

The Effect of Diabetes on Implanted Dentures, A Systematic Review

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Abstract

Background: Dentures are removably inserted dental prosthetics that fill up tooth gaps. There are many types of dentures, including complete, partial and implant-supported dentures. As long-term supports for tooth replacements, dental implants have significantly changed the treatment philosophies of conventional prosthodontics. However, the success and durability of these prosthetic devices may be impacted if a person seeking denture implants has diabetes. Diabetes affects the body in many ways, including the mouth's oral health. Immediate dentures have many benefits, including better oral functions, preservation of lower facial height, preservation of tooth sockets, improvement of aesthetics, and replication of natural teeth's shape, form, and location by artificial teeth. Diabetes mellitus has been reported to be associated strongly with the oral health. The higher glucose microenvironment prolongs healing of tooth extraction sockets. Thus, encouraging the healing of tooth extraction sockets is crucial from a therapeutic perspective for people with diabetes mellitus. **Methods:** An electronic search of English peer-reviewed dental literature on PubMed, Science Direct and Google Scholar was conducted to identify all publications reporting on how diabetes affect dentures until August 2023. Overall, 977 publications were found through an electronic and manual search, out of which 130 articles were selected after screening based on title and abstract. A total of 52 publications passed the second review phase after assessment for eligibility, from which 24 studies were excluded after full-text screening. Finally, a total of 28 studies were selected. A total of 10 articles were found to match our eligibility criteria to the full and were included in the final systematic review. **Conclusion:** Diabetes negatively impacts implanted dentures' success and longevity, leading to complications like Candida infection, poor bone integration, peri-implantitis, and compromised healing. Larger clinical trials are needed to understand diabetes's impact on implant therapy outcomes. Clinicians should assess patients' overall health, monitor glycemic control, maintain oral hygiene, and perform regular maintenance for optimal outcomes.

Keywords: Dentures, prosthetic teeth, diabetes, diabetes complication, systematic review.

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INTRODUCTION

The World Health Organization (WHO) reports that worldwide, 422 million people have diabetes, with the majority residing in low- and middle-income nations. Diabetes mellitus (DM) is closely related to oral health. It is a chronic metabolic illness that results in a number of problems typically resulting from weakened immune systems that make the body more vulnerable to opportunistic infections. Diabetes mellitus is thought to be a risk factor for periodontitis which is a significant factor in tooth loss [1-3]. Poorly controlled or untreated DM has been reported to delay tooth extraction socket

(TES) healing [4]. This can affect the treatment outcome of denture placement. Dentures are prosthetic devices that are designed to replace missing teeth and restore the functionality and aesthetics of the oral cavity. The prevalence of edentulism, or the loss of all natural teeth, can significantly affect a person's ability to eat, speak, and smile confidently, necessitating the use of dentures to improve their quality of life. The predominance of edentulism, slow wound healing, and xerostomia in diabetic patients could make treating numerous oral disorders more difficult and undermine the success of the procedure [5, 6].

Stability, support, and retention of the denture are important factors to take into account when placing dentures. The existence of alveolar bone resorption, which reduces denture retention, is one of the factors to be taken into account while utilizing dentures in people with diabetes mellitus. Hyposalivation can also make it harder for dentures to stay in place. Hyposalivation increases the growth of bacteria and fungus, including *Candida albicans* (*C. albicans*), which increases the risk of oral infection [7]. This can lead to denture stomatitis, which is mostly brought on by *Candida albicans* and related *Candida* species [8, 9].

It has also been reported that diabetes amplifies the negative effects of mechanical irritation from denture wearers [10]. The objective of this systematic review is to evaluate the effect of diabetes on implanted dentures. This study reviews and analyzes the available literature on the topic to determine how diabetes impacts the success and longevity of implanted dentures.

METHODS

SEARCH STRATEGY:

The systematic review adhered to the reporting guidelines of PRISMA [11].

