

Age Estimation by Eruption and Apical Foramina Closure of Second Premolar Teeth

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Abstract

One of the major arenas of Identification in Forensic Medicine is age-estimation. The sequence of both deciduous and permanent tooth formation and eruption is considered as an excellent age-marker. Medico-legal importance of age in Forensic Medicine jargon like criminal responsibility (12 years), judicial punishments for juveniles (16 years), rape (16 years) and kidnapping (10 and 16 years) etc. fall in the age group of 10-16 and as literature on age determination among Indians from root formation is rarely encountered, this study was undertaken to aid the investigating agencies in the above mentioned circumstances and also in Identification.

The present study was conducted to estimate the age by eruption and apical foramina closure of permanent mandibular second premolar teeth, and to bring out the differences among the two genders. IOPA (Intra Oral Peri-Apical) radiographs of 200 children (100 males and 100 females) of age ranging from 8-18 years were taken. Eruption of teeth into the oral cavity was the criterion. The assessment of complete root formation and apical foramina closure was done using the stage 'H' of Demirjian method.

Key Words

Age estimation; eruption; apical foramina closure; second premolar; IOPA radiographs;

Introduction

"The real aim of all forensic science is to establish individuality or to approach it as closely as the present state of the science allows" is the citation of Paul Kirk, which shows the essence of identification process in the field of criminalistics¹. The assistance of dental expertise can aid in personal identification either individually or in the context of mass disasters. The dental evidence in identification is equally valuable and reliable as that of finger prints². The positive identification of living or dead using unique traits and characteristics of teeth is the corner stone of Forensic Odontology. Be it in the living, recently deceased or in human remains which are rendered unrecognizable by advanced decomposition or are completely skeletonised, experts must be able to make the four determinations: age, sex, race and stature. Of these, estimation of age is the most challenging task.^{3,4}. In addition to identification, age estimation has other medico-legal significance in categorization of an individual for rehabilitation (juvenile) or conviction.

The most reliable way to estimate age in children and adolescents is based on the sequence of both deciduous and permanent tooth formation and eruption. These are excellent age markers because there is consistency in the timing and sequence of eruption⁵. Medico-legal importance of age estimation in adolescents can be solved by radiological study, determining the development of crown, root and closure of apical foramina.

Aim of The Study

Bone growth and dental development are the two important objective criteria for estimation of age. The most reliable way to estimate age in children and adolescent is considered to be the sequence of both deciduous and permanent tooth formation and eruption. Although this sequence is well established and rarely varies, population

variation exists in the timing of dental eruption. In the present study an attempt has been made to test the variability among the population of Southern India and also to test the reliability and validity, so as to increase the accuracy of age determination in growing period of life.

Objectives

1. To estimate the age by eruption and apical foramina closure of permanent mandibular second premolar teeth.
2. To know the differences among the two gender.

Material and Methods

The study was conducted on the population of southern India, comprising of all the three major communities namely Hindus, Muslims, and Christians. A total of 200 students (100 males and 100 females) of age ranging from 8-18 years fulfilling the following criteria were included in the study.

Inclusion Criteria

1. Subject who has a proper document to certify the age stated.
2. Have a healthy oral hygiene.
3. Voluntary informed consent of the parent / guardian is obtained.

Exclusion Criteria

Subject with congenital missing tooth, injuries, loss of tooth (accidental or extracted), decaying of tooth, and restoration are excluded from the study.

The subjects selected were categorized into 10 groups of assorted age at an interval of 12 months. Thus 10% of the subjects were selected in each of the 10 different age groups.

