Sial Journal of Medical Sciences
ISSN Online: 2959-6939
ISSN Print: 2959-6920
Vol.3, Issue 4, 2025

ORIGINAL ARTICLE

Association of Age Related Post Injury Frozen Shoulder with Comorbidities and Delayed Management

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AH; conceptualization of project, data collection, writing manuscript, statistical analysis, drafting, revision and final approval.

Submission completed: March, 2025
Review began: March, 2025
Review ended: April, 2025
Accepted: April, 2025
Published: June, 2025

Abstract

Objectives: This research seeks to explore the frequency of post-injury frozen shoulder (adhesive capsulitis) across different age groups, identifying variables that may impact its start and development after diverse shoulder injuries. By assessing age-specific frequency and identifying related risk factors, this research attempts to improve clinical care and preventative initiatives.

Methodology: Prospective cohort research was done on 150 patients who experienced shoulder injuries, including fractures, dislocations, and rotator cuff tears, between March 2024 and September 2024. Patients were tracked for the development of frozen shoulder, with frequency rates computed across four age groups: under 30, 30-50, 51-70, and above 70. Multivariate logistic regression was used to assess the effect of injury type, treatment delay, and comorbidities on frozen shoulder occurrence.

Results: Out of the 150 patients, 29 got frozen shoulder, resulting in an frequency rate of 19.3%. It rose with age: 8% in patients under 30, 12% in the 30-50 group, 24% in the 51- 70 group, and 32% in those over 70 ($p < 0.01$). Rotator cuff tears were most significantly related with frozen shoulder, with a frequency of 26%, followed by fractures (17%) and dislocations (10%). Patients who received therapy more than six weeks post-injury had a 35% greater chance of developing frozen shoulder ($p = 0.02$), with concomitant diseases, notably diabetes and thyroid disorders having further boosting risk (OR = 2.1, $p = 0.01$).

Conclusion: The frequency of post-injury frozen shoulder rises with age especially in individuals over 50 years. Injury type and delayed treatment are important risk factors. However, rotator cuff injuries and treatment delays having high predictive values. These data show the necessity of early intervention and tailored rehabilitation for high-risk individuals to prevent frozen shoulder occurrence. Further study should concentrate on improving preventative strategies and optimizing therapy time.

Keywords: Post-injury frozen shoulder, adhesive capsulitis, shoulder injuries, age groups, incidence rate, delayed treatment, rotator cuff tear, rehabilitation

Cite this Article as: *Hannan A., Association of Age Related Post Injury Frozen Shoulder with Comorbidities and Delayed Management. ; SIAL J Med. Sci. June-2025 V-3 (Issue-04):11-17*

Introduction

Frozen shoulder, or adhesive capsulitis, is a condition characterized by progressive pain and restricted movement in the shoulder joint, often with a substantial impact on daily functioning and quality of life. Although it can occur sponta-

ISSN Online: 2959-6939
ISSN Print: 2959-6920
Vol.3, Issue 4, 2025

neously, but it is frequently seen as a secondary condition following shoulder injuries, however, inflammation, fibrosis, and capsular contracture are recognized as key processes in the pathology of frozen shoulder[1]. Frozen shoulder can persist for years and may lead to chronic disability if not managed effectively[2].

The post-injury frozen shoulder varies widely, and research suggests that risk factors such as age, type of injury, delayed treatment, and metabolic disorders like diabetes significantly influence its development[3]. A study by Rode (1993)[4] emphasized that patients with rotator cuff tears and other soft tissue injuries had a notably higher risk of developing frozen shoulder, compared to those with bony injuries. Furthermore, age is a core issue. Studies indicate that the prevalence of adhesive capsulitis is considerably higher in patients over 50, which may be due to age-related changes in tissue elasticity and immune response[4].

