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Interdental and Interradicular Bone Loss in Diabetic and Non-Diabetic Patients - A Correlation of Radiographic Assessment

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Abstract

Context: The evidence of furcation involvement or interradicular bone loss is an important clinical finding influencing severity of periodontitis and a less favorable prognosis of the involved teeth due to limited access for mechanical plaque control. Diabetes is a risk factor for periodontal disease.

Aim: The aim of the present study is to correlate the bone loss in the interdental and interradicular region in diabetic and non-diabetic patients.

Materials and Method: A total of 96 (48 non-diabetic and 48 diabetic) patients diagnosed with chronic generalized periodontitis with grade I furcation involvement in mandibular molars were enrolled for the study. The patients were further categorised into groups depending on the probing pocket depth, as group A (5-6mm), Group B (7-8mm) and Group C (>8mm). Under standardized conditions, IOPA radiographs were taken using grid and the morphological measurements of the furcation areas were recorded and analysed.

Statistical analysis: Differences among means were compared using the Independent Sample t Test. The correlations for interdental bone loss to the interradicular bone loss were analysed using the Pearson correlation coefficient.

Result: The interdental bone loss and interradicular bone loss in diabetic patients was more than non-diabetic patients.

Conclusion: The bone loss in interdental area was associated with progressive destruction of bone in the furcation area suggesting that early detection of interdental bone loss can prevent interradicular bone loss in future.

Keywords: Furcation Involvement, Interdental Bone Loss, Interradicular Bone Loss, Diabetes, Prognosis

Key Messages: The early signs, symptoms, and clinical presentation of periodontitis need to be recognized, so that diabetic patients are promptly referred for treatment, preventing any further complications.

Introduction

Furcation involvement is a greatest challenge to deal with for the success of a periodontal therapy. Several studies have reported poor prognosis for molars with furcation involvement, as the complex anatomy of the multirooted tooth results in reduced efficiency of periodontal treatment.

Furcation involvement and interradicular bone loss are critical clinical finding that increase the severity of periodontitis and an unfavorable prognosis of the involved teeth due to limited access for mechanical plaque control. Therefore, it is of great importance to treat chronic periodontitis before involving the furcal areas.

According to Loe.et al in 1993, Systemic conditions such as diabetes, affects the progression of periodontal diseases. According to Tsai et al. in 2002, his study showed that Type 2 diabetes significantly increases the risk for periodontal disease than Type 1. Later Collin et al. in 1998 and Campus et al. in 2005 said that periodontal disease severity is also increased by type 2 diabetes.

Periodontal disease leads to destructive effects of pro-inflammatory mediators (Williams et al., 1985; Assuma et al., 1998), while diabetes exerts cytokine dysregulation effect on the periodontium. The long-term diabetes mellitus is associated with complications like altered bone metabolism. This study aims to evaluate and correlate the interdental bone loss with interradicular bone destruction in diabetic and non-diabetic patients.

Subjects and Methods

A total of 96(48 non-Diabetic and 48 Diabetic) out patients from the Department of Periodontics, were selected for the study. The patients were further categorised into three groups according to the probing pocket depth, as Group A (5-6mm), Group B (7-8mm) and Group C (>8mm).

Ethical clearance for the study was permitted by the college ethical clearance committee, Mahe Institute of Dental Sciences and Hospital, Mahe. Study design was explained to the subjects and informed consents were obtained. The subjects were average of 30 and 60 years of age with chronic periodontitis and grade I furcation involvement in mandibular first molars. The Furcation involvement was interrupted using a calibrated Nabers probe with color coded marked at 3-mm intervals according to Glickman's classification.[9]

Inclusion criteria

- Chronic generalized periodontitis (AAP 1999 classification) [2]
- Patient With type II Diabetes Mellitus
- Well,-aligned mandibular first molars with grade I furcation involvement (checked using Naber's probe)
- Probing pocket depth of 5-6mm,6-7mm,>8mm (All the surface of the tooth was evaluated and the highest measure of the pocket depth was considered for categorising the tooth for respective group)

Exclusion criteria

- Mandibular first molars with developmental anomalies
- Patients with history of any periodontal therapy.

