RESEARCH ARTICLE

Quality of life in patients with adhesive capsulitis and diabetes mellitus

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Abstract

Background: Adhesive capsulitis is a common and disabling musculoskeletal complication in diabetes mellitus, often affecting the dominant shoulder. This results in significant pain, limited movement, and decreased quality of life (QoL). This study aimed to evaluate the stage-specific effects on QoL in diabetic patients with adhesive capsulitis of the dominant shoulder.

Methods: This cross-sectional study was carried out over six months at a tertiary care hospital in Bangladesh. Diabetic patients with adhesive capsulitis of the right shoulder were included. Pain, disability, and quality of life were assessed using the Visual Analogue Scale, shoulder pain and disability index, disabilities of the arm, shoulder and hand score, and the Short-Form Health Survey (SF-36). Data were analysed using nonparametric tests, correlation analysis, and multiple linear regression.

Results: Among 80 participants, most were in the freezing stage (77.5%). This stage was marked by the most severe pain [mean (standard deviation) Visual Analogue Scale: 7.5 (0.9)] and the highest overall upper-limb disability [mean (standard deviation) disabilities of the arm, shoulder and hand: 80.3 (6.3)]. The frozen stage also showed the most significant shoulder-specific disability [mean (standard deviation) shoulder pain and disability index-Disability: 76.0 (4.3)] and the lowest scores on the SF-36 physical 30.9 (3.7) and mental 28.1 (0.5) components. Regression analysis identified the SF-36 physical component summary as the strongest predictor of mental health-related QoL ($\beta=0.900$, $P<0.001$).

Conclusion: Adhesive capsulitis of the dominant shoulder imposes a significant, stage-specific burden on QoL in patients with diabetes. The burden shifts from a pain-focused phase to a stiffness-focused phase, with substantial functional and psychosocial effects. Early detection and stage-specific rehabilitation are crucial for reducing disability and improving patient outcomes.

Key messages

Adhesive capsulitis of the dominant shoulder in diabetic patients significantly impairs quality of life. The freezing stage involves intense pain, while the frozen stage is marked by severe stiffness and the greatest decline in physical and mental well-being. Recognizing these distinct stages early is crucial for guiding targeted treatment, reducing disability, and enhancing long-term functional and quality-of-life outcomes.

Introduction

Adhesive capsulitis, also known as frozen shoulder, is a disabling musculoskeletal condition characterized by progressive shoulder pain and stiffness, accompanied by restriction of active and passive glenohumeral movements. Although often considered self-limiting, with resolution occurring over 12–18 months, up to 40% of patients experience persistent pain, stiffness, and functional limitations due to capsular inflammation and fibrosis [1, 2].

Adhesive capsulitis is associated with diabetes mellitus [3]. People with diabetes have a 5 fold higher risk of developing adhesive capsulitis , with a reported prevalence of 10–30%. In patients with diabetic, adhesive capsulitis is often more severe, lasts longer, and responds poorly to treatment, which increases the risk of long-term disability [4, 5, 6].

Clinically, adhesive capsulitis progresses through well-recognised stages-painful, freezing, frozen, and thawing-over months or even years, with variable degrees of pain and functional impairment [7]. While many patients eventually regain shoulder motion, recovery may be delayed or incomplete, particularly in the presence of diabetes or poor glycaemic control [8]. Conservative management remains the cornerstone of treatment, though diabetic patients frequently experience residual symptoms despite intervention. Clinically, adhesive capsulitis progresses through stages of pain, freezing, and thawing over several months to years, with varying degrees of pain and functional limitation [6]. Recovery may be delayed or incomplete, especially in patients with diabetes or poor glycaemic control, and residual symptoms often persist despite conservative treatment [8].

The shoulder plays a critical role in performing activities of daily living, occupational tasks, and self-care. Adhesive capsulitis affecting the dominant shoulder, typically the right, can substantially impair function, leading to increased dependency and psychosocial stress. In individuals with diabetes, who often present with additional systemic complications, involvement of the dominant shoulder may further exacerbate functional limitations and compromise quality of life (QoL). QoL, encompassing physical, psychological, and social well-being, is substantially reduced in adhesive capsulitis, particularly in physical functioning and pain, and these effects are more pronounced among patients with diabetes [9]. Despite this, data on QoL in diabetic patients with adhesive capsulitis of the dominant shoulder remain limited, especially in low- and middle-income countries [10]. The present study aims to assess QoL in patients with adhesive capsulitis of dominant shoulder and diabetes mellitus.

Methods

Design and population

This cross-sectional study was conducted at the Department of Physical Medicine and Rehabilitation at Dhaka Medical College Hospital from July to December 2018. The study population included diabetic patients presenting with adhesive capsulitis of the dominant (right) shoulder at the outpatient department.

