ORIGINAL RESEARCH

Validity of Demirjian and Cameriere Methods for Dental Age Estimation of Children aged 9 – 13 years in and around Puducherry– A Comparative Study

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ABSTRACT : Background: Several methods relying on dental calcification of the teeth, up to the second molar, are used for evaluation of age in childhood. The objective of this research was to evaluate the reliability and validity of Demirjian's and Cameriere's radiographic methods of dental age estimation in Puducherry population aged between 9 and 13 years.

Aim : The purpose of this study was to evaluate the accuracy of Demirjian and Cameriere methods for dental age estimation in order to obtain a more reliable and reproducible age estimation method as an aid in forensic odontology.

Settings and Design: The sample was comprised of 200 digital OPG of children in and around Puducherry (90 female and 110 male) aged 9 to 13 years.

Method: Demirjian & Cameriere method, both are assessed by the dental maturity of seven left mandibular teeth. The mean age error and absolute age error for both the methods were calculated and the difference between the estimated dental age and chronological age were compared with the paired t – test

Results: The Demirjian method tends to overestimate (1.10 years) the chronological age of participants and Cameriere method underestimated (-0.31 years) the chronological age. On gender comparison, boys and girls showed overestimation by 0.99 years and 1.22 years for Demirjian methods respectively, while underestimation by -0.30 years and -0.33 years for boys and girls respectively was observed with Cameriere method.

Conclusions: Cameriere method of dental age estimation is more accurate than Demirjian method for estimating the age among 9 – 13 year old in Puducherry population.

Key-words: *Forensic dentistry, Panoramic radiograph, Tooth mineralisation*

Introduction:

Age is one of the essential factor which plays an important role in every aspect of life. Person identification is an important aspect of forensic medicine and dentistry, wherein age, gender, race are used for identification of a person. It can be estimated on the basis of chronological age, bone age, dental age, mental age, etc. Chronological Age as recorded by registration of birth date, is referred throughout an individual's life.[1] The age estimation process has to be highly accurate in predicting the individual's age and easy to use. 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 are required to deduce the age of the person. But the biggest pitfall has 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.[2]

Radiography was the one ray of hope for standardization of tooth formation, i.e., its calcification and eruption. Degree of calcification in permanent teeth has been used to develop different method to identify dental age. One such widely used methods are Demirjian Method and Cameriere Method, using left mandibular seven teeth. However, several authors[3,4,5,6,7,8] have found results to be less accurate when Demirjian and Cameriere standards were applied to different populations necessitating creation of a larger data base including different populations [4,9]

The aim of the present study was to evaluate the accuracy of Demirjian and Cameriere methods for dental age estimation in Puducherry population.

Subjects and Methods:

The study was conducted at Indira Gandi Institute of Dental Sciences, Puducherry, after obtaining approval from the Institutional Ethical Committee and Internal Review Board over a period of time from January 2014 to June 2015. The sample size was calculated as 200.

The design of this study was a retrospective study of panoramic radiographs. The criteria for inclusion in the sample are children undergoing orthodontic treatment, who has taken OPG for dental treatment. Children with systemic diseases, congenital anomalies, tooth agenesia, tooth undergone endodontic treatments, large carious lesions involving the dental pulp, mandibular pathologies, poor quality X-rays were excluded from the study. Observers were blinded to sex, name and age of subjects by using numerical identity number on each OPG. Birth date of each individual was subtracted from the date of exposure to find the Chronological age

Statistical analysis:

The data were tabulated and subjected to statistical analysis. The p value for our study was kept < 0.05 which was considered statistically significant. The mean difference between the two groups (Demirjian & Cameriere method) with respect to age and gender was analyzed using paired t–test. The level of significance was set as 5%. Data were tabulated in tables and analyze using SPSS version 16.0.

Procedure

In the present study we collected 200 samples aged between 9 and 13 years of age. Out of which 90 were females (45%) and 110 were males (55%). Using collected OPG's dental age was estimated using Demirjian & Cameriere methods.

