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Musculoskeletal Manifestations in Type 2 Diabetes Mellitus and their Relation to Hba1c Levels: A Cross Sectional Observational Study

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Abstract: ***Musculoskeletal manifestations are under-recognized complications of Type 2 Diabetes Mellitus (T2DM), contributing to pain and functional limitation. This cross-sectional study evaluates types of musculoskeletal involvement, pain severity, functional disability, and their association with glycemic control in 96 patients with T2DM. Knee osteoarthritis (37.5%) and frozen shoulder (25%) were the most common conditions observed. Hand involvement included trigger finger (16.7%), carpal tunnel syndrome (16.7%), and Dupuytren's contracture (6.2%). Pain was frequently moderate to severe, and functional disability was predominantly moderate. An increasing trend of musculoskeletal involvement was observed with worsening glycemic control, showing a statistically significant association (p=0.048). These findings highlight the importance of glycemic control and routine musculoskeletal assessment in diabetic care.***

Keywords: Type 2 Diabetes Mellitus, Musculoskeletal manifestations, Pain, MHAQ, Hand findings, Disability

1. Introduction

Type 2 Diabetes Mellitus (T2DM) is associated with a spectrum of musculoskeletal complications that significantly impair quality of life. Chronic hyperglycemia leads to accumulation of advanced glycation end products, resulting in collagen stiffness and periarticular tissue changes[3,4].

These alterations predispose patients to conditions such as frozen shoulder, osteoarthritis, and hand syndromes including trigger finger and Dupuytren's contracture[2,3]. Musculoskeletal involvement contributes to chronic pain, reduced mobility, and difficulty in performing activities of daily living. Despite this, such complications remain under-evaluated in routine clinical practice. This study evaluates types of musculoskeletal manifestations, pain, functional disability, and their association with glycemic status.

2. Methodology

Study Design and Setting

A hospital-based **cross-sectional observational study** was conducted in a tertiary care centre (DY Patil Hospital, Navi Mumbai), OPD and IPD patients between September 2025 to January 2026. This is a study in part of an on-going thesis study regarding musculoskeletal manifestations in Type 2 DM and their relation with glycemic control.

Study Population

- Total sample size: **96 patients with T2DM**
- Inclusion: Adults (>18 years) diagnosed with T2DM
- Exclusion: Patients with trauma, inflammatory arthritis, or systemic connective tissue disorders

Sampling Method

- **Consecutive sampling** was used until the required sample size was achieved.

Data Collection

Data were collected using a structured case record form including:

1) Musculoskeletal Assessment

Musculoskeletal assessment included frozen shoulder, osteoarthritis, trigger finger, carpal tunnel syndrome, Dupuytren's contracture, DISH, and Charcot joint[2,3].
For DISH, radiological assessment was done (Flowing anterior longitudinal ligament ossification across ≥4 vertebrae with preserved disc spaces) [9].

2) Pain Assessment

Pain severity was categorized as: Mild, Moderate, Severe and Not reported.

3) Functional Disability (MHAQ)

Functional disability was assessed using the Modified Health Assessment Questionnaire (MHAQ), a validated tool for assessing activities of daily living[1].

a) Covers 8 domains: dressing, arising, eating, walking, hygiene, reach, grip, and daily activities.
b) Scoring:
   - 0 = no difficulty
   - 3 = unable to perform
c) Final score: mean of all items (range 0–3)

4) Hand Findings

Finger tenderness, locking during movement, flexed posture, swelling, palmar skin tethering, pretendinous bands, and flexion deformity were examined.

5) Glycemic Control:

HbA1c categorized as <7%, 7–9%, and >9%.

Statistical Analysis

- Data analyzed using **SPSS version 22.**
- Chi square tests applied wherever necessary.

- Results expressed as frequencies, percentages, and mean ± SD.
- Descriptive analysis used for musculoskeletal, pain, and functional outcomes.
- Statistical outcomes of $p<0.05$ were considered significant.

3. Results & Discussion

The study included 96 patients with Type 2 Diabetes Mellitus, with a nearly equal gender distribution (49.0% males and 51.0% females). The majority of participants were in the 40–50 years age group (42.7%), followed by 51–60 years (35.4%), with a mean age of 51.26 ± 7.45 years. The mean duration of diabetes was 9.22 ± 3.89 years, indicating a population with relatively long-standing disease.

Table 1: Types of Musculoskeletal Manifestations (n=96)

Condition	Number (n)	Percentage (%)
Knee Osteoarthritis	36	37.5
Frozen Shoulder	24	25
Hip Osteoarthritis	12	12.5
Trigger Finger	16	16.7
Carpal Tunnel Syndrome	16	16.7
Dupuytren's Contracture	6	6.2
DISH	5	5.2
Charcot Joint	5	5.2

The findings demonstrate involvement of both large and small joints in T2DM. Weight-bearing joints, particularly the knee, show higher involvement, while periarticular conditions such as frozen shoulder are also prominent.

