



## PREVALENCE OF MUSCULOSKELETAL COMPLICATIONS OF THE HAND IN TYPE 2 DIABETES MELLITUS PATIENTS

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### ABSTRACT

**Background:** Diabetes Mellitus (DM) is one of the most common metabolic disorders; it is a chronic disease that imposes enormous social and economic burdens. Several musculoskeletal complications have been linked to diabetes. These complications greatly affect the quality of patients' lifestyles, so it is necessary to early diagnose and treat these complications. **Objective:** This study aimed to determine the prevalence of musculoskeletal complications of the hand in patients with type 2 diabetes mellitus, and their relation to age, sex, duration of diabetes, and fasting plasma glucose levels. **Research Methods:** A cross-sectional study was conducted on 150 patients with type 2 diabetes mellitus at Tishreen University Hospital in Lattakia, between May 2022 to May 2023. **Results:** One hundred and fifty patients with type 2 diabetes were included in this study. The prevalence of musculoskeletal (MS) complications of the hand in those patients was 52%. The most common complication studied was trigger finger (TF) with an incidence of 18%, followed by limited joint mobility (LJM) and carpal tunnel syndrome (CTS) with the same prevalence of 16%, and Dupuytren's contracture (DC) at 2%. We found a statistically significant relation between type 2 diabetes mellitus and the incidence of musculoskeletal complications of the hand. Long duration of diabetes and poor glycemic control were associated with increased odds of these complications. Female gender was associated with increased odds of CTS, while there was no relation between age and these complications. **Conclusions:** Musculoskeletal complications of the hand are common in patients with type 2 diabetes, and their occurrence is often related to the duration of diabetes and poor glycemic control. A routine examination with a rheumatologist is necessary to detect and treat these complications.

**KEYWORDS:** Type 2 Diabetes Mellitus, Musculoskeletal complications, Limited Joint Mobility, Trigger Finger, Carpal Tunnel Syndrome, Dupuytren's Contracture.

### INTRODUCTION

Diabetes Mellitus (DM) is one of the most common metabolic disorders and a chronic disease that imposes enormous social and economic burdens due to the complications it can cause, which affect almost all body systems.<sup>[1]</sup> In 2019, the number of people diagnosed with diabetes was approximately 463 million (9.3% of the total world population), and the number of people diagnosed with diabetes is expected to reach approximately 700 million (10.9% of the total world population). By 2045, according to the World Health Organization.<sup>[1]</sup> The increase in the prevalence of diabetes is associated with an increasing proportion of the population, increasing rates of obesity, concomitant social changes, and a sedentary lifestyle.<sup>[1]</sup>

Diabetes leads to complications affecting all organs of the body, which are closely related to the duration of diabetes and the degree of its control. These complications can be classified into large vascular complications, Microvascular complications: affect about 80% of patients with diabetes, and appear in 20-50% of patients with type 2 diabetes upon diagnosis. Vascular complications include Diabetic nephropathy: which is the main cause of ESRD. Diabetic retinopathy: is the first cause of blindness in the world in the age group of 20-74 years. In addition, Diabetic neuropathy.<sup>[2,3]</sup>

Musculoskeletal complications are among the chronic complications of diabetes mellitus.<sup>[4]</sup> However, it has received less medical attention than life-threatening vascular complications. The occurrence of

musculoskeletal complications in the hands was observed in patients with diabetes in more than 30% of patients, and it can manifest in many forms, including Trigger Finger (TF), Dupuytren's Contracture (DC), Limited Joint Mobility (LJM), Carpal Tunnel Syndrome (CTS) and others. Musculoskeletal complications greatly affect the quality of life for patients, so early diagnosis and treatment significantly improve patients' quality of life.<sup>[5]</sup>

Most studies investigating the prevalence of musculoskeletal complications in patients with diabetes have been conducted in the Western world, and to a lesser extent in other parts of the world, despite the high prevalence of diabetes all around the world. Therefore, because of the little data available from Arab countries due to the paucity of such studies in this field, this study was conducted to determine the prevalence of musculoskeletal complications of the hand in patients with type 2 diabetes mellitus, and their relation to age, sex, duration of diabetes, and fasting plasma glucose levels in Syria.

