Pattern of periodontal disease progression in restored versus non-restored teeth

PADRÃO DE PROGRESSÃO DA DOENÇA PERIODONTAL EM DENTES RESTAURADOS VERSUS NÃO RESTAURADOS

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At current state of the art, two tests are considered as the "gold standard" parameters for the diagnosis of active periodontal disease: attachment level and alveolar bone loss. New methods were developed to improve diagnostic accuracy, including digitalization of conventional radiographic images. Considering the existing discussion around the marginal periodontal tissue response to the insertion of prostheses or restorations, this research was designed to evaluate periodontal disease progression in sites adjacent to metal restorations compared to non-restored teeth in 25 patients monitored for a 6-month period. The distance between cemento-enamel junction and the most coronal portion of alveolar crest was measured in vertical bitewing digitized radiographs. Statistical data analysis by Student's t-test showed no significant difference between the experimental and control groups (p>0.05) and between 30-day and 6-month examinations (p>0.05). These results suggested that there is no difference in the pattern of progression of periodontal disease in restored and non-restored teeth, according to this methodology.

UNITERMS: Periodontal disease, progression; Radiography; Metallic restorations.

INTRODUCTION

Since the early 1980's, it has been well accepted the pattern of periodontal disease progression can be explained by an alternative model, characterized by random bursts of activity separated by long periods of quiescence[8,22,27]. Strong evidence suggest that these bursts are evenly distributed among population and even in some sites in the same individual[8]. These concepts resulted in the development of new diagnostic tests, with higher sensibility and sensitivity values to identify high risk groups and individuals[20], since conventional clinical parameters, such as bleeding on probing, have demonstrated to be poor predictors of future attachment loss, even in combination[10].

Currently, the more frequently used parameters to identify active periodontal lesions are attachment and alveolar bone loss[18,20]. Radiographic evaluation of conventional radiographs has improved with the development of new methods, such as subtraction radiography[24,30], ^{125}I absorptiometry[22,24] and digitalization of conventional radiographic images[6,15,19,23].

The positioning of interproximal restorations, changing the effective aproximal contact between adjacent teeth, could result in alveolar bone loss, even without disturbance of the marginal periodontium biological width[4].

The aim of this study was to evaluate alveolar bone loss in sites adjacent to metallic restorations compared to non-restored sites, since one of the main concerns of Restorative Dentistry refers to marginal periodontal tissue response to the insertion of restorations and prostheses.

MATERIALS AND METHODS

A total of 25 patients (14 men and 11 women) age-ranged 18-45 years attending the Periodontics Clinics of School of Dentistry at Bauru were selected according to the following criteria:

- Probing depth > 5 mm in at least 2 teeth
- Attachment level > 4 mm in at least 1 tooth
- No sistemic alterations
- No periodontal treatment or antibiotic use in the previous 6 months

Pregnant or bilaterally posterior edentulous patients were excluded from the study. The patients were divided into two groups according to the presence (experimental) or absence (control) of interproximal metallic restorations. All participants were submitted to probing depth measurements, ultra-sonic scaling (Profi II, Dabi Atlante, Brasil) and OHI procedures at baseline examination.

Vertical bitewing radiographs for posterior teeth were obtained with radiographic stents developed at discipline of Periodontics of Bauru Dental School. The stent was comprised of a film-holder and an acrilic bite-block (Duralay, BioArt), allowing correct positioning of the radiographic film and maintaining a fixed position at subsequent radiographic examinations. Duplicates were built with a special acrilic material (Repasol T 208) based on a matrix stent. The bite-blocks were obtained for each radiographic area of each patient. Duralay acrilic was added over the occlusal device of the stent and the patient was asked to intercuspidate their teeth in the habitual position, reproducing the occlusal aspects of posterior teeth.

The radiographic expositions were taken in a 70Kv, 8 mA Dabi Atlante equipment with 0.8 seconds of exposition and 35 cm of focus-film distance 30 days after the first appointment and 6 months after the first radiographic examination. The films belonged to the same series (Agfa-Gevaert Dentus M2, Brentford, UK) in order to avoid fabrication and storage variations and were developed in an automatic machine (Peri-Pro II, Air Techniques Inc.), according to fabricant specifications.

