Journal of Forensic Sciences And Criminal Investigation
ISSN: 2476-1311

Juniper Publishers key to the Researchers

Research article
Volume 19 Issue 4 - May 2025
DOI: 10.19080/JFSCI.2025.18.556016

J Forensic Sci & Criminal Inves

Dental Age Estimation in Egyptian Children Using Demirjian Method: Comparison of Three Mandibular Permanent Teeth

Eman Abdelrazik[1]*, Amal A El-Bakary[1] and Mohammad Abd-El-Same'e El-Kattan[1,2]

[1]*Department of Forensic Medicine and Clinical Toxicology, Faculty of Medicine, Mansoura University, Mansoura, Egypt*

[2]*Kuwait Poison Control Center, Ministry of health, Kuwait City, Kuwait*

Submission: May 11, 2025; **Published:** May 29, 2025

***Corresponding author:** Mohammad Abd-El-Same'e El-Kattan, Kuwait Poison Control Center, Ministry of health, Kuwait City, Kuwait, Email: moh_s@mans.edu.eg

Abstract

Background: Demirjian method first described in 1973 is one of the most common methods for evaluating dental maturation. Objectives: This study aimed to estimate the accuracy of Demirjian method in assessing the chronological age 12 and 15 years based on the comparison of three mandibular permanent teeth (canine, second premolar and second molars) in dental panoramic radiographs.

Materials and Methods: About 845 panoramic radiographs of healthy Egyptian children (8 - 18 y) who visited Oral Medicine, Periodontology, Oral Diagnosis and Radiology departments, Faculty of Dentistry, Mansoura University were included in the study. The panoramic radiographs were evaluated according to the Demirjian method.

Results: The best performance to discriminate individuals below or above 12 years showed stage H for canines (71.1% sensitivity, 97.8% specificity), and stage G for second premolars (48.6% sensitivity, 90.7% specificity) and second molars (50.1% sensitivity, 98.8% specificity). Stage H was a useful marker for predicting age equal to or over 15 years, in canines (94.5% sensitivity, 77% specificity) and second premolars (70.2% sensitivity, 93.6% specificity) but stage G for second molars (54.5% sensitivity, 78.6% specificity).

Conclusion: it is possible to predict age over 12 and 15 years in Egyptian children using Demirjian method based on the evaluation of three mandibular permanent teeth (canine, second premolar and second molars) in dental panoramic radiographs with a relatively high good diagnostic accuracy.

Keywords: Dental Age; Teeth; Demirjian Method; Egyptian; Children

Abbreviations: DA: Dental age; ICC: Intra-class correlation coefficient; OPGs: Orthopantographs; PPV: The positive predictive value; NPV: Negative predictive value

Introduction

Estimation of age is one of the crucial criteria of identification. Identification is defined as recognition of an unknown person (living or dead) through certain features and characters that differentiate him from other people. It is very important to find a dependable and accurate method to estimate age, especially in children [1]. Teeth are resistant to different external mechanical, chemical and thermal insults. Additionally, a person's dentistry possesses individual characteristics like arrangement, size, shape and color [2]. One of the good indicators for estimating the biological age in growing children is odontology methods since it is less affected by variation in endocrine and nutritional status compared to the other methods [3]. Demirjian method first described in 1973 is one of the most common methods for evaluating the dental maturation. Demirjian method consists of 8 stages: A to H as shown in figure [1]. The crown formation starts from cusp appearance of the crown until the completion is represented by stages from A to D, while stages E to H signifies root formation from radicular bifurcation to apical closing [4]. In Egypt, the age of 12 and 15 years have specific medico-legal importance. Law 4 of 2005 states that the custody right of the mother or other female relative for both girls and boys ends at 15 years. After that the court will ask the child to choose with whom she/ he would like to stay [6]. Also, at the time of committing the crime if the child

has not reached 12 years, he isn't responsible criminally. Yet, if a child aged 7- 12 years had committed a misdemeanor or a felony only the Child Court is the competent one "Law no.126 of 2008- Article 94". Furthermore, if a child commits two crimes or more under the age of 15 years, the Court should pass a verdict in order to enforce a suitable measure. This measure should be performed even if the child committed another crime either subsequent or prior to that verdict "Law no.126 of 2008- Article 109" [7].

Additionally, a child aged less than 15 years shouldn't be kept in temporary custody. The child may be placed in one of the observation centers only by the decision of the Public Prosecution for a period not more than 7 days. If it is necessary to keep the child in custody, he should be available upon each request "Law no.126 of 2008- Article 119" [7]. Only the Child Court should exclusively transact the accused child in case of his delinquency or committing a crime. At the same time, if the child who committed a crime necessitates forced labor, life imprisonment or capital sentence, he should be instead sentenced to imprisonment. Moreover, the child should be kept in custody for not less than 90 days if the crime committed is punishable by imprisonment [7]. For these important issues and the need to accurately determine these ages, the current study aimed to test Demirjian method accuracy for detection of age 12 and 15 years in a sample of Egyptian children based on the evaluation of three mandibular permanent teeth (canine, second premolar and second molars) in dental panoramic radiographs.

