บทวิทยาการ
Original Article

อิทธิพลของฟันกรามซี่ที่สามต่อขนาดของช่องระหว่างรากฟันสำหรับการปักหมุดเกลียวขนาดเล็ก

Influence of Third Molars on the Availability of Interradicular Spaces for Miniscrew Implant Placement

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บทคัดย่อ

วัตถุประสงค์ของการศึกษานี้เพื่อประเมินถึงอิทธิพลของฟันกรามซี่สามต่อขนาดของช่องระหว่างรากฟันสำหรับการปักหมุดเกลียวขนาดเล็กในบริเวณฟันหลังของกระดูกขากรรไกรบนและล่าง ภาพรังสีปริทัศน์ของ ตัวอย่างจำนวน 60 คน อายุเฉลี่ย 18.1±3.1 ปี ถูกใช้เพื่อประเมินการปรากฏของฟันกรามซี่ที่สามจำนวนทั้งสิ้น 240 ตำแหน่ง พบการปรากฏของฟันกรามซี่ที่สาม 195 ตำแหน่ง ขนาดของช่องระหว่างรากฟันของฟันหลังในกระดูกขากรรไกรบนและล่างประเมินโดยใช้

Abstract

The purpose of this study was to assess the influence of the third molars on the availability of interradicular spaces for miniscrew implant placement in the posterior areas of the maxilla and mandible. Panoramic radiographs of 60 subjects (mean age, 18.1±3.1 years) were examined to assess the presence of the third molars. A total of 240 sites were observed. The presence of third molars was observed at 195

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ภาพรังสีรอบปลายรากฟันที่ถ่ายด้วยเทคนิคแบบขนาน โดยการวัดพื้นที่ระหว่างรากฟันในแต่ละตำแหน่งระหว่างรากฟัน เปรียบเทียบค่าเฉลี่ยของพื้นที่ระหว่างรากฟันระหว่างกลุ่มที่พบการปรากฏและไม่พบการปรากฏของฟันกรามซี่ที่สามโดยใช้สถิติแมนวิทนีย์ยู ผลการศึกษาพบว่าในกระดูกขากรรไกรบน การปรากฏของฟันกรามซี่ที่สามมีผลลดขนาดของช่องระหว่างรากฟันเฉพาะตำแหน่งระหว่างฟันกรามซี่ที่หนึ่งและสอง (17.2±0.5 ตารางมิลลิเมตร) เมื่อเปรียบเทียบกับกลุ่มที่ไม่พบการปรากฏของฟันกรามซี่ที่สาม (20.8±1.2 ตารางมิลลิเมตร) ในกระดูกขากรรไกรล่าง การปรากฏของฟันกรามซี่ที่สามไม่มีผลต่อขนาดของช่องระหว่างรากฟัน จากการศึกษานี้สามารถสรุปผลได้ว่า ในกระดูกขากรรไกรบนการปรากฏของฟันกรามซี่ที่สามมีบทบาทสำคัญต่อขนาดของช่องระหว่างรากฟันระหว่างฟันกรามซี่ที่หนึ่งและสอง

คำสำคัญ: ฟันกรามซี่ที่สาม ช่องระหว่างรากฟัน หมุดเกลียวขนาดเล็ก

Periapical radiographs, made using the paralleling technique, of posterior sites in the maxilla and mandible were examined. For each interradicular site, the interradicular area was measured. The Mann-Whitney U test was used to compare the mean interradicular area values between the groups in which third molars were present or absent. In the maxillary arch, the presence of third molars significantly reduced the amount of the interradicular space only between the first and second molars (17.2±0.5 mm^2), compared to the absence of third molars (20.8± 1.2 mm^2). In the mandibular arch, the presence of third molars did not affect the amount of interradicular space. The presence of the maxillary, but not the mandibular, third molars played an important role in the availability of interradicular spaces between the first and second molars.

