



EVALUATION OF THE UTILITY OF PERMANENT MAXILLARY CANINES IN AGE AND GENDER DETERMINATION: A CLINICO-RADIOGRAPHIC STUDY.

Dental Science

Dr. Apurva Mohite Khator* Assistant Professor, Department of Oral medicine and radiology, VSPM'S dental college, Nagpur. *Corresponding Author

Dr. Pallavi Assudani Former Post Graduate Student, Department Of Oral Medicine And Radiology, Vspms Dental College, nagpur.

Dr. Mukta Motwani Professor And Hod, Department Of Oral Medicine And Radiology, Vspms Dental College, nagpur.

Dr. Apeksha Balpande Professor, Department Of Oral Medicine And Radiology, Vspms Dental College, nagpur.

ABSTRACT

Background: Gender determination and age estimation are important parts of forensic odontology. In severe cases of devastation or decomposition, dental identification is the most commonly used biometric method.

Aim and Objectives : To study reduction of coronal pulp chamber using Tooth Coronal Index (TCI) on RVG images of permanent maxillary canines and correlate with chronologic age and determination of gender using the clinically measured mesio - distal width of maxillary canines.

Materials and Methods: 80 patients comprising of equal number of males and females in the age range of 20-60 years, who were willing to participate in the study and were selected as study subjects. For gender determination mesio - distal widths of both the maxillary canines were measured using manual divider and scale.

For age estimation RVG images of both the canines were obtained and the Tooth Coronal Index (TCI) was calculated.

Results: Mean M-D width in males on the right side was found to be $8.025 \pm (0.52)$ and on the left side was found to be $8.125 \pm (0.61)$. In females it was found to be $7.475 \pm (0.59)$ on the right side and $7.7375 \pm (0.63)$ on the left side.

The statistical analysis of the obtained data indicated that the mean width of the canines of either side in males is significantly higher than that in females.

Conclusion: The age prediction potential of TCI using bilateral maxillary canines is uncertain.

KEYWORDS

Tooth Coronal Index, Rvg, Gender, age.

Introduction

The need for determination of age or gender via forensic odontology comes into play for diagnosis and therapeutic examination and evaluation of injuries to jaws, teeth, and oral soft tissues. It is also crucial for identification of individuals, especially casualties in criminal investigations and/or mass disasters. Accurate age and gender determination also aids in identification, examination, and evaluation of bite marks which occur with some frequency in sexual assaults, child abuse cases, and in personal defence situations.¹

Various Methods are used for identification in forensics which includes visual analysis, personal or medical information, clothing, personal documentation, dentistry, fingerprints, and DNA profiling. The diagnostic measures used in forensic dentistry are dental arch shape, alignment, occlusion, number and position of teeth present and missing, size, shape, position and material of any restorations, presence and position of decayed surfaces, design and material of denture or other appliances. Individual tooth characteristics, for example tooth wear, fractures, anomalies of size, shape and colour, status of the hard tissues and soft tissues, abnormalities or pathologies and any other findings of interest, or clues to age, race, diet, occupation etc.²

Teeth being one of the last parts of the body to undergo decomposition, they remain relatively unchanged for years to go and even survive death.^{3,4} In cases of severe body devastation and fragmentation on decomposition dental identification is commonly used as a biometric method.⁵ There is severe sexual dimorphism present between males and females, which refers to difference in size, structure and appearance. This is also applicable in the field of dentistry. Sex prediction of the patient in forensic odontology can be done by measuring mesio-distal and bucco-lingual dimensions of tooth. Whereas age determination can be done using coronal pulp biomarker as tooth is fully mineralised when it erupts in a very stable form in the oral cavity. As the age increases there are changes in the size of pulp chamber which can be correlated with the age.⁶

Thus, the present study was undertaken to evaluate the use of coronal

pulp biomarker for determination of chronological age and tooth dimensions for the determination of sex by using simple clinical means.

This cross – sectional, observational study was carried out in the Department of Oral Medicine and Radiology, V.S.P.M's Dental College and Research Centre, Nagpur. 80 patients were selected, comprising of equal number of males and females in the age range of 20-60 years, reporting to the outpatient department, fulfilling the exclusion and inclusion criteria and who were willing to participate in the study.

Inclusion criteria

1. Healthy individuals aged between 20 - 60 years, who came for routine dental treatment.
2. Individuals with bilateral presence of morphologically normal permanent maxillary canines.

Exclusion criteria

1. Clinically evident dental caries / fracture / malalignment / developmental / regressive changes with the maxillary canines.
2. History of any dental treatment with the maxillary canines.
3. Pregnant females.

