

CHAPTER 3

Materials and methods

3.1 Materials

3.1.1 Samples

The samples consisted of the CBCT images of 60 infrazygomatic crest sites obtained from two groups of pre-orthodontic treatment Thai patients with Class III skeletal pattern including

1. 20 operated unilateral cleft lip and palate patients provided 20 CBCT images of infrazygomatic crest site from non-cleft sides and 20 CBCT images of infrazygomatic crest site from cleft sides.
2. 10 non-cleft Class III patients provided 20 CBCT images of infrazygomatic crest site from left and right sides.

The selection criteria of cleft Class III patients

- Non-syndromic operated unilateral cleft lip and palate patients
- Age seven to 13 years
- Prepubertal stage of skeletal maturity according to the cervical vertebral maturation method (CS1-CS3)
- Skeletal Class III relationship ($ANB < 0$)
- Reverse incisor relationship and positive overbite
- Placement of miniscrew implants on the infrazygomatic crest area was planned for protraction of the maxilla with facemask appliance or CBCT image was required for alveolar bone graft
- No history of previous orthodontic treatment
- No missing of posterior teeth (exclude third molars)

- No radiographic signs of severe periodontitis or periapical lesion
- No large metal restoration

The selection criteria of non-cleft Class III patients

- Age seven to 13 years
- Prepubertal stage of skeletal maturity according to the cervical vertebral maturation method (CS1-CS3)
- Skeletal Class III relationship (ANB<0)
- Reverse incisor relationship and positive overbite
- Placement of miniscrew implants on the infrazygomatic crest area was planned for protraction of the maxilla with facemask appliance or CBCT image was required as a diagnostic tool.
- No history of previous orthodontic treatment
- No missing of posterior teeth (exclude third molars)
- No radiographic signs of severe periodontitis or periapical lesion
- No large metal restoration

3.1.2 Instruments

CBCT images were taken with a DentiScan (NSTDA, Bangkok, Thailand) CBCT unit (Figure 3.1) at 90 kVp, 6 mA, scanning time 18 seconds and voxel size 0.4 mm. Software DentiPlan professional V. 3.0 (NECTEC, Thailand) Viewer program (Figure 3.2) was used for CBCT image orientations and measurements.

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Figure 3.1 DentiScan (NSTDA, Bangkok, Thailand) CBCT unit



Figure 3.2 DentiPlan professional V. 3.0 (NECTEC, Thailand) Viewer program

3.2 Methods

3.2.1 CBCT image orientations and measurements

1) CBCT image orientations

The CBCT images were oriented in all three planes of space.

- *Coronal slice orientation*, the CBCT images were oriented until the maxillary molar occlusal plane (a plane between the mesiobuccal cusp and mesiolingual cusp of the maxillary first molar) was parallel to the yellow horizontal line. (as shown in Figure 3.3)

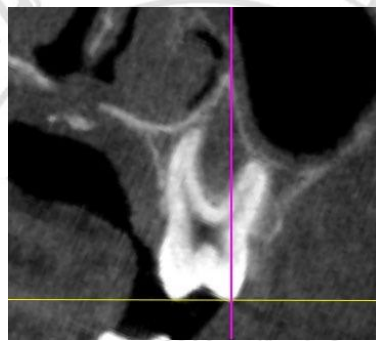


Figure 3.3 coronal slice orientation

- *Sagittal slice orientation*, the CBCT images were oriented until the functional occlusal plane was parallel to the yellow horizontal line and the long axis of the mesiobuccal root of the maxillary first molar was parallel to the blue vertical line. (as shown in Figure 3.4)

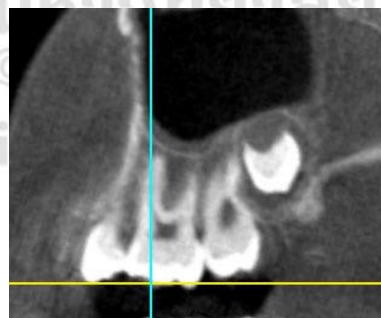


Figure 3.4 Sagittal slice orientation

- *Axial slice orientation*, the CBCT images were oriented to ensure that the blue horizontal line is superimposed to the mesiobuccal root of the maxillary first molar. (as shown in Figure 3.5)

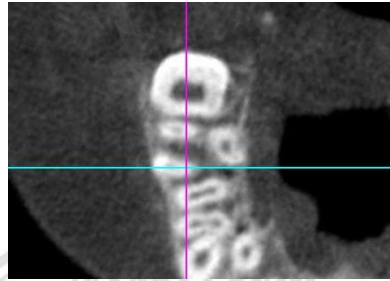


Figure 3.5 Axial slice orientation

2) CBCT measurements

In the sagittal view, the buccal cortical bone and buccal plate thickness were measured at 5 vertical cut levels with 1.2-mm interval from 4.8 – 9.6 mm from the buccal cemento-enamel junction (CEJ) of the maxillary first molar to the root apex (Figure 3.6). In coronal view, the buccal cortical bone and buccal plate thickness were measured at three mesiodistal sections; mesiodistal, middle of buccal furcation and distobuccal root axis of maxillary first molar (Figure 3.7), producing a grid pattern of measurements (Figure 3.8). Each measurement site was named according to the vertical cut levels and the mesiodistal sections. For example, the measurement site marked “x” in Figure 3.8 would be named B8.4.