- Systemic disease or medication
- Patients with any bone disorders, vitamin D deficiency
- Post-menopausal women

Radiographic Measurements

The morphological measurements describing the furcation areas used in the present study are:

1. Height of defect (H)
- Height of mesial interdental bone loss
- Height of distal interdental bone loss
- Height of interradicular bone loss
2. Width of defect (W)
- Width of mesial interdental bone loss
- Width of distal interdental bone loss
- Width of interradicular bone loss

Ninety-six intraoral periapical (IOPA) radiographs of first molars were obtained from 96 subjects. The patient was in an upright position in the dental chair and was shielded with a lead apron, in order to follow radiation safety standards. Under standardised condition, radiograph was taken with the help IOPA Grid (Figure 1 and 2) on the mandibular first molars in paralleling (or long cone) technique using holders (Figure 3,6 and 7). Intraoral dental films of size two were placed inside the oral cavity by the operator and exposed to an X-ray source for about 0.5 sec and developed under standardized conditions to reduce the differences in brightness and contrast.

The following guidelines were kept for radiograph standardisation

• The radiograph should depict tips of the molar cusps with minimal of the occlusal surface.

• Enamel and pulp chambers should be distinct

• Interproximal space should be open

• Proximal contact should not overlap.

All IOPA's were evaluated and radiographs that did not fulfil the above criteria were repeated.

The following measurements were recorded: [5,7]

- **CEJ-AC**: Cementoenamel junction – alveolar crest (in horizontal bone loss) (Figure 4)
- **CEJ-BD**: Cementoenamel junction – apical extension of the bony defect (in angular bone loss) (Figure 4)
- **Fx-BL**: The distance from the Furcation fornix to the intact interradicular Bone Level (interradicular bone loss). (Figure 4)
- **Bone defect width (BW)** – Measured from the lateral margin of the alveolar crest defect between the two adjacent tooth root surfaces. (Figure 5)
- **Furcation width (FW)** – The distance between the mesial and distal root on the level

of the AC within the furcation. (Figure 5)

The measurements were carried out by a single examiner to avoid interobserver variation.

Statistical Analysis

The statistical analysis was performed with SPSS software and the mean values for the mesial, and distal interdental bone loss and the interradicular bone loss were calculated. Differences among means were compared using the Independent Sample t Test. Comparative evaluation of the mesial and the distal bone loss in the interdental to the interradicular areas were analysed using the Pearson correlation coefficient.

The mean values of height and width of interdental and interradicular bone loss was calculated for diabetic and non-diabetic patients separately and the mean values were correlated. (Table 1, Table 2, Table 3, Table 4)

Results

The Results for Present Investigation Revealed That:

- **In Non-Diabetic patients**

Interdental Bone Loss

- Minimum height of bone loss - 3.09mm (mesially and distally)
- Maximum height of bone loss – 6.78mm (distally)
- Minimum width of bone loss – 1.8mm (mesially)
- Maximum width of bone loss – 3.28mm (distally)

Interradicular Bone Loss

- Height and width of bone loss was similar
- Minimum height of bone loss – 1.27mm
- Maximum height of bone loss – 1.79mm
- Minimum width of bone loss - 1.11mm
- Maximum width of bone loss – 1.95mm

- **In Diabetic patients**

Interdental Bone Loss

- Minimum height of bone loss – 2.63mm (mesially)
- Maximum height of bone loss – 7.19mm (mesially)
- Minimum width of bone loss – 2.07mm (mesially)
- Maximum width of bone loss – 2.91mm (distally)

And Interradicular Bone Loss

- Height and width of bone loss was not similar
- Minimum height of bone loss – 0.63mm
- Maximum height of bone loss – 2.5 mm
- Minimum width of bone loss – 1.04mm
- Maximum width of bone loss – 2.19mm

In Interdental Bone Loss

- Maximum height of bone loss – 7.19mm (mesially in diabetic)
- Maximum width of bone loss – 3.28mm (distally in non-diabetic)

In Interradicular Bone Loss

- Maximum height of bone loss – 2.5mm (in diabetic)
- Maximum width of bone loss – 2.19 mm (in diabetic)

Discussion

Tooth with furcation involvement are 2.5 times more prone to lose attachment as compared with teeth without furcation involvement.[17] Bone destruction is always more than what appears in a radiograph. Therefore, furcation involvement can be present without any radiographic changes. According to the results obtained from the present study, both the interdental and interradicular bone lose in diabetic patients was more than non-diabetic patients with increasing pocket depth.