The images were converted in a digital signal by a 35 mm slide scanner (SprintScan35, Polaroid) with 1700 dpi resolution and stored and analised in a Pentium 100 mhz computer. The digitalization process converts an image in 61.107 pixels/mm after calibration.

The distance between cemento-enamel junction and alveolar crest was adopted as the reference point, according to the parameters described in literature by HAUSMANN et al.[13] (1989). The cut-value was determined as being 3 times the standard deviation of a normal population (0.44 mm). The image analysis was performed by a specific image analysis system named MOCHA, Jandel Scientific.

The results obtained were statistically evaluated according to Student's t-test and descriptive methods.

RESULTS

As mentioned before, 25 patients participated of this study. The distance between CEJ and AC was measured in restored teeth of each patient, constituting the experimental group, while its contra-lateral non-restored teeth served as control. This resulted in a total of 377 sites to be evaluated. Among these, 212 (56.23%) belonged to group 1 (experimental) and 165 (43.77%) to group 2 (control). There were alveolar bone level changes in the 6-month period of the study in 7.54% of the experimental (4.24% of the total) and 9.09% of the

TABLE I - Absolute numbers (n) and percentage (%) of sites with alveolar bone level alterations in restored (group 1) and non-restored (group II) during the six-month study. Statistical analysis by Student's t-test showed no significant differences between groups (p > 0,05)

Alveolar bone Status	*Group 1*		*Group 2*		*Total*	
	n	%	n	%	n	%
No alteration	196	51.99	150	39.79	346	91.78
Alteration	16	4.24	15	3.98	31	8.22
Total	212	56.23	165	43.77	377	100

TABELA 2- Descriptive analysis of the linear distance from cemento-enamel junction and alveolar crest level in restored (Group 1) and non-restored (Group 2). Statistical analysis by Student's t-test showed statistically significant differences between groups (p < 0,01), indicating that restored teeth presented more severe bone loss than non-restored teeth

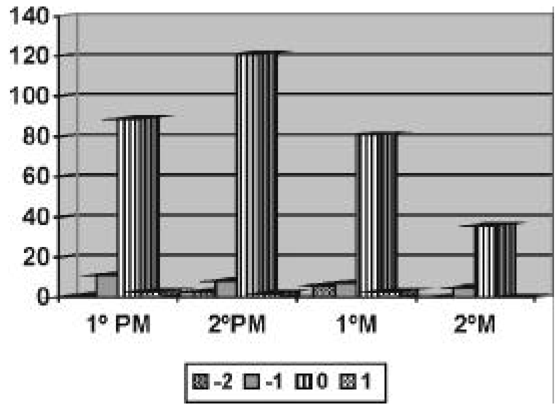
Groups	*Minimum*	*Maximum*	*Range*	*Mean*	*s.d.*
1	0.167	4.861	4.694	1.659	0.826
2	0.218	3.505	3.287	1.268	0.910

sd - standard deviation

control group, representing 3.98% of the total number of sites evaluated (Table 1).

The medium linear distance CEJ-AC was 1.659 and 1.268 for groups 1 and 2, respectively. There was a statistically significant difference between experimental and control group linear CEJ-AC distances (p<0.001), greater for the first one (Table 2).

It can be observed in Figure 1 that most sites in the different tooth groups showed little or no variation between both first and second examinations (p=0.163). Bone level changes (gain or loss) were observed mainly in the frequency distribution group –1.0 - +1.0 (87%) and only 2.66% of the cases showed bone loss above 2.0 mm (frequency distribution group __ -2). These results are described on Table 3.



where: -2 = — -2.0 mm
-1 = -2.0 |— -1.0 mm
0 = -1.0 |— 1.0 mm
1 = 1.0 |— 2.0 mm

FIGURE 1 - Frequency distribution of bone level changes between 1st and 2nd examinations according to tooth group

Legend: Absolute number of teeth presenting alveolar bone level changes < -2mm (-2), > -2 and < -1mm (-1), > -1 and < 1 mm (0) or > 1 and < 2 mm (1). There was no statistical differences between groups (p > 0,05) and between the 1st and 2nd examinations (p = 0.163). The negative values represent alveolar bone gain, while the positive values represent alveolar bone loss between the examinations.

