# EVALUATION OF AGE IN LEGAL PROCEDURES OF INDIVIDUALS WITHOUT LEGAL RECORDS 

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#### Abstract

Background: Forensic science deals with illegal cases that need to be solve by using specialized methods and one of the method is age detection. Evaluation of age in legal procedures plays a vital role in solving the case. Changes related to chronological age are seen in both hard and soft tissue. A number of methods for age estimation have been proposed which can be classified in four categories, namely, clinical, radiological, histological and chemical analysis. In forensic odontology, age estimation based on tooth development is universally accepted method. Aim: To Evaluation the age in legal procedures of individuals without legal records Material \& Method: Total 50 panoramic radiographs were collected randomly. The panoramic radiographs were divided into following two groups based on the age of subjects. Results: Demirjian's method of age estimation combined with Acharya's India specific formula is reliable for the calculation of age in males from age 16.1-23, but it is not reliable in males in age group of 7-16.


## KEYWORDS : forensic Odontology, Demirjian's method, age estimation, Acharya's method

## INTRODUCTION:

Forensic odontology is an evolving science and has a greater scope of development. It has established as an indispensable science in medico-legal matters and in the identification of the dead person. ${ }^{1}$

The need for age estimation has increased in recent years because there is increase in numbers of unidentified cadavers and human remain especially in metropolitan cities and age estimation for living individuals who do not have valid proof of date of birth with them ${ }^{21}$

In the current scenario, most of the age estimation modalities are invasive, requiring lengthy processing times, use of expensive instruments and the services of an experienced pathologist to deduce the age of the person. But the biggest pitfall had been the lack of the usability of these methods in-vivo. It is in this juncture, that the branch of radiology comes handy as it offers an insight into the developmental stages of the teeth, which provides $\alpha$ baseline data for age estimation in children and adolescents ${ }^{3}$ Several methods of age estimation have been developed to access the dental age according to the degree of calcification observed in permanent teeth ${ }^{4}$. Tooth development is a useful measure of maturity since it represents a series of recognizable events that occur in the same sequence from an initial event to $\alpha$ constant end point ${ }^{5}$.

Demirjian's Method of Age Estimation has been widely used throughout the world for age estimation of an individual in developing dentition ${ }^{6}$. This method uses only an orthopantomogram of the patient for calculating the age of the individual. The method is based on ratings of the radiographs of the seven left side teeth of the mandible, which were shown to be representive of all the teeth of the mandible. Eight stages of calcification for each tooth were identified and described and each one was allocated a score ${ }^{7}$. The scores were summed up and compared to the centile chart to arrive the age. It has been seen that there is wide range of variations in age estimates and thus a new India specific formula has been adapted by modifying the Demirjian's original formula by 8 teeth instead of 7 teeth method by including third molar given by Dr. Acharya in the year 2011, to use it on a wider range of population.

In this study we are going to evaluate the accuracy of age estimation using Demirjian's 8 teeth method of age estimation combined with Acharya's India specific formula random population which can be further used for legal procedures of individuals without any legal records of age.

## AIMS \& OBJECTIVES:

To evaluate age in legal procedures of individuals without legal records

## MATERIAL \& METHOD:

Source Of Data:
In the present study a total of 50 panoramic radiographs were included which were obtained from archives of Department of Orthodontics and Department of Oral Medicine and Radiology of Divya Jyoti College of Dental Sciences and Research, Modinagar, Uttar Pradesh. Clearance from the ethical committee was obtained.

## Inclusion Criteria:

1. Patients free of obvious developmental anomalies.
2. OPGs without any distortions.
3. Radiographs of patients with the full complement of teeth in the mandibular left or right side.

## Exclusion Criteria:

1. Radiographs of patients with developmental anomalies.
2. Radiographs with distortion and crowding of teeth where the root is overlapped.
3. Radiographs in which structures of the teeth were not clearly visible.
4. Radiographs of patients with bilaterally missing teeth in the mandible.

## MATERIALS:

The materials used in the study are:
KODAK 8000 digital panoramic unit,KODAK Dental Imaging Software,Adobe Photoshop Software 7.0.,Microsoft Office 2013 Software.,Laptop (HP),Compact Disc (Mosebaer), Permanent Marker, Pen ,Pencil ,Eraser ,Statistical Package for Social Sciences (SPSS) Statistical Software Versionl0.

