ORIGINAL ARTICLE

Demirjian approach of dental age estimation: Abridged for operator ease

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Abstract

Background: Present times have seen an alarming increase in incidence of crimes by juveniles and of mass destruction that Highlight the preponderance of individual age estimation. Of the numerous techniques employed for age assessment, dental age estimation (DAE) and its correlation with chronological age (CA) have been of great significance in the recent past. Demirjian system, considered as gold standard in DAE is a simple and convenient method for DAE, though,, although, referring to multiple tables make it cumbersome and less eco friendly due to excessive paper load. **Aim:** The present study was aimed to develop a comprehensive chart (DAEcc) inclusive of all Demirjian tables and developmental stages of teeth and also to as well as to test the operator ease of 50 undergraduate dental students in performing DAE using this chart. **Materials and Methods:** The study was performed in two stages, wherein the first stage was aimed at formulation of the comprehensive chart (DAE_{CC}) which included pictorial representation of calcification stages, the Federation Dentaire Internationale notation of the teeth, and the corresponding scores for each stage with a concluding column at the end to enter the total score. The second stage assessed the applicability of the ease of DAE by DAE_{CC}, whereby fifty 2nd year BDS students were asked to trace the calcification stages of the seven permanent left mandibular teeth on a panorex, identify the correct stage, assign the corresponding score, and to calculate the total score for subsequent dental age assessment. **Results and Conclusions:** showed that average time taken by the students for tracing seven mandibular teeth was 5 min and for assessment of dental age was 7 min. The total time taken for DAE was approximately 12 min, thus making the procedure less time consuming. Hence, this study proposes the use of DAEcc for age estimation due to ease in comprehension and execution of Demirjian system.

Key words: Chronological age, Demirjian method, dental age estimation

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Introduction

In developing countries like India, the rationale for the impetus on estimation of chronological age (CA) is varied. First and foremost, 80% of Indian population resides in rural areas where the awareness for registration of childbirth is minimal. Hence, individuals are not aware of their definite date of birth. Apart from this, there has been an alarming

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increase in the number of mass disasters as well as criminal offenses rendered by the juveniles in the country making age estimation mandatory for legal deliberations and forensics. Furthermore, intentional manipulation in age at national level sports selections, as mentioned in a recent issue of the Times of India dated September 11, 2015,[1] highlights the need for determination of exact CA of players by means other than birth certificate. A viable alternative for estimation of individual age is would be Dental Age Estimation (DAE) and establishment of its correlation with CA. DAE is an integral part of forensic odontology, that has recently been introduced in undergraduate BDS curriculum, hence methods of dental age estimation that are user friendly, less time consuming and more easily comprehended by undergraduate students are bound to gain importance.

The techniques routinely employed for DAE are based on gingival emergence, eruption sequence of the teeth, or developmental stage analysis using radiographs of which panorex assessment by Demirjian[2,3] and Nolla[4] have been most widely used. Radiographs have proved to be most accurate and less prone to inter-examiner errors.[5] Demirjian's method considered as the gold standard is based on the calcification of the permanent seven teeth on the left side of the mandible, i.e., from central incisor to the second molar, whether erupted or not.[2] The calcification of a tooth is divided into eight stages, and each stage has been designated a particular score which is different for boys and girls.[2] Although numerous studies have been done utilizing this method in different ethnic populations,[6-9] the most commonly witnessed drawback is that the method is time consuming[2] and less user friendly as numerous tables have to be referred to. Thus, the authors felt the need to simplify this tedious process and prepare a comprehensive chart compiling data from all the original tables of Demirjian (DAEcc) and test its interpretation and ease of applicability by undergraduate BDS students.

Materials and Methods

Preparation of comprehensive chart (DAE_{cc})

The comprehensive chart (DAE_{cc}) was prepared and submitted as a proposal for STS (Short Term Studentship) project conducted by ICMR in the year 2015.

Original Demirjian method

The original Demirjian tables provide with a chart representing the calcification stages and separate scoring tables for boys and girls, assigning a particular score to each calcification stage, the sum of which is then compared with the tables provided for DAE, separately for boys and girls.[2] Thus, a total of three tables are required to be considered at a particular time while estimating the age of a person.

Abridged form of Demirjian (DAE_{CC})

DAE_{cc} prepared in the present study depicted tooth number in FDI notation as well as all the eight developmental stages of each tooth, as given separately in the original tables by Demirjian [Table 1].[2] In addition, it included scanned copies of pictorial representation of developmental stages of all seven teeth under consideration, i.e., incisors, canines, premolars and molars. The scoring system of each developmental stage was also incorporated into DAE_{CC} for both boys and girls, the sum of which would be added to give a final score at the end of the table. The total score mentioned in DAE_{CC} would be subjected for calculation of dental age in reference to the original tables by Demirjian for boys and girls. Annexure has been provided by the authors, wherein a common description for each stage with respect to the amount of calcified crown and root, formation of root apices and closure of root apices has been described for a better understanding [Table 2].[2]

Application of DAE_{cc} for ease of operator

The ease of operator in using DAE_{cc} for age estimation was evaluated on 50 second year BDS students of Faculty of Dentistry, Jamia Millia Islamia, after explaining the study to them and obtaining due consent from them for participating in the study. A demonstration was given by single instructor to this group of students for tracing the seven mandibular teeth (as explained by Demirjian) on the panorex. This was followed by matching the tracing to the pictoral representation of teeth in the DAEcc and assigning the corresponding score to the tracing. A sum total of all individual scores was computed for locating the analogous dental age in the original tables by Demerjian, separately for boys and girls. The time taken by demonstration was approximately 15 minutes after which the students were given an exercise to trace.

