

## Diabetes Mellitus and Removable Dental Prosthesis: An Updated Systematic Review

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### Abstract

Diabetes mellitus (DM) is reported to be associated with dental problems, such as periodontitis and dental caries, that may require using a removable dental prosthesis. The aim of the current study is to provide an updated overview of removable dental prosthesis usage in patients with DM. For that, a systematic electronic database search was conducted for relevant studies published from 2010 and till 10<sup>th</sup> June 2020 in seven databases. Finally, we included 6 studies in this systematic review. an increased risk of diabetes among men using removable dental prostheses compared to those who are not; whether using removable partial or removable complete dentures. The same association was also found between glycemic control and men using partial and complete removable dentures. Moreover, socket opening diameter, chewing ability, blood glucose fluctuations, and the ability of food intake; were all better in patients with removable dentures, compared to patients who did not use it. In terms of satisfaction, the major complaints in patients with removable dentures included xerostomia, poor mastication/pain, Gag reflex, and poor esthetics. In conclusion, the removable dental prosthesis may not be the best option for diabetic patients. Whenever indicated, removable partial dentures are more satisfactory than complete ones. More robust studies of prospective nature, larger sample sizes and a clear treatment protocol are still warranted.

**Keywords:** Diabetes Mellitus; Removable Prosthesis Dentures

### Introduction

Diabetes mellitus (DM) is comprised of a group of metabolic disorders currently recognized and classified as a set of diseases characterized by chronic hyperglycemia [1]. In the general population, type 2 DM is the most common form of DM which begins with the inability

of cells to properly respond to insulin (insulin resistance) [2]. Globally, the number of individuals with DM has more than doubled during the past 20 years, projecting an estimate of 642 million cases in 2040 [3]. These numbers, partly fueled by the accompanying increase in excess weight and adiposity, pose alarming concerns on population health around the world and respective health care systems [4,5]. Rather than DM itself, the management of adverse outcomes consequent to the disease remains one of the most important burdensome challenges. The World Health Organization estimates that DM is the 8<sup>th</sup> leading cause of death, largely attributable to high blood glucose and the increased risks of cardiovascular disease and other complications (e.g. chronic kidney disease, visual-related outcomes) [6]. The need for DM primary prevention and associated complications is particularly pressing committed to halt the rise in the prevalence and if the disease is established, to achieve a 50% coverage of drug treatment and counseling in DM [7]. DM is also one of the four main non-communicable diseases for which there is a global target of 25% reduction in premature mortality by 2025 compared with 2010 [8].

The use of dental implants in patients with DM is a debatable issue due to the adverse effects of hyperglycemia on osseointegration [9]. Although dental implant therapy is an effective treatment modality, the predictability relies on the osseointegration formed during the healing period, and the critical dependence on bone metabolism for implant survival may be heightened in patients with DM [10]. Experimental studies have demonstrated an impaired osseous healing response to implant placement in diabetic animals as compared to non-diabetic controls, both quantitatively and qualitatively [11].

Bone-to-implant contact has been reported to be statistically significantly lower in diabetic than non-diabetic rats [12]. Nevins., *et al.* reported that the statistical significance of the difference between the diabetic and non-diabetic groups shown 4 weeks after implant placement, was no longer evident at a later stage of the healing process of 8 weeks [13]. Ottoni and Choppard confirmed that bone-to-implant contact is significantly lower in diabetic rats than non-diabetic rats, it was reported that little osteogenic activity occurred during the second and third weeks, and the period of highest osteogenic activity was at the beginning of the fourth week and the end of the fifth week [14]. On the other hand, Fiorellini., *et al.* demonstrated that strict insulin therapy was able to upregulate the formation of bone around implants inserted in the streptozotocin-induced diabetic rat model [15]. However, there was significantly less bone-to-implant contact in the insulin-controlled diabetic group as compared with non-diabetic controls [15]. Siqueira., *et al.* reported that bone growth area and bone-to-implant contact were not statistically different between the insulin-treated and control groups [16]. These studies have demonstrated that the use of insulin around implants may reduce the deleterious effects of diabetes on osseous healing [11].

### Aim of the Study

The aim of the current study is to provide an updated overview of removable dental prosthesis usage in patients with DM.

