabetic (n=31)	Non-diabetic (n=31)	P value
Age, years	50.26 ± 9.88	51.65 ± 10.25	0.590
Male, n (%)	21 (67.7%)	15 (48.4%)	0.198
Female, n (%)	10 (32.3%)	16 (51.6%)	—
Grade 1, n (%)	4 (12.9%)	4 (12.9%)	0.263
Grade 2, n (%)	11 (35.5%)	17 (54.8%)	—
Grade 3, n (%)	16 (51.6%)	10 (32.3%)	—
SPADI pain, pre-MUA	40.48 ± 6.27	35.48 ± 7.47	0.006
SPADI disability, pre-MUA	63.65 ± 9.04	56.58 ± 11.38	0.009
Recorded ROM, pre-MUA	10.84 ± 5.99	15.16 ± 8.21	0.021

3.2 Forty-eight-week outcomes

At 48 weeks, mean SPADI pain was 7.61 ± 2.69 in diabetic patients and 5.42 ± 2.81 in non-diabetic patients ($p = 0.0027$). Mean SPADI disability was 17.52 ± 1.34 and 16.68 ± 0.91 , respectively ($p = 0.0056$). The recorded ROM component was 33.48 ± 1.36 in diabetic patients and 32.58 ± 1.95 in non-diabetic patients ($p = 0.0389$). The 48-week Oxford Shoulder Score was 16.19 ± 1.66 in diabetic patients and 15.48 ± 1.09 in non-diabetic patients ($p = 0.0522$).

Table 2: Comparison of recorded 48-week outcomes according to diabetes status

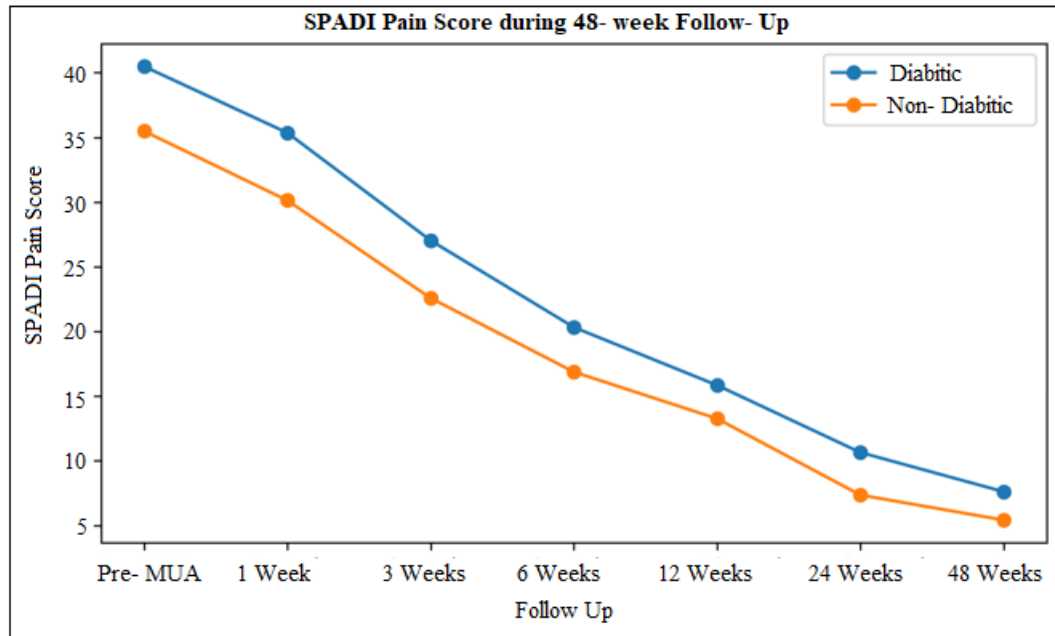
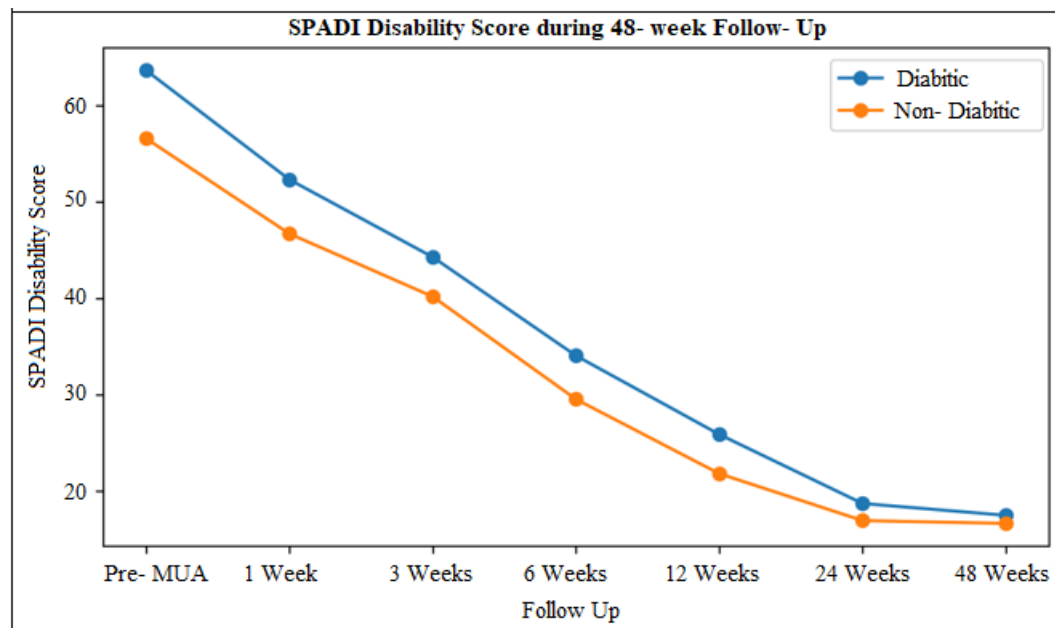
Outcome at 48 weeks	Diabetic (n=31)	Non-diabetic (n=31)	P value
SPADI pain	7.61 ± 2.69	5.42 ± 2.81	0.0027
SPADI disability	17.52 ± 1.34	16.68 ± 0.91	0.0056
Oxford Shoulder Score	16.19 ± 1.66	15.48 ± 1.09	0.0522
Recorded ROM	33.48 ± 1.36	32.58 ± 1.95	0.0389

