Comparison of Cameriere's and Demirjian's methods of age estimation among children in Kerala: a pilot study

Vivek Velayudhan Nair,[1] Sunila Thomas,[1] Jincy Thomas,[1] Shabna Fathima Salim,[1] Deena Thomas,[2] Tomson Thomas[3]

[1]Department of Oral Medicine and Radiology, PMS College of Dental Science and Research, Trivandrum; [2]Department of Oral Medicine, Metropath, Metro Lab., Trivandrum; [3]Department of Oral and Maxillo Facial Pathology, PMS College of Dental Science and Research, Trivandrum, Kerala, India

Abstract

The aim was to compare age estimation using Cameriere's and Demirjian's methods to chronologic age in children with mixed dentition in a rural population of Kerala. The present study comprised of 10 subjects of age range 7-12 years. Dental age was assessed using Cameriere's and Demirjian's methods and was compared to the chronologic age. Panoramic radiographs were used for assessment of dental age. Data were analysed using paired t-test. The mean of difference obtained was 0.92 and the p-value was 0.172 which showed insignificant difference between the two methods. Cameriere's method showed a positive linear correlation (0.6393) with chronologic age and was statistically significant (P=0.0171), whereas Demirjian's method showed a negative correlation (−0.7598) and was statistically insignificant (P=0.9967). The present study indicated that Cameriere's method is reliable for age estimation in our population and is more accurate than Demirjian's method.

Introduction

Age estimation is an important component and fundamental question in forensic sciences in the identification of an individual concerning pediatric issues, orthodontic treatment and legal matters. During the growth of a person, skeletal, odontological, anthropological and psychological methods can be applied for age assessment. In children, the most common methods for age estimation is based on skeletal maturation using hand wrist radiographs and assessment of dental development.[1] However, the skeletal method is limited as variability in bone maturation is influenced by environmental factors. Teeth consist of bradytrophic tissues which do not undergo continuous remodeling process. Age estimation in children based on dental development is preferred as the calcification is controlled by genes, rather than environmental factors.[2]

The most common method of age estimation was the method proposed by Demirjian, Goldstein and Tanner with subsequent modification.[2] In 2006, a method of assessing chronological age in children based on relationship between age and measurement of open apices in teeth in European population was presented by Cameriere et al.[3,4] This method was reported to be much more accurate than other measures. Using radiographic methods for age estimation is simple, non-destructive and reliable.

Aim of the study was to compare age estimated using Cameriere's and Demirjian's methods to chronologic age in children with mixed dentition in a rural population of Kerala.

Materials and Methods

The study was carried out using 10 randomly selected digital panoramic radiographs of children, both males and females in mixed dentition period (7-12 years), taken as part of diagnostic procedure, showing all seven left permanent teeth. Exclusion criteria included previous orthodontic correction, developmental anomalies of jaws and unclear radiographs.

Chronological age was recorded from patients birth certificate informed consent was taken from patient/parent. Ethical committee clearance was obtained. The chronological age at the time of recording was calculated by subtracting date of birth from the date on which radiograph was taken. Radiographic evaluation was done using the computer program SIDEXIS provided along with the system and age estimation was done using two methods - Cameriere's and Demirjian's methods.

Radiographic evaluation

Cameriere's method

The seven left permanent mandibular teeth were valued. The number of teeth with root development complete, apical ends of the roots completely closed (N0), was calculated. Furthermore, the teeth with root development incomplete, and therefore with open apices, were considered. For teeth with one root, the distance (A_i, $i=1,...,5$) between the inner sides of the open apex was measured (Figure 1). For teeth with two roots (A_i, $i=6, 7$), the sum of the distances between the inner sides of the two open apices was evaluated (Figure 1). To take into account the effect of possible differences in magnification and angulation among x-rays, we normalized the measurements by dividing by the tooth length (L_i, $i=1,..,7$). Finally, dental maturity was evaluated using the normalized measurements of the seven left permanent mandibular teeth ($x_i=A_i/L_i$, $i=1,…,7$), the sum of the normalized open apices (s) and the number (N_0) of teeth with root development complete was a variable equal to 1 for boys and 0 for girls. All measurements were carried out by the same observer.[1]

