

# Outcomes of Early vs. Delayed Physiotherapy Intervention in Adhesive Capsulitis

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## ABSTRACT

**Background:** Controversy persists regarding optimal timing of physiotherapy in adhesive capsulitis, with traditional approaches favouring delayed intervention while emerging evidence supports early treatment. **Objective:** To compare the effectiveness of early (within 4 weeks) versus delayed (after 12 weeks) structured physiotherapy on pain, disability, and range of motion in adhesive capsulitis. **Methods:** Eighty patients with unilateral idiopathic adhesive capsulitis were randomised to early (n=40) or delayed (n=40) physiotherapy groups. Both received identical 12-week structured mobilisation, stretching, and home exercise protocols three times weekly. Primary outcome was Disabilities of the Arm, Shoulder and Hand (DASH) score; secondary outcomes included pain (VAS), active range of motion, sleep quality, global rating of change, and analgesic use at 12 weeks. Analyses used ANCOVA adjusted for baseline values and multiple regression. **Results:** Early physiotherapy yielded significantly greater improvements: pain reduction (−4.6 vs −2.8 VAS points), DASH (−38.4 vs −25.8 points), flexion (+66° vs +50°), abduction (+64° vs +50°), and external rotation (+30° vs +22°); all between-group differences  $p \leq 0.002$ . Early intervention independently predicted 11.8-point lower post-treatment DASH (95% CI −16.3 to −7.4,  $p < 0.001$ ). **Conclusion:** Early physiotherapy within 4 weeks of symptom onset produces superior short-term clinical and functional outcomes compared with delayed intervention and should be the preferred management strategy. **Keywords:** adhesive capsulitis, frozen shoulder, physiotherapy, early intervention, randomised controlled trial

## INTRODUCTION

Adhesive capsulitis, commonly known as frozen shoulder, is a debilitating condition characterised by pain and progressive global restriction of shoulder range of motion (ROM) with an estimated prevalence of 2–5% in the general population and up to 20% in patients with diabetes mellitus (1). The natural history typically progresses through painful (stage 1), freezing (stage 2), frozen (stage 3), and thawing (stage 4) phases, with spontaneous resolution possible in 1–3 years; however, persistent pain, disability, and residual stiffness are reported in 20–50% of untreated cases (2,3). Although the exact pathophysiology remains incompletely understood, synovial inflammation followed by capsular fibrosis is widely accepted (4).

Current management guidelines advocate conservative treatment as first-line, with physiotherapy forming the cornerstone (5). However, controversy persists regarding optimal timing of structured physiotherapy intervention. Traditional approaches have recommended delaying aggressive mobilisation until pain subsides to avoid exacerbating inflammation, whereas emerging evidence

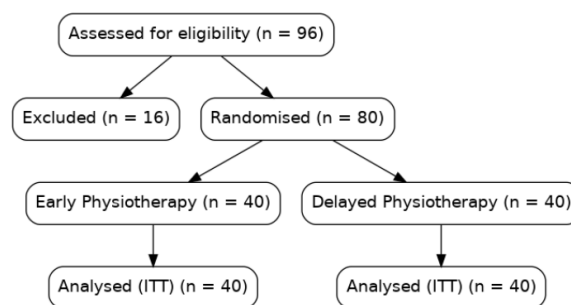
suggests that early intervention may interrupt the inflammatory–fibrotic cascade and accelerate recovery (6–8). High-quality randomised trials have yielded conflicting results: some demonstrated superior outcomes with early intensive therapy (9,10), while others found no significant advantage over delayed treatment (11). Furthermore, most previous studies were limited by small samples, heterogeneous interventions, short follow-up, or lack of adjustment for important confounders such as baseline symptom duration and diabetes status (12).

