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The Assessment of Tooth Length on CBCT of Mongolian Population

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Abstract

Introduction: Radiographic tooth length is useful in evaluating the dental treatment effects. CBCT images are considered accurate and reliable in terms of linear measurements of tooth morphology.

Methods: This study design was a retrospective study. Total 108 CBCT images 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. Data analyzed using IBM SPSS version 26 software. 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 and conclusion: the entire length of the permanent central incisor in the maxilla on the CBCT image 21.08±1.92 mm, crown length 9.76±0.95 mm, root length 11.32±1.76 mm and R/C ratio was 1.16. In the mandible 18.82±1.33 mm, 7.82±0.82 mm, 10.98±1.09 mm and 1.4, respectively ($p<0.01$) For the permanent canine in the maxilla the entire length 24.19±2.09 mm, crown length 8.81±0.87 mm, root length 15.38±1.91 mm and R/C ratio was 1.75. In the mandible 23.18±2.03 mm, 8.63±0.91 mm, 14.54±1.72 mm and 1.68, respectively ($p<0.01$) The entire length of the permanent first molar in the maxilla 17.43±1.62 mm, crown length 5.82±0.52 mm, root length 11.60±1.38 mm and R/C ratio was 1.99. In the mandible 19.30±1.41 mm, 6.30±0.52 mm, 12.99±1.24 mm and 2.06, respectively ($p<0.01$) There were a weak, negative correlation significantly between the root length of maxillary permanent teeth and gender, age.

Keywords: Tooth length; Central incisor; Canine; First molar; CBCT

Introduction

The prevalence of dental caries and its complications are very widespread in Mongolia. Therefore, the negative influence of dental caries is a main public health problem in nowadays [1]. A radiographic examination is a very essential part of the diagnostic process in dentistry, and it is also known that tooth length plays an important role in many branches of dentistry; such as orthodontics, endodontics, prosthodontics, oral surgery, implant surgery and etc. The radiographic tooth length is useful in evaluating the dental treatment effects [2]. The tooth length determination was based mainly on radiographic interpretation until the late 1970s [3]. Several methods of determining tooth length exists [2], but mostly by the intraoral periapical radiography and orthopantomography (OPG). The major advantages of the OPG include less radiation exposure, decreased patient chair time, minimal operator time, better patient co-operation, and added benefit of visualizing of entire lower half of the face [4]. Although OPG is often used in diagnosis, a full mouth examination consisting of 14 or more periapical radiographs is performed occasionally as periapical radiographs are considered to be of higher image quality [5]. As a single panoramic film can provide same data with less radiation exposure OPG replaced periapical radiographs [6].

OPG images known to have some shortcomings like magnification, unsharpness, distortion, etc., and the Cone beam computed tomography (CBCT) images are to be free from these disadvantages [6]. CBCT is a radiographic imaging method that allows accurate, three-dimensional (3D) imaging of hard tissue structures of maxillofacial region. This imaging modality is capable of providing sub-millimeter resolution (2 line pair/mm) images of higher diagnostic quality, with shorter scanning times (~60 s). Radiation exposure dose from CBCT is 10 times less than from conventional CT scans during maxillofacial exposure (68 μSv compared with 600 μSv of conventional CT) and also it has got great dimensional accuracy (only about 2% magnification) [7]. CBCT has gained increased acceptance as a 3D imaging modality offering an alternative to CT especially in the maxillofacial area [8]. While CBCT images are considered accurate and reliable in terms of linear measurements [9], CBCT images may occasionally present false positives and false negatives.

CBCT is a radiographic technique introduced to the United States dental market in 2001 [10] and in the dental clinics of our country in 2014. Therefore, Mongolian dental researchers interested to the CBCT assessment study of maxillofacial part, organ, region and some tissue. This study aim to determine the entire, crown and root length of permanent incisor, canine and first molar by using CBCT imaging of Mongolian population.

Materials and Methods

The study design was a retrospective study. Total 108 CBCT images

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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 (85kW, 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 1st molar. The crown length measurements were made between the top cusp point of tooth crown and cementoenamel junction and the root length between cementoenamel 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 liner 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).

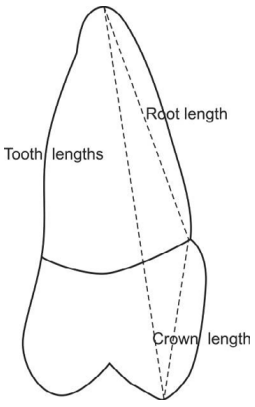

Figure 1: The measure points of the crown, root and entire length of tooth.