Sample and sampling

A purposive sampling technique was used to enroll eligible participant patients were recruited consecutively form the start date. A total of 80 patients were enrolled. Inclusion criteria included: (i) diagnosed cases of adhesive capsulitis of the right shoulder, (ii) confirmed diagnosis of diabetes (type 1 or type 2), and (iii) age 30 years or older. Patients with a history of shoulder trauma, rotator cuff tears, cervical radiculopathy, inflammatory arthritis, or recent shoulder surgery were excluded.

Data collection process

Eligible participants were selected through a detailed clinical history, physical examination, and relevant investigations. The diagnosis of adhesive capsulitis was made clinically, based on established diagnostic criteria, including an insidious onset of shoulder pain, progressive restriction of both active and passive glenohumeral range of motion-particularly external rotation-and exclusion of alternative causes of shoulder stiffness through regular radiographic evaluation.

Data collection tools

The visual analogue scale (VAS) [11] was used to measure pain intensity. The shoulder pain and disability index (SPADI) [12] assessed pain and functional limitations related to shoulder movement. The disabilities of the arm, shoulder, and hand (DASH) [13] score measured overall upper-extremity disability. Finally, the Short-Form Health Survey (SF-36) [14] assessed QoL across eight domains, encompassing physical and mental health.

Statistical analysis

Data were analysed using SPSS version 26. Descriptive statistics summarised demographic and clinical variables, presenting frequencies and percentages for categorical data and means with standard deviations for continuous data. The normality of continuous outcome variables VAS, DASH, SPADI, and SF-36 scores was assessed with the Shapiro-Wilk test. Since the assumption of normality was violated, non-parametric tests were used for subsequent inferential analysis. The Kruskal-Wallis H test compared scores across the three stages of adhesive capsulitis (Freezing, Frozen, Thawing). When a significant difference was found ($P < 0.05$), post-hoc pairwise comparisons were carried out using the Dunn-Bonferroni method.

To identify predictors of mental health-related QoL, a multiple linear regression analysis was conducted with the SF-36 mental component summary score as the dependent variable. The model included key clinical scores (VAS, DASH, SPADI, and SF-36 physical component summary scores) and demographic

variables. Multicollinearity was evaluated through variance inflation factors. For all analyses, a $P <0.05$ was considered statistically significant.

Ethical considerations

All participants provided prior written informed consent after being thoroughly informed about the study's purpose and procedures. Participation was voluntary, with confidentiality maintained through data anonymisation and secured storage. Patients had the right to withdraw at any time without affecting their medical care. The study was conducted in accordance with the Declaration of Helsinki to ensure that participants' rights and welfare were protected throughout the study.

Results

The study participants (n=80) primarily consisted of older adults, women, and socioeconomically disadvantaged individuals. The mean (standard deviation) age was 56.6 (7.3) years, with women making up 66.3%. Nearly 40% were illiterate, and most were homemakers (66.3%). The average duration of adhesive capsulitis was 7.0 (3.7) months (Table 1).

Table 1 Background characteristics of the study participants (n=80)

Variables	Number (%)
Age in years [a]	56.6 (7.3)
Sex	
Male	27 (33.7)
Female	53 (66.3)
Educational status	
Illiterate	31 (38.8)
Primary	23 (28.8)
Secondary and above	26 (32.5)
Occupational status	
Homemaker	53 (66.3)
Service holders	18 (22.5)
Others	9 (11.3)
Duration of adhesive capsulitis in month [a]	7.0 (3.7)

[a] Mean (standard deviation)

The distribution of participants across adhesive capsulitis stages was as follows: 77.5% in the freezing stage, 18.8% in the frozen stage, and 3.8% in the thawing stage. Patient-reported outcomes varied significantly across these stages (Table 2). The freezing stage was characterised by the most severe pain, with a mean (standard deviation) VAS score of 7.5 (0.9), and the highest overall upper limb disability, reflected in a mean (standard deviation) DASH score of 80.3 (6.3). In contrast, the frozen stage showed the most significant shoulder-specific functional disability, with an average SPADI score of 78.0 (2.9),

despite lower pain levels. The thawing stage demonstrated significant improvement across all measures, approaching normal function and minimal pain.

Health-related QoL, as assessed by the SF-36, was significantly reduced during active disease phases. Both the physical component summary and mental component summary scores were at their lowest during the frozen stage [physical component summary: 30.9 (3.7); mental component summary: 28.1 (0.5)], reflecting significant declines in physical and mental health. Scores improved substantially during the thawing stage [physical component summary: 79.5 (1.0); mental component summary: 85.6 (1.0); $P <0.001$] for both comparisons), highlighting the reversible nature of QoL impairment with disease recovery (Table 3).