Keywords: third molar, interradicular spaces, miniscrew implant

Introduction

Recently, the use of miniscrew implants has become an accepted and reliable method for providing orthodontic anchorage.[1-3] Because of their small size, they can be inserted in sites that were previously unavailable, such as the interradicular space.[4,5] However, concerns about damaging dental roots, allied with the limited interradicular space, still represent a barrier for the clinical application of these implants.[6-8]

Several studies have been performed to assess the safest locations in the interradicular spaces for miniscrew implant placement, the so-called "safe zones".[9-15] Accordingly, the safe zones in dentoalveolar bone for miniscrew implant placement have been described, in the maxilla as the area between the second premolar and the first molar, and, in the mandible the area between the first and the second molars.[10-15]

However, in these studies, the assessments of the safe zones were performed in samples with complete normal dentition, except for third molars. Therefore, the presence or absence of the third molars were not considered or taken into account for the assessment of interradicular spaces. Moreover, no study has investigated the effect of the third molar on the availability of interradicular spaces.

The third molars are the teeth that are most often congenitally missing. If present, they might follow an abortive eruption path and become impacted.[16] A recent study showed that the eruption of maxillary third molars played an important role in the sagittal inclination of the maxillary first and second molars.[16]

Therefore, we hypothesized that the presence of the third molar influenced the inclination of these teeth, and thus might affect the availability of interradicular spaces.

The purpose of this study was to assess the influence of the third molars on the availability of interradicular spaces for miniscrew implant placement in the posterior areas of the maxilla and mandible.

Materials and Methods

Samples

Pre-treatment panoramic and periapical radiographs, made using the paralleling technique, of 60 orthodontic subjects (both males and females, age range: 15-28 years) were selected from the orthodontic database in the Department of Orthodontics and Pediatric Dentistry, Faculty of Dentistry, Chiang Mai University, Thailand. Selection criteria included acceptable radiographic quality, fully erupted permanent dentition (except for third molars), no missing teeth (except for third molars), and no history of previous orthodontic or prosthodontic treatment. Dental arches with severe crowding or rotation in the posterior region, or radiographic signs of periodontal disease, or periapical lesions, were excluded.[10]

Presence or absence of the maxillary and mandibular third molar

Maxillary and mandibular third molars were recorded as present or absent based on information from each panoramic radiograph. The effect of the presence or absence of the third molar on the interradicular area was evaluated (Figure 1).

Figure 1 *Examples of interradicular areas in the groups in which A, maxillary third molars were present; B, maxillary third molars were absent; C, mandibular third molars were present; D, mandibular third molars were absent.*

รูปที่ 1 *ตัวอย่างของพื้นที่ระหว่างรากฟันในกลุ่ม A, พบการปรากฏของฟันกรามซี่ที่สามบน; B, ไม่พบการปรากฏของฟันกรามซี่ที่สามบน; C, พบการปรากฏของฟันกรามซี่ที่สามล่าง; D, ไม่พบการปรากฏของฟันกรามซี่ที่สามล่าง*

Interradicular area measurements

A total of 12 posterior tooth interradicular sites were examined in each subject (Figure 2). All periapical radiographs were photographed as digital images at fixed magnification with a resolution of 600 DPI and then transferred to a computer. Interradicular area measurements were made on the computer display monitor with custom-made software, Smart'n Ceph V 15.0 software (Y&B Products, Chiang Mai, Thailand).

The interradicular area was defined as the area between the lamina dura of adjacent tooth roots, from the alveolar bone crest to a level 11 mm

apical to the alveolar crest. This area was calculated using the reference landmarks at the alveolar crest and at 3, 5, 7, 9, and 11 mm depths from the alveolar crest (Figure 3).

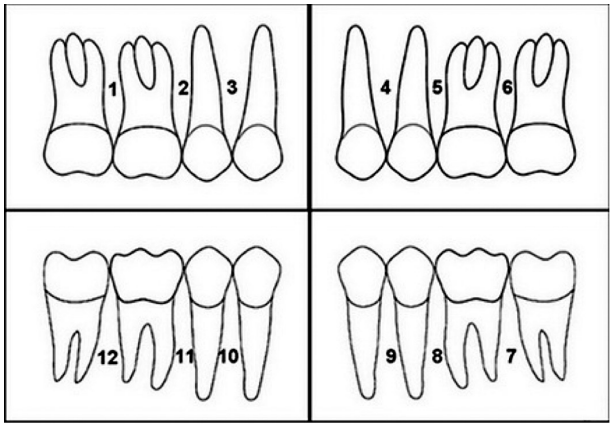

Figure 2 *A schematic of periapical radiographs indicating locations of interradicular area measurements.*

