Review Article

# Orthodontic Treatment in Patients with Diabetes Mellitus: A Narrative Review

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## ABSTRACT

Diabetes mellitus (DM) is a significant challenge for patients. Dentists regularly encounter DM patients seeking orthodontic therapy, emphasizing the significance of comprehensive diagnosis and care before commencing orthodontic interventions. Regarding the importance of this issue, we aimed to review the orthodontic treatment in these patients. In this narrative review, a thorough search was conducted across multiple reliable databases including PubMed, Web of Science, and Scopus, utilizing relevant keywords such as Orthodontics, Diabetes mellitus, patients, and treatment. The search encompassed articles from the inception to March 2024 in order to ensure a comprehensive understanding. We first found 76 articles and after thorough assessment, we included 31 of them. Orthodontic treatment may be postponed in situations with poorly controlled DM since it has been shown that uncontrolled situations might impair orthodontic outcomes by changing bone remodeling. Since plaque accumulation aided by orthodontic appliances can aggravate pre-existing periodontal disease, especially in diabetic patients, prioritizing good oral hygiene and periodontal maintenance is imperative for diabetic patients undergoing orthodontic treatment. In conclusion, maintaining periodontal health throughout therapy and providing detailed oral hygiene instructions are critical for patients with DM undergoing orthodontic treatment.

**Keywords:** Orthodontists must recognize the impact of diabetes mellitus on periodontitis susceptibility, prompting considerations like postponing treatment during poorly controlled DM phases due to exacerbated periodontal issues. Besides, watchful periodontal health monitoring throughout treatment is crucial, requiring regular assessments and interventions to prevent complications.

## Introduction

Diabetes mellitus (DM), characterized by hyperglycemia due to insufficient insulin, poses significant challenges in control and management, impacting systemic health [1]. Diabetes mellitus (DM) is characterized by hyperglycemia due to inadequate insulin management, with diagnosis and monitoring relying on parameters such as blood glucose concentration or glycosylated hemoglobin levels [2]. In 2021, the prevalence of diabetes and prediabetes among individuals over 18 years of age in Iran was estimated at 14.15% and 24.79%, respectively. This marks a 45.5% increase in the prevalence of diabetes compared to 2016. Additionally, according to the latest national survey on risk factors for non-communicable diseases (NCDs), 15.14% of the Iranian population over 25 years old had diabetes in 2021[3, 4]. By 2013, the global estimated DM cases reached approximately 382 million, projected to rise to 592 million by 2035 [5].

This chronic metabolic disorder disrupts glucose regulation, leading to abnormalities in carbohydrate, protein, and fat metabolism, resulting in hyperglycemia and acute metabolic complications like ketoacidosis, along with chronic micro- and macrovascular complications. Uncontrolled DM is associated with various complications including delayed wound healing, stroke, renal failure, anxiety, retinopathy, and limb amputation due to compromised vascular and nervous system integrity [6]. Furthermore, individuals with DM are more susceptible to oral complications such as caries, periodontal disease, and oral infections due to impaired immune function and reduced salivary flow [7].

With the increasing demand for orthodontic treatment, dentists encounter a growing number of patients with systemic comorbidities, including DM [8]. Consequently, dentists must possess a comprehensive understanding of DM diagnosis, management, and considerations before initiating orthodontic interventions, as they may encounter diabetic patients seeking

orthodontic therapy or diagnosing undiagnosed diabetics presenting with oral signs and symptoms [9].

Given the rising prevalence of DM and its implications for orthodontic treatment, it is imperative to review the orthodontic management of patients with DM. Despite the typical age range for orthodontic treatment is between 12 and 15 years, there is a noticeable trend of older individuals seeking such interventions, highlighting the necessity for dentists to be equipped to handle patients with various systemic conditions, particularly DM [10,11]. Understanding how DM affects orthodontic treatment planning and outcomes is crucial in providing effective care for patients with this chronic metabolic disorder, emphasizing the significance of addressing this issue through comprehensive review and research in orthodontics [9]. This study fills a gap in understanding the complex relationship between DM and oral health. By synthesizing existing research findings, it emphasizes the heightened susceptibility of individuals with DM to oral complications.

