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Effect of iatrogenic factors on periodontal health: An epidemiological study

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Abstract *Introduction:* Periodontitis is a multifactorial disease. Among conglomerate etiological factors, overhanging interproximal restorations are viewed as contributing factors causing gingival inflammation due to their retentive capacity for bacterial plaque leading to periodontal destruction. Hence this study is intended to determine the prevalence of overhanging restorations and its effect on periodontal status of the teeth and to assess the iatrogenic effects of overhanging margins on periodontal health.

Materials and methods: A total of 100 subjects of 15–65 years of age were recruited for this study. Dental restorations which affect periodontal health like amalgams, composite or glass ionomer restorations (overhanging margins proximally), fixed prosthesis, cervical abrasions, class V restorations extending sub-gingivally were included in the study. Patients with known systemic diseases, smokers, and on any medication in past 6 months were excluded from the study. Various parameters like bleeding on probing, probing depth, clinical attachment loss, biological width, gingival recession, duration of restoration were assessed according to the site of the restorations.

Statistical analysis: A commercially available SPSS version 20.0 Software, was used to perform the statistical analysis. The data were distributed normally and it was investigated using paired *t*--test. The prevalence of overhanging restorations was done through percentages comparison between restorative sites with non-restorative sites.

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Results: The presence of sub-gingival restorations was greater in males than in females. This can be attributed to the oral hygiene maintenance of the subjects. The prevalence of sub-gingival restorations was more prevalent in the age groups between 35 and 45 years of age.

Conclusion: This study clearly identified a higher prevalence, 50.8% of sub-gingival restorations causing gingivitis and has shown significant influence on periodontal status of the tooth.

1. Introduction

Periodontitis is a multifactorial disease. Overhanging interproximal restorations are viewed as contributing factors for gingivitis and periodontal attachment loss by causing gingival inflammation owing to their retentive capacity for bacterial plaque (Gilmore et al., 1971). The pathophysiology of overhangs is associated with environmental changes and the disruption of the balance between the beneficial microflora and periopathogens, which is similar to that observed in chronic periodontitis. There is an increase in the proportion of gram negative anaerobic rods, particularly the black pigmented bacteriodes. Overhanging restorations are at a higher risk; they are directly proportional to the plaque mass and are associated with periodontal destruction (Lang et al., 1983). Such restorations pose a significant concern as their prevalence has been estimated to be 25–76% in the restored surfaces (Bjom et al., 1969).

In routine practice, the overhanging margins of the restorations present a frequently encountered problem. The condition will result in excessive loss of the alveolar bone support if it is not recognized and removed immediately or recontoured within a few years. In a committee meeting held as part of the World Workshop in Periodontics, it wasstated that "overhanging restorations are local factors which initiate, enhance or supplement periodontal disease" (Ramfjord et al., 1966).

The probable reasons for periodontal disease, in addition to microflora, might be impingement on interdental embrasure, violation of gingival contour and biological width, failure to restore the tight contact point, incorrect placement of the restorative material, improper self cleansibility, etc. (Lang et al., 1983). In general, the purpose of restorative dentistry is to reinstate good periodontal health and functional comfort of the natural dentition, apart from providing satisfactory esthetic appearance (Matthews et al., 2004). All dental restorations should satisfy the established requirements for periodontal physiology and health, with regard to the surface, esthetic and functional characteristics. However, the role of the clinician is not only to restore the tooth but also to maintain the adjacent soft and hard tissues. Hence, evaluating the site-specific parameters will be beneficial in providing evidence for the periodontal status. In this regard, the buccoproximal surface of the restored tooth has been evaluated and compared with the corresponding site of the contralateral tooth (Sirajuddin et al., 2015).

The aim of the present study was to compare the periodontal parameters of the sub-gingivally restored tooth with the healthy one. Furthermore, the prevalence of sub-gingival restorations and their effects on the periodontal status of the teeth were examined.

