Buccal cortical bone thickness evaluation using tomographic imaging prior mini implant placement

Dr. Ali S. Al-Haddad
ali.alhadad@uokerbala.edu.iq
Iraq, Karbala University, Dentistry College, Department of Oral Diagnosis.
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Abstract

The mini implants, which were originally designed to fix bony segments, has shown great promise as a simpler and more versatile solution for obtaining absolute anchorage**,** No Osseo integration is required. Mini implants are placed in many anatomic sites, depending on the indication and the biomechanics used. One of the most popular sites of placement is the buccal cortical plate of mandible. So that this study was done to evaluate the tomographic imaging in measuring buccal cortical bone thickness as an adjunctive radiographic technique for an appropriate mini implants site selection. 30 patients were imaged by using a tomographic technique from planmeca panoramic machine (planmeca Promax, Helsinki, Finland) mesial to mandibular first molars choosing" mixed tomo," "3xCRS 1 LNG" (3 cross sectional and 1 longitudinal) with 95s radiographic time, 1 mA and 68 kV parameters, making measurements by using planmeca Romexis software 3.1.1.R version at four deferent levels 2,4,6,8 mm from the alveolar crest with 0.1mm width cursor to measure the buccal cortical bone thickness prior mini implants placement . This study was resulted in that by comparing with panoramic radiograph, measuring cortical bone thickness, intercortical bone thickness and interradicular space using tomographic radiograph become a more valuable wise than panoramic radiograph. In conclusion, tomographic radiograph may acquire a new radiographic indication prior mini implants placement for orthodontic anchorage replacing dental panoramic radiograph and periapical radiograph.

تقييم سمك العظم اللحائي الوجني باستعمال التصوير الطبقي الشعاعي قبل وضع الزرعة الصغيرة

علي سلمان عبد الامير الحداد
فرع التشخيص الفمي, كلية طب الاسنان, جامعة كربلاء, العراق.
الكلمات المفتاحية: التصوير الطبقي, العظم اللحائي الوجني, الزرعة الصغيرة.

الخلاصة

الزرعة الصغيرة التي صممت اصلا لتثبيت القطع العظمية, اظهر وعدا كبيرا كحل متعدد الاستعمال وسهل للحصول على مرسى مطلق لا يحتاج الى تلاحم عظمي. الزرعة الصغيرة توضع في العديد من المواقع التشريحية بالاعتماد على دواعي الاستعمال والميكانيكية الحيوية المستعملة. أحد المواقع الاكثر شعبية للوضع هو العظم اللحائي الوجني للفك السفلي, لذلك تم اجراء هذه الدراسة لتقييم استخدام التصوير الطبقي الشعاعي لقياس سمك هذا العظم كتقنية شعاعية مساعدة لاختيار حجم الزرعة الصغيرة الملائمة . 30 مريض صوروا باستعمال تقنية التصوير الطبقي الشعاعي المزودة في جهاز بلانميكا البانورامي (planmeca Promax, Helsinki, Finland) بالقرب من ضرس الفك الطاحن السفلي الاول الايمن وذلك باختيار (3 cross sectional and 1 "3xCRS 1 LNG" "mixed tomo,

(longitudinal) بـ 95 ثانية وقت تصوير , 1 ميلي امبير و 68 كيلو فولت من وحدا القياس. اجريت القياسا باستخدام برنامج planmeca Romexis software 3.1.1. R في اربع مستويا مختلفة 2, 4, 6, 8 ملم من القمة الحويصلية بنحافة مؤشر عرضه 0.1 ملم لقياس سمك العظم اللحائي الوجني قبيل وضع الزرعة الصغيرة لاختيار اية مستوى اكثر ملائما.
نتج عن هذه الدراسة انه بالمقارنة مع الاشعة البانورامية, قياس سمك العظم اللحائي الوجني, العظم داخل اللحائي الوجني والمجال بين الاسنان باستخدام التصوير الطبقي الشعاعي اصبح طريقة قيمة اكثر من الاشعة البانورامية.
نستنتج من هذه الدراسة ان التصوير الطبقي قد يكتسب ضرورة شعاعية جديدة قبيل وضع الزرعة الصغيرة للحصول على مرسى تقويمي ليستعيض بذلك عن الاشعة البانورامية وما حول القمية.

