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Effect of Age on the Dimensions of Pulp to Tooth Crown Ratio of Permanent Maxillary Canine by Using Cone Beam Computed Tomography in Subjects Visiting Khyber College of Dentistry Peshawar

Dr. Farhan Dil[1], Dr. Shafqat Ali Shah[2*], Dr. Fawad Ali Shah[3], Dr. Umar Nasir[4], Dr. Umer Farooq[5]

[1]Assistant Professor, Department of Oral Biology, Khyber College of Dentistry, Peshawar
[2*]Professor, Department of Operative Dentistry, Khyber College of Dentistry Peshawar
[3]Assistant Professor, Department of Operative Dentistry, Khyber College of Dentistry Peshawar
[4]Professor, Department of Oral Biology, KMU-IDS Kohat
[5]Assistant Professor, Department of Oral Pathology, Khyber College of Dentistry Peshawar

*Correspondence Author's Email: shafqatalishah@hotmail.com

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ABSTRACT

Introduction: Maxillary canine is most important tooth in the dental and facial esthetics because of the amount of visible coronal structure. It has wider pulp chamber, single straight root and withstand with high masticatory forces so its survival rate is high.

Objective: The objective of the current study is to assess the effect of age and gender on dimension of pulp to tooth crown ratio in permanent maxillary canine by using CBCT in subjects visiting Khyber College of Dentistry Peshawar.

Material and Methods: It's a cross-sectional study in which 180 subjects of both gender fulfill the inclusion criteria were selected and there age range from 13 years to 60 years.

Results: The mean age was 27.23±10.5 (SD). The high frequency was in 13-23 years and lowest frequency was in 54 and above. As age is compared with variables, it shows that P value is highly significant (p=.005). As gender is compared with tooth variables it also shows that P-value is highly significant (p=.005)

Conclusion: The relationship between age and pulp chamber volume was significant (p=.005) which demonstrated that with age the size of the pulp chamber decreases.

Keywords: Maxillay Canine, Pulp Chamber, Crown Volume, CBCT

INTRODUCTION

Oral Cavity is composed of two different types of tissues i-e soft tissues and hard tissues. Soft tissues include oral mucosa and salivary gland where as hard tissues include bone and teeth. Enamel forms the outer surface of the tooth while dentin makes up the bulk of the tooth and supports enamel and cementum covers root dentin[(1)]. However, as a tooth ages, it undergoes a number of changes including secondary dentin formation throughout life, resorption of root and deposition of cementum[(2)].

A radiographic examination of the teeth is a method that demonstrates changes in relation to age. Radiographic technique is a simple and non-invasive means of evaluating the teeth and gathering information of their various structures[(3)]. Secondary dentin formation begins after completion of root and eruption of teeth in the oral cavity. Secondary dentin deposition occurs throughout life and protects the pulp and it is not formed in response to any stimuli. Pulp chamber also decreases in size because of deposition of secondary dentin [(4)].

A study was conducted on Spanish population in which 313 CBCT images of upper incisors were examine with age range from 14 years to 70years. They found that the ratio between pulp chamber and crown volume is R^2=36.6%, which is highest coefficient of determination [(5)]. In another study of Someda et al in which 155 scan images of mandibular central incisor of age between 12 to 79 years showed high coefficient of determination for volume ratio of the pulp cavity and the whole tooth[(6)].

Most of the studies have been performed on permanent canines because it is the strongest tooth in the oral cavity and less prone to caries[(7)]. Permanent canines have wider pulp chamber, single straight root and withstand with high masticatory forces so its survival rate is high [(8)].

Previously, studies have been done on extracted teeth to estimate the deposition of secondary dentin. Penaromic and periapical radiographswere frequently used to measure the deposition.Cone Beam Computed Tomography (CBCT) has recently made it possible to visualizethe teeth in three dimensions without superimposition and it helps to estimate the relationship between volume of pulp chamber over entire tooth volume with age[(4)]. Afify mention in his study that CBCT is a simple and conservative procedure which provides accurate measurement [(9)].

To date, no such data is available on secondary dentin deposition of local population of Peshawar, Khyber Pakhtunkhwa, because it is one of several parameters in methods of age estimation. The aim of the study is to document the effect of age on the dimensions of pulp to tooth crown ratio of permanent maxillary canine by using cone beam computed tomography in subjects visiting Khyber College of Dentistry Peshawar. This study will help the Forensic Odontologist to estimate the age of the individuals.