2. Materials and methods

2.1. Patient population and selection

This research was a cross-sectional study with a sample size of 100 subjects aged 15–65 years (62 males and 38 females) recruited from the Department of Periodontics. During the course of the investigation, 148 restored teeth were examined in 100 participants. The required clinical and radiographic parameters were recorded and assessed. The study was approved by the Institutional Ethical Committee. Informed consent was obtained from each patient and the work was carried out as per the assigned inclusion and exclusion criteria. The patients with at least one proximal restoration, such as sub-gingival amalgams, composite or glass ionomer restorations (proximally overhanging margins), fixed prosthesis, cervical abrasions, class V restorations and orthodontic brackets and bands acting as foci for plaque accumulation, as well as those having a contralateral healthy non-restored tooth, were included in the study. Patients with known systemic diseases affecting the periodontal status, restorations, supra erupted teeth, marginal ridge discrepancies, open contacts and third molars, as well as smokers, were excluded.

2.2. Clinical parameters and radiographic evaluation

Clinical examination was conducted by an examiner according to the instructions. Parameterssuch as bleeding on probing by using the Modified Gingival Index, Plaque Index and probing pocket depth (PPD) were estimated at six sites from the gingival margin to the bottom of the sulcus/pocket in the tooth having subgingival restorations. The clinical attachment loss (CAL) was measured as the distance between the base of the pocket and a fixed point on the crown, such as the cemento-enamel junction, using the UNC 15 probe at six sites per tooth simultaneously. Gingival recession and the duration of restoration were also assessed.

Intraoral periapical radiographs were taken at 70 kvp and 7 ma by using Ektha speed films and digital x-ray unit. The exposure time was 0.20 s. Radiographic parameters, such as PDL space widening, discontinuity or absence of lamina dura, and attachment loss were assessed [Fig. 1a–c].

Duration of the restoration was checked by including the period from one week post-restoration to greater than five years. The range was accordingly divided into 1 week, 1 month, 1–4 years, and > 5 years, and the extent of periodontal destruction was examined by clinical and radiographic parameters.

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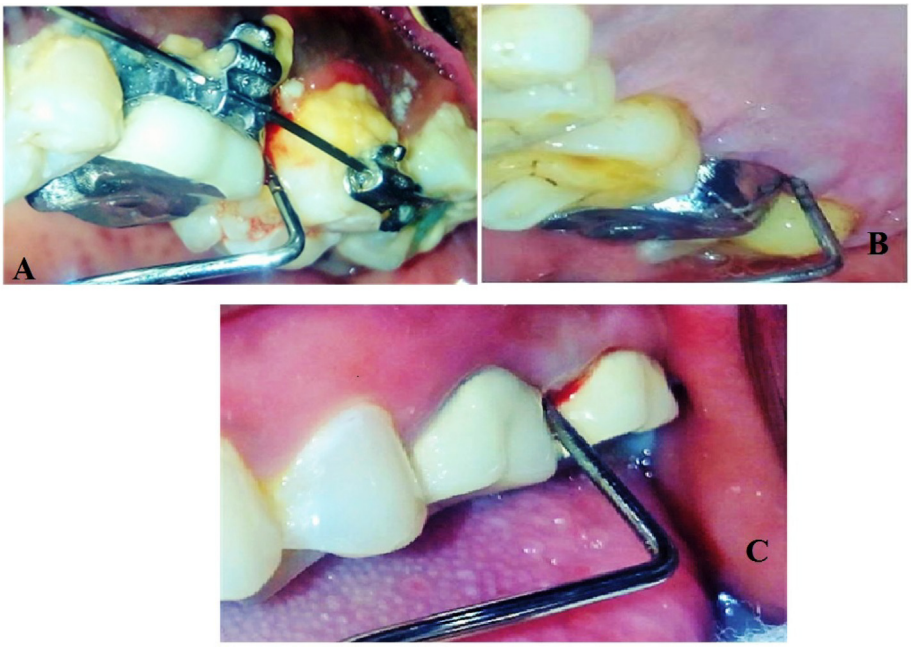


Fig. 1 (a) Measuring the probing depth in a patient with braces, (b) Measuring the probing depth in a patient who has metal crown, (c) the probing depth in patient with metal ceramic crown.

2.3. Radiographic examination

The radiographic parameters were assessed using intraoral periapical radiographs. A periapical destruction was registered if the periodontal space was widened and the discontinuity of lamina dura was absent during visual examination. The percentage of radiographs depicting the above parameters were recorded [Figs. 2 and 3].

2.4. Statistical analysis

Commercially available SPSS version 20.0 software was used to perform the statistical analysis. The data were distributed normally and investigated using student's paired *t*-test. In this study, several variables were evaluated to analyze the effect of metal restoration with and without marginal overhangs on the pocket depth and clinical as well as radiographic attachment losses. Student's *t*-test was used for the paired samples. The pairing was effective when compared with a *t*-test between two independent groups since the positive correlation within the patient was significant.