## Materials and Methods

In this narrative review, a thorough search was conducted across multiple reliable databases including PubMed, Web of Science, and Scopus, utilizing relevant keywords such as Orthodontics, Diabetes mellitus, patients, and treatment. This rigorous approach aimed to gather a comprehensive understanding of the intersection between orthodontic treatment and DM in patients, elucidating potential implications, and considerations for clinical practice. Regarding the nature of our narrative review, we tried to assess original and review articles focusing on Orthodontic Treatment in Patients with Diabetes Mellitus. The search encompassed articles from the inception to March 2024 to ensure a comprehensive understanding. Through meticulous search, all identified articles were thoroughly reviewed **(Figure 1)**.

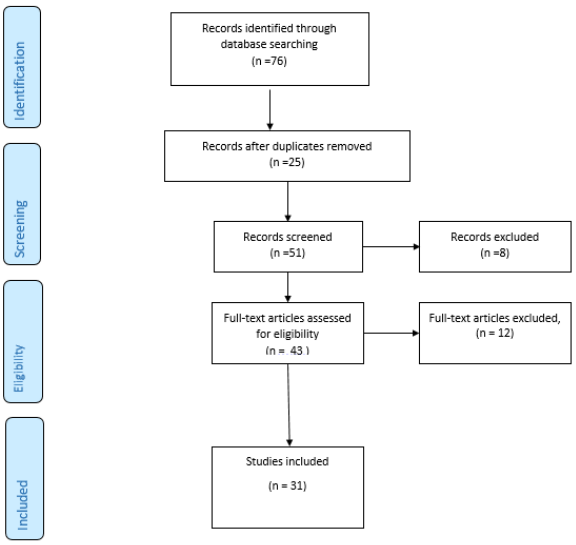


**Figure 1.** The flow diagram

## Results and Discussion

Initially, 76 articles were identified, and after a thorough assessment, 31 were included. Recognizing the complex interaction between DM and oral health is essential for comprehensive care approaches, emphasizing the need for treatment strategies addressing both metabolic control and associated comorbidities to mitigate complications and enhance the quality of life for affected individuals [12].

### *Classification of Diabetes Mellitus*

Most cases of diabetes mellitus (DM) can be categorized into two main types: type 1 (T1DM) and type 2 (T2DM). It is crucial for clinicians to accurately distinguish between T1DM and T2DM to effectively manage patients with DM [13]. T1DM, previously known as insulin-dependent DM, constitutes approximately 5–10% of all DM cases. This autoimmune condition is characterized by hyperglycemia resulting from the destruction of pancreatic beta cells responsible for insulin production [14]. The exact cause of this destruction remains unclear, but it is believed to involve a complex interplay of genetic predisposition and environmental factors [15]. While T1DM may onset in infancy, it typically manifests during childhood or young adulthood, although it can develop at any age. Common symptoms include polyuria, polydipsia, and polyphagia, with many cases progressing to absolute insulin deficiency and subsequent ketoacidosis [16].

On the other hand, T2DM, which constitutes the majority of DM cases, presents a complex pathophysiological scenario characterized by chronic hyperglycemia due to defects in insulin secretion, action, or both [16]. While factors like obesity, advancing age, and sedentary lifestyles have traditionally been recognized as significant risk factors for T2DM, recent research has highlighted the role of genetic susceptibility in predisposing individuals to this metabolic disorder [17]. Although the precise mechanisms of heritability are not fully understood, emerging evidence suggests that genetic factors interact with environmental influences to modulate disease risk [18]. The clinical implications of T2DM extend beyond glycemic control, as affected individuals face an increased risk of cardiovascular disease, stroke, peripheral neuropathy, and renal dysfunction, emphasizing the importance of comprehensive management strategies targeting both metabolic control and associated comorbidities [19].

