

CHAPTER 5

Discussion

Recently, protraction headgear with skeletal anchorage, such as miniscrew, has been reported to minimize unfavorable outcome such as proclination of the maxillary incisors, and loss anchorage of the maxillary molars.^{11,17,18} Non-interradicular sites for miniscrew placement were suggested to be safer than interradicular site.⁴⁵ Palatal site of miniscrew placement was not appropriate in UCLP patients due to the cleft at the palate. Recently, the IZ crest is usually used for a single miniscrew. The IZ crest has two cortical plates which are the buccal cortical plate and the sinus floor. This anatomic advantage allows for bicortical fixation and possibly contributes to better primary stability of the miniscrew.^{2,43}

The success rate of miniscrew depends greatly on primary stability.²⁴ Cortical bone thickness is one of fundamental factor on the primary stability of miniscrew placement.^{26,28,51-53} The bone thickness of IZ crest has been studied in several previous studies. In this study the CEJ was selected as the starting point for the measurements, unlike other studies that used the alveolar crest, which could be affected by different periodontal problems. The maximum level of measurement in this study was 9.6 mm from CEJ. We excluded the higher levels because it was not infrazygomatic area, but lateral wall of sinus. As an insertion site for orthodontic skeletal anchorage, the IZ crest is usually used for a single miniscrew because of its thicker bone, whereas the lateral wall of the maxillary sinus is used for miniplates with several miniscrews because of its thinner wall.³⁹

Motoyoshi et al.²⁹ demonstrated that the cortical bone thickness should be at least 1.0 mm for adequate primary stability. Our study found that the cortical bone thickness at both non-cleft and cleft side increased from the mesial aspect of the maxillary first molar

to the distal (Figure 5.1). That agreed with a non-cleft adult study by Ono et al.⁵⁴, however, an incongruity was available. In this study, all measurements were greater than 1.0 mm excepted at 4.8 mm vertical level of MB root of maxillary first molar at non-cleft side (Figure 4.1 and 4.2) while Ono et al.⁵⁴ reported that the thickness in the posterior segment of the maxilla was all greater than 1.0 mm at 5.0 mm from alveolar crest through apical areas in non-cleft adults. The discrepancy may be related to age difference. According to this study, the greater values of cortical bone thickness were along the DB root of maxillary first molar, increasing at higher vertical levels (Figure 5.1). This is consistent with Park and Cho²⁸ who conveyed that buccal cortical bone thickness tended to increase from the buccal CEJ to the apex. Nonetheless, Hu et al.⁵³ claimed no significant differences. Baumgaertel et al.¹ even revealed that the thickness at the posterior area of the maxilla decreased at the 4-mm vertical cut level, and then increased again at the 6-mm vertical cut level from the alveolar crest.

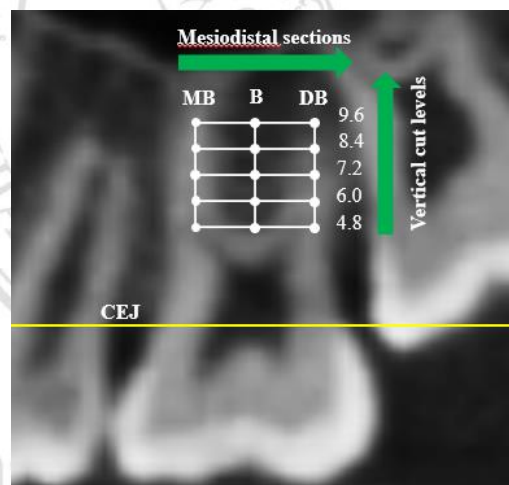


Figure 5.1 The pattern of the buccal cortical bone and buccal plate thickness at various sites at non-cleft and cleft sides. The heads of the arrows represent the direction of the increase in bone thickness.

According to Lin⁴⁵, at least 1.0 - 2.0 mm initial biting depth of buccal plate was required prior to changing the insertion direction in order to avoid an injury to the maxillary molar roots by miniscrew implant. In our present study, the buccal plate thickness in every vertical cut levels and mesiodistal sections of both non-cleft and cleft sides is adequate for miniscrew implant placement (Figure 4.3 and 4.4). In addition, this study clarified that the buccal plate thickness at non-cleft and cleft sides were greater

toward the apex (Figure 5.1). This is consistent with Lin⁴⁵ who studied the series of CT image sections from 1.0 mm to 10.0 mm above cervical line, and summarized that the buccal plate thickness of the upper molar area was tend to be wider toward the apex due to convergence of the upper molar roots and the smaller upper molar root apex. Moreover, our study found that the greater values of buccal plate thickness were along the DB root of maxillary first molar (Figure 5.1). This is consistent with Temple⁵⁵ who studied the buccal plate thickness of both arches using CBCT, and found that Both arches demonstrates increasing buccal plate thickness form anterior to posterior.