Material and Methods

The Ortho pantographic (OPGs) samples used in this study were digital panoramic radiographs for 845 children of known age and sex who visited the Oral Medicine, Periodontology, Oral Diagnosis and Radiology Departments, Faculty of Dentistry, Mansoura University from 2019 - 2021, also from private dental clinics. Approvement of the study by institutional research board of Mansoura Faculty of Medicine was obtained (code: R.21.10.1499). The IBMª SPSSª Sample Powerª version 3.0.1 (IBMª Corp., Armonk, NY, USA) was used for measuring sample size. A previous study by Lee et al. [8] stated that the accuracy mean (in years) of Demirjian's method in a sample of Korean juveniles and adolescents was 0.300 (SD 0.811). A minimal sample size of 516 subjects will have the power of 80% to detect a 0.1 difference in the mean accuracy and 5% significance level. All children with Egyptian ethnicity and age 8-18 years were entered in this research. Exclusion criteria were tooth with any pathology that alter the surface area of tooth, badly destructed tooth and filled tooth or any prosthetic crown. By the age of 12 y, second molars will be completely developed. That is why we selected the mandibular permanent canine, 2nd premolar and 2nd molar. The Demirjian method (DI) was used for evaluation of teeth development, in which 1 of the 8 stages of calcification (A to H) was assigned to the tooth [9]. The selected teeth of any one side (right or left) were evaluated where the pulp chamber was more visible as the difference between the right and the left teeth is statistically insignificant. One observer evaluated the developmental stages of the selected teeth. Inter-observer reliability was checked by testing and assessing twenty randomly selected OPGs and were re-examined after four weeks.

Statistical analysis

The collected data were organized and statistically analyzed using SPSS software statistical computer package for windows version 22. For quantitative data, the Shapiro-Wilk test for normality was performed. For data that were not normally distributed median and interquartile range (expressed as 25th -75th percentiles) were calculated and Mann Whitney test was used for comparison between independent groups while Wilcoxon signed rank test was used to compare related samples. Spearman's correlation was performed. For normally distributed data, values were expressed as mean and standard deviation and independent sample test was used for comparison between independent groups. For qualitative data, Pearson's Chi-square was used.

Results

Table 1: Age distribution of the studied subjects.

	n	Range	Median	Mean	SD
Age (years)	**845**	**18-8**	**13**	**12.83**	**3.06**
Age group (12 years)			Number	Percent	
< 12 years			324	38.3	
≥ 12 years			521	61.7	
Age group (15 years)			Number	Percent	
< 15 years			590	69.8	
≥ 15 years			255	30.2	
Sex			Number	Percent	
Males			361	42.7	
Females			484	57.3	

n: number, SD: standard deviation

How to cite this article: Shane M. Empowering State and Local Law Enforcement in the Counterintelligence Fight. J Forensic Sci & Criminal Inves. 2025; 19(3): 556012. DOI: 10.19080/JFSCI.2025.19.556012

The present study included ortho-pan tomographs of 845 participants of known age and sex (484 girls and 361 boys). Their chronological age (real age) ranged between 8 and 18 years with a mean 12.82 ± 3.06 years (median: 13 years). It was found that (38.3 %) of children were less than 12 years old while (69.8%) of children were less than 15 years old (Table 1). Results of this Egyptian sample according to Demirjian stages of canines showed that most of studied children were in stage H, while the least were in stage C. Meanwhile, Demirjian staging of the second premolars and the second molars, showed that most of the studied children were in stage G, while the least were in stage B as shown in table (2). There was no significant difference between boys and girls regarding Demirjian stages of canines, 2nd premolars and 2nd molars (Table 3). For children at or more than 12 years, most of the samples studied showed that canines were in stage H meanwhile, second premolars and second molars were in stage G. On the other hand, in children less than 12 years, most of the samples studied showed that canines and second premolars were in stage F; meanwhile, second molars were in stage E. There are significant differences observed between groups of canines, second premolars and second molars ($p < 0.001$) at the cut-off point of age 12 years (Table 4). Girls tend to be advanced in the formation and the eruption of the teeth before boys.

Table 2: Demirjian stages of canines, 2nd premolar and 2nd molar of the studied subjects (n=845).

