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Original Research Paper

Oral Pathology

RELIABILITY OF AGE ESTIMATION USING DEMIRJIAN'S 8 TEETH METHOD COMBINED WITH ACHARYA'S INDIA SPECIFIC FORMULA IN A MODINAGAR POPULATION'.

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ABSTRACT

Background: Age estimation forms one of the most important sub-disciplines of forensic sciences and is of paramount importance in medico-legal issues. The age estimation process has to be highly accurate in predicting the individual's age and easy to use. Several methods of age estimation have been developed to access the dental age according to the degree of calcification observed in permanent teeth. **Aim:** To evaluate the reliability of age estimation using Demirjian's 8 teeth method following the French maturity scores and India specific formula in Modinagar, Uttar Pradesh population **Material & method:** Total 100 panoramic radiographs were collected from 50 males and 50 female subjects. The panoramic radiographs were divided into following four groups based on the age and sex of the subjects. **Results:** Demirjian's method of age estimation combined with Acharya's India specific formula is reliable for the calculation of age in Modinagar population in females from age 7-23 and 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:

The broadening frontiers of dentistry have taken the dentist as an expert witness in legal room proceedings and in the field of forensic sciences. But forensic odontology for long had been a less explored area of dentistry. 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 a baseline data for age estimation in children and adolescents[1]

Several methods of age estimation have been developed to access the dental age according to the degree of calcification observed in permanent teeth [2]. 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 a constant end point[3].

Demirjian's Method of Age Estimation has been widely used throughout the world for age estimation of an individual in developing dentition [4]. 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[5]. 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 in Modinagar, Uttar Pradesh population which can be further used for legal procedures of individuals without any legal records of age.

AIMS :

To evaluate the reliability of age estimation using Demirjian's 8 teeth method following the French maturity scores and India specific formula in Modinagar, Uttar Pradesh region.

MATERIAL & METHOD:

Source Of Data:

In the present study a total of 100 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 Version10.

METHOD:

Total 100 panoramic radiographs were collected from 50 males and 50 female subjects. The panoramic radiographs were divided into following four groups based on the age and sex of the subjects.

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
3. Group C: Females in the age group of 7–16 years

4. Group D: Females 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 a. 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 50th centile attains the maturity score value.

RESULTS:

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%

$$t = \frac{\bar{x} - 0}{SE(d)} = \frac{\bar{x}}{SD(x)/\sqrt{n}}$$

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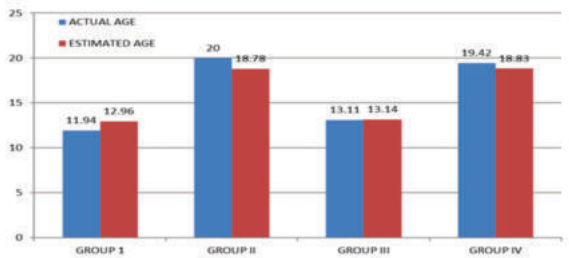
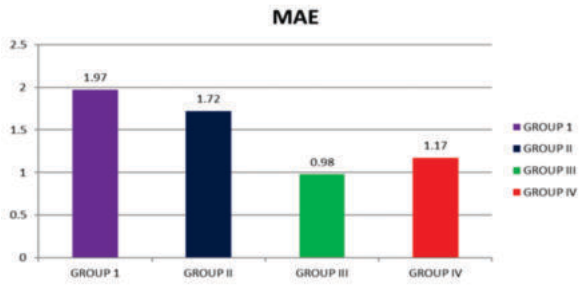
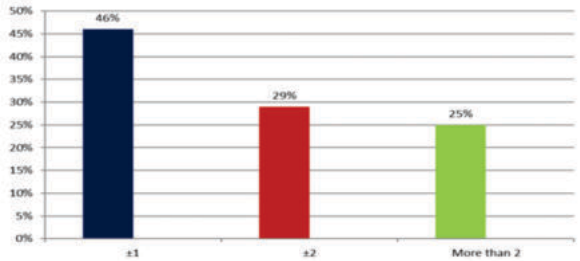


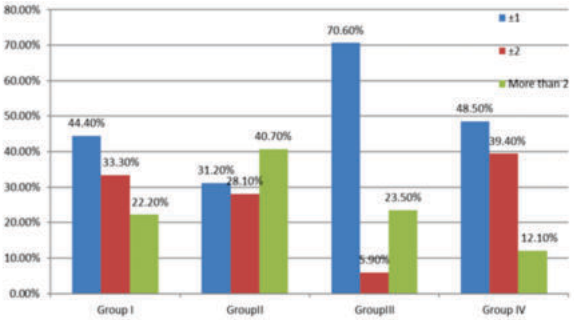
Correlation Between Estimated Age And Actual Age



Error Of Age Estimation In All The Groups During The Study



Percentage Of Subjects With Different Levels Of Accuracy In The Age Estimation



Percentage Of Subjects With Different Levels Of Accuracy In Different Groups

In our study the relation between actual age and estimated age is found to be significant (P = 0.001) and the overall estimated error was found to be 1.46±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 females from age 7-23 and males from age 16.1-23, but it is not reliable in males in age group of 7-16.

