Research Article

The Effect of Biological Width Violation on Periodontium - Radiographic Study

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Abstract

Faulty restorations in general and overhanging restorations, in particular, harm the health of the periodontium. This retrospective trial study was conducted to investigate the prevalence, severity and pattern of biological width violation and their relation to different types of overhanging dental restorations using the Orthopantomogram (OPG).

Materials and methods: *to achieve this study, we analyzed a sample of 5000 OPGs for patients attending Ajman University clinics and used 303 radiographs with overhanging restorations for calibrating the severity and pattern of alveolar bone loss. For each tooth, distances between the cementoenamel junction, and alveolar crest (AC) were measured using* ***Planmeca 4.0*** *software. The obtained data were analyzed by* ***IBM SPSS Statistics*** *software.*

Results: *overhanging restorations are associated mainly with mild, vertical bone loss. Besides, it has been shown that there is no relationship between different types of restoration and the severity or the pattern of bone loss.*

Conclusion: *the effect of overhanging restorations in the violation of biological width was extremely deleterious. Moreover, digital orthopantomographs were found to be accurate in the determination of bone loss.*

Keywords: *overhang restorations, biological width, Cemento-enamel junction, alveolar bone, orthopantomographs.*

Introduction

Biological width is the dimension of the soft tissue, that is attached to the portion of the tooth coronal to the crest of alveolar bone. **(**1**)** It functions as a natural seal to preserve the periodontal health and prevents the ingress of microorganisms that might damage the supporting structures of the teeth. **(**2**)** It is of substantial importance particularly in the field of restorative dentistry.

Overhanging dental restoration is defined as an extension of the restorative material beyond the boundaries of a cavity preparation. In addition to being widely prevalent, it is one of the major etiological factors in the progression of periodontal disease. It implicates a violation of the biological width causing an increase of gingival recession and crestal bone loss. **(**3**)**

The mechanism by which overhanging restorations develop periodontal disease is multi-factorial. Overhanging restorations promote the accumulation of plaque mass, in addition to the development of higher level of specific bacterial pathogens in the plaque. **(**3,4**)** Moreover, overhanging restorations cause damage to the periodontium by impinging the interproximal embrasure and biological width, which Prevents the accessibility for cleaning the accumulated Plaque. **(**4**)**

Detection of overhanging restorations could be misleading, since it is not always showing on radiographs, so combination of both clinical and radiographic assessments is the best diagnostic aid. **(**5,6**)**

This study discusses the concept of biological width and its relationship to periodontal health, by evaluating the prevalence and severity of alveolar bone loss in association with overhang restorations using the radiographic method, and in particular Orthopantography (OPG).

Aims and Objectives

- The purpose of this study is to evaluate and measure the severity of the interproximal bone loss in association with faulty restorations, and in particular overhanging restorations in patients visiting Ajman University dental clinics using **Orthopantography** (OPG), to further support the negative influence of this type of restorations on the periodontium and biological width.
- The study further includes comparing the amount of bone loss associated with different types of overhanging restorations, which include bridges, class II amalgam/composite restorations and crowns, in order to estimate the readings from certain types of restorations.

- To stress the significance of maintaining the biological width within all dental specialties, and to emphasize the need for regular recall and maintenance therapy.

Materials and Methods

1.This Retrospective study was conducted within Ajman University Dental College premises. The radiographs for the current study were obtained after accessibility to all orthopantographs (OPG) belonging to patients visiting Ajman University dental clinics between the years 2013 until 2016, and selecting a random sample of 5000 radiographs.

2.The Radiographic calibration software (Planmeca 4.0) was used to estimate the amount of alveolar bone loss adjacent to overhang restorations.

- The two parameters included in the study are the Alveolar Crest (AC) and cementoenamel junction (CEJ).
- The CEJ was the fixed coronal reference for these measurements.

3.The criteria for selection were radiographs containing overhanging restorations in the proximal tooth surface, including bridges, crown class III and class II composite/amalgam restorations.