## PATIENTS AND METHODS

Our cross-sectional study was conducted at a medical college hospital at Tishreen University in Syria between May 2022 to May 2023. We included 150 patients with type 2 diabetes mellitus diagnosed at least a year ago, according to the American Diabetes Association criteria,<sup>[6]</sup> who were attending endocrinology and rheumatology clinics and departments. We excluded any patient with a history of previous trauma to the hand, epilepsy, thyroid disorders, chronic rheumatic diseases, patients with advanced renal disease, and a family history of Dupuytren's contracture.

Demographic characteristics of patients were recorded, including sex and age; also, we obtained the following clinical information including duration of DM (in years), type of diabetic therapy (hypoglycemic agents and/or Insulin), and laboratory data: fasting plasma glucose levels of all patients.

Musculoskeletal complications of the hand (LJM, DC, TF, and CTS) were assessed by a rheumatologist using medical history and standardized physical examination and investigations if needed. Limited joint mobility was evaluated by the "tabletop sign" and "prayer sign" in which if one or more Interphalangeal or Metacarpophalangeal joints failed to make contact when the patient was asked to oppose the palmar surfaces of the fingers in a praying position with the wrist maximally flexed.<sup>[7]</sup> Dupuytren's contracture was diagnosed if there was one or more of the following four features on examination: a palmar or digital nodule, tethering of the palmar or digital skin, a pre-tendinous band, and a digital flexion contracture.<sup>[8]</sup> Trigger finger or flexor tenosynovitis was diagnosed if there was a palpable nodule or thickened flexor tendon over the Metacarpophalangeal joint with locking happening in

extension and flexion of any fingers. CTS was diagnosed based on clinical symptoms such as pain, dullness, aching discomfort, paresthesia, and dryness of the hand, in the area of the median nerve. These symptoms increase during sleep and improve by shaking the wrist. Tinel's and Phalen's signs with pinprick test were also performed on each patient who had symptoms suggestive of CTS.<sup>[9]</sup>

In our study, we relied on fasting plasma glucose values as a modest guide to glycemic control, given that HbA1c measurement was not always available in the hospital, based on the latest update from the American Diabetes Association.<sup>[10]</sup>

## Ethical consideration

All patients were provided complete and clear informed consent after a discussion about the study. This study was performed following the Declaration of Helsinki.

## Statistical Analysis

Analysis was done using the Statistical Package for Social Sciences (SPSS version 20). The quantitative variables were described as mean and standard deviation (SD), and the qualitative variables were described as frequencies and proportions. Sociodemographic and diagnostic variables were shown in both numbers and percentages. The relation between the prevalence of musculoskeletal complications of the hand and various variables was assessed using the Chi-square test. Multiple logistic regression analysis was performed to evaluate the multivariate association between hand complications and accompanying factors. Separate logistic regression models were created for each diabetic hand variable. A *P*-value < 0.05 was considered statistically significant.

## RESULTS

### Participant's characteristics

The study included 150 patients with type 2 diabetes. Out of them, 56 patients were males (37%) and 94 were females (63%). The mean age of the patients was  $57.9 \pm 10.04$  years. The median duration of diabetes was  $10.12 \pm 6.11$  years. 37.3% of our patients had more than 10 years of diabetes. 82.6% were treated with oral hypoglycemic medications. The mean fasting plasma glucose levels were  $195.17 \pm 62.6$  mg/dl. Poor glycemic control was noted in 50% of patients. Characteristics of study patients are shown in Table 1.

### Prevalence of musculoskeletal complications

Musculoskeletal complications of the hand were diagnosed in 78 (52%) out of 150 patients. Trigger finger (TF) was the most prevalent complication in 27 (18%) patients, followed by both CTS and LJM in the same number of cases in 24 (16%) patients, and DC was seen in 3 (2%) patients. Table 2 shows the prevalence of musculoskeletal complications among the study participants.

In the multivariate analysis, the factors that were significantly associated with hand complications were gender, duration of diabetes, and poor glycemic control. Females were more likely to have CTS, (p-value = 0.02, OR= 0.4), CI = [1.5 -1.7] Duration of diabetes also seemed to confer higher risk; thus patients having diabetes for more than 10 years were more likely to have hand complications like LJM (p = 0.002) and TF (p = 0.02), OR= 0.4, CI = [8.1 -11.1], but not DC and CTS. In

addition, poor glycemic control was a significant predictor of the presence of musculoskeletal complications (CTS, TF, and LJM) with P-values respectively (0.00004, 0.001, 0.004), OR= 0.12 and CI = [185.03 -205.3]. While age did not correlate with the studied complications status, p-value > 0.05, OR= 1.3, CI = [56.3 -59.5]. DC did not appear to have any correlation with the studied variables.

