



Original Article

Inadequate Fixed Prosthesis Design Affecting the Periodontal Health

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ABSTRACT

A prerequisite for any type of restoration or replacement prosthesis is to be in harmony with the adjacent periodontal tissue and have no harmful effect on its health. **Objective:** To assess the effect of fixed prosthesis design on health of periodontal tissue. **Methods:** By using a pre-structured proforma for this observational descriptive study, during the period from September to December 2021, data were collected from sample subjects at Peshawar Dental College and Hospital, Peshawar. A total of 175 (93 females, 82 males) subjects of different ages, were selected with a pre-determined inclusion and exclusion criteria. Different variables, such as gingival index, probing pocket depth, margin location of crown / bridge and proximal contact between crown/bridge with adjacent teeth were assessed via William's Probe. The data were analyzed with SPSS version 22. **Results:** All of the 175 subjects had fixed Prosthesis for 10 years or less, among these, 95 received Crown and 80 received Bridge as Fixed Prosthesis. Among these 58 % had Sub-gingivally placed crown margin, 38 % had equi-gingival, while 3 % had Supra-gingival, whereas, 57% of this prosthesis had a tight proximal contact while 42% had an open proximal contact with the adjacent tooth. 55% showed high level of severity for developing Localized periodontal issue at the site of abutment after the insertion of prosthesis, where as 44% developed localized gingivitis at the site of abutment. **Conclusion:** It was concluded that high score of gingival index and probing depth were recorded for subgingival finish line location and discrepancies in proximal contact points.

INTRODUCTION

Replacement and restoration of missing teeth or parts of teeth should be compatible with periodontium and other structures intra-orally. Periodontal tissue is an integral component for the foundation, esthetic requirements, proper function and comfort of all-natural dentition as well as prosthodontics replacement of teeth [1]. Presence of biological width, comprising of gingival tissue and connective tissues, around the teeth serves as protective barrier and assures a long term intact periodontal health against all types of tissue damage caused by restorative procedures [2]. Restoration and replacement of missing tooth structure or teeth has a direct or indirect influence on health of periodontal tissue in the vicinity of these

restorations/ replacements. Respecting the periodontal health will ensure successful and long-term outcome of the restorations [3]. A large number of studies have concluded that factors related to prosthesis in terms of design, form and material have an influence on biological width and periodontium, leading to deterioration of surrounding tissue by plaque accumulation [4]. Maintaining a good oral hygiene practice is imperative for the health of periodontal structures. A well-designed prosthesis is doomed to be a failure in presence of weak and diseased health status of the periodontium. Considering the effects of a faulty prosthesis on the periodontium and vice versa, locating the margins of fixed prosthesis in relation to the alveolar bone

height and maintenance of periodontal health at the margins of crowns are important factors for the success of not only the prosthesis but also the health of gingiva. Despite the advocacy of respecting the perio-restorative interface, many practitioners lack behind during prosthodontics replacement therapies, leading to gingival inflammation and loss of supporting structures [5-7]. Periodontal problems are found in restorative cases where the concerned tooth is damaged by caries or trauma near the alveolar crest, extending the finish line sub gingivally for esthetics demand, enhancing retention, cervical abrasion or root sensitivity. These procedures may affect the health status of the attached soft tissues leading to gingival inflammation, attachment loss and bone loss, clinically manifested by gingival recession and deep periodontal pocketing [8]. A study concluded that success of crown and fixed partial dentures from periodontal health point of view, depends on baseline health of periodontal tissues, irrespective of placement and location of finish line [9]. They recommended limiting the margin extension sub gingivally up to 0.5-1.0 mm, based on evidence of uncertainty for the clinician to assess and detect the end point of sulcular epithelium and starting point for junctional epithelium [10]. Damage caused by approximation of restorative margins is coupled with formation of bacterial biofilm, which further compromises the host response in dealing with periodontal inflammation process. Several studies indicated that poor marginal adaptation, sub-gingival margin placement, over-contoured crowns and proximal contact relationship contribute to localized periodontal inflammation. These studies have enforced clinicians and researchers to emphasize on the qualities of design of fixed prosthesis in order to preserve good long-term periodontal health. Since most of the relevant studies were carried out in different western countries and because of the lack of such studies from our local set up, it would be interesting to investigate in our populations with different cultural, ethnic and dietary backgrounds. Thus, the aim of the present observational study was to assess the periodontal conditions in relation to inadequate prosthetic designs in general.