Dimirjian stages	Canines	Premolars	Molars
	n (%)	n (%)	n (%)
B	0 (0)	1 (0.1)	2 (0.2)
C	1 (0.1)	3 (0.4)	15 (1.8)
D	15 (1.8)	37 (4.4)	101 (12.0)
E	64 (7.6)	120 (14.2)	168 (19.9)
F	154 (18.2)	184 (21.8)	187 (22.1)
G	234 (27.7)	283 (33.5)	265 (31.4)
H	377 (44.6)	217 (25.7)	107 (12.7)

n= number

Table 3: Demirjian score of canines, premolar and molar of the studied subjects according to gender (n).

Dimirjian stages	Canines			2nd Premolars			2nd Molars		
	Boys n (%)	Girls n (%)	Test of significance	Boys n (%)	Girls n (%)	Test of significance	Boys n (%)	Girls n (%)	Test of significance
B	0	0	MC= 6.860 P = 0. 097	0 (0)	1 (0.2)	MC= 2.369 P = 0.152	1 (0.3)	1 (0.2)	MC= 1.251 P = 0.324
	0	0							
C	0 (0)	1 (0.2)		1 (0.3)	2 (0.4)		8 (2.2)	7 (1.4)	
D	10 (2.8)	5 (1.0)		20 (5.5)	17 (3.5)		43 (11.9)	58 (12.0)	
E	33 (9.1)	31 (6.4)		60 (16.6)	60 (12.4)		76 (21.1)	92 (19.0)	
F	70 (19.4)	84 (17.4)		69 (19.1)	115 (23.8)		82 (22.7)	105 (21.7)	
G	102 (28.3)	132 (27.3)		127 (35.2)	156 (32.2)		109 (30.2)	156 (32.2)	
H	146 (40.4)	231 (47.7)		84 (23.3)	133 (27.5)		42 (11.6)	65 (13.4)	

n: number, MC= Monte-carlo test, *: statistically significant (p< 0.05)

For children at or more than 15 years, most of the studied sample showed that canines and second premolars were in stage H meanwhile, second molars were in stage G. Meanwhile, in children less than 15 years, most of the samples showed that canines and second premolars were in stage G; meanwhile, second molars were in stage F. According to cutoff point age of 15 years, there are significant differences observed between groups of canines, second premolars and second molars ($p < 0.001$) (Table 5). Table (6) and figures (2, 3 and 4) display the predictive ability of Demirjian categories, for children at or more than 12 years. Canines in stage H showed 71.1% sensitivity, 97.8% specificity, 44.6% accuracy and 98.1% positive predictive value. Stage G in second premolars showed 48.6% sensitivity, 90.7% specificity, 64.7% accuracy and 89.4% positive predictive value. Second

How to cite this article: Eman A, Amal A El-B, Mohammad Abd-El-Same'e El-K. Dental Age Estimation in Egyptian Children Using Demirjian Method: Comparison of Three Mandibular Permanent Teeth. J Forensic Sci & Criminal Inves. 2025; 19(4): 556016. DOI: 10.19080/JFSCI.2025.19.556016

marks in stage G showed 50.1% sensitivity, 98.8% specificity, 68.8% accuracy and 98.5% positive predictive value. Table (7) and figures (5-7) display the predictive ability of Demirjian categories, for children at or more than 15 years. Canines in stage H showed 94.5% sensitivity, 77% specificity, 82.2% accuracy and 63.9% positive predictive value. Stage H in second premolars showed 70.2% sensitivity, 93.6% specificity, 86.5% accuracy and 82.5% positive predictive value. Second molars in stage G showed 54.5% sensitivity, 78.6% specificity, 71.3% accuracy and 52.4% positive predictive value. High correlations were found between the first results and the results that were evaluated four weeks later (r = 0.9); it indicates that there was high repeatability and reproducibility.

Table 4: Comparison of Demirjian stages of canines, 2nd premolars and 2nd molars according to cut-off point of age 12 years.

Demirjian stages	Canines			Premolars			Molars		
	< 12 years n (%)	≥ 12 years n (%)	Test of significance	< 12 years n (%)	≥ 12 years n (%)	Test of significance	< 12 yearsn (%)	≥ 12 years n (%)	Test of significance
B	0	0	MC= 553.405 p < 0.001*	1 (0.3)	0 (0)	MC= 562.902 p < 0.001*	2 (0.6)	0 (0)	MC= 594.766 p < 0.001*
	0	0							
C	1 (0.3)	0		3 (0.9)	0 (0)		15 (4.6)	0 (0)	
		0							
D	15 (4.6)	0		37 (11.4)	0 (0)		99 (30.6)	2 (0.4)	
		0							
E	64 (19.8)	0		117 (36.1)	3 (0.6)		151 (46.6)	17 (3.3)	
		0							
F	147 (45.4)	7 (1.3)		135 (41.7)	49 (9.4)		53 (16.4)	134 (25.7)	
G	90	144		30 (9.3)	253 (48.6)		4 (1.2)	261 (50.1)	
	-27.8	-27.6							
H	7	370		1 (0.3)	216 (41.5)		0 (0)	107 (20.5)	
	-2.2	-71.1							

n: number, MC= Monte-carlo test, *: statistically significant (p < 0.05)

Table 5: Comparison of Demirjian score categories of canines, Premolars and molars according to cutoff point age of 15 years.