Determination of Gender

After thorough clinical examination, bilateral measurement of mesio-distal width of permanent maxillary canines was recorded using a sharp pointed manual divider and scale.

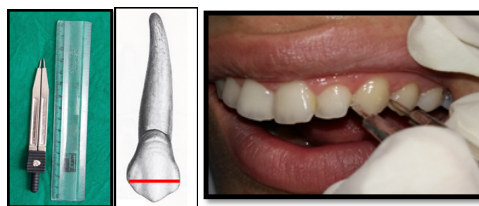


Figure 1

Determination of Age

For determination of the age of the patient, IOPA using paralleling angle technique was taken using radio-visiography and measurements for the age estimation were made in the obtained RVG images. A straight line was traced horizontally along the cemento-enamel junction and vertically a line was traced from this horizontal straight line to the highest point of the pulp horn for measurement of the height of the pulp chamber, denoted by CPCH (coronal pulp height).

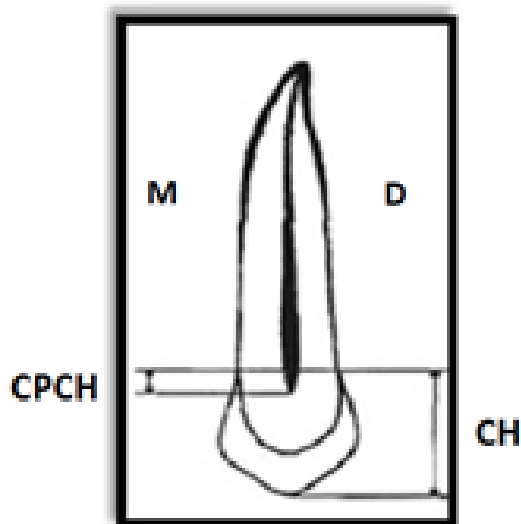


Figure 2

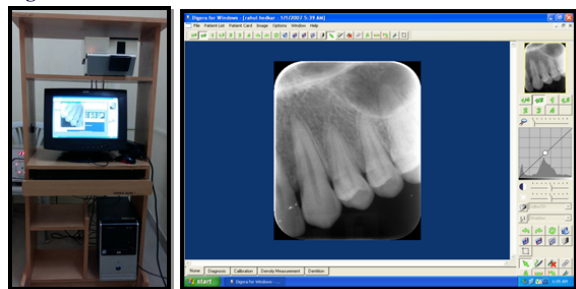


Figure 3

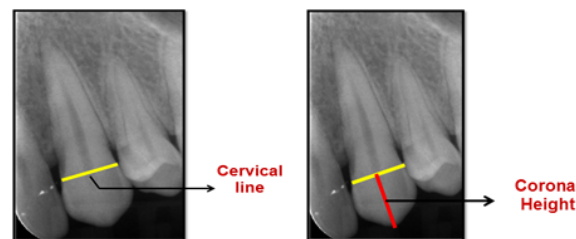


Figure 4

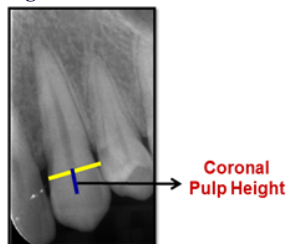


Figure 6

This was followed by tracing another line from the horizontal line straight up to the highest point of the crown for the measurement of the crown height, denoted by CH (coronal height). The lengths of these two vertical lines was measured in millimetres and the values obtained were used to calculate the Tooth coronal index (TCI) by using following formula :-

$$TCI = CPCH \times 100/CH.$$

The TCI thus calculated was correlated with the chronological age for appraisal.

Statistical analysis and Results

The collected data was subjected to statistical analysis. The data was subsequently processed and analyzed using the SPSS software version 17. For determination of the size of the teeth, the range, mean and standard deviation were calculated. This data was interpreted using linear regression analysis, which explores the nature of a relationship between two or more quantitative variables so that one variable can be predicted from the other. The primary goal of a simple linear regression is to establish a statistical relationship that makes it possible to predict one variable in terms of another.

Gender determination by mesio-distal width:

Mean M-D width in males on the right side was found to be $8.025 \pm (0.52)$ and on the left side was found to be $8.125 \pm (0.61)$. In females it was found to be $7.475 \pm (0.59)$ on the right side and $7.7375 \pm (0.63)$ on the left side. On both the sides, the mean M-D width was significantly higher in males than that of females ($p < 0.0001$).

A linear regression model was developed using the widths for both right and left canines and the expression was obtained with coefficient of determination 0.202, thus indicating that MD width is a weak predictor of gender determination.

