

Pulp Cavity Width of the Mandibular Canine Used as an Adjunct for Assessment of Age. A Forensic Approach

Rohit Singh¹ Supriya Singh^{2*} D K Singh³ Stuti Kumari⁴ Vaibhav Kamal⁵ Vishwendra Pratap⁶

¹Lecturer, Department of Prosthodontic Crown Bridge and Implantology, Patna Dental College & Hospital, Patna, Bihar, India.

²Lecturer, Department of Oral Medicine and Radiology, Awadh Dental College and Hospital, Jamshedpur, Jharkhand, India.

³Principal, Department of Prosthodontics, Patna Dental College & Hospital, Patna, Bihar, India.

⁴Senior Resident, SKMCH, Muzaffarpur, Bihar, India.

⁵Reader, Department of Pedodontics and Preventive Dentistry, Dr B R Ambedkar, Institute of Dental Sciences, Patna, India.

⁶Private Consultant, Patna, Bihar, India.

ABSTRACT

Background: Based on the radiographic evaluation of the pulp cavity width of the mandibular canine the age of the patients belonging to the age group of 15 – 60 years was estimated, those coming to Patna dental college and hospital, patna-4.

Materials and Methods: The study group comprised of 180 subjects. Intraoral periapical radiographs of the mandibular canine were taken for all subjects, using the conventional paralleling angle technique and the pulp cavity width was measured at the cervical and middle third using a digital vernier caliper. The data obtained was subjected to correlation and regression analysis.

Results: A negative linear relationship was obtained between the age and pulp cavity width (cervical third, $r = -0.459$ and middle third, $r = -0.704$). Cubic regression analysis was done and the regression formulae were obtained. A mean difference of 0.1 years was obtained between the estimated age and real age, indicating the reliability of the derived formula.

Conclusion: It can be concluded that the width of the pulp cavity of mandibular canine are reliable for estimation of age.

Keywords: Mandibular canine, Forensic dentistry, Age determination.

INTRODUCTION

Age is an important aspect and has assumed increasing importance for the assessment of both criminal culpability and legal/social categorization. It also constitutes an important factor in the identification of an individual in forensic odontology.

Most of age estimation methods described in literature offer an approach in the form of preparation of microscopic sections of teeth. The demerits of the above procedures are that they are

irreversible, as the tooth structures may not be available for employing other age estimation methods, and moreover, it may not be acceptable for ethical and religious reasons.[1] In such circumstances, age estimation through radiographs is more suitable as it can easily clarify issues with significant legal and social ramifications for individuals as well as for the community. Age estimation techniques developed over the years, using radiographs, were based mostly on developmental stages of the tooth, however, when

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*Correspondence Dr. Supriya Singh.

Department of Oral Medicine and Radiology, Awadh Dental College and Hospital, Jamshedpur, Jharkhand, India.

Email: Not Disclosed

they were applied at large among different age groups, the results was found to be futile. Age-related changes occur in teeth approximately between 6 weeks *in utero* to old age.[2] As the age advances, the volume of the pulp cavity gradually decreases because of the secondary dentin deposition in the pulp cavity wall.[3] These morphological changes in the pulp cavity serve as one of the most promising predictors for age estimation.

In light of the above factors, the aim of our study was to estimate the age of the patients based on the radiographic evaluation of the width of the pulp cavity of the mandibular canine.

MATERIALS AND METHODS

A total of 180 subjects (90 males and 90 females) were selected for the study. The patients enrolled in the study belonged to the age group of 15–60 years. Patients with full complement of sound mandibular canine, with an integrated dentition and good occlusion, were considered for the study. The selected sample was subjected to conventional intraoral periapical radiographs of the mandibular canine using the paralleling angle technique taken at standard parameters with proper radiation protection measures. The radiographs were processed with a constant strength of developing and fixing solutions, as recommended by the manufacturer. Measurements of the lateral incisors were recorded from the radiographs using a magnifying glass, a radiographic viewer, and a digital vernier caliper with 0.01 mm calibration. The pulpal cavity width (mesio-distal diameter) was measured at the cervical portion of the tooth and middle third of the root.

The recorded measurements were entered in the proforma specially designed for the study and the final data was subjected to statistical analysis using the SPSS software 17.0 version. The Pearson's correlation test was performed to determine the correlation between the pulp cavity width and age. Regression analysis was carried out to obtain the cubic regression formula for age estimation.

