CHAPTER THREE: MATERIALS AND METHODS

3.1. Introduction

This study focused an investigation on the incisive canal and foramen from several aspects. These included; (1) incisive foramen diameter; (2) nasal foramen diameter; (3) incisive canal length and width; (4) the number of channels at the middle portion of incisive canal; (5) determination of incisive canal course and direction. Also, the anterior maxillary bone infront of the canal was investigated using Cone Beam Computed Tomography and SimPlant interactive software.

3.2. Materials and Methods:

Ninety-four images of patients stored at the Oral Radiology Division, Faculty of Dentistry at the University of Malaya was obtained. These images fulfilled the inclusion and exclusion criteria that were listed.

3.3 The subjects of the study

3. 3. 1. Sample of the study

The sample was selected according to gender and ethnicity (Malays and Chinese). The selections were further limited to ages from minimum of 15 years to the maximum of 75 years.

Table 3.1 Selection of cases based on ethnicity and gender.

Ethnicity (race)	Gender	No. of images
Malay	Male	25
	Female	22
Chinese	Male	23
	Female	24
	Total	***94***

Table 3.2 Age group distribution of the patients.

Age group	No.
15 – 25 years	20
26 – 35 years	17
36 – 45 years	19
46 – 55 years	19
56 – 75 years	19
Total	**94**

3.3. 2. The variables of the study

The predictor variables used for the purpose of this study shall be gender (male and female), ethnicity (Malays and Chinese) and age.

3.3. 3. Selection criteria of the samples

The samples were carefully selected based on the inclusion and exclusion criteria as follows:

Inclusion criteria for this study were as follows:

- An age range of 15-75 years was considered.
- Subjects should have intact anterior maxillary region.
- All subjects should not have undergone any surgical procedures.

Exclusion criteria for this study were as follows:

- Subjects with any pathological lesion in the anterior maxillary region.
- Subjects who have undergone a surgical procedure.
- Subjects with congenital deformations (cleft lip and palate).
- The reformatted CBCT images which appear distorted or blurred with artifacts due to the presence of metal within the jaw or teeth and those resulting from patients' motion or due to improperly angled CBCT scan.

Images recorded with CBCT machine namely (i-Cat machine) were employed. They were recorded with 0.3 voxel size.

3.4. Methodology

To reduce the measurement error and increase the reliability of the measurement, all the measurements were done from two sides (right and left) and each of incisive canal width and anterior maxillary bone thickness were measured at three different areas and the mean was taken as the final measurement.

Two types of studies were done:

3.4. 1. Measurement was carried out in the incisive canal from i-Cat images:

Two dimension sagittal cross-section slices were selected on which the maximal canal length (main canal and lateral branches) were visualized. From these slices, both incisive foramen and nasal foramina were measured at the entrance of the bony canal. Then at the midpoint between these two levels, another measurement was done to determine the width of incisive canal (Liang *et al*., 2009) (Fig 3.1). All the measurements were taken from two views (right branch and left branch), then the mean value was calculated.