MATERIAL AND METHODS

Study Design

- Cross-sectional study, Only CBCT records of the patient were used

Setting

- Department of Radiology, Khyber College of Dentistry Peshawar

Duration

- 1-4 months

Sample size

- 180

Sampling Technique

- Non-Probability, Convenient sampling

Inclusion Criteria

- Fully developed maxillary permanent canine without caries
- CBCT images of both male and female gender
- Age ranges from 13 years to 60 years

Exclusion criteria

- CBCT images of Maxillary permanent canine showing pulp stone or calcified tissue

- Maxillary canine having RCT, post cores buildup crown, resorption defects or fracture

Data Collection Procedure

Patients visiting Radiology department of Khyber College of Dentistry Peshawar and advised for CBCT for diagnosis and treatment and fulfilling the inclusion criteria were included in the study. CBCT data was taken from Radiology department. All standards research protocols were followed. CBCT scans were analyzed using Planmeca Romexis Software. Volume of the crown was measured, dotted lines were placed on the outer surface of the permanent maxillary canine crown circumferentially, passing from the cemento-enamel junction and the CBCT scan was directly measure the volume of the canine crown. Volume of the pulp chamber was measured; dotted lines were placed on the outer surface of the pulp chamber including pulp horn of permanent maxillary canine circumferentially passing from CEJ. Ratio of tooth crown volume and pulp chamber volume was measured by using the formula;

$$R = \frac{Tooth\ Crown\ Volume}{Pulp\ Chamber\ Volume}$$

Data Analysis

Statistical analysis was performed using SPSS version 22. Descriptive statistics such as mean and standard deviation was calculated. Pearson correlation coefficient was used to calculate the correlation between age and pulp chamber to tooth crown volume ratio.

RESULT

The total sample size of this study was 180 in which males were 117 (65%) and females were 63 (35%). There age range from 13 years to 60 years, which were further, divided in 5 groups. Group 1 (13-23), Group 2: (24-33), Group 3: (34-43), Group 4 (44-53) and Group 5 (54 and above). The frequency in Group 1 is higher (41.1%), Followed by Group 2, Group 3, Group 4 and lowest in Group 5in which the frequency was 3.3% (Table 1). The mean age group calculated was 27.233±10.5 (SD) and mode of the group was25 (Table1)

Comparison of tooth crown and pulp chamber dimensions with different age group

In this study the Pearson correlation coefficient is used to analyze the relationship between measures variables and various age groups (Table 2). The results indicated a negative correlation across all variables, suggesting a decline in their values with increasing age. In group 1 (ages 13 to 23) mean tooth crown length is -0.96, mean tooth crown width is -0.013, mean crown volume is -0.03, mean pulp chamber length is -0.08, mean pulp chamber width is -0.11, mean pulp chamber volume is -0.053, mean ratio is 0.127 in females it is 0.015 and in males it is 0.027. While the mean values decreasing with age in remaining age groups II, III, IV, and V. in group V ages 54 to 60 mean tooth crown length is -0.005, mean tooth crown width is -0.01, mean crown volume is -0.001, mean pulp chamber length is -0.006, mean pulp chamber width is -0.009, mean pulp chamber volume is -0.004, mean ratio is 0.010, in females it is 0.001andin males it is 0.002. This pattern indicates consistent reduction in tooth crown and pulp chamber dimensions with advancing age (Table 2)

Comparison of tooth crown and pulp chamber dimension by gender

The result indicate a negative correlation for all measured variables, suggesting that as age increases, the size of these variables tends to decrease. For males, the average age is 34.4, with the following mean values; tooth crown length is -0.226, width is -0.096 and volume is -0.260. Similarly the mean values for pulp chamber dimensions are; length (-0.143), width (-0.133) and volume (-0.109). The mean ratio for males is recorded at 0.094 (Table 3).

