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Prevalence of Diabetes and Its Effect on the Course and Treatment of Frozen Shoulder

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Abstract

Background: Frozen shoulder is a painful condition that can lead to long-term disability. The frequency of frozen shoulder among diabetic patients is about 10% to 39%. Diabetics have a higher prevalence of frozen shoulder than the general population, and these individuals are less responsive to therapy and have a larger range of motion limitation. **Aim:** The aim of this thesis is to determine the prevalence of diabetes among patients with frozen shoulder and to compare them in terms of demographics, clinical and treatment features. **Method:** This study was performed on patients who had been diagnosed with frozen shoulder at an orthopedic center in Mashhad, Iran, from 2012 to October 2021. The frequencies and cross tabulations were used to analyze the data by SPSS to determine the significance of relationships. The chi-square and t-tests have been used with a p-value less than 0.05 as the alpha level of significance. **Results:** Among the patients, the average age was 56 years old. Among 310 patients with Frozen shoulder, 36% were diabetic. There was no statistically significant difference in gender and level of activity between patients with and without diabetes. In contrast, the side of the affected shoulder, duration of frozen shoulder, stage of frozen shoulder and treatment of frozen shoulder were statistically significantly different between the two groups ($p < 0.001$). There also were statistically significant differences between treatment of frozen shoulder in patients with good and bad control diabetes groups ($p < 0.001$). **Conclusion:** Based on this study, around one-third of frozen shoulder patients have diabetes. Although there was a statistically significant difference in the treatment of frozen shoulder between patients with and without diabetes groups, diabetic individuals have a more severe course of illness, and their treatment is less effective.

Keywords

Frozen Shoulder, Diabetic, Non-Diabetic

1. Introduction

In 1934, Codman created the term "frozen shoulder." and described it as a progressive shoulder pain that is accompanied by sleep difficulties on the affected side [1] [2]. In addition, frozen shoulder (FS), also known as adhesive capsulitis (AC), is a painful condition that can lead to long-term disability [3].

Prevalence of frozen shoulder is estimated to be about 2% to 5.3% in general population and about 10% to 39% among diabetic patients [4] [5] [6]. Frozen shoulder is more common in women and those over the age of 40 [7] [8] [9].

A frozen shoulder is classified clinically into three stages. The first stage (freezing) is characterized by moderate to severe shoulder discomfort and stiffness that lasts around 2 - 9 months. The severity of the discomfort decreases, but the stiffness in the shoulder worsens. The length of the second stage of the sickness (frozen) is around 4 - 14 months. The third stage (thawing) is when the symptoms progressively subside and the limited mobility in the shoulder joint begins to heal. This period lasts around 5 to 24 months [10].

There are many ways to treat this condition, including benign neglect, supervised physical therapy, nonsteroidal anti-inflammatory drugs, oral corticosteroids, intraarticular steroid injections, distention arthrography, closed manipulation, open surgical release, and arthroscopic capsular release [11]. The goal of therapy should be to reduce discomfort, reduce inflammation, and educate the patient.

Primary frozen shoulder is frequently related to various diseases and conditions, including diabetes mellitus, and it might be a diabetic patient's initial screen [12].

Shoulder pain and other consequences of diabetes may be reduced if the disease is diagnosed and treated early in its progression [13].

According to Czelusniak, Patricia *et al.*, there is a correlation between length and diabetes control as determined by hemoglobin A1c (HbA1C) and fasting blood sugar (FBS) [14].

Diabetes patients have a higher prevalence of frozen shoulder than the general population and these individuals are less responsive to therapy and have a larger range of motion limitation [15].

According to one study, the prevalence of frozen shoulder among diabetic patients was 13.30 percent [16].

Higher rates of frozen shoulder have been linked to diabetes mellitus, and it has been suggested that this is because higher systemic levels of glucose speed up glycosylation, which leads to higher rates of frozen shoulder and other soft tissue disorders like Dupuytren's disease [17].

High HBA1C is linked to the development of frozen shoulder in people with diabetes [18].

Arthroscopic biopsies of synovium from diabetic patients show more endothelial growth factors than in non-diabetic frozen shoulder and less inflammatory growth factors, like ADAMTS-4, MMO-1, and especially M-CSF [17]. This

may be what causes the inflammatory response to slow down, which makes the disease last longer and get worse. Some studies, however, have found that inflammatory markers are not much different between diabetic and non-diabetic people. It's important to know that studies that use arthroscopic biopsies only look at the most severe and stubborn cases of frozen shoulder that need surgery.