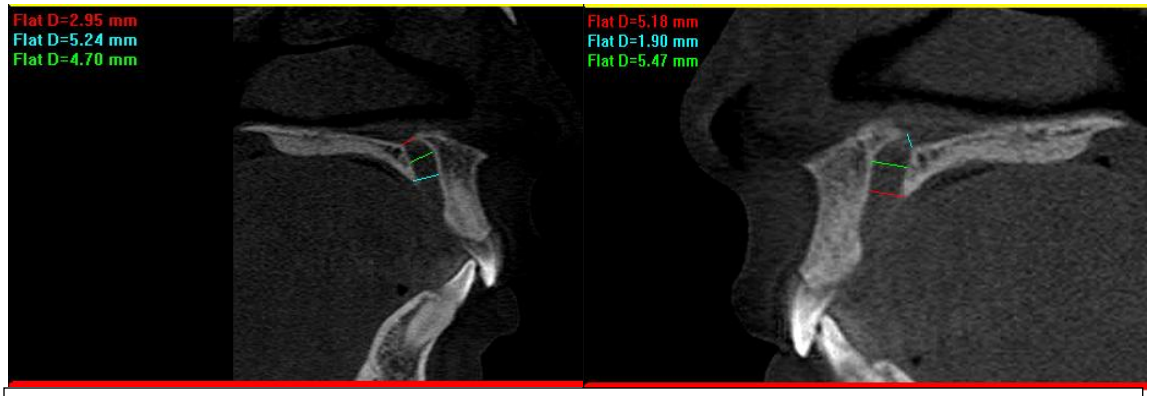

Figure 3.1: Measurements of incisive foramen, nasal foramen and incisive canal width.

Incisive canal length will be measured as a distance between nasal foramen and incisive foramen, one from right view and another from left view (Fig 3.2).

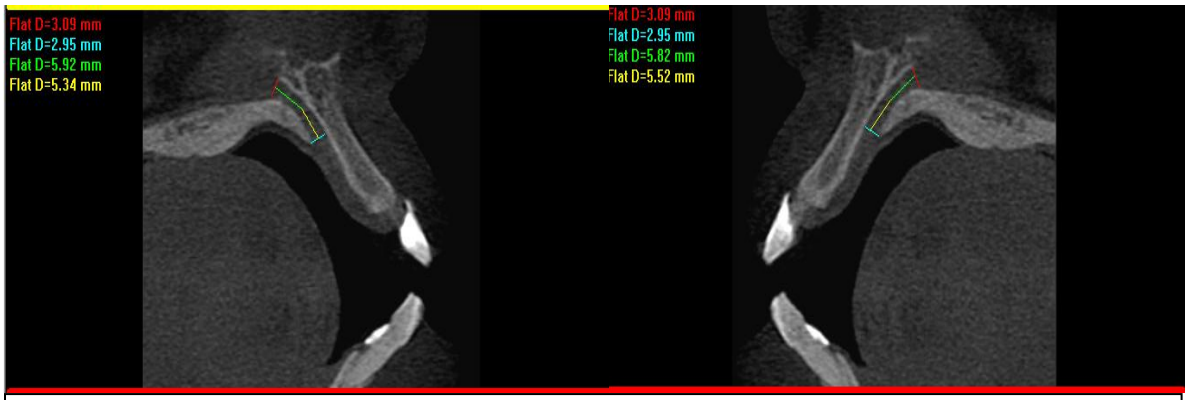

Figure 3.2: A.incisive canal length- left view**, B.** incisive canal length -right view.

On the same slices the location of incisive foramen was determined as a distance between the incisive foramen and the most anterio-inferior point of the cortical plate of the buccal bone of the maxilla (Liang *et al*., 2009). Distance was measured from the two views (right and left) and then the mean distance was calculated (Fig 3.3).

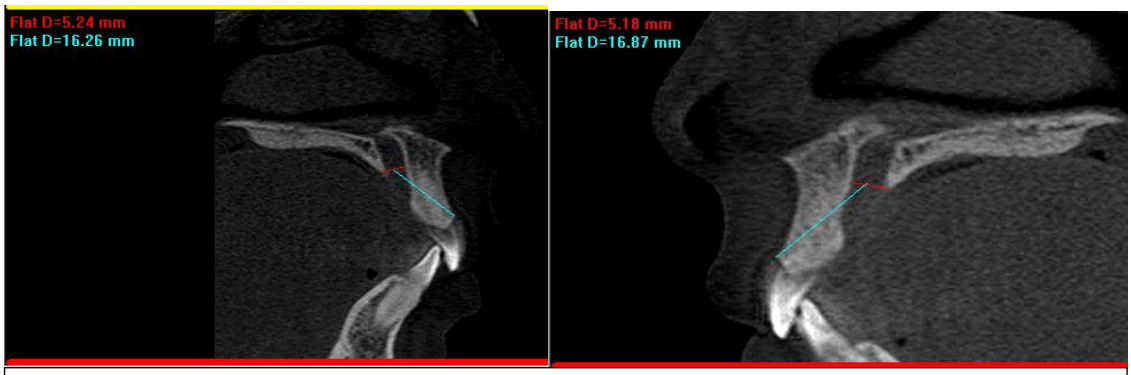

Figure 3.3: Incisive foramen location. left view, Right view.

