

Buccal Cortical Bone Thickness in Iraqi Arab Adults by Cone Beam Computed Tomography for Orthodontic Mini-Implants

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ABSTRACT

Background: Cortical bone thickness is important for the stability of mini implants. Placing mini implants in sites of favorable cortical bone thickness would guarantee better initial stability and long-term success. The aim of this study was to investigate gender, side and jaw differences of the buccal cortical bone thickness as a guide for orthodontic mini screw placement.

Materials and Methods: The sample was selected from the patients attending the Specialized Health Center in Al-Sadr City / 3D department. Thirty patients (15 males and 15 females) were selected and cone beam computerized tomographic images were done. Then the buccal cortical bone thickness was measured at thirteen inter radicular sites in the maxilla and mandible from the mesial side of the second molar to the mesial side of the second molar on the other side. The resulting data were statistically analyzed using independent t-test on SPSS program.

Results: The buccal cortical bone thickness of the males was more than the females for both jaws. The mandibular buccal cortical bone thickness was thicker than in the maxillary and in the anterior region was thinner than in the posterior region for each jaw. The thickness of the buccal cortical bone was generally greater on the left side.

Keywords: Mini-implant, cortical bone thickness, bone quality. (J Bagh Coll Dentistry 2017; 29(1):183-187)

INTRODUCTION

Provision of anchorage is one of the most challenging aspects of orthodontic treatment planning. Routine and conventional anchorage techniques are generally dependent on patient compliance and usually result in untoward reciprocal tooth movements. To overcome such a problem, orthodontic mini-implants have been incorporated into orthodontic treatment techniques. Adequate bone at mini-implant placement site can affect the success or failure of anchorage; therefore, a large number of studies have been carried out to determine appropriate locations for and stability of mini-implants. It is necessary to have knowledge about the thickness of bone to select a proper length for mini-implants to avoid perforation of the nasal cavity.

In addition, knowledge about bone thickness is useful for the determination of the length of mini-implants and the height of mini-implant neck.⁽¹⁻⁹⁾

Recent studies showed that factors related to the stability of mini-implant included: the cortical bone quality and quantity, soft tissue inflammation around the mini-implant, inter-radicular space, the design of the mini-implant as well as surgical insertion techniques.⁽¹⁰⁻¹⁴⁾

Motoyoshi recommended that a cortical bone thickness of 1.0 mm or more was the critical value of cortical bone thickness for the success of mini-implants implantation^(15,16). Therefore, the

cortical bone thickness is very important for the stability of mini-implants⁽¹⁵⁻¹⁹⁾

In recent years, CBCT technique has been used to place mini-implants accurately because the technique provides high-resolution images with less patient radiation or comparable to that of the CT technique⁽²⁰⁻²³⁾

MATERIALS AND METHODS

The sample

In the Specialized Health Center of Al-Sadr City, 351 patients referred to the 3D Department for the diagnosis of various dental problems from December 2014 till May 2015 were examined. Thirty Iraqi Arab adults (15 males and 15 females) were selected being 18-25 years of age with a full set of permanent teeth regardless of third molar, bilateral class I molar and canine relationships, normal overjet and overbite⁽²⁴⁾, well-aligned arches or mild crowding or spacing less than 3mm, periodontally healthy dentition and no history of orthodontic treatment.

The method

The subjects and their parents were informed about the study and consent to participate in it. Preparing and positioning the patient was done according to the operator manual of the CBCT machine (Kodak 9500 3D). Images were taken at 90 kV and 10 mA with a scanning time of 10.8s and voxel size 300. The data then was imported and saved on the main computer after acquisition.

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The acquired images are axial or transverse images (coronal and sagittal images) in addition to 3D image. All these images are reconstructed by the 'KODAK dental imaging software' with different types of slicing techniques (orthogonal, curved, custom and oblique slicing).

For each point to be measured, the area of interest is assessed by using the same software. Then "curved slicing" is chosen from the menu bar of the software window and four views appear in the screen (panoramic, axial, cross-sectional and 3D views). Then the panoramic view was maximized and by using the vertical blue line the site is determined (Fig. 1).

Before measuring the alveolar cortical bone thickness, each site was oriented in all view windows. The panoramic and axial views were used to locate the interradicular area of interest while the cross-section image (perpendicular to the panoramic curve) was used to select four areas at 2, 4, 6 and 8 mm from the alveolar crest by using the tools menu of the software to do the measurement.

Then the buccal cortical bone thickness was measured in the maxilla and mandible at thirteen interradicular sites from the mesial side of right second molar to the mesial side of left second molar.⁽²⁵⁾

Statistical Analysis

The statistical package for social science (SPSS) was used for statistical analysis. Independent t-test was used for comparing buccal cortical bone thickness between males and females, right and left sides and between the maxilla and mandible. P values of less than 0.05 were considered as statistically significant.