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 $p \leq 0.05$.

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±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±1.92 mm, crown length 9.76±0.95 mm, root length 11.32±1.76 mm and R/C ratio was 1.16. In the mandible 18.82±1.33 mm, 7.82±0.82 mm, 10.98±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±2.09 mm, crown length 8.81±0.87 mm, root length 15.38±1.91 mm and R/C ratio was 1.75. In the mandible 23.18±2.03 mm, 8.63±0.91 mm, 14.54±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.

Table 1: The tooth length measurements of permanent central incisors of Mongolian adults by using CBCT.

	Maxillary central incisor				Mandibular central incisor			
	Crown length (mm)	Root length (mm)	Entire length (mm)	R/C ration	Crown length (mm)	Root length (mm)	Entire length (mm)	R/C ration
N	101	101	101	101	97	97	97	97
Mean	9.76	11.32	21.08	1.16	7.82	10.98	18.82	1.4
Standart deviation	0.95	1.76	1.92		0.82	1.09	1.33	
Variance	0.9	3.12	3.71		0.67	1.189	1.79	
Min	7.7	6.5	16.7		5.7	8.6	15.4	
Max	11.9	15.3	26.3		9.6	14	21.7	
p value	<0.01							

The first molar teeth measurement

The entire length of the permanent first molar in the maxilla on the CBCT image 17.43±1.62 mm, crown length 5.82±0.52 mm, root length 11.60±1.38 mm and R/C ratio was 1.99. In the mandible 19.30±1.41 mm, 6.30±0.52 mm, 12.99±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±1.62 mm in the mandible 19.30±1.41 mm among

Table 2: The tooth length measurements of permanent canine of Mongolian adults by using CBCT.

	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
N	102	102	102	102	98	98	98	98
Mean	8.81	15.38	24.19	1.75	8.63	14.54	23.18	1.68
Standart deviation	0.87	1.91	2.09		0.91	1.72	2.038	
Variance	0.76	3.66	4.37		0.84	2.97	4.15	
Min	7	10.4	18.6		6	9.4	17.6	
Max	10.8	22	31.7		11.4	19	27.9	
p value	<0.01							

Table 3: The tooth length measurements of permanent first molar of Mongolian adults by using CBCT.

	Maxillary first molar				Mandibular first molar			
	Crown length (mm)	Root length (mm)	Entire length (mm)	R/C ration	Crown length (mm)	Root length (mm)	Entire length (mm)	R/C ration
N	89	89	89	89	73	73	73	73
Mean	5.82	11.6	17.43	1.99	6.3	12.99	19.3	2.06
Standart deviation	0.52	1.38	1.62		0.52	1.24	1.41	
Variance	0.27	1.9	2.63		0.27	1.54	2.012	
Min	4.3	8.8	13.3		5.3	9	14.6	
Max	7	15.5	21.6		7.7	16.6	22.6	
p value	<0.01							

Table 4: The correlation between the root length of permanent tooth and gender in Mongolian adults.

	Maxillary teeth			Mandibular teeth		
	Central incisor	Canine	First molar	Central incisor	Canine	First molar
Correlation coefficient	-0.33	-0.29	-0.24	-0.33	-0.48	-0.37
p value	0.01	0.03	0.02	0.19	0.01	0.03
N	101	102	89	97	98	73

Table 5: The correlation between the root length of permanent tooth and age in Mongolian adults.

	Maxillary teeth			Mandibular teeth		
	Central incisor	Canine	Central incisor	Canine	Central incisor	Canine
Correlation coefficient	0.06	0.01	0.09	0.09	-0.08	0.85
p value	0.50	0.88	0.38	0.37	0.40	0.48
N	101	102	89	97	98	73

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]. 2017, In Indian researchers reveal that there is a positive correlation between stature and posterior tooth length in both males and females [17]. Therefore we have to study in the further the relation between heights of the individual to the length of the tooth.

Since 2014, CBCT is landed in Mongolia, so that is not widespread nowadays. If we can measure the real length of tooth of Mongolian people, it would be lead to new advanced stage of the dental treatment.

Conclusion

The length of maxillary central incisor, canine and first molar were 21.08±1.92 mm, 24.19±2.09 mm, 17.43±1.62 mm and in mandible 18.82±1.33 mm, 23.18±2.03 mm, 19.30±1.41 mm, respectively.

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