Correlation of Radiovisuographic Analysis of Interdental and Interradicular Bone Loss in Furcation Involvement of Mandibular First Molars: A Retrospective Study

Abstract

Background and Objectives: The presence of furcation involvement represents a formidable problem in the treatment of periodontal disease. Advances in radiographic analysis such as radiovisuographic (RVG) aid in the early diagnosis and treatment planning, which is critical for long-term success. The present investigation aims to correlate the interdental and interradicular bone loss in chronic periodontitis patients so as to explore the potential of interdental bone loss as a rough approximate screening tool for early furcation diagnosis in mandibular first molar. Materials and Methods: RVG radiographs with furcation radiolucency in mandibular first molars were selected. The morphometric measurements of mesial, distal interdental bone loss, and interradicular bone loss in mandibular first molars were recorded using RVG. The correlation between mesial and distal interdental bone loss and interradicular bone loss was analyzed. Results: In this retrospective investigation, it was observed that distal interdental bone loss was not significantly different when compared with mesial interdental bone loss. The interradicular bone loss was significantly different when compared with mesial interdental bone loss, whereas on analysis between distal interdental bone loss and interradicular bone loss was also found to be statistically significant. Interpretation and Conclusion: Interdental bone loss was found to be associated with progressive bone destruction in furcation area which suggests that early detection of interdental bone loss can be helpful in predicting future interradicular bone loss.

Keywords: Furcation involvement, interradicular bone loss, radiovisuographic analysis

Introduction

Periodontitis is an infectious disease which most often leads to progressive attachment loss and bone loss. The presence of furcation involvement or interradicular bone loss is one of the clinical findings that can lead to a diagnosis of advanced periodontitis. Higher morbidity and compromised prognosis for molars with furcation involvement have been reported in several retrospective studies of tooth loss.[1,2]

It is observed that the frequency of furcation defects increases with age and its existence increases the risk of tooth loss.[3]

Several morphological factors such as furcation entrance width, root trunk length and the presence of root concavities, cervical enamel projections, bifurcation ridges, and enamel pearls contribute to the etiology and compromised prognosis of furcation involved teeth.

Furcation involvement most often affects the mandibular first molars, followed by mesial furcation of the maxillary first molars, whereas the maxillary premolars are the least frequently involved. The buccal furcation entrance of the maxillary molars and buccal and lingual furcation entrance of the mandibular molars are normally accessible for examination. The difficult access to distal furcation of maxillary molars presents a formidable problem in clinical diagnosis.[4]

Ross and Thompson reported that clinical examination alone detected furcation involvement in only 3% of maxillary and 9% of mandibular molars. The combination of radiographic and clinical examinations improved detection to 65% in maxillary molars but only 23% in mandibular molars.[5]

The inherent limitations associated with conventional diagnostic procedures further limit the sensitivity and reliability of furcation diagnosis.[6-13] Clinical probing is dependent on a multitude of technical factors, for example,

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the probing force and angulations, while radiographs may over or underestimate the amount of bone loss due to projection errors and lack of three-dimensional (3D) information.[14]

Furcation areas present some of the greatest challenges to the success of periodontal therapy. It is known that with the progression of periodontal destruction and the involvement of furcation areas, the severity of periodontitis increases and treatment is less effective because of limited access.[15]

Therefore, furcation defects represent formidable problem in the treatment of periodontal disease thus necessitating an early diagnosis and treatment.

The need of a simple, less elaborate, time and cost-efficient diagnostic tool is required for careful comprehensive examination, diagnosis, and timely intervention of furcation lesions at their earliest, so that the best clinic outcomes can be achieved. The present investigation aims to correlate the interdental and interradicular bone loss in chronic periodontitis patients using radiovisuography, so as to explore the potential of interdental bone loss as a rough approximate screening tool for early furcation diagnosis in mandibular first molar.

Materials and Methods

This is a retrospective study where a total of 70 RVGs of Mandibular right and left first molars with furcation involvement were evaluated from database of outpatient Department of Periodontics, The Oxford Dental College, Bengaluru. Out of the 70 RVG radiographs, 15 were excluded because of radiographic errors. Based on the clinical and radiographic records, the radiographs of patients diagnosed with chronic generalized moderate-to-severe periodontitis were selected.

The criteria for radiograph selection were:

Inclusion criteria

• RVG radiographs of mandibular first molars with furcation radiolucency.

Exclusion criteria

• Molars with fused roots
• Subjects with endo-perio lesion/periapical lesion according to clinical records
• Open contacts with respect to mandibular molars
• Crowding with respect to mandibular molars.

RVGs procured were subjected to morphometric measurements defining the interdental and furcation areas.

The length of the tooth was measured from cusp tip of the crown (C) to apex of the root (A) and calibrated with the standard value using Kodak dental imaging software.

The mesial interdental bone loss, the distal interdental bone loss, and the interradicular bone loss were calculated [Figure 1].