Age calculated using the formula:

$$Age = 8.971 + 0.375\,g + 1.631\,x_5 + 0.674\,N_0 - 1.034\,s - 0.176\,s \cdot N_0$$

Demirjian's method

In this technique, calcification of permanent teeth on the left mandible was assessed. Based on the amount of calcification visible on the radiograph, each tooth was given an appropriate developmental stage. Depending on the developmental stage, each tooth was given a corresponding maturity score ranging from 0 to 9.

Considering differences in tooth development between males and females, separate maturity scores were given for each sex. The score assigned for each of the eight teeth was added and a total maturity score (S) obtained. The total was substituted in formulae to derive age.[5-7]

Dental age calculated using Acharya's formula for Indian population:

Males: Age = 27.4351 − (0.0097 × S^2) + (0.000089 × S^3);

Females: Age = 23.7288 − (0.0088 × S^2) + (0.000085 × S^3).

Statistical analyses

Mean and standard deviation was used to describe the age assessed by Cameriere's and Demirjian's methods. SPSS software was used for analysis. Age was estimated using the two methods. The difference was calculated by finding the difference between estimated age and chronological age for the two methods. Mean of the difference in ages by the two methods were also evaluated. Comparison of mean difference in age assessed by two methods with actual age was calculated and statistical analysis was done using paired-t test. Correlation between chronological age and age estimated using the two methods was done using Karl Pearson coefficient of correlation. Interclass correlation and p value using both the techniques were also assessed. P value was significant at 0.05.

Results

Ages calculated using Cameriere's and Demirjian's method were compared to the chronological age. The mean of difference in estimated ages by Cameriere's and Demirjian's methods and chronologic age was 1.08 and 2.0 respectively (Table 1). Comparison of difference of age with actual age under the two methods showed a mean difference of 0.92. Paired t-test showed insignificant difference (paired t= 1.48, P=0.172) (Table 2). However, age estimated using Cameriere's method showed a positive correlation (0.6393), whereas using Demirjian's method shows a negative correlation (–0.7598). The p valve obtained for Camerier's method showed significant results (P=0.0171) and Demirjian's method was insignificant (P=0.9967).

Discussion

In this study we compared the age estimated using Cameriere's and Demirjian's methods to the chronological age of patients in the mixed dentition. Chronological age was calculated exactly by subtracting date of birth given by the patient/guardian from the date on which the radiograph was taken. The measurements were done on panoramic radiographs on seven mandibular left permanent teeth in both methods. Measurement of open apices was done for Cameriere's method and stage of mineralizaion of tooth was the basis for Demirjian's method.[6]

In the present study where we compared age estimated using Cameriere's and Demirjian's method, we found that the accuracy of Cameriere's method in age estimation was comparable with that of Demirjian's with a mean difference of 0.92. Our study showed a great overestimation of age by using Demirjian's method, while Cameriere's method showed mostly under-
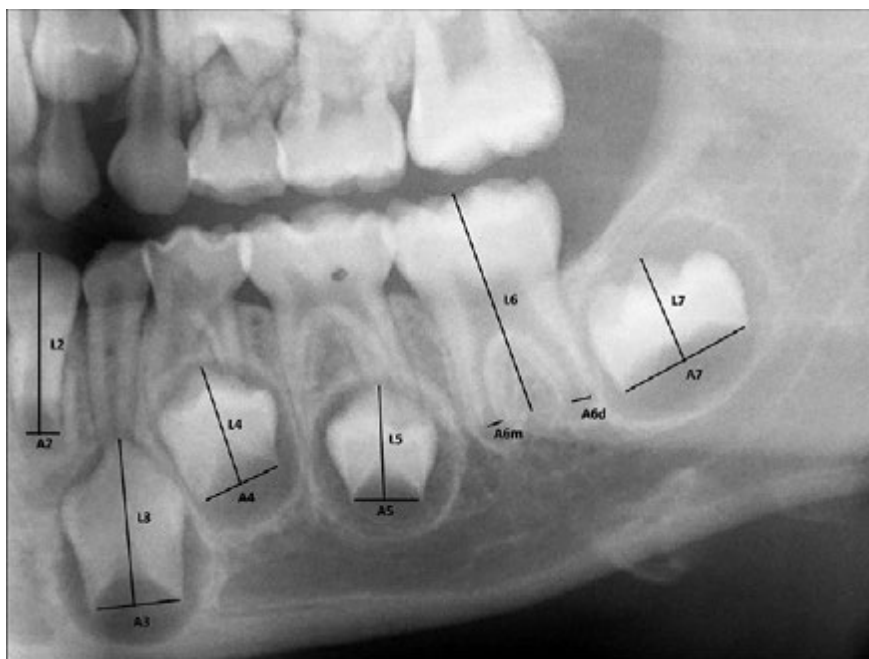

