Clin Oral Invest (2005) 9: 192–196
DOI 10.1007/s00784-005-0314-7

ORIGINAL ARTICLE

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Overeruption without root exposure of third molars and periodontal health in the mandible

Received: 30 September 2004 / Accepted: 14 March 2005 / Published online: 7 June 2005

Abstract Bone formation is seen around the third molar even when the tooth is exposed to the oral environment due to overeruption. To determine if overeruption of the third molar with or without root exposure is related to the status of the exposure of other teeth in the mandible, using orthopantomographs, 424 third molars were studied in 371 patients who were over 41 years of age. The rate of overeruption and root exposure in third molars was measured, and its relationship to the number of teeth lost and the rate of root exposure in other teeth in the mandible was analyzed. Tooth loss in the group of third molars with overeruption without root exposure was greater than in that without overeruption or root exposure in men, whereas the relationship was not seen in women. We found that root exposures of other teeth in the group of third molars with overeruption without root exposure were significantly smaller than in those with root exposure in both genders. Third molars with overeruption without root exposure, in which bone formation was easy to observe for radiographic diagnosis, were correlated with periodontal health in the mandible, suggesting a component of precision determination for predicting resistance to periodontitis.

Keywords Third molar · Root exposure · Mandible · Periodontium

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Introduction

Assessment of periodontal bone formation ability has been rare in comparison with bone absorption studies because improvement in the alveolar bone level is mainly seen in individuals under 25 years of age [5]. Melson [7] showed, regarding alveolar bone height and the hygiene, clear signs that bone depositing is increased during forced eruption, and Polsen et al. [10] noted that in orthodontic tooth movement into intrabony periodontal defects, new bone formation is found in the periodontal ligament side of the alveolus and newly formed cementum is found on the apical root surface. Thus, orthodontic tooth movement is a stimulating factor in bone apposition [12]. In 1930, Hirshfeld [4] noted the tendency of the alveolar process to elongate with the tooth. Elongation beyond the occlusal plane of the arch is due to congenital absence, delayed eruption, or partial or complete impaction of the opposing tooth [4]. It is well recognized that overeruption results in malocclusion, gingival or mucosal ulceration, or interference with mastication through disturbance of the mandibular path in the grinding phase of mastication. Although weak occlusal interferences due to overeruption have been studied [2], occlusal discrepancy is a risk factor contributing to periodontal disease [9]. These problems allow the removal of overeruptions. However, we found clinically that not all individuals with overeruptions reveal bone formation around the root, suggesting a relationship between bone formation ability and the periodontal status of the alveolar bone. Nevertheless, it remained unclear whether bone formation in overeruption of the mandibular third molar relates to periodontitis of the other teeth in the mandible. The aim of the present study was to examine whether individuals with bone formation around the overerupted mandibular third molar were associated with periodontitis by comparing them to individuals without overeruption of the mandibular third molar, and thus to find out whether overeruption with bone formation predicts healthy periodontal status, which can be assessed by using orthopantomograms.

Materials and methods

Participants were selected from patients who previously had panoramic radiographs taken for diagnostic purposes at Matsumoto Dental University Hospital between April 1984 and May 2004. Only those over 41 years of age with a vertical erupted mandibular third molar present in or above the curve of Spee were selected. Maxillary third molars were required to be absent or impacted, and the second molars were required to be in normal occlusion with the opposing tooth. Participants with signs of trauma to the teeth or jaws, congenital defects, oral pathology, history of orthodontic treatment, crowned second or third molars, or angled erupted mandibular third molars were excluded from the study. Participants were also excluded if the alveolar bone height could not be measured due to close contact between the second and third molar. The overall study sample comprised 165 women (193 mandibular third molars) and 206 men (231 mandibular third molars) (Table 1). Teeth were evaluated by a single examiner using panoramic radiographs (Panoramax Auto I, 20 mV, 80–84 kVP; Asahi, Kyoto, Japan) taken in the standard position and processed by automatic development (Konica SRX 501; Konica, Tokyo, Japan). Overeruption of the mandibular third molar was noted when the occlusal surface was above the occlusal plane of the second molar, and the mandibular third molars were present behind the distal surface of the maxillary second molars. The degree of overeruption was measured as a fraction of the crown height. Exposure of the root surface of the lower third molar was measured from the cemento–enamel junction to the alveolar crest at the mesial site, and exposure of the root surface was calculated as a fraction of the root length as determined radiographically.