RESULTS

The mean buccal cortical bone thickness ranged between 1.247mm in the female maxillary anterior region at 4mm from the alveolar crest to 3.087mm in the male mandibular posterior region at 8mm from the alveolar crest.

The buccal cortical bone thickness in males was significantly greater than in females in both jaws at 4, 6 and 8mm from the alveolar crest, but not significant at 2mm from the alveolar crest (Fig. 2).

Mandibular measurements were statistically significantly ($p < 0.01$) higher than those of the maxilla for both males and females, on both right and left sides at 2, 4, 6 and 8mm from the alveolar crest.

The thickness of the buccal cortical bone was greater on the left side of male and female mandibles and female maxillae, but there was no clear pattern in male maxillae. However, all these differences were statistically non-significance (Fig. 3).

DISCUSSION

The thicker buccal cortical bone thickness found in males was consistent with the findings of Ono et al.⁽²⁶⁾, but contrary to those of Deguchi et al.⁽²⁷⁾. This may be due to differences in sampling and measurement methods taken by Deguchi et al.⁽²⁷⁾ who had a sample consisting of only five males and five females with different malocclusions and the thickness of cortical bone was evaluated at two levels only (3-4mm and 6-7mm from the alveolar crest) and in the posterior region only.



Figure 1: Site assessment technique.

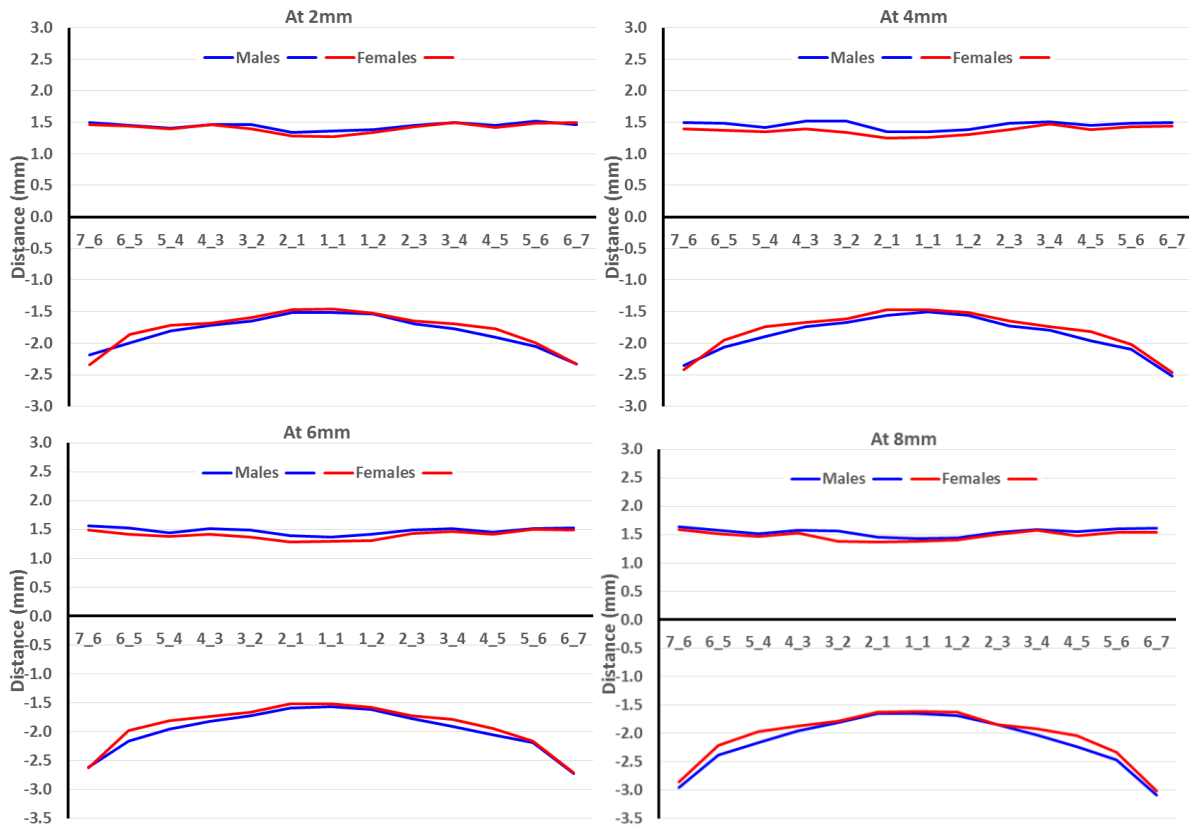


Figure 1: The buccal cortical bone thickness of the maxilla and mandible for males and females at 2, 4, 6 and 8mm from the alveolar crest.