For females, the average age is 32.6. The corresponding mean values are: tooth crown length (0.121), width (-0.148) and volume (-0.140). Meanwhile, the mean pulp chamber measurement include: length (-0.077), width (-0.072) and volume (-0.054). The mean ration for females is 0.051. A comparison of gender with tooth variables (crown length, width, and volume) revels statistical significance with a P-value of 0.004. Similarly, a comparison with pulp chamber dimensions (length, width and volume) shows high statistical significance (P=0.005) (Table 3)

Table 1: Age Groups distribution of patients CBCT

Groups	Age Groups	Frequency	Percentage	Mean	Mode	Standard

						Deviation
Group 1	13-23	74	41.1%	27.23	25.00	10.5
Group 2	24-33	68	37.9%			
Group 3	34-43	22	12.4%			
Group 4	44-53	10	5.7%			
Group 5	54-60	6	3.3%			

Table 2: Distribution Characterization for Correlation with Age

	Age Groups	Tooth Crown Length	Tooth Crown Width	Tooth Crown Volume	Pulp Chamber Length	Pulp Chamber Width	Pulp Chamber Volume	Ratio
Mean	13-23	-0.068	-0.013	-0.32	-0.080	-0.115	-0.053	0.127
	24-33	-0.063	-0.012	-0.030	-0.073	-0.104	-0.049	0.117
	34-43	-0.02	-0.004	-0.009	-0.024	-0.034	-0.016	0.038
	44-53	-0.009	-0.0018	-0.004	-0.011	-0.015	-0.007	0.017
	54-60	-0.005	-0.0010	-0.002	-0.006	-0.009	-0.004	0.010
P value		.005	.005	.005	.005	.005	.005	.005

Table 3: Distribution Characterization for Correlation with Gender

		Mean Age	Tooth Crown Length	Tooth Crown Width	Tooth Crown Volume	Pulp Chamber Length	Pulp Chamber Width	Pulp Chamber Volume	Ratio
Mean	Male	34.4	-0.226	-0.096	-0.260	-0.143	-0.133	-0.100	0.094
	Female	32.6	0.121	-0.148	-0.140	-0.077	-0.072	-0.054	0.051
P Value		.005	.004	.004	.004	.005	.005	.005	.005

DISCUSSION

Assessing pulp cavity changes with age using 2D dental radiograph is an accepted method of estimating asymptomatic age for adults [(10)]. Previous studies have demonstrated that the evaluation of pulp cavity and tooth volume is more accurate in terms of tooth area. It has been revealed that the storage of secondary dentin is not uniform in all surfaces of pulp. It mainly accumulates on the floor and ceiling of the pulp chamber, resulting in disproportionate reduction in its size and shape. Therefore, significant dental changes occur in the pulp chamber [(11)].

However age related changes in the pulp are of most importance in clinical dentistry because of the continuous deposition of secondary dentin, which may be used as a tool for determination of age [(12)]. Secondary dentin is formed when the root is fully developed and the teeth are fully formed. Accumulation of secondary is slower than that of primary dentin and it accumulates mostly in the pulp chamber wall. This has a direct effect on the reduction of the pulp cavity volume. This reduction is mostly occurring in mesiodistal direction. Pulp cavity decreases significantly in size from 22-30 years of age to 51 to 60 years. No significant changes have been observed [(11, 12)].

The transformation of pulp dentin in pulp chamber area is clearly seen on CBCT. CBCT scans were used to have a 3D image of the dental arches of the participants of current study because they are cost effective and have high resolution of the images then the conventional computed tomography. CBCT provides accurate details in 3D, allowing individual teeth to be viewed in axial, sagittal and coronal view. In the present study maxillary canine were used because they often remain unaffected and well anchored in the jaw for declining years. It is single and straight tooth with wider pulp cavity [(13)].

The present study is in accordance with those previous studies which showed that age had no effect on the tooth [(14)]. The result of the current study show that sagittal view of the volume of the pulp chamber of the maxillary canine was significantly correlated with age (p=0.005). Therefore current study shows better correlation between age and pulp chamber volume. Similar studies have suggested canine to measure pulp cavity rather than other dental group [(11)].

In the present study, the ratio between the volume of the pulp chamber and the volume of the tooth crown as the dimension of the teeth reduces with age, similar result was found in the study of Gulsahi et al [15, 16]. In 2019 Kazmi conducted a study on 719 Pakistani, age between 15 years to 65 years. The results showed that significant difference in the pulp volume among both genders, R^2=0.33 [13]. The current study results shows a significant difference in the pulp chamber volume of maxillary canine in females (-.054) and males (-.100), which shows decrease in pulp volume with age.
In addition, Single et al, 2019 conducted a study in Rohtak with age range of 15 years to 54 years [17]. It has also been found that the coronal pulp cavity of maxillary canine shows a greater correlation with age than the mandibular canine. It is also revealed that the ratio of width shows more relation to age then length.

CONCLUSION

The relationship between age and pulp chamber volume was statistically significant (p=0.005) which demonstrate that the size of the pulp chamber decreases with age

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