3. Results

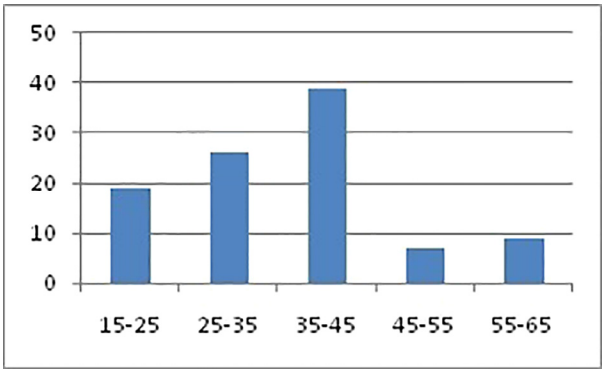
The prevalence of sub-gingival restorations affecting periodontal health is listed in Table 1. The presence of such restorations was greater in males than in females, which can be attributed to the difference in the oral hygiene maintenance of the subjects. The occurrence of sub-gingival restorations was more prevalent in the age group of 35–45 years [Graph 1].

Fig. 2 Radiograph of one of the patients showing overhanging restoration.

Fig. 3 Radiograph showing excess cement.

Table 1 Illustration of prevalence of clinical parameters.

SNO	Clinical parameter	Percentage of occurrence
1.	Over hanging margins	50.8% of total restorations
2.	Sites with probing depths	59.3% of total sites
3.	Over hanging margins with bleeding on probing	38.9%
4.	Over hanging margins with probing depths	17.6%
5.	Bleeding on probing	Score < 2 75% 2–4 25%
6.	Probing depth	3–5 mm 62.1% > 5 mm 37.8%
7.	Biological width	< 2 mm 35.1% > 2 mm 64.9%
8.	Plaque score	Score > 2 68.2% > 3 31.7%



Graph 1 Comparison of Subgingival restorations among different age groups.

3.1. Pocket depth

As inferred from Table 1, the prevalence of the overhanging restoration was 50.8%, and the proportion of sites with probing depths was 59.3%.

Among the overhanging margins of the total restorations, 62.1% of the probing depths were seen on the buccal interproximal surfaces and not in the lingual surfaces ($p = 0.005$).

Table 2 illustrates a positive and significant correlation between the duration of restoration and the buccoproximal probing depths. This period has been compared with the other parameters such as probing depths, CAL, BI, PI (Plaque index) and BW (Biological width) in Table 3. As per the data in Table 2, duration of restoration and probing depths of the proximal sites correlated to 0.289 in cases with a significant value for the above parameters.

3.2. Radiographic parameters

In 50.8% of the overhanging restorations, all the teeth showed PDL space widening. The lamina dura was totally absent in 21.6% of the teeth, discontinuity of the lamina dura was seen in 46.6%, and peri apical bone loss was witnessed in 38.5% (Table 4).

Table 4 Illustration of radiographic parameters.

S.No	Radiographic parameter	Prevalence (In Perentage)
1.	Lamina dura absent	21.6%
2.	Lamina dura discontinuity	46.6%
3.	Periapical bone loss	38.5%

Table 2 The Correlation between below parameters is assessed with duration of restoration.

		Bucco- proximal	CAL	BI	PI	BW
Duration of the restoration	Pearson Correlation	0.289**	−0.023	0.071	0.181	0.083
	p-value	0.004	0.818	0.481	0.073	0.414

Duration of restoration and periodontal depth (PD).
Duration of restoration and clinical attachment loss (CAL).
Duration of restoration and bleeding index (BI).
Duration of restoration and plaque index (PI).
Duration of restoration and biologic width (BW).
** Correlation is significant at the 0.01 level (2-tailed).

Table 3 The relationship between the type of restoration and various parameters (BI, PI, CAL and PD) is analyzed using ANOVA test.

	Type of Restoration									p-value
	Amalgam			Crown			GIC			
	Mean	SD	N	Mean	SD	N	Mean	SD	N	
B- PROX	4.30	1.15	43	4.40	1.16	43	4.64	1.08	14	0.626: NS
CAL	5.00	1.54	43	4.88	1.20	43	4.86	1.17	14	0.903; NS
BI	2.28	0.73	43	2.07	0.83	43	2.64	0.84	14	0.062; NS
PI	1.93	0.74	43	2.12	0.80	42	2.07	0.92	14	0.536; NS
BW	1.75	0.60	43	1.93	0.73	43	1.54	0.57	14	0.138; NS

NS = Non-significant.

