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Pulp chamber size of permanent maxillary canines as an age indicator: A cross- sectional study in a dental teaching hospital, Peshawar.

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ABSTRACT

INTRODUCTION: Age estimation is more significant in the forensic sector since it helps with a variety of concerns, including missing persons, suspected criminals, and child abuse, in addition to helping with deceased identification. owing to teeth's extreme resistance to time, force, and physical assaults. Consequently, age determination in the forensic sector depends on the morphological and radiological study of teeth. The pulp dentinal complex reacts to different stimuli. This leads to the production of secondary dentine, a crucial aspect of aging, which causes the pulp cavity to shrink. The secondary dentin that forms on the pulp cavity walls as people age causes the pulp chamber to shrink.

OBJECTIVES: To determine the relationship between chronological age and pulp chamber size of permanent maxillary canines in patients visiting the dental teaching hospital Peshawar, A cross-sectional study.

METHODOLOGY: This cross-sectional study involved 150 patients visiting the radiology department of Sardar Begum Dental College and Hospital, Peshawar . Individuals between 18 – 65 age who had previously been advised Cone Beam Computed Tomography were included. The CNIC card was used to record the birthdate. Depending on the type of tooth, the Pearson correlation coefficient and linear regression were utilized to evaluate the association between the pulp chamber's size and chronological age. Data analysis was performed using SPSS version 27. A fixed significance level of $p < 0.05$ was applied.

RESULTS: The research involved a total of 150 patients. 18 was the minimum age that was recorded, while 65 was the maximum. 47 was the average age. In this study, there was a significant inverse association between age and changes in the pulp chamber size of maxillary permanent canines.

CONCLUSION: In the current investigation, there was a statistically significant relationship between age and the pulp chamber size of maxillary permanent canines. Therefore, the maxillary permanent canine is a helpful index for estimating human age with some degree of precision and accuracy.

Keywords: Estimation of age, Computing cone-beam tomography, pulp cavity dimensions, Secondary dentin.

Introduction:

Tracing an individual's biological profile from skeletal remains is a fundamental problem in studying ancient human populations and forensic science.¹ Partially or fully skeletonized human remains can be difficult to identify visually or in poor condition², especially when figuring out the age of death³. Teeth are essential for reconstructive identification due to their greater resistance to biological, pathological, and environmental variables than bones,⁴ and are preserved after the death.⁵ Other methods like dental growth, tooth eruption and skeletal maturation are also employed. The physiological and morphological changes in teeth, such as pulp volume, secondary dentin deposition, root dentin transparency, and tooth attrition are the age estimation techniques.⁶ Both genetic and environmental factors have less impact on these alterations.⁷ One of the most important markers of age estimation is secondary dentin deposition, which results in a reduction of pulp cavity volume in adults after the full eruption of permanent teeth.⁸ Dental examination is a key component of forensic identification and it is complemented by a number of sophisticated procedures such as mineralization studies of molars, radiocarbon analysis and biochemical evaluations.⁶ New non-invasive techniques for determining the dental age include panoramic, periapical, and cone beam tomography (CBCT) images.⁹ Periapical and panoramic radiographic methods are 2D projections¹⁰ which are extremely prone to distortion and significant magnification problem.¹¹ Cone beam computed tomography (CBCT) is now the method of choice for researching dental microstructures because to advance imaging techniques, reduced radiation, faster imaging and more accurate visualization are just a few benefits of CBCT.^{12,13} Prior studies was on the pulp tooth volume ratio(PTVR) and age revealed complexity.¹⁴ Permanent maxillary canines have resilience to wear, durability, and bigger pulp dimensions.¹⁵ These characteristics make data processing easier and increase their accuracy as indicators of chronological age.¹⁶ The study attempts to determine a relationship between age and pulp chamber size in maxillary canines, assessing the methods suitability for both clinical and forensic uses.

Material and Methods:

A cross-sectional investigation was conducted. Duration of study was 6 months. Patients above the age of 18 who had fully developed maxillary canines were included. Excluded patients with developmental abnormalities, crown restorations, occlusal trauma, periodontal disease, orthodontic therapy, caries, missing or impacted canines, and pregnant women. After receiving approval from the institutes ethical council, 150 volunteers who were prescribed CBCT selected from the private dental college radiology department. Informed consent was provided by the participants. Radiographic evaluations were performed. Single tooth per arch was selected. Used a scanner equipped with an x-ray source and detector, took pictures, and used MIMIC software to process them, The image was trimmed, the object was rebuilt, the surrounding structures were eliminated, and the measurements were taken. The link between the size of the pulp chamber and its chronological age was assessed using a linear regression model and the Pearson coefficient test. To analyze the data, SPSS version 27 was utilized. The level of significance was $p < 0.05$.

Results:

There were 150 participants in the study. 55 (37%) were men and 95 (63%) were women. The average age of the patients were 47 years old with lowest and maximum ages of 18 and 65 respectively and standard deviation was 16.198. In table 1 and 2, the Pearson test and the regression model of age and permanent maxillary canines are displayed. The results showed that the size of pulp chamber of maxillary canines were negatively correlated with age. A steady reduction in pulp chamber size was noted with increasing age. A statistical investigation that employed regression analysis and Pearson correlation revealed a substantial association ($p < 0.05$), suggesting that age is a powerful predictor of pulp chamber size. Secondary dentin deposition caused the pulp chamber to shrink in size in elderly people, but in younger people, it seemed larger and more defined. Its possible application in age estimation is supported by these results, which indicate the pulp chamber size declines predictably with age.