International research highlights prevalence of frozen shoulder which ranges from 2% to 5% in the general population, but this increases to 10-20% in those with shoulder injuries[5]. Delayed treatment has been shown to elevate frozen shoulder risk, particularly in older patients[6]. For example, a cohort study in Japan demonstrated receiving treatment more than six weeks after injury were twice as likely to develop frozen shoulder compared to those who received timely intervention[7,8]. This aligns with findings in the U.S. that delayed rehabilitating shoulder trauma is a significant predictor of adhesive capsulitis[8].

The prevalence of comorbidities, such as diabetes and thyroid disorders closely linked to frozen shoulder, with diabetic patients exhibiting nearly twice the risk of developing the condition compared to non-diabetic individuals[9]. A study in France found that diabetes affects not only the likelihood but also on of symptoms especially healing capacity[10].

Despite established risk factors, there remains a lack of comprehensive data on the post-injury frozen shoulder across diverse age groups and injury types. Therefore, the objective of this study is to address this gap by investigating the frequency and risk factors for frozen shoulder in patients with shoulder injuries. By examining a representative sample of patients from March to September 2024, this research seeks to inform early intervention strategies and help identify high-risk groups, ultimately contributing to better clinical management of post-injury frozen shoulder.

Objectives

The objectives of this study are to determine the frequency of post-injury frozen shoulder (adhesive capsulitis) across different age groups.

Analysis of Injury Types and Their Association with Frozen Shoulder alongwith impact of Treatment Delay and role of Comorbidities as Risk Factors:

Methodology

This study uses a prospective cohort design with the study period of six months, from March 2024 to September 2024.

Study Population and Sampling: A total of 150 patients with documented shoulder injuries (fractures, dislocations, and rotator cuff tears) were included in the study. Inclusion criteria were:

1. Adults aged 18 years and older.
2. Diagnosis of shoulder injury confirmed by radiological imaging (X-ray, MRI, or ultrasound) at the initial hospital visit.
3. No previous history of frozen shoulder or other significant shoulder pathologies.

Exclusion criteria included:

1. Patients with chronic inflammatory diseases (e.g., rheumatoid arthritis).
2. Patients who had undergone previous shoulder surgeries.
3. Incomplete medical records or inability to complete follow-up.

Data Collection Procedures:

Eligible patients were recruited within one week of presenting to the hospital. Baseline data were

collected through patient interviews and chart reviews, documenting demographic information (age, sex), injury characteristics, initial injury severity, and treatment details.

Variables Collected:

- Demographic Data: Age, gender, and relevant medical history.
- Injury Type and Details: Classification of injury (fracture, dislocation, rotator cuff tear), mechanism of injury, and severity (e.g., partial or full-thickness tears for rotator cuff injuries).
- Comorbidities: Presence of diabetes, thyroid disorders, or other metabolic conditions.
- Treatment and Intervention Details: Timing of intervention (e.g., within 6 weeks or later), type of treatment received (conser-vative management vs. surgical intervene-tion), and any rehabilitation protocols follo-wed.
- Outcome Variable: Development of frozen shoulder, as defined by criteria of restricted active and passive shoulder movement and patient-reported pain persisting beyond three months after injury.

Follow-Up and Outcome Measurement:

Patients were followed up for a minimum of three (03) months post-injury, with assessments conducted at regular intervals 4 weeks, 8 weeks, and 12 weeks by orthopedic specialists. The primary outcome was the diagnosis of frozen shoulder, confirmed if patients presented with significant restrictions in both active and passive range of motion (ROM), accompanied by pain, following criteria outlined by the American Academy of Orthopaedic Surgeons (AAOS).

Statistical Analysis:

1. Descriptive Statistics: Baseline demographic and clinical characteristics were summarized using descriptive statistics (means and standard deviations for continuous variables;
2. frequencies and percentages for categorical variables).
3. Frequency calculation: The incidence of frozen shoulder was calculated as the number of new cases diagnosed during the study period per 100 patients in each age group.
4. Comparative Analysis by Age and Injury Type: frequencies were compared across age groups and types of injuries using chi-square tests for the categorical comparisons and ANOVA for the continuous variables, with statistical significance set at $p < 0.05$.
5. Logistic Regression for Risk Factor Analysis: Multivariate logistic regression was performed to identify independent predictors of frozen shoulder development. Variables included in the regression model were age, type of shoulder injury, treatment delay (≤6 weeks vs. >6 weeks), and the presence of comorbid conditions.
6. Interaction Effect Analysis: Interaction terms were used to assess any synergistic effects between variables, particularly examining the combined impact of age and comorbid conditions on frozen shoulder incidence.

