CHAPTER 3

Materials and Methods

3.1 Materials

3.1.1 Samples

CBCT images of 24 pretreatment Thai orthodontic patients, comprising of 12 patients with Class I skeletal pattern and 12 patients with Class II skeletal pattern, were included in the study. All CBCT images were taken with a ProMax 3D (Planmeca OY, Helsinki, Finland) CBCT unit, at 8 cm field of view, 84 kVp, and 10 mA, in the Division of Oral and Maxillofacial Radiology, Department of Oral Biology and Diagnostic Sciences, Faculty of Dentistry, Chiang Mai University (Figure 3.1). Each patient was positioned at the device, keeping the occlusal plane parallel to the floor.

The selected patients met the following criteria: (1) age 13-29 years; (2) full eruption of permanent dentition (except for third molars); (3) no history of previous orthodontic treatment; (4) no missing teeth (exclude third molars); (5) no severe craniofacial disorders; (6) no severe periodontitis or periapical lesion; (7) no large metal restoration; (8) no severe crowding and spacing in posterior teeth; and (9) Class I skeletal pattern (ANB angle = $2^{o} \pm 2^{o}$) or Class II skeletal pattern (ANB angle > 4^{o}) and orthodontic treatment planning required miniscrew implant placement.

This study was approved by the Human Experimental committee, Faculty of Dentistry, Chiang Mai University. Before taking a CBCT image, the patients were informed of the study procedure. Then, inform consents were obtained from all patients.

Figure 3.1 ProMax 3D (Planmeca OY, Helsinki, Finland) CBCT unit

3.1.2 Instrument

Software Planmeca Romexis Viewer 2.3.1.R program was used for orthogonal tomographic image construction and measurements.

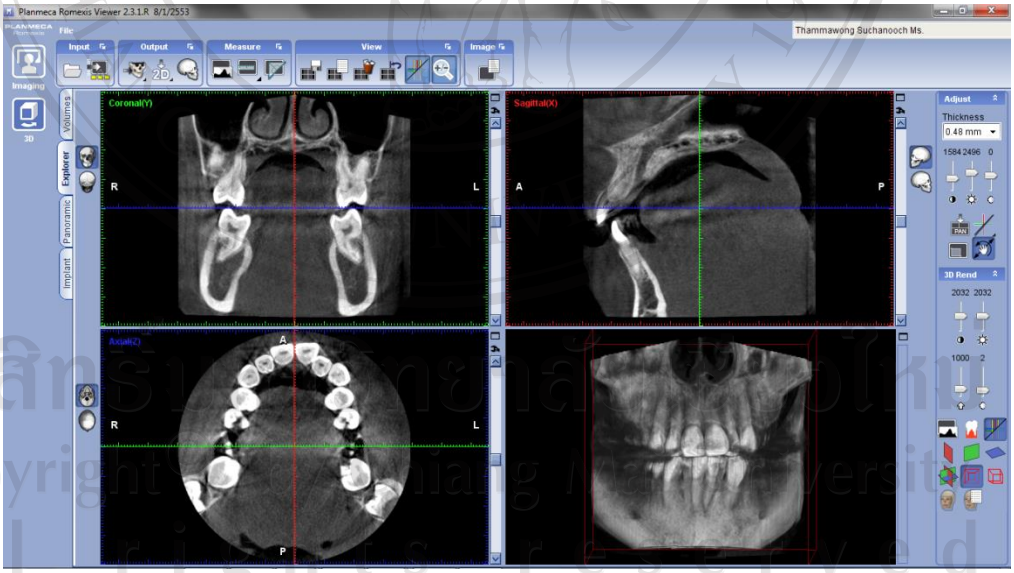

Figure 3.2 Software Planmeca Romexis Viewer 2.3.1.R program

3.2 Methods

3.2.1 Variables

1) Independent variables

Class I and Class II skeletal pattern

2) Dependent variables

The mesiodistal distance, buccolingual alveolar process width, and buccal cortical bone thickness of each interradicular area and different measurement heights from the cementoenamel junction (CEJ)

Twelve interradicular areas were surveyed in each subject, from the distal aspect of the first premolar to the mesial aspect of the second molar of the maxilla and mandible (on both right and left sides), and each area was measured at 5 different vertical heights (2, 4, 6, 8, and 10 mm) from the CEJ (Figure 3.3).