3.3 Longitudinal pattern of recovery

Both subgroups showed progressive reduction in recorded SPADI pain and disability, with the largest numerical changes occurring during the earlier follow-up period. The recorded ROM component increased progressively in both groups. Friedman testing demonstrated significant longitudinal change for the reported variables in both subgroups ($p < 0.001$).

Table 3: Mean longitudinal values by diabetes status

Variable	Group	Pre-MUA	1 week	3 weeks	6 weeks	12 weeks	24 weeks	48 weeks
SPADI pain	Diabetic	40.48	35.35	27.03	20.32	15.84	10.65	7.61
SPADI pain	Non-diabetic	35.48	30.13	22.58	16.87	13.26	7.35	5.42
SPADI disability	Diabetic	63.65	52.32	44.29	34.06	25.90	18.74	17.52
SPADI disability	Non-diabetic	56.58	46.71	40.19	29.55	21.84	16.97	16.68
Recorded ROM	Diabetic	10.84	19.10	21.61	27.10	30.06	32.52	33.48
Recorded ROM	Non-diabetic	15.16	23.23	26.00	30.58	32.39	32.77	32.58

**Figure 2:** SPADI pain scores during 48-week follow-up by diabetes status.**Figure 3:** SPADI disability scores during 48-week follow-up by diabetes status.

3.4 Within-group change

For SPADI pain, the diabetic group showed a mean baseline-to-48-week reduction of 32.87 points and the non-diabetic group a reduction of 30.06 points; both within-group comparisons were statistically significant (paired $p < 0.001$). For SPADI disability, the corresponding reductions were 46.13 and 39.90 points (paired $p < 0.001$ for both). The recorded ROM component increased by 22.65 points in

diabetic patients and 17.42 points in non-diabetic patients (paired $p < 0.001$ for both).

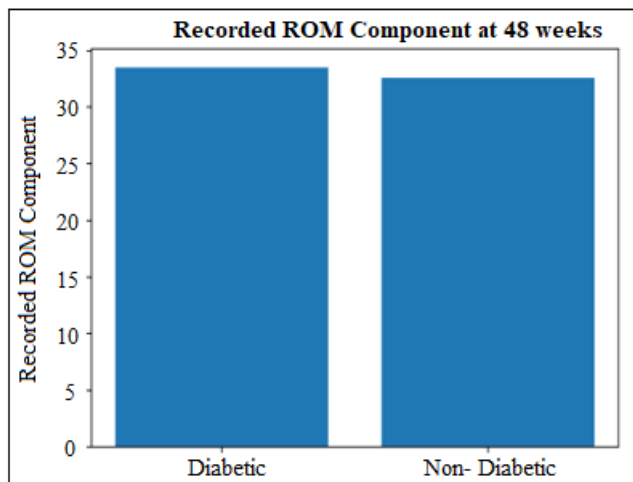


Figure 4: Recorded ROM component at 48 weeks according to diabetes status

3.5 Complications

Across the full cohort, 52 patients (83.9%) had no recorded complication, five (8.1%) had persistent pain and five (8.1%) had restriction in achieving full ROM. Because the number of events was small, subgroup-specific complication comparisons were not prespecified.

