Comparison of the Demirjian Age with The Chronologic Age and Their Correlation

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ABSTRACT

Background: People of French-Canadian descent were initially the major data source for Demirjian's dental age estimate technique. However, due to chronologic variety, Dr. Acharya altered the data in 2011 to reflect the Indian population. The current study was conducted to improve the accuracy of Demirjian's technique and to link Demirjian's age with the chronologic age.

Materials and Methods: A study of 300 participants was conducted in a dental college in Mathura, using orthopantomographs (OPGs) to evaluate dental maturity. The Demirjian 8 teeth method was applied, and chronological age was determined by subtracting the radiograph date from birthdate. Pearson's correlation test was used to analyze the correlation between chronologic age and Demirjian's age.

Results: Pearson's correlation test revealed a significant correlation between chronologic age and Demirjian s age. The Demirjian s age has been overestimated in comparison to the chronologic age.

Keywords: Chronologic age, Demirjian s age, Orthopantomograph

Introduction

There are two types of age in a living individual: Chronological and biological age. They are not always coincident.[1] Chronological age is the amount of time that has elapsed from birth to a given date and is the main way of defining age. Biological aging occurs as a person gradually accumulates damages to various cells.[2] Also known as physiological or functional age, biological age differs from chronological age and it considers not only the time elapsed, but also a number of different biological and physiological developmental factors, such as genetics, lifestyle, nutrition and comorbidities.

The biological age of an organism is essential to determine the degree of physiological maturity of the individual. Some widely accepted methods of biological age estimation of an organism include skeletal age using intervertebral discs, ribs and pubic symphysis and dental age.

Age estimation is crucial in the fields of clinical and forensic dentistry, pediatric endocrinology, forensic medicine, and archaeology. Out of various methods for age estimation, dental maturity or dental age is one of them.[3]

The degree to which various tissue systems have matured is the foundation for the idea of estimation of physiological age. Maturation is not only growth in size but also it is the dimension of overall development. Teeth mature at different milestones. Calcification and progressive sequence of eruption and maturation of each tooth represent the dental age through which age can be estimated. They play a crucial role in identification and age estimation of individuals as they are durable and resist putrefaction, fire and chemicals.[4]

Nolla [1960][5] assessed the age based on the radiographic appearance of the tooth. Demirjian et al. [1973][6] formulated the method of dental age assessment by reference to the radiological appearances of the seven teeth on the left side of the mandible. Hagg and Matsson [1985][7] found high precision and accuracy with the

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Demirjian s method when applied to the younger age group rather than in older ages. The authors concluded that the estimation of age is preferably done during early childhood. Nystrom et al. [1986][8] found a more advanced dental maturation in Finnish children than in French-Canadian children and concluded that maturity standards should be based on studies made on the same population for which they are going to be used. Davis and Hagg [1994][9] stated that the Demirjian system could not be accurately applied to other population groups due to ethnic differences

when it was tested on the Chinese population. Staaf et al. [1991] concluded that the Canadian studies gave an over-estimate of about 6-10 months when used on a Scandinavian population.[10]

Using distinct scoring methods for each gender, Demirjian's technique of dental age assessment calculates the overall dental age by assigning a score depending on the stage of tooth production shown in each tooth. Panoramic radiographs are used in this method to evaluate and visualize the stages of formation of 8 teeth. The subject is exposed to less radiation for a full mouth radiograph than individual intraoral periapical radiographs.

Originally the primary data source for Demirjian's dental age estimation approach was people with French-Canadian ancestry. But due to diversity in population, the same was revised according to Indian population by Dr. Acharya in 2011. The present study was carried out to find the accuracy of the Demirjian s 8 teeth method and also to correlate the means Demirjian s age and the chronologic age.