### *Orodental Manifestations of Diabetes Mellitus*

It is widely recognized that a significant proportion of individuals living with DM encounter oral and dental manifestations of the disease at least once during their lifetime [20, 21]. Remarkably, for some patients, a visit to the dentist may serve as their initial encounter with a DM diagnosis [22]. Mechanisms commonly leading to oral complications of DM include impaired neutrophil function, increased collagenase activity, decreased collagen synthesis, microangiopathy, and neuropathy [23]. Among the prevalent oral symptoms associated with DM are sensations of

mouth dryness and burning, often referred to as xerostomia, along with the distinctive acetone-like odor indicative of poorly controlled diabetes. Additionally, individuals with DM may exhibit dental fragility, heightened susceptibility to caries, oral candidiasis, mucosal ulcerations, altered taste perceptions, and impaired wound healing in oral tissues [24]. The systemic effects of DM extend to periodontal health as well, frequently resulting in the degradation of periodontal tissue and subsequent teeth misalignment, thereby exacerbating oral health challenges for affected individuals [25].

## The definition and the use of Orthodontics

Orthodontics, which involves manipulating tooth movement through appliances, aims to correct the malalignment of teeth and/or jaws, sometimes modifying craniofacial growth [26]. Over the past three decades, there has been a significant rise in adult orthodontic patients, with surveys indicating substantial improvements in both professional and personal life post-treatment, particularly among adults with compromised function and aesthetics due to tissue loss [27]. Increased self-confidence often prompts these patients to recommend orthodontic treatment to others [28]. Orthodontic therapy not only focuses on establishing functional occlusion and enhancing dental and facial aesthetics but also emphasizes the preservation and enhancement of periodontal health, crucial for maintaining teeth, function, and aesthetics [29]. However, comprehensive diagnosis, especially regarding periodontal health, before orthodontic therapy is frequently overlooked in routine practice. Neglecting periodontal considerations can lead to treatment failure, relapse, or worsening of existing pathologies [30].

## Orthodontic in diabetes

Diabetes mellitus (DM) triggers both local and systemic inflammatory responses that adversely affect teeth and compromise glycemic control, underscoring the importance of tight DM management to minimize dental complications. Periodontal treatment is pivotal in reducing HbA1c levels in diabetic patients [31]. In orthodontic care for diabetics, maintaining good medical control is vital to mitigate the risk of periodontal breakdown. The use of lighter orthodontic forces is recommended to avoid exacerbating osseous regeneration retardation and weakening the periodontal ligament, especially in diabetic individuals [32]. Emphasis should also be placed on maintaining excellent oral hygiene, including the use of chlorhexidine mouth rinse. Moreover, scheduling appointments in the early morning, ensuring patients have consumed a regular meal and taken their medication, and staff readiness to manage diabetic emergencies, particularly hypoglycemia, are essential considerations [33].

Dentists administering orthodontic treatment should prioritize monitoring for potential diabetic emergencies, notably hypoglycemia. Symptoms of hypoglycemia include shivering, sweating, tremors, and tachycardia in the adrenergic stage, progressing to dizziness, blurred vision, confusion, weakness, coma, or death in the neuroglycopenic stage [34]. Dentists must be adept at early identification and management of hypoglycemia, administering oral glucose if symptoms arise, and promptly utilizing intramuscular glucagon or intravenous dextrose for unconscious patients. Preventive measures such as ensuring diabetic patients consume a morning meal before procedures are also crucial for hypoglycemia avoidance [35, 36].

Our study significantly advances dental science by elucidating the complex relationship between diabetes mellitus (DM) and oral health for orthodontic care in diabetic patients. We highlight the mechanisms leading to oral complications in DM, such as impaired neutrophil function and microangiopathy, which aid in better diagnosis and management. The bidirectional relationship between glycemic control and periodontal health emphasizes the need for integrated care. Additionally, we advocate for dentists to be vigilant in early DM detection and underscore the need for rigorous periodontal health monitoring during orthodontic treatment.

The review identified several key themes regarding DM. Firstly, it emphasized the increasing global prevalence of DM and its significant impact on individuals' health. Secondly, it discussed the pathophysiology of DM, highlighting how inadequate insulin management leads to hyperglycemia and disrupts various metabolic processes. Thirdly, the review outlined the wide range of complications associated with uncontrolled DM, including cardiovascular issues, renal failure, neuropathy, and delayed wound healing. Additionally, it addressed the heightened susceptibility of individuals with DM to oral health complications such as caries and periodontal disease, underscoring the need for comprehensive oral care strategies. Lastly, the review emphasized the importance of holistic care approaches that address both metabolic control and associated comorbidities to improve the quality of life for individuals with DM.