Table 1. Showing distribution of study population

Age group (in years)	No. of Cases		Total(n)
	Males	females	
8.0-9	10	10	20
9.1-10	10	10	20
10.1-11	10	10	20
11.1-12	10	10	20
12.1-13	10	10	20
13.1-14	10	10	20
14.1-15	10	10	20
15.1-16	10	10	20
16.1-17	10	10	20
17.1-18	10	10	20
Total	100	100	200

Radiographs of right mandibular permanent second pre-molar were then taken by a single exposure using paralleling cone technique from each of the participants. Each of these radiographs was interpreted in light ambient room with proper view box and magnifying lens for root development and apical foramina closure. The eruption of teeth into the oral cavity was the criterion. The root formation is said to be completed when the apical foramina in it is closed⁵. The criteria for assessment of complete root formation and apical closure was adopted from the description of dental formation stages by 'Demirjian et al'

Age Estimation by Epiphyseal and Apical Formations of Second Premolar Teeth

Submitted by: [Name] Department of [Department Name] [Institution Name]

Abstract: This study aims to evaluate the effectiveness of epiphyseal and apical formations in second premolar teeth for age estimation. The study involves a series of experiments and observations on a sample of teeth from individuals of various ages.

Introduction: The purpose of this study is to determine the relationship between the development of epiphyseal and apical formations in second premolar teeth and the age of the individual. This is a preliminary study and the results are subject to further investigation.

Methodology: The study was conducted using a series of experiments and observations. The teeth were collected from individuals of various ages and the epiphyseal and apical formations were examined under a microscope.

Results: The results of the study indicate that there is a significant correlation between the development of epiphyseal and apical formations in second premolar teeth and the age of the individual. The study also found that the development of these formations is more rapid in younger individuals.

Conclusion: The study concludes that the development of epiphyseal and apical formations in second premolar teeth can be used as a reliable method for age estimation. The study also suggests that further research is needed to confirm these findings.

References: [List of references]

Appendix: [List of appendices]

Tables: [List of tables]

Figures: [List of figures]

Summary: [Summary of the study]

Conclusion: [Conclusion of the study]

References: [List of references]

The experimental error and bias of assessing the apical foramina closure was minimized by studying each radiograph by two separate observers independently. Whenever there was a difference of opinion expressed, the particular radiograph was studied jointly by both observers and a common opinion sought.

Observation and Results

Table 2. Showing Eruption and Root Completion of Second Premolar.

Age in years	Eruption		Root completion	
	Male	Female	Male	Female
8.00-9.00	01	00	01	00
9.01-10.00	01	00	01	00
10.01-11.00	00	02	00	02
11.01-12.00	06	09	05	04
12.01-13.00	06	09	05	07
13.01-14.00	08	09	08	09
14.01-15.00	10	10	10	10
15.01-16.00	10	09	09	09
16.01-17.00	10	10	10	10
17.01-18.00	10	10	10	10

- From 11.1yrs to 14 yrs around 60% of boys and 90% of girls presented with erupted second pre-molar. From 14.1yrs to 18 yrs almost 100% of girls and boys presented with erupted second pre-molar.
- In the age-group 11.1yrs to 12yrs, 50% of boys and 40% girls presented with root-completion of second premolar. This increased to 70% in girls of age-group 12.1yrs to 13.0 yrs, then to 80% boys and 90% girls in between 13.1yrs to 14 yrs age group. Almost 100% of boys and girls presented with root-completion of second pre-molar after 14 yrs. Only 10% each among boys and girls did not show root-completion in the age group of 15.1yrs to 16 yrs.

Table 3. Showing Accuracy percentage for estimation of Age by Second Premolar eruption