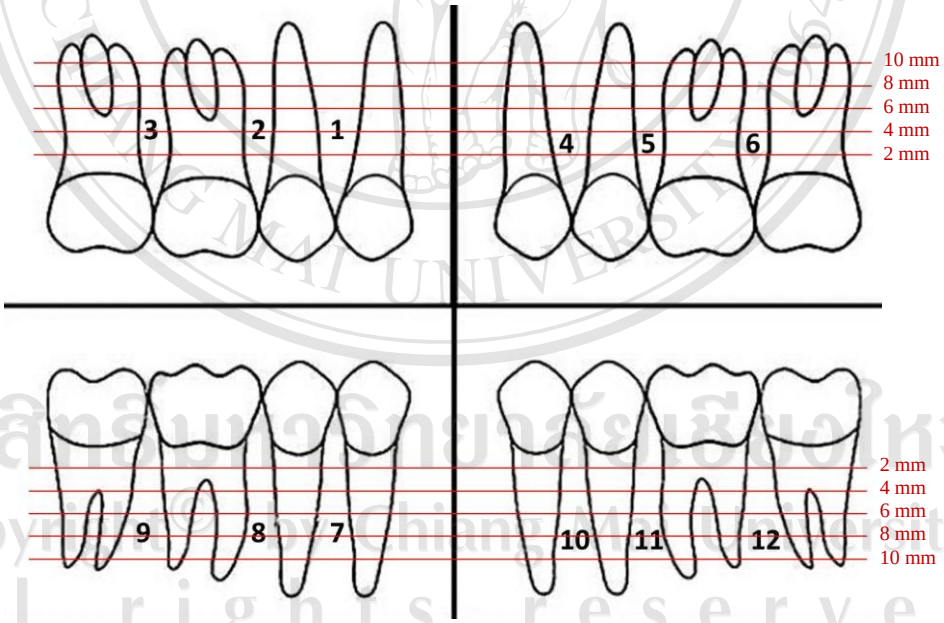

Figure 3.3 Diagram of interradicular areas and different heights of measurement

3.2.2 CBCT image orientations and measurements

1) CBCT image orientations

All CBCT images were oriented using a standardized protocol as follows (Figure 3.4).

In the axial view (Figure 3.4, C), the CBCT image was oriented until the green line supplied by the software was perpendicular to the buccal bone surface and bisects the interradicular area to be measured. In the sagittal view (Figure 3.4, B), the CBCT image was oriented until the occlusal plane is parallel to the blue line. The cursor was adjusted until the red line in the axial image was centered on each contact area, at approximately the midroot level.

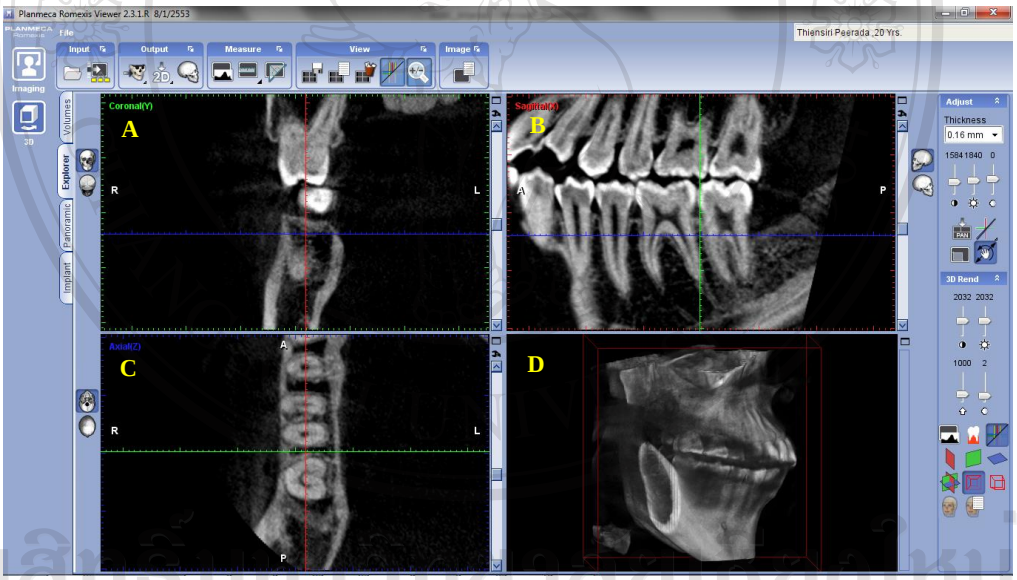

Figure 3.4 The views of the CBCT image orientation of the interradicular area between the right mandibular first and second molar, at the 4-mm height from the CEJ: A, coronal; B, sagittal; and C, axial views