TABLE 3 - Frequency distributions of bone level alterations in absolute number (n) and percentage (%) of teeth on groups 1 and 2, where — -2.0 mm represents alveolar bone changes above –2mm, -2.0 |— -1.0 mm represents bone changes between –2 and –1 mm, -1.0 |— 1.0 mm represents alveolar bone changes between –1 and + 1 mm and 1.0 |— 2.0 mm represents alveolar bone changes between +1 and + 2mm

Bone level alteration	***Group 1***		***Group 2***		***Total***	
(mm)	***n***	***%***	***n***	***%***	***n***	***%***
____-2 mm	8	2.12	2	.53	10	2.66
- 2.0 |— -1.0 mm	16	4.24	15	3.98	31	8.22
- 1.0 |— 1.0 mm	184	48.81	144	38.20	328	87
1.0 |— 2.0 mm	4	1.06	4	1.06	8	2.12
Total	212	56.23	165	43.77	377	100

DISCUSSION

Conventionally, alveolar bone loss is measured in relation to the distance between CEJ and AC[1,2,7,8,11,13,25]. Based on literature, distances ≤ 2 mm are considered as "normal" or "physiologic" values[1,2,7,11,13], although distances ≤ 1.5[16] to ≤ 3.0[21] mm can also be found. This technique has the disadvantage of representing the periodontal tissue status at the moment of the exposition[18], but does not allow the observation of minimal alterations in alveolar bone tissue. It is also known that the random bursts of active destruction are separated by remodeling phases, which could obscure the disease process[8,26]. Besides that, for an incipient lesion to be detected by conventional methods, it is fundamental the acquisition of higher values than the method's standard deviation or wait until the cortical plate has been reached. At this moment, mineral content must have already been lost without being noticed by the human eyes[19].

Considering that every technique has implicit errors, it is important to establish a value in which the obtained measurement could not be attributed to a measurement error. This cut-off value is determined in a randomly selected "normal" population according to a single measurement. Once established, the cut-off value creates a dichotomous evaluation parameter, that is, presence or absence of the disease. In this research, 4 randomly selected patients (132 sites) were radiographically evaluated in relation to static alveolar bone loss. The resulting standard deviation was 0.149 mm. This value was 3 times multiplied and the cut-off value was then determined as 0.44 mm. The existence of great individual variation resulting in high standard-deviation values could obscure real minimal alterations that may have happened, leading to misinterpretation. In addition, high cut-off values result in decreasing disease prevalence while small values result in increasing disease prevalence[18].

Digital images have improved the capacity of demonstrating small bone tissue changes even in a short period of time[7,15,23]. Digital methods improve accuracy of linear measurements of anatomic points of reference[7], as performed in the present research. Comparative studies have shown that conventional radiographs could not identify 53% active lesions detected by ^{125}I absorptiometry[23] and subtraction methods have been proven to be superior than conventional methods[9].

Since misangulations and differences in the central direction of x-ray beam can interfere with CEJ-AC distances and lead to distortions in the image[19,], we used in this study a device specially developed to maintain a fixed position between the focus and the film-object. The bite-block component allowed reproducibility of the radiographic examinations taken after a long period. Besides, all radiographs were processed in an automatic Peri-Pro II device, avoiding the introduction of a new source of error.

In addition, software programs can correct little image distortions that may have happened[18,19]. It is relevant to know that the digitalization process enhance the resultant images by adjusting the gray-scale to every converted pixel[23]. Image digitalization can be performed in many ways, but scanners have been showing superiority when compared to other techniques, such as video camera[18,23].

Data analysis by Student's t-test has not shown significant statistical differences in the pattern of bone loss progression in restored sites comparatively to non-restored sites ($p > 0.3$), with 0.49-0.97 standard deviation values, according to tooth type (1st and 2nd pre-molars and 1st and 2nd molars), higher to molars (0.5-0.9) than to pre-molars (0.4-0.6) groups. These results are in accordance with literature, where values of 0.3 mm[3] to 0.71-0.83[14] can be found. Silness, Gustavssen[26] found a small improvement of interproximal alveolar bone loss (0.41 mm) associated to prostheses insertion after a 12-year monitoring period. Than, Duguid, Mc Kendrick[29] found, in extracted teeth with and without proximal restorations, a small but significant difference of attachment loss in restored teeth . Brunsvold, Lane[4] showed greater gingival inflamation and alveolar bone loss in restored than non restored teeth with and without overhanging margins, which was also observed in this study.