Demirjian Method[9]

Seven left mandibular permanent teeth were rated in the order of second molar (M2), first molar (M1), second premolar (PM2), first premolar (PM1), canine (C), lateral incisors (I2) and central incisor (I1) and determined eight stages (A to H) of tooth mineralization together with stage zero for nonappearance as follows:

Stage description:

If there is no sign of calcification, the rating 0 is given; the crypt formation is not taken into consideration.

(A) 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 calcification points;

(B) Fusion of calcified points form one or more cusps which unite to give a regularly outlined occlusal surface, or mineralized cusps are united so the mature coronal morphology is well defined;

(C) Crown half-formed, pulp chamber is evident, dentinal deposition is occurring;

(D) The crown formation is completed down to the cemento-enamel junction, pulp chamber has a trapezoidal form and beginning of root formation is seen;

(E) Initial formation of the radicular bifurcation is seen, the root length is still less than the crown height;

(F) The apex ends in a funnel shape; the root length is equal to or greater than the crown height;

(G) The walls of the root canal are now parallel and its apical end is still partially open; and

(H) The apical end of the root canal is completely closed; the periodontal membrane has a uniform width around the root and the apex.

Each case was analyzed using Demirjian method then converted the attributed stage for each tooth to a self-weighted numerical score.

For example, if the tooth number 47 of a male was assessed as being at stage A, this would be converted to a score of 1.7; similarly, the tooth 47 of a female assessed as being stage A would be converted to a score of 1.8. This conversion gives a set of tooth scores for each case, the sum of which results in a 'Summative Maturity Score' for that case. The total maturity score which obtained is compared in the chart for both males and females to derive the dental age.

Cameriere Method[10]

The dental age estimation was done by using Cameriere's regression formula

$$9.402 - 0.879g + 0.663N_0 - 0.711s - 0.106sN_0$$

g variable is 1 for boys and 0 for girls. Where N_0: teeth with apical ends of the roots completely closed.

s: sum of A/L ratio for every tooth at open apex. Ai: radiographic distance between inner sides of the open apex. Li: radiographic tooth length. (Li, i= 1… 7). An example of tooth measurement. Ai, i = 1. . . 5 (teeth with one root), is distance between inner sides of open apex; Ai, i = 6 and 7 (teeth with two roots: A7 is the sum of the distances (A7=A7a+A7b) between inner sides of the two open apices, and L7 is the length of second molar) and Li, i = 1. . . 7, is length of seven teeth and N_0 = tooth with a closed root: A6. Once the measurements were recorded in digital panoramic radiograph, it is calculated by dividing magnification factor 1.2, which was applied in Cameriere's Indian formula. Dental maturity was evaluated with the normalized measurements of the 7 left permanent mandibular teeth. (xi= Ai/Li, i = 1……7), the sum of the normalized open apices (s= x1+x2+x3+x4+x5+x6+x7). All measurements were carried out using CORELDRAW X5 (Figure 1) software and by the same observer.

The obtained values were subjected to statistical analysis. The p value < 0.05 was considered statistically significant. The mean difference between the two groups (Demirjian & Cameriere method) with respect to gender was analyzed using paired t–test. The level of significance was set as 5%. The analysis was done using SPSS version 16.0

Results:

Mean Chronological age (CA) of the total subject was found to be 11.571 ± 1.4645, whereas when estimated using Demirjian method it was 12.673 ± 1.4811 and by Cameriere method (CM) it was 11.252 ± 1.4842. The difference between Chronological age and Demirjian method (DM) was found to be statistically significant (p<0.001). The difference between Chronological age and Cameriere method was also significant statistically (p<0.001). The mean difference between DM and CA was 1.1028 and the mean difference between CM and CA was -0.3182.[Graph 1]

Mean CA of males was 11.576 ± 1.4985 and for DM it was 12.576 ±1.5244 and for CM it was 11.272 ± 1.5160. The difference between Chronological Age and DM in males was found to be statistically significant (p<0.001). The difference between CA and CM in males was found to be statistically significant (p<0.001). The mean difference among males was 0.9995 for DM and -0.3044 for CM. This shows that Cameriere Method is

more accurate than Demirjian Method in 9 - 13 year old male children.[Graph 2]

Mean CA of females was 11.564 ± 1.4301 and for DM it was 12.793 ± 1.4257 and for CM it was 11.229 ± 1.4525. The difference between CA and DM in females was found to be statistically significant (p<0.001). The difference between CA and CM in females was found to be statistically significant (p<0.001). The mean difference among females was 1.2289 for Demirjian Method and -0.3351 for Cameriere Method.[Graph 3].