Demirjian stages	Canines			Premolars			Molars		
	< 15 years n (%)	≥ 15 years n (%)	Test of significance	< 15 years n(%)	≥ 15 years n (%)	Test of significance	< 15 years n(%)	≥ 15 years n(%)	Test of significance
B	0	0	MC= 368.682 P < 0.001*	1 (0.2)	0 (0)	MC= 422.743 P < 0.001*	2 (0.3)	0 (0)	MC= 436.251 P < 0.001*
	0	0							
C	1 (0.2)	0		3 (0.5)	0 (0)		15 (2.5)	0 (0)	
		0							
D	15 (2.5)	0		37 (6.3)	0 (0)		99 (16.8)	2 (0.8)	
		0							
E	64 (10.8)	0		118 (20)	2 (0.8)		165 (28)	3	
		0						-1.2	
F	151 (25.6)	3 (1.2)		182 (30.8)	2 (0.8)		177 (30)	10 (3.9)	
G	223	11		211 (35.8)	72 (28.2)		126 (21.4)	139 (54.5)	
	-37.8	-4.3							

How to cite this article: Eman A, Amal A El-B, Mohammad Abd-El-Same'e El-K. Dental Age Estimation in Egyptian Children Using Demirjian Method: Comparison of Three Mandibular Permanent Teeth. J Forensic Sci & Criminal Inves. 2025; 19(4): 556016. DOI: 10.19080/JFSCI.2025.19.556016

H	136 (23.1)	241		38 (6.4)	179		6	101 (39.6)	
		-94.5			-70.2		-1		

n: number, MC= Monte-carlo test, *: statistically significant (p< 0.05)

Table 6: Predictive ability of Demirjian stages of canines, premolars and molars to detect age ≥ 12 years (n=521).

Demirjian stages	Sensitivity (%)	Specificity (%)	Accuracy (%)	PPV (%)	NPV (%)
Canines					
C	0	99.7	38.2	0	38.3
D	0	95.4	36.6	0	37.2
E	0	81.2	31.1	0	33.5
F	1.3	54.6	21.8	4.5	25.6
G	27.6	72.2	27.7	61.5	38.3
H	71.1	97.8	44.6	98.1	67.7
Overall value	16.7	83.5	33.3	27.4	40.1
Premolars					
B	0	99.7	38.2	0	38.3
C	0	99.1	38	0	38.1
D	0	88.6	34	0	35.5
E	0.5	63.9	24.9	2.5	28.6
F	9.4	58.3	28.2	26.6	28.6
G	48.6	90.7	64.7	89.4	52.3
H	41.5	99.7	63.8	99.5	51.4
Overall value	14.3	85.7	41.7	31.1	39
Molars					
B	0	99.4	38.1	0	38.1
C	0	93.8	36	0	36.8
D	0.4	69.4	26.9	1.9	30.2
E	3.3	53.4	22.5	10.1	25.6
F	25.7	83.6	47.9	71.7	41.2
G	50.1	98.8	68.8	98.5	55.2
H	20.5	100	51	100	43.9
Overall value	14.3	85.5	41.6	40.3	38.7

PPV= positive predictive value, NPV= negative predictive value.

Table 7: Predictive ability of Demirjian score categories of canines, Premolars and molars to detect age ≥ 15 years (n=255).

Demirjian score categories	Sensitivity (%)	Specificity (%)	Accuracy (%)	PPV (%)	NPV (%)
Canines					
C	0	99.8	69.7	0	69.8
D	0	97.5	68	0	69.2
E	0	89.2	89.2	0	67.3
F	1.2	74.4	52.3	1.9	63.5

How to cite this article: Eman A, Amal A El-B, Mohammad Abd-El-Same'e El-K. Dental Age Estimation in Egyptian Children Using Demirjian Method: Comparison of Three Mandibular Permanent Teeth. J Forensic Sci & Criminal Inves. 2025; 19(4): 556016. DOI: 10.19080/JFSCI.2025.19.556016