### Methods

#### Search strategy and study selection

The study process was conducted following the accepted methodology recommendations of the PRISMA checklist for systematic review [17]. A systematic electronic database search was conducted for relevant studies published from 2010 and till 10<sup>th</sup> June 2020 in seven databases including Google Scholar, Scopus, Web of Science (ISI), PubMed, Cochrane Central Register of Controlled Trials (CENTRAL), Embase and CINAHL using keywords, medical subject (MeSH) terms. In databases not supporting MeSH terms, combinations of all possible terms were used. Moreover, We conducted a manual search of references from the included articles by searching the primary studies that had cited our included papers and scanning references of the relevant papers in PubMed and Google Scholar to avoid missing any relevant publications [18].

We included all original relevant studies, published within the last ten years, which are discussing removable dental prosthesis usage in patients with DM. Papers were excluded if there was one of the following exclusion criteria: non-human (*in vitro* or animal) studies,

pilot studies, duplicate records, data could not be reliably extracted or incomplete reports, abstract only articles, thesis, books, conference papers. Moreover, studies with no specification for prosthesis type (removable or fixed) were excluded. Title and abstract screening were done independently by four reviewers. Then, three independent reviewers performed a full-text screening to ensure the inclusion of relevant papers in our systematic review. Any disagreement was resolved by discussion and referring to the senior author when necessary.

**Data extraction**

Two authors developed the data extraction sheet using the Microsoft Excel software. Data extraction was performed by three independent reviewers using the excel sheet. The fourth independent reviewer performed data checking to ensure the extracted data accuracy. All the disagreements and discrepancies were resolved by discussion and consultation with the senior author when necessary.

**Quality assessment**

Three independent reviewers evaluated the risk of bias in the included studies. The National Institutes of Health (NIH) quality assessment tools were used to determine the quality of included studies, according to their study design [19]. Quality assessment of each study was obtained through a scoring system including 14 questions. The criterion was judged as following; a score of 13 to 14 was good, 9 to 12 was fair, and studies scoring below 9 are considered of poor quality [20]. Any discrepancy between the reviewers was solved through discussion.

**Results and Discussion**

**Search results**

We identified 1622 records after excluding of 830 duplicates using the Endnote software version X9. Title and abstract screening resulted in 33 records for further full-text screening. No papers were added after performing manual search trials. Finally, we included 6 studies in this systematic review (Figure 1).

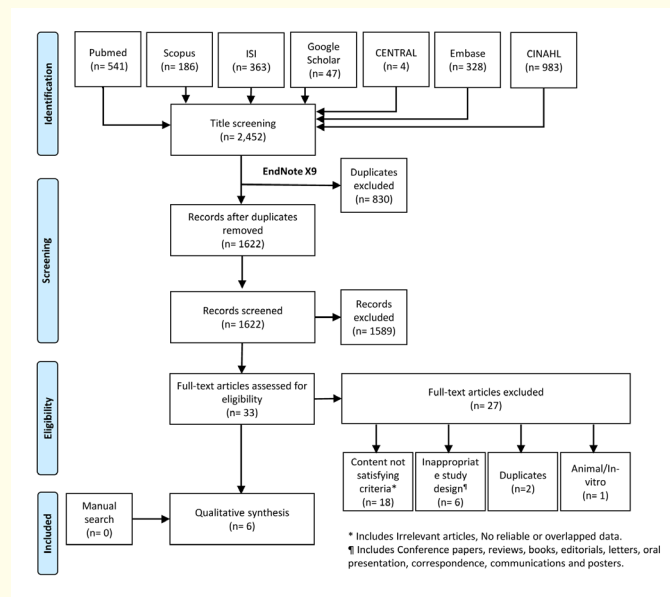


Figure 1: The PRISMA flowchart of the search and screening process.

Study characteristics and quality of the included studies

The population was not fully diabetic in some studies; the number of diabetic patients ranged from 25 to 2504 individuals. The male percentage of included patients ranged from 44% to 79% and the mean ages ranged from 59.5 to 64.3 years. The quality of the included studies was variable where two studies have a good quality, three studies have a fair quality, and only one with poor quality (Table 1).