METHOD:
Total 50 panoramic radiographs were collected. The
panoramic radiographs were divided into following two groups based on the age

1. Group A: Males in the age group of 7-16 years
2. Group B: Males in the age group of 16.1-23 years

The soft copies of these radiographs were retrieved from the computer system. The rationale for dividing the sample based on sex was that the maturity scores assigned to each tooth based on its developmental stages was gender specific due to the differing rates in the development of the teeth in either sex. Within each sex, the samples were divided into two subgroups to assess the reliability of the third molar in age estimation, since after 16 years, it is only the third molar, which is still developing under normal conditions.

The images from the digital OPG machine were in JPEG format, integrated with the KODAK 8000 digital panoramic unit. The digital images were then analysed with Adobe Photoshop 7.0. During the analysis, 'Magnify' and 'Ruler' tools were used. By using the scoring criteria total maturation score (S) was calculated.

## Interpretation

The panoramic radiographs would be interpreted according to the French Maturity Scores given by A Demirjian, H. Goldstein, and M. Tanner in the year 1973.

## Dental Formation Stages

0 Tooth not yet calcified.
1 Crypt Stage: Bone crypts are visible without dental germ inside it.
2 In both uniradicular and multiradicular teeth, a beginning of calcification is seen at the superior level of the crypt in the form of an inverted cone or cones. There is no fusion of these calcified points.
3 Fusion of the calcified points forms one or several cusps which unite to give a regularly outlined occlusal surface.
$4 \alpha$. Enamel formation is complete at the occlusal surface. Its extension and convergence towards the cervical region is seen.
b. The beginning of the dentinal deposit is seen.
c. The outline of the pulp chamber has a curved shape at the occlusal border.
5 a. The crown formation is completed down to the cementoenamel junction.
b. the superior border of the pulp chamber in the uniradicular teeth has a definite curved form, being concave towards the cervical region. The projection of the pulp horns if present, gives an outline shaped like an umbrella top. In molars the pulp chamber has a trapezoidal form.
c. Beginning of root formation is seen in the formation is seen in the form of a spicule.

6 Uniradicular Teeth:
a. The wall of the pulp chamber now form straight lines, horn, which is larger than the previous stage.
b. The root length is less than the crown height.

## Molars:

a. Initial formation of the radicular bifurcation is seen in the form of either a calcified point or a semilunar shape.
b. The root length is still less than the crown height.

## 7 Uniradicular Teeth:

a. The walls of the pulp chamber now form a more or less isosceles triangle. The apex ends in a funnel shape.
b. The root length is equal to or greater than the crown height.

## Molars:

a. The calcified origin of the bifurcation has developed further down from its semi-lunar

Stage to give the roots a more definite and distinct outline with funnel shaped endings.
b. The root length is equal to or greater than the crown height.
8 a. The walls of the root canal are now parallel and its apical end is still partially open.
9 a. The apical end of the root canal is completely closed. b. The periodontal membrane has a uniform width around the root and the apex.

## Using the scoring system:

1. Each tooth will have a rating, assessed by the procedure described.
2. This is converted into a score for boys or girls as appropriate.
3. The scores for all seven teeth are added together to give the maturity score.
4. The maturity score may be plotted on the centile charts where the age of the child is known.
5. The maturity score may be converted directly into a dental age either by reading off on the horizontal scale the age at which the $50^{\text {th }}$ centile attains the maturity score value.

## Statistical Analysis

The data was entered in the Microsoft Excel and processed using the Statistical Package for Social Sciences (SPSS Ver. 19). The Mean, Standard Deviation and frequency (percentage) of the data was calculated for the purpose of descriptive statistics. The paired t test was used for the estimation of correlation between the actual age and the estimated age. The level of significance was fixed at $5 \%$.

Correlation Between Estimated Age And Actual Age

|  | Actual Age | Estimated <br> Age | Correlation <br> Coefficient | Significance |
| :--- | :--- | :--- | :--- | :--- |
| GROUP A | $11.94 \pm 2.64$ | $12.96 \pm 3.32$ | 0.373 | 0.124 (Non- <br> Significant) |
| GROUP B | $20.00 \pm 2.12$ | $18.78 \pm 0.96$ | 0.657 | 0.001 <br> (Significant) |

Error Of Age Estimation In All The Groups During The Study

|  | NO OF SAMPLES | MAE |
| :--- | :--- | :--- |
| GROUP A | 18 | $1.97 \pm 2.90$ |
| GROUP B | 32 | $1.72 \pm 1.11$ |

In our study group A shows non significant results and group B shows significant results.