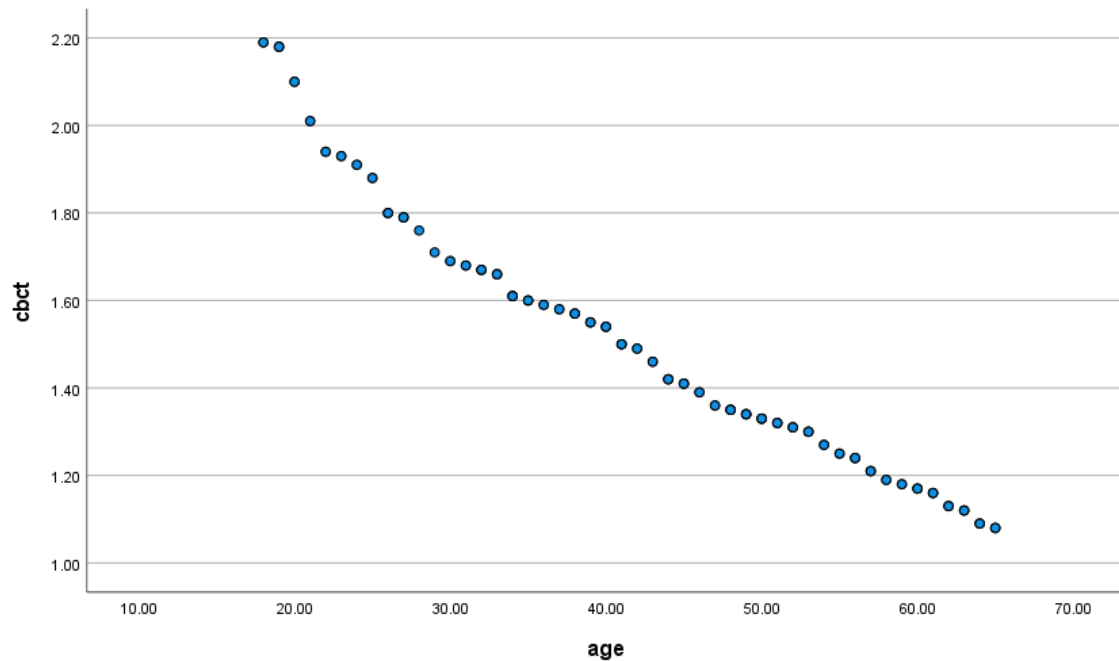
Table1: Pearson test

	Value	Standard error	Approximate T	Approximate significant
Pearson test	-986	.002	-72.827	<.001
Correlation	-1.000	.000	-37724.23	.000
No. Of valid cases	150			

Table 2: Regression model

	Sum of squares	df	Mean square	F	Significant
Regression	15.642	1	15.642	5303.817	<.001
Total	16.078	149			

Graph1: Scatter graph



Age and the pulp chamber size of maxillary canines were clearly correlated negatively, according to the scatter graph analysis. The pulp chambers dimensions gradually shrunk with age. The data points in the scatter plot showed that older people had smaller pulp chamber diameters, with data points moving downward, and younger people had larger pulp chambers, with data points clustering in the higher range. These results demonstrate that the pulp chamber size regularly decrease with age, most likely as a result of secondary dentin deposition.

Discussion:

Estimating an adults age in forensic odontology is a difficult task. Teeth must be sectioned in order to express morphological changes, which is not feasible in living people. As a result, the radiography method is mostly used to determine the age of live people.¹⁷ By assessing the pulp dimensions, Kvaal et al. Developed a radiographic method in 1995 to determine age based on secondary dentin deposition. Pulp width was thought to be significantly linked with the participants ages.¹⁸ For this use, any tooth will do. However, canines are preferable due to their lower incidence of caries, one root and pulp chamber, and the fact that they typically stay in the mouth cavity until old age.¹⁹ Currently, CBCT scans provide valuable

three- dimensional information about teeth and are used more often in forensic dentistry than standard CT due to their excellent resolution and minimal radiation exposure.²⁰ Furthermore, the precise volume of teeth and pulp may be calculated using CBCT, which also enables the determination of tooth and pulp areas in both buccolingual and mesiodistal dimensions.²¹ Therefore, this study used CBCT to estimate the age of adults based on maxillary canines. CBCT has been used in several research for forensic age estimation.²² PTR of lower canines was found to have a better reliability in determining age, $p < 0.05$ in an Indonesian investigation.²³ Another study found that CBCT of upper jaw canines and PTR analysis ($R^2=0.392$) may reliably determine the age of individuals of Iranian heritage.²⁴ According to the results of earlier research, pulp area and age have an inverse connection.²¹ The results of the current investigation showed negative correlation between age and upper maxillary canine pulp chamber size, were comparable to this finding. The findings of the current study were confirmed by a few other investigations. A high association between PTR and estimated age ($r=0.88$) using CBCT was observed by Salemi et al.²⁰ Nevertheless, Molina et al. Found that assessing canines ,PTR was an unreliable method for FAE. The result of the current investigation showed that maxillary canines had the highest coefficient of determination.

Conclusion:

The study shows a strong correlation between maxillary canine pulp chamber size and age. Secondary dentin deposition throughout time is responsible for the steady decrease in pulp chamber size that is seen as age rises. In both clinical and forensic dentistry , this correlation emphasizes the value of maxillary canine pulp chamber size as a possible age estimation indicator. Larger sample sizes and more sophisticated imaging methods in future studies could improve the precision and relevance of this association in a number of domains, such as forensic investigation and dental practice age determination.

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