G	4.3	62.2	44.7	4.7	60.1
H	94.5	77	82.2	63.9	97
Overall value	16.7	83.4	67.7	11.8	71.2
Premolars					
B	0	99.8	69.7	0	69.8
C	0	99.5	69.5	0	69.7
D	0	93.7	65.4	0	68.4
E	0.8	80	56.1	1.7	65.1
F	0.8	69.2	48.5	1.1	61.7
G	28.2	64.2	53.4	25.4	67.4
H	70.2	93.6	86.5	82.5	87.9
Overall value	14.3	85.7	64.2	15.8	70
Molars					
B	0	99.7	69.6	0	69.7
C	0	99.5	68	0	69.7
D	0.8	83.2	58.3	1.9	66
E	1.2	72	54.2	1.8	62.8
F	3.9	70	50.1	5.3	62.8
G	54.5	78.6	71.3	52.4	80
H	39.6	99	81.1	94.4	69.1
Overall value	14.3	86	64.7	22.3	68.6

PPV= positive predictive value, NPV= negative predictive value.

Discussion

It is quite different in medico-legal consequences if an individual with an unknown age is below or above 12 and 15 years. Therefore, age must be estimated individually using different criteria in children between 8 and 18 y. Forensic age assessment in unidentified individuals should include left-hand plan radiography and physical dental examination followed by an ortho-pantomogram according to the guidelines of International Interdisciplinary Study Group on Forensic Age Diagnostics (AGFAD) [10]. Many studies and reviews had written a lot about the use of teeth and their time of eruption in age estimation in forensic sciences [11,12,13]. Previous studies reported he estimation of dental age in Egyptians individuals [14,15,16,17]. Age estimation using teeth is more precise, reliable and acceptable under the age of 15 years because at the same time there are multiple teeth at different developmental stages [18,19]. This is the first Egyptian study "to the best of our knowledge" that uses Demirjian developmental stages of three mandibular permanent teeth (canine, second premolar and second molar) for determining age of 12 and 15 years. This study confirms previous results by Tomás et al [20] and Marques et al [18], that there were no significant differences between boys and girls regarding the frequency of Demirjian developmental stages of canines, premolars and molars.

Additionally, the present results correspond with Marques et al [18] findings that the eruption and the formation of the teeth tend to be more advanced in females. The present study shows that canines of most children (about 45%) were in stage H, while most of them showed stage G for the second premolars and the second molars (about 34% and 31% respectively). This is expected as the development of canines is completed at an earlier age than the second premolars and the second molars. This corresponds with the findings of Uysal et al. [21] who suggested that the first premolar root formation and completion of the mandibular canine can be used as an indicator of maturity for a pubertal growth spurt. Similarly, Krailassiri et al. [22] and Trakinienè et

How to cite this article: Eman A, Amal A El-B, Mohammad Abd-El-Same'e El-K. Dental Age Estimation in Egyptian Children Using Demirjian Method: Comparison of Three Mandibular Permanent Teeth. J Forensic Sci & Criminal Inves. 2025; 19(4): 556016. DOI: 10.19080/JFSCI.2025.19.556016

al. [23] have demonstrated that the second premolar, maxillary canines and mandibular second molars are highly correlated with skeletal maturity and growth. The present data showed that most of the studied children ≥12 y showed stage H for canines (71.1% sensitivity, 97.8% specificity), and stage G for second premolars (48.6% sensitivity, 90.7% specificity) and stage G for second molars (50.1% sensitivity, 98.8% specificity). On the other hand, most of the studied children aged less than 12 y showed stage E for second molars and stage F for canines and second premolars.