METHODS

This cross-sectional study was conducted at the department of Periodontics at Peshawar Dental College and Hospital, Peshawar (September 2021 to December 2021). An ethical approval certificate was obtained from Institutional Review Board before starting the current study. Participants of the study were selected through random convenient sampling method. The target population included patients attending periodontology department for prophylactic periodontal treatment, after receiving fixed prosthodontics treatment. These included

crowns and bridges with irrespective of the design of prosthesis, type of material, location of the finish line, and location of the abutment teeth in the arch either maxillary or mandibular. Patients with previous or current, generalized periodontitis, diabetes, hypertension, smoking history and pregnant females were excluded from the study. A total of 175 participants were recruited in the study with 82 males and 93 females, having crowns and bridges with less than ten years of replacement history. The sample size was determined with the help of WHO calculator with a significance level of 95%, power of 80% and margin of error 5%. Prosthesis replacement history was measured from time of first cementation of the prosthesis till the patient was examined for the purpose of this study. An informed verbal consent was obtained from the participants after comprehensively explaining the nature of the study. A thorough clinical examination, performed by a single Author (MI), included assessment of periodontal tissue around the prosthesis, location of the prosthesis margin and proximal contact of the prosthesis with the adjacent tooth. The clinical parameters noted were Gingival Index (Loe and Silness) and Probing Pocket Depth. The probing pocket depth was measured at six sites per abutment tooth (mesio-buccal, buccal, disto-buccal, distolingual, lingual and mesio-lingual) using the William's periodontal probe (Signor), sulcus depth more than 3mm were noted as periodontal pockets. Location of the Crown margin were assessed visually, the margins were considered sub-gingivally located, if they were 1 mm or more below the gingival margin with William's periodontal probe clinically. Proximal contact relationship with adjacent tooth was also assessed with the help of waxed dental floss. The collected data were statistically analyzed using the Statistical Package for Social Sciences (SPSS) version 22.0.

RESULTS

The study included total 175 subjects. Out of which, 82 (46.8%) were males while 93 (57.3%) were females, with the age ranging between 21-60 years. Participants were categorized as Group-A comprised of age 21-30 years, Group-B from age 31-40 years, Group-C from age 41-50 years and Group-D from age 51-60 years. The number of total participants in Group A, B, C and D was 45 (25.7%), 55 (31.4%), 41 (23.4%), 34 (19.4%) respectively as shown (Table 1).

Gender		Age Groups (yr)			
Male	Female	Group-A (21-30)	Group-B (31-40)	Group-C (41-50)	Group-D (51-60)
82 (47%)	93 (53%)	45 (26%)	55 (31%)	41 (23%)	34 (20%)

Table 1: Frequency of gender and age groups

All the subjects were checked for the extent of margin placement, 102 (58.2%) had sub-gingival margins i.e.,

crown margin extending more than 1mm, apical to the free gingival margin, 67 (38.2%) had equi- gingival margins i.e., prosthesis margin at the level of free gingival margin (with a positive / negative ledge) and 6 (3.4%) had supra-gingival i.e., prosthesis margin 1mm or more coronal to the free gingival margin (with a positive / negative ledge). Periodontal status around each prosthesis for all subjects were also assessed, it was found, out of 102 sub-gingival margin prosthesis, 38 (21.7%) had high gingival index score around the margin area, clinically manifested as localized gingivitis and 64 (36.5%) had more than 3mm pocket formation around the prosthesis margin, clinically manifested as localized periodontitis. Similarly, out of 67 (38.2%) equi-gingival margin prosthesis, 36 (20.5%) had localized gingivitis and 31 (17.7%) had localized periodontitis. Out of 6 (3.4%) supra-gingival margin prosthesis, 4 (2.2%) had localized gingivitis and 2 (1.1%) had localized periodontitis (Table 2).

Margin Location	Periodontal Status	
	Localized Gingivitis	Localized Periodontitis
Sub-Gingival margin 102 (58.2%)	38 (21.7%)	64 (36.5%)
Equi-Gingival margin 67 (38.2%)	36 (20.5%)	31 (17.7%)
Supra-Gingival margin 6 (3.4%)	4 (2.2%)	2 (1.1%)
Total 175 (100%)	78 (44.5%)	97 (55.4%)

Table 2: Frequency of inadequate fixed prosthesis margin and its periodontal status

The fixed prostheses were also examined for the proximal contact points with their adjacent teeth, and the periodontal status around them. A total of 100 (57%) had tight proximal contact point, i.e., it was hard to pass dental floss from between the fixed prosthesis & adjacent tooth, among these 35 (20%) had high gingival index score and clinically manifested as localized gingivitis whereas 65 (37%) had more than 3mm pocket formation around the proximal contact area, clinically manifested as localized periodontitis. While the rest of 75 (42.8 %) had open contact point, out of which, 43 (25%) had localized gingivitis and 32 (18%) had localized periodontitis (Table 3).

