Accuracy of Two Dental Age Estimation Methods in 6-18 Year old Children-A Radiographic Pilot Study

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Abstract
Aims And Objectives: Age assessment is of broader importance in forensic science for identification of individuals in crimes and accidents involving legal issues. Although various age estimation methods do exist radiographic age estimation methods such as Demirjians and Williems methods are more commonly employed. In the present study the above mentioned methods were used. This time bound study was to test the applicability of both the methods among children residing in Mangalore.
Materials And Methods: The study consisted of randomly selected 30 subjects ranging from 6 to 18 years. Dental age estimation was performed from orthopantomogram images from archives by Demirjian's and Willem's methods. The differences between the chronological age and the estimated dental age were calculated and the data obtained was statistically analysed.
Results: This study emphasized that Demirjians method was more accurately applied for the population in Mangalore.
Kewwords: Demirjians method ,Williems method, chronological age , dental age , panoramic Radiograph

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I. Introduction

Age estimation,is a subdiscipline of the forensic sciences, which has immense importance in forensic medicine for identification of the deceased victims also in connection with accidents and crimes(1). Prof. Arthur Schuster in 1896 introduced application of radiology in forensic science. Dental tissues has been widely used due to its durability and resistance to chemical, mechanical and thermal changes . Histo-pathological investigation especially aspartic acid racemization was supposed to be the best(2). But as it was not ethical to extract a tooth of a person just to know the age, radiology has attained a greater importance.Dental age can be estimated through various methods. Among many proposed methods the Demirjian method of age assessment was widely accepted. Demirijian and his co-workers in 1973 gave scoring criteria which was based on maturation stages of seven teeth that is from mandibular left central incisor up to second molar.(3,4).Scores were summed up and compared to the chart.Willems et al modified Demirjians technique by creating new tables and matuarity score was directly expressed in years.Which was more simpler also retaining the advantages of Demirjians technique.(1).

This study deals with comparison of accuracy of the two commonly used dental age estimation methods Demirjian's and Willem's methods.

II. Objectives
* Evaluate the possible correlation between dental age(DA) and Chronological Age (CA).
* To study the feasibility of this technique in Mangalorean population.

III. Materials And Methods
The present study is conducted in the department OPD,Mangalore. The sample size was 30 patients of 15 males and 15 females between the age group of 6-18yrs.Study consisted of randomly selected orthopantamogram(OPG) samples from archives. Each OPG (digital) was taken by Planmeca machine under standard protocols and radiographs were measured using Agfa NX software.

INCLUSION CRITERIA
1. Patients of age group 6-18years.
2. Having required compliment of teeth.
3. Standardised OPGs are selected with no positional errors.

IV. Exclusion Criteria

1. Developmental anomalies.
2. Undergoing orthodontic treatment.
3. Any patient undergone maxillofacial surgery.

The chronological age of each individual was calculated by subtracting the birth date from the date on which the radiographs were exposed for that individual. Digital OPG of all children were used to assess the status of maturation based on the calcification of the permanent teeth on the left side of mandible, from central incisor to the second molar. Right side tooth was selected for scoring in case of missing left mandibular tooth. The digital images were evaluated and the stages of tooth formation was assigned to each teeth under the study by comparison with the Demirjian's stages.[FIGURE 1] . Demirjian's score for each tooth was determined based on Demirjian's stage which had seperate tabulations for boys and girls. A sum of scores of 7 teeth was obtained which was designated as the 'maturity score' for each subject. The dental age in years based on Demirjian's method was obtained from the maturity score of each subject by referring to the tabulations (separate for boys and girls) . Willem's score was also designated to each tooth based on the Demirjian's stages as per the tabulations(separate for boys and girls) . The sum of Willems' scores for all 7 teeth were then done to directly obtain a dental age in years based on Willem's method.

Figure 1
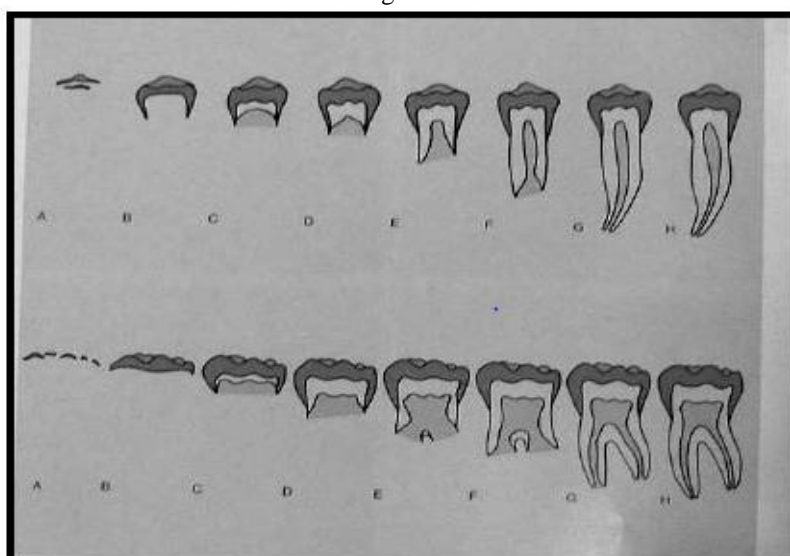
Dental calcification stages (adapted from demirjian *et al.* (1973))
A - Calcified cusp tips that are not fused.
B- Calcified cusp tips that are fused with well-defined occlusal surface outline.
C- Complete formation of enamel at occlusal surface. Commencement of dentinal deposition. D- Completion of crown formation upto cement enamel junction. Root formation is seen and   pulp horns begin to differentiate.
E- Pulp horns and pulp chamber are more differentiated. Root length is less than crown length. Radicular bifurcation is visible in molars
F- Funnel shaped apex is seen. Crown length is equal and greater than root length. G- Root canal walls are parallel and the apical ends are still open.
H- Apical ends are closed and uniform periodontal ligament space is seen around the tooth.