4.The exclusion criteria were:

- Orthopantographs without overhang restorations.
- Overhanging restorations adjacent to the edentulous area or associated with generalized bone loss.

5.After screening all the radiographs in the mentioned years, the selected radiographs with overhang restorations were calibrated. The distance between the alveolar crest and the cementoenamel junction was measured using the ruler in the calibration software.

Figure 1 OPG showing mild bone loss associated with tooth #16

Figure 2 OPG showing moderate bone loss associated with tooth #27

Figure 3 OPG showing severe bone loss associated with tooth #17

- A finding of less than **2mm** was considered as normal, and the overhang restorations were considered to cause no significant effect on the periodontium.
- A distance between **3-4mm** was considered to cause a **mild** violation of biological width. (**Figure-1**)
- A distance between **5-6mm** was considered to cause **moderate** violation of biological width. (**Figure-2**)
- A distance above **7mm** was considered to cause **severe** violation of biological width. (**Figure-3**)

6.The pattern of bone loss, whether horizontal or vertical, associated with each restoration was recorded.

7.Data analysis is performed after collecting all the results; using **IBM SPSS Statistics** software. Mean and standard deviation have been calculated. Moreover, to assess the association between the type of restoration and severity or pattern of bone loss, a chi-square test has been used.

Results

A total of 5000 radiographs belonging to patients attending Ajman University dental clinics were observed to determine the presence of overhanging restorations. Of these, 303 (6.06%) radiographs had met the inclusion criteria. Amongst these radiographs, 498 different types of overhanging restorations were detected as shown in **table-1**. A total of 88 restorations (17.7%) were excluded because of the

presence of a generalized bone loss in the dentition, or due to their proximity to an edentulous space. (**Table-2**)

Type of restoration	**No.**
Crown	**167(33.5%)**
Bridge	**34(6.83%)**
Class II	**292(58.6%)**
Class III	**5 (1.00%)**

Table 1 No. of restorations types.

Restorations excluded	**Type of restoration**	**Number**
Generalized /adjacent to edentulous area	Class II	44(15%)
	Class III	0 (0%)
	Crown	32(19.2%)
	Bridge	12(35.3%)

Table 2 No. of restorations excluded.

Severity:

The severity of bone loss (BL) for the different types of restorations was determined by calibrating the distance between CEJ and the crest of the alveolar bone. The graphs of this study were formulated using the ***Minitab 17*** software. It has been shown that the most prevalent category of bone loss was mild (0<BL<3) for all types of restorations, followed by the moderate category (3≤BL <5). Moreover, the overhanging restorations associated with no bone loss (BL=0) were significantly higher than the severe category (BL ≥5). (**Figure-4**).

	Type of restoration	Mean	Std. Deviation	N
Amount of bone loss	class II	2.39	.837	248
	Crown	2.34	.839	135
	Bridge	2.27	.883	22
	class III	2.40	.894	5
	Total	2.37	.838	410