## DISCUSSION :

Forensic odontology is a new branch of dentistry that is developed as a separate speciality for the knowledge of a dentist to serve the judiciary system. Estimation of age is an important aspect of forensic research. The use of teeth for determining the age of an individual has its origin 170 years ago when tooth eruption was first used for dental age estimation in connection with child labour. In response to the need for age estimation of factory children who were not allowed to be employed under the age of nine and with a restricted working time between 9 years and 12 years of age. ${ }^{8}$

In ancient times, age estimations of living adolescents were considered important. According to records in Ancient Rome adolescents were judged to be fit for service, as soon as the second molars had erupted completely. It was mainly dentists who had to carry out age estimations ${ }^{9}$ In 1973 Demirjian et al gave a new method of age estimation known as Demirjian's method of age estimation based on the based on the developmental stages of teeth ${ }^{10}$ This method has undergone a number of modifications, since then due to its lack of reliability in several subsequent studies ${ }^{3}$. In order to overrule the differences in age detection, Acharya carried out a regression analysis and derived a formula incorporating third molars as
well into the age estimation process in an Indian population ${ }^{6}$. In this study a total 50 panoramic radiographs were taken from the archives of Department of Orthodontics and Department of Oral Medicine and Radiology of Divya Jyoti College of Dental Sciences and Research to check the reliability of age estimation using Demirjian's 8 teeth method of age estimation combined with Acharya's India specific formula in and around Modinagar population. The subjects were divided into four groups i.e. Group A consisting of males within of 7-16 years, and Group B consisting of males within of 16.1-23 years.

In the present study Group $A$ has P value $=0.124$ which is $\geq$ 0.05 and as the P value exceeds the limit it is statistically considered to be insignificant. Out of 18 samples the MAE was calculated to be $1.97 \pm 2.90$ which is statistically very high. The difference obtained is divided in three groups i.e. within $\pm 1$ year within l.1-2 years \& 2 years. In group A we found that $44.4 \%$ in $\pm 1,33.3 \%$ within $\pm 2$ and contains $22.2 \%$ in $> \pm 2$. This shows that there is not much correlation between the actual age and the calculated age. Hence the result was in accordance with similar study conducted by Gandhi et al ${ }^{11}$ and Tandon et al ${ }^{12}$.

Gandhi et al $2015^{11}$ Indian formula was more reliable for age estimation with only slight underestimation ( -0.65 years) in males and overestimation ( 0.68 years) in females with $\mathrm{P}=$ 0.071. Demirjian's formula is less reliable as it gave a considerable difference in age, with underestimation in both males and females of approximately $2-3$ years. Mean chronological age and standard deviation for the mineralization stages of mandibular third molar in males and females showed that dental development was almost parallel in males and females from 13 to 15 years.

Tandon et al $2015^{12}$ On comparing calculated age with estimated age using India specific formula, mean estimated age was found to be significantly higher than calculated age for overall as well as both the genders independently. The difference between the estimated age and calculated age was significant for all age groups except the age group 16-18 years.

Group B shows significant co relation between estimated age and actual age i.e. $\mathrm{P} \leq 0.05$ which is calculated to be $\mathrm{P}=0.001$. Group B containing 32 no. of samples shows a MAE of $1.72 \pm 1.11$ which is permissible. Hence the result obtained is taken to be significant. The difference obtained in group B is found that $31.2 \%$ in $\pm 1,28.1 \%$ within $\pm 2$ and contains $40.7 \%$ in $> \pm 2$. This shows statistically good correlation between the actual age and the calculated age. The result was in accordance with Kumar et al $^{3}$, Khorate et $\mathrm{al}^{13}$ and Tandon et al $^{12}$

Kumar et al $2011^{3}$ the reliability of age estimation using the Demirjian's 8 teeth method following the French maturity scores and India specific formula provides fairly reliable results. This has resulted in the error of age prediction narrowing down to just over 1 year, which a slight improvement compared to the original method is carried out in the Indian population. We also noted that incorporation of the third molar results in slightly greater errors in age estimates.