Figure 1. Cameriere's method for taking measurements.

Table 1. Mean difference of estimated age using Cameriere and Demirjian's methods to the chronological age.

Sl No.	CA	EA using Cameriere's method	Difference	Mean	EA using Demirjian's method	Difference	Mean
1.	10.7	8.8	−1.9	1.08	9.76	−0.94	2.0
2.	12	10.1	−1.9		9.8	−2.2	
3.	11.8	11.4	−0.4		10.9	−0.9	
4.	7.8	7.2	−0.6		13.79	+5.99	
5.	12	10	−2.0		9.77	−2.23	
6.	10	11.5	+1.5		14.33	+4.33	
7.	10.5	10.5	0.0		10.56	+0.96	
8.	11.9	11.0	−0.9		9.75	−2.15	
9.	10.1	10.0	+0.1		11.3	+1.23	
10.	10.9	9.4	−1.5		10.89	−0.01	

CA, chronologic age; EA, estimated age.

Table 2. Comparison of difference in age with actual age under different methods.

	Mean	SD	N	Mean difference	Paired t	P
Cameriere's Method	1.08	0.77	10	0.92	1.48	0.172
Demirjian's Method	2.0	0.59	10			

estimation of ages. Of the two methods, Cameriere's method showed a positive correlation (r=0.6393) and was statistically significant (P=0.0171).

In a study done by Javedinejad etal 2015, Demirjian's method overestimated ages by a mean value of 0.87 while Cameriere's method underestimated all ages by a mean of 0.19. Paired t-test revealed significant difference between mean chronologic age and dental age.[8] In our study, the mean of difference of estimated age by Cameriere's method was 1.08 and by Demirjian's method was 2.0 years. Our study also indicated an underestimation of age by Cameriere's method, while overestimation of age by Demirjian's method was noted only in four patients. However due to limited sample size, the overestimation by Demirjian's method may not be considered significant.

According to the study done by Wolf TG etal in 2016, the mean difference between chronologic age and dental age using Demirjian's method for boys and girls were –0.6 and –0.18 respectively and by Cameriere's method were 0.07 and 0.08. Cameriere's method showed slight underestimation of real age[6] which is consistent to our result showing an underestimation by Cameriere's method. When the individual age groups were analyzed in their study, Demirjian's method showed an overestimation of age compared to the chronologic age in all age groups for boys (mean difference= –0.16, P=0.010) and for girls there was an overestimation of age except for one age group (8 and 13) (mean difference= –0.18, P=0.008). Cameriere's method for boys showed an overestimation for age groups 6-11 and underestimation for 12-14. For girls (mean difference=0.08, P=0.48) showed an overestimation for age groups from 6-10 and an underestimation in age groups 11-14. The comparison shows an advantage for both genders.[6] Our study also showed an underestimation of age by Cameriere's method. However, we have not grouped the patients according to age or gender.

The results of Pinchi etal 2012 showed a tendency to underestimate age by using Cameriere's method, while Demirjian's method overestimated the age. Demirjian's method was more accurate than Cameriere's method, but overestimated age. Cameriere's method largely underestimated the age (~1 year) in both genders.[7] The present study also indicated underestimation of

age using Cameriere's method by approximately 1 year.