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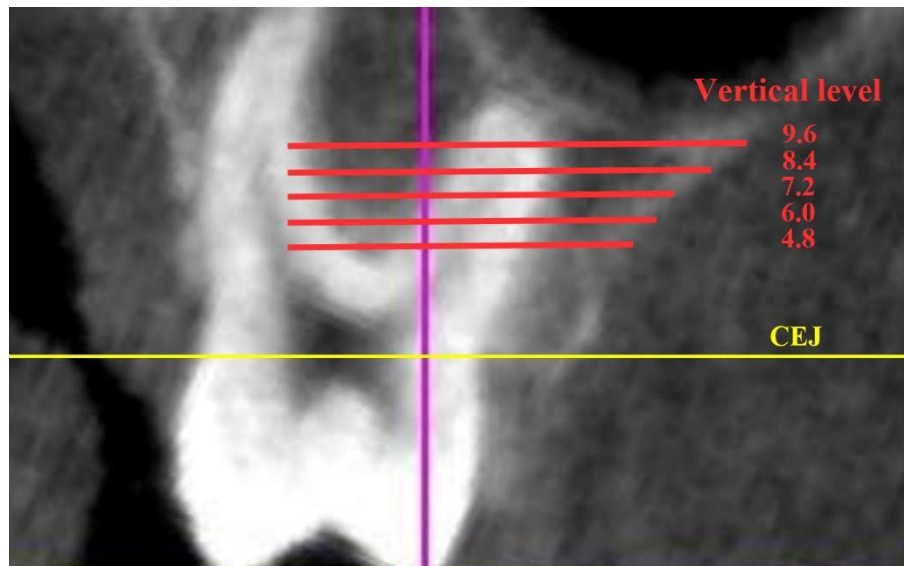


Figure 3.6 The buccal cortical bone and buccal plate thickness were measured at 5 vertical cut levels with 1.2-mm interval from 4.8 – 9.6 mm from the buccal cemento-enamel junction (CEJ) of the maxillary first molar to the root apex.

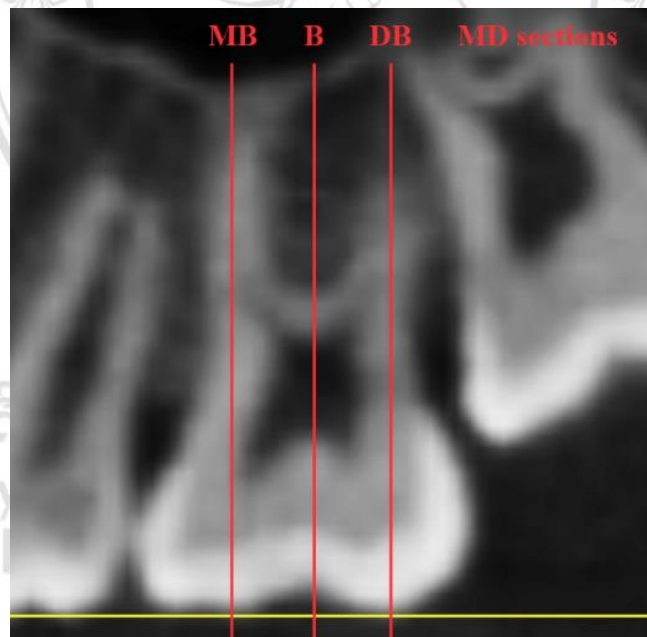


Figure 3.7 In coronal view, the buccal cortical bone and buccal plate thickness were measured at three mesiodistal sections; mesiodistal (MB), middle of buccal furcation (B) and distobuccal (DB) root axis of maxillary first molar.

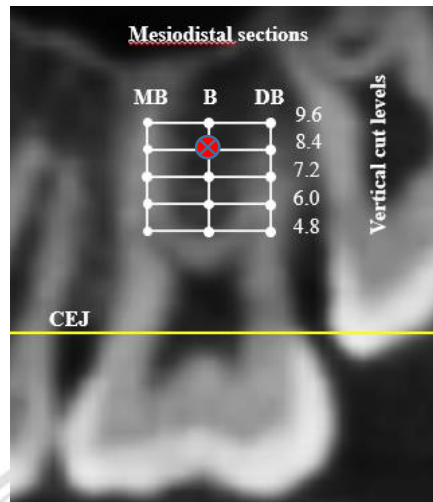


Figure 3.8 Measurement sites at three mesiodistal sections from MB section to DB section of maxillary first molar, and 1.2 mm interval of five vertical cut levels from 4.8 – 9.6 mm from buccal CEJ toward root apex of maxillary first molar. The measurement site marked “x” was named B8.4.

2.1) The buccal cortical bone thickness

On axial slice orientation, the buccal cortical bone thickness or the distance (mm) between the internal and external aspects of the buccal cortex were measured at three mesiodistal sections at each vertical level of cutting bone as shown in Figure 3.9.