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Khorate et $\mathrm{al} 2014^{13}$ in their study on Goan population found

Acharya's India specific formula is limited to an age group 1020 years in males.

This study was conducted in the Department of Oral Pathology and Microbiology of DJ College of Dental Sciences and Research, Modinagar, UP. The aim of this study was to evaluate the reliability of age estimation using the modified Demirjian's 8 teeth method following the gender specific French maturity scores, combined by Acharya's India specific formula derived in the Indian population in a Modinagar population.

The study consisted of 50 subjects 50 males divided in an age group of 7-16 and 16.1-23 years. The soft copies of the OPG's were collected from the archives of Department of Oral Medicine and Radiology and from the Department of Orthodontics of the DJ College of Dental Sciences and Research Modinagar, UP. The age was calculated according to the Acharya's India Specific Formula using the French maturity scores given by Demirjian's 8 teeth method. Then the estimated age and the actual age were compared to determine the accuracy of the method in Modinagar population for age estimation in the field of health sciences, being relevant to the timing of various treatment procedures and to evaluate age in legal procedures of individuals without legal records.

In our study the relation between actual age and estimated age is found to be significant ( $\mathrm{P}=0.001$ ) and the overall estimated error was found to be $1.46 \pm 1.57$ which is permissible.

This study shows that the Demirjian's method of age estimation combined with Acharya's India specific formula is reliable for the calculation of age in Modinagar population in males from age 16.1-23, but it is not reliable in males in age group of 7-16.

The sole limitation of the study is that it cannot be used on individuals before 7 years of age and beyond 23 years of age. It is formula specific and error may occur according to the sample size and clarity of the radiograph. Though India specific formula is reliable for Modinagar population but further studies are recommended with larger sample size.

## CONCLUSION:

Forensic odontology is that branch forensic medicine has established itself as an important and indispensable service in medico legal matters toward the creation of justice and secures society for the future inhabitants.

## REFERENCES:

1. Jeddy N, Ravi S, Radhika T. Current trends in forensic odontology. J Forensic Dent Sci. 2017 Sep-Dec;9(3):115-119.
2. Divakar KP. Forensic Odontology: The New Dimension in Dental Analysis. Int J Biomed Sci. 2017 Mar;13(1):1-5
3. Kumar VJ, Gopal KS. Reliability of age estimation using Demirjian's 8 teeth method and India specific formula. J Forensic Dent Sci 2011:3(1):19-22.
4. Warhekar AM, Wanjari PV, Phulambrikar T. Corelation of radiographic and chronological age in human by using Demirjian's method: A radiographic study. Journal of Indian Academy of Oral Medicine and Radiology. 2011 23(1): 1-4.
5. Prabhakar AR, Panda AK, Raju OS. Applicability of Demirjian's method of age assessment in children of Davangere: J Indian Soc Pedo Peav Dent 2002; 20(2):54-62.
6. Acharya AB. Age estimation in Indians using Demirjian's 8-teeth method. Forensic Sci 2011; 56(1):124-7.
7. Demirjian A, Goldstein H. New systems of dental maturity based on seven and four teeth. Ann Hum Biol 1976; 3(1):411-21.
8. Saunders E. The Teeth a Test of Age, Considered with Reference to the Factory Children, Addressed to the Members of Both Houses of Parliament. London: Renshaw; 1837.
9. Manjunatha BS, Soni NK. Estimation of age from development and eruption of teeth. J. Forensic Dent Sci. 2014; 6(2): 73-6.
10. Demirjian A, Goldstein H, Tanner JM. A new system of dental age assessment Hum Biol 1973; 45:211-27
11. Gandhi N, Jain S, Kumar M, Rupakar P, Choyal K, Prajapati S. Reliability of third molar development for age estimation in Gujarati population: A comparative study. J Forensic Dent Sci. 2015; 7(2): 107-13.
12. Tandon A, Agarwal A, Arora V. Reliability of India-specific regression formula for age estimation of population in and around Bahadurgarh, Haryana (India). Journal of oral biology and craniofacial research 2015; 5(1): 193-7
13. Khorate MM, Dinkar AD, Ahmed J. Accuracy of age estimation methods from orthopantomograph in forensic odontology: a comparative study. Forensic Science International. 2014; 234(184) el-8.