The research on frozen shoulder in diabetics is critical because for many diabetics, musculoskeletal disorders may make it difficult to maintain regular exercise routines, which is essential in managing the disease and enhancing overall health and well-being. These conditions aren't exclusive to diabetics since they affect non-diabetics as well [19].

2. Aims

The main aim of this thesis was to find the prevalence of diabetes patients among frozen shoulder patients.

Furthermore, look for any difference between diabetic and non-diabetic patients in terms of demographics, clinical and treatment features.

3. Methods

3.1. Participants

This retrospective study was performed among patients who had been diagnosed with frozen shoulder at orthopedic center at Imam Reza University and Sina hospitals in Mashhad, Iran, from January 2012 to October 2021. The sample population in this study consisted of patients with frozen shoulder of ages ranging from 35 to 77 years. All the patients' data were recorded after physical examination and taking history. Subsequently, all patients with frozen shoulder were treated with medication, except for those with severe disabilities (phase II) and who needed to return to normal physical activity earlier that were treated by combined medication and physiotherapy. Also, refractory cases underwent arthroscopic surgery.

In addition, frozen shoulder was categorized into three stages: group I are patients with pain and limited shoulder rotation; group II are patients with pain and significant restriction in all directions; and patients with symptoms improvement were assigned to group III [20].

Also, diabetic patients were diagnosed based on their FBS and HbA1C. Also, patients' glycemic control was assigned as good or poor diabetes control using HbA1C. All of the diabetics were under treatment with either insulin or medicine for at least two years. The patients' information was extracted from the clinic's archive file, where all the information on the examination, history and paraclinical tests was recorded.

Independent variables included sex (male/female), mode of anti-diabetic medication (insulin-dependent/non-insulin-dependent), treatment of Frozen shoulder (Medication, Medication + Physiotherapy, Medication + Physiotherapy + Arthroscopy), affected shoulder (Right/Left/Bilateral), age (Year), Duration of

Diabetes (Year) and duration of frozen shoulder (Week) and dependent variable was only diabetes.

3.2. Inclusion Criteria

All the patients with diagnostic signs of frozen shoulder such as progressive stiffness, dryness, severe pain, limitation of active and passive external rotation of shoulder, and normal shoulder imaging and laboratory tests (imaging and laboratory tests were done to rule out other pathologies) were included in the study.

3.3. Exclusion Criteria

Individuals with shoulder stiffness and limited movement due to osteoarthritis, rheumatoid arthritis, post-traumatic stiffness, post-operative stiffness, severe physical illness (new myocardial infarction), pregnant women, calcified tendonitis were excluded from the study.

3.4. Statistical Analysis

Statistical analysis was done using IBM SPSS Statistics for macOS, version 28.0.1.1. (IBM, 2022). Frequencies, cross tabulations, chi-square, t-tests, ANOVA are used to analyze the data. Normal distribution was determined using the Kolmogorov-Smirnov Test (K-S test). P-value of less than 0.05 is set as the alpha level of significance.

4. Results

The number of patients studied was 310, of which 173 were women and 137 were men. There were 197 non-diabetics and 113 diabetics.

Out of 113 diabetic people, 35 people were insulin dependent and 42 people had poor control.

The demographic and clinical characteristics of the frozen shoulder patients are summarized in Table 1(a) and Table 1(b). The mean age of the patients was 56 years old. Based on Table 1(a), there were more females than males with frozen shoulders in this study group (56% vs. 44%), right shoulder (52%) is more affected than left side (41%). Also, 7% of patients suffered from bilateral frozen shoulder.

Among all 310 patients with frozen shoulder 197 patients were non-diabetics and 113 were diabetics. Based on our results, among patients with frozen shoulder the prevalence of diabetics is 36%.

Also, among those with diabetes, 31% were insulin-dependent and 69% were non-insulin dependent. Additionally, more than half of the diabetic patients (63%) had good control diabetes (based on their HbA1C test results checked by physicians).

Of the 310 frozen shoulder patients, 175 (57%) had stage I Frozen Shoulder while 112 (36%) had stage II and 23 (7%) had stage III.

Table 1. (a) Demographic data in patients suffering from frozen shoulder; (b) Demographic data in patients suffering from frozen shoulder.