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3.3. Description of the patient population

The age and sex distribution, as well as the distribution of the teeth according to the patient, are presented in Tables 1–4. The mean age was 50.3 years. The prevalence percentage (Graph 1) of the sub-gingival restorations was higher in the age group of 35–45 years.

3.4. Description according to the variables

Inter- and intra-examiner correlations of clinical and radiographic assessments were calculated for the 143 teeth that were evaluated. Inter-proximal overhangs were observed in 50.8% of the total restorations. The buccoproximal overhangs constituted 62.1% of the total restorations. The results revealed that 62.1% and 37.8% of the pocket depths were 3–5 mm and >5 mm, respectively. Deeper pockets were more frequently observed in the proximal sites with overhanging margins.

An apparent difference between the groups was found in the distribution of radiographic attachment loss. Lamina dura was totally absent in 21.6% of the observed teeth, and discontinuity was noted in 46.6% of the restored teeth. The correlation coefficient between the test and control sites within the patient in terms of pocket depth and clinical attachment loss were significant ($p < 0.01$) and amounted to 4.39 and 5.00, respectively.

4. Discussion

4.1. Patient population and sample

The sample consisted of patients from the Outpatient Department of Periodontics and represented an adult population of 100 subjects aged 35–45 years. One hundred forty-eight teeth were found to have overhanging restorations affecting periodontal health.

4.2. Prevalence

Sub-gingival restorations with probing depths of 3–5 and >5 mm were observed in 62.1% and 37.8% of the patients, respectively in the current study. A higher prevalence, ranging from 25 to 76%, has been reported in several earlier studies (Rodriguez-Ferrer et al., 1980; Schatzle et al., 2001; Leon, 1976). This disparity might be owing to the fact that the radiographic registration was combined with the clinical examination. In the present study, radiographic assessment showed 46.6% lamina dura discontinuity and revealed a correlation between periodontal depth, CAL and overhanging restorations, which could be considered as the cause of periodontitis in the particular tooth.

4.3. Overhanging restorations in relation to PD, CAL and radiographic changes

When the clinical attachment loss was compared between the different restorations (type of material), a 1.54 mm difference was seen between the amalgam and glass ionomer cement (GIC) restorations. This result strongly indicates that the amalgam restorations are more prone to plaque retention than the GIC restorations consisting of fluorine (Mokeem, 2007).

However, both the patient's oral hygiene level and the type of restoration appear to influence the effect of overhanging on pocket depth and clinical attachment loss. The mean plaque score and bleeding index score were higher in the GIC restorations than in the amalgam restorations. This observation, in combination with the previous findings that professional plaque removal without elimination of the overhangs causes a significantly decreased but not complete gingival inflammation, indicates that the effect of overhanging restorations may act synergistically and potentiate the effect of poor hygiene (Jansson et al., 1994; Pack et al., 1990; Waerhaug, 1974).

When the radiographic parameters were considered, 46.6% of lamina dura discontinuity, 38.5% of periapical bone loss and 21.6% of absent lamina dura were noticed. This result is in accordance with the earlier studies in which it was observed that the influence of overhangs on radiographic parameters increased with the severity of periodontitis (Jeffcoat et al., 1980; Ibraheem, 2005).

The present study has clearly demonstrated a strong relationship between the size of the overhang, type of restoration, pocket depth and clinical attachment loss. It has also been proven that the prevalence rate of overhanging restorations agrees with the radiographic attachment loss.

5. Conclusion

Based on the present study, it can be concluded that the influence of the overhanging restorations on pocket depth and clinical attachment loss rises with the increasing loss of periodontal attachment in periodontitis-prone patients. The effects on clinical attachment loss, pocket depth and overhanging may act synergistically, potentiating and compromising the effect of good oral hygiene.

Source(s) of support

None.

Presentation at a meeting

None.

Ethics statement

The consent of the patient was sought prior to study. The approval was obtained from the Ethics Committee from Sri sai college of dental surgery prior to study.

Declaration of Competing Interest

Author declares that there is no conflict of interest.

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