As it was mentioned, there has been a notable increase in adult orthodontic patients over the past three decades [27]. The use of this method in patients with chronic diseases such as DM may impose different concerns that should be considered before and during the procedure. Diabetic patients often seek orthodontic treatment due to the erosion of gum bones caused by diabetes, leading to misalignment of teeth [37]. Extensive research highlighted poor bone turnover as a significant factor contributing to bone destruction and tooth misalignment in diabetic individuals [38, 39]. Braga *et al.*, revealed the detrimental impact of DM on alveolar bone remodeling, with reversal of DM associated with improved bone health and reduced inappropriate tooth movement [40]. While DM itself is not a contraindication for orthodontic interventions, rigorous glycemic control and careful monitoring are essential prerequisites. Maintaining good oral hygiene and periodontal health are also crucial for successful orthodontic treatment, as poorly controlled glucose levels in diabetic patients significantly increase the risk of periodontal breakdown during orthodontic procedures [41].

Moreover, diabetic patients face a heightened risk of developing periodontal disease, which can exacerbate poor bone health and tooth loss [42]. Dental diseases like periodontitis can adversely affect DM control, as evidenced by its significant impact on increasing blood glucose levels and fluctuations [43]. Treatment of gum disease has been shown to improve blood glucose control in diabetic patients, emphasizing the importance of addressing periodontal health before initiating orthodontic treatment to mitigate the risk of unpredictable tooth movement due to inflammation [44].

Due to reduced blood flow to teeth and dental tissue in diabetic patients, dentists must be cautious of their teeth's fragility [45] and should apply minimal physiological forces during orthodontic procedures to avoid overloading compromised teeth [29]. Additionally, considering the compromised immune system of diabetic patients, antibiotic prophylaxis is crucial for specific orthodontic interventions such as band placement, separator placement, or screw insertion to prevent oral infections. However, routine adjustments or replacements of appliances generally do not require antibiotics [46].

Future research in dental science should focus on the long-term outcomes of orthodontic treatment in diabetic patients, determining the optimal orthodontic forces that minimize periodontal damage, and exploring how different levels of glycemic control affect dental treatments. Additionally, studies should investigate effective preventive strategies for oral complications, the efficacy of new therapeutic agents, and the impact of patient education on treatment compliance. Research into the genetic and environmental interactions influencing diabetes and oral health, as well as the benefits of integrated dental and medical care models, is also crucial. Finally, examining how diabetes acts as a risk factor for oral diseases will help improve overall health outcomes for diabetic patients.

## Conclusion

In conclusion, orthodontists must recognize DM's impact on periodontitis susceptibility, prompting considerations like postponing treatment during poorly controlled DM phases due to exacerbated periodontal issues. Watchful periodontal health monitoring throughout treatment is crucial, requiring regular assessments and interventions to prevent complications. Equally providing comprehensive oral hygiene guidance to empower patients to maintain dental health among DM challenges is important. Strategic appointment scheduling, especially post-insulin and breakfast, ensures patient comfort and safety, minimizing blood sugar fluctuations during procedures. Integrating these approaches enables orthodontists to effectively manage DM complexities in orthodontic care, ultimately enhancing oral health outcomes.

**Conceptualization:**

Study concept and design: H.M, N.SH., and F.K..; Acquisition of the data: H.M, N.SH., and F.K..; Analysis and interpretation of the data: H.M, and F.K. Drafting of the manuscript: H.M, and F.K...; Critical revision of the manuscript for important intellectual content: H.M, N.SH., and F.K..; Administrative, technical, and material support: H.M, N.SH., and F.K..; Study supervision: N.SH., and F.K.

Acknowledgments: We appreciate our colleagues for their warm cooperation.

Conflict of interest: The authors confirm no conflicts of interest, financial support, or employment related to this research. They have no personal financial interests, shares, stocks, patents, consultation fees, or unpaid memberships in organizations. No editorial board members or reviewers from this journal are associated with the study.

Financial support:. None

Ethics statement: None

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