



A Comparative Evaluation of Removable Partial Denture Prostheses and Dental Caries Status among Diabetic and Nondiabetic Patients

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Abstract

Introduction Oral health is an integral part of general health. Systemic diseases such as diabetic condition and local factors have an impact on oral health of individuals. Dental caries is one of the most common oral health conditions affecting 60 to 90% of the population. Acrylic removable partial denture (RPD) is one of the most widely accepted means of tooth replacement. Its insertion in the mouth leads to altering the oral environment and increases plaque formation, particularly on tooth surface of those in contact with the acrylic partial denture facilitating the initiation of caries.

Aim The aim of the study was to evaluate the effect of acrylic RPDs on caries prevalence in diabetic and nondiabetic patients.

Methodology This comparative study was performed on 400 patients of age between 20 and 64 years visiting JSS Dental College and Hospital in Mysuru. Patients participating in this study were explained regarding the survey analysis and informed consent was taken. It was a questionnaire-based clinical study. Inclusion and exclusion criteria were considered for the selection of the study sample and categorize the patients into one of the following groups, with prostheses (Group A) and without prostheses (Group B) and subgroups diabetic patients with prostheses (Group A1) and nondiabetic patients with prostheses (Group A2). Diabetic patients without prostheses (Group B1) and nondiabetic patients without prostheses (Group B2). Sociodemographic information of each patient was recorded, and clinical examination was performed for decayed, missing, and filled teeth (DMFT) using DMFT index.

Results A statistically significant high prevalence of dental caries was observed among nondiabetic patients with acrylic RPD (Group A2).

Conclusion Acrylic RPD and diabetes had least role in caries prevalence.

Keywords

- ▶ removable partial prostheses
- ▶ dental caries
- ▶ diabetic
- ▶ nondiabetic

Introduction

A removable partial denture (RPD) is one of the noninvasive and most economical options for the replacement of missing teeth. Since its affordability and fabrication are easier, its usage is also higher. It is also considered as one of the preferred prostheses for patient with inadequate knowledge about oral health, low education, multiple edentulous areas, and poor socioeconomic status (SES).¹ Studies revealed that the caries rate was higher among acrylic RPD wearers as it facilitates high plaque formation, and patients with RPD for a long duration showed a high plaque index favoring initiation and progression of caries.²

Dental plaque produces large quantities of lactate, formate, and pyruvate where organic acids can more readily demineralize the enamel resulting in the progression of the caries. Dental caries is initiated by the process of demineralization and is a multifactorial disease where host, substrate, and immune capacity of the patients play an important role.³ Oral health is an integral part of general health where general health conditions that are affected by systemic diseases such as diabetes, cardiovascular diseases have oral manifestations that increase the risk of oral disease. Among them, diabetes has a much impact on oral health conditions and there is a complex relationship between diabetes and dental caries. Risk factors for caries in diabetic patients were insufficient salivary flow and altered composition results in increased bacterial population, less subjected to fluoride exposure, gingival recession, decreased immunological factors, and genetic factors. Poor metabolic control is one of the contributing factors for the prevalence of dental caries among diabetic individuals.⁴ At the same time, nondiabetic patients with high carbohydrates and sugar intake along with poor oral hygiene reported high caries rate when compared with diabetic individuals.⁵ Studies revealed that nondiabetic patients with acrylic RPD for a minimum duration of 6 months were susceptible to high caries index.⁶

Studies have also stated that oral health-related quality of life is influenced by socioeconomic factors, lifestyle, and systemic diseases. Recent research stated that urbanization, industrialization, and obesity are also contributing factors for diabetes that indirectly affects the oral health.⁷

The impact of acrylic RPD and diabetes on caries prevalence was unclear. Therefore, the aim of this study was to evaluate the effect of acrylic RPD on caries prevalence in diabetic patients.

