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Reliability of Third Molar Root Development According to Kullman's Method to Estimate Chronological Age

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ABSTRACT

Background: Identification of the living person and the dead is of paramount importance for variety of reasons in forensic practice routinely. Age estimation is one of the prime factors employed to establish identity. Estimating age from teeth is generally reliable as they are naturally preserved long after all the tissues and bones have disintegrated.

Method: A study was done to compare the chronological age with that of the dental age. Dental age was assessed by taking intraoral periapical radiographs of the right and left mandibular third molars, adopting the Leif Kullman et al method. 151 males and 152 female subjects were included in the study of the age ranging from 15.1-25yrs.The subjects were radiographically examined for the different stages of the root development of the third molars

Results: A strong correlation coefficient was seen between the chronological age and mandibular third molars (0.856 with 38, 0.847 with 48, P<0.001).

Conclusion: The study showed a positive correlation between the chronological (true) age and the dental age. The use of third molars as a developmental marker is appropriate.

Keywords: Dental age, Kullman's method, Age estimation.

INTRODUCTION

Age estimation is of great importance for variety of reasons in forensic practice. Estimating age from teeth is generally reliable as they are naturally preserved long after all the tissues and even bones have disintegrated. Teeth are the most durable structures in the human body, less influenced by environmental factors.[1]The timing and sequence of the developing dentition follow a very strict pattern although they are influenced by genetic, nutritional and environmental factors. Owing to the comparatively low variability of tooth formation in relation to chronological age, it is likely that the method for assessing age, based on stages of tooth formation, is more appropriate than those based on other indicators of somatic age. In childhood, the observation of the dentition status results in highly accurate age assessment. However, this accuracy decreases simultaneously with the completion of a person's dental development. In addition to its clinical importance, the radiographic diagnosis may have possible medico-legal implications, because it is one of the parameters

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proposed to determine the age of undocumented youths.

Skeletal indicators, such as diaphysis–epiphysis fusion, hand– wrist examination, cervical vertebrae assessment, amino acid racemization, sternoclavicular bones, changes in the pubic symphysis, fusion of cranial sutures, or changes in secondary sex characteristics, all have their advantages and disadvantages and are more or less indecisive. Determining chronologic age in persons within the range of 15.5–23.5 years remains a problem.

The third molar offers a unique advantage over other teeth because its development tends to continue over a long period and until a later age. But third molars are the most inconstant of all teeth. However, evaluation of third-molar maturity seems to be an adequate method for estimating the age of undocumented juvenile suspects.

MATERIALS AND METHODOLOGY

This study included a total of three hundred subjects, comprising of 150 males and 150 females in the age group ranging from 15.1 to 25 years. They were further divided into five groups that is, 15.1-17years, 17.1-19yeras, 19.1-21 years, 21.1-23 years, 23.1-25 years. Patients with good oral hygiene and good health, without congenitally missing third molars were included in the study.

The patients were examined according to the methods described in Kerr, Ash, Millard.[2] In the Proforma the age, gender, date of birth, and the other details of the patient were recorded so as to assess the chronological age of the patient and the patient consent was taken. A detailed history of each patient was taken.

IOPA radiograph of the third and the forth quadrant third molar were taken on a Planmeca Intra, 00886 machine using standardized technique. Exposure factors were kept at 68kvp, 6mA with an exposure time of 0.125 seconds for the exposure of the mandibular right and left third molars. All the films were processed under standardized conditions and were analyzed for age estimation using view box under good illumination. The IOPA radiographs were then studied for 7 different stages of root development of the third molars by the method adopted by Kullman.[3] The stages of tooth development are as follows:

1. Ri-R1/4: root development initiated but < ¼ of the estimated root length.
2. R1/4-R1/2: root development > ¼ but < ½ of the estimated root length.
3. R1/2-R3/4: root development > ½ but < ¾ of the estimated root length.
4. R3/4-Rc: root development > ¾ but less than full estimated length.
5. Rc-Aci: the full estimated root length is formed but apical closure not initiated.
6. Aci-Ac: apical closure started but not closed.
7. Ac: apex fully closed & root development completed.

Age and sex distribution:

The total sample is divided into 5 groups that is, 15.1-17years, 17.1-19yeras, 19.1-21 years, 21.1-23 years, 23.1-25 years. In the first age group 30 males and 31 females were included. In the age group of 17.1-19yrs 32 males and 30 females were included. In the age group of 19.1-21yrs , 21.1-23yrs and 23.1-25yrs 30 male subjects and 30 female subjects were included.

RESULTS

Statistical analysis was performed using SPSS software.For assessing correlation between dental age and chronological age Pearson's correlation coefficient and Spearman's rank correlation co-efficient was calculated. A *P* value of less than 0.005 was considered as significant. The results obtained are shown in tables(table 1-5)

Age group 15.1-17yrs

90 %-93%of male subjects and 84%-81%of female subjects belonged to stage 1 of root development as shown in table 1, indicating good correlation between these two parameters.

Age group 17.1-19yrs

44-47% of male subjects belonged to stage 4 of root development while 20-33%of female subjects belonged to stage 3 of root development, showing correlation between these two stages as shown in table 2.

Table 1: Root development of 38 and 48 in age group 15.1-17yrs.

15.1-17	Males				Females			
	38		48		38		48	
Grade	No.	%	No.	%	No.	%	No.	%
I	27	90	28	93	26	84	25	81
II	3	10	2	7	3	10	4	13
III	0	0	0	0	2	6	2	6
IV	0	0	0	0	0	0	0	0
V	0	0	0	0	0	0	0	0
VI	0	0	0	0	0	0	0	0
VII	0	0	0	0	0	0	0	0
Total	30		30		31		31	

Table 2: Root development of 38 and 48 in age group 17.1-19yrs.