รูปที่ 2 *แผงผังภาพรังสีรอบปลายรากฟันแสดงตำแหน่งที่ใช้ในการวัดพื้นที่ระหว่างรากฟัน*

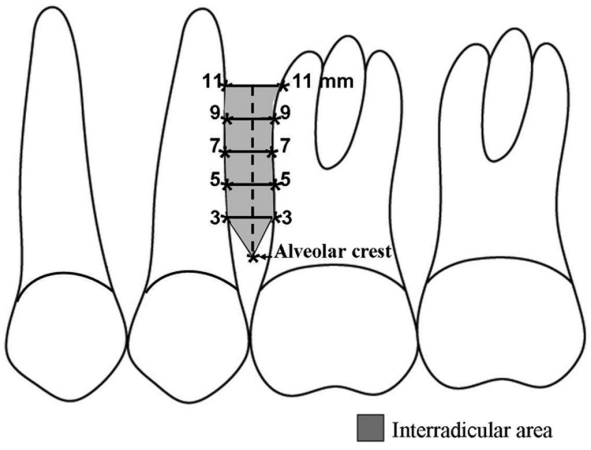

Figure 3 *Interradicular area measurement at each interradicular site.*

รูปที่ 3 *พื้นที่ระหว่างรากฟันที่วัดในแต่ละตำแหน่งระหว่างรากฟัน*

Statistical analysis

The statistical analyses were performed using the SPSS program (SPSS Inc, Chicago, Ill., USA) on a personal computer. The mean and the standard deviation of the interradiuclar area measurements were calculated. The Mann-Whitney *U* test was used to compare mean interradicular area values between the groups in which the third molars were present or absent. Results were considered statistically significant at $P < 0.05$.

Results

A total of 240 sites, 120 sites for each dental arch, were observed on panoramic radiographs to assess the presence of the third molars. In the maxillary arch, the presence of the third molars was observed at 98 sites, whereas in the mandibular arch, the presence of the third molars was observed at 97 sites.

Tables 1 and 2 show the interradicular area measurements in the maxillary and mandibular arches, respectively, and comparisons between the groups in which the third molars were present or absent.

In the maxillary arch, the greatest amount of interradicular area, 35.5±1.2 mm^2 (mean±SD), was between the second premolar and the first molar in the group in which the third molars were present. The least amount of interradicular area (17.2±0.5 mm^2) was between the first and second molars in the group in which the third molars were present.

In the mandibular arch, the greatest amount of interradicular area (52.3±1.7 mm^2) was between the first and second premolars in the group in which the third molars were present. The least amount of interradicular area (40.7±1.6 mm^2) was between the first and second molars in the group in which the third molars were present.

Significant difference in the amount of interradicular area between the first and second molars in the maxilla between the groups in which the third molars were present or absent was observed. The amounts of interradicular area between the maxillary first and second molars in

Table 1 *Means and standard deviations of the interradicular area measurements in the maxillary arch and comparisons between the groups in which maxillary third molars were present or absent.*

ตารางที่ 1 *ค่าเฉลี่ยและส่วนเบี่ยงเบนมาตรฐานของพื้นที่ระหว่างรากฟันในกระดูกขากรรไกรบนและเปรียบเทียบระหว่างกลุ่มที่พบการปรากฏและไม่พบการปรากฏของฟันกรามซี่ที่สามบน*

Variable	Maxillary third molar				The Mann-Whitney *U* Test
	Present (n = 98)		Absent (n = 22)		
	Mean (mm^2)	SD	Mean (mm^2)	SD	*P*-values
area U 4-5	30.1	1.7	27.9	1.1	0.263
area U 5-6	34.8	3.0	35.5	1.2	0.776
area U 6-7	20.8	1.2	17.2	0.5	0.006**

U, maxillary teeth. ** Significance of $P < 0.01$

Table 2 *Means and standard deviations of the interradicular area measurements in the mandibular arch and comparisons between the groups in which mandibular third molars were present or absent.*

