

# The Effect of Gender on the Linear and Volumetric Changes of Maxillary Permanent Canine Teeth on the Cone Beam Computed Tomography

Changes of  
Maxillary  
Permanent  
Canine Teeth on  
CBCT

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## ABSTRACT

**Objective:** This study assessed the impact of gender on the pulp chamber dimensions relative to the tooth crown ratio in permanent maxillary canines using CBCT scans.

**Study Design:** Cross-sectional study.

**Place and Duration of Study:** This study was conducted at the Radiology Department of Khyber College of Dentistry and Sardar Begum Dental College, Peshawar, from September 2021 to June 2022.

**Methods:** Analysis of 180 CBCT radiographs from participants aged 13 to 60 was conducted using non-probability convenience sampling. The study focused on structurally sound maxillary canines, measuring tooth crown length, width, volume, and pulp chamber dimensions. Images were oriented in axial, coronal, and sagittal planes for accuracy. A significance level of  $p \leq 0.05$  was applied for statistical analysis.

**Results:** For males, mean values were: crown length (-0.226), width (-0.096), volume (-0.260), and pulp chamber dimensions (-0.143 length, -0.133 width, -0.100 volume), with a mean ratio of (0.094). For females, mean values were: crown length (0.121), width (-0.148), volume (-0.140), and pulp chamber dimensions (-0.077, -0.072, -0.054), with a mean ratio of (0.051). Significant differences in measurements between genders were noted ( $p = 0.004$  for crown;  $p = 0.005$  for pulp).

**Conclusion:** A statistically significant relationship exists between gender and both crown and pulp chamber volumes.

**Key Words:** Maxillary Canine, Crown volume, Gender, Pulp chamber volume

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## INTRODUCTION

Gender determination is the first step in human identity. Forensic professionals find it extremely difficult to determine a person's gender from skeletal remains, particularly when just fragments of the corpse are found. Using the skull and teeth, forensic dentistry can assist in identifying the gender of the remains. The shape, crown size, root lengths, and other characteristics of teeth are specific to males and females.

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Using the teeth and skull, forensic dentistry can help identify the gender of the remains because different aspects of teeth, such as morphology, crown size, root lengths, etc., are characteristic of males and females. By determining their mesiodistal and buccolingual dimensions, teeth can be utilized to distinguish between genders<sup>(1,2)</sup>. This is especially crucial for young people who have not yet established skeletal secondary sexual traits. Research indicates notable distinctions in the crown dimensions of permanent and deciduous teeth between males and females. It is emphasized that the environment has a significant impact on odontometrics, or tooth size. Because of this, these metrics are population-specific and do not apply to the entire planet<sup>(3,4)</sup>. Males have larger mandibular canines than females, exhibiting the largest size difference between the teeth. Additionally displaying variations are the maxillary incisors, premolars, and first and second molars<sup>(5)</sup>. A study on the mesio-distal crown diameter of permanent teeth belonging to Australia's aborigines (those of Aboriginal descent) found gender disparities in tooth sizes. The difference was greatest in the mandibular canines.<sup>(6)</sup> In a research on Saudi Arabian

population, Abdullah et al. found that although it was not statistically significant, the mean mesiodistal width of maxillary canines was larger in males than in females. In an other study, researcher measured the mesiodistal width of canines in various ethnic groups to study sexual dimorphism. Furthermore, the mandibular canines showed higher levels of sexual dimorphism than the maxillary canines

Male versus female mandibular canine mesiodistal breadth was considerably greater. All these variable lead to sexual dimorphism that are most likely because of the subject's varying ethical background and the use of non-standard assessment techniques. CBCT images of 521 left maxillary and 681 left mandibular canines were obtained from 368 females and 349 males aged between 15 and 65 years in a other study on a local community of Pakistanis<sup>(7)</sup>. The pulp cavity volume was computed and the pulp shape was traced using Planmeca Romexis software. It demonstrated the correlation ( $R^2 = 0.33$ , where  $R^2$  is the highest prediction power) between the volume and gender of the mandibular canine pulp.

CBCT allows teeth to be seen in three dimensions without the need for magnification, superimposition, or distortion<sup>(8)</sup>. The ability to discern various focus objects from very small distances is one of the most appealing aspects of CBCT imaging, and this is partly due to the capture of isotropic data and flat panel detector technology<sup>(9)</sup>. CBCT is a simple and conservative method with reasonable accuracy and precision<sup>(10)</sup>.