Table 3 Distribution of patients by stages of adhesive capsulitis (AC) with shoulder pain and disability index (SPADI) and short form health survey (SF-36) scores (n=80)

Scores by stages	Mean (standard deviation) [a]
SPADI scores	
Pain scale	
Freezing	39.4 (4.4)
Frozen	26.2 (1.4)
Thawing	11.0 (1.0)
Disability scale	
Freezing	54.6 (5.1)
Frozen	76.0 (4.3)
Thawing	35.0 (1.0)
SF-36 scores	
Physical component summary	
Freezing	38.5 (1.1)
Frozen	30.9 (3.7)
Thawing	79.5 (1.0)
Mental component summary	
Freezing	31.2 (1.0)
Frozen	28.1 (0.5)
Thawing	85.6 (1.0)

[a] Kruskal-Wallis H test; Post-hoc adjustment method (Dunn-Bonferroni), All differences were significant at 1% level

Multiple regression analysis further clarified predictors of mental health-related QoL (Table 4). The physical component summary ($\beta=0.900$, $P <0.001$) and duration of adhesive capsulitis ($\beta=0.185$, $P <0.001$) were significant positive predictors of the mental component summary. Meanwhile, the DASH score was a significant negative predictor ($\beta=-0.170$, $P=0.001$). The model accounted for 96% of the variance in mental health outcomes (Adjusted $R^2=0.96$).

Discussion

Adhesive capsulitis is a chronic, debilitating musculoskeletal disorder that substantially affects health-related QoL depending on the stage. This study specifically explored this impact in a high-risk group diabetic patients with adhesive capsulitis of the dominant shoulder. Our results not only confirm a significant decline in QoL but also demonstrate a clear temporal progression in disability type, shifting from an initial pain-focused phase to a later stiffness-

Table 2 Distribution of patients by stages of adhesive capsulitis and pain score according to visual analogue scale, disabilities of the arm, shoulder and hand score, and shoulder pain and disability index (n=80)

Stages of adhesive capsulitis	Freezing	Frozen	Thawing	P[a]
Visual analogue scale	7.5 (0.9)	5.6 (0.5)	1.0 (0.0)	0.001
Disabilities of the arm, shoulder and hand	80.3 (6.3)	73.1 (5.6)	10.0 (0.0)	0.001
Shoulder pain and disability index	78.0 (2.9)	78.6 (3.4)	35.4 (1.5)	0.427

[a] Kruskal-Wallis H test; Values are mean (standard deviation); Post-hoc adjustment method (Dunn-Bonferroni)

focused phase, with the latter having the most significant overall effect on physical and psychological health.

Table 4 Multiple regression model of mental component summary with physical component summary, visual analogue scale, shoulder pain and disability index, disabilities of the arm, shoulder and hand among the respondents (n=80)

Independent variables	Unstandardized Coefficients β	Standardized Coefficients β	Partial Correlations	P
Visual analogue scale	-0.24	-0.036	-0.082	0.493
Shoulder pain and disability index	0.197	0.161	0.219	0.064
Disabilities of the arm, shoulder and hand	-0.123	-0.170	-0.373	0.001
Physical component summary	1.08	0.900	0.823	<0.001
Age	0	0	-0.001	0.994
Duration of adhesive capsulitis	0.529	0.185	0.446	<0.001
Sex	-0.694	-0.031	-0.051	0.669
Education	0.228	0.026	0.066	0.582
Occupation	-0.661	-0.043	-0.091	0.447

Dependent variable: Mental component summary; Adjusted R2 = 0.96

The established association between adhesive capsulitis and diabetes mellitus is evident in our cohort, in which all participants had a confirmed diabetes mellitus diagnosis [3, 4]. Although detailed data on the duration of diabetes were not formally analysed due to inconsistencies in data collection methods, the literature strongly supports the conclusion that prolonged hyperglycemia, along with associated microvascular and collagen abnormalities, contributes to the development and severity of capsular fibrosis [4, 10]. The demographic composition of our sample—primarily older women of lower socioeconomic status provides essential context. However, it is essential to note that socioeconomic variables were only described and not included in the inferential analyses, as the validity and standardization of their measures were not ensured within the scope of this study.

The distribution of participants across disease stages freezing, frozen and thawing likely reflects real-world healthcare-seeking patterns, in which patients most often seek treatment during the highly symptomatic freezing phase [6]. This distribution also highlights the chronic nature of adhesive capsulitis, with only a few individuals achieving full resolution during the study's cross-sectional observation period [15].

