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Assessment of Periodontal Status of Teeth with and without Single Fixed Prosthesis

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ABSTRACT

Introduction

Any dental prosthesis should be compatible with existing hard and soft tissues fulfilling the necessary functional and aesthetic requirements for the longevity of periodontal health. Hence, this study was done to assess the periodontal status of teeth rehabilitated using single fixed prosthesis and compare it with their contralateral homologue.

Methods

This analytical, split-mouth, cross-sectional study was conducted among patients visiting department of Periodontics, GMCTH from July 1 to February 30, 2021. The periodontal parameters (visible plaque index, gingival bleeding index, probing pocket depth, clinical attachment level) of 103 patients with single unit crown were compared with their unrestored, healthy contralateral teeth. The effect of crown material and duration of its insertion on the periodontal parameters were also assessed. The independent t-test, Mann Whitney-U test, Kruskall-Wallis test, ANOVA test were used in the study, wherever applicable.

Results

All periodontal parameters of crowned teeth were found to be greater in comparison to sound teeth which was statistically significant ($p<0.001$). The duration of crown placement did not have significant effect on periodontal health. Mean visible plaque index, probing depth and clinical attachment level were greater in all metal crown followed by metal ceramic crown and all ceramic crowns having the least values, which was statistically significant ($p<0.001$).

Conclusions

Crowned teeth had significantly larger amount of supragingival plaque, increased gingival bleeding, deeper pocket depths and greater clinical attachment loss than sound teeth. Thus, an adequate periodontal assessment and treatment, when planning a prosthodontic rehabilitation, can limit or avoid any potential detrimental effects on periodontium.

Keywords: clinical attachment level; periodontal diseases; pocket; prosthesis.

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INTRODUCTION

Rehabilitation of teeth with fixed prosthesis largely depends on baseline health and stability of surrounding periodontium.[1] The success of any dental prosthesis is considered to be accomplished if it remains in situ over time and with optimal periodontal health.

Several studies advocate dental prosthesis as one of the risk factors for periodontal diseases.[2–5] The biofunctionality and concordance between prosthesis and periodontium largely influence the aesthetics and lifespan of prosthesis.[6] Prosthetic factors like poor marginal adaptation,[7,8] crown margin location,[9–11] contour of crown,[12] crown material,[13,14] and duration of insertion[2] cause periodontal inflammation. This consequence can be minimalized by improving quality of dental prosthesis. Taking this into consideration, prosthesis should be compatible with existing hard/soft tissues, fulfilling necessary functional and aesthetic requirements. Hence, it is imperative for clinicians to have knowledge about interactions of prosthodontic appliances with oral tissues and the outcomes of violating integrity of these structures.

Relatively, very few researches are available on evaluation of effect of fixed prosthesis on periodontal health.[15,16] Therefore, this study was designed to assess the periodontal status of teeth rehabilitated using single fixed prosthesis and compare it with their contralateral homologues. Additionally, the effect of crown materials and the duration of its insertion on the periodontal health were also observed.

METHODS

An analytical, split-mouth, cross-sectional study was conducted from July 1 to February 30, 2021 among the patients visiting Periodontics department of Gandaki Medical College, Pokhara. Sample size was calculated applying formula: $n= 2\ SD^2\ (Z\alpha + Z\beta)^2/d^2$ and based on study by Giollo et al.[17] where, Mean (SD) of Visible plaque index (VPI) in crowned teeth = 30.42 ± 46.10,

Mean (SD) of VPI in sound teeth = 49.17 ± 50.10

Mean difference (d) = 18.75

$Z\alpha$ =1.96 at 95%

$Z\beta$ = 0.84 (i.e. 80% power)

The sample size was calculated as 103 in each group. The convenience sampling technique was used for data collection. The periodontal parameters of the individuals with single unit crown were examined and was compared with their unrestored, healthy contralateral teeth. A single investigator recorded the demographic details and clinically assessed all the prosthetic and periodontal parameters. Under strict aseptic condition, clinical examinations were carried out using sterile set of instruments including mouth mirror, dental explorer and University of North Carolina (UNC-15) periodontal probe.