Materials and Methods

Study Design and Setting

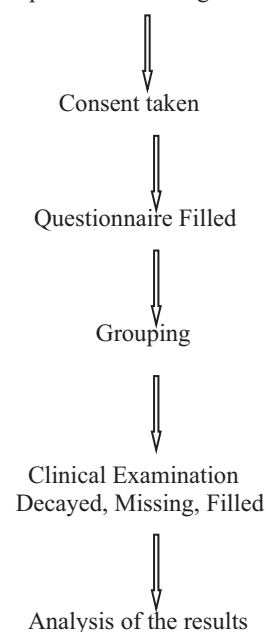
This comparative study was performed on 400 patients of age between 20 and 64 years visiting JSS Dental College and Hospital in Mysuru. Ethical clearance ref. no. JSS/DCH/Ethical/PhD-07/2017–18 was taken to carry out the study. Patients participating in this study were explained regarding the survey analysis and informed consent was taken. The study was done in two stages: (1) questionnaire study and (2) clinical examination. The following inclusion and exclusion

criteria were considered for the selection of the study sample and categorized the patients into one of the following groups: Group A with prostheses and Group B without prostheses and further divided into subgroups. Group A1 diabetic patients with prostheses and Group A2 nondiabetic patients with prostheses. Group B1 diabetic patients without prostheses and Group B2 nondiabetic patients without prostheses. The following inclusion criteria were considered for selection of an individual's for participating in the survey analysis. Patients who were partially edentulous should have a minimum number of seven teeth per arch, and teeth within the flange extension area of RPD were considered for decayed, missing, and filled teeth (DMFT). Traumatically lost teeth rehabilitated with RPD were also considered. Single tooth RPD patients are accepted if the flange is extending beyond two teeth on either side of edentulous arch. Patients should have worn the RPD for a minimum period of 6 months to be included in the study. Teeth that are decayed, restored only after the RPD insertion adjacent to flange extension were included in the study. The oral hygiene index of the patients should be 0.1 to 1.2 (►Flowchart 1).

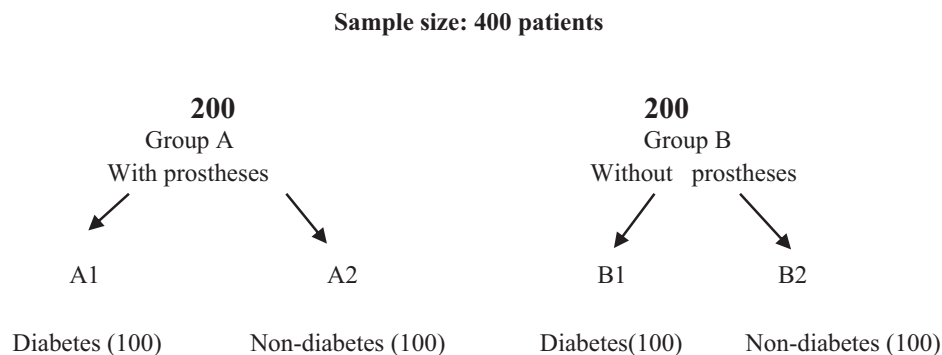
Exclusion criteria include patients suffering from any systemic diseases other than diabetes, fully dentate and completely edentulous patients, neuromuscular disorders patients, periodontally compromised, orthodontically extracted teeth patients with RPD and caries under single crown/FPD were excluded from the study.

A self-constructed 15-item close-ended questionnaire was verbally explained to patients and data were recorded by the researcher to avoid errors. The questionnaire included sociodemographic information related to patients name, age, gender, education, occupation, income, medical history, medications for diabetes, dietary habits, sweet intake, parafunctional and deleterious habits. It was further categorized

Selection of patients according to inclusion criteria



Flowchart 1 Indicates procedure for data collection.



Flowchart 2 Sample size: 400 patients. Describes the design of the study.

to evaluate the knowledge about oral hygiene practices, duration of wearing RPD prosthesis, cleaning regime, and satisfaction.

The clinical examination included an evaluation of dental caries by using a dental mirror and dental probe under dental chair light source. The dental caries was assessed using the DMFT index according to the criteria and recommendations of Klein, Palmer, and Knutson (1938) (double blind trial).

Sampling Procedure

Purposive sampling, where sample size was calculated based on overall diabetic prevalence in India at 11 and 40% prevalence of dental caries among diabetic population which would amounts ~5% prevalence. This calculation is as follows based on 80% power, 95% confidence interval, and allowable error 5%.

$$S = \frac{Z \cdot PQ}{D^2}$$

S = sample size, Z = standard value at 0.01 level = 1.96, P = proportion of prevalence = 5% becomes 0.05, Q = 1 – p = 1.00–0.05 = 0.95, D² = margin of error or confidence interval = 5% (to be expressed in decimals) = 0.05, S = (1.96 × 1.96 × 0.05 × 0.95)/(0.05 × 0.05) = 73 per group.⁷

Researcher would employ 100 per group × 4 = total sample 400 (►Flowchart 2). The values obtained were collated into Excel sheet and statistical analysis was done.