According to Socransky et al, 1998 [20]and Graves & Cochran in 2003, Periodontitis is bacterial plaque induced disease which stimulates host response leading to the destruction of connective tissue and bone in the oral cavity. Among various complications of Diabetes, Periodontitis is the sixth complication. Common adverse effects of Diabetes on periodontium are, decreased collagen turnover, impaired neutrophil function, and increased periodontal destruction. Various studies states, the periodontitis to be 3–4 times higher risk factor in people with diabetes.[11] Poor glycaemic control increases production of cytokines in gingival fluid (Salvi et al., 1997; Lalla et al., 2000; Engebretson et al., 2004). Increased inflammation causes increasing bone loss, inhibiting repair of resorbed bone, or both.

Bone remodelling process begins in the resorption lacunae with the resorption of bone by osteoclasts, and new bone formation by osteoblasts. Under normal physiological conditions, these two activities are coupled; however, the processes are uncoupled in pathological conditions.[6]

Diabetes increases the expression of inflammatory mediators, RANKL/osteoprotegerin (OPG) ratios and enhance the levels of AGEs and ROS by altering the osteoclast and osteoblasts in the periodontium.[18] Animal studies showed that Rats with T2DM exhibit a two- to four-fold increase in osteoclast number due to bacterial infection by a periodontal pathogen ligature inducing periodontitis compared with control rats.[8]

Evidences based analysis indicated that metabolic and endocrine alterations in diabetes affect the bone quantity

and quality.[16] Further studies have also reported an association between poor glycemic control and increased occurrence of periodontitis,[12] A direct relationship exists between the level of glucose control and the severity of periodontitis.[1,10] The risk and amount of alveolar bone loss is positively correlated with lack of metabolic control.[13,14]Although a number of studies have also reported no association.[15]

In literature various studies have correlated the bone destruction in interdental and interradicular area in chronic periodontitis patients. But studies comparing the bone loss in interdental and interradicular region among non-diabetic and diabetic patients are not available to support the outcomes of the present investigation. The amount of bone destruction in interdental and interradicular area can be a screening tool to detect the disease at its earliest stage. Treating advanced stage of furcation involvement is highly complex, expensive, time-consuming and requires an interdisciplinary approach. Therefore, periodontal intervention in its primitive stage appears quite promising for a successful periodontal outcome. Hence further such investigations are need to be done with larger sample size and advance techniques to confirm these results and to identify further influencing factors.

Conclusion

Diabetes accelerates the progression of periodontitis and bone resorption. The quantity and quality of alveolar bone destruction depends on the metabolic control. Diabetic patients can be promptly referred for treatment, preventing any further complications, if early signs, symptoms, and clinical presentation of periodontitis are recognized.

In this study a detailed analysis showed the bone lose in interdental and interradicular area in diabetic patients to be more than non-diabetic patients with increase in the periodontal pocket depth.

Within the limitations of the present investigation, bone loss in interdental and interradicular area was associated with progressive bone destruction in furcation area suggesting that their early detection can be helpful in predicting future bone loss in interradicular area. Persistent hyperglycaemia causing exaggerated immune-inflammatory responses that are induced by periodontal pathogens is likely to be responsible for the greater risk and severity of periodontal disease in diabetics.[4]

Limitation

The smaller sample size, probable bias in patient selection and manual evaluation of the radiographs can add certain limitation to the present study.

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Legend Tables and Figures

Table 1: The Mean and Standard Deviation of interdental and interradicular bone loss in Group A (Pocket Depth= 5-6 mm)

	Patient Type	N	Mean	Std. Deviation	Std. Error Mean
Mesial Interdental bone loss (H)	Diabetic	16	2.625	.3416	.0854
	Non-Diabetic	16	3.094	.7353	.1838
Distal Interdental bone loss (H)	Diabetic	16	2.719	.5154	.1288
	Non-Diabetic	16	3.094	1.1579	.2895
Interradicular bone loss (H)	Diabetic	13	.631	.5105	.1416
	Non-Diabetic	14	1.464	.9896	.2645
Mesial Interdental bone loss (W)	Diabetic	16	2.069	.5689	.1422
	Non-Diabetic	16	1.800	.7439	.1860
Distal Interdental bone loss (W)	Diabetic	16	2.344	.6511	.1628
	Non-Diabetic	16	2.156	.8310	.2078
Interradicular bone loss (W)	Diabetic	13	1.038	.4312	.1196
	Non-Diabetic	14	1.107	.4463	.1193