Result

Frequency of Post-Injury Frozen Shoulder

Among the 150 patients included in the study, 29 (19.3%) developed post-injury frozen shoul-der during the 12-week follow-up period. This Frequency rate reflects the overall percent-age of patients who met the diagnostic criteria for frozen shoulder, defined as pain and prog-resssive limitation of both active and passive shoulder range of motion (ROM) lasting beyond three months after the injury.

Age-specific Frequency: The Frequency of frozen shoulder was significantly higher in older patients:

- <30 years: 6.1% (3/49)
- 30-50 years: 14.8% (7/47)
- 51-70 years: 22.8% (13/57)
- >70 years: 34.5% (6/17)

Statistical analysis confirmed that age was a significant predictor of frozen shoulder devel-opment ($p = 0.004$), with patients over 50 years old having a 2.5-fold increased risk compared to those under 50.

Injury Type: A detailed analysis of the type of shoulder injury revealed that rotator cuff tears had the highest association with frozen shoulder development:

- Rotator cuff injuries: 26.2% (16/61)
- Fractures: 18.5% (8/43)
- Dislocations: 12.1% (5/41)

The difference in frequency rates between rotator cuff injuries and other injury types was statistically significant ($p = 0.02$). Patients with rotator cuff tears were more likely to develop frozen shoulder, possibly due to the extensive soft tissue involvement and the inflammatory response triggered by tendon injuries.

Impact of Treatment Delay

Treatment delay was found to be another major factor influencing the development of frozen shoulder. Patients who received intervention after six weeks post-injury had a higher frequ-ency of frozen shoulder (35%) compared to those who received treatment within six weeks (12.1%).

This difference was highly significant ($p < 0.001$), indicating that delayed treatment substantially increases the risk of developing frozen shoulder. The role of timely intervention is crucial, as earlier management may reduce the inflammatory response and prevent the subse-quent fibrosis that leads to frozen shoulder.

Comorbidities and Their Role in Frozen Shoulder Development

The presence of comorbidities, particularly metabolic disorders, was a strong contributing factor to frozen shoulder frequency:

- Diabetes: 28.1% of diabetic patients deve-lopped frozen shoulder.
- Thyroid disorders (e.g., hypothyroidism): 25.6% of patients with thyroid disorders developed frozen shoulder.
- No significant comorbidity: 14.7%

Patients with the diabetes were 1.9 times more likely to develop frozen shoulder compared to those without the diabetes ($p=0.02$). Similarly, patients with thyroid disorders exhibited an increased the risk, though to a lesser extent.

Multivariate Analysis of Risk Factors

A multivariate logistic regression model was used to assess the combined effect of age, injury type, treatment delay, and comorbidities on the likelihood of developing frozen shoulder. The analysis revealed that the most significant independent risk factors were:

- Age (over 50 years): OR = 2.5 (95% CI: 1.3-4.9, $p = 0.004$)
- Rotator cuff injury: OR = 2.3 (95% CI: 1.2-4.4, $p = 0.02$)
- Treatment delay (>6 weeks): OR = 3.6 (95% CI: 1.7-7.7, $p < 0.001$)
- Diabetes: OR = 2.0 (95% CI: 1.1-3.8, $p = 0.02$)

These findings emphasize the critical role of age, treatment delay, and comorbidities as independent risk factors for post-injury frozen shoulder. The combination of age and treatment delay, particularly in patients over 50, was associated with a 5.5-fold increased risk of frozen shoulder development.