Statistical Analysis

Descriptive statistics, analysis of variance (ANOVA), and Scheffe's post hoc tests were used to test the significance between the variables and groups. A p-value of 0.05 or less than was considered significant and SPSS software for windows version 28 was used (SPSS V.28.0, 1.0 IBM, Armonk, New York, United States).

Descriptive statistics was used since there was more than two groups comparison. Statistical significance was found between the groups, one-way ANOVA was applied. Significance difference between and within the groups was found Scheffe's post hoc test was used where significance among decayed and missing groups was found between the groups (►Tables 1–3).

Results

Results revealed that (►Fig. 1) decayed teeth were statistically higher among acrylic RPD patients who are nondiabetic (Group A2). When compared between diabetic and nondiabetic patients not wearing RPD, the percentage of decayed teeth was statistically higher among nondiabetics (Group B2). From these results, it can be concluded that, irrespective of RPD, nondiabetic patients had more decayed teeth. Missing teeth were statistically higher among acrylic RPD patients who were nondiabetics (Group A2). However, it was not statistically significant when compared with diabetic patients without prostheses (Group B1). When comparing among patients without RPD in diabetics and nondiabetics, diabetic patients had statistically higher number of missing teeth. Therefore, when missing teeth were analyzed, acrylic RPD patients who were nondiabetic (Group A2) and diabetic patients without acrylic RPD (Group B1) were statistically significant. There was no statistically significant difference among the filled group.

Discussion

Conventional acrylic RPDs which provide provisional prostheses to overcome the economic limitations lacks hygiene access. It overcomes the biomechanical and pragmatic issues associated with dental implants,⁸ but restricts the cleansing mechanism of tongue and lips which results in plaque accumulation.⁹

It has been reported that RPD aggravates caries susceptibility and periodontal diseases resulting in tooth loss. Patients with satisfactory RPD were more susceptible to caries prevalence than periodontal diseases.¹⁰ It may adversely affect the caries incidence and periodontal problems among the remaining natural teeth¹¹ by quantitatively increasing *Streptococcus mutans* in saliva that contributes to increase risk of caries once microbial environment alters due to external factors apart from RPD.¹²

Therefore, this might be one of the reasons for increase in (►Fig. 1) DMFT among nondiabetic patients with acrylic RPD. Majority of the patients (85%) in this group brushed once daily and 45% of them worn the denture during day and night.

Table 1 Descriptive statistics indicates prevalence of decayed, missing, and filled teeth among diabetic and nondiabetic patients with and without RPD

	N	Mean	Standard deviation	Standard error	Minimum	Maximum
B1	100	2.2800	1.70015	0.17001	0.00	6.00
A1	100	2.2700	1.28594	0.12859	0.00	5.00
B2	100	2.5400	2.10060	0.21006	0.00	13.00
A2	100	3.0000	2.03505	0.20350	0.00	7.00
Total	400	2.5225	1.82698	0.09135	0.00	13.00
B1	100	5.1900	4.36630	0.43663	1.00	15.00
A1	100	3.8300	2.38283	0.23828	1.00	9.00
B2	100	3.9400	3.51280	0.35128	1.00	18.00
A2	100	5.4000	4.26875	0.42687	1.00	17.00
Total	400	4.5900	3.77193	0.18860	1.00	18.00
B1	100	2.1000	2.52062	0.25206	0.00	12.00
A1	100	2.0800	1.40475	0.14048	0.00	4.00
B2	100	1.9800	2.12717	0.21272	0.00	7.00
A2	100	2.5500	2.64909	0.26491	0.00	8.00
Total	400	2.1775	2.23124	0.11156	0.00	12.00

Abbreviation: RPD, removable partial denture.

Table 2 ANOVA indicates prevalence of decayed, missing, and filled teeth among diabetic and nondiabetic patients with and without RPD

	Sum of squares	df	Mean square	F	Significance
Between groups	35.088	3	11.696	3.572	0.014
Within groups	1,296.710	396	3.275		
Total	1,331.798	399			
Between groups	201.620	3	67.207	4.861	0.002
Within groups	5,475.140	396	13.826		
Total	5,676.760	399			
Between groups	19.327	3	6.442	1.297	0.275
Within groups	1,967.070	396	4.967		
Total	1,986.397	399			

Abbreviations: ANOVA, analysis of variance; RPD, removable partial denture.