The duration of crown placement were recorded as: 1 to 2 years, >2 to 5 years and >5 years. Similarly, the crown materials were recorded as: all metal, metal ceramic and all ceramic crown. Ainamo and Bay (1975)[18] suggested the use of two dichotomous indices: a) VPI: It is assessed as a dichotomic evaluation of the Silness & Löe Plaque Index and aggregates Plaque Index (PlI) scores 0 and 1 as absence and scores 2 and 3 as presence of visible plaque, b) Gingival Bleeding Index (GBI): A dichotomous index of Löe and Silness Gingival Index (GI) to evaluate gingival inflammation. It combines the GI scores of 0 and 1 as absence and scores 2 and 3 as presence of gingival bleeding. Thereafter, VPI and GBI were calculated as a percentage of affected sites. Probing pocket depth (PPD) is the distance from the gingival margin to the base of the gingival sulcus or periodontal pocket, measured in millimetres.[19] Similarly, clinical attachment level (CAL) is the distance from the cemento-enamel junction (CEJ; or another definite chosen landmark) to the base of the sulcus or periodontal pocket.[19] We evaluated four sites for VPI and GBI (mesial, distal, buccal, lingual) and six

sites for PPD and CAL (distobuccal, midbuccal, mesiobuccal, mesiolingual, midlingual, and distolingual).

Ethical clearance was obtained from Institutional Review Committee, Gandaki Medical College (Reference No.6/2078/2079). After explaining the nature of the study and possible discomfort, written informed consent were obtained from the enrolled participants. Only the willing participants, with age ≥18 years who have single unit crown on vital or non-vital tooth for at least one year and those who have unrestored, sound contralateral tooth were included in the study. However, patients with evident generalized periodontal problems, history of known systemic diseases or conditions, patients under medication, tobacco users (in any forms) and pregnant women were excluded in the study.

The data were entered into the excel sheet and was analysed using Statistical Package for the Social Sciences (SPSS) version 23.0. The frequencies of VPI(%) and GBI(%) in crowned and sound teeth were compared using Mann Whitney-U test (non-normal distribution). The mean values of PPD and CAL were calculated and compared between crowned and sound teeth by the independent t-test. The effect of crown materials on VPI was assessed using Kruskall-Wallis test (non-normal distribution) while its effect on GBI score, mean PPD and CAL were evaluated using ANOVA test. Similarly, the effect of duration of crown insertion on VPI and GBI score was analysed using Kruskall-Wallis test and on mean PPD and CAL using ANOVA test. The p-value <0.05 was considered as statistically significant.

RESULTS

Table 1 outlines the demographic details of the study participants and the descriptive data of the characteristics of crowns in terms of crown materials and duration of its placement. The mean age group in our study was found to be 45.36 ± 14.51 years. On categorization by age group, most patients 48(46.60%) with single fixed prosthesis belonged to years 41 to 60 years of age group. Out of 103 patients, 45(43.70%) were females and 58(56.30%) were males. The majority of the patients 61(59.20%) had placed metal ceramic crowns. Similarly, most patients 51(49.50%) had the crown placed for >2 to 5 years.

Table 1. Details of the study participants. (n=103).

Parameters	Frequency	Percentage(%)
Age		
18-40 years	40	38.80%
41-60 years	48	46.60%
>61 years	15	14.60%
Sex		
Male	58	56.30%
Female	45	43.70%
Duration of crown placement		
1-2 years	23	22.30%
>2-5 years	51	49.50%
>5 years	29	28.20%
Crown material		
All Metal	22	21.40%
Metal ceramic	61	59.20%
All ceramic	20	19.40%

The clinical parameters of the examined teeth are demonstrated in Table 2. Crowned teeth had higher mean VPI and GBI percentages than the sound teeth which was found to be statistically significant (p<0.001). Similarly, mean PPD and CAL around crowned teeth was also found to be greater than sound teeth. This difference was also statistically significant (2.75 versus 1.80 mm, 2.35 versus 1.41 mm respectively, p<0.001).

Table 2. Comparison of clinical parameters in crowned and sound teeth. (n = 206 sites, 103 patients).

Parameters	Crowned teeth		Sound teeth		Mann-Whitney U value	p-value
	Mean rank	Median	Mean rank	Median		
VPI (%)**	124.17	50	82.83	25	3175	<0.001*
GBI (%)**	124	50	82.90	25	3183	<0.001*

Parameters	Crowned teeth	Sound teeth	95% confidence Interval		p-value
			Lower limit	Upper limit	
PPD (mm) †	2.75 ± 1.04	1.80 ± 0.66	0.71	1.19	<0.001*
CAL (mm) †	2.35 ± 0.92	1.41 ± 0.54	0.73	1.14	<0.001*

*statistically significant, ** Mann-Whitney-U test, †Independent t-test

Table 3. Effect of duration of crown placement on the periodontal parameters.