Materials and Methods

The study was conducted in K.D. Dental college and hospital Mathura with sample size of 300 participants (180 males and 120 females) from age 7 years to 15 years. The participants' Orthopantomographs (OPGs) were obtained, and the Demirjian 8 teeth method was applied for analysis. On OPG, dental maturity was evaluated using the Acharya-developed, India-specific Demirjian et al. 8 teeth technique. Each subject's chronological age was determined by deducting the radiograph date from their birthdate. The correlation between chronologic age and Demirjian s age was analyzed using Pearson s correlation test

The statistical analysis was done using statistical package of social sciences (SPSS) software, v.22 The difference between the means of different continuous variables was calculated using independent student "t" test. The correlation of the continuous variables was analyzed using Pearson correlation test. The difference will be considered as significant, when the P value is below 0.05 and highly significant if the P value is below 0.001.

Results

When the descriptive statistical analysis was made, it was found that the males were 60% of the study population and 40% were females. Out of total of 300 participants, 180 were male and 120 were female. [Table 1] [Graph 1] The mean age of the participants was 126.3±20.9 months, and when the dental age was analyzed, the mean age was found to be 128.4±23.5 months. The mean chronologic age and Demirjian s age was tabulated and a graph was made. [Table 2] [Graph 2].

The mean difference was calculated between the chronologic age and Demirjian s age, the mean difference was compared between males and females. The males showed a mean difference of -1.41± 10.4 and among females -3.25±6.08. When comparison was done the difference between males and females was significant with P value of 0.05. [Table 3][Graph 3]

The correlation between chronologic age and Demirjian s age was analyzed using Pearson s correlation test, it was found to be significantly correlated with a P value of

Table 1: Distribution of study population among genders

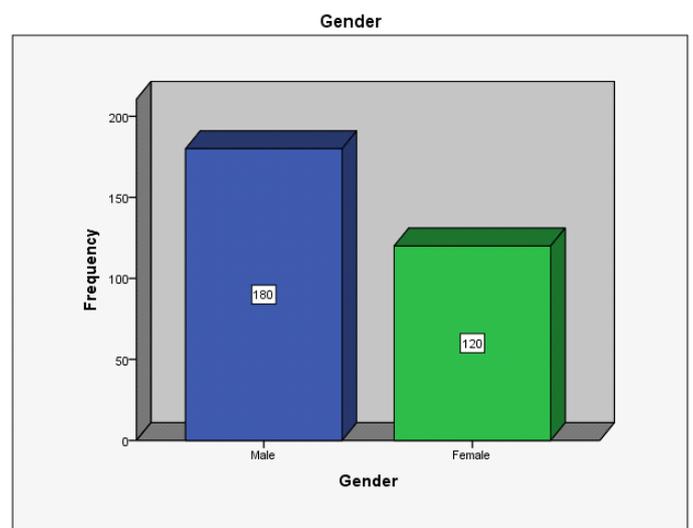| Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	180	60.0	60.0	60.0
Female	120	40.0	40.0	100.0
Total	300	100.0	100.0	

Figure 1: Graph showing the gender distribution

Table 2: Mean chronologic and Demerjian age

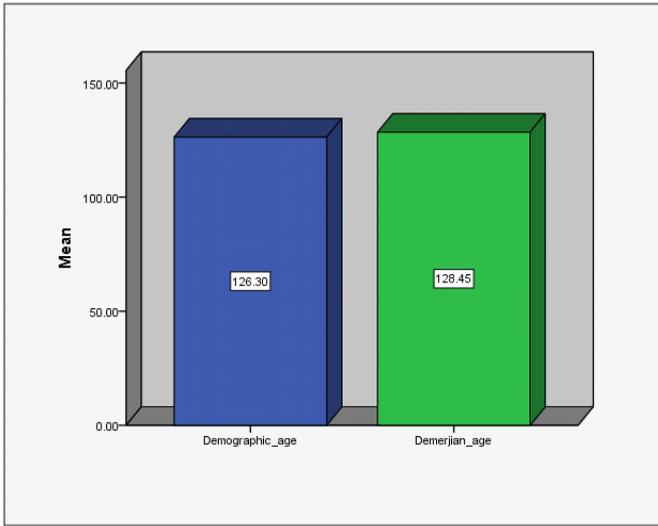|	N	Minimum	Maximum	Mean	Std. Deviation
Chronologic_age	300	93.00	168.00	126.3000	20.99235
Demerjian_age	300	97.00	178.00	128.4500	23.50509
Valid N (listwise)	300				