Table 3 Decayed and missing teeth Scheffe's post hoc test

Decayed				Missing	
Scheffe's post hoc test				Subset for $\alpha = 0.05$	
Groups	N	Subset for $\alpha = 0.05$			
		1	2	1	2
A1	100	2.2700		3.8300	
B1	100	2.2800		5.1900	5.1900
B2	100	2.5400	2.5400	3.9400	3.9400
A2	100		3.0000		5.4000

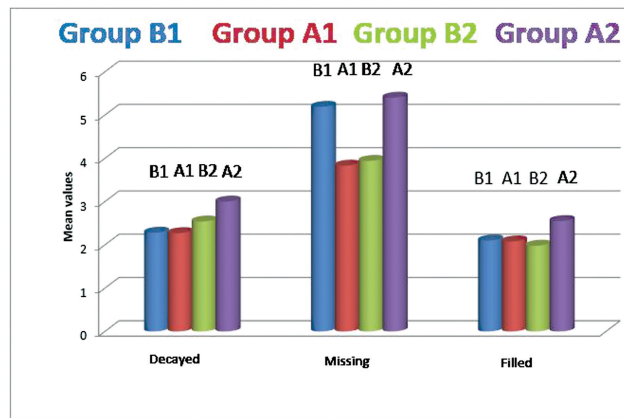


Fig. 1 Graphic representation of prevalence of decayed, missing, and filled teeth in diabetic and nondiabetic patients with and without acrylic partial denture. Group A1—Diabetic patients with prostheses. Group A2—Nondiabetic patients with prostheses. Group B1—Diabetic patients without prostheses. Group B2—Nondiabetic patients without prostheses.

Diabetes mellitus (DM) contributes to increased caries prevalence due to poor metabolic control.¹³ Type 2 DM is one of the risk factors for hyposalivation and quality of the saliva might also be affected. Therefore, decayed teeth were higher in poorly controlled type 2 DM¹⁴ where calcium levels are severely affected that facilitates in demineralization.¹⁵ Glucose in saliva is converted to lactic acid by dental plaque lowering the salivary pH. Aciduric bacterial growth increases suppressing the oral protective bacteria. This effects the status of oral microbiota in the oral environment.

Differences between oral microbiota among healthy and diabetic individuals significantly influence the prevalence of oral disease.¹⁶ Oral microbial community is also interrupted with external factors such as alcohol consumption, stress, anxiety, puberty, hormonal imbalance which results in shift from symbiotic state to dysbiotic state inducing oral disease.¹⁷ Thus, disturbances in oral microbiota results in tooth decay contributing to tooth loss.

Tooth loss contributes to decrease in calorie dense nutrients, poor diet leading to decrease intake of antioxidant and thus increase intake of carbohydrate-rich food results in obesity. Therefore, poor metabolic control resulting in tooth loss is also one of the contributing factors for obesity leading to diabetes.¹⁸

This study reported that missing teeth were statistically significant among diabetic patients without RPD. Since diabetic patients were more vulnerable to periodontal problems, missing teeth was higher among diabetic patients.¹⁹ Age of the diabetic patients without prostheses participated in this study had an average age of 54 years and 64% individuals who were diabetic without RPD participated in this survey brushed once daily and 59% belongs to low-income group, and 52% had medium-level education. So, these factors were also had an influence on oral hygiene resulting in loss of teeth.

Diabetic patients with prostheses (Group A1) had less missing teeth. Nondiabetic patients had better DMFT in-

dex,²⁰ and majority of individuals had high-level education and are more aware about their health needs.

Caries is a multifactorial disease. Socioeconomic factors such as education, occupation, income, diet, oral hygiene, knowledge about oral health also influence on caries prevalence.²¹ When other factors were considered, age and gender of the patients also play an important role. In this survey, average age of the patients among nondiabetic patients with prosthesis and diabetic patients without prosthesis which had higher number of missing teeth was 50 and 54 years, respectively. Both male and female patients were participated in the study, among them nondiabetic patients with prostheses group had highest male ratio when compare with other groups and majority of them belongs to low-income group; 65% nondiabetic male patients with RPD participated in this survey in larger number compared with 44% diabetic patients with RPD and 53% without RPD.