DISCUSSION :

Dental age estimation in the living is mostly based upon non-invasive methods, which evaluate the timing and sequence of defined growth stages of the developing dentition and the sequence or modification of traits in the mature dentition and the surrounding tissues[6].

Eruption of teeth is one of the changes observed easily among the various dynamic changes that occur from the formation of teeth to the final shedding of teeth. The times of eruption of teeth are fairly constant and assessment of age of an individual by examination of teeth is one of the accepted methods of age determination[6].

In this context Demirjian et al in 1973 classified the development of teeth into 8 stages and arrived at an age estimation method for French population[7]. This study has undergone several modifications for its applicability in different regions[7,8,9]. Later on third molar was incorporated in to expand the scope and duration of age prediction. Acharya has carried out a regression analysis and worked out a formula that uses the percentile scores of Demirjian's 8 teeth method for age estimation in Indian population. This formula is known as India specific formula[1].

In this study a total 100 panoramic radiographs i.e. 50 males and 50 females respectively 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, Group B consisting of males within of 16.1-23 years, Group C consisting of females ranging from 7-16 years and Group D consisting of females in the age group of 16.1-23 years respectively In this study a total 100 panoramic radiographs i.e. 50 males and 50 females respectively 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, Group B consisting of males within of 16.1-23 years, Group C consisting of females ranging from 7-16 years and Group D consisting of females in the age group of 16.1-23 years respectively In the present study **Group A** has P value = 0.124 which is ≥ 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±2.90 which is statistically very high. The difference obtained is divided in three groups i.e. within ± 1 year within 1.1-2 years & 2 years. In group A we found that 44.4% in ±1, 33.3% within ± 2 and contains 22.2% in >± 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[10] and Tandon et al[11].

Gandhi et al 2015[10] 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 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[11] 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. P ≤ 0.05 which is calculated to be P=0.001. Group B containing 32 no. of samples shows a MAE of 1.72±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 ±1, 28.1% within ± 2 and contains 40.7% in >± 2. This shows statistically good correlation between the actual age and the calculated age. The result was in accordance with Kumar et al[1], Khorate et al[12] and Tandon et al[11]

Kumar et al 2011[1] 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.

Tandon et al 2015[11] 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.

Khorate et al 2014[12] in their study on Goan population found Acharya's India specific formula is limited to an age group 10-20 years in males.

Group C has P value = 0.001 which is ≤ 0.05 which is statistically significant. It contains 17 samples with MAE of 0.98±1.06 and the difference obtained in group C is found that 70.6% in ±1, 5.9% within ± 2 and contains 23.5% in >± 2. Hence this shows good correlation between the actual age and the calculated age. The result obtained was in

accordance to the result of similar study conducted by Kumar et al[1], Khorate et al[12] and Tandon et al[11].

Kumar et al 2011[1] 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, as was also noted previously.

Khorate et al 2014[12] in their study on Goan population found Acharya's India specific formula is limited to an age group of 9-22 years in females and 10-20 years for males.

Tandon et al 2015[11] 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 D has a statistically significant result of P value = 0.001 which is ≤ 0.05. Out of the 33 samples the MAE was calculated to be 1.17±0.97. The difference in group D was calculatd 48.5% in ±1, 39.4% within ± 2 and contains 12.1% in > ± 2. The result obtained was in accordance with the result of a similar study conducted by Kumar et al[1], Khorate et al[12]and Tandon et al[11] .

Kumar et al 2011[1] 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, as was also noted previously and it agrees with my result.

Khorate et al 2014[12] in their study on Goan population found Acharya's India specific formula is limited to an age group of 9-22 years in females which agrees with our criteria.

Tandon et al 2015[11] 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. Hence it almost matches with the result of our study.

The overall result shows the P value was calculated to be 0.001 which is ≤ 0.05 and the overall error in all the groups during the study is 1.46±1.57 which is statistically significant and with the accuracy of 46% in ±1 and 29% in between 1 ±2 and only 25 % of the samples have > 2.

Hence from the above findings of the study we conclude that the Demirjian's method of age estimation can be used for the estimation of age of individuals in and around Modinagar but its accuracy is less in males than in females as females are ahead of dental maturity than males suggesting that completion of dental maturity is attained earlier in females as accordance to Gandhi et al[10]

CONCLUSION:

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 females from age 7-23 and 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.

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