AGE DETERMINATION USING TOOTH CORONAL INDEX (TCI):

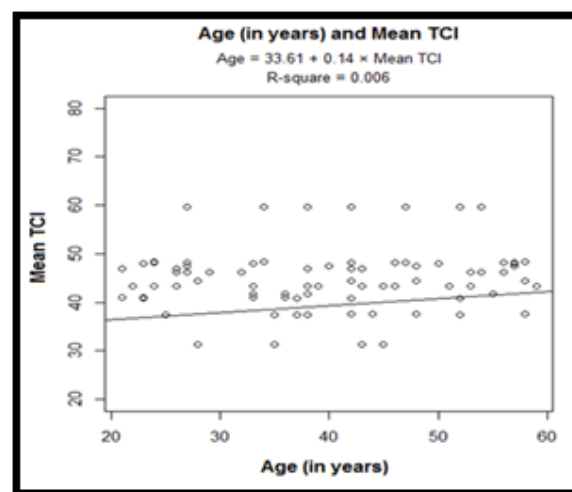


Figure 7

Linear regression analysis was performed for predicting age based on TCI, with coefficient of determination 0.006. Thus indicating that, the age prediction potential of TCI using bilateral maxillary canines is uncertain.

Discussion

Forensic odontology plays an important role in medico legal investigations in mass disasters, especially transportation mishaps such as aircraft accidents where fragmentation and thermal injuries are common. A consistent effort has been made to computerize much of the data to improve comparative efforts. Today it is not unusual to observe a forensic odontologist working alongside identification teams at an air crash, gathering bitemark evidence at a crime scene, or examining a victim of child abuse. Therefore, dental professionals working in the field of Forensic Dentistry should incorporate new technologies in their work to improve their investigations.

There are metric and non metric ways for the identification of a dental specimen. Non-metric features of the crown and root can be used as method for identification of a population group or ethnicity, where as metric features are based on various measurements of the tooth.^{7,8} The use of the metric approach in gender estimation is more planned, less subjective, and additionally, can be repeated to validate the obtained results.⁸ In this study, the mesio-distal dimensions of the teeth were

measured directly in the subjects by a single operator and each measurement was taken thrice. Presence of differences in the odontometric features in different populations, and even within the same population were found. Therefore, determination of specific population values in order to make personal identification possible can be done on the basis of tooth measurements. This study was conducted to evaluate the mesio-distal dimension of the maxillary incisors and canines of the central Indian population for males and females. Determination of gender using this method is relatively quick, easy, and inexpensive, compared to other costly, time-consuming, and technique-sensitive methods. Furthermore, it has a high utility in identifying subjects from fragmented jaws and dental remains.

In the present study we chose the permanent canines for our measurements similar to a study conducted by Hashim HA and Murshid ZA (1993)⁹ who examined Saudi males and females in the age group of 13-20 years, to determine the teeth in human dentition with the highest likelihood of dimorphism and found that only the canines in both the jaws exhibited a significant sexual difference, while the other teeth did not. In continuation of the same study, they also determined that there was no statistically significant difference between the left and right side suggesting that the measurements of the teeth on one side could be truly representative when the corresponding measurements on other side were unobtainable.

In the present study, only the mesio-distal widths of the teeth were evaluated for sexual dimorphism similar to Singh et al. (2006)¹⁰ who conducted a study to correlate the gender with the mesio-distal crown dimensions of permanent teeth on Punjabi population from a state of Northern India. The results revealed that the mesio-distal crown dimensions of the teeth of males were more than that of females. Khan et al. (2011)¹¹ conducted a similar study among the Bangladeshi population using the maxillary central incisors and mandibular second premolars. The results from this study showed that males had significantly larger dimensions than females. The results of the present study were in accordance with the previous studies. It reveals that the permanent maxillary canines show statistically significant sexual dimorphism and could be used as an adjunct for determination of gender in individuals as well as in groups such as mass disasters and archaeological sites.