Table 2: The Mean and Standard Deviation of interdental and interradicular bone loss in Group B (Pocket Depth= 7-8 mm)

	Patient Type	N	Mean	Std. Deviation	Std. Error Mean
Mesial Interdental bone loss (H)	Diabetic	16	3.781	.6575	.1644
	Non-Diabetic	16	4.531	.4990	.1247
Distal Interdental bone loss (H)	Diabetic	16	4.906	1.7437	.4359
	Non-Diabetic	16	4.469	.8459	.2115
Interradicular bone loss (H)	Diabetic	14	2.500	1.6756	.4478
	Non-Diabetic	15	1.267	.4952	.1279
Mesial Interdental bone loss (W)	Diabetic	16	2.469	.7631	.1908
	Non-Diabetic	16	2.625	.6708	.1677
Distal Interdental bone loss (W)	Diabetic	16	2.906	.6638	.1659
	Non-Diabetic	16	2.750	.9661	.2415
Interradicular bone loss (W)	Diabetic	13	2.192	1.0712	.2971
	Non-Diabetic	15	1.600	.5732	.1480

Table 3: The Mean and Standard Deviation of interdental and interradicular bone loss in Group C (Pocket Depth = >8 mm)

	Patient Type	N	Mean	Std. Deviation	Std. Error Mean
Mesial Interdental bone loss (H)	Diabetic	16	7.188	1.2230	.3058
	Non-Diabetic	16	5.969	.9031	.2258
Distal Interdental bone loss (H)	Diabetic	16	5.500	2.3664	.5916
	Non-Diabetic	16	6.781	1.7124	.4281
Interradicular bone loss (H)	Diabetic	16	2.375	.7188	.1797
	Non-Diabetic	16	1.794	.8290	.2073
Mesial Interdental bone loss (W)	Diabetic	16	2.500	.5164	.1291
	Non-Diabetic	16	2.781	.5468	.1367
Distal Interdental bonr loss (W)	Diabetic	16	2.563	1.0145	.2536
	Non-Diabetic	16	3.281	.9304	.2326
Interradicular bone loss (W)	Diabetic	16	1.688	.4031	.1008
	Non-Diabetic	16	1.950	.9557	.2389

Table 4: Correlation of the mean values of interdental and interradicular bone loss in diabetic and non-diabetic patient

	Diabetic	Non – diabetic	Diabetic	Non - diabetic	Diabetic	Non - diabetic
	5-6 mm	5-6 mm	7-8 mm	7-8 mm	>8 mm	>8mm
Mesial interdental bone loss (H)	2.63	3.09	3.78	4.53	7.19	5.97
Distal interdental bone loss (H)	2.72	3.09	4.91	4.47	5.5	6.78
Interradicular bone loss (H)	0.63	1.46	2.5	1.27	2.38	1.79
Mesial interdental bone loss (W)	2.07	1.8	2.47	2.63	2.5	2.78
Distal interdental bone loss (W)	2.34	2.16	2.91	2.75	2.56	3.28
Interradicular bone loss (W)	1.04	1.11	2.19	1.6	1.69	1.95

Figure 1: IOPA Holder, Film & Grid.