V. Results

The present study was conducted with 30 sample size, in which 15 wer females and 15 were males .The mean chronological age of 30 samples was 13.28.while the mean estimated age by Demijians method was 12.37 and by Willems method was 12.32.(TABLE 1)

(Table 1) Mean Chronological Age And Mean Estimated Age Of 30 Samples.

CHRONOLOGICAL AGE	N	MEAN	STD.DEVIATION
	30	13.281	2.057
ESTIMATED AGE-DEMIRJIANS METHOD	30	12.373	2.352

The correlation between chronological age and estimated age using Demirjians method- .908, Willems method- .960and it is statistically significant [p value < 0.05] (TABLE 2).

(Table 2) Correlation Between Chronological Age And Estimated Age Of 30 Samples

Chronological Age & Estimated Age	N	Correlation	Sig.
Demirjians Method	**30**	.908	**.000**
Williems Method	**30**	.960	**.000**

Since P value <0.001,both the methods are statiscally significant.

In females:
The mean chronological age was 13.83.
The mean estimated age using Demirjens method was 13.16 and by Willems method was 12.81.
In males:
The mean chronological age was 12.56
The mean estimated age using Demirjens method was 11.33 and by Willems method was 11.68
The correlation between chronological age and estimated age in Demirjians method:
 females was .666 while in **males** was 1.22 .
The correlation between chronological age and estimated age in Willems method:
Females-1.02 while in **males**-.881.
In females since p value <0.05 both the methods are statistically significant ,but Willems method was showing more significance.
In males p<0.05 in both the methods,but Demijens method is showing more significance than Willems method.(**TABLE 3**).

Gender	N	Chronological Age & Estimated Age	Correlation	Sig.
Females	15	Demirjians Method	.666	.030
		Willems Method	1.02	.017
Males	15	Demirjians Method	1.22	.000
		Willems Method	.881	.005

(TABLE.3-efficacy of demirjians and willems method)

VI.   Discussion

Age estimation should be as accurate as possible since it narrows down the search of a person of unknown age, enabling a more time saving and efficient approach. Although various methods for the age determination do exist, a universal system has not been achieved due to the varying differences in different ethnic populations(5). Hence, each method needs to be tested in varying populations.The high number of teeth and the continuous modification of both crown and root in children mean that several methods of age estimation can be applied(6). The aim of the present study is to estimate chronological and dental age in individuals from Mangalore district between 6-18years of age. This age group was selected as this age range forms a crucial factor to determine whether the child is a juvenile or an adult and is commonly accepted for dental age estimation in children as teeth development passes through various stages during this age group.

The evaluation of mineralization of teeth from OPGs is the most suitable and reliable method for estimation of age because a single radiograph gives the complete developmental status of the dentition.(7) Subjects with gross malocclusion were excluded as it may lead to discrepancies during staging of teeth development. The present study consisted of 30 samples;15 females and 15 males residing in Mangalore district.Purvs.s.patel et al had conducted similar study but on different populations(1) The maxillary posterior teeth were omitted from the study because superimposition of calcified structures in this area resulting in inaccurate assessment of the stage of development.(1)

The method described by Demirjian *et al*., (1973) was chosen in the present study because its criteria consists of distinct details based on shape and proportion of root length which are precise and simple, using the relative value to crown height rather than on absolute length.(5,1). However, there is consistent overestimation of age by Demirjian's method of dental age estimation in certain populations.[8] Hence, Willem's dental age estimation method was also tested in this study. In 2001, Willems *et al*.[8] evaluated the accuracy of Demirjian's method and they concluded that no two individuals grow and develop at the same rate(9). The *P* value of paired sample *t* test for comparison between chronological age and dental age by Demirjian's method in the current study was greater than 0.05 for almost all age groups among male and females [Tables 2 and 3]. This suggested that there was no statistically significant

difference between chronological age and dental age by Demirjian's method for most age groups and that this method was applicable to the population under study. This finding was consistent with the results of patel *et al*(1) .

The *P* value of paired sample *t* test for comparison between chronological age and dental age by Willem's method was greater than 0.05 for almost all age groups among males and all age groups in females [Tables 2 and 3]. This suggested that there was no statistically significant difference between the chronological age and dental age by Willem's method for almost all age groups and that this method was applicable to the population under study.Maber et al and akbar at al also had the similar conclusion.(10,9). Differences of chronological and dental age by Demirjian's method were consistently smaller than those between chronological age and dental age by Willem's method.This suggested that Demirjian's method is more accurate than Willem's method for the population under study. The differences in certain age groups may be due to environmental factors such as the nutrition,dietary habits and socio-economic status that vary in different population groups.[1]

VII.   Conclusion

Demirjian's and Willem's dental age estimation methods are applicable for estimating the age of this particular population under study. Although various age estimation methods do exist, the results are varied in different populations due to ethnic differences. Amongst the age estimation methods used in this study,the Demirjians dental age estimation method was the most accurate and consistent for the 6-18 year old children residing in and around Mangalore district.

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