Other teeth assessed for periodontal disease were the right second molar, right first molar, left central incisor, left first molar, and left second molar of the mandible. Root exposures of those teeth were also measured as described above.

The mean±SD number of teeth lost and the mean±SD rate of root exposure in other teeth were studied in relation to right or left third molars in both genders, and grouped in the following categories: with overeruption without root exposure, with overeruption and root exposure, without overeruption or root exposure, and without overeruption but with root exposure.

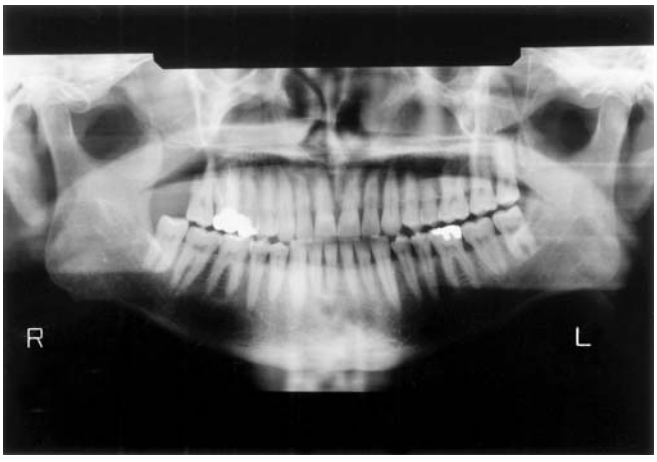

Fig. 1 Right third molar with overeruption of one fifth of the crown without root exposure in a 44-year-old man, and healthy periodontal condition in other teeth in the mandible

Statistical analysis

Differences in the prevalence of third molars with or without overeruption, and with or without root exposure were calculated using Fisher's analysis or the chi-square test. The mean and standard deviations of the number of teeth lost and the rate of root exposure were calculated, and Student's *t* test was used to compare data between groups. The significance level was set at 5%.

Results

A case of mandibular third molar with overeruption without root exposure and one with overeruption and root exposure are shown in Figs. 1 and 2, respectively. The mean (SD) of the age of the subjects was 51.9 (8.0) in men and 52.8 (8.6) in women.

Overeruption with root exposure was found more often in men (75 teeth) than in women (31 teeth) ($p<0.0001$) (Table 1). There were fewer teeth without overeruption or

Table 1 Number of mandibular third molars

Age (years)	Men				Women				*P*
	41–50	51–60	≤61	Total	41–50	51–60	≤61	Total	
With overeruption									
Without root exposure	24	8	6	38	18	16	4	38	
With root exposure	28	36	11	75	11	10	10	31	<0.0001
Without overeruption									
Without root exposure	29	25	5	59	38	35	10	83	<0.001
With root exposure	30	20	9	59	19	9	13	41	
Total	111 (100)	89 (76)	31 (30)	231 (206)	86 (72)	70 (62)	37 (31)	193 (165)	

Number of patients are enclosed within parentheses

Fig. 2 Right third molar with overeruption and root exposure in a 42-year-old woman, and periodontitis in other teeth

root exposure in men (59 teeth) than in women (83 teeth) ($p<0.001$). Moreover, there were more teeth with root exposure in men (134 teeth) than in women (72 teeth) ($p<0.0001$). To test the effects of overeruption in the mandibular third molar on tooth loss in the mandible, we compared the relationship between the status of mandiblular third molars and the number of teeth lost in the mandible (Fig. 3). In cases of the left third molar with overeruption without root exposure in men, there were more teeth lost than in those with overeruption and root exposure ($p<0.001$). In cases of the left third molar without overeruption or root exposure in men, there were fewer teeth lost than in those without overeruption but with root exposure ($p<0.05$). In cases of the left third molar with overeruption without root exposure, there were more teeth lost than in those without overeruption or root exposure ($p<0.05$). In the other groups there were no significant differences between the genders.