Like the present study numerous studies have used permanent maxillary canines because the pulp of canines is larger, less wear and a high survival rate than other teeth<sup>(11)</sup>. Canines are less prone to caries or rot, have a straight root and a wide pulp chamber<sup>(12)</sup>. Apart from identification, Gender based variable in teeth is also a very concerning topic for practicing dentists. Especially during endodontic treatment where morphological changes are bound to changes the difficulty index as well as the outcome of treatment. A study by Soleymani et al reported the due to the diverse changes possible in the morphology of canine in association with gender they recommended the use of CBCT for assessment during endodontics in their Iranian population<sup>(13)</sup>. To date, no published data on the subject is available for the local population of Khyber Pakhtunkhwa. This study will help physicians in diagnosis and treatment planning for endodontically compromised teeth i.e., the dentist will have a better understanding of the crown morphology of the tooth and its root canal system and therefore the chances of failure will be avoided.

The primary goal of this study was to use cone beam computed tomography to measure the impact of gender on the length and width of the pulp chamber to tooth crown ratio in permanent maxillary canine teeth in

patients visiting Peshawar's dental teaching hospitals between the ages of 13 and 60.

## METHODS

180 participants of all genders participated in this cross-sectional study, which ran from September 2021 to June 2022 at the radiology departments of Khyber College of Dentistry and Sardar Begum Dental College in Peshawar. The non-probability convenience sampling technique was used for the sampling process. Participants had structurally good permanent maxillary canines and ranged in age from 13 to 60 years, representing both genders. The subjects' cone-beam computed tomography (CBCT) results, which were available in Digital Imaging and Communication in Medicine (DICOM) File Format, had been recommended by dental clinicians for routine treatment planning.

Inclusion Criteria:

1. Maxillary permanent canines are fully developed and structurally sound (without caries) as seen on CBCT.
2. Crown and root of bilaterally erupted permanent maxillary canines seen on CBCT.
3. CBCT images of both genders females and males having an age group of 13 – 60 years.
4. CBCT images show fully developed roots of permanent maxillary canine with a completely formed root apex.

Exclusion Criteria:

1. CBCT images showing Maxillary canines with pulp stones or calcified canals.
2. CBCT images of permanent maxillary canines having root canal treatment, post and cores build-up, crowns, resorption defects, calcification and fractures.

For the calculation of the linear measurements of permanent maxillary canine, Planmeca Romexis 6<sup>th</sup> version software was used. The images were exported in the Digital Imaging and Communication in Medicine (DICOM) file format using the Planmeca Romexis software program. After the CBCT pictures were corrected for brightness, contrast, and sharpness, they were imported as DICOM files into the Mimics program. To determine the tooth crown length, tooth crown width, tooth crown volume and pulp chamber length, pulp chamber width and pulp chamber volume of permanent maxillary canine the image was first oriented properly in axial, coronal and sagittal planes. The image was scrolled on the software's cross-sectional plane to identify the optimal midsagittal section of the pulp after the longitudinal axis of the tooth from the crown tip to root apex was initially established in the sagittal plane. (figure1)

CBCT images were collected from Khyber College and Sardar Begum dental college and hospital prior consent from patients who were already advised CBCT.

**Statistical Assessment:** SPSS version 22 was used to conduct the statistical analysis. Calculations were made for descriptive statistics such frequency, mean, and standard deviation. Pearson correlation coefficient were used to estimate the correlation between gender and pulp chamber to tooth crown ratio, tooth crown length, tooth crown width, tooth crown volume, and pulp chamber length, pulp chamber width, pulp chamber volume. For the differences to be statistically significant,  $P \leq 0.05$  was considered.

**RESULTS**

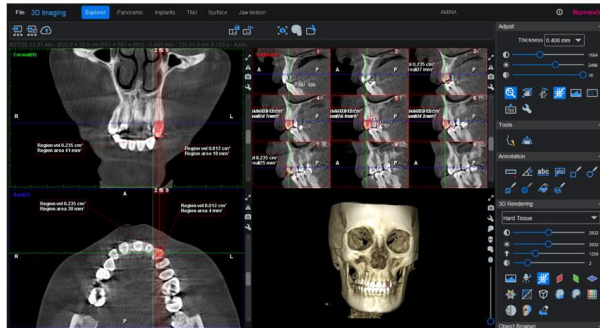


Figure No. 1: Volumetric measurements of the crown and pulp chamber of the permanent maxillary canine.