We performed a search on PubMed, Science Direct, Scopus and Google Scholar for articles reporting the effect of diabetes on implanted dentures. The search strategy aimed to identify articles that discuss the effect of diabetes on various aspects of implanted dentures, including their design, retention, repair, and outcomes such as prosthesis failure and peri-implantitis. The search strategy in PubMed was as follows: ("diabetes"[Title/Abstract]) OR ("diabetes mellitus" [MeSH Terms]) OR ("diabetic"[Title/Abstract]) AND (("implanted dentures"[Title/Abstract]) OR ("dental implants"[MeSH Terms]) OR ("denture retention" [MeSH Terms]) OR ("prosthodontics"[MeSH Terms]) OR ("dental prosthesis"[MeSH Terms]) OR ("dental restoration failure"[MeSH Terms]) OR ("dental restoration, permanent"[MeSH Terms]) OR ("denture, partial, fixed"[MeSH Terms]) OR ("denture, complete"[MeSH Terms]) OR ("denture design"[MeSH Terms]) OR ("denture, overlay"[MeSH Terms]) OR ("denture, partial, removable"[MeSH Terms]) OR ("denture, complete, immediate"[MeSH Terms]) OR ("denture, complete, upper"[MeSH Terms]) OR ("denture, complete, lower"[MeSH Terms]) OR ("denture, partial, fixed, unilateral"[MeSH Terms]) OR ("denture, partial, fixed, bilateral"[MeSH Terms]) OR ("denture, partial, removable, unilateral"[MeSH Terms]) OR ("denture, partial, removable, bilateral" [MeSH Terms]) OR ("dental prosthesis, implant-supported"[MeSH Terms]) OR ("denture, implant-supported"[MeSH Terms]) OR ("dental prosthesis design"[MeSH Terms]) OR ("denture, immediate"

[MeSH Terms])) OR ("denture retention" [MeSH Terms])) OR ("denture repair"[MeSH Terms])) OR ("denture rebasing"[MeSH Terms])) OR ("denture relining" [MeSH Terms])) OR ("denture rebasing" [Title/Abstract]) OR ("denture relining" [Title/Abstract]) OR ("denture repair"[Title/Abstract]) OR ("implant-supported denture"[Title/Abstract]) OR ("implant-retained denture"[Title/Abstract]) OR ("implant overdenture"[Title/Abstract]) OR ("implant-supported prosthesis"[Title/Abstract]) OR ("dental implantation"[MeSH Terms]) OR ("osseointegration" [MeSH Terms]) OR ("peri-implantitis"[MeSH Terms]) OR ("dental prosthesis failure"[MeSH Terms]) OR ("treatment outcome"[MeSH Terms]) OR ("prosthesis failure"[MeSH Terms]) OR ("dental abutments"[MeSH Terms]) OR ("gingival hemorrhage"[MeSH Terms]) OR ("oral hygiene"[MeSH Terms]) OR ("dental plaque index"[MeSH Terms]) OR ("peri-implantitis" [Title/Abstract]) OR ("treatment outcome" [Title/Abstract]) OR ("prosthesis failure" [Title/Abstract]) OR ("dental abutments" [Title/Abstract]) OR ("gingival hemorrhage" [Title/Abstract]) OR ("oral hygiene" [Title/Abstract]) OR ("dental plaque index" [Title/Abstract])).