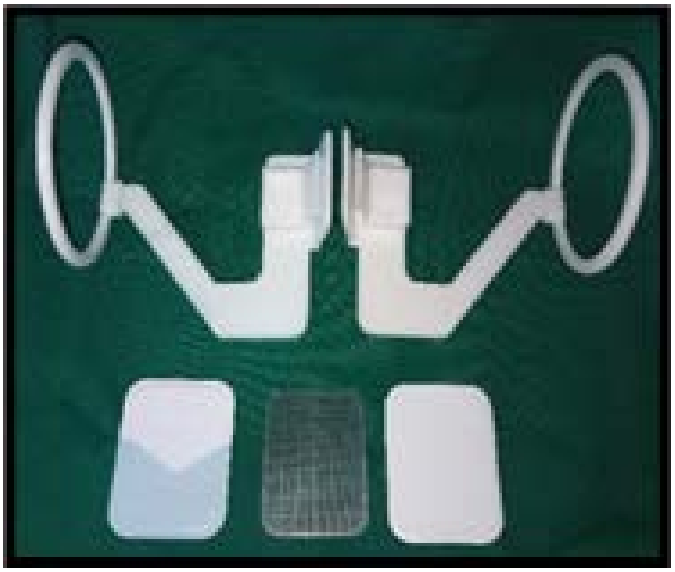

Figure 2: IOPA film and IOPA grid in holder position

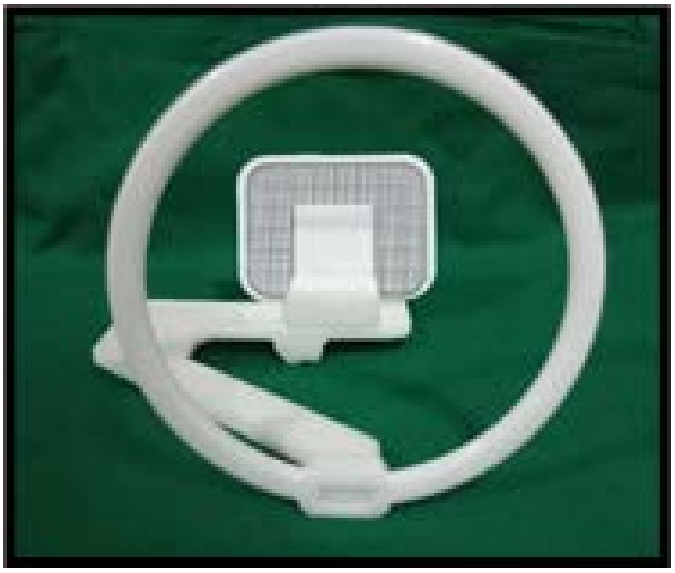

Figure 3: Paralleling technique used for taking radiograph

Figure 4: Landmarks to measure height of bone loss

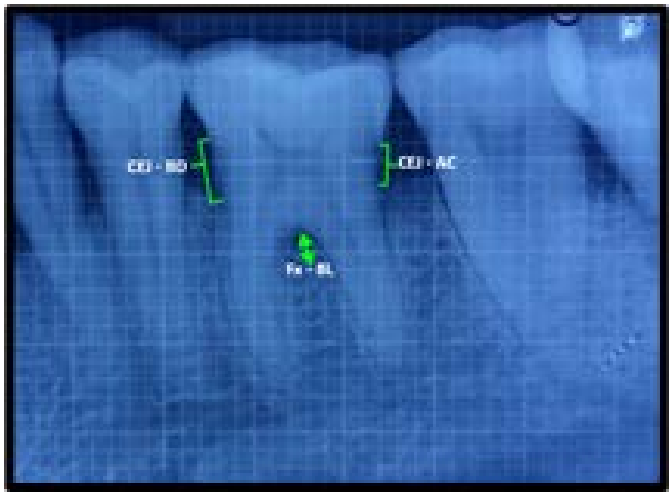

Figure 5: Landmarks to measure width of bone loss

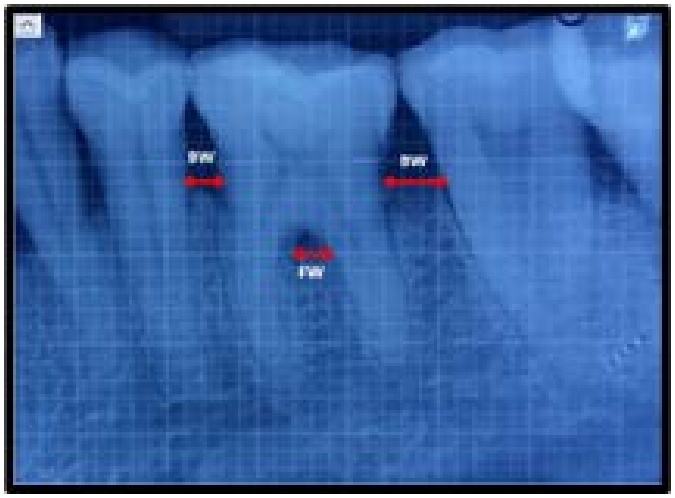

Figure 6: Radiographs taken in non-Diabetic patients (Sample)

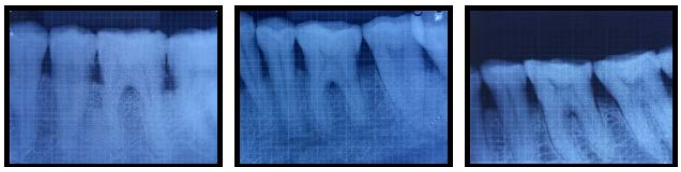

Figure 7: Radiographs taken in Diabetic patients (Sample)