Relatively to the monitoring period and the pattern of periodontal disease progression, Hausmann, Dunford, Wikesjö, Christersson, McHenry[12] (1986) have shown that, from a total of 190 sites in 15 patients with untreated periodontal disease monitored for 6 months, 2% showed alveolar bone gain, 10% showed alveolar bone loss and the remaining 88% did not show any bone level alterations, which seems to be in agreement with this research. Also, Jeffcoat, Reddy[18] followed 30 patients with adult periodontitis during 6 months in order to determine the prevalence and global features of periodontal disease progression in active sites. The minimum cut-off value established was 0.4mm, which is in agreement with our study, and the maximum cut-off value was 2.4mm, resulting in a disease prevalence of 76% in the first case and 2% in the second. The results referred to disease progression were submitted to regression analysis, which suggested that this progression pattern could be explained by the linear model.

The metallic restorations evaluated here were of different qualities and extensions, but it was not the main purpose of this work to determine such conditions. In some cases, it was observed the use of prosthetic crowns and restorations over the cemento-enamel junction. A few of them showed marginal discrepancies, overhangs and overcontour (unpublished observations), resulting in more variable results than expected. The absence of significant discrepancy between the groups can be explained by the low number of unsatisfactory restorations and prostheses. Most of the cases have not shown bone alterations, which can atest the biocompatibility of the performed restorations, being in accordance to other scientific results[3]. Many epidemiological studies, as reviewed by Johnson, Griffiths, Wilton, et al.[20], have showed that only a small percentage of the population is responsible for most part of periodontal lesions. This pattern was also found in restored and non-restored teeth in this study, without statistically significant differences between both groups (Table 1). It is important to state that these patients were previously selected among high risk groups patients.

The variations in bone level mostly occurred in the -1 to +1 mm interval (Figure 1, Table 3), suggesting its small size and, despite of this, could be identified in this investigation. Significant alterations above the cut-off value (0.44) were identified in 3.98 and 4.24% in control and experimental groups, respectively, without statistical significant differences between both ($p > 0.05$), as can be observed on Table 1. Neverthless, as shown on Table 2, greater linear distances are observed to restored than to non-restored teeth ($p < 0.001$). This distance seems to increase with age[25], but this study refers to age cohort of 18-45, excluding old and very young ages that may have greatly influenced the final result.

In fact, more important than the marginal position of prostheses (supra or subgingivally) is the respect to normal biologic width[5,28] described by Gargiulo, Wentz, Orban[7] in 1961. De Waal, Castelucci[5] stated that the biological width is fundamental to marginal periodontal tissue homeostasis and to periodontal health. For these reasons, the insertions of prostheses and/or restorations must be confined to 0.5 mm inside the gingival crevice[17].

CONCLUSIONS

It can be suggested from this study that the pattern of periodontal disease progression does not differ in restored and non-restored teeth, although it can be observed more severe bone loss in restored than non restored sites.

RESUMO

Atualmente, dois testes são considerados como o “padrão ideal” para o diagnóstico de doença periodontal ativa: nível de inserção clínica e perda óssea periodontal. Novos métodos foram desenvolvidos para melhorar a precisão diagnóstica, incluindo a digitalização de imagens radiográficas convencionais. Considerando-se a discussão existente relativa à resposta do tecido periodontal marginal à inserção de próteses ou restaurações, este estudo foi realizado para avaliar a progressão da doença periodontal em sítios adjacentes a restaurações metálicas comparativamente a dentes não restaurados em 25 pacientes acompanhados por um período de 6 meses. A distância da junção cemento-esmalte e a porção mais coronal da crista alveolar foi medida em radiografias interproximais verticais digitalizadas. A análise estatística pelo teste-t de Student não mostrou diferenças significativas entre os grupos experimental e controle (p>0,05) e entre os exames realizados aos 30 dias e 6 meses (p>0,05). Esses resultados sugeriram que não existe diferença no padrão de progressão da doença periodontal em dentes restaurados e não restaurados, de acordo com esta metodologia.

UNITERMOS: Doença periodontal, progressão; Radiografia; Restaurações metálicas.

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