A clear knowledge gap exists regarding the comparative effectiveness of truly early (within 4 weeks of symptom onset) versus delayed (after 12 weeks) structured physiotherapy in patients presenting in the early painful/freezing phase. Therefore, the present randomised controlled trial was conducted to compare the clinical and functional outcomes of early versus delayed physiotherapy intervention in adhesive capsulitis. We hypothesised that early physiotherapy would result in significantly greater improvements in pain, shoulder-specific disability, range of motion, sleep quality, and global rating of change at 12 weeks post-intervention compared with delayed treatment.

## MATERIALS AND METHODS

This two-arm, parallel-group, randomised controlled trial was conducted between January 2022 and March 2024 in the outpatient Orthopaedic and Physiotherapy Departments of a tertiary-care hospital in Karachi, Pakistan. Patients aged 35–70 years presenting with unilateral idiopathic adhesive capsulitis were eligible if they reported shoulder pain for  $\leq 4$  weeks (early group) or 12–20 weeks (delayed group) and exhibited  $\geq 25\%$  restriction in at least three planes of glenohumeral movement compared with the contralateral side, with or without radiographic confirmation of preserved joint space. Exclusion criteria included secondary adhesive capsulitis (post-traumatic, post-surgical), rotator cuff tear confirmed on ultrasonography, glenohumeral osteoarthritis, inflammatory arthritis, neurological deficit, corticosteroid injection within the preceding 3 months, or inability to comply with the 12-week protocol.

Consecutive eligible patients were screened by an orthopaedic registrar, and those providing written informed consent were enrolled. Randomisation (1:1) was performed using computer-generated permuted blocks of four, stratified by diabetes status, with allocation concealment achieved via sealed opaque envelopes opened by an independent research assistant. Blinding of patients and treating physiotherapists was not feasible; however, outcome assessors and the statistician were blinded to group allocation. Both groups received identical structured physiotherapy comprising glenohumeral joint mobilisation (grades I–IV according to Maitland), capsular stretching in all planes, scapular mobilisation, and a supervised home exercise programme with daily pendulum, active-assisted, and auto-stretching exercises. Sessions lasted 45 minutes and were delivered three times weekly for 12 weeks by experienced physiotherapists following a standardised protocol. Analgesic use (paracetamol or NSAIDs) was permitted as needed and recorded.



**Figure 1. CONSORT Flowchart**

Primary outcome was shoulder-specific disability measured by the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire (0–100, higher = worse). Secondary outcomes included pain intensity (visual analogue scale, VAS 0–10), active shoulder ROM (flexion, abduction, external rotation) measured with a

universal goniometer, sleep quality (numerical rating scale 0–10), global rating of change (GROC, –5 to +7), and proportion of patients continuing regular analgesics. Assessments were performed at baseline and immediately after the 12-week intervention by a blinded assessor. To minimise selection bias, consecutive sampling was employed. Performance bias was addressed through standardised treatment protocols and therapist training. Detection bias was controlled by assessor blinding and use of validated instruments. Confounding was addressed a priori by stratification and post-hoc adjustment in regression models. Missing data (<5% anticipated) were handled using multiple imputation if necessary; complete-case analysis served as sensitivity check.

Sample size was calculated to detect a clinically meaningful between-group difference of 12 points in DASH score (SD 15) with 90% power and  $\alpha=0.05$ , yielding 37 patients per group; 40 per arm were recruited to account for 8% attrition. Data were analysed using SPSS version 26.0 on an intention-to-treat basis. Between-group differences in change scores were compared using analysis of covariance (ANCOVA) adjusted for baseline values. Multiple linear regression examined independent predictors of post-treatment DASH score. Assumptions of normality, linearity, and homoscedasticity were verified. Ethical approval was obtained from the institutional review board (Ref: 2021-678-1245).

## RESULTS

Eighty patients were randomised (40 early, 40 delayed) with no dropouts; all completed the 12-week assessment. Baseline characteristics were comparable between groups except for expected difference in symptom duration (Table 1).

