**Original Article**

# Assessment of Interradicular Spaces for Miniscrew Placement in Class I Subjects

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**Abstract**

**Objectives:** To assess interradicular spaces of maxilla and mandible in subjects with class I sagittal skeletal relationship as an aid for miniscrew placement. **Materials and Methods:** The study was carried out using cone-beam computed tomography (CBCT) images of 47 adult subjects with class I skeletal relationship. Interradicular spaces were obtained at the alveolar processes from first premolar to second molar at 2 different vertical levels (6 and 8mm) from the cementoenamel junction (C.E.J). **Results:** In the maxilla, the highest interradicular space existed between second premolar and first molar. In the mandible, the highest interradicular space existed between first and second molar. All mandibular measurements were higher than their respective maxillary measurement. Generally, availability of interradicular space increases apically in both arches, but the difference is not significant. In the maxilla, male subjects' measurement were significantly higher at 8 mm level between second premolar and first molar and between first and second molar **Conclusions:** Interradicular spaces in the maxillary and mandibular alveolar spaces are available for miniscrew placement. In both arches, a more apical location provides more interradicular space. However, careful planning is needed to avoid sinus perforation.

**Keywords:** Miniscrew; Interradicular spaces; CBCT.

## Introduction

The use of miniscrews to provide anchorage has become a reliable practice in orthodontic treatment [1-3]. Miniscrews are usually placed in the interradicular space to allow for simple placement and removal procedures, and simple force systems application [4]. However, damaging dental roots, is still a valid concern in the clinical application of these miniscrews [5]. Various anatomical sites have been suggested previously for miniscrew placement [6]. However previous studies were more focused on design , shape and diameter of miniscrews [7, 8], leaving more to be studied on the anatomical assessment of the most commonly suggested sites for miniscrews.

Previous studies on assessment of interradicular spaces and determining the so-called "safe zones" for miniscrew placement, have recommended minimal clearance of 1 mm of alveolar bone around the screw to preserve the health of the periodontium [2, 9]. And since the minis-

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crews used currently have a diameter that range between 1.2-2 mm [9] , it is logical to assume that an interradicular space of more than 3 mm is needed for miniscrew placement [10].

Min et al [11] used three dimensional images (CBCT) to examine the relation between root proximity and the success rate of miniscrew and concluded that root proximity was significantly related to the success rate. A similar conclusion was reached by Kuroda et al [12]. However, Kim et al [13] claimed that root proximity was not a major risk factor for miniscrew success. Nevertheless, root contact by miniscrews should be avoided as this contact is a possible cause for external root resorption [14].

Although previous studies showed that interradicular distance can be influenced by skeletal relationship [10], studies on root proximity mostly pool data from different skeletal relationships. Therefore, the objective of this study was to evaluate interradicular distance in subjects with Class I skeletal relationship as a guide for miniscrew placement.

## Materials and Methods:

The sample was retrospectively selected from cone-beam computed tomography (CBCT) scans in the Radiology department of Faculty of Dentistry, University Kebangsaan Malaysia (UKM). The images were created using i-CAT unit (Imaging Sciences International, Hatfield, PA). All selected images were taken with the following settings: 120 KVp, 5mA, 4 seconds exposure time and 0.3 mm voxel size. Approval of institutional ethical committee was obtained to collect the data. The following general inclusion criteria were used: age between 20-45 years, no alveolar bone loss, no facial asymmetries, no cleft lip or palate or any craniofacial anomaly, no impacted or missing teeth in the measured quadrant, no history of orthognathic surgery or orthodontic treatment. The following skeletal criteria were used for patient inclusion: subjects had normal mandibular plane angle with SN/GoMe angle, 27º- 37º [15] and sagittal relation Class I with ANB angle 1º-3º.