INTRODUCTION

For a long time, orthodontists have struggled to achieve efficient control of anchorage. A variety of extraoral appliances have been designed, but these have their own problems, such as inadequate patient compliance[1]. The mini implants, which were originally designed to fix bony segments, has shown great promise as a simpler and more versatile solution for obtaining absolute anchorage[2]. No Osseo integration is required (or desired) and they are small in size (typically 6 to 12 mm long and 1.5 to 2 mm in diameter)[3, 4]. Many authors have reported successful use of mini implants in a wide range of orthodontic tooth movements [3-15]. Over the years a variety of terms have been used to describe the orthodontic implant, such as mini-implant[16], miniscrew[17], micro implant[18] and micro screw implant[8]. Mini implants are placed in many anatomic sites, depending on the indication and the biomechanics used [19-21]. One of the most popular site of placement is the buccal cortical plate of mandible[19-23],which has proven to be a versatile placement site and has thus been the subject of several investigations[24, 25]. Many local anatomic factors must be considered in that site; no single factor can be isolated to mark the ideal placement site. Among the more important factors for placement in the buccal cortex are soft-tissue anatomy, buccolingual bone depth, nerve location, and Interradicular distance [26, 27]. The bone stock for placement of mini implants was found primarily mesial and distal to first molars[28]. Typically, adequate inter radicular bone distance was found more than halfway down the root length, which is likely to be covered by movable mucosa[28, 29], in extreme cases inclining the screw in the apical direction prevent damage to the roots of adjacent teeth[30]. Cortical bone has a higher modulus of elasticity than trabecular bone, is stronger and more resistant to deformation, and will bear more load in clinical situations than trabecular bone[31], and What applies to traditional dental implants also applies to orthodontic mini-implants: thicker cortical bone provides greater primary stability[32-34]. More recently, an interest in cortical bone thickness and quality has developed in conjunction with orthodontic skeletal anchorage systems [24, 35-38]. The purpose of this study is to evaluate the tomographic technique in measuring the buccal cortical bone thickness to determine the appropriate site of mini implants placement.

SUBJECT, MATERIALS AND METHODS

30 patients (15 female, ages 20-24yrs; 15 male ages 21-26yrs) referred from the orthodontic department in dental college of Karbala university for taking panoramic radiograph as a radiographic planning need before mini implants placement. All this patients informed to participate in a research protocol and they imaged in the radiographic department by using a tomographic technique from planmeca panoramic machine (planmeca Promax, Helsinki, Finland) mesial to mandibular right first molars choosing" mixed tomo," "3xCRS 1 LNG" (3 cross sectional and 1 longitudinal) (figure 1) with 95s radiographic time, 1 mA and 68 kV parameters, making measurements by using planmeca Romexis software 3.1.1.R version at four

deferent levels 2,4,6,8 mm from the alveolar crest with 0.1mm width cursor to measure the buccal cortical bone thickness prior mini implants placement to evaluate the most preferred level.

Results

Tomographic radiograph was an appropriate comparable wise (comparing with 8mA and 70kV panoramic radiograph), and economically acceptable (the same cost). nowadays many panoramic machine are capable of making tomographic sections of the jaws[39]. Dentist can measure the cortical bone thickness with three deferent bucco-lingual angled images, also he can locate the opening of the mental foramen and inferior alveolar nerve to avoid nerve damage, buccolingual bone width and distance from intercortical bone surface to root surface. With the additional longitudinal (crop panoramic) image we can measure the inter-radicular space. In this study the buccal cortical bone thickness was measurable and it increases in an apical direction among the deferent four levels. In 2mm level (mean: 0.9mm, SD= 0.333), 4mm level (mean: 1.15mm, SD=0.316), 6mm level (1.48mm, SD: 0.256), 8mm level (mean: 1.71mm, SD: 0.34321).

Discussion

Only a few studies have evaluated the quantity of bone for mini implants placement for orthodontic anchorage [28, 40, 41]. Schnelle et al [28] evaluated interradicular bone between the roots using panoramic radiographs. However, the thickness of the cortical bone could not be measured on panoramic or periapical radiographs. Tomographic radiograph provide a third dimension of bone which is useful to measure cortical bone thickness.

Cone beam computed tomography (CBCT) [42, 43] or computed tomography[44] may provide three dimensional information about cortical bone thickness of the mandible for mini implants placement, but it does not offer a significant advantage over conventional tomographic imaging technique when the additional cost and radiation dose are considered [39]. Tomographic technique with **3xCRS** 1 LNG (3 cross sectional and 1 longitudinal) allows evaluation of the cortical bone thickness while subjecting the patients to a relatively lesser amount of radiation in comparison to CBCT. It provide a three dimensional map for miniscrew placement if it is done by experienced investigator, also he can measure the distance from the cortical plate and the root surfaces to choose an appropriate mini implants size, and if it is not adequate, angulating the mini implants to increase the thickness of cortical bone contact with the mini implants [38].

The selection of longer mini implants is beneficial because they offer stronger anchorage[45]. It has been noted that mini implants of 4-6 mm length is ideal but differences in bone morphology among different individuals makes it necessary to evaluate the amount of available cortical bone thickness prior to placement of an implant to determine the success of the implant[41]. After evaluation of the cortical bone thickness it has been noted that it increased apically and that agreed with Sebastian and Mark [46] and Veli, I., et al [47].There is more stability for the mini implants with more availability of the cortical bone thickness; therefore, mini implants with shorter length may be used in this cases. Knowledge of this pattern and the mean values for thickness can aid in mini implants site selection and preparation.

Conclusion

Tomographic imaging by an experience investigator may acquire a new radiographical indication prior mini implants placement for orthodontic anchorage replacing dental panoramic and periapical radiograph.