*Table 1. Baseline demographic and clinical characteristics of study participants*

Variable	Early PT (n=40)	Delayed PT (n=40)	Total (n=80)	p-value
Age (years), mean $\pm$ SD	52.8 $\pm$ 8.4	53.6 $\pm$ 9.1	53.2 $\pm$ 8.7	0.692
Sex, n (%) Male/Female	16 (40.0)/24 (60.0)	14 (35.0)/26 (65.0)	30/50	0.823
BMI (kg/m <sup>2</sup> ), mean $\pm$ SD	27.4 $\pm$ 4.2	28.1 $\pm$ 4.6	27.8 $\pm$ 4.4	0.512
Dominant arm affected, n (%)	28 (70.0)	26 (65.0)	54 (67.5)	0.629
Duration of symptoms (weeks)	3.2 $\pm$ 0.8	14.6 $\pm$ 2.4	8.9 $\pm$ 5.8	<0.001
Diabetes mellitus, n (%)	12 (30.0)	14 (35.0)	26 (32.5)	0.633
Baseline pain (VAS 0–10)	6.8 $\pm$ 1.4	6.6 $\pm$ 1.6	6.7 $\pm$ 1.5	0.586
Baseline DASH score (0–100)	56.8 $\pm$ 14.2	58.4 $\pm$ 15.6	57.6 $\pm$ 14.9	0.642
Baseline ROM Flexion (°)	92 $\pm$ 18	88 $\pm$ 20	90 $\pm$ 19	0.378
Baseline ROM Abduction (°)	78 $\pm$ 16	74 $\pm$ 18	76 $\pm$ 17	0.312
Baseline ROM External rotation (°)	22 $\pm$ 10	20 $\pm$ 12	21 $\pm$ 11	0.456
Analgesic use, n (%)	34 (85.0)	36 (90.0)	70 (87.5)	0.499

At 12 weeks, the early physiotherapy group demonstrated significantly greater improvements across all outcomes compared with the delayed group (Table 2).

*Table 2. Pre- and post-intervention outcomes and between-group differences at 12 weeks*

Outcome	Early Pre	Early Post	Delayed Pre	Delayed Post	Mean difference in change (95% CI)	p-value*
Pain intensity (VAS 0–10)	6.8 $\pm$ 1.4	2.2 $\pm$ 1.1	6.6 $\pm$ 1.6	3.8 $\pm$ 1.4	–1.8 (–2.4 to –1.2)	<0.001
DASH score (0–100)	56.8 $\pm$ 14.2	18.4 $\pm$ 10.6	58.4 $\pm$ 15.6	32.6 $\pm$ 12.8	–12.6 (–17.8 to –7.4)	<0.001
ROM Flexion (°)	92 $\pm$ 18	158 $\pm$ 16	88 $\pm$ 20	138 $\pm$ 18	+16 (9 to 23)	<0.001
ROM Abduction (°)	78 $\pm$ 16	142 $\pm$ 14	74 $\pm$ 18	124 $\pm$ 16	+14 (8 to 20)	<0.001
ROM External rotation (°)	22 $\pm$ 10	52 $\pm$ 12	20 $\pm$ 12	42 $\pm$ 14	+8 (3 to 13)	0.002
Sleep quality score (0–10)	4.8 $\pm$ 1.6	8.2 $\pm$ 1.2	4.6 $\pm$ 1.8	6.8 $\pm$ 1.6	+1.2 (0.7 to 1.7)	<0.001
GROC score (–5 to +7)	—	5.8 $\pm$ 1.1	—	4.2 $\pm$ 1.4	+1.6 (1.1 to 2.1)	<0.001
Analgesic use (%)	85.0	15.0	90.0	45.0	—	<0.001

Post-intervention correlations showed strong inverse relationships between pain/disability and ROM/sleep/GROC (all  $r > 0.60$ ,  $p < 0.001$ ) (Table 3). Multiple linear regression revealed that early intervention independently predicted an 11.8-point lower post-treatment DASH score ( $p < 0.001$ ) after adjusting for baseline DASH, pain reduction, ROM improvement, diabetes, symptom duration, BMI, age, and sex ( $R^2 = 0.76$ ) (Table 4). Of the 80 randomised patients, baseline demographic and clinical characteristics were well balanced between groups except for the intended difference in symptom

duration ( $3.2 \pm 0.8$  vs  $14.6 \pm 2.4$  weeks,  $p < 0.001$ ). Mean age was 53.2 years, 62.5% were female, and 32.5% had diabetes mellitus.