The relationship between the status of third molars and root exposure in other teeth was studied in men and women (Fig. 4). The rate of root exposure was shown by the mean (SD) of root exposure in other teeth. The group with overeruption without root exposure in the right third molar showed less root exposure in other teeth than the group with overeruption and root exposure in both men ($p< 0.0001$) and women ($p<0.0001$). In cases with the right third molar without overeruption or root exposure, the rate of root exposure of other teeth was smaller than in those without overeruption but with root exposure in both men ($p<0.0001$) and women ($p<0.0001$). Similarly, the group with overeruption without root exposure in the left third molar showed less root exposure in other teeth than the group with overeruption and root exposure in men ($p< 0.001$). The group without overeruption or root exposure in the left third molar showed less root exposure in other teeth than the group without overeruption but with root exposure in both men ($p<0.01$) and women ($p<0.001$). Thus, the subjects with root exposure in third molars showed high values of root exposure in other teeth compared with those without root exposure, in both genders.

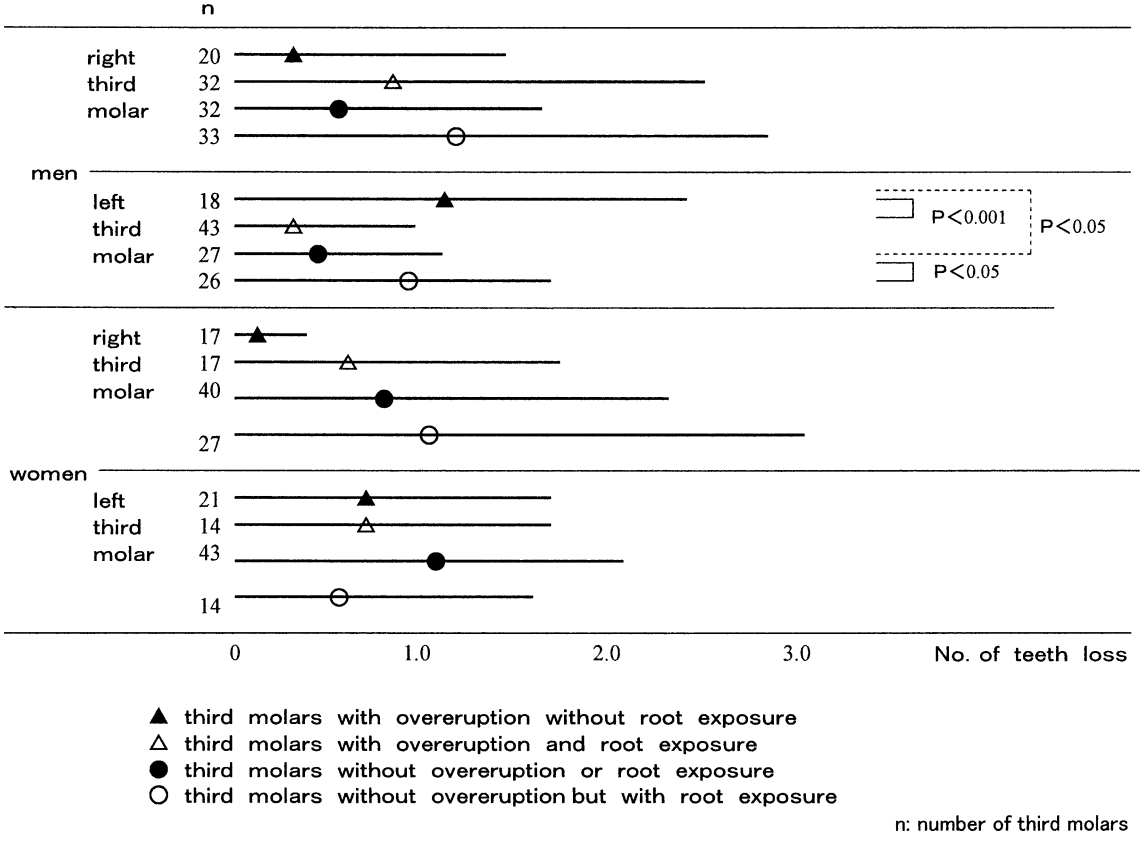

Fig. 3 Status of third molars and number of teeth lost in the mandible

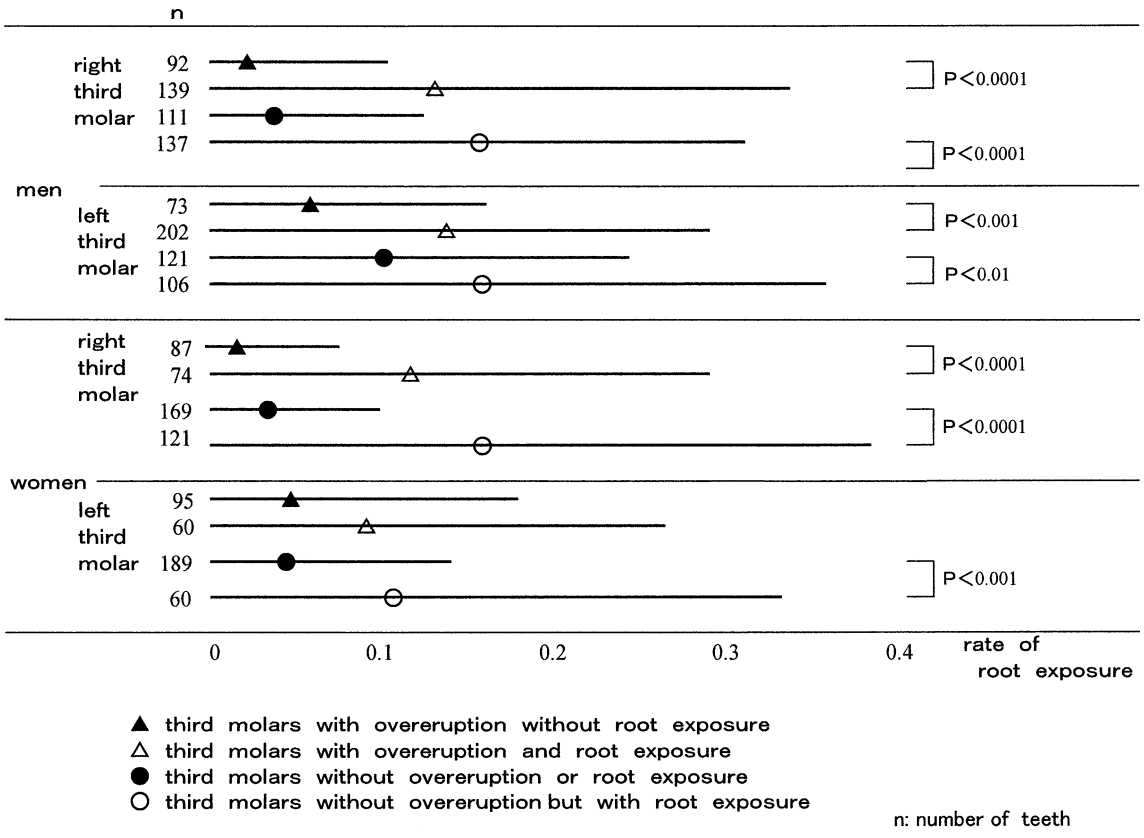

Fig. 4 Status of third molars and root exposure of other teeth in the mandible

Discussion