Table 2: Hand Findings (n=96)

Finding	Number (n)	Percentage (%)
Finger tenderness	16	16.7
Locking during movement	16	16.7
Flexed posture	16	16.7
Finger swelling	16	16.7
Palmar skin tethering	6	6.2
Pretendinous bands	6	6.2
Flexion deformity	6	6.2

Hand involvement reflects a combination of tendon pathology, nerve compression, and fibrotic changes[6,7,8]. These manifestations contribute to impaired grip and fine motor function. These findings indicate predominant involvement of flexor tendons and periarticular soft tissues, leading to impaired tendon gliding and joint mobility. Such abnormalities can significantly affect grip strength and fine motor function, thereby interfering with routine daily activities.

Table 3: Pain Severity Distribution (n=96)

Category	Number (n)	Percentage (%)
Mild	25	26
Moderate	27	28.1
Severe	25	26
Not reported	19	19.8

Moderate pain was the most commonly reported category (28.1%), followed closely by mild and severe pain, each accounting for 26.0% of cases. A smaller proportion of patients (19.8%) did not report pain. Overall, a substantial number of patients experienced moderate to severe pain, indicating that pain is a significant clinical feature associated with musculoskeletal involvement in Type 2 Diabetes Mellitus.

Table 4: Functional Disability Based on MHAQ (n=96)

Category	Number (n)	Percentage (%)
Mild disability	28	29.2
Moderate disability	49	51
Severe disability	19	19.8

Mean MHAQ Score: 1.58 ± 0.46

Functional disability is predominantly moderate, indicating significant limitations in daily activities. This highlights the impact of musculoskeletal manifestations on overall functional status.

Table 5: Association of Glycemic Control with Musculoskeletal Manifestations

HbA1c Category	MSK Present (n)	MSK Absent (n)
<7%	10	14
7–9%	19	21
>9%	20	12

p-value = 0.048 (statistically significant)

A higher proportion of musculoskeletal involvement was observed with increasing HbA1c levels, with patients in the >9% category showing greater involvement compared to those with HbA1c <7%. This association was statistically significant ($p = 0.048$).

4. Discussion

The present study highlights a substantial burden of musculoskeletal (MSK) manifestations in patients with Type 2 Diabetes Mellitus (T2DM), involving both articular and periarticular structures. The predominance of knee osteoarthritis and frozen shoulder observed in our cohort is consistent with previous studies, which have reported a higher prevalence of large joint and periarticular involvement in diabetic populations ([2,3]). The underlying pathophysiology is largely attributed to chronic hyperglycemia leading to non-enzymatic glycation of collagen and accumulation of advanced glycation end products, resulting in increased cross-linking, tissue stiffness, and reduced elasticity ([4]).

Hand manifestations such as trigger finger, carpal tunnel syndrome, and Dupuytren's contracture in this study are in agreement with earlier clinical and epidemiological findings ([6,7,8]). These conditions arise due to tendon sheath thickening, nerve compression, and fibrotic changes in palmar fascia, respectively, leading to impaired tendon gliding and reduced joint mobility. Such alterations contribute significantly to decreased grip strength and fine motor dysfunction, thereby affecting daily activities.

The occurrence of diffuse idiopathic skeletal hyperostosis (DISH) and Charcot joint in a subset of patients reflects the broader skeletal involvement associated with diabetes. DISH is characterized by ligamentous ossification and is commonly associated with metabolic disorders ([9]), while Charcot

arthropathy results from neuropathy-induced joint destruction and altered biomechanics ([10]).

Pain was a prominent clinical feature in the present study, with a considerable proportion of patients experiencing moderate to severe pain. Similar findings have been reported in previous studies, where chronic pain in diabetic patients was shown to significantly impact physical activity and overall quality of life ([15]). Functional disability, assessed using the Modified Health Assessment Questionnaire (MHAQ), was predominantly moderate in our study, consistent with earlier validation studies demonstrating its effectiveness in assessing limitations in daily living activities ([1]).

Importantly, a statistically significant association was observed between poor glycemic control and increased MSK manifestations in this study. This finding is supported by previous research demonstrating a higher prevalence of musculoskeletal disorders in patients with elevated HbA1c levels ([11],[12]). Additional studies have also emphasized the role of prolonged hyperglycemia in the development of structural and functional musculoskeletal impairments ([13],[14],[16]).

Overall, the findings of this study suggest that musculoskeletal manifestations in T2DM are multifactorial in origin, involving metabolic, mechanical, and neuropathic mechanisms. These complications are often under-recognized but have a significant impact on patient mobility, independence, and quality of life. Routine musculoskeletal assessment, along with optimal glycemic control, should therefore be incorporated into comprehensive diabetes care.

5. Conclusion

Musculoskeletal manifestations are common yet often under-recognized complications of Type 2 Diabetes Mellitus, significantly contributing to pain and functional limitation. This study demonstrates a meaningful association between poor glycemic control and increased musculoskeletal involvement, underscoring the need for routine musculoskeletal assessment as part of comprehensive diabetes care. However, the findings should be interpreted in light of certain limitations, including the cross-sectional design, relatively small sample size, and single-center setting, which may limit generalizability and causal inference. Further large-scale, longitudinal studies are warranted to better elucidate causal relationships and to evaluate the impact of early intervention and glycemic control on musculoskeletal outcomes.

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