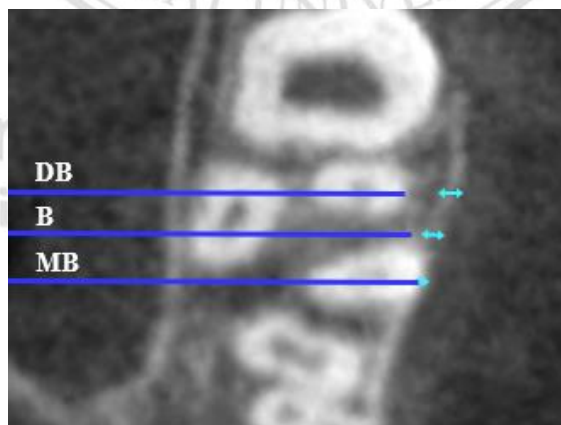


Figure 3.9 Axial slice orientation of CBCT image at 4.8 mm vertical cut level, the buccal cortical bone thickness was measured at three mesiodistal sections (blue arrows).

2.2) The buccal plate thickness

On axial slice orientation, the buccal plate thickness were measured at three mesiodistal sections at each vertical level of cutting bone as shown in Figure 3.10.

2.2.1) At MB section, the buccal outermost point of the MB root (point A) was determined. A line (blue horizontal line) parallel to the horizontal line and passed the point A was then drawn. The blue horizontal line intersected the buccal outermost border of the buccal plate at the point X. The A-X distance, or the buccal plate thickness at the MB root of 1st molar, was then measured (yellow arrows) as shown in Figure 3.10.

2.2.2) At middle of buccal furcation section, the tangential line from point A to point C was created. The middle of this tangential line was determined as point B. A line (blue horizontal line) parallel to the horizontal line and pass the point B was drawn. The blue horizontal line intersected the buccal outermost border of the buccal plate at the point Y. The B-Y distance, or the buccal plate thickness at the middle of buccal furcation of 1st molar, was then measured (yellow arrows) as shown in Figure 3.10.

2.2.3) At DB section, the buccal outermost point of the DB root (point C) was determined. A line (blue horizontal line) parallel to the horizontal line and passed the point C was then drawn. The blue horizontal line intersected the buccal outermost border of the buccal plate at the point Z. The C-Z distance, or the buccal plate thickness at the DB root of 1st molar, was then measured (yellow arrows) as shown in Figure 3.10.

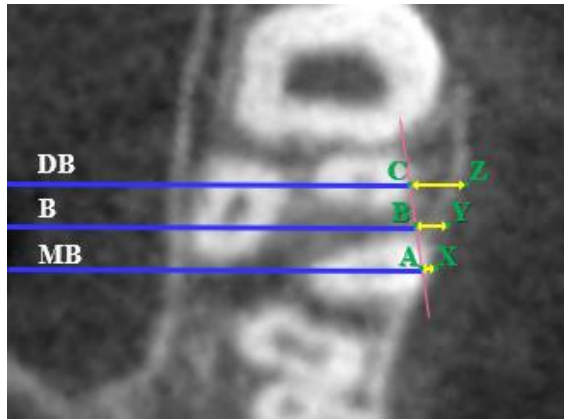


Figure 3.10 Axial slice orientation of CBCT image at 4.8 mm vertical cut level, the buccal plate thickness was measured at three mesiodistal sections (yellow arrows).

2.3) The bone thickness of the infrazygomatic (IZ) crest (Biting depth)

The bone thickness of IZ crest was the distance from the outermost point of buccal cortical bone to the innermost of floor of maxillary sinus or the MB or DB root surface of maxillary first molar. On coronal slice orientation, the bone thickness of IZ crest above the MB root, middle of buccal furcation and DB root of maxillary first molar for each combination of vertical insertion position and insertion angle for miniscrew placement was measured. The vertical insertion positions were from 4.8 to 9.6 mm from the buccal CEJ of the maxillary first molar to the root apex. The insertion angles included 45°, 50°, 55°, 60°, 65°, 70° angulation in relation to the maxillary molar occlusal plane (the plane between the mesiobuccal cusp and mesiolingual cusp of maxillary first molars), as shown in Figure 3.9.



Figure 3.11 Measurements of the bone thickness of the IZ crest at MB section: On coronal slice orientation, the bone thickness of the IZ crest at MB9.6 with 45 - 70° were measured

3.2.2 Statistical analysis

1) Statistical assessment of method errors

The errors of the method and the reliability of the measurements were tested. The CBCT images of 60 IZ crest sites were randomly selected and measured twice by the same examiner, separated by a 4-week interval. The intra-examiner variation was assessed using intraclass correlation.

2) Statistical assessment of results

- Descriptive analysis was used to obtain the means and standard deviations of all studied measurements.
- Paired t-test was used to compare the means of all studied measurements between non-cleft sides and cleft sides of cleft patients
- Independent t-test was used to compare the means of all studied measurements between non-cleft patients and non-cleft side of cleft patients.
- SPSS version 16.0 for windows was used for calculation in order to analyze both the results and the errors of the method.