Although the present study evaluated the relationship between overeruption of mandibular third molars with or without root exposure and periodontitis in the mandible, the number of subjects was very limited because in Japan most patients with overeruptions are treated with tooth extraction. The approach of deriving bone formation data from radiograms to estimate resistance to periodontitis has not been previously discussed. However, radiographic measurements found no association between bone status in overeruption and periodontitis in individual teeth. DeVore et al. [3] suggested that teeth considered periodontally "hopeless" and subsequently retained have no effect on the proximal periodontium of adjacent teeth. Even though the average prognosis of the teeth studied at each interval remained relatively stable over time, individual prognosis categories and individual tooth prognoses changed frequently [6]. In the 45- to 64-year-old group, almost all subjects had some sign of periodontal disease [8]. We studied a mean (SD) of the number of teeth lost in the mandible and a mean (SD) of the rate of root exposure, which—by exposure of the cementum to the oral environment—is an important cause of future tooth loss, in the five teeth of the mandible. A problem is also present in the mandibular third molar, in which bone resorption is seen sometimes in bone resorption-negative individuals because oral hygiene is not easily maintained due to the narrow vestibular space around the tooth. It is also noted that periodontal disease can occur in areas of the periodontium adjacent to malaligned teeth where meticulous oral hygiene is not practiced [1].