Results

The results as observed on evaluation of tracings by the single instructor are compiled in Table 3.

Discussion

Literature supports DAE using Demirjian's method in Northeastern Turkish children,[10] Malay population,[11] Western Chinese children,[12] Malaysian children,[13] Belgaum population,[14] and Lucknow children[15]. However, our study validates the use of Demirjian system in North Indian population. The studies that have employed Demirjian for DAE indicate referral to a number of tables and charts, making the whole process very time consuming and cumbersome. Hence, ease of operator and abatement of time requirement necessitated the formulation of a comprehensive chart. We found no precedence of our study with respect to assessment of ease of operator in DAE on using the Demirjian system. Results of our study demonstrated that 42 out of 50 2nd year undergraduate students with no prior experience in tracing or reading radiographs were able to trace the panorex correctly. Average time taken by the students for tracing was 5 min, thus, attested the simplicity of the process and reduction in time taken. Subsequent to the tracing, 39 out of these 42 students

Table 1: Comprehensive chart for dental age estimation*

Patient ID: _____ OPD number: _____
Gender: _____ Nationality: _____
Date of data collection: _____ Place of origin: _____
Dentition present: _____

Determination of score based on developmental stages of the tooth

Tooth number	Developmental stages of the tooth							
	A	B	C	D	E	F	G	H
31								
CS: By/Gr				0.0/0.0	1.9/2.4	4.1/5.1	8.2/9.3	11.8/12.9
32								
CS: By/Gr			0.0/0.0	3.2/3.2	5.2/5.6	7.8/8.0	11.7/12.2	13.7/14.2
								
33								
CS: By/Gr			0.0/0.0	3.5/3.8	7.9/7.3	10.0/10.3	11.0/11.6	11.9/12.4
								
34								
CS: By/Gr		0.0/0.0	3.4/3.7	7.0/7.5	11.0/11.8	12.3/13.1	12.7/13.4	13.5/14.1
35								
CS: By/Gr	1.7/1.8	3.1/3.4	5.4/6.5	9.7/10.6	12.0/12.7	12.8/13.5	13.2/13.8	14.4/14.6
								
36								
CS: By/Gr			0.0/0.0	8.0/4.5	9.6/6.2	12.3/9.0	17.0/14.0	19.3/16.2
37								
CS: By/Gr	2.1/2.7	3.5/3.9	5.9/6.9	10.1/11.1	12.5/13.5	13.2/14.2	13.6/14.5	15.4/15.6
								
Total score								

*Adapted from the scoring and calcification tables given by Demirjian.[2] OPD: Outpatient department

were able to correctly perform the age estimation, the average time taken for which was approximately 7 min. The time taken to precisely to evaluate the dental age was divided in three groups of less than <10 min, 10–12 min, and >12 min. The original sample of Demirjian was French Canadian population and when used in other ethnic populations, it was found to overestimate the dental age. The abridged DAE_{cc} as proved in our study, is less time consuming and is easy to interpret, thus making it a potential tool for forensic age estimation in a large sample of North Indian population in future studies. Also, its ease in comprehensibility by BDS undergraduates supports its introduction in forensic odontology manual in BDS curriculum.

Advantages of DAE_{cc}

- Reduced paper work

Table 2: Developmental stages of the tooth*

Stage	Substages	Description	
		Uniradicular	Multiradicular
A		Beginning of calcification at superior level of crypt without fusion of CP	
B		Regularly outlined occlusal surface with fusion of CP	
C	A	EF complete at occlusal surface with extension and convergence at CR	
	B	Beginning of dentinal deposit	
	C	Curved shape of PC outline at occlusal border	
D	A	CF complete to CEJ	
	B	PC - superior border curved, cervically concave with visible PH occasionally	PC - trapezoidal form
E	A	R formation beginning in spicule form	
	B	PC walls form straight line with PH breaking continuity	RL < BCH
	C	RL < CH	RL < CH Initial formation of RB-CP/semi-lunar space
F	A	PC walls in isosceles triangle with funnel-shaped A	
	B	RL = or > CH	RL = or > CH R outline definite& distinct- funnel shaped
G		Parallel RC walls with partially open AE	
H	A	RC - Completely closed AE	
	B	Uniform width of pdl around R and A	

*Adapted from the scoring and calcification tables given by Demirjian.[2] RC: Root canal, RL: Root length, PC: Pulp chamber, PH: Pulp horn, CH: Crown height, R: Root, A: Apex, AE: Apical end, pdl: Periodontal membrane, RB: Radicular bifurcation, CP: Calcification points, CEJ: Cementoenamel junction, CF: Crown formation, EF: Enamel formation, CR: Cervical region

Table 3: Results of tracing by single instructor

Total number of students	Students with correct tracings		
50	42		
	Students with correct score		
	39		
Time taken for tracing	<10 min	10-12 min	>12 min
Number of students	10	23	6

- Ease in comprehension
- Less time taking

Conclusion

An abriged form of Demirjian (DAEcc) was prepared to ease the interpretation and evaluation of dental age using panorex. It was easily comprehended by dental undergraduate students and average time taken to trace and interpret the calcification stages was 10 to 12 minutes.

Proposal based on the present study

- The authors propose inclusion of DAEcc in forensic odontology manual for BDS undergraduate students as part of dental age estimation techniques.
- DAEcc to be used for a wider Indian population to establish its correlation with CA so that it may be used for forensic age estimation purposes.

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Conflicts of interest

There are no conflicts of interest.

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