In an experimental study on the IZ crest of 4 monkeys, Melsen and Costa⁴² reported that a 6-mm miniscrew biting depth sustained all 8 miniscrews during the 6-month experimental period. In another study on the reduced maxillary height of the edentulous ridges of 2 dogs, Wehrbein et al⁵⁶ reported that, after 8 weeks of healing and then 2N of orthodontic loading for 6 months, a 6-mm miniscrew biting depth sustained all 4 miniscrews throughout the experimental period. According to these studies, it seems that, a 6-mm miniscrew biting depth in the IZ crest is sufficient for sustaining the miniscrew throughout the loading period. In our study, At non-cleft sides, The combination of MB4.8-7.2 site with 65-70°, the combination of MB9.6 site with 45-50°, the combination of B4.8-7.2 site with 45-70°, the combination of B8.4 site with 45-55° and the combination of DB4.8 site with 60-70° angulation to the maxillary molar occlusal plane provided adequate biting depth (Figure 4.5). At cleft sides, The combination of MB4.8-7.2 sites with 60-70°, MB8.4 site with 50-55°, the combination of B4.8-7.2 sites with 45-70°, B8.4 site with 45-55°, and the combination of DB4.8 site with 60°, DB6.0 site with 50-70° and the combination of DB7.2 site with the 45 degree angulation to maxillary molar occlusal plane provided adequate biting depth (Figure 4.6).

For clinical implication, We suggested that the proper position and angulation of miniscrew placement should be at 6.0-7.2 mm vertical levels from the buccal CEJ of maxillary first molar with the 65-70 degree angulation at MB root axis of maxillary first molar (MB6.0-7.2/65-70°) and 4.8-7.2 mm vertical levels with all angulation (45-70 degree) at middle of buccal furcation (B4.8-7.2/45-70°) for non-cleft sides. At non-cleft side, we suggested that the proper position and angulation of miniscrew placement should be at 4.8 -7.2 mm vertical levels with 60-70 degree angulation at MB root axis (MB4.8-7.2/60-70°) and 4.8 - 7.2 mm vertical levels with all angulation (45-70 degree) at middle

of buccal furcation of maxillary first molar (B4.8-7.2/45-70°). The bone thickness at DB root axis was not recommended for miniscrew placement due to lowest IZ crest thickness. The 8.4 and 9.6 mm vertical levels were not proper for miniscrew placement because there were not sufficient IZ crest thickness at these area. From previous study, The insertion angle ranging from 60 to 70 was advisable to achieve the best primary stability.⁵⁷ A more oblique direction of insertion seems to be favorable to minimize the risk of root contact. In our study, Although the middle of buccal furcation seems to be the safest area of minimal risk of root contact, further study of the distance between MB root and DB root of maxillary first molar in UCLP should be investigated to find the proper miniscrew size at this area.

Baungaertel and Hans²⁰ stated that great individual variation exists in the thickness of the infrazygomatic crest. Indeed, the present study also found that measurements had large variation, which is probably due to differing root lengths, maxillary sinus pneumatization, buccolingual inclination of the maxillary first molar, and the height of the alveolar processes among the individuals studied, all of which are determinants to the available bone depth for miniscrew placement.

This study found that miniscrew placement at the maxillary first molar area at the cleft side considering the buccal cortical bone, buccal plate and IZ crest thickness is adequate for stability as same as at the non-cleft side. However, success of miniscrew placement is affected by other crucial factors. Cortical bone quality, for example, was also essential for the primary stability.^{26,58} Failure might related to the bone immaturity, particularly in growing patients. In addition, several studies revealed that non-keratinized mucosa was a risk factor for miniscrew implant dislodgement. It has been recommended that miniscrew implants should be placed in keratinized gingiva because lower survival rate was found in the movable non-keratinized mucosa area.⁵⁹ It has been suggested that when miniscrews are placed in keratinized gingiva, the probability of tissue hyperplasia and inflammation is lower.³⁰ Plakwixz et al.⁶⁰ studied the periodontal status in growing patients with UCLP and found that keratinized gingiva was statistically significantly narrower on the cleft side. Therefore, zone of attached gingiva should be considered prior to determining the proper miniscrew implant placement site as well.^{45,59,61-63}

Statistically significant differences of the buccal cortical bone and buccal plate thicknesses comparing the cleft and non-cleft sides were discovered. Almost all values were greater on the cleft side. No other studies are available on searching to equate those findings. Characteristics of malocclusions of UCLP patients at mixed dentition stage should be considered. Disthaporn et al.⁶⁴ measured the mediolateral arch widths on the cleft and non-cleft sides and declared that arch contraction was more severe on the cleft side at the maxillary first permanent molar. Temple et al.⁵⁵ also suggested that the position of the tooth root was a significant determinant of buccal plate thickness. Those may imply that the palatal position of the maxillary first molar on the cleft side relates to the greater buccal plate thickness at that area. Moreover, we found the correlation of the buccal cortical bone and buccal plate thickness when testing with correlation coefficient.

Limitation of this study was a small sample size as a result of specific criteria for the samples. In addition, the anteroposterior position of maxillary first molar was not considered in this study but the different anteroposterior position of the maxillary first molar might effect the bone thickness of that area.