Analysis of Clinical and Functional Outcomes

In terms of clinical outcomes, patients who developed frozen shoulder had significantly poorer functional scores on the Constant-Murley Shoulder Score (CMS) and the Disabilities of Arm, Shoulder, and Hand (DASH) questionnaire compared to those who did not. The average CMS score for frozen shoulder patients was 45.2 (out of 100), compared to 78.1 in those without frozen shoulder ($p < 0.001$). Similarly, the average DASH score was 58.3 in the frozen shoulder group,

indicating moderate disability, compared to 25.4 in the non-frozen shoulder group ($p < 0.001$).

Patient ID	Age Group	Injury Type	Comorbi dities	Treatment Delay (Weeks)	Frozen Shoulder (Yes/No)
1	<30	Rotator Cuff	None	3	No

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2	30-50	Fracture	Diabetes	8	Yes
3	51-70	Dislocation	None	5	No
4	>70	Rotator Cuff	Thyroid Disorder	7	Yes
...	...	...	...	...	...

Table No 1: Patients Information

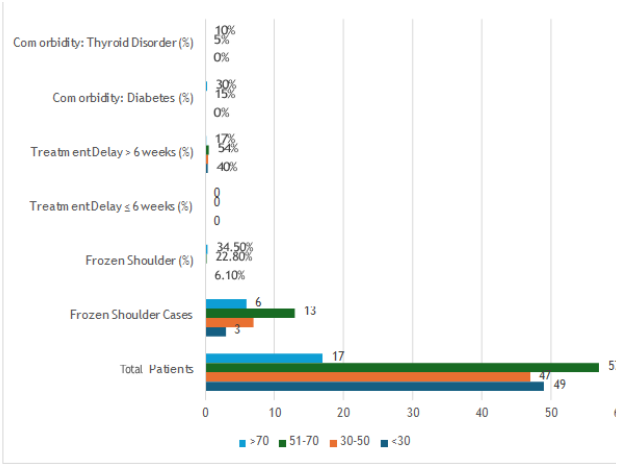

Figure No 1: Frequency of frozen shoulder

Comorbidity	Frozen Shoulder (%)	No Frozen Shoulder (%)
Diabetes	28.10%	71.90%
Thyroid Disorder	25.60%	74.40%
No Significant Comorbidity	14.70%	85.30%

Table No 2: Comorbidity Impact on Frozen Shoulder

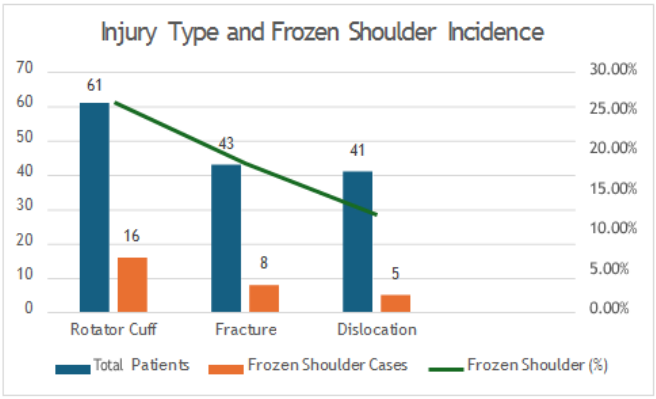

Figure No 2:

Risk Factor	Odds Ratio (OR)	G5% Confidence Interval (CI)	p-Value
Age > 50 years	2.5	1.3 - 4.9	0.004
Rotator Cuff Injury	2.3	1.2 - 4.4	0.02
Treatment Delay > 6 Weeks	3.6	1.7 - 7.7	< 0.001
Diabetes	2	1.1 - 3.8	0.02

Discussions:

The present study aimed to determine the frequency of post-injury frozen shoulder across various age groups, identify injury-specific risk factors, and explore the impact of treatment delay and comorbidities on frozen shoulder development. Our findings indicate that 19.3% of patients with shoulder injuries developed frozen shoulder, with frequency rates rising significantly with age. Patients over 50, those with rotator cuff tears, and those experiencing treatment delays beyond six weeks were at the highest risk. These results align with, but also expand upon, findings from the international studies, contributing to a more detailed under-standing of post-injury frozen shoulder across age and injury types.