Table 3 Mean and Standard deviation of the severity

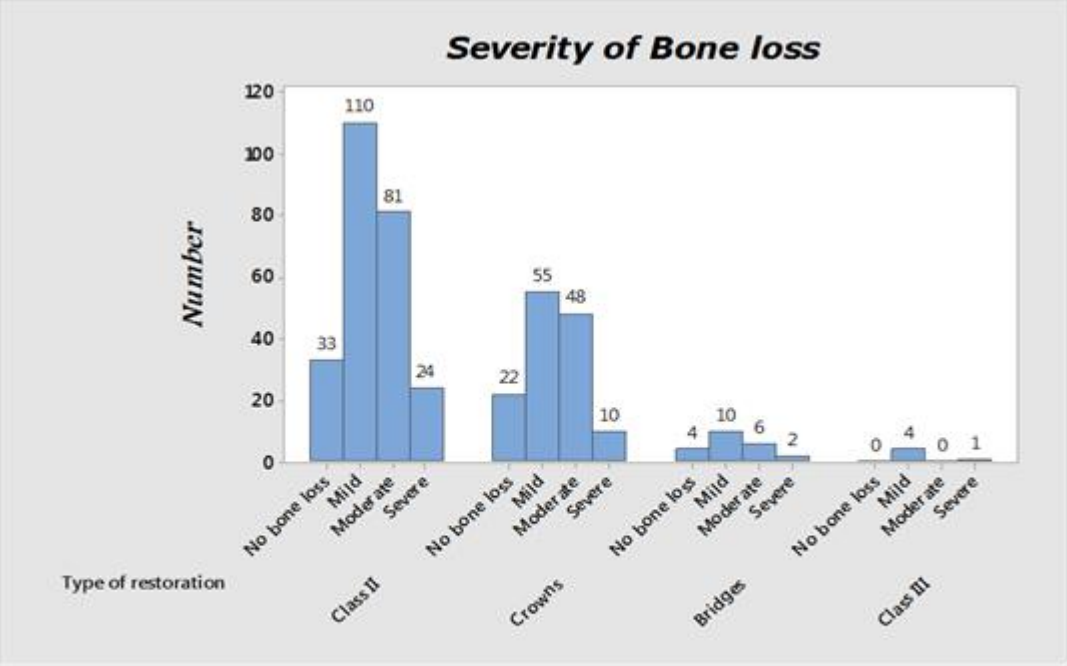

Figure 4 Severity of bone loss.

The tables of the current study were calculated and designed with the aid of the **SPSS statistical program**. According to **table-3**, the mean of each type of restoration was shown in the mild category of bone loss. The mean of the bone loss for all types of restorations was calculated as 2.37, with a standard deviation (SD) of 0.838. These results were further supported by the calculation of the chi-square statistical test. (**Table-4**)

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.627[a]	9	.676
Likelihood Ratio	8.526	9	.482
N of Valid Cases	410		

Table 4 Chi-Square test for the Severity.

Correlation between the type of restoration and severity of bone loss

As shown in table-5, both Pearson Chi-Square and Likelihood Ratio were found to be larger than 0.05 (alpha= 0.05), therefore we accept that a non-significant difference exists between the different types of the studied restorations and the severity of a bone loss.

Pattern:

Furthermore, the results were additionally analyzed by evaluating the pattern of bone loss (horizontal or vertical). The results revealed that the vertical pattern of bone loss is more frequent than the horizontal pattern amongst the different restorations as shown in **Figure-5**. The percentage of the vertical pattern bone loss for class II, crowns, bridges, and class III restorations was calculated as 66.4%, 54%, 66.7%, and 80%, respectively. The results were further supported using the **chi-square test** demonstrated in **table-5**.

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.225[a]	6	.222
Likelihood Ratio	8.847	6	.182
N of Valid Cases	410		

Table 5 Chi-Square test for the Pattern.