In order to have an idea on the presence of bone anterior to the incisive canal for potential implant placement, the buccopalatal bone width anterior to the canal was assessed on the lower, middle and upper third of the canal. Measurements of horizontal distances were performed from the outer canal wall to the outer cortical plate of the maxillary buccal bone (Mraiwa *et al*., 2004). The assessment was performed from two sides (right and left), then the mean value was determined (Fig 3.4).

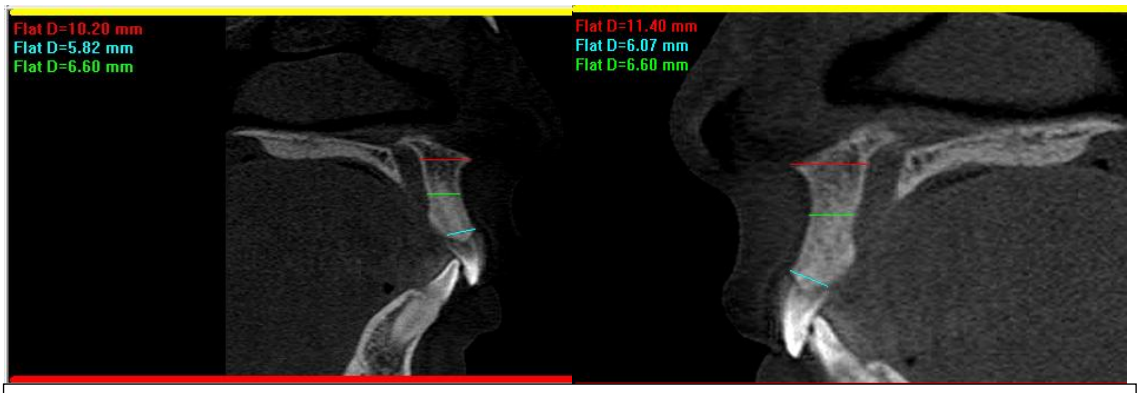

Figure 3.4: Thickness of anterior maxillary bone.left view, right view.

3.4. 2. Classification of the types of incisive canal (non-metric):

Incisive canal was classified in two ways. The first one according to the number of channels in the middle portion of the canal. In this case horizontal cross-section slices was studied in the middle portion of the axial view to determine the number of channels (Fig 3.5)

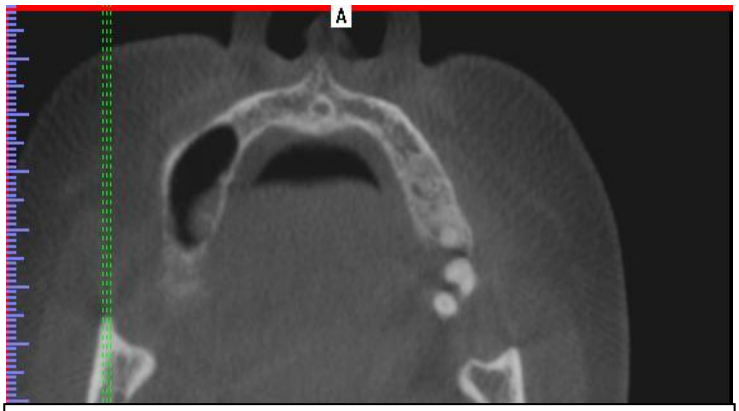

Figure 3.5: The number of channel at the middle portion of incisive canal.