Author, year	Country	Number of diabetics	Male (%)	Age (Year) Mean (SD)	Aim	Main conclusion	Quality
Abdullah, 2015 [21]	Iraq	39	45	NA	To investigate the prevalence of xerostomia among dental patients and explore the possible risk factors and symptoms associated with this condition	There was a high prevalence of xerostomia among dental patients; xerostomia was significantly more prevalent among females and significantly associated with age, systemic diseases and medications; xerostomia adversely affects oral functions; dentist must be familiar with sign and symptoms of xerostomia and can have an active role in the management of xerostomia and preventing or treating complications.	Poor
Al-Dwairi, 2012 [22]	UK	71	56	59.5	To investigate the prevalence of dry mouth in a select sample of edentulous Jordanian older population wearing complete dentures and to evaluate its impact on oral functions	Xerostomia is significantly more prevalent in women and associated with increased age and smoking. Xerostomia adversely affects oral functions and overall satisfaction with dentures.	Good
Goguta, 2018 [23]	Romania	50	46	64.3 (9.77)	to find out which was the impact of the treatment with removable dentures on the satisfaction of the type 2 diabetes patients.	The prosthodontic treatment of type -2 diabetic patients with removable denture should be started after stabilizing the blood glycemic levels and treating the xerostomia, when present.	Fair
Lee, 2019 [24]	Korea	2504	47	61.35 (3.35)	To assess whether the prevalence and control of diabetes differed based on the use of removable dental prostheses through an analysis of nationally representative data	The use of removable dental prostheses is a potential risk indicator for uncontrolled diabetes in Korean men adults, suggesting the need for a comprehensive approach to minimize the complications of diabetes mellitus.	Good

Nikolopoulou, 2013 [25]	Greece	25	44	NA	To determine the prevalence of xerostomia among patients attending a dental clinic for the provision of dentures and to investigate the oral cleanliness in those patients.	There was a high prevalence of xerostomia in the patient population. A high proportion of subjects had poor oral cleanliness	Fair
Radović, 2016 [26]	Serbia	78	79	65 (range: 45 - 80)	To compare socket opening diameters (SOD), chewing ability, changes in blood glucose level, and food intake in type 2 DM patients with and without maxillary immediate complete denture (MICD) during a three-week wound healing period.	Maxillary immediate complete denture presents a good therapeutic choice for type 2 DM patients, as it provides the possibility of adequate mastication after teeth extractions and maintenance of nutritional status and blood glucose level.	Fair

Table 1: Summary of the included studies.

Association between DM and removable dental prostheses usage

We included one large study of 8,155 individuals (2504 diabetics) that assessed the association between DM and removable dental prostheses in Korans [24]. The study found an increased risk of diabetes among men using removable dental prostheses compared to those who are not; whether using removable partial dentures (odds ratio [OR] = 1.165; 95% confidence interval [95% CI] = 0.878 - 1.544) or removable complete dentures (OR= 1.491; 95% CI = 1.034 - 2.151) [24]. The same association was also found between glycemic control and men using partial (OR = 0.971; 95% CI = 0.511 - 1.845) and complete removable dentures (OR = 0.232; 95% CI = 0.091 - 0.591) [24]. Women did not show any significant association with diabetes or glycemic control, which may be explained by gender differences in nutritional habits [24,27-29].

These results show that individuals with removable dental prostheses may have some nutritional habits leading to poor glycemic control, nutritional deficiencies, and metabolic syndrome [30-32]. It is known that removable dental prostheses users prefer softer foods over chewier foods, such as vegetables [33-35]. This can be explained by the differences in the maximum biting force, where patients with complete removable dentures have only one-seventh to one-fourth of the maximum biting force of the average intact individuals [30,36]. These findings may favor the use of fixed dental prostheses over the removable ones in patients with DM [35].

This association can be explained by going the opposite way; DM is reported to be associated with dental problems that may require using removable dental prosthesis [24]. Periodontitis and dental caries rates are higher in diabetic patients [37-39]. Increased oxidative stress, higher production of glycation end-products, diminished salivary flow, and higher levels of glucose in the parotic gland; are all contributing factors to the pathogenesis of dental problems in diabetics [37,40]. Moreover, apical periodontitis rates are higher in diabetic patients compared to non-diabetics [41]. Furthermore, different oral infections are more prevalent in patients with uncontrolled DM, including infection of teeth pulp [42]. Consequently, diabetic patients are more prone to loose teeth; hence, higher rates of using dental prosthesis [41,43,44].

**Effectiveness and satisfaction of removable dental prostheses in DM**

One study was included in the current study with 78 diabetic individuals; out of them, 36 are using partially removable denture wearers following teeth extractions and 42 are not [26]. Following a three-week period of follow up, socket opening diameter was better (P-value < 0.001) in patients with removable dentures (mean = 0.4 ± 0.08), compared to patient who did not use it (mean= 0.1 ± 0.04) [26]. The same was found on measuring chewing ability where patients with dentures (mean= 3.5 ± 0.12) were superior (P-value< 0.01) to those without any dentures (mean= 1.2 ± 0.3) [26]. In the same context, blood glucose fluctuations and the ability of food intake were better in patients with removable dentures compared to those who did not have dentures (Table 2).