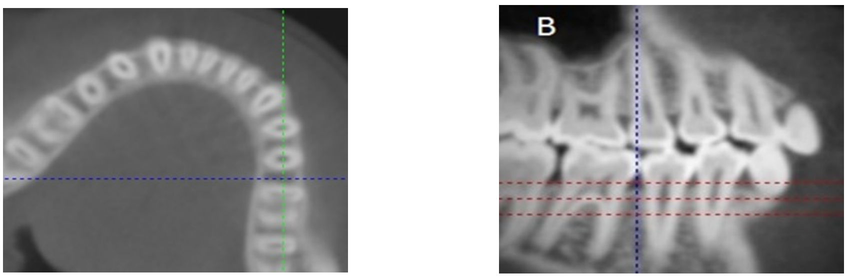


**Figure 1:** A, Axial view with horizontal reference line bisecting the area between the adjacent roots. B, sagittal view with the horizontal reference line marking (C.E.J).

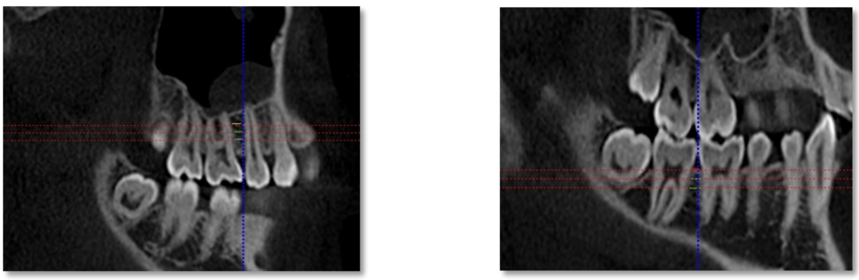

**Figure 2:** A, Sagittal view with mandibular interradicular measurement. B, Sagittal view with maxillary interradicular measurement.

The i-CAT Vision software was used to view and reconstruct the three dimensional views, CBCT scans of 47 subjects were included in this study (21 males and 26 females). Subjects mean age was 34.25 years.

Interradicular distance was measured in the alveolar process of the maxilla and mandible from distal of first premolar to mesial of second molar at two different vertical levels (6, and 8mm) from the cementoenamel junction (C.E.J). Areas measured are between first and second premolar (P-P), between second premolar and first molar (P-M), and between first and second molar (M-M).

To orient the area to be measured, the axial view of the software was rotated so that the vertical reference line is at the centre of the two teeth where interradicular distance between them to be measured, and the horizontal reference line is between the two teeth (Fig 1, A). The sagittal view is rotated to orient the teeth roots parallel to each other and the horizontal reference line is used to mark the cementoenamel junction (C.E.J) (Fig 1, B). The interradicular distance then is measured in the sagittal view using the distance tool of the software (Fig 2, A, B). Since previous studies concluded that there is no difference between right and left side measurements of interradicular distance [16] only one side was measured in each alveolar process.

Since all measurement were conducted by one operator, only intra observer reliability was measured. 10 images were remeasured two weeks apart. All data entered into excel worksheet and analyzed using SPSS software version 20.0. Descriptive statistics (mean and standard deviation), were performed. t- test was used for gender comparisons. Intra –class correlation coefficient was used to assess intra observer reliability. Level of significance was set at $P < 0.05$.

## Results

Intra –class correlation coefficient ranged between 0.84-0.95, which shows high intra observer consistency.

In the maxilla, interradicular distance was

**Table 1:** Maxillary interradicular distance (mm)

| Cut level | Site | Male | | Female | | t- test P value |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| 6 mm | P-P | 3.42 | 1.2 | 3.22 | 0.8 | NS |
| | P-M | 3.83 | 0.9 | 3.46 | 1.4 | NS |
| | M-M | 2.6 | 0.85 | 2.7 | 0.7 | NS |
| 8 mm | P-P | 3.44 | 0.6 | 3.4 | 0.9 | NS |
| | P-M | 3.85 | 0.8 | 3.6 | 0.4 | * |
| | M-M | 2.55 | 1.1 | 2.43 | 1.2 | * |