In the second the incisive canal was classified according to their laterally viewed direction and course with the nasal floor being regarded as the horizontal plane. Based on the vertical line perpendicular to the horizontal plane, incisive canals which changed during its course by >10°from vertical were regarded to be “slanted,” and those which were changed by <10° from vertical were regarded as “vertical.” Whether the course of

the incisive canal was straight or curved was also noted (Song *et al*., 2009) (Fig 3.6). To enable this procedure, the SimPlant software was used.

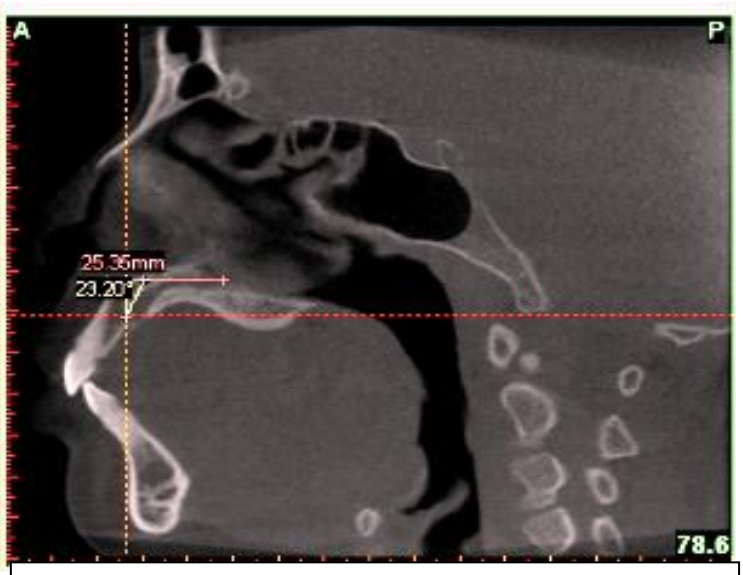

Figure 3.6: Incisive canal course and direction

3.5. Reliability of the measurements

Intra-examiner reliability was assessed by re-evaluating randomly 10% of all samples thrice with a one week interval and without the knowledge of the previous measurements. All the data obtained were by using the same methods described earlier. Data collected was analyzed statistically. The reliability test (Tables 3.3, 3.4) shows that there was correlation between the first, second and third measurements.

The variations between the measurements were negligible. Therefore, reproducibility of the evaluation method was acceptable.

Table 3.3: Reliability test (Intraclass Correlation)

	Intraclass Correlation	95% Confidence Interval		F test with True value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.975	.964	.984	119.85	70	140	0.001
Average Measures	.992	.988	.995	119.85	70	140	0.001

Table 3.4: Reliability test (Kappa test)

	Value	Asymp. Std Error	Approx. T	Approx Sig
Measure Agreement Kappa	1.000	.000	4.472	.001
N of Valid Cases	20			

3.6. Data Analysis

Data were analyzed by SPSS version 12.

- **Gender**
  - Independent t-test and nonparametric Mann-Whitney test were used to compare the mean values between genders from each ethnic group.
  - Paired t-test was used to compare the mean length value between the right and left side of the incisive canal and this test was employed to compare between the right and the left nasal foramina within the same gender.

- Chi-square test was used to compare the categorical data (number of the channels and direction of the canal).

- **Race**
  - Independent t-test and nonparametric Mann-Whitney test were used to compare the mean values between the gender in each race group and between the same genders in the different races.
  - Chi-square test was used to compare the categorical data (number of the channels and direction of the canal) in each race.

- **Age**
  - One-way ANOVA and nonparametric Kruskal-Wallis test were used to compare means values between the age groups.
  - Chi-square test was used to compare the categorical data (course and direction of the canal).

As indicated earlier we obtained 94 good images from the server stored at the Division of Oral and Maxillofacial Radiology. These numbers of cases were enough statistically for the numerical variables. However, due to the small differences in the values of the categorical variables, this number of cases may not be sufficient to provide a good inference of this research.

