



were taken in the Department of Radiology, University Dental Hospital, Mongolian National University Medical Sciences (MNUMS), between 2014 and 2021. We collected all images according to the inclusion and exclusion criteria. The inclusion criteria of this study were no periodontal disease, no alveolar bone loss, no missing teeth, no root anomalies, no severe dilacerations and no idiopathic root resorption. Exclusion criteria were tooth with metal restoration, fractures and pathological conditions in maxilla and mandible.

### Measurements

We used Free FOV (4cm\*5cm) and Full CBCT (16cm\*8cm) scans using the target sampling method. The all CBCT images (85kV, 7mA) were obtained with HDX, WILL (DENTRI, Seoul, Korea) using OnDemand3D software for linear measurements. All images were observed and evaluated by an expert radiologist. We selected 10 cases randomly and then all measurements were made twice to calculate intra-rater reliability by 3 weeks interval.

Using the CBCT scan and looking at the axial plane, it was possible to measure the linear measurements in the following maxillary and mandibular permanent teeth: central incisor, canine and 1<sup>st</sup> molar. The crown length measurements were made between the top cusp point of tooth crown and cemento-enamel junction and the root length between cemento-enamel junction and tip of root apex. The entire length of the tooth was measured between the longest points from buccal cusp to the tip of root apex (Figure 1). In cases of multiple roots, the buccal root was used [11]. The all linear measurements made by the digital ruler of the OnDemand3D software and were recorded to the nearest tenth of a millimeter and done by only one experienced examiner. The root to crown (R/C) ratio of an individual tooth was calculated by dividing the root length by the crown height (Figure 1).

### Statistical analysis

Data analyzed using IBM SPSS version 26 software. Normal distribution of the measured data was confirmed by using the Kolmogorov-Smirnov method. The mean and standard deviation of linear measurements in the axial plane were reported based on the patient's tooth types. Chi-square (exact test when actual or expected cell filling was low) test was used to analyze differences between gender and age groups. Statistical significance was set at  $p < 0.05$ .

### Ethical approval

The study was approved by the Research Ethics Committee of Mongolian National University of Medical Sciences on January 07, 2020 (No. 2020/3-01/20).

### Results

#### Descriptive and reproducibility

In total 108 CBCT images of Mongolian adults collected according to the inclusion criteria. Mean age was  $26.7 \pm 7.1$  years of the all subjects and 70% of them were female. There was no statistically significant difference between the gender and age.

#### The central incisor measurement

The entire length of the permanent central incisor in the maxilla on the CBCT image  $21.08 \pm 1.92$  mm, crown length  $9.76 \pm 0.95$  mm, root length  $11.32 \pm 1.76$  mm and R/C ratio was 1.16. In the mandible  $18.82 \pm 1.33$  mm,  $7.82 \pm 0.82$  mm,  $10.98 \pm 1.09$  mm and 1.4 respectively ( $p < 0.01$ ) (Table 1).

Table 1 show that the longest maxillary central incisor was 26.3mm and the shortest was 16.7 mm in Mongolian adults. In the mandible 21.7 mm and 15.4 mm, respectively ( $p < 0.01$ ). Otherwise the central incisor of maxilla 2-3 mm longer than mandible.

#### The canine measurement

The entire length of the permanent canine in the maxilla on the CBCT image  $24.19 \pm 2.09$  mm, crown length  $8.81 \pm 0.87$  mm, root length  $15.38 \pm 1.91$  mm and R/C ratio was 1.75. In the mandible  $23.18 \pm 2.03$  mm,  $8.63 \pm 0.91$  mm,  $14.54 \pm 1.72$  mm and 1.68, respectively ( $p < 0.01$ ) (Table 2).