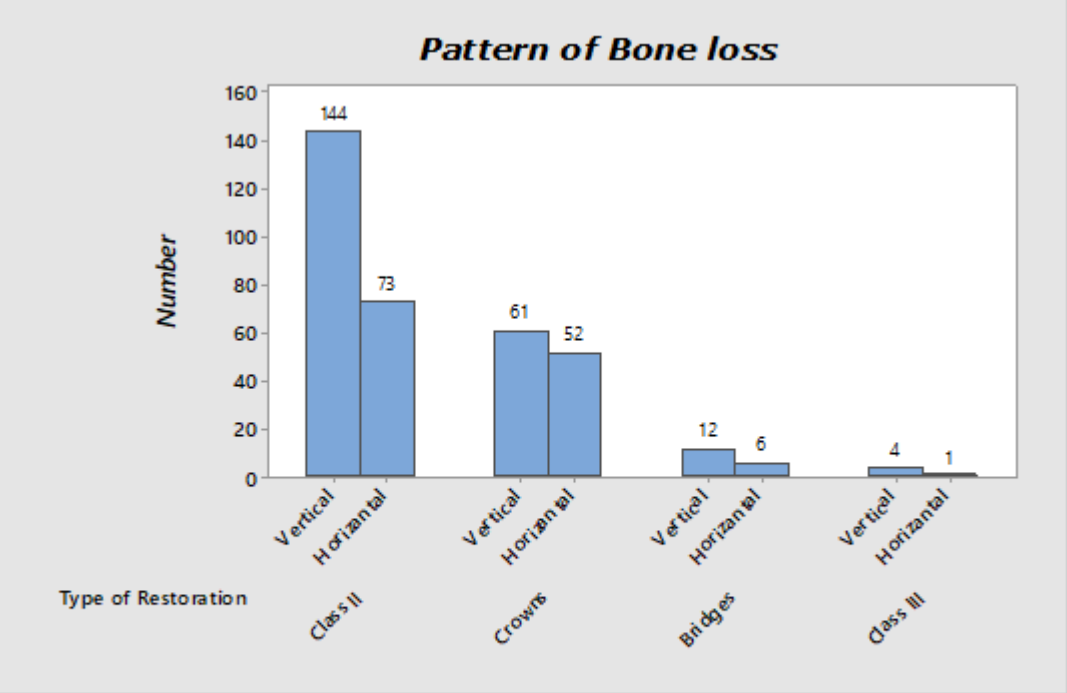

Figure 5 Pattern of bone loss.

Correlation between the type of restoration and pattern of bone loss

According to **table-6**, both Pearson Chi-Square and Likelihood Ratio were found to be larger than 0.05(alpha= 0.05), therefore we accept that a non-significant difference exists between the different types of restorations and the pattern of bone loss.

Discussion

It has been stated that the presence of a local predisposing factor, such as an overhanging restoration, can significantly increase the periodontal attachment loss both clinically and radiographically, which owes to a change in microbial plaque in addition to exacerbation of plaque accumulation. **(**7,8**)** This demonstrates strong evidence that the overhanging proximal margins of dental restorations can shift a non-disease associated microbial flora to a disease-causing flora. **(**1**)**

The baseline analysis performed on 303 radiographs in the current study showed a significantly higher amount of bone loss adjacent to restored teeth with overhanging restorations in comparison with

unrestored or properly contoured teeth. The major objective of the current study was to evaluate whether there is a relation between the type of dental restoration/prosthesis and the severity of the pattern of bone loss. The findings of the present study have revealed that there is no statistical significance or correlation between the restoration types and the two criteria investigated. The results obtained from this study are concurrent with the Swiss army study which had no statistically significant difference while comparing different types of restorations. **(**9**)**

People in different specialties, especially periodontology have neglected the use of OPGs in the diagnosis and examination of the amount of attachment loss due to the lack of accurate calibrating programs. Nowadays, digital panoramic radiographs have improved the diagnostic ability of the practitioner towards an accurate treatment planning of the bony defects, over the results of the conventional panoramic radiographs. **(**10**)**

Several obstacles were encountered during the conduction of the study, such as the accessibility to patients' files to assess the history of these restorations and the qualifications of the operator. Moreover, the sample size in addition to the inability to the evaluation of the overhanging restorations adjacent to edentulous spaces and the presence of generalized bone loss, might equalize the effect of the overhanging restoration on the bone. **(**11**)**

Conclusion

In conclusion, this study has further supported the harmful effect of overhanging restoration and prosthesis on the periodontal attachment associated with the violation of biological width, stressing the significance of properly contoured restoration in the maintenance and longevity of periodontal health.

The main purpose of this study was to determine whether the violation of the biological width differs between the restoration types. The null hypothesis stated was rejected due to the statistically non-significant difference in the results, therefore it has been demonstrated that there is no relationship associated between the different types of restorations and prosthesis included in this study and the severity or pattern of bone loss in the dentition.

Orthopantographs (OPG), and is particularly the recent digital radiography, has been shown to aid in the diagnosis and examination of periodontal problems associated with the level of alveolar bone. Due to the limitations and technical difficulties associated with radiographic assessment, the clinical examination should always be incorporated for the most accurate diagnosis.

Finally, we recommend that further studies about a similar topic should be conducted to emphasize the importance of biological width on the health of the periodontium.

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