Figure 2: Graph showing Mean chronologic and Demerjian age

Table 3: Comparison of the mean difference between chronologic and Demerjian age

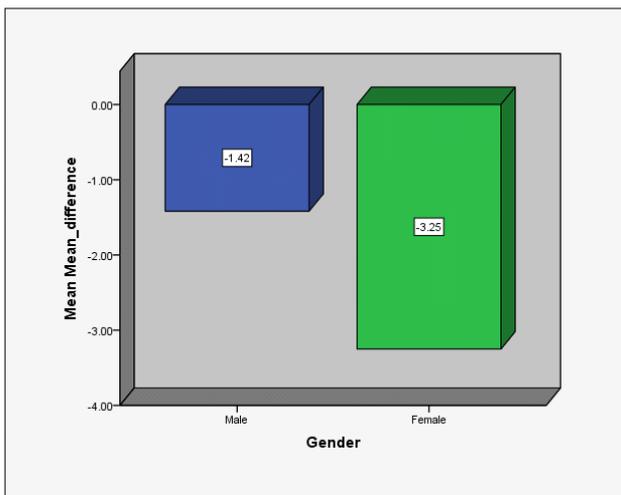| Gender	N	Mean difference	Std. Deviation	Std. Error Mean	P value
Male	180	-1.4167	10.45708	.77942	0.05*
Female	120	-3.2500	6.08242	.55525	

Figure 3: Comparison of the mean difference between chronologic and Demerjian age

Table 4: Correlation of the chronologic and Demerjian age

		Demerjian_age
	Pearson Correlation	.924**
Chronologic_age	Sig. (2-tailed)	.000
	N	300

<0.001**. [Table 4] It can be said that the Demirjian s age has overestimated the age when compared with the chronologic age

Discussion

Age determination plays a crucial role in situations involving juvenile offenders, undocumented immigration, underage employment, child marriage, and individual identification during mass disasters. Out of various methods for age estimation, Demirjian method developed on French-Canadian population has been the most widely used jaw radiograph-based method till now. [6] Originally it employed appraisal of calcification stages of seven left permanent mandibular teeth to estimate dental age up to 16 years which is called the 7 teeth method. It is one of the simplest methods of use.

Chaillet and Demirjian later modified it to include mandibular third molar and increase estimation age to 18 years to enhance age correlation of dental development. Koshy S. et al conducted a study in south Indian population and found that Demirjian's seven tooth method gave overestimation of age 3.04 and 2.82 year in male and female subject respectively.[11] Similarly Prabhakar AR at al in Davangere population and Hegde RJ and Sood PB in Belgaum children also found overestimation of age.[12,13] Mohammed et al. used modified Demirjian's method in 330 subjects and the found underestimation of mean age of 0.8 years and 0.5 years in boys and girls respectively.[14] In contrast, Jain et al conducted a study in Malwa population and concluded Acharya's method is more reliable as compared to Demirjian s 8 tooth method. These results were consistent with the current study. Acharya's method is more reliable than Demirjian's method in Malwa population, mean difference between chronological age and Demirjian's method is 1.41 year and for Acharya s method is 0.43 year.[15]

In this study correlation was done between chronologic age and Demirjian's method. In the study population, 60% were males and 40% were females. The pearson coefficient stated a significant correlation between both the methods suggesting that the India-specific formula provided a relatively approximately correct estimate of the sample subjects' chronological ages. This correlation of the Demirjian s method with chronologic age should be done in other population-based studies in all parts of country for validity and accuracy of the method. This will in turn provide a customized and standardized protocol for age estimation for more reliability in forensic studies in the country.

The present study concluded that the correlation between chronologic age and that estimated by Demirjian s method is significant and both closely resemble in the study population. Therefore, this method is a reliable way of age estimation, although there was a slight overestimation of age was shown using the Demirjian s method.

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