17.1-19	Males				Females			
	38		48		38		48	
Grade	No.	%	No.	%	No.	%	No.	%
I	7	22	7	22	5	17	5	17
II	0	0	0	0	9	30	5	17
III	3	9	1	3	6	20	10	33
IV	14	44	15	47	3	10	3	10
V	4	13	0	0	3	10	2	7
VI	2	6	5	16	3	10	4	13
VII	2	6	4	13	1	3	1	3
Total	32		32		30		30	

Table 3: Root development of 38 and 48 in age group 19.1-21yrs.

19.1-21	Males				Females			
	38		48		38		48	
Grade	No.	%	No.	%	No.	%	No.	%
I	1	3	1	3	0	0	0	0
II	0	0	0	0	1	3	2	7
III	0	0	0	0	5	17	6	20
IV	1	3	2	7	12	40	10	33
V	4	13	3	10	4	13	3	10
VI	19	63	20	67	4	13	5	17
VII	5	17	4	13	4	13	4	13
Total	30		30		30		30	

Table 4: Root development of 38 and 48 in age group 21.1-23yrs.

21.1-23	Males				Females			
	38		48		38		48	
Grade	No.	%	No.	%	No.	%	No.	%
I	0	0	0	0	0	0	0	0
II	1	3	0	0	0	0	0	0
III	0	0	0	0	0	0	0	0
IV	0	0	0	0	0	0	0	0
V	2	7	2	7	0	0	0	0
VI	22	73	24	80	19	63	16	53
VII	5	17	4	13	11	37	14	47
Total	30		30		30		30	

Table 5: Root development of 38 and 48 in age group 23.1-25yrs.

23.1-25	Males				Females			
	38		48		38		48	
Grade	No.	%	No.	%	No.	%	No.	%
I	0	0	0	0	0	0	0	0
II	0	0	0	0	0	0	0	0
III	0	0	0	0	0	0	0	0
IV	0	0	0	0	0	0	0	0
V	0	0	0	0	0	0	0	0
VI	9	30	9	30	6	20	4	13
VII	21	70	21	70	24	80	26	87
Total	30		30		30		30	

Table 6: Correlation analysis, of the chronological age with that of dental age.

	38	48
Actual age	0.856	0.847
P* Value, sig	P<0.001 HS	P<0.001 HS

Age group 19.1-21yrs

63-67% of male subjects showed stage 6 of root development while 33-40% of female subjects showed stage 4 of root development showing relative correlation between these stages as shown in table 3

Age group 21.1-23yrs

73-80%of male subjects and 63-53% of female subjects belonged to stage 6 showing relative correlation between these two stages as shown in table 4.

Age group 23.1-25yrs

70% of male subjects and 80-87% of female subjects belonged to stage 7 of root development showing correlation between these two as shown in table 5.

Table 6 shows values of correlation coefficient assessed between 38 and 48. High significant correlation was noticed in most cases. However,

15.1-17.0yrs age group male subjects showed non-significant correlation.

Table 7 shows Spearman's correlation coefficient between chronological age and dental age. High significant correlation was noticed between chronological age and dental age with values of 0.856 and 0.847 relating to 38 and 48 respectively.

DISCUSSION

Various Radiological, histologic and biochemical methods may be used to determine the age of patient for forensic needs. Radiologic methods are preferred over other methods as other methods require extraction and preparation of microscopic sections. Further radiologic methods are simpler, economic and can be performed on living individuals as well.[4]

The third molar offers a unique advantage over other teeth in that its development tends to continue over a longer period and until later age. It is claimed that tooth development is an accurate measure of chronological age that seems to be independent of exogenic factors like disease, malnutrition etc. whereas, some indicators of maturity such as skeletal development, from the bones seemed to be dependent on exogenic factors.

Various methods used to assess the stages of tooth mineralization were studied by Demirjian et al.,[5] Harry H Mincer et al.,[6] Leif Kullman et al.,[3] .Demirjian method is most popularly used in several studies to evaluate tooth mineralisation stages. Study by Naik et al[7] using Demirjian index showed positive correlation between third molar stages and chronological age However, Demirjian's formula was considered less reliable as it gave a considerable difference in age, with significant (P < 0.0001) underestimation in both males and females of approximately 2–3 years.[8,9] Study by Mincer et al.,[6] also did not support the use of the third molar as an age indicator. However, population analyses by Bhat et al[10] using Kullman's method, noted a strong correlation between the chronological age and dental development with the third molar developmental stages. This was reconfirmed in the present study. Also,correlation coefficient and P value between the dental parameter and chronological age were similar to those in present study.

Significant positive correlation was found between chronological and dental age, these findings were coinciding with observations made by Hegde RJ et al,[11] Naik et al[7]

In the present study male subjects showed a relatively higher mineralisation initially but female subjects achieved complete tooth mineralisation earlier than male subjects. Observations by Jashwant A Darji et al.,found statistically significant sex differences.[12]

Noticeable variations in dental development between individuals and between different population groups in different regions may be observed.[13] Study by Mincer et al showed no significant difference in the development of the third molar as observed with regard to race. However, third molar mineralization among Germans, Japanese and South Africans were compared in a study conducted by Olze et al[14] using Demirjian's classification system, which showed development completed first in South Africans, then in Germans, and finally in the Japanese participants. The findings of the present study relates to population of Indian subcontinent.

CONCLUSION

Positive correlation exists between the chronological (true) age and the dental age as determined by third molar. The use of third molars as a developmental marker is appropriate.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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