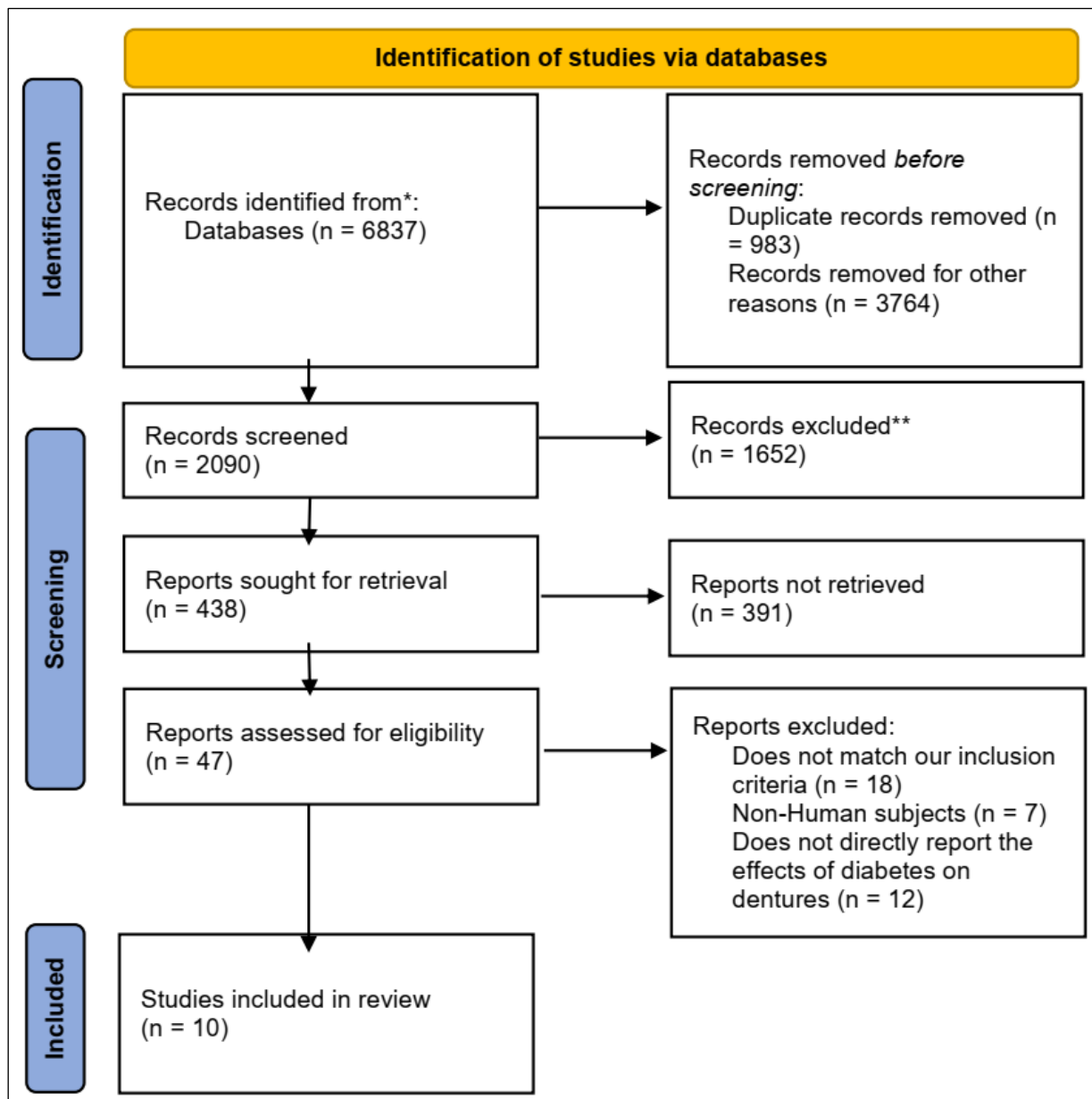
Following keywords combined with Boolean operators were used to find relevant literature on Google Scholar, Science Direct and Scopus: (("diabetes" OR "diabetes mellitus")) AND (("implanted dentures" OR "dental implants" OR "denture retention" OR "prosthodontics" OR "dental prosthesis" OR "dental restoration failure" OR "denture design" OR "denture repair" OR "denture rebasing" OR "denture relining" OR "implant-supported denture" OR "implant-retained denture" OR "implant overdenture" OR "implant-supported prosthesis")) AND (("osseointegration" OR "peri-implantitis" OR "treatment outcome" OR "prosthesis failure" OR "dental abutments" OR "gingival hemorrhage" OR "oral hygiene" OR "dental plaque index"). We also reviewed the references of included articles to find other literature. Google was also searched for any grey literature reporting the effect of diabetes on denture health. A total of 10 articles were included in the study that satisfied our eligibility criteria to full extent.

ELIGIBILITY CRITERIA:

After the initial search, duplicate entries, reviews, conference abstracts, editorials, and full-text articles that were unavailable were eliminated. We considered original studies and clinical trials that reported the impact of diabetes on denture health and denture related infections i.e., periimplantitis, denture stomatitis, denture related candidiasis. The article records were then assessed based on the title and abstract and excluded if they had an inappropriate link with the keywords used in the current study. The full-text papers were then assessed for eligibility criteria (Table 1).

Table 1: Eligibility criteria *N/A: Not applicable

No	Criteria	Description
1	Study Design	Inclusion: Original articles, clinical trials, cohort studies Exclusion: A review article, meta-analysis, conference abstracts, editorials, short-communication
2	Population	Inclusion: Diabetic people who wore dentures Exclusion: N/A*
3	Intervention	Inclusion: Dentures Exclusion: N/A*
4	Outcome	Inclusion: Denture health (denture life/stability, periimplantitis, denture stomatitis, denture related candidiasis) Exclusion: N/A*
5	Language	Inclusion: No limitation Exclusion: N/A*
6	Time of Publication	Inclusion: January 2005- August 2023 Exclusion: N/A*

**Figure 1: PRISMA flowchart showing the study selection process****QUALITY ASSESSMENT:**

For assessing the quality of comparative studies, we employed the Cochrane's ROBINS-E tool ("Risk Of Bias In Non-randomized Studies - of Exposures") [12]. The visualization was done using

robvis tool [13]. Only studies with low and moderate risk of bias were included in the systematic review. The results of the quality assessment has been summarized in Figure 2.

