The Relevance of Root’s Convergence with Trauma from Occlusion

Abstract

Background: The relevance of root’s convergence with trauma from occlusion has not been widely studied. Anatomically, alveolar bone support can be divided into several levels. The root which is convergent gives a critical mass of alveolar bone support to the teeth so that it is inadequate to stabilize the tooth. Aims: The purpose of the study is to observe the relevance of root’s convergence with traumatic from occlusion. Settings and Design: This was an observational retrospective design. Subjects and Methods: Samples in this study consist of periapical radiograph of the maxillary and mandibular first molar teeth from the patients with periodontitis, which are aggrivated with trauma from occlusion. For the root’s convergence measurement, we use a line on the outer edge of the mesial, distal, occlusal, and apical planes of the tooth. To get the cutoff point of the root convergence value, receiver operating characteristic-curve test is performed. Statistical Analysis Used: Spearman test results, based on the analysis of gingival recession and loss of attachment, indicating that each increase of root convergence value will be followed by a decrease of attachment. Conclusions: Tooth which has a convergent/very convergent root contour can contribute to trauma from occlusion.

Keywords: First molar teeth, the root’s convergence, trauma from occlusion

Introduction

Trauma from occlusion affects the tooth-supporting structure; it may occur interconnected or separately with periodontal disease. Although trauma from occlusion and periodontal disease can occur simultaneously, each condition can be solved independently. Occlusal therapy is performed before or in conjunction with periodontal treatment. Trauma from occlusion will give excessive occlusal forces. Many contradictory findings from a human study state that excessive occlusal forces contribute to periodontal tissue destruction and affect the periodontal treatment.

The symptoms of trauma from occlusion include periodontal and pulpal pain, temporomandibular joint pain, mastication muscle pain, and lose teeth. At the time of examination of patients suspected of having traumatic from occlusion, some clinical and radiographic signs need attention. Clinical signs of trauma from occlusion include mobility (progressive), pain during chewing or percussion, fremitus, prematurity/occlusal discrepancies, wear facets, tooth migration, cracked or fractured teeth, and thermal sensitivity. Radiographic signs are used as indicators of trauma from occlusion including widening of periodontal ligament space, bone loss (furcation, vertical, circumferential), thickening of lamina dura, and root resorption.

Teeth with conical root tend to have the biggest root area in half coronal root, and the root area becomes smaller in the apical half of the root. It is not known for certain if root’s convergence is participating as one of the factors that determine the stability of the teeth because not many studies have reported their relevance between root’s convergence with trauma from occlusion.

Subjects and Methods

In this study, periapical radiographs are used on the maxillary and mandibular first molars. The radiographs show the trauma from patients with periodontitis at the Periodontia Clinic, with trauma from occlusion that has given a radiographic picture. The periapical radiographs that were examined must have: (1) sufficient contrast, detail, and sharpness so each anatomical structure is clear; (2) features of the first molar to be examined in its entirety is intact, not cutoff; (3) no distortion of the shape and size; and (4) apparent interdental area. The root’s convergence of maxillary and mandibular first molars in this study is

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the convergence of the three roots to the apex of the palatal root from the buccal-lingual view. The convergence of the mandibular first molars in this study is the convergence of the two roots (distal root and mesial root) from buccal-lingual view. No assessment was taken on each root.

To measure the convergence of the maxillary and mandibular root, we made an occlusal reference line and an apical reference line [Figure 1]. Root’s convergence value measurement is based on the reduction of the occlusal width of the width of the apical. The measurement resulted in the convergence value in millimeter scale. The additional clinical examinations that were analyzed include: (1) tooth mobility, (2) the depth of the pocket, (3) gingival recession, and (4) loss of attachment.

**Results**

Convergence boundaries are made into three categories based on the mean of each difference of the occlusal plane width with apical plane width, which can be seen in the descriptive data in Table 1. To get the cutoff point of convergence value of the root, receiver operating characteristic (ROC)-curve test is conducted by state variables are tooth mobility and thickening of the lamina dura. The determination of cutoff point is based on the sensitivity, specificity, and area under the ROC curve ($\alpha$: 0.05). Because the anatomical root’s convergence of the maxillary molar is significantly different from the mandibular molar, the root’s convergence is made into two groups: the convergence of the maxillary molar root and the convergence of the mandibular molar root. The result of the ROC-curve analysis for maxillary and mandibular first molars is 2.6250.