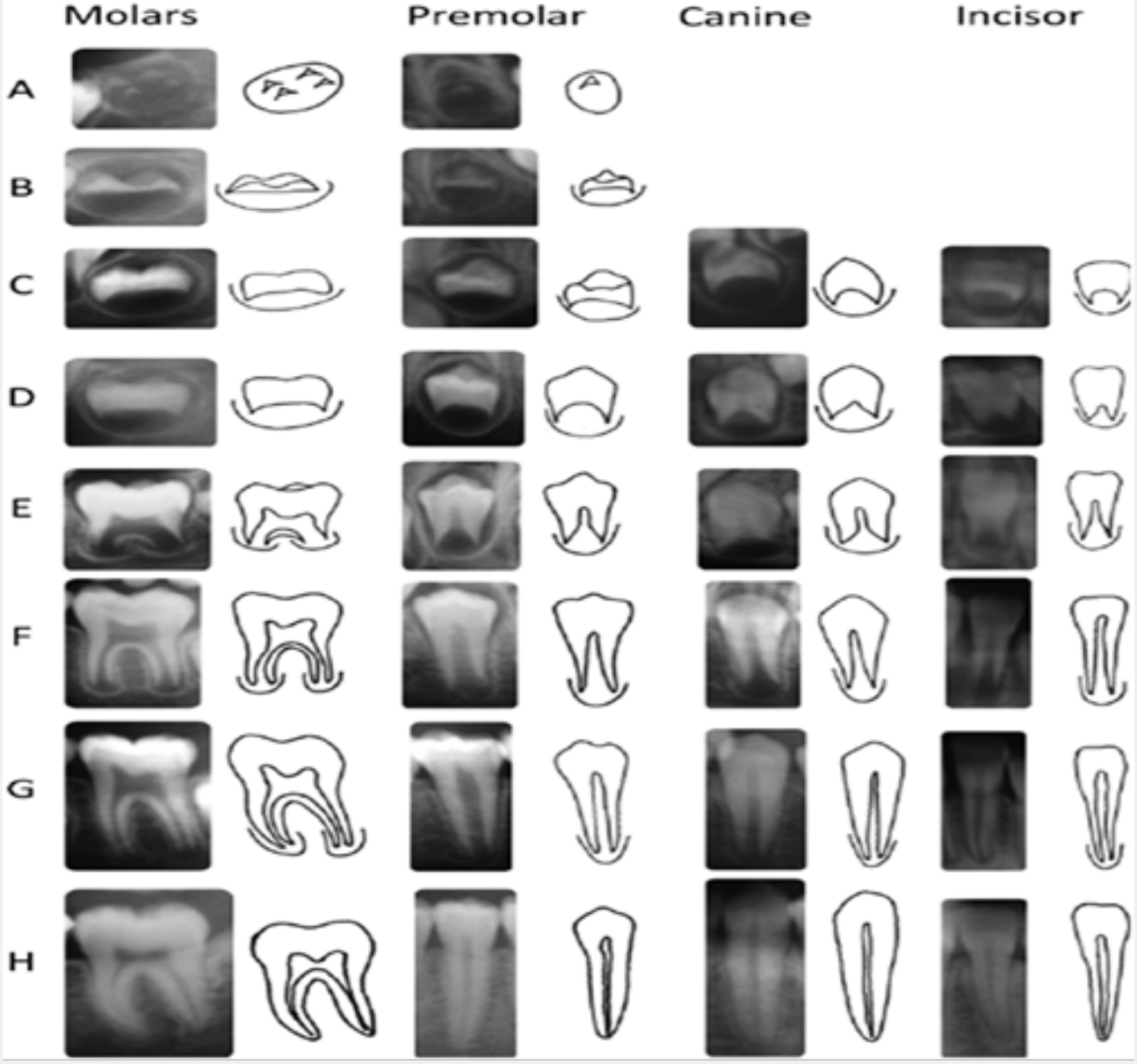

Figure 1: Developmental dental calcification stages in Demirjian's method (5).

Pinchi et al. [24], stated that a very high probability (at least 90%) and the specificity issues (to avoid false positives) are essential to support the age assessment process and to fulfil the legal requirements in criminal court. When applied to the present results, the cut-off stage to detect the threshold of 12 years can be stage G for second molars (98.8% specificity and 98.5% post-test probability), stage G for second premolars (90.7% specificity and 89.4%. post-test probability) while stage H for canines (97.8% specificity and 98.1% post-test probability) can be obtained. The current study showed that completely erupted teeth until the occlusal level (stage H) were good indicators to predict age over or equal to 15 years, in canines [94.5% sensitivity, 77% specificity] and second premolars [70.2% sensitivity, 93.6% specificity] but stage G for second molars [54.5% sensitivity, 78.6% specificity].

How to cite this article: Eman A, Amal A El-B, Mohammad Abd-El-Same'e El-K. Dental Age Estimation in Egyptian Children Using Demirjian Method: Comparison of Three Mandibular Permanent Teeth. J Forensic Sci & Criminal Inves. 2025; 19(4): 556016. DOI: 10.19080/JFSCI.2025.19.556016

Meanwhile, most children than 15 showed stage G for canines and second premolars while most of them showed stage F for second molars. It can be assumed that the completely erupted second premolar and molars can be used as a reasonable secured predictor of 15 years when the lower third molars tooth is absent.