P-P, first premolar-second premolar; P-M, second premolar- first molar;
M-M, first molar-second molar. * $P< 0.05$; NS, not significant

**Table 2:** Mandibular interradicular distance (mm)

| Cut level | Site | Male Mean | Male SD | Female Mean | Female SD | t-test P value |
|---|---|---|---|---|---|---|
| 6 mm | P-P | 3.7 | 0.8 | 3.7 | 0.7 | NS |
| | P-M | 4.1 | 0.9 | 3.8 | 1.2 | NS |
| | M-M | 4.4 | 0.85 | 4.6 | 0.7 | NS |
| 8 mm | P-P | 3.9 | 0.8 | 3.5 | 1.2 | NS |
| | P-M | 4.2 | 1.5 | 4.2 | 1.4 | NS |
| | M-M | 4.6 | 1.1 | 4.2 | 1.2 | NS |

P-P, first premolar-second premolar; P-M, second premolar- first molar;
M-M, first molar- second molar. NS, not significant

higher at 8 mm level in all sites. The highest root distance existed between second premolar and first molar. Male subjects' measurement was higher at all sites, but gender difference was only significant at 8 mm level between second premolar and first molar and between first and second molar. Table 1, shows descriptive statistics of maxillary measurements and t-test result for gender differences.

In the Mandible, interradicular distance was also higher at 8 mm level in all sites. The highest root distance existed between first molar and second molar. Male subjects' measurement was higher at most sites, but the difference was not significant. Table 2, shows descriptive statistics of mandibular measurements and t-test result for gender differences.

## Discussion

In our study, only subjects with sagittal skeletal Class I were included as previous research shows that different skeletal pattern shows different bone dimensions. Also all sample subjects had normal vertical relation as this is also a previously studied factor that was demonstrated to influence bone dimensions [16].

In this study, the C.E.J was selected as the starting point for the measurements, unlike other studies that used the alveolar crest as a reference point, which could be affected by periodontal problems.

Yang et al [3] stated that in the anterior maxilla, most interradicular distances were not sufficient to accommodate a mini-implant. In this study, only the posterior part of the maxilla and mandible was studied as they offer a wider and more favourable area for miniscrew placement.

In addition, our measurements were conducted using CBCT files, which are more accurate in distance measurements than previous studies, which were conducted using periapical and panoramic x-ray that have magnification errors [9, 10].

Min et al [11]and Kuroda et al [12] concluded that root proximity was significantly related to the success rate of miniscrew placement .

Hence avoiding this proximity by knowledge of probable area interradicular distance can increase miniscrews success rate.

Our results confirmed that in the maxilla, the preferred site for mini-implant placement is between the maxillary second premolars and first molars because of the large space and easy accessibility for various orthodontic mechanics.

17]. Authors have studied interradicular distance at various depths from C.E.J [3, 11, 17, 18] in this study we only assessed interradicular distance in the attached gingiva as this placement choice was recommended by previous studies to avoid soft tissue inflammation and sinus perforation in the maxilla [2, 10, 12].

Our results showed that for the mandible the site between the two molars offers a wider root distance for miniscrew placement. This finding agrees with previous studies [11, 19, 20]. In Both arches root distance increase apically but this increase is not of statistical significance.

Miyawaki et. al [21] studied stability after implantation, and suggested that miniscrews move after placement, so one should allow at least 1 mm of distance between the root surface and the mini-screw.

Although our results show generally a higher male mean values for interradicular distance, gender differences in the mandible was not significant, while in the maxilla at 8 mm cut level a significant difference is seen in interradicular distance at two sites, between second premolar and first molar and between first and second molar.

**Conclusions**

The recommended site for miniscrew placement in the maxilla is between second premolar and first molar. Although a more apical position gives more root distance, it is not recommended to insert miniscrews higher than 8 mm above C.EJ. to avoid soft tissue inflammation and also to avoid sinus perforation. In the mandible, the recommended site is between first and second molar at 8 mm below C.E J.

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