Outcome	Patients without MICD (n = 42)	Patients with MICD (n = 36)
Socket opening diameter (mm)	0.1 ± 0.04	0.4 ± 0.08
Chewing ability (verbal rating scale)	3.5 ± 0.12	1.2 ± 0.3
BGL: changed	61.9% (26)	38.9% (14)
Food intake: less than usual	73.8% (31)	47.2% (17)

**Table 2:** Effectiveness of removable dental prostheses in DM [26].  
MICD: Maxillary Immediate Complete Denture; BGL: Blood Glucose Levels.

In terms of satisfaction, 50 patients with DM were investigated; out of them, 37 were treated by using a partial removable denture and 13 were receiving a complete denture [23]. The major complaints were poor mastication/pain, Gag reflex, and poor esthetics [23]. Satisfaction was more in patients with removable partial dentures with about 87% of the patients who did not have any complaints, compared to only 39% of the patients with complete dentures [23]. This is consistent with previous literature; a recent study of removable partial dentures found that aesthetic issues are the main concerns among studied patients [45]. It was reported that patients satisfaction was declined with age [23], this could be mainly driven by the progressive perception of mouth dryness over time [46].

**Prevalence of xerostomia in patients with removable prosthesis**

There were no studies assessing xerostomia exclusively in diabetic patients with a removable prosthesis so, we have included studies that included diabetics among the studied population. Three studies [21,22,25] have discussed the prevalence of xerostomia in patients with a removable prosthesis, which ranged from 16.07% to 29.9% among total populations. Among diabetics, the ranges were higher and ranged from 53.84% [21] to 62% [22]. Moreover, the risk xerostomia was much higher in diabetic patients with removable prosthesis compared with non-diabetics (OR = 6.7; 95% CI = 3.5 - 12.9; P-value < 0.001) [21]. Moreover, xerostomia rates were higher in patients using removable complete (61%) dentures, compared to partial dentures (39%). Furthermore, xerostomia was associated with fewer patients' satisfaction (29.9%) compared to those with non-xerostomia (70%) [22]. The effect of xerostomia prevalence and different outcomes are summarized in table 3.

Outcome	Non-dry mouth	Dry mouth	P-value
	(n = 319)	(n = 136)	
<b>Ability to chew; n (%)</b>			
Dissatisfied	67 (21%)	99 (72.8%)	0.004
Satisfied	41 (12.8)	9 (6.6%)	
Fairly satisfied	211 (66.1%)	28 (20.6%)	
<b>Ability to speak; n (%)</b>			
Dissatisfied	66 (20.7%)	106 (77.9%)	< 0.001
Satisfied	30 (9.4%)	5 (3.7%)	
Fairly satisfied	223 (69.9%)	25 (18.4%)	

<b>Ability to taste; n (%)</b>			
Dissatisfied	66 (20.7%)	111 (81%)	0.001
Satisfied	35 (11%)	2 (1.5%)	
Fairly satisfied	218 (68.3%)	23 (16.9%)	
<b>Denture stability</b>			
Stable	252 (79%)	30 (22%)	0.001
Unstable	67 (21%)	106 (78%)	
<b>Feeling soreness</b>			
Yes	48 (15%)	100 (73.5%)	0.003
No	271 (85%)	36 (26.5%)	
<b>Overall satisfaction</b>			
Satisfied	62 (19.4%)	10 (7.4%)	< 0.001
Fairly satisfied	208 (65.2%)	32 (23.5%)	
Unsatisfied	49 (15.4%)	94 (69.1%)	

**Table 3:** Effect of xerostomia prevalence and different denture-related outcomes [22].

The current study has some limitations. First, the number of the included studies is relatively low and the sample size of those studies is small in some studies. Second, the design of most studies is retrospective in nature which has its limitations. Finally, not all studies are good in quality which may affect the quality of the evidence.

**Conclusion**

The removable dental prosthesis may not be the best option for diabetic patients. Although it showed good effectiveness, patient satisfaction rates were not satisfactory. Moreover, removable partial dentures were more satisfactory than removable complete ones. More robust studies of prospective nature, larger sample sizes, and a clear treatment protocol are still warranted.

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**Conflicts of Interest**

No conflicts related to this work.

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