Periodontal parameters	Mean rank			Median			p-value
	1-2 years	>2-5 years	>5 years	1-2 years	>2-5 years	>5 years	
VPI*	39.83	54.61	57.07	25.0 (0, 100)	50.0 (0, 100)	50.0 (0, 100)	0.066

Periodontal parameters	Mean S.D.			F-statistics	C.I.		p-value
	1-2 years	>2-5 years	>5 years		Lower limit	Upper limit	
GBI**	58.70 ± 28.81	58.24 ± 29.56	69.23 ± 59.66	0.238	53.79	65.53	0.789
PPD**	2.39 ± 0.70	2.88 ± 1.06	2.83 ± 1.19	1.845	2.55	2.96	0.163
CAL**	2.11 ± 0.80	2.41 ± 0.79	2.35 ± 0.92	1.001	2.17	2.53	0.371

*Kruskall-Wallis test, **ANOVA test

Table 3 depicts the effect of duration of crown placement on the periodontal parameters. There was increase in mean VPI and GBI percentages with the increasing duration of crown placement which was found to be statistically non-significant (p=0.066, p=0.789, respectively). In case of mean PPD and CAL, the values increased from 1-2 years to >2-5 years and then decreased afterwards. However, this difference was also found to be statistically non-significant (p=0.163, p=0.371, respectively).

All metal crowns had greater mean VPI(%) followed by metal ceramic crowns with all ceramic crowns having least mean VPI(%). This finding was statistically significant (p<0.001). Conversely, the analysis of data revealed that mean GBI(%) was found to be greater in metal ceramic crowns followed by all metal crowns and then all ceramic crowns which was also found to be statistically significant (p<0.001). Mean PPD and CAL was greatest in all metal crowns followed by metal ceramic crowns and then all ceramic crowns. This finding was also found

to be statistically significant (p=0.014, p=0.004, respectively). (Table 4) Further analyis with post-hoc (Tukey test) for mean PPD and CAL showed that there was a statistically significant difference in mean PPD and CAL between all metal and all ceramic crowns (mean PPD and CAL of all metal crowns > all ceramic crowns, p-value < 0.001). However, there was no significant difference in mean PPD and CAL between all metal and metal ceramic crowns (p=0.314, p=0.138, respectively) and metal ceramic and all ceramic crowns (p=0.086, p=0.065, respectively).

Table 4. Effect of crown material on the periodontal parameters.

Periodontal parameters	Mean rank			Median			p-value
	All metal	Metal ceramic	All ceramic	All metal	Metal ceramic	All ceramic	
VPI**	57.50	55.42	35.53	50 (0, 100)	50 (0, 100)	25 (0, 75)	0.016*
GBI**	52.66	61.15	23.38	75 (0, 100)	75 (0, 100)	25 (0, 75)	<0.001*
Periodontal parameters	**Mean ± S.D.**			**F-statistics**	**C.I.**		**p-value**
	All metal	**Metal ceramic**	**All ceramic**		**Lower limit**	**Upper limit**	
PPD†	3.15 ± 1.36	2.78 ± 0.90	2.22 ± 0.86	4.470	2.55	2.96	0.014*
CAL†	2.78 ± 0.84	2.36 ± 0.92	1.84 ± 0.73	5.934	2.17	2.53	0.004*

*Statistical significance, **Kruskall-Wallis test, †ANOVA test

DISCUSSION

The relationship between restoration of teeth and periodontal health is intimate and inseparable. This analytical cross-sectional study assessed the periodontal parameters of the teeth rehabilitated with single fixed prostheses and compared it with their unrestored, healthy contralateral homologues. The split mouth design included in our study (crowned versus contra-lateral sound teeth in the same individual) intended at minimizing inter-individual differences, so that a more reliable result could be obtained. The periodontal parameters examined in the present study comprised VPI, GBI, PPD and CAL. VPI and GBI are considered markers of gingival health status while PPD and CAL may indicate both inflammation and destruction of periodontium. With the aim of ascertaining the role of supragingival plaque control on the periodontal health of crowned teeth, a dichotomization of the total VPI and total GBI of the participants was performed.[17]