Proximal Contacts n (%)	Periodontal Status	
	Localized Gingivitis	Localized Periodontitis
Tight contact 100 (57%)	35 (20%)	65 (37%)
Open contact 75 (43%)	43 (25%)	32 (18%)
Total = 175 (100%)	78 (44.5)	97 (55.4%)

Table 3: Frequency of inadequate proximal contacts and its periodontal status

DISCUSSION

Periodontal diseases are considered one of the most prevalent diseases of the oral cavity, affecting almost 90% of the world population. Plaque accumulation, calculus formation, neglected oral hygiene and systemic diseases are some of the factors responsible for altered periodontal

health status. However faulty and inadequate design of the restorations of teeth along with ill-planned treatment planning can play a pivotal role in adversely affecting the periodontal health. The closer is the margin of crown and bridge to the alveolar bone, the more are the chances of violating the integrity of the biological width, for example subgingival margins. The present study focused on understanding the relationship between the two mentioned factors i.e., finish line location and biological width, second proximal contact and periodontal tissue health. Our study observed that all subjects showed high gingival index score and increased pocket depth formation in the area of abutment tooth. No positive relation was found between the developments of gingival or periodontal issue in the area of abutment tooth, with age of the subjects, gender of the subjects and the time duration for which the subject was provided with the prosthesis, Distribution of gingival or periodontal issues showed similar pattern between male and female subjects. This finding was in relation to a descriptive study conducted by Khan *et al.*, at a dental college in Bangladesh that concluded periodontal diseases are primarily correlating with the age but gender may not be associated [11]. Majority of subjects 97 (55.4%) showed high gingival index score as well as increased pocket depth and manifested clinically as localized periodontitis at the abutment site and its adjacent tooth after receiving fixed prosthodontics treatment, among these 64 (36.5%) were found with subgingival margin, 31 (17.7%) with equi-gingival margin and 2 (1.1%) with supragingival margin. 78 (44.5%) of the 175 (100%) subjects, exhibited high gingival index score only, among these 38 (21.7%) were found with subgingival margin, 36 (20.5%) with equi-gingival margin and 4 (2.2%) with supragingival margin. This outcome indicates a relation that placement of prosthesis margin below the gingival margin, is detrimental to periodontal health. This finding is in agreement with the study done by Gunay *et al.*, where majority of diseased cases were involved with subgingival finish line of the restorations [12]. A minimal width of 2mm, from the deepest point of gingival sulcus and alveolar bone crest is needed for junctional epithelial and connective tissue attachment with the root surface of the tooth. Our study observed this distance to be less in majority of cases which is in agreement to the previous studies [13-15]. Relation between biological with violation and bleeding on probing was justified in one another study that evaluated the histological and clinical response of periodontal tissues to the position of the restoration margins within the biologic width [16]. The gingival recession and inflammation were clinically observed in yet another study by Carvalho *et al.*, in addition to the correlation between the presence of width invasion and the

decrease in the level of the bone crest observed radiographically [17]. These findings similar to those reported by Douglas *et al.*, second major defect in the prosthetic design that led to formation of localized gingivitis / localized periodontitis among the subjects was the proximal contact discrepancies i.e., either a too tight or open contact was found between prosthetic crown and its adjacent natural tooth [18]. About 57% subjects had tight contact between the prosthesis and adjacent tooth and amongst these 37% had clinical manifestation of localized periodontitis with high gingival index score and deep pockets. Also 20% among tight contact and 24% among open contact, showed high gingival index score only. Our findings are in agreement with a study done earlier which showed attachment loss in many cases and gingival inflammation [19]. Jernberg *et al.*, study regarding the impact of open contacts on periodontium showed greater prevalence of food impaction, in sites with open contacts which presented with deep pockets and clinical attachment loss although there was no significant difference for gingival index, bleeding and calculus index between contact types [20]. Another cross-sectional study reported by Koral *et al.*, that an increase of bone loss (2.4%) in the patients with open contact between prosthesis and adjacent tooth that initiated periodontitis [21]. Regardless of an indirect relationship between open contact and periodontal inflammation, it could be postulated from these studies that food impaction contributes to increase in pocket depth and clinical attachment levels.

CONCLUSIONS

Within the limitation of this study, it can be concluded that a high score of gingival index and probing depth were recorded for subgingival finish line location and discrepancies in proximal contact points.

Conflicts of Interest

The authors declare no conflict of interest

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