3. 7. Summary of research methodology

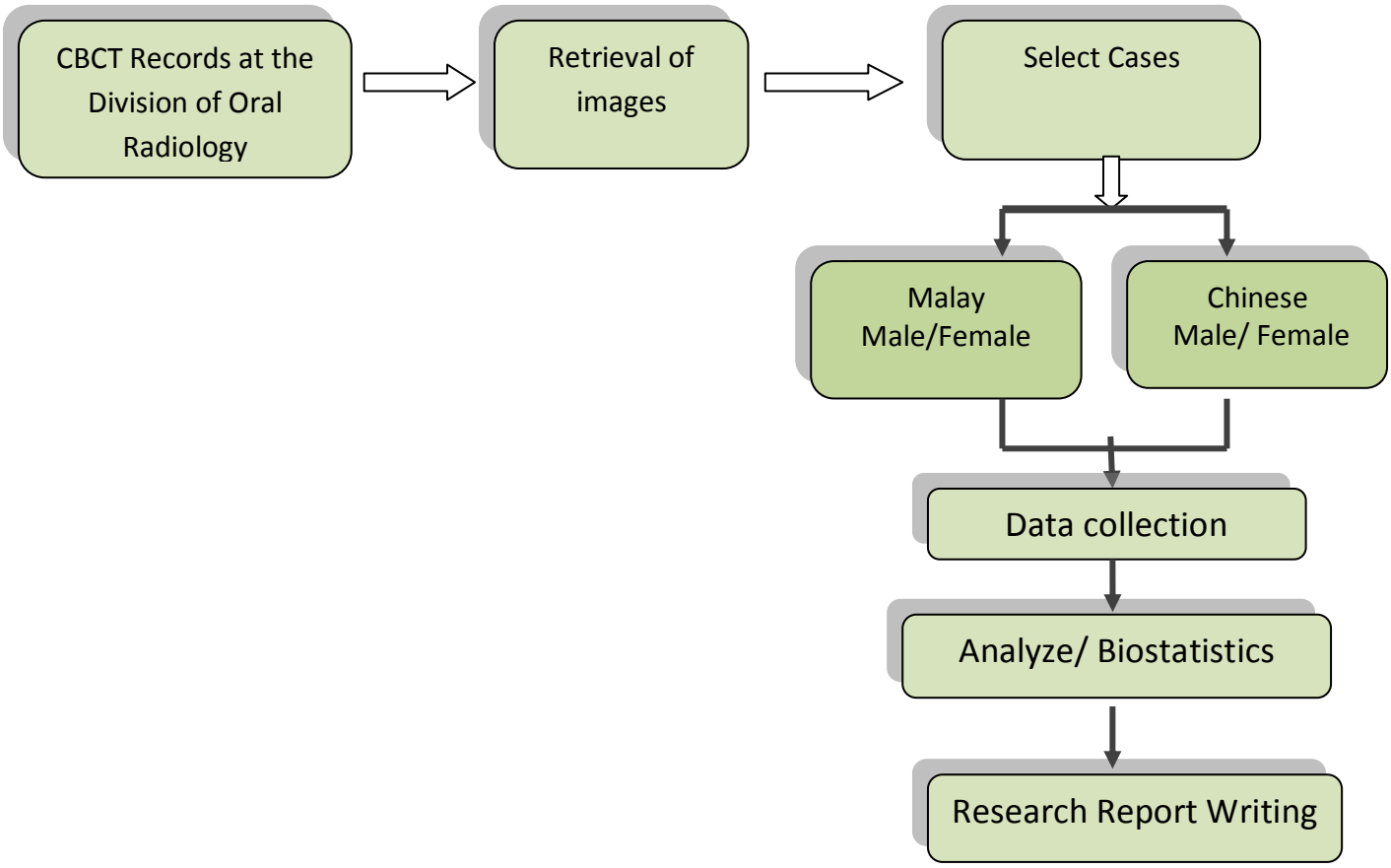

Figure 3.7: Summary of the research methodology