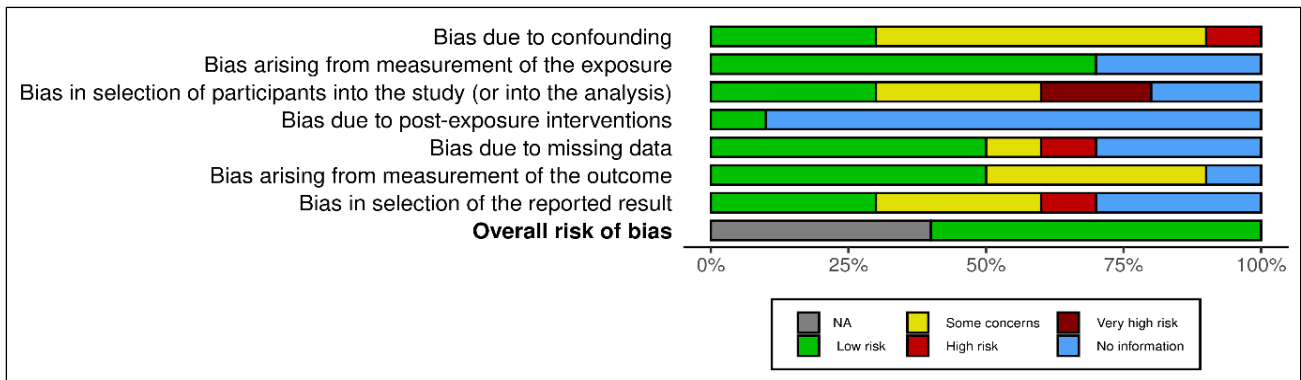


Figure 2: ROBINS-E tool for risk of bias assessment

RESULTS

A total of 10 studies that satisfied our eligibility criteria in full were included in the final systematic review [8, 9, 14-21]. Among the included studies, eight studies were comparative observational studies [8, 9], [14-19] while one was retrospective observational [21] and one prospective observational study [20]. The minimum number of participants included in any study was 30 and the maximum was 304. The general information pertaining to the included articles is summarized in the Table 2.

Three studies reported that the patients with diabetes mellitus had a higher incidence of denture stomatitis, denture-related hyperplasia, and denture instability after wearing denture compared to patients without diabetes mellitus [14, 15]. However, one study reported no significant relationship between diabetes and

the severity of denture stomatitis (DS) [18]. One study [17] reported that diabetic patients had higher levels of salivary stress factors during the adaptation period compared to non-diabetic patients while one reported that there was no significant differences in salivary flow, denture retention, or oral lesions in diabetic and nondiabetic subjects wearing complete dentures [16]. One study reported that diabetic patients are more likely to experience xerostomia (dry mouth) than non-diabetic patients, which can adversely affect oral functions and overall satisfaction with dentures [20]. Two studies reported that patients with diabetes have increased prevalence of Candida colonization in dentures as compared to nondiabetic patients [8, 9]. The study by Watanabe et al. reported that diabetes increases the risk of decreasing alveolar bone density and increased distance between the cemento-enamel junction (CEJ) and bone crest level (BCL) on the denture side of the abutment teeth [21].

Table 2: Summary of the information about the included articles

Study Author, Reference	Year of Study	Study Title	Study Location	Study Design	Total Number of Patients	Study Group	Control group	Type of dentures	Outcome
Konstantin <i>et al.</i> , [14]	2020	A study of the occurrence of complications of dental orthopedic treatment in patients with diabetes mellitus	Russia	Comparative observational study	304 patients	Patients with an established diagnosis of DM (71 in total, 36 with removable dentures, and 35 with fixed dentures)	233 patients (122 with removable dentures, 111 with fixed dentures) who did not have a history of diabetes mellitus (DM) or other general somatic diseases	Removable and fixed dentures	The patients with diabetes mellitus had a higher incidence of denture stomatitis, denture-related hyperplasia, and denture instability after dental orthopedic treatment compared to patients without diabetes mellitus