**Table 1: Characteristics of study patients with type 2 diabetes mellitus (n=150).**

Characteristics	N= 150
Age (years)	57.9 ± 10.04
Male: Female	56 (37%): 94 (63%)
Duration of type 2 diabetes (Years)	10.12 ± 6.11
Fasting plasma glucose levels (mg/dl)	195.17 ± 62.6
Musculoskeletal complications prevalence	78 (52%)
Data are mean±SD or number (%)	

**Table 2: Prevalence of musculoskeletal complications among the study participants.**

Name of the complication	Prevalence (N=150)
Limited Joint Mobility LJM	16% (24)
Trigger Finger TF	18% (27)
Carpal Tunnel Syndrome CTS	16% (24)
Dupuytren's contracture DC	2% (3)
Musculoskeletal complications prevalence	52% (78)
Data is expressed in numbers (%)	
There was a statistically significant relation between type 2 diabetes and the incidence of musculoskeletal complications of the hand in patients (P-value: 0.0004).	

**Table 3: Patients' distribution according to sex.**

	Male	Female
Number	56	94
%	37%	63%

**Table 4: Patients' distribution according to age (years).**

	28 – 40 years	41 – 60 years	61 – 86 years
Number	7	83	60
%	4.6%	55.3%	40%

**Table 5: Patients' distribution according to the duration of diabetes (years).**

	< 5 years	[5– 10] years	>10 years
Number	28	66	56
%	18.6%	44%	37.3%

**Table 6: Patients' distribution according to fasting plasma glucose levels (mg/dl).**

	[70– 130]	[131– 180]	>180
Number	25	50	75
%	16.6%	33.3%	50%

**Table 7: The correlation between the occurrences of musculoskeletal complications of the hand in patients with type 2 diabetes mellitus with sex.**

	Male (n,%) n= 56	Female (n,%) n= 94	P- value
Limited joint mobility LJM	12 (21.4%)	12 (12.8%)	0.1
Trigger finger TF	9 (16.07%)	19 (20.2%)	0.5

Carpal tunnel syndrome CTS	4 (7.14%)	20 (21.2%)	0.02
Dupuytren's contracture DC	2 (3.57%)	1 (1.06%)	0.2
There was a statistically significant relation between the occurrence of carpal tunnel syndrome and female gender in patients with type 2 diabetes (P-value: 0.02).			

**Table 8: The correlation between the occurrences of musculoskeletal complications of the hand in patients with type 2 diabetes mellitus with age (years).**

	28 – 40 years n=7, (n,%)	41 – 60 years\ n=83, (n,%)	61 – 86 years n=60, (n,%)	P- value
LJM	0 (0%)	12 (14.36%)	12 (20%)	0.3
TF	0 (0%)	19 (22.89%)	8 (13.33%)	0.1
CTS	1 (14.28%)	10 (12.04%)	13 (21.66%)	0.2
DC	0 (0%)	1 (1.2%)	2 (3.33%)	0.6
There was not any statistically significant relation between the incidence of musculoskeletal complications of the hand and age in patients with type 2 diabetes.				

**Table 9: The correlation between the occurrences of musculoskeletal complications of the hand in patients with type 2 diabetes mellitus with the duration of diabetes (years).**

	< 5 years n=28, (n,%)	[5– 10] years n=66, (n,%)	>10 years n=56, (n,%)	P- value
LJM	0 (0%)	8 (12.12%)	16 (28.57%)	0.002
TF	2 (7.14%)	9 (13.63%)	16 (28.57%)	0.02
CTS	4 (14.28%)	9 (13.63%)	11 (19.64%)	0.6
DC	0 (0%)	1 (3.57%)	2 (3.57%)	0.5
There was a statistically significant relation between the incidence of each of the complications: LJM (P-value: 0.002), TF (P-value: 0.02), and the duration of type 2 diabetes.				