Our results reveal distinct, stage-specific profiles of pain, disability, and QoL impairment. The freezing stage was characterised by the most intense pain, as indicated by peak VAS and SPADI pain scores. This phase also corresponded to the highest level of overall upper-limb disability, as reflected by the maximum DASH score. This aligns exactly with the clinical understanding of the initial, inflammatory pain-focused phase of adhesive capsulitis [6]. In contrast, progression to the frozen stage was characterised by a notable decrease in pain, yet it exhibited the greatest shoulder-specific functional disability, as indicated by the peak SPADI-disability score. Importantly, this stage was linked to the most severe decline in overall QoL, with both the physical and mental component summaries of the SF-36 reaching their lowest points. This pattern indicates that while pain primarily drives early suffering and overall dysfunction, the intense stiffness and mechanical restriction during the frozen stage.

The multiple regression model, which explained 96% of the variance in mental health-related QoL, identified the physical component summary as the most significant positive predictor, underscoring the close association between physical and mental well-being in chronic musculoskeletal disease [16]. Additionally, although adhesive capsulitis duration was a significant positive predictor in the model, the DASH score a measure of overall upper-limb disability was a significant negative predictor, indicating that general functional impairment affects mental health outcomes beyond the shoulder joint.

These findings sharpen the clinical understanding of disability in adhesive capsulitis. The high DASH score during the freezing stage shows that severe pain significantly hinders integrated arm function. Conversely, the peak SPADI-disability score in the frozen stage indicates the specific mechanical failure of the stiffened glenohumeral joint. This distinction has direct therapeutic implications: during the freezing stage, management should focus on aggressive multimodal pain control to enable patient participation in rehabilitation, whereas the frozen stage requires targeted, persistent manual therapy and mobilization techniques aimed at restoring joint mechanics and functional capacity [8].

The SF-36 results effectively quantify the multidimensional burden of adhesive capsulitis. The significantly decreased scores across both physical and mental health domains during the active disease stages, especially the frozen phase, confirm that adhesive capsulitis is not merely a localised orthopedic condition but a substantial determinant of overall health status. The notable normalisation of scores during the thawing stage strongly suggests that resolution of capsular pathology is directly linked to the restoration of QoL. This underscores the importance of incorporating patient-reported outcome measures, such as the SF-36, into routine clinical assessment to fully understand the disease burden and guide patient-centered management strategies [16].

This study's strengths include the use of multiple validated tools to provide a thorough, patient-centered clinical assessment, a focus on the dominant shoulder in a diabetic population in a low-resource setting an understudied context and the use of advanced statistical methods to clarify predictive relationships. However, limitations must be acknowledged. The cross-sectional design prevents causal conclusions about disease progression. The small sample size, especially during the thawing stage, restricts the generalizability of the results for that phase. The purposive sampling approach may introduce selection bias. Importantly, although some demographic and

clinical variables were collected, they were not included in formal multivariate models because of concerns about their measurement validity and consistency, which limits the ability to examine their potential moderating or mediating effects.

Despite these limitations, this study provides valuable clinical insights. It highlights the usefulness of clinical staging not only for prognosis but also for predicting the patient's primary challenge-whether pain or stiffness-and for assessing the resulting impact on QoL. This knowledge is essential for setting realistic treatment expectations, prioritising stage-specific rehabilitation goals, and ultimately improving functional and quality-of-life outcomes for diabetic patients with this disabling condition. The sample is predominantly female, older, and of lower socioeconomic status, which may limit the generalisability of the findings to other populations. Socioeconomic and duration-of-diabetes data were excluded from the analysis due to insufficient data collection validity.

Conclusion

Adhesive capsulitis of the dominant shoulder significantly affects QoL in patients with diabetes, which vary with stages. The freezing stage is marked by severe pain and overall upper-limb impairment, whereas the frozen stage is characterised by extreme stiffness, maximal shoulder dysfunction, and the most significant decline in both physical and mental health. The regression analyses showing physical health and overall disability as key predictors of mental well-being, emphasize the complex effects of this condition. Management strategies should be adjusted to target the main challenge at each stage such as aggressive pain management during the freezing phase and intensive mobilisation in the frozen phase. Patient-reported QoL measures in routine assessments can enhance clinical understanding, guide personalised treatment, and ultimately improve functional and mental outcomes for this vulnerable group.

Author contributions

Concept or design of the work; or the acquisition, analysis, or interpretation of data for the work: JJU, NN. *Drafting the work or reviewing it critically for important intellectual content:* FN, SC. *Final approval of the version to be published:* JJU, FN, NN, SC, MAA. *Accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved:* JJU, NN.

Conflict of interest

We do not have any conflict of interest.

Data availability statement

We confirm that the data supporting the findings of the study will be shared upon reasonable request.

Supplementary file

None

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