Leybyuk <i>et al.</i> , [17]	Motta-Silva <i>et al.</i> , [9]	Cristina de Lima <i>et al.</i> , [16]	Radović <i>et al.</i> , [15]
2020	2009	2008	2014
Study of Salivary Stress Factor Activity in Patients with Diabetes Mellitus During the Period of Adaptation to Complete Removable Laminar Dentures	Erythematous Oral Candidiasis in Patients with Controlled Type II Diabetes Mellitus and Complete Dentures	Oral manifestations of diabetes mellitus in complete denture wearers	Denture stomatitis and salivary vascular endothelial growth factor in immediate complete denture wearers with type 2 diabetes
Ukraine	Brazil	Brazil	Serbia
Comparative observational study	Comparative observational study	Comparative observational study	Comparative observational study
104 edentulous patients	274 patients	60 subjects	78 participants aged 45 to 64 years
Group I included 52 edentulous patients with type 2 diabetes mellitus	118 complete denture wearers with type 2 diabetes.	30 subjects with a diagnosis of diabetes	42 participants with diabetes.
Group II comprised 52 edentulous patients without endocrine pathology	156 complete denture wearers without diabetes	30 subjects without a diagnosis of diabetes	42 participants without diabetes.
Complete removable laminar dentures (CRLD)	Complete denture	Complete dentures	Maxillary partial removable dental prostheses and mandibular complete dentures
Diabetic patients had higher levels of salivary stress factors during the adaptation period compared to non-diabetic patients.	The prevalence of clinically erythematous lesions (representative of oral candidiasis) was 59.6% in patients with diabetes.	There was no significant differences in salivary flow, denture retention, or oral lesions in diabetic and nondiabetic subjects wearing complete dentures. However, salivary buffering capacity was significantly lower in the diabetic group compared to the nondiabetic group. Denture retention was observed in 66.7% of the control group and in 50% of the diabetic group, but the difference was not statistically significant.	The incidence of denture stomatitis was found to be 61% in participants with diabetes mellitus type 2 and 38% in those without diabetes

Goguta <i>et al.</i> , [20]	Lotfi-Kamran <i>et al.</i> , [19]	Dorocka-Bobkowska <i>et al.</i> , [18]	Mantri <i>et al.</i> , [8]
2018	2009	2010	2012
Removable Dentures Treatment Satisfaction of Patients with Type-2 Diabetes	Candida Colonization on the denture of Diabetic and Non-diabetic Patients	Candida-associated denture stomatitis in type 2 diabetes mellitus	Candida colonisation and the efficacy of chlorhexidine gluconate on soft silicone-lined dentures of diabetic and non-diabetic patients
Romania	Iran	Poland	India
Prospective observational study	Comparative observational study	Comparative observational study	Comparative observational study
50 patients with type-2 diabetes who received removable dentures treatment	106 patients who wore complete dentures for more than one year	160 patients	30 patients aged from 58 to 66 years
-	60 diabetic patients (28 men and 32 women) with complete denture and more than one year fasting blood glucose (FBS) level more than 130 mg/dl.	110 with type 2 diabetes mellitus (T2DM)	Nine men and six women with diabetes
-	The control group included 46 non-diabetics (24 men and 22 women) with the fasting blood glucose level less than 110 mg/dl	50 control subjects	Eight men and seven women without diabetes
37 were treated by using a partial removable denture and 13 were receiving a complete denture	Complete dentures	Complete acrylic resin dentures	
Diabetic patients are more likely to experience xerostomia (dry mouth) than non-diabetic patients, which can adversely affect oral functions and overall satisfaction with dentures. Diabetic patients have a greater need for periodontal treatment, caries prevention, and prosthetic corrections.	The density of isolated colonies was higher in the diabetic group compared to the control group, and <i>C. albicans</i> was the most common isolated <i>Candida</i> species in both groups, though diabetic patients with dentures had more non- <i>albicans</i> <i>Candida</i> isolated from their dentures compared to non-diabetic patients.	There was no significant relationship between diabetes and the severity of denture stomatitis (DS). However, poor glycemic control was associated with a higher prevalence of DS in diabetic patients.	There is increased <i>Candida</i> colonization in mandibular dentures lined with soft liner in diabetic patients as compared to nondiabetic patients after 21 and 30 days.