2) CBCT image measurements

The axial view was used to measure the mesiodistal, buccolingual alveolar process width, and buccal cortical bone thickness of the interradicular area of interest. In the coronal view

orientation (Figure 3.4, A), the five cutting lines were created at 2, 4, 6, 8, and 10 mm vertical heights from the CEJ. Then, in the axial view at each height of cutting bone (in the coronal view), the following measurements were performed.

2.1) The mesiodistal distance (MD): This distance was defined as the shortest distance between parallel lines tangent to the adjacent proximal root surfaces (Figure 3.5, A).

2.2) The buccolingual alveolar process width (BL): This width was measured at the center of the interradicular distance between tangent lines to the adjacent proximal root surfaces, from the outermost point on the buccal side to the outermost point on the palatal/lingual side (Figure 3.5, B).

2.3) The buccal cortical bone thickness (BC): This thickness was the distance between the internal and external aspects of the buccal cortex at the center of the interradicular distance between the tangent lines to the adjacent proximal root surfaces (Figure 3.5, C).

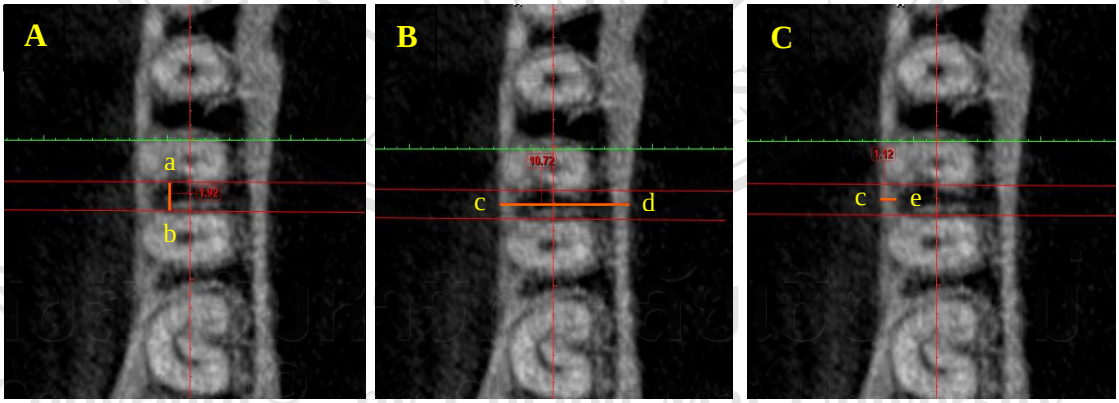

Figure 3.5 A, Measurement of the mesiodistal distance of the interradicular area (a-b); B, the buccolingual alveolar process width (c-d); C, the buccal cortical bone thickness (c-e)

3.2.3 Statistical analysis

The data were analyzed using the Statistical Package for Social Sciences version 17.0 for Windows (SPSS Inc., Chicago, Illinois, USA).

1) Statistical assessment of measurement errors

The error of the measurements was tested. The CBCT images of 10 patients were randomly selected and re-measured by the same examiner after a 4-week interval. The intra-examiner reliability was assessed using the paired Student's t-test ($P<0.05$).

2) Statistical assessment of results

2.1) Descriptive statistics was used to describe the means and standard deviation values of the studied measurements (the mesiodistal distance, buccolingual alveolar process width, and buccal cortical bone thickness of each interradicular area and different vertical height from the CEJ)

2.2) Independent t-test was used to compare the mean of all the studied measurements between right and left side ($P<0.05$), between maxilla and mandible ($P<0.05$ and $P<0.01$), and between Class I and Class II skeletal patterns ($P<0.05$ and $P<0.01$).

2.3) One-way analysis of variance (one-way ANOVA) was used to compare the mean of all the studied measurements among the different interradicular areas (at the same vertical height) and different vertical heights (at the same interradicular area) ($P<0.05$).

2.4) *Post hoc* multiple comparisons was performed with Duncan's multiple range test when one-way ANOVA yielded significant results indicating that there was a difference in the mean of the studied measurements among the different interradicular areas or different vertical heights ($P<0.05$).