The present study revealed significantly larger amount of supragingival plaque, increased gingival bleeding, deeper pocket depths and greater clinical attachment loss in crowned than in sound teeth. Similar findings were observed in a study by Giollo et al. where mean values of GBI, PPD and CAL were greater in crowned teeth. However, in their study, VPI values were surprisingly higher in sound than crowned teeth.[17] Al-Wahadani et al. also reported that crowns had poorer periodontal health and more clinically evident plaque than uncrowned teeth.[20] This results shed some light into the fact that the higher VPI and GBI values observed in crowned teeth can be attributed to crowns providing favourable niche for continued plaque accumulation, its retention in close proximity to gingiva, difficulty in periodontal maintenance and gingival inflammation. Further, in support to our study, Valderhaug et al.[21], and Reitermier et al.[22] also reported increased PPD values in crowned teeth. In relation to CAL, our results

showed significantly greater loss of attachment in crowned than in sound teeth. Although showing higher values of CAL for crowned teeth, Schatzle et al.[23] and Wang et al.[24] did not find statistically significant differences. Dental plaque is the primary etiologic factor for gingival inflammation, which leads to pocket formation. The pocket, in turn, withholds a sheltered area for plaque and bacterial accumulation that will ultimately lead to clinical attachment loss and alveolar bone destruction.

The present study revealed that with the increasing duration of crown placement, the mean values of VPI and GBI also increased while mean PPD and CAL increased in initial years and then declined later. However, these findings were statistically non-significant. In contrast to our study, Al-Sinaidi et al. demonstrated that the crowned teeth with functioning prosthesis for >5 years had the highest mean values of all the clinical parameters and that the individual's duration of crown placement can affect the periodontal health.[2]

In our study, all metal crowns showed significantly greater mean values of VPI, PPD and CAL followed by metal ceramic crown and all ceramic crowns having the least values. However, GBI values were significantly higher in metal ceramic crowns followed by all metal and then all ceramic crowns. Disagreement exists regarding the effects of various type of crown materials on periodontal health. Al-Wahadni et al.[20] reported that all ceramic restorations attract more plaque irrespective of level of placement of crown margin while all metal and metal ceramic crowns did not have significant differences in any periodontal parameters. However, Weishaupt et al. concluded in their study that galvanoceramic crowns may accumulate less plaque as compared to metal ceramic crowns. They attributed certain stabilizing effect of this particular material for a favorable gingival response.[14] Most studies have also reported that type of alloy did not affect the level of plaque accumulation and that the type of crown materials had no any effect on the health of periodontium.[9,22,25] Such disparities in the results of several studies regarding the effect of different crown materials on periodontal health could be attributed to the detrimental effect of marginal discrepancies and roughness of the crown on periodontal health irrespective of the alloy or material used.

De Baker et al. reported that it is the baseline periodontal health of the tooth that determines the long-term stability of periodontium around the fixed restoration.[1] It is also believed that the increase in plaque accumulation is related to negligence of the patient and not necessarily brought about by the prosthesis. Periodontal alteration may be solely due to the patient's poor oral hygiene with no prosthesis involvement.[26] However, one cannot deny the fact that crown provides a fixed nidus for the continued accumulation of bacterial plaque and its retention in close proximity to the gingiva. Deficiencies in the quality of dental restorations or prostheses are contributing factors to gingival inflammation and ultimately, periodontal destruction. Hence, to prevent plaque build up, it is necessary to create optimal crown contours with proper coronal form, embrasure form, and subgingival fit at the margin.[9]

The longevity of any prosthesis is not only influenced by the duration of its placement or the materials used to fabricate them, but also equally by the manufacturing techniques and operator/patient related factors. Hence, incorporation of these factors in this study with the larger sample size would have increased the generalisability of the result. Furthermore, while planning a dental prosthesis, adequate periodontal assessment and treatment, appropriate instructions, and motivation for plaque control as well as patient compliance to maintenance protocols, appear to

be the one of the most important factors to limit or avoid any potential detrimental effects on the periodontium caused by fixed prostheses.

CONCLUSIONS

It may be concluded, taking into consideration the design and limitations of the present study, that crowns can be a contributing factor associated with more signs of inflammation, and periodontal breakdown. If periodontal health is necessary for the future success of dental care, then it is imperative to use restorative procedures and materials judiciously which can help maintain a healthy periodontium. Hence, before starting prosthetic treatment, the condition of the periodontal tissues should be evaluated for their oral hygiene status, as well as the gingival and periodontal conditions. The knowledge of such responses of periodontal tissues to the dental prosthesis and consequences of violating the integrity of these structures is imperative in treatment planning that entails a predictable prognosis and better patients' acceptance.

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Conflicts of Interest: None declared

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