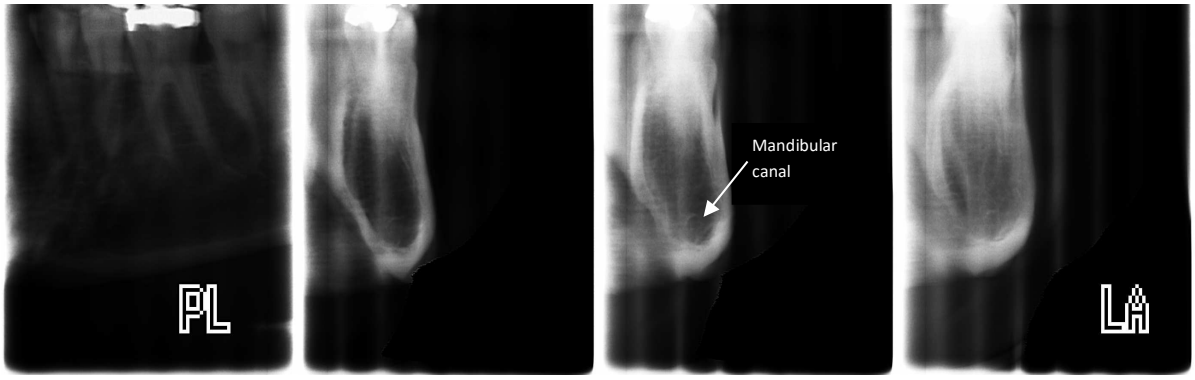

Figure 1: tomographic radiograph (3xCRS 1 LNG) showing the buccal cortical bone

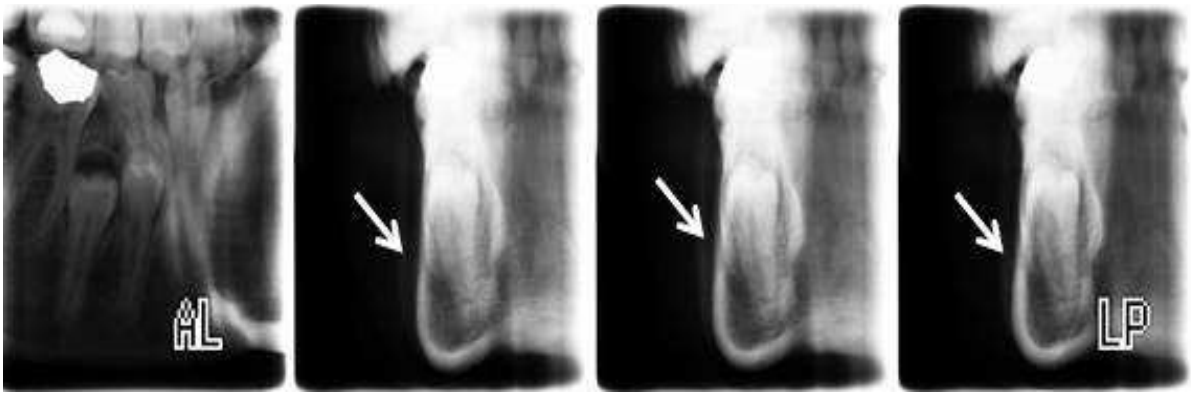

Figure 2: patient with impacted 44, 45. White arrow shows the opening of the mental foramen.

REFERENCES:

[1] Roberts, W. E., Marshall, K. J., and Mozsary, P. G.,(1990) Rigid endosseous implant utilized as anchorage to protract molars and close an atrophic extraction site. **The Angle orthodontist**. 60.

[2] Mah, J., and Bergstrand, F.,(2005) Temporary anchorage devices: a status report. **Journal of clinical orthodontics: JCO**. 39.

[3] Kanomi, R.,(1997) Mini-implant for orthodontic anchorage. **Journal of clinical orthodontics: JCO**. 31.

[4] Mitchell, L.,(2013) An introduction to orthodontics, **OUP Oxford**.

[5] Crismani, A. G., Bertl, M. H., Čelar, A. G., Bantleon, H.-P., and Burstone, C. J.,(2010) Miniscrews in orthodontic treatment: review and analysis of published clinical trials. **American Journal of Orthodontics and Dentofacial Orthopedics**. 137.

[6] Chang, Y.-J., Lee, H.-S., and Chun, Y.-S.,(2004) Microscrew anchorage for molar intrusion. **Journal of clinical orthodontics: JCO**. 38.

[7] Costa, A., Raffainl, M., and Melsen, B.,(1997) Miniscrews as orthodontic anchorage: a preliminary report. **The International journal of adult orthodontics and orthognathic surgery**. 13.

[8] Park, H.-S., Bae, S.-M., Kyung, H.-M., and Sung, J.-H.,(2001) Micro-implant anchorage for treatment of skeletal Class I bialveolar protrusion. **Journal of clinical orthodontics: JCO**. 35.

[9] Kyung, S., Hong, S., and Park, Y.,(2003) Distalization of maxillary molars with a midpalatal miniscrew. **Journal of clinical orthodontics: JCO**. 37.

[10] Park, H.,(2001) The use of micro-implant as orthodontic anchorage. **Seoul, Korea: Nare**.