Discussion:

Demirjian method is based on orthopantomographs which has eight stages of dental maturity observed in seven left mandibular teeth. Cameriere et al in 2006, took a completely different approach and published a mathematical formula for calculating dental age on teeth based upon measuring the completeness of apical development via a computer method using special software. As till date no study has been conducted in Puducherry population comparing the dental age estimation using Demirjian and Cameriere method.[11] It will be valuable if we find an accurate method of age estimation for Puducherry population. Thus this study was planned with the aim of estimating the chronological and dental age in individuals from Puducherry aged 9 -13 years of age. Early intervention orthodontic treatments are usually planned during 9 - 13 years of age which necessitates estimating a child's dental age. This study aimed to test the accuracy of two age estimation methods for Puducherry children by determining the mean absolute difference for each gender.

An in-depth knowledge about the development and maturity of permanent dentition is highly applicable for clinical, medico-legal, and forensic purposes. The surveillance of different morphological stages of tooth formation in radiographs serves to be the most reliable element in dental-age estimation. Various dental-age estimation methods proposed in the past are highly applicable to the Western population. With all of the possible differences in environmental factors, dietary habits, growth rate, and ethnicity, such methods may not be readily applicable to Indian population, which is an aspect that has not been exclusively studied in the recent past. In addition, recent studies have shown acceleration in tooth development and eruption in

contemporary children when compared with those children who lived 30 years ago,[12] which implies that the older methods of dental-age estimation may not be suitable for the present population of children. For this reason, in this study we validated the two methods of dental age estimation most frequently used, ranging from the earliest method (Demirjian method) developed some decades previously, to the latest (Cameriere method). However, reliability and validity of an age-estimation method for a particular population largely depends on its accuracy and precision level.[13]

Tomas et al calculated dental age using Demirjian and Nolla method in Portuguese and Spanish sample. The sample populations age was from 4 to 34 years old. In his study he found out that Demirjian method was overestimating the chronological age. They also found out that predictive power is good in younger age group (4 – 8 years).[14] In our study Age estimated by DM showed overestimation of about 1.10 years in the 9 – 13 years age group. Demirjian method overestimated the CA by 0.99years for males and 1.22 years for females in the age group of 9 – 13 years. In contrast with our study and Nur et al study, overestimation of 0.84 years was seen in boys and 0.89 years in girls of Northeastern Turkish population of age group 5 – 15 year[15] Similarly in a study done in Belgaum by Hegde RJ et al they found that the estimated age is overestimating the true age. The mean difference between true age and assessed age (DM) for total male sample was 0.14 years and 0.04 years. Older age group (10 – 12 years) overestimation of CA was noted compared to younger age group.[16]

Cameriere L et al done a study on Italian children aged 5 – 15 years and the results showed a significant correlation with chronological age[17]. Another study was on Indian children aged 5 – 14 years by Rai B et al also showed significant correlation between chronological age and dental age. The Cameriere method yielded a mean estimation of 0.05 for boys 0.04 years for girls; accuracy between boys and girls was significantly different (p<0.01).[18] In contrast with the above study the current study shows underestimation of assessed age by -0.30 years for boys and 0.33 years for girls aged 9 -13 years. It also showed a median absolute value of -0.318 thus suggests that it is underestimating the CA for the entire children.