Age estimation rooted on tooth morphology is broadly categorized as morphologic and radiological methods. Size of the pulp chamber, which is expected to reduce with age, may show a consistent relationship with chronological age. Chronological age computation is accomplished by determining the ratio of coronal pulp height to that of the coronal height. The ratio obviates the need to standardize tooth sizes, so dental radiographs obtained with different techniques may be used. Digital radiographs with software tools permit metric measurements of morphological parameters of teeth which are relatively precise.^{12,13,14,15} In addition to this, computer-assisted image analysis, avoids the bias inherent in observer subjectivity and improves the reliability. It is, therefore, highly pertinent to devise a simple cost-effective study to perform morphometric analysis of dental pulp utilising the digital radiographic method which may have a bearing on estimation of age in individuals. Drusini et al. (1997)¹⁶ found strong correlation of TCI with chronological age. Veera sd et al. (2014)⁶ studied Tooth Coronal Index (TCI) using permanent mandibular premolars and molars on panoramic radiographs (OPG). They concluded that the prediction potential of TCI below 50 years was good without much difference between premolars and molars. The present study did not show a definite relation between the TCI and age and probable reasons could be various including technique variability. The use of RVG in the present study as compared to the use of OPG in earlier studies which allowed relatively precise measurements of morphological parameters of teeth using advanced software tools and it also avoided magnification which is usually seen in OPG. Tooth parameter changes can also be attributed to geographical area, race and ethnic variations.

Limitations and shortcomings of the study:

The present study did not show a definite co-relation between the TCI and age owing to the following probable reasons:

1. Technique variability
2. RVG:
 - a. Unavoidable magnification
 - b. Provides software tools which permit metric measurements of

morphological parameters of teeth and are relatively precise

3. Geographical, ethnic and racial variations
4. Small sample size

Conclusion

Thus we conclude that considering the mesio-distal dimensions of maxillary canine seems to be an inexpensive and easy method for gender determination. However the study also concludes that the Tooth Coronal Index is not an accurate predictor of age. As a result, further research on a larger sample size is required to prove their efficacy and accuracy in predicting the gender and age respectively.

REFERENCES

1. Zakirulla M, Allahbaksh Meer. Modern Tools in Forensic Dentistry. IJCD, 2011 •2(3)
2. Hinchliffe. Forensic odontology, part 1. Dental identification Brit Dent J 2011; 210(5):219-224.
3. Leung CK. Forensic odontology. Hong Kong Med Diary Dent Bull 2008;13:16-20.
4. Jurel SK. Role of dentist in forensic investigations. J Forensic Res 2012;3:148.
5. Grover M, Bai RG, Ram T, Puri PM, Ghodke KR. An odontologist's key to sex determination: Study analysis of mandibular canine teeth in south Indian population. J Orofac Res 2013;3:157-60.
6. Veera SD, Kannabiran J, Suratkal N, Chidananda DB, Gujjar KR, Goli S. Coronal pulp biomarker: A lesser known age estimation modality. J Indian Acad Oral Med Radiol 2014;26:398-404
7. Rajendran R, Sivapathasundharam B. Forensic odontology. In: Rajendran R, editor. Shafer's Textbook of Oral Pathology. 6th ed. New Delhi: Elsevier India; 2009. p. 880-2.
8. Bidmos MA, Gibbon VE, Štrkalj G. Recent advances in sex identification of human skeletal remains in South Africa. S Afr J Sci 2010;106:238. Available from: [p://www.sajs.co.za/sites/default/files/publications/pdf/238-3116-4-PB.pdf](http://www.sajs.co.za/sites/default/files/publications/pdf/238-3116-4-PB.pdf)
9. Hashim HA, Murshid ZA. Mesiodistal tooth width. A comparison between Saudi males and females. Part 1. Egypt Dent J 1993;39:343-6.
10. Singh SP, Goyal A. Mesiodistal crown dimensions of the permanent dentition in North Indian children. J Indian Soc Pedod Prev Dent 2006;24:192-6.
11. Khan SH, Hassan GS, Rafique T, Hasan MN, Russell MS. Mesiodistal crown dimensions of permanent teeth in Bangladeshi population. Bangabandhu Sheikh Mujib Medical University Journal 2011;4:81-7.
12. Cameriere R, Cunha E, Sassaroli E, Nuzzolese E, Ferrante L. Age estimation by pulp/tooth area ratio in canines: Study of a Portuguese sample to test Cameriere's method. Forensic Sci Int 2009;193:128.e1-6.
13. Tao J, Wang Y, Liu RJ, Xu X, Li XP. Accuracy of age estimation from orthopantomograph using Demirjian's method. Fa Yi Xue Za Zhi 2007;23:258-60.
14. Kullman L, Tronje G, Teivens A, Lundholm A. Methods of reducing observer variation in age estimation from panoramic radiographs. Dentomaxillofac Radiol 1996;25:173-8.
15. Moss ML, Chase PS, Hower RI Jr. Comparative odontology of the permanent post-canine dentition of American whites and negroes. Am J Phys Anthropol 1967;27:125-42.
16. Drusini AG, Toso O, Ranzato C. The coronal pulp cavity index: A biomarker for age determination in human adults. Am J Phys Anthropol 1997;103:353-63.