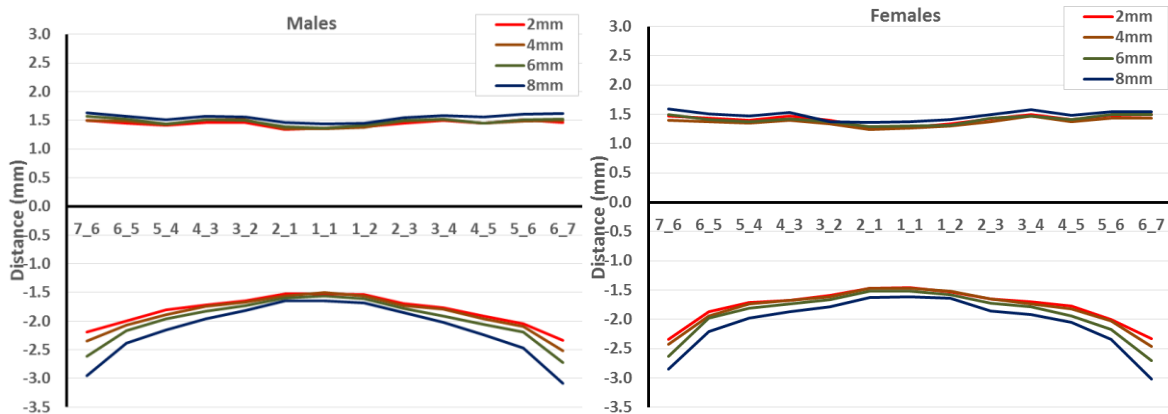


Figure 2: The height of the buccal cortical bone thickness in the maxilla and mandible for males and females at different sites from the alveolar crest.

The thicker cortical bone in the mandible was consistent with the results of many studies (26-30). The mandibular cortical bone thickness tends to increase with increasing distance away from the alveolar crest which also agrees with the findings of several studies (26,28-30).

In the maxilla, the buccal cortical bone thickness mesial to the first premolars was found to increase with increasing distance from the alveolar crest. This was consistent with the

finding reported by Hong et al. (30) and Baumgaertel and Hans (28).

The buccal cortical bone was thin in the anterior regions of both jaws and increased gradually toward the posterior region. These results agree with those found by Baumgaertel and Hans (28). It is found that not only the thickness of buccal cortical bone was thin in the anterior region but also the attached gingiva was short and insufficient interradicular distance, so

for these reasons implanted miniscrews at the anterior part of both jaws should be cautioned (27,29,31).

The mandibular cortical bone was thicker on the left sides than on the right sides but these differences did not reach statistical significance. This was consistent with the findings of the studies reported by Ono et al. (26) and Hong et al. (30).

This result confirms the clinical study which stated that mini implants in the right side of the lower arch reveal a higher failure rate than those in the left side, may be because most people chew more frequently on the right side than the left side, which result in more force applied to the implant and that people brush better on the left side (32).

In the maxilla, the present study showed no significant differences between the right and left sides of cortical bone thickness in males and females which was consistent with findings of the studies reported by Lim et al. (31) and Ono et al. (26) but inconsistent with the findings of another study reported by Hong et al. (30) who found a significant difference between the right and left sides of maxilla at 4 and 8 mm from the alveolar crest only. This may be attributed to ethnic differences as Hong et al. (30) examined 32 Chinese subjects with age between 21-44 years.

Clinical considerations

Based on findings of this study, the following clinical considerations can be drawn:

1. The buccal cortical bone in the anterior region is thin in both jaws, so the use of mini-implant with large diameter is preferred to insure better primary stability and long term success.
2. The thickest buccal cortical bone was at 4 and 6mm from the alveolar crest in the maxilla and at 6 and 8mm in the mandible, so these sites are more suitable for mini-implant placement.
3. The mandibular posterior buccal cortical bone was the thickest site, so the use of short mini-implant may give sufficient stability.

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الخلاصة

الخلفية: سمك العظم الشدقي القشري مهم من أجل ثبات الزرعات التقويمية. تثبيت الزرعات التقويمية في أماكن ذات عظم سميك يؤمن ثبات ابتدائي أفضل ونجاح بعيد الأمد. الهدف من هذه الدراسة هو تقويم سمك العظم الشدقي القشري ما بين الأسنان في الفكين العلوي والسفلي وعلى الجانبين الأيمن والأيسر من أجل وضع الزرعات التقويمية.

المواد والطرق: تم اختيار العينة من مراجعي المركز الصحي التخصصي في مدينة الصدر - شعبة الأشعة ثلاثية الأبعاد. تم اخذ صورة شعاعية لثلاثون مراجع (15 ذكرا و15 انثى) بجهاز التصوير المقطعي المخروطي لأشخاص بالغين يمتلكون اطباق طبيعي وبعد ذلك تم قياس سمك العظم القشري للفكين في 13 موقع بين الأسنان ومن ثم تحليل النتائج احصائيا.

النتائج: كان العظم الشدقي القشري أسمك في الذكور من الاناث وفي الفك السفلي من العلوي وفي مؤخرة الفك السفلي والعلوي والسفلي من مقدمتهما وكذلك اسمك في الجانب الأيسر من الجانب الأيمن.