The Student's t-test was performed to compare the mean estimated age with the known mean age of the individual.

RESULTS

The mean real age was 35.04 years in males and 35.25 years in females. The mean values of the cervical third pulp cavity width in males and females were 3.69 mm and 3.55mm, respectively. The mean values of the middle third pulp cavity width in males and females were 2.80 mm and 2.70 mm, respectively.

Student's t-test was performed for comparing the mean values of the pulp cavity width at the cervical and middle third in males and females. No statistical significant difference was observed in the cervical and middle third pulpal widths in males and females [Table 1]. This suggested that no definitive sex difference could be made considering the width of the pulp cavity. Therefore, we had to determine the correlation and cubic regressions for males and females on the whole.

Table 1: Comparison of mean age, cervical and middle third pulp cavity widths in males and females.

Variables	Male Mean	Male SD	Female Mean	Female SD	P-value
Age(years)	35.04	12.40	35.25	12.44 ±0.790	NS
Cervical third pulp cavity width (mm)	03.65	0.54	03.55	00.46± 0.138	NS
Middle third pulp cavity width (mm)	02.80	0.56	02.70	00.35± 0.138	NS

The Pearson correlation was performed between the width of the cervical and middle third of the pulp cavity and age. A negative linear relationship was obtained between the age and pulp cavity width (cervical third, $r = -0.459$ and middle third, $r = -0.704$). This was suggestive of the fact that as age increases, the pulp cavity width decreases. A strong correlation was observed with the middle third of the root canal when compared to the cervical third of the pulp cavity.

Cubic regression analysis was performed with age as a dependent factor and the pulp cavity width as an independent factor. In order to obtain an estimated age, the cubic functions were calculated

using the formula, $y = ax^3 + bx^2 + cx + d$, Where, y is the estimated age and x is the sum of the corresponding pulp widths at the cervical and middle third regions, respectively. The regression formula obtained in our study is — Age = $0.106 \times x^3 + (-18.274 \times x) + 117.26$.

The mean real age obtained in the study was 35.04 years. The mean estimated age obtained in the study using the regression formula was 36.17 years. Student's t-test revealed no significant difference ($P = 0.998$) between the estimated age and real age [Table 2].

Table 2: Student's t-test between mean estimated age and mean real age

	Mean	N	Std. deviation	Std. error	mean P value
Real age	35.04	180	13.361	1.329	0.998
Estimated age	36.17	180	08.813	0.876	

N = Sample size, P value < 0.01 significant

DISCUSSION

Estimation of the human age at time of death is often an important step in the identification of human remains.[3] Although several parts of the body can be used for age estimation, the poor condition of the remains often prevent their use. However, the teeth are usually more resistant to peri- and postmortem tissue altering effects.[4]

In the present study, the mandibular teeth were used, as they are more convenient for age determination than maxillary teeth. Brkic et al. found that the teeth of both jaws were reliable for dental age estimation, but the correlation coefficient was stronger for all types of teeth in the upper jaw.[5] In addition, Fancy et al. stated that the growth layers of maxillary teeth were more regular and distinct than those of mandibular teeth.[6] Among the mandibular teeth, the canine were preferred as they are single rooted teeth, and the pulp cavity width is comparatively greater.

In the previous studies, the ratios between the tooth and pulp measurements, such as, the pulp / tooth length and the pulp / tooth width at different levels, were calculated and used in the analyses to reduce the possible variation because of the angulation of the radiographs.[7-9] In the present study, we have

considered the mesio-distal diameters of the pulp cavity (rather than the ratio of pulp/root width) at two levels, as the predictors for age estimation.

It is known that under physiological conditions the volume of the pulp cavity gradually decreases with age, because of the secondary dentin deposition in the pulp cavity wall. This was in agreement with the present study, where we found a negative correlation between age and the pulp cavity width. Similar results were seen with Du et al., Agematsu et al., and Zaher et al.[10-12] Singh et al. (2004), evaluated the physiological changes

Zaher et al. (2011), proved that the estimated ages were very close to the chronological age, with an insignificant difference between them.[12] Similar results were obtained in our study where we obtained a mean difference of 0.1 years between the estimated age and real age, indicating the reliability of the derived formula. Therefore, it can be concluded that derived regression formulae can be used to estimate the age of an adult population with minimum age difference, using pulp cavity width. This would be a useful alternative or complementary tool for age identification in forensic medicine and archeology.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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