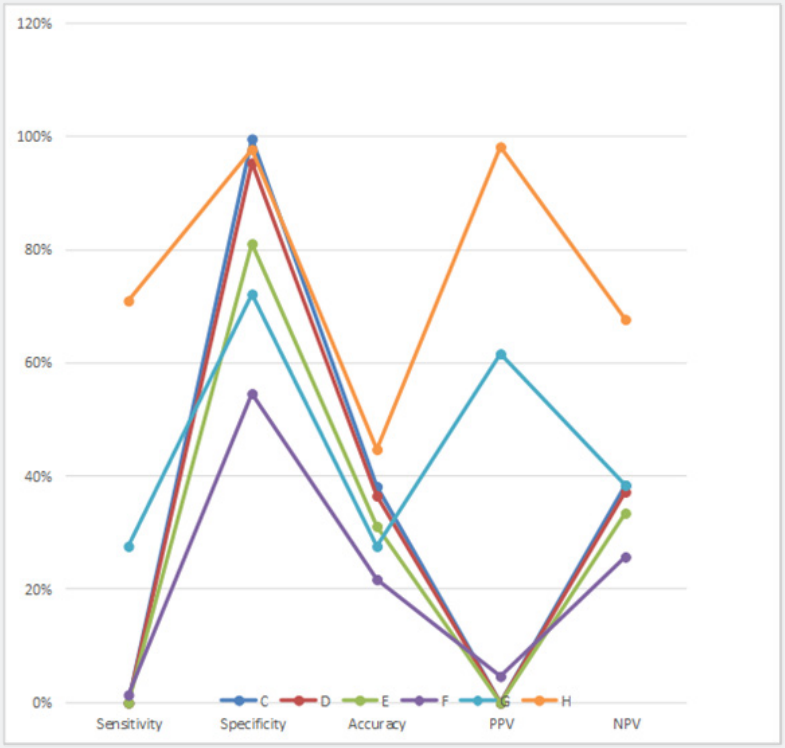

Figure 2: Predictive ability of Demirjian stages of canines to detect age ≥ 12 years.

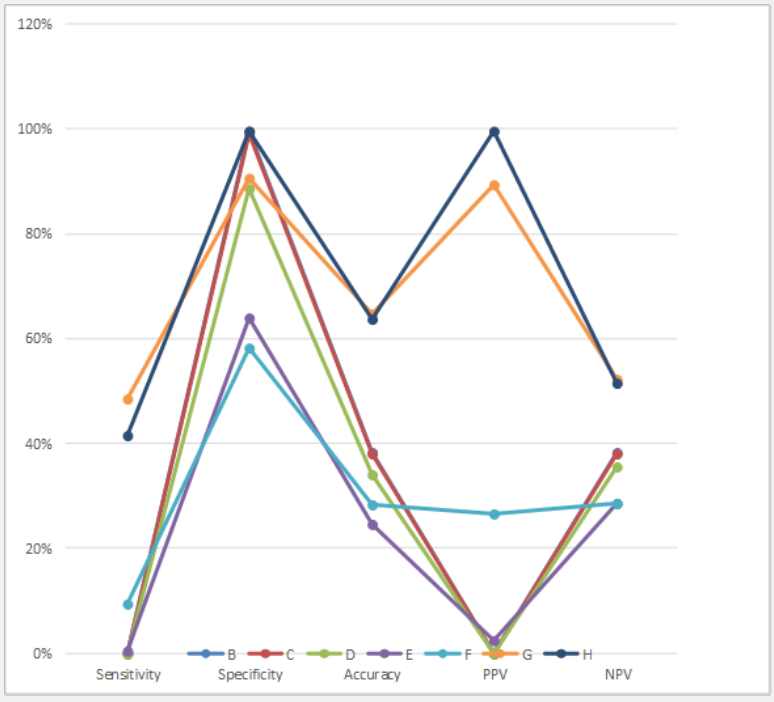

Figure 3: Predictive ability of Demirjian stages of Premolars to detect age ≥ 12 years.

How to cite this article: Eman A, Amal A El-B, Mohammad Abd-El-Same'e El-K. Dental Age Estimation in Egyptian Children Using Demirjian Method: Comparison of Three Mandibular Permanent Teeth. J Forensic Sci & Criminal Inves. 2025; 19(4): 556016. DOI: 10.19080/JFSCI.2025.19.556016