Earlier study has also showed that male patients were more willing to replace missing teeth with RPD when compare with females.²² Chandra Shekar et al in their research had reported that 62.1% of male and 51% of females who belong to lower income group had higher caries prevalence.²³

Income of majority individuals in this study among nondiabetic patients with prostheses and diabetic patients without prostheses belong to low-income groups. The income groups were based on modified BG Prasads (2019) income group such that less than 42,000 per capita income (PCI)/annum is considered low, between 42,000 and 84,000 PCI/annum medium, and more than 84,000 PCI/annum high. Chandra Shekar et al in their study had mentioned that SES plays a vital role in caries prevalence. Individuals who belong to lower SES had higher caries rate (78.6%) when compared with higher SES (43.3%) individuals which was statistically significant.²⁴

The education qualification of nondiabetic patients with and without RPD and diabetic patients without RPD had medium level of education. This had an impact on oral hygiene maintenance and periodic dental checkup. Higher level of education had knowledge about oral health when compared with medium- and low-level education status.²⁵

In majority of nondiabetic patients with RPD, 60% preferred vegetarian diet compared with other groups with mixed diet. Majority of the individuals with RPD irrespective of diabetes preferred vegetarian diet. High consumption of fermentable carbohydrates leads to caries prevalence and a study reported that RPD patients consume high sugar in addition to what was consumed in meals.²⁶ Twenty-five percent nondiabetic patients with prostheses and 31% without prostheses also consumed more sweets compared with diabetic patients. Increased sugar intake increased the oral microbiota that ferments sugar into acids that results in demineralization of calcified tissue resulting in dental caries.²⁵

Oral hygiene practices also had an influence on caries prevalence. In this study, 52% diabetic patients with RPD, 64% diabetic patients without RPD, 85% nondiabetic patients

with RPD, and 72% without RPD brushed once daily. Tooth brushing and its frequency is a reflective image of oral health²⁷ that effectively removes plaque deposition. Bristle of the brushes reaches the interdental areas which prevents plaque accumulation.²⁸ Therefore, brushing twice a day reduces plaque accumulation.

Wearing the acrylic partial RPD continuously results in more plaque accumulation favoring initiation of caries when compared with individuals wearing it during the day time.²⁹ Forty-five percent nondiabetic patients with RPD had worn the denture day and night, whereas 78% diabetic patients had worn the RPD during day time only. Therefore, the oral hygiene practices, diet, income, and education among each individual also play a vital role which had an influence on caries prevalence and tooth loss among nondiabetic patients. These factors also contribute to caries prevalence and tooth loss among individuals irrespective of diabetic condition.

Recent studies had also mentioned that psychological stresses, disabilities, and physical inactivities also had a high impact on oral health of diabetic individuals when compared with nondiabetics.

Psychological stresses counterregulate the hormones such as dopamine, neurotransmitters, glucocorticoids, growth hormones, and glucagon that are activated. It hinders the activation of insulin resulting in increased blood glucose level. Thus, impairment in glucose levels results in development of diabetic complications such as depression and anxiety among individuals.³⁰

It also results in habitual changes of an individual incorporating deleterious habits such as smoking, alcohol intake which affects indirectly the general health and oral health of an individuals.³¹

Limitations

The study was performed in patients who reported to JSS Dental College and Hospital for treatment. Diabetic condition of the patients was assessed from the medical history that revealed the health of the patient. Frequency of acrylic RPD usage among individuals was not recorded.

Conclusion

Within the limitation of the study, it was concluded that acrylic RPD and diabetes had least role in caries prevalence. Caries is a multifactorial disease, and other associated factors play a vital role in individuals' oral health. Preventive measures have to be taken to improve the oral hygiene and health of the general population. Reinforcement through education programs should be conducted regarding oral and systemic health. Dental practitioners should be more responsible for educating the patients regarding denture hygiene of RPD, maintenance and its usage, following postinsertion instructions and importance of periodic dental checkup and recall visits. Henceforth, diet counseling, good oral hygiene practices, verbal and written denture hygiene instructions should be addressed to the RPD wearer's such that it will help them to combat further

caries initiation, progression, and periodontal problems that help them to maintain good oral health. RPD users and nonusers who are deprived of psychological and social status, psychological therapy, and motivation help achieve good oral health which results in maintenance of general health.

Conflict of Interest

None declared.

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