ตารางที่ 2 *ค่าเฉลี่ยและส่วนเบี่ยงเบนมาตรฐานของพื้นที่ระหว่างรากฟันในกระดูกขากรรไกรล่างและเปรียบเทียบระหว่างกลุ่มที่พบการปรากฏและไม่พบการปรากฏของฟันกรามซี่ที่สามล่าง*

Variable	Mandibular third molar				The Mann-Whitney *U* Test
	Present (n =97)		Absent (n = 23)		
	Mean (mm^2)	SD	Mean (mm^2)	SD	*P*-values
area L 4-5	52.0	3.2	52.3	1.7	0.965
area L 5-6	41.4	2.7	41.1	1.4	0.855
area L 6-7	42.2	2.7	40.7	1.6	0.426

L, mandibular teeth.

the group in which the third molars were present was significantly less than in the group in which the third molars were absent ($P < 0.01$). However, no significant difference in interradicular area in the mandible between the groups in which the third molars were present or absent was observed.

Discussion

In contrast to previous studies, which assessed the interradicular distances (mm), this study assessed interradicular area (mm^2) in the posterior sites of the maxilla and mandible. In the maxillary arch, the greatest amount of interradicular area was between the second premolar and the first molar; the least between the first and second molars. Similar results have been reported by Schnelle et al,[9] Poggio et al,[10] Carano et al,[11] Lee et al,[14] and Hu et al,[15] who assessed the interradicular distances.

In the mandibular arch, the greatest amount of interradicular area was between the first and second premolars. These results support the studies of Poggio et al,[10] and Lee et al.[14]

In our study, a significant difference in the amount of interradicular area between the groups in which the third molars were present or absent was observed only between maxillary first and second molars. In the maxillary arch, the presence of third molars significantly reduced the amount of the interradicular area between the first and second molars when compared to the absence of third molars.

A possible explanation is that the eruption of the maxillary third molars altered the axial inclination of the first and second molars, thus influencing the amount of interradicular area between these teeth.

Fayad et al[16] reported a relationship between eruption of third molars and sagittal inclination of adjacent molars. They reported that the maxillary first and second molars were more mesially inclined in the subjects with erupted third molars than in those with impacted or unerupted third molars. Most of the maxillary third molars of the subjects in our study were unerupted. Therefore, the presence and position of the maxillary third molar influenced the inclination of the maxillary first and second molars and also played an important role in the size of the interradicular area between these teeth.

In contrast, no effect was observed, in our study, of the presence of the mandibular third molar on interradicular area. These results suggest that not only the presence of the third molars, but also the path of eruption and positioning are involved in the amount of displacement of the adjacent teeth.[16] These factors should be further evaluated in future studies.

Interradicular distance has been the conventional method for assessment of interradicular space using radiograph images. Although the use of the alveolar crest as a reference for measurements is relatively simple and reliable, and provides a clinical guideline for miniscrew placement, the simple linear measurements at defined heights from the alveolar crest do not provide complete information about each interradicular space. In order to avoid this limitation, we assessed interradicular area to provide more complete information of the interradicular space.

In our study, only the effect of the presence of the third molar on the availability of interradicular spaces was analyzed. Several factors that would potentially affect the availability of interradicular spaces, such as dento-skeletal pattern, severity of crowding, tooth anatomy, and ethnic variability, were not addressed.

A limitation of the study was the use of conventional periapical radiographs to assess the interradicular space, since they provide limited, 2-dimensional representations of 3-dimensional anatomic structures.[17]

Although all periapical radiographs were made using the long-cone paralleling technique, thus providing images with minimal distortion, the use of cone-beam computed tomography with 3-dimensional images would provide more accurate and reliable results.[18] Therefore, it might be preferable to use cone-beam computed tomography to determine the relationship between the availability of interradicular spaces and the presence and positioning of the third molars in a future study.

Conclusion

This study demonstrated that the presence of the maxillary third molars played an important role in the availability of interradicular space between the first and second molars in the maxillary arch. The availability of interradicular space between the first and second molars was mainly influenced by the inclination of these teeth. The presence and positioning of the third molar might alter the inclination of the first and second molars, thus influencing the amount of interradicular area between these teeth.

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