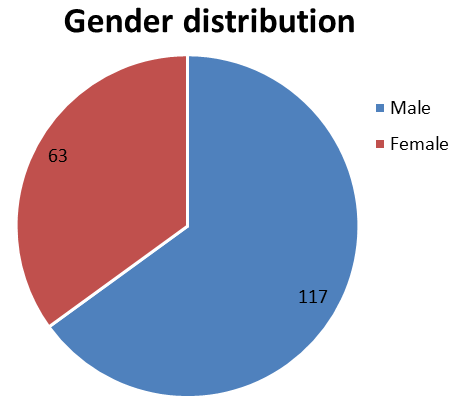


Figure No. 2: Gender distribution

Table No. 1: 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	-.068	-.013	-.032	-.080	-.113	-.053	.127
	24-33	-.063	-.012	-.030	-.073	-.104	-.049	.117
	34-43	-.020	-.004	-.009	-.024	-.034	-.016	.038
	44-53	-.009	-.0018	-.004	-.011	-.015	-.007	.017
	54-60	-.005	-.0010	-.002	-.006	-.009	-.004	.010
P - value		.005	.005	.005	.005	.005	.005	.004

**DISCUSSION**

In the present study, maxillary permanent canines were selected because they often remain unaffected and are well anchored in the jaw for declining years. Has single, straight tooth and wider pulp cavity. The canine crown is designed in a way that promotes cleanliness. With good anchorage in the jaw, this quality of self-cleaning keeps the tooth safe for life. Therefore, canines carry less risk of caries or rot. Such characteristics of the permanent maxillary canine allows an easy approach for the morphological quantification.<sup>(14)</sup>

In 2019, Kazmi et al. studied a group of 719 Pakistanis. Using Planmeca Romexis software, they obtained CBCT images of 521 left maxillary and 681 left mandibular canines from 368 females and 349 men between the ages of 15 and 65. According to the data, there was a significant difference in pulp volume between the sexes ( $R2 = 0.3310$ ). Consequently, the results of the most recent study also indicate that the pulp chamber volume of the maxillary canine differs significantly between males (-.100) and females (-.054).<sup>(11)</sup> They found a decrease in pulp volume with

age, but did not determine the rate of change in pulp volume between different stages of age (early, middle, and old age). The present study shows a significant inverse relationship between gender and age of permanent maxillary canine. This is in line with another study conducted on 131 CBCT images of patients aged 17 to 75 years with fully exploding maxillary canines<sup>(15)</sup>. In this study, Planmeca Pro Max 3D was used to calculate the volume of the pulp and to detect the pulp and tooth pattern on the axial part. The results show that ( $r = -0.486$ ) is most closely related to age. Another researcher conducted a study on 150 sets of CBCT images of mandibular canines in the Egyptian population between the ages of 18 and 70. Sample sizes were divided into 5 age groups. i-CAT scanner used. The pulp and tooth volume ratio and age were shown to be statistically significantly and negatively correlated ( $r = -0.869$ ,  $p < 0.001$ ).

A study on 110 scanned CBCT data of maxillary central incisors (56 men and 54 females) in Malaysia. This study found that pulp chamber/crown had higher coefficients of values for volume analysis ( $R2 = 0.78$ ) than pulp cavity/tooth ( $R2 = 0.64$ )<sup>(16)</sup>. Researcher

calculated the pulp-to-tooth volume ratio of incisors, canines, and premolars using 111 CBCT images of Belgian patients aged 10 to 65 (57 women and 54 men). Went. Implant Pro software was used. The results indicated that incisors showed the greatest correlation with age ( $R^2 = 0.41$ ). They found that in females ( $R^2 = 0.38$ ) compared to males ( $R^2 = 0.31$ ), there was a stronger correlation between pulp and tooth volume with age<sup>(17)</sup>.

## CONCLUSION

A statistically significant relationship ( $p = 0.004$ ) was observed between the tooth crown and pulp chamber volume for both males and females.

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

### Author's Contribution:

Concept & Design of Study: Hira Manan  
 Drafting: Asma Sattar, Munawar Aziz Khattak  
 Data Analysis: Dania Hassan, Bushra Khan, Momena Rashid  
 Revisiting Critically: Hira Manan, Asma Sattar  
 Final Approval of version: By all above authors

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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