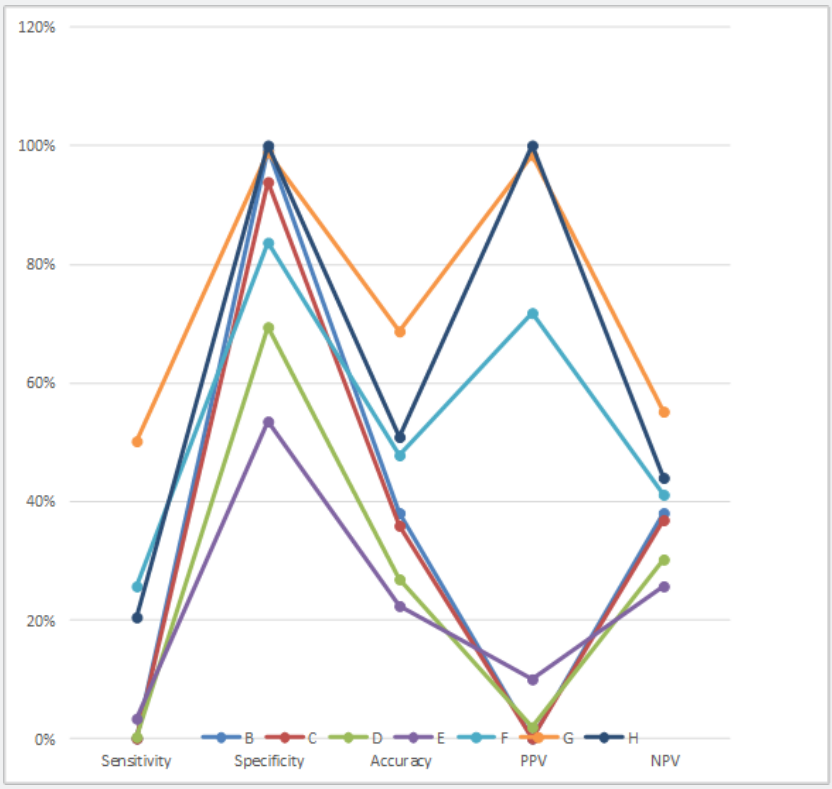

Figure 4: Predictive ability of Demirjian stages of molars to detect age ≥ 12 years.

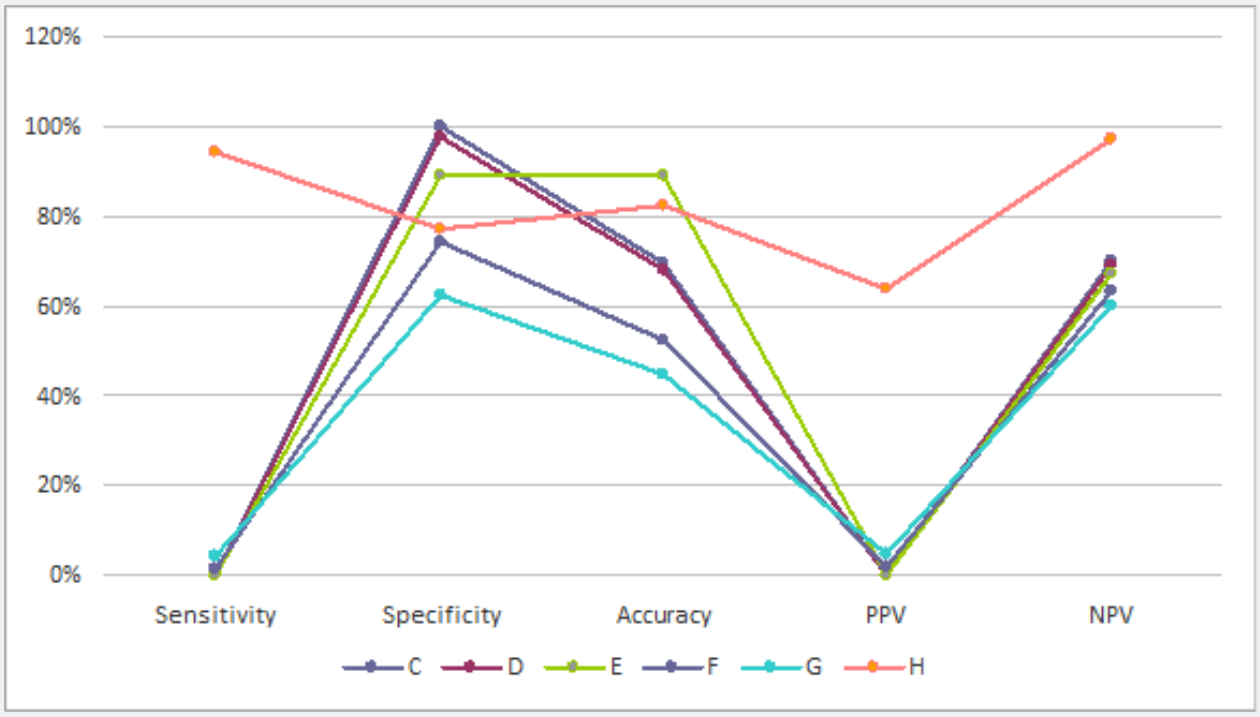

Figure 5: Predictive ability of Demirjian stages of canines to detect age ≥ 15 years.

How to cite this article: Eman A, Amal A El-B, Mohammad Abd-El-Same'e El-K. Dental Age Estimation in Egyptian Children Using Demirjian Method: Comparison of Three Mandibular Permanent Teeth. J Forensic Sci & Criminal Inves. 2025; 19(4): 556016. DOI: 10.19080/JFSCI.2025.19.556016