Watanabe <i>et al.</i> , [21]	2021	Long-term observation of periodontal condition following placement of removable partial dentures with rigid retainers and major connector in patients with/without diabetes: A retrospective study	Japan	Retrospective observational study	235 patients	118 patients who had type 2 diabetes (T2D)	117 patients who did not have T2D.	Removable partial dentures (RPDs)	The patients with type 2 diabetes and a history of chronic periodontitis who were treated with removable partial dentures (RPDs) had a higher risk of decreasing alveolar bone density and increased distance between the cemento-enamel junction (CEJ) and bone crest level (BCL) on the denture side of the abutment teeth compared to those without diabetes.
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DISCUSSION

Our systematic review analyzed studies to report a conclusion for a potential impact of diabetes on denture stability, denture stomatitis, infection and peri-implantitis. The systematic review included 10 studies that fulfilled our eligibility criteria. It has been widely reported that diabetes mellitus (DM) is a risk factor for periodontitis [1, 2]. Chen *et al.*, reports that dental costs are higher in people with diabetes [22]. The negative effects of diabetes on implanted dentures can be attributed to several factors. These include reduced blood supply to the oral tissues, impaired immune response, elevated glucose levels, and compromised wound healing. These factors can disrupt the osseointegration process, leading to decreased implant stability and increased risk of complications. Furthermore, diabetes is associated with a higher prevalence of periodontal disease, which can further compromise the success of implant therapy [23]. The study by Konstantin *et al.*, [14] investigated the impact of diabetes on dentures and concluded that patients with DM adjust to dentures more slowly than patients in the control group. It also found that patients with DM have rapid atrophy of the prosthetic bed. After receiving dental orthopedic treatment, patients with diabetes mellitus had a greater incidence of denture stomatitis, denture-related hyperplasia, and denture instability. Similar findings have been reported by Watanabe *et al.*, who concluded that patients with type 2 diabetes and a history of chronic periodontitis who received removable partial dentures (RPDs) were at an increased risk of losing alveolar bone density and extending the distance between the cemento-enamel junction (CEJ) and bone crest level (BCL) on the denture side of the abutment teeth.

However, there are conflicting studies on the association of diabetes and denture related stomatitis. The study by Maciąg *et al.*, [24] found that diabetes and endothelial dysfunction are connected to denture-related stomatitis in older patients who wear dentures [24]. Similarly Martorano-Fernandes *et al.*, [25] concluded

that compared to non-diabetic individuals, diabetic patients had a higher likelihood of presenting with denture stomatitis [25]. However, the study by Dorocka-Bobkowska *et al.*, [18] reported no correlation between diabetes and the severity of denture stomatitis (DS). However, it concluded that among diabetic people poor glycemic management is linked to a higher prevalence of DS [18].

Previously, a higher risk of periodontal disease [26] and oral candidiasis has been linked to diabetes mellitus, although the findings are still debatable and conflicting [27–30]. In the first study to compare changes in alveolar bone density around the abutment teeth after RPD treatment in patients with and without T2D, it was discovered that after 21 and 30 days, diabetic patients had more *Candida* colonization in their mandibular dentures lined with soft liners than non-diabetic patients [8]. This is explained by the access to glucose that facilitate the growth of fungi even in the presence of the typical bacterial flora [31].

However, there were certain limitations to our systematic review. One limitation was the lack of large clinical trials specifically evaluating the impact of diabetes on dentures. Another limitation was the limited number of studies available on this topic. In order to address the limitations of the systematic review and further investigate the effects of diabetes on dentures, future research could focus on conducting large clinical trials specifically targeting diabetic populations.

CONCLUSION

The systematic review concludes that diabetes does affect the success and longevity of implanted dentures. Overall, the literature supports that diabetes has a negative impact on the success and longevity of implanted dentures. Diabetic patients have higher rates of complications such as *Candida* infection, poor bone integration, peri-implantitis, and compromised healing processes. There is a need for larger clinical trials to

further investigate the specific mechanisms through which diabetes impacts implant therapy outcomes in order to develop more effective strategies for managing diabetic patients seeking denture implants. In addition, it is important for clinicians to carefully assess the overall health of diabetic patients before recommending dental implant therapy. Furthermore, close monitoring and management of glycemic control, along with proper oral hygiene and regular professional maintenance, are crucial for optimizing outcomes in diabetic patients with implanted dentures.

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