From Table 2, we can see that the longest maxillary canine was 31.7 mm and the shortest was 18.6 mm in Mongolian adults. In the mandible 27.9 mm and 17.6 mm respectively ( $p < 0.01$ ). And the canine root is longer than crown by nearly twice.  $mm$ , crown len  $4.480$  Tw  $0 - 1.311$  Tw


### The first molar teeth measurement

The entire length of the permanent first molar in the maxilla on the CBCT image  $17.43 \pm 1.62$  mm, crown length  $5.82 \pm 0.52$  mm, root length  $11.60 \pm 1.38$  mm and R/C ratio was 1.99. In the mandible  $19.30 \pm 1.41$  mm,  $6.30 \pm 0.52$  mm,  $12.99 \pm 1.24$  mm and 2.06 respectively ( $p < 0.01$ ) (Table 3).

We summarize the tooth length measurements results of the first molar teeth of Mongolian adults on the CBCT imaging in the Table 3. From here we can see that the maxillary first molar teeth shorter than mandibular ( $p < 0.01$ ). The root of first molar teeth is longer than crown by twice, exactly.

### Evaluation of the correlation of root length of the permanent teeth and gender, age

When we assessed the correlation between the root length of maxillary permanent teeth and gender there were weak, negative correlations significantly: the central incisor  $r = -0.33$ ,  $p = 0.01$ , the canine  $r = -0.29$ ,  $p = 0.03$ , the first molar  $r = -0.24$ ,  $p = 0.02$ . In the mandibular permanent teeth medium, negative correlation significantly was observed: the central incisor  $r = -0.33$ ,  $p = 0.19$ , the canine  $r = -0.48$ ,  $p = 0.01$ , the first molar  $r = -0.37$ ,  $p = 0.03$  (Table 4).

### Evaluation of the correlation of root length of the permanent teeth and age

When we assessed the correlation between the root length of maxillary permanent teeth and age, there were a very weak correlation no significantly: the central incisor  $r = 0.06$ ,  $p = 0.5$ , the canine  $r = 0.01$ ,  $p = 0.88$ , the first molar  $r = 0.09$ ,  $p = 0.38$ ; and of mandibular teeth  $r = 0.09$ ,  $p = 0.37$ ,  $r = -0.08$ ,  $p = 0.40$ , and  $r = 0.85$ ,  $p = 0.48$ , respectively (Table 5).

### Discussion

CBCT is an alternative technology for evaluating root length before, during, and after dental treatment. Sherrard et al. reported that the CBCT based measurements of the entire tooth and root lengths did not differ significantly from the actual lengths [12]. The CBCT based root length measurements of the maxillary and mandibular central incisor and canine Korean adults according to Seon-Young Kim et al. [13] were longer than Mongolian adults. Alam MS et al. revealed that average length of upper 1st molar is 20.62 mm and for lower 1st molar is 20.28 mm in Bangladeshi adults. The study also revealed that the tooth length has no significance on the gender of the people of same race [14].

The average length of the permanent first molar in the maxilla on the CBCT image is  $17.43 \pm 1.62$  mm in the mandible  $19.30 \pm 1.41$  mm among

	Maxillary canine				Mandibular canine			
	Crown length (mm)	Root length (mm)	Entire length (mm)	R/C ration	Crown length (mm)	Root length (mm)	Entire length (mm)	R/C ration
<b>N</b>	102	102	102	102	98	98	98	98
<b>Mean</b>	8.81	15.38	24.19	1.75	8.63	14.54	23.18	1.68

Mongolian adults. Otherwise, the first molar teeth of Bangladeshi is a longer than Mongolians.

There was no significant correlation between the root lengths of incisor, canine, first molar of Mongolian adults and age of this study. However, Chantha GJ et al. (2009) noticed in the conclusion of their study result, that there was a significant correlation of age with the root length of incisor tooth in the Sri Lankan Sinhalese [15]. Yingying W et al. suggested from the results of meta-analysis that symmetry of left and right sides and measuring method do not influence tooth dimension [16]. In 2017, Indian researchers reveal that there is a