Our results showed that bone status around the mandibular third molar was related to that around the other teeth, whereas bone resorption or formation around the overeruption of the third molar showed few significant correlations with the loss of other teeth. Alveolar bone formation was the dominant detectable influence on overeruptions without root exposure even in mandibular third molars that were in a degraded condition of oral hygiene. Hence, the results suggest that bone formation around overeruptions can be a potential indicator for resistance to periodontitis. Indeed, root exposure of the third molar with or without overeruption in both men and women was significantly correlated with root exposure of other teeth (Fig. 4). This did not agree with the data for the number of teeth lost, because tooth loss is caused not only by periodontitis, but also by decay. In cases with overeruption without root exposure in the left third molar, the number of teeth lost in the mandible was greater than in those with overeruption and root exposure, as well as in those without overeruption or root exposure in men. This finding indicates that tooth loss is not preceded only by increased root exposure, and may indicate that men lose more teeth due to decay compared to women. On the other hand, the basic finding of fewer root exposures in women (Table 1) may indicate periodontal health or stability in women, leading to tooth longevity. This may be due to the status of oral health in

women, or to the role of estrogen deficiency in bone loss in aging men [11].

Thus, periodontitis resistance expectancy can be predicted by third molars without root exposure in both genders, based on radiographic examination. And mandibular third molars with overeruption without root exposure may be useful for the specific diagnosis of the prognosis of periodontitis as a clinical parameter in detecting periodontal disease resistance activity. In addition, it is clinically useful for radiographic diagnosis that overeruption with bone formation is easy to observe. This phenomenon indicates activity of osteocytes in concert with periodontal fibroblasts and cementoblasts even when there is the possibility of root exposure due to overeruption. It can be speculated that bone formation accompanying with overeruption may depend on a survival mechanism in the periodontal tissue. Subjects selected for the present study had maxillary and mandibular second molars for the definition of overeruption of the mandibular third molar, indicating a status of good oral circumstances. Hence, the rate of bone formation accompanying overeruption may decline in populations that have no second molars. Therefore, even if the prediction could be applied to the limited population that has second molars, our testing is efficient for positive predictive values and leads to better results in decision making for conservative treatment of patients on the borderline of periodontitis. If a relationship between overeruptions of teeth other than the third molar and periodontal status can also be found in the mandible, it would be useful for predicting periodontal bone formation efficacy in a substantial number of patients—although it is not known how accurate it would be compared to overeruption of the third molar or how long the resulting bone formation has lasted—for long-term predictability. Moreover, occlusal trauma applied to overeruptions may result in attachment loss, bone loss, or sometimes bone formation. Evaluation of whether occlusal force interferes with, coordinates, or stimulates bone formation around overeruptions needs to be studied together with potential associations between oral health status and overeruption. And, since use of the panoramic radiogram for diagnosis of periodontitis may cause ethical problems, probing or use of dental radiogram for the diagnosis of bone formation around overeruptions could be clinically beneficial.

Our results show that overeruption without root exposure offers an advantage for screening for alveolar bone health when compared not only to overeruption with root exposure, but also to non-overeruption without root exposure in middle-aged and elderly persons. Accurate gauging of bone resorption resistance is crucial when deciding on the suitability of surgery in patients with periodontitis, and may yield information on the success of regenerative therapy for alveolar defects. Therefore, diagnosis of overeruption without root exposure may contribute to improvement in the healing rate of periodontitis and might prove cost-effective by preventing needless surgery for periodontitis. This approach will find application as a radiographic marker for the prognosis of periodontal disease.

Acknowledgements This work was performed in part by consignment for the Creation and Support Program for Start-ups from Universities from the Japan Science and Technology Agency. We would like to thank Ms. Hitomi Koike for her contribution to this study.

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