Differences among means were compared. The correlation for the mesial and the distal interdental bone loss to the interradicular bone loss were analyzed.

These were measured by a single examiner to avoid error due to interobserver variation using the digital software, the ‘Kodak dental imaging software’ installed within the RVG.

Statistical analysis

The mean values for the mesial interdental bone loss, the distal interdental bone loss, and the interradicular bone loss were calculated. Differences among means were compared using the two-tailed t-test. The correlation for the mesial and the distal interdental bone loss to the interradicular bone loss were analyzed using the Pearson correlation coefficient.

Results

In this retrospective investigation, it was observed that distal bone loss was not significantly different when compared with mesial bone loss whereas interradicular bone loss was significantly different when compared with mesial bone loss. The analysis between distal bone loss and interradicular bone loss was also statistically significant [Figure 2 and Table 1].

It was observed that mean interdental bone loss was significantly different when compared with interradicular bone loss [Figure 3 and Table 1]. However, there was no significant difference seen in between mandibular right first molar and left first molar.

According to the results of the present investigation, when the bone loss at interdental area was equal or exceeding 3.1 mm, a minimum interradicular bone loss of 1.3 mm was evident.

Discussion

The prevalence of involvement of the furcation area in the maxillary and mandibular molars ranges from 25% to 52% and from 16% to 35%, respectively.[16-20]

Teeth with furcation involvement are 2.5 times more likely to lose attachment as compared with teeth without furcation involvement.[21]

The aim of our study was to correlate the interdental and interradicular bone loss in RVGs of chronic periodontitis patients and to explore the potential of interdental bone loss as a landmark for screening of early furcation diagnosis.

As a general rule, bone loss is always greater than its appearance in the radiograph. Therefore, it is possible for furcation involvement to be present without radiographic changes. Variations in the radiographic technique may obscure the presence and extent of furcation involvement. A tooth may present marked bifurcation involvement in one film but appear to be uninvolved in another.[11]

With regard to methodology, digital radiography was used in the present study for the evaluation of bone loss, whereas

Figure 1.

The length of the tooth was measured from cusp tip of the crown (C) to apex of the root (A) and calibrated with the standard value using Kodak dental imaging software.

Figure 2.

Table 1. Differences in bone loss among mandibular right and left first molars.

Table 2. Correlation of bone loss in mandibular right and left first molars.

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earlier studies used intraoral periapical radiographs and bitewing radiographs for the analysis of bone loss,\[16,15,22\]

RVGs were taken from 39 male and 16 female individuals. Based on the gender, there was no statistical significant
difference in the correlation between the interradicular to the interdental bone loss. This is supported in a longitudinal
study by Rohner \textit{et al.}\[16\]

The comparison between the interradicular and interdental
bone loss in males and females were found to be significant
in both the genders.

In the present study, it was seen that values ranging from 1.20
to 16.70 mm for the mesial and those ranging from 2.70 to
13.60 mm for the distal interdental bone loss were associated
with interradicular bone loss in the range of 1.30–9.10
mm,
and both were significantly correlated with each other.

The results of the present investigation revealed that
the smallest amount of interradicular bone loss of
approximately 1.3 mm and above was observed only
when the bone loss at the interdental area was equal to or
exceeding 3.1 mm. The findings of the present investigation
are consistent with the results of the study conducted by
Grover \textit{et al.}, where the furcation bone loss with the range
of 0.80 mm and above were in correlation with interdental
bone loss of above 3.70 mm.\[23\]

The present study demonstrated that interradicular bone
loss associated with the progression of bone destruction
in multi-rooted teeth of patients with chronic periodontitis
had a significant correlation to the loss of bone in the
interdental area.

The assessment of the interdental bone loss can be used
as a screening tool to detect the periodontal disease in the
earliest stage. Because treatment of furcation involvement in
its advanced stage is complex, expensive, time-consuming
and requires an interdisciplinary approach.\[23\]

Therefore, to detect the earliest lesions of furcations, the
interdental bone loss can be kept as an approximate guide
for the comprehensive management of such patients. This
correlation suggests that if the disease progression can
be halted with approximate periodontal therapy when the
interdental bone destruction has just ensued, it may lead to
an improved prognosis for the interradicular areas.

Within the limitation of the present study, root trunk
length is not considered. Furthermore, radiographs may
underestimate the amount of bone loss due to projection
errors or lack of 3D information.
Further clinical studies should aim to confirm these results and to identify further influencing factors.

**Conclusion**

Interradicular bone loss was associated with the progression of bone destruction in multi-rooted teeth in patients with chronic periodontitis. Interdental bone loss was also found to be associated with progressive bone destruction in furcation area which suggests that early detection of interradicular bone loss can be helpful in predicting future interradicular bone. Future studies with root trunk length consideration can precisely mark the limits of bone loss in chronic periodontitis when the involvement of the furcation is present.

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**Conflicts of interest**

There are no conflicts of interest.

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