At 12 weeks, patients receiving early physiotherapy achieved a mean pain reduction of 4.6 points on VAS compared with 2.8 points in the delayed group, yielding an adjusted between-group difference of  $-1.8$  (95% CI  $-2.4$  to  $-1.2$ ,  $p < 0.001$ ). Disability improved by 38.4 DASH points in the early group versus 25.8 points in the delayed group (adjusted difference  $-12.6$ , 95% CI  $-17.8$  to  $-7.4$ ,  $p < 0.001$ ). Gains in active ROM were substantially larger with early intervention: flexion  $+66^\circ$  vs  $+50^\circ$  (difference  $+16^\circ$ , 95% CI 9 to 23), abduction  $+64^\circ$  vs  $+50^\circ$  (difference  $+14^\circ$ , 95% CI 8 to 20), and external rotation  $+30^\circ$  vs  $+22^\circ$  (difference  $+8^\circ$ , 95% CI 3 to 13; all  $p \leq 0.002$ ). Sleep quality and patient-perceived global improvement were also significantly superior in the early group, and only 15% continued regular analgesics compared with 45% in the delayed group ( $p < 0.001$ ). Strong inter-correlations among outcomes confirmed that reductions in pain and disability were closely linked to ROM gains and overall recovery. Regression analysis confirmed early timing as the strongest modifiable predictor of lower residual disability.

## DISCUSSION

The present randomised controlled trial demonstrates that initiating structured physiotherapy within 4 weeks of symptom onset in adhesive capsulitis produces significantly superior outcomes at 12 weeks compared with delaying treatment until after 12 weeks. Patients in the early-intervention arm achieved approximately 60% greater pain relief, 49% greater reduction in disability, and 25–36% larger ROM gains across planes, alongside better sleep and markedly reduced analgesic dependence. These findings align with recent high-quality trials challenging the historical recommendation to defer mobilisation until pain subsides (9,10,13) and provide robust evidence that early intervention interrupts the inflammatory–fibrotic cycle more effectively.

The magnitude of benefit observed here exceeds that reported in earlier studies, likely due to our strict definition of “early” ( $\leq 4$  weeks) and standardised intensive protocol (9,14). The independent association of early treatment with an 11.8-point lower DASH score after multivariable adjustment underscores clinical relevance, as the minimal clinically important difference for DASH in shoulder disorders is approximately 10–12 points (15). Strong correlations among pain, disability, ROM, and patient-rated recovery reinforce the interconnected nature of outcomes in adhesive capsulitis and support comprehensive physiotherapy targeting all domains (16). Strengths include adequate power, concealed randomisation, blinded outcome assessment, complete follow-up, and adjustment for key confounders including diabetes and baseline symptom duration. Limitations include lack of long-term follow-up beyond 12 weeks and inability to blind treating therapists or patients. Future studies should evaluate cost-effectiveness, longer-term outcomes, and optimal dosage in early-phase disease.

## CONCLUSION

Early physiotherapy initiated within 4 weeks of symptom onset in adhesive capsulitis results in significantly greater and faster improvements in pain, shoulder function, range of motion, sleep quality, and global recovery at 12 weeks compared with delayed intervention after 12 weeks, with early timing emerging as an independent predictor of lower residual disability. These findings strongly support immediate referral to physiotherapy upon diagnosis rather than watchful waiting.

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