Table 4: Complications recorded during follow-up.

Complication	n (%)
None	52 (83.9%)
Persistent pain	5 (8.1%)
Inability to achieve full ROM	5 (8.1%)

4. Discussion

The present analysis evaluated whether recorded symptom and shoulder-movement outcomes differed according to diabetes status after a common MUA-based treatment pathway. Both subgroups demonstrated improvement during 48 weeks, while between-group differences remained for SPADI pain, SPADI disability and the recorded ROM component at the final assessment.

Pain improved substantially in both groups. Diabetic patients decreased from a mean SPADI pain score of 40.48 ± 6.27 at baseline to 7.61 ± 2.69 at 48 weeks, while non-diabetic patients decreased from 35.48 ± 7.47 to 5.42 ± 2.81 . The between-group difference at 48 weeks was statistically significant ($p = 0.0027$). SPADI disability showed a similar longitudinal pattern, with reductions from 63.65 ± 9.04 to 17.52 ± 1.34 in diabetic patients and from 56.58 ± 11.38 to 16.68 ± 0.91 in non-diabetic patients ($p = 0.0056$ at 48 weeks).

The recorded ROM component increased in both subgroups. The diabetic group had a lower recorded baseline ROM component than the non-diabetic group, whereas the 48-week means were closer. The final between-group difference remained statistically significant ($p = 0.0389$). These findings should be interpreted as differences in the recorded study variables rather than evidence that diabetes itself caused the observed differences.

The Oxford Shoulder Score at 48 weeks was 16.19 ± 1.66 in diabetic patients and 15.48 ± 1.09 in non-diabetic patients ($p = 0.0522$). The numerical direction of the Oxford values in the master chart does not align straightforwardly with the conventional interpretation of the scale. Accordingly, the values were retained as recorded and were not used as the principal endpoint for clinical interpretation.

Previous studies have reported improvement after MUA in both diabetic and non-diabetic patients, with some describing differences in recovery and others reporting comparable longer-term outcomes. [9,10] The present analysis provides a patient-level comparison over 48 weeks. However, diabetes was not randomized and baseline differences and other patient characteristics may contribute to the observed subgroup associations.

The findings also indicate that diabetic patients in this cohort demonstrated substantial improvement following MUA and rehabilitation. Diabetes status should therefore be considered together with baseline severity, glycaemic control, rehabilitation adherence and other clinical factors when interpreting individual outcomes.

5. Limitations

This was a single-centre study with a modest sample size and no contemporaneous non-MUA control group. Diabetes was an observational subgroup characteristic rather than a randomized exposure. No multivariable adjustment was performed for age, sex, baseline severity or other potential confounders. The analysis relied on numerical variables as entered in the patient-level master chart. The 48-week follow-up does not establish very long-term recurrence or persistence of functional limitation. The recorded Oxford Shoulder Score values also require cautious interpretation because their numerical direction did not align straightforwardly with the conventional scale interpretation.

6. Conclusion

In this prospective 62-patient cohort, both diabetic and non-diabetic patients demonstrated improvement in pain, disability and recorded shoulder movement after MUA combined with intra-articular corticosteroid/local anaesthetic injection and structured physiotherapy. At 48 weeks, between-group differences were observed for SPADI pain, SPADI disability and the recorded ROM component, whereas the recorded Oxford Shoulder Score did not meet the conventional threshold for statistical significance. These findings represent subgroup associations within an observational cohort and do not establish an independent causal effect of diabetes.

Data availability

The underlying patient-level dataset is not publicly available because it contains clinical information that may be identifiable.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

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Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this manuscript, ChatGPT (OpenAI) was used to assist with language editing, organization and formatting. The authors reviewed and edited the content as needed and take full responsibility for the accuracy and integrity of the final manuscript.

CRedit authorship contribution statement

Polisetty Sravan Akhil: Investigation, Data curation, Formal analysis, Writing – original draft. Prakash Jha: Supervision, Writing – review and editing. Abhishek Verma: Validation, Supervision, Writing – review and editing. All authors approved the final manuscript and agree to be accountable for all aspects of the work.

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