In our study, comparison of difference in actual age and in estimated age by the two methods showed that Cameriere's and Demirjian's were comparable with a mean difference of 0.92. However paired t-test showed insignificant difference (paired t=1.48, P=0.172). This is in accordance to the results obtained by Javedinejad etalwho found that Demirjian's and Cameriere's methods were comparable (mean=1.06, P=0.000).[8] However Wolf etal in their study on comparison showed an advantage of Demirjian's method for both genders.[6]

But our study proved Cameriere's method to be more accurate statistically with a positive correlation between chronological and estimated ages (r=0.6393, P=0.0171), eventhough the mean difference between Demirjian and Cameriere's methods showed in significant difference (mean=0.92, P=0.172). Demirjian's method showed a negative correlation with chronologic age and was statistically insignificant (r= –0.7598, P=0.9967). This indicates that Cameriere's method was more accurate than Demirjian's method. This was in contrast with previous reports where a higher inaccuracy by Cameriere's method was noted in all age groups.[6]

Galic *et al*. in 2011 compared the accuracy of Cameriere's, Haavikkon and Willems [revisited Demirjian's method by Willems] radiographic methods in age estimation on Bonnian-Herzegovian children age groups 6-13. Cameriere's method overestimated the mean age by 0.09 years for girls and underestimated by –0.02 years for boys. Demirjian's method tend to have overestimated the age in both genders. Cameriere's method was more accurate for both genders[5] which was similar to our study where a greater accuracy was noted for Cameriere's method.

Our study showed a mean difference of age by 1.08 in Cameriere's method and 2.0 in Demirjian's method. Eventhough there was an underestimation of age by Cameriere's method, there was a positive correlation which showed a greater accuracy for this method compared to Demirjian's. But the mean of difference showed insignificant difference. However, our sample size was small and was not grouped based on age and gender.

Conclusions

The present study showed that the ages estimated using Cameriere's and Demirjian's methods were comparable. This shows that Cameriere's method based on the measurements of the width of open apices is equally good as Demirjian's method which is a fairly accurate and widely practiced method based on the stage of mineralization of teeth. Cameriere's method is more acceptable if accuracy is important and Demirjian's method is acceptable if ease of application is important. However keeping in view the limitation of our study, further studies using increased number of observers and larger sample size is recommended.

References

1. Cameriere R, Ferrante L, Cingolani M. Age estimation in children by measurement of open apices in teeth. Int J Legal Med 2006;120:49-52.
2. Shrestha A, Yadav RP, Shrtestha S, et al. Measurement of open apices in teeth for estimation of age in children. Health Renaissance 2015;12:33-7.
3. Rai B, Kaur J, Cingolani M, et al. Age estimation in children by measurement of open apices in teeth: an Indian formula. Int J Legal Med 2010;124:237-41.
4. Bagh T, Chatra L, Shenai P, et al. Age estimation using Cameriere's seven teeth method with Indian specific formula in south Indian children. Int J Adv Health Sci 2014;1:2-10.
5. Galić I, Vodanović M, Cameriere R, et al. Accuracy of Cameriere, Haavikko, and Willems radiographic methods on age estimation on Bosnian-Herzegovian children age groups 6–13. Int J Legal Med 2011;125:315-21.
6. Wolf TG, Briseño-Marroquín B, Callaway A, Int J Legal Med. Dental age assessment in 6-to 14-year old German children: comparison of Cameriere and Demirjian methods. BMC Oral Health 2016;16:120.
7. Pinchi V, Gian-Aristide N, Pradella F, et al. Comparison of the applicability of four odontological methods for age estimation of the 14 years legal threshold in a sample of Italian adolescents. J Forens Odonto-Stomatol 2012;30:2.
8. Javadinejad S, Sekhavati H, Ghafari R. A comparison of the accuracy of four age estimation methods based on panoramic radiography of developing teeth. J Dent Res Dent Clin Den Prospect 2015;9:72.