Cameriere L et al done a study to find the accuracy of Cameriere method on 5 -15 years old children, which

Graph 1: Comparison of Mean difference of Cameriere method and Demirjian method in 200 samples
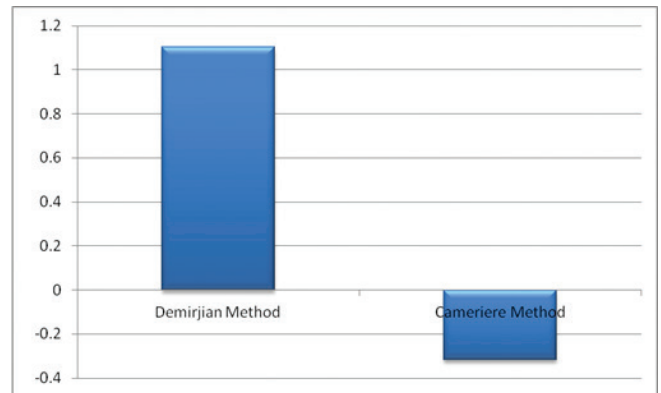

When compared 200 samples using the Demirjian Method & Cameriere Method with the chronological age it shows overestimation by DM and underestimation by CM

Graph 2: Comparison of Mean difference of Cameriere method and Demirjian method for 9 -13 year males
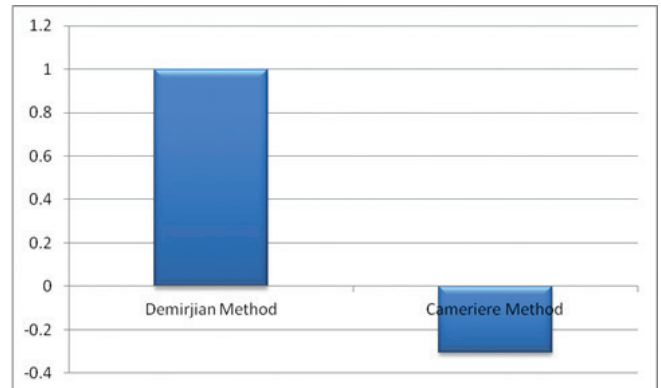
When the mean difference of 9 -13 year males was compared it showed overestimation by Demirjian Method and under estimation by Cameriere Method

Graph 3: Mean difference of Cameriere method and Demirjian method for 9 – 13 year females
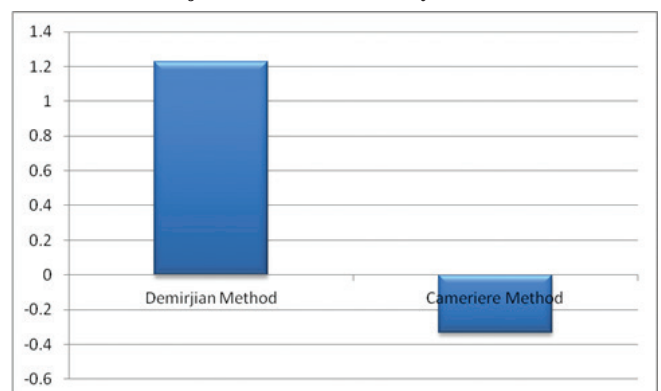
While comparing of 9 – 13 year old females overestimation of Demirjian Method and underestimation of Cameriere Method when compared with the chronological age was observed

is then compared with Demirjian and Willems method and concluded that Cameriere method was more accurate than Willems and Demirjian method. They also stated that the Demirjian method overestimated the real age of both boys and girls, with a median residual error of 0.750 years for girls and 0.611 years for boys and CM under estimated the CA of children, which is 0.081 years for males and 0.668 years for boys.[12] In comparison with the present study done on 9 – 13 year old children both DM and CM can be used for assessing CA. When comparing the estimated DA with the CA, DM overestimated the age and CM underestimated. But the value showed CM to be more accurate than DM as CM underestimated by 0.31 years where as DM overestimated the age by 1.1 year. While comparing the sex, for girls (aged 9 – 13 years) the mean dental age was over estimated by 1.2 years by DM and for boys (aged 9 – 13 years) it was 0.99 years. As in CM underestimation for both boys and girls were seen, the mean dental age for girls was 0.33 years and for boys it was 0.3 years.

Given the different legal requirements imposed by civil and criminal law, and especially for the latter, the examiner should therefore apply at least two methods of dental age estimation for a sound comparative examination and provide estimation that report the false positive rates registered for the applied methods. Further more studies are required with larger samples to come up with more accurate results.

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