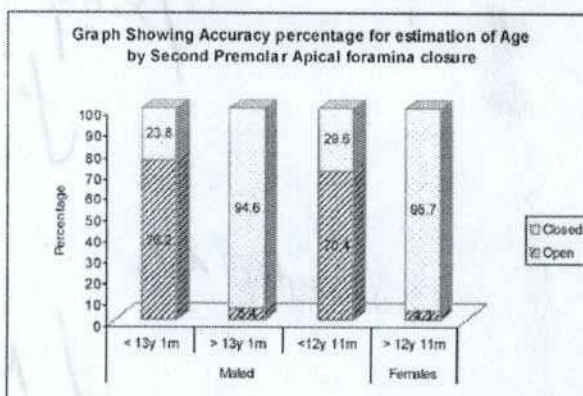
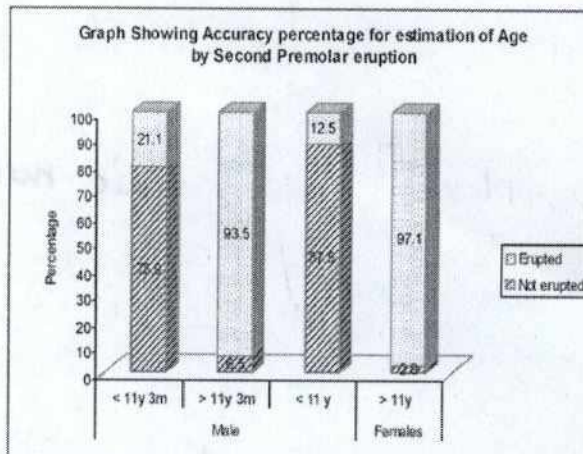
	Age	Second pre molar Eruption		Total
		Not erupted	Erupted	
Males	<11y 3m	30 (78.9%)	04 (6.5%)	34
	>11y 3m	08 (21.1%)	58 (93.5%)	66
Total		38	62	100
Females	<11y	28 (87.5%)	02 (2.9%)	30
	>11y	04 (12.5%)	66 (97.1%)	70
Total		32	68	100

Eruption of second pre-molar: Based on the data obtained from Table 3, eruption of second premolar occurred at 11 years 3 months (93.5%) and 11 years (97.1%), in male and female participants respectively.

The maximum age at which eruption of second premolar had not occurred was 13yrs 11months and 15yrs 1month and the earliest age of eruption of second premolar was 9yrs 9 months and 10yrs 3months in males and females respectively.

Table 4. Showing Accuracy percentage for estimation of Age by Second Premolar Apical foramina closure

	Age	Second pre molar Apical foramina closure		Total
		Open	Closed	
Males	<13y 1m	48(76.2%)	02(5.4%)	50
	>13y 1m	15(23.8%)	35(94.6%)	50
Total		63	37	100
Females	<12y 11m	38(70.4%)	02(4.3%)	40
	>12y 11m	16(29.6%)	44(95.7%)	60
Total		54	46	100



Apical foramina closure of pre-molar: According to Table 4 the closure of apical foramen was observed at the ages of 13 years 1 month and 12 year 11 months in 94.6% in males and 95.7% in females respectively.

The highest age of patent apical foramina was 15yrs 5months and 15yrs 1month in males and females respectively, while the least age of apical foramen closure was 11yrs 6months and 12yrs in males and females respectively.

Discussion

Methods for determination of a child's growth and development are of great value for medico-legal experts. Although various methods for age-determination do exist, a universal system has not been achieved due to regional differences in growth patterns. The present study is done with the main objective of determining age among the South Indian population by observing eruption and apical foramina closure of permanent mandibular second pre-molar teeth. The main aim of this study is to test the variability, reliability and validity of eruption and apical foramina closure, so as to increase the accuracy of age-determination in the growing period of life. In most of the previous studies, IOPA (Intra Oral Peri Apical) radiographs were taken using Bisecting angle technique. In the present study paralleling cone technique is used, which has more accuracy than other traditional methods. Comparison between dental ages shows that, premolar erupts and calcifies earlier in females than males. The literature in various Indian Textbooks give the age-range for eruption and apical foramina closure of second pre-molar to be between 10-12 years and 12-14 years respectively.

A study by Rajendran, Daniel. T from Chennai shows the average age of eruption of second pre-molar to be 11.10 with standard deviation ± 1.37 years. Whereas our study shows the cut-off age of eruption to be 11 years 3 months, for second pre-molar⁶. Thus in

children, if the second premolar has not erupted, the age is below 12 years⁷.

The ethnic and regional differences between populations necessitates for the studies of individual population as observed in the present study. The effect of environmental, nutritional and socio-economic factors may play an important role in the development of teeth, which may cause variations in the values reported.

Conclusion

The following conclusions were drawn from the present study:

- 93.5% of males and 97.1% of females presented with erupted second premolar at the ages of 11 yrs. 3 months and 11 yrs respectively.
- 94.6% of males and 95.7% of females presented with closed apical foramina of second premolar at the ages of 13 yrs 1 month and 12 yrs 11 months respectively.

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