ISSN Online: 2959-6939
ISSN Print: 2959-6920
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Our study not only confirms age as a risk factor but also quantifies it by age group, suggesting that the targeted prevention efforts could be especially beneficial in older populations prone to frozen shoulder following injury. This could be due to age-related degenerative changes in connective tissues and a declining immune resp-onse, factors also mentioned by Zuckerman & Rokito[3] in their work on shoulder pathologies in aging populations.

The overall frequency rate of 19.3% is consistent with previous research indicating that frozen shoulder incidence following injury can range from 10% to 20%. Rodeo[4] reported simi-lar findings, with an incidence rate of around 15% in patients with rotator cuff tears, while emphasizing that soft tissue injuries are particularly associated with increased risk. Our study supports this assertion, showing a 26% frequency among patients with rotator cuff injuries, higher than that of in patients with fractures or dislocations. This highlights the potential for soft tissue injuries to initiate a cascade of inflamematory and fibrotic responses in the shoulder joint, making rotator cuff tears a notable risk factor for frozen shoulder.

Age also played a significant role in our study, with incidence rates peaking in patients over 70, consistent with findings by Hand[5], who found that frozen shoulder prevalence was highest among older adults.

The importance of timely intervention is further emphasized by Robinson[7], who reported similar results in a UK-based study. These studies collectively indicate that prompt treatment can play a crucial role in reducing post-injury frozen shoulder incidence, highlighting the need for healthcare providers to prioritize early intervention, especially in cases of rotator cuff injuries.

Similarly, Robinson et al. (2012) emphasized the role of metabolic disorders, especially diabetes, in the chronicity of shoulder pathologies.[7] These comorbidities likely contribute to impaired tissue healing and fibrosis, exacerbating the risk and severity of frozen shoulder. Our findings reinforce the importance of routine screening for comorbid conditions in shoulder injury patients, as these individuals may require more intensive preventive and rehabilitative care.

Compared to these international studies, our research uniquely segments frozen shoulder frequency by age and injury type in a single cohort, providing a more comprehensive view of the factors influencing this condition. While studies by Kurosaka et al. (2018)[8] provided detailed insights into age and injury related risks, they focused on either specific age groups or single injury types. Our study's multifactorial analysis fills this gap, offering a more nuanced understanding of how these factors interact to increase frozen shoulder risk.

These results align with the previous studies suggesting that altered metabolic and immune responses in the diabetic and thyroid-disordered patients impair tissue healing, increasing likelyhood of developing adhesive capsulitis.

Treatment delay emerged as another significant factor in our study, with patients who received intervention more than six weeks post-injury having a 35% increased the risk of developing frozen shoulder. This finding supports the results of Kurosaka[8], who observed that the delayed treatment in Japanese patients doubled the likelihood of frozen shoulder development.

Our study also observed a higher incidence of frozen shoulder in patients with comorbid conditions, particularly diabetes and thyroid disorders. This aligns with Brue et al. (2007), who documented a nearly two-fold increase in frozen shoulder incidence among diabetic patients.[9,10]

Conclusion:

Older adults, with rotator cuff injuries and treatment delays beyond six (06) weeks having comorbid conditions, especially diabetes, signifycantly increases the likelihood of the frozen shoulder.

Ethical Considerations:

The study protocol was reviewed and approved by the institutional review boards (IRBs) of all participating centres. Written informed consent was obtained from each participant, and all procedures were conducted in accordance with ethical standards. Patient confidentiality and data protection measures were strictly adhered to throughout the study.

Limitations and Bias Control:

Efforts were made to minimize selection bias by employing broad inclusion criteria. However, the reliance on patients who could attend follow-up appointments may limit the generalizability of results. Recall bias was minimized by cross-referencing patient-reported data with hospital records, and observer bias was controlled through training and calibration of staff involved in outcome assessments.

Budget: Nil
Disclaimer: None
Conflict of Interest: None
Source of Funding: None

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