| Table 1: Distribution of mean, minimum-maximum, standard deviation on the value of root’s convergence on maxillary and mandibular first molars |
|--------------------------|--------------------------|--------------------------|
|                       | $N$          | Min-Max (mm) | Mean (mm)          |
| Maxillary first molars  | 96           | 2.00-12.00   | 7.3302±2.20041     |
| Mandibular first molars | 87           | 0.50-9.00    | 4.7816±1.68992     |

Based on the cutoff point from the ROC curve analysis, the root’s convergence category of maxillary first molars can be determined as follows: straight/slightly convergent (0.00–2.60 mm), convergent (2.65–7.30 mm), and very convergent (≥7.35 mm). Categories for root’s convergence of mandibular first molars are: straight/slightly convergent (0.00–2.60 mm), convergent (2.65–4.80 mm), and very convergent (≥4.85 mm). Tooth with divergent root is not found [Figure 2].

To determine whether the maxillary and mandibular root’s convergence were associated with clinical features of trauma from occlusion, Spearman’s correlation test was performed. The test results show that there is a weak relationship between root’s convergence with: (1) recession in mesial, $rs$: −0.213; $P = 0.013$; (2) recession in distal, $rs$: −0.184; $P = 0.013$; and (3) recession in lingual/palatal, $rs$: −0.149; $P = 0.044$. The maxillary and mandibular root’s convergence is not related to tooth mobility, $P = 0.943$ and with thickening of the lamina dura, $P = 0.170$.

Spearman correlation test was also performed to determine whether there is a relationship between the maxillary and mandibular first molars’ root’s convergence with loss of attachment. The results show that there is a negative correlation between root’s convergence with: (1) mesial loss of attachment, $rs$: −0.182 (very weak correlation), $P = 0.013$; (2) loss of attachment in buccal, $rs$: −0.243 (weak correlation), $P = 0.001$; and (3) the loss of attachment means, $rs$: −0.179 (very weak correlation), $P = 0.0150$. All of the negative associations above indicate that any addition of the root’s convergence value will be followed by a decrease of attachment.

**Discussion**

The diagnosis of trauma from occlusion can be enforced if several clinical signs and symptoms of injury in some parts of the masticatory system are found. Clinical knowledge, experience, and clinical intuition also required diagnosing trauma from occlusion. The signs and symptoms of occlusion trauma can be divided into two: clinical and radiographic. Indicators of trauma from occlusion may include one or more signs and symptoms.

Trauma from occlusion exhibits a severe toothache, pain when chewing, percussion pain, and tooth hypermobility.
In severe cases, the formation of a periodontal abscess and cementum damage occur.[6,8] Other clinical symptoms are fremitus, heat sensitivity, occlusal prematurity, persistent discomfort, infrabony pockets, furcation involvement, wear facet, crack teeth or fractures, gingival recession, and pathologic migration.[5,6,8]

Increased tooth mobility is not always an indication of trauma from occlusion.[9] The term of primary and secondary trauma from occlusion is used to describe clinical signs of trauma from occlusion based on clinical mobility. Primary trauma from occlusion is defined as "trauma caused by excessive occlusal forces in teeth with normal supporting structures." Tooth mobility, in this case, can be recovered by restoring the occlusal load to normal. Teeth that lose the periodontal tissue may experience secondary trauma from occlusion. Normal occlusal forces can cause trauma to the dental attachment apparatus with inadequate support. Clinical mobility cannot be improved due to reduced bone support to the involved tooth.[4] It shows that trauma from occlusion can accelerate further attachment loss in patients with active periodontitis.[9]

The radiographic features of trauma from occlusion include widening of periodontal ligament space, thickening of lamina dura along the lateral edges of the root, apical, and bifurcation areas, and lamina dura discontinuities.[6,9,10] Destruction of the interdental septum is more vertical than horizontal, furcation radiolucency, the apex of vital teeth or visible root resorption.[6,8,11] Comparison of root-crown ratio, a convergent form of root with a relatively large crown are the indicator of trauma from occlusion.[12,13]

The maxillary first molars have three divergent root teeth, and the mandibular first molars have a distal apex which located more distal to the distal surface of the crown.[14] Anatomically, in the conical or convergent root, one-third of apical roots provide only 15%–20% of the total surface area of the root for efficient attachment. Meanwhile, at the one-third of apical, dental stabilization given by alveolar bone is inadequate. The morphology of root will determine the available root surface area for the attachment and natural support of alveolar bone both quantitatively and qualitatively.[15] Based on these analyses, a tooth which has a convergent/very convergent root contour can contribute to trauma from occlusion.

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### Conflicts of interest

There are no conflicts of interest.

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