**Table 10: The correlation between the occurrences of musculoskeletal complications of the hand in patients with type 2 diabetes mellitus with the fasting plasma glucose levels (mg/dl).**

	[70– 130] mg/dl n=25, (n,%)	[131–180] mg/dl n=50, (n,%)	>180 mg/dl n=75, (n,%)	P- value
LJM	0 (0%)	5 (10%)	19 (25.33%)	0.004
TF	0 (0%)	5 (10%)	22 (29.33%)	0.001
CTS	0 (0%)	2 (4%)	22 (29.33%)	0.00004
DC	0 (0%)	1 (2%)	2 (2.66%)	0.7
There was a statistically significant relation between the occurrence of musculoskeletal complications of the hand: LJM (P-value: 0.004), TF (P-value: 0.001), CTS (P-value: 0.00004), and fasting plasma glucose levels in patients with type 2 diabetes.				

## DISCUSSION

Type 2 Diabetes Mellitus (DM) is one of the most common metabolic disorders and has become a growing health and economic problem in our country. Where it needs a lifelong follow-up to prevent its complications and reduce their severity. Diabetic patients may suffer from a wide range of musculoskeletal complications that can cause pain and some functional disorders that negatively affect the course of treatment and reduce the quality of patients' lives. Although the majority of these complications can occur in non-diabetic patients, their frequency is higher in diabetic patients, but they are not specific to it.

Estimating the prevalence of musculoskeletal complications in patients with diabetes varies according to the definition used for each case and according to the study population of patients with diabetes.

Musculoskeletal complications of the hand were detected in 52% of patients in our study, the frequency of these complications in other research ranged from 30% to 69.5%.<sup>[11,12,13]</sup>

In our study, female sex and duration of diabetes were observed to be associated with the studied complications. Mustafa et al. reported similar findings.<sup>[11]</sup> Nevertheless, such an association was not supported by some previous reports.<sup>[12]</sup>

In our study, TF was found in 18% followed by CTS and LJM seen in 16% of patients for each one. DC was found in 2%. Prior studies reported variable prevalence rates of LJM between 3.5% to 63.1%, while the prevalence rate of TF ranged between 2.8% to 7.2%, and the prevalence rates of CTS were between 4% to 17.7%. DC prevalence rate was reported between 0.6% to 18.6%.<sup>[8,11,12,13]</sup>

Some research demonstrated a relation between high glucose levels and poor glycemic control with various diabetic hand complications.<sup>[12,13]</sup> while other reports do not demonstrate such associations.<sup>[8,11]</sup> In our study, high fasting plasma glucose levels were associated with a high prevalence of hand complications, which is supported by some theories in the medical literature.<sup>[15,16,14]</sup>

Opinions in previous studies about the association of the studied complications with sex were conflicting.<sup>[8,11,12,13]</sup> In our research, there was an association between the female sex and the occurrence of CTS, possibly diabetes was not the only reason for it, It could be caused by overuse injuries according to the daily chores of homemakers, but diabetes played a role in exacerbating the condition.

As for the relationship between the occurrence of DC and the variables studied in our research, we cannot generalize the result due to the small sample size and its low prevalence.

The specific pathophysiological mechanisms of the musculoskeletal complications of diabetes are still not well understood. Evidence indicates that increased accumulation of (AGEs: Advanced Glycation End-products plays an important role in this mechanism. These products are formed by non-enzymatic condensation of metabolic intermediates and glucose, and this process is increased in cases of chronic hyperglycemia. Accumulation of these products in connective tissues causes damage to ligaments, tendons, joint capsules, and nerves, which in turn leads to structural and functional deterioration. The formation of these products also leads to a defective localization of collagen in the tissues around the joint, which may contribute to the injury.<sup>[17]</sup>

These complications may be due to neurological or Microvascular and Macrovascular disorders and may be related to the duration of diabetes mellitus and the degree of its metabolic control.<sup>[17]</sup>

Type 2 diabetes is often associated with obesity and metabolic syndrome, which are all risk factors for joint injuries. Tendon damage in obesity is often associated with two different mechanisms: the first is the increased load applied to the body-bearing tendons, and the second is the biochemical changes associated with systemic metabolic disorders.<sup>[18]</sup>

Our study has some limitations; we were unable to perform HbA1c measurements for patients, and we relied on clinical examination because we could not do electrodiagnostic criteria to diagnose CTS, However, we were very careful about the accuracy of the clinical examination and were keen to get a detailed and specific patient history.

## CONCLUSIONS

In our study, musculoskeletal complications of the hand are common in patients with type 2 diabetes in Syria. Trigger Finger was the most frequently seen complication. The occurrence of these complications is often related to the duration of diabetes, poor glycemic control, and female gender. A routine examination with a rheumatologist is necessary to detect and treat these complications.

## Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declared no conflicts of interest.

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