(a)

Characteristics	Category	Frequency/Percent
Gender	Female	173 (56%)
	Male	137 (44%)
Diabetes	No	197 (64%)
	Yes	113 (36%)
Insulin Dependent	No	78 (69%)
	Yes	35 (31%)
Glucose control	Good Control	71 (63%)
	Poor control	42 (37%)
Affected Shoulder	Right	162 (52%)
	Left	127 (41%)
	Bilateral	21 (7%)
Stages of FS	Freezing (Stage I)	175 (57%)
	Frozen (Stage II)	112 (36%)
	Thawing (Stage III)	23 (7%)
Treatment Of FS	Medication	137 (44%)
	Medication + Physiotherapy	161 (52%)
	Medication + Physiotherapy + Arthroscopy	12 (4%)
Level of Activity based on Occupation	High	160 (52%)
	Low	150 (48%)

N: Number/%: percentage/FS: Frozen shoulder

(b)

Characteristics	Mean/SD
Duration of FS (Week)	6.5 (3.9)
Duration of Diabetes (Year)	12 (5.3)
Age (Year)	56 (8.3)

SD: standard deviation/FS: Frozen shoulder.

One Hundred thirty-seven (44%) patients were treated with the medication, 161 (52%) used a combination of medication with physiotherapy and others 12 (4%) were treated with medication and physiotherapy and arthroscopic surgery. All frozen shoulder patients had a mean duration of frozen shoulder of 6.5 weeks.

The comparison of demographic and clinical characteristics between diabetics and non-diabetic groups are shown in Table 2.

There was no statistically significant difference in gender between those with

Table 2. Comparison of demographic and clinical characteristics between diabetics and non-diabetic groups.

Variables	Category	Non-Diab. (N)	Diab. (N)	P value
Gender	Female	104	69	0.158#
	Male	93	44	
Affected Shoulder	Right	100	62	<0.001*#
	Left	96	31	
	Bilateral	1	20	
Stages of FS	Freezing (Stage I)	133	42	<0.001*#
	Frozen (Stage II)	58	54	
	Thawing (Stage III)	6	17	
Level of activity Based on Occupation	High	101	49	0.180#
	Low	96	64	
Treatment Of FS	Medication	118	19	<0.001*#
	Medication + Physiotherapy	74	87	
	Medication + Physiotherapy + Arthroscopy	5	7	
Duration of FS/Week		197	113	<0.001*+

*Statistically significant ($p \leq 0.05$) difference between groups/# Pearson Chi-square test used /+ student t-tests used.

and without diabetes (p-value = 0.158). In contrast, the side of affected shoulder, duration of frozen shoulder, stage of frozen shoulder and treatment of frozen shoulder were statistically significant difference between two groups ($p < 0.001$).

The number of both right and left affected side is more in non-diabetic group, but bilateral disease is more in diabetic group. Stage I frozen shoulder is more common in the non-diabetic group, but stage II and III are more common in diabetics.

Medical treatment in the non-diabetic group and medical treatment, physical therapy, physical therapy and surgery in diabetics are more. The duration of frozen shoulder is longer in the group without diabetes.

In this study, there was no difference in the level of activity based on occupation between those with and without diabetes.

According to Table 2, among all diabetic patients there was no difference between the duration of diabetes and various stages of frozen shoulder, meaning that stages of frozen shoulder are not affected by duration of diabetes.

Table 3 showed there was statistically significant difference between the treatment of frozen shoulder in poor and good glycemic control groups ($p < 0.001$). In poor control diabetic patients treatment of frozen shoulder was difficult and 81% had medication with physiotherapy, 14% had medication, physiotherapy, arthroscopic surgery, and only 5% had medication. In good control diabetic patients,

Table 3. Association between treatment of frozen shoulder and glycemic control group.

Treatment of Frozen Shoulder	Glycemic Control		*P* value
	Poor Control	Good Control	
Medication	2 (5%)	17 (24%)	
Medication + Physiotherapy	34 (81%)	53 (75%)	<0.001*
Medication + Physiotherapy + Arthroscopic	6 (14%)	1 (1%)	

*Statistically significant ($P < 0.05$) difference between groups.

24% had medication, 75% medication with physiotherapy, and only 1% had medication, physiotherapy, arthroscopic surgery.

5. Discussion

In this study, we compared the prevalence of diabetic and non-diabetic patients among those with frozen shoulder. Based on our results, among patients with frozen shoulder, the prevalence of diabetics 36% was quite similar to an American study, where the prevalence was 39%, so, among patients with frozen shoulder the prevalence of non-diabetics is more than diabetics. [21] In contrast to our study, some studies showed that association between frozen shoulder and diabetes is minimal [17].

Our study revealed that the mean age of individuals with frozen shoulder is 56 years old. A clinical review by Dias R *et al.* found that "peak age" of patients with frozen shoulder is 56 years old; in addition, another study found that the mean age of the disease occurrence is 53 years old [20]. Another study conducted in Turkey discovered that the average age of frozen shoulder was between 40 to 60 years old [22].

Therefore, these previous studies confirm the result of our study meaning that this age group is at higher risk of shoulder disorders such as arthritis and frozen shoulder [23] [24].

Although diabetes may raise the risk of developing Adhesive Capsulitis for unknown reasons [25], various biological explanations have been presented. [26] It is believed that one of the reasons for high prevalence of frozen shoulder in diabetic group is related to micro vascular changes that happen due to high blood glucose which leads to nonenzymatic glycosylation of the vascular basement membrane. These micro vascular changes cause abnormal collagen repair, which predisposes patients to adhesive Capsulitis [20].

In this study, non-diabetic patients with frozen shoulder were mostly diagnosed with stages I and II; however, patients with frozen shoulder and diabetes were mostly diagnosed with stages II and III. These higher stages of frozen shoulder at the time of diagnosis in diabetics probably can be due to delay in diagnosis of frozen shoulder [13] because their shoulder pain can be mistaken for muscular pain and generalized weakness, which occur in the course of high blood sugar in diabetes. Also, lowering the pain threshold of diabetics due to di-

abetic neuropathy also causes a delay in referral and diagnosis.

Among all patients with frozen shoulder and diabetes, 14% of patients with good glucose control and 86% of patients with poor response were treated by medication, physiotherapy and arthroscopic. This higher percentage of patients who underwent the combination of medication, physiotherapy and arthroscopic in poor glucose control group shows that patients with higher blood sugar need more aggressive treatment. Therefore, the treatment of frozen shoulder is more difficult in diabetics than in non-diabetics, and it is more difficult in poorly controlled diabetics than in non-diabetics and well-controlled diabetics. This finding is a good guide in the treatment of frozen shoulder and indicates sufficient accuracy in examining and treating frozen shoulder in diabetic patients, especially diabetic patients with poor control. Although some studies revealed that shoulder pain in diabetes was often more resistant to conventional treatment, it can be resolved without any treatment in some cases and can improve from stage one to stage three (thawing) within a few months [27] [28] [29].

There are some studies that support these results [20] [30].

Similar to our results, previous studies have also shown that the frozen shoulder affect mostly women, which can be attributed to the different shoulder body composition and anatomy between females and males [7] [10] [13].

Although some studies have shown that the left side is more affected than the right side, there is a study which shows that the right shoulder was affected more commonly than the left one, which is similar to our results [20] [31]. The incidence of both upper limbs in diabetic patients is high compared to non-diabetic patients and it is 20 to 1.

The reason for right shoulder involvement can be due to the fact that this side is more active than the other one [32].

6. Study Limitations

Despite the efforts to conduct a perfect study, there were several limitations that impacted the study's accuracy such as the following:

The sample size was insufficient to generalize the results of the study.

The study was placed at the orthopedic center in Mashhad, Iran. Therefore, this research cannot be applied to the entirety of Iran.

There was no possibility that the physician misdiagnosed frozen shoulder and diabetic disease, since they diagnosed it based on the diagnostic and classification criteria. Otherwise, there could be a classification bias. In contrast, there was the possibility of an error when entering the patient's record. Patients' database did not include information on potential confounding variables such as lifestyle, body mass index (BMI), smoking habits, and alcohol consumption. The level of blood glucose might be confounder since it could affect both diabetes and frozen shoulder.

Lastly, diabetic duration was predicated on identifying events that led to each patient's diabetes diagnosis. If the patient joined the insurance plan after devel-

oping diabetes, his or her diabetic history wouldn't be known. This may have underestimated the time since the patient's first diagnosis.

I believe that further study is needed to determine the true impact of the link between frozen shoulder and diabetes, including paired groups, prospective cohort design, and control of confounding variables.

7. Conclusions

In the present study, around one-third of the frozen shoulder patients are diabetic, diabetic individuals have a more severe course of illness, and their treatment is less effective.

This is critical to increasing awareness of physicians about the higher occurrence of frozen shoulder n diabetics so that they consider that as one of the differential diagnoses in diabetic patients who complain about shoulder pain or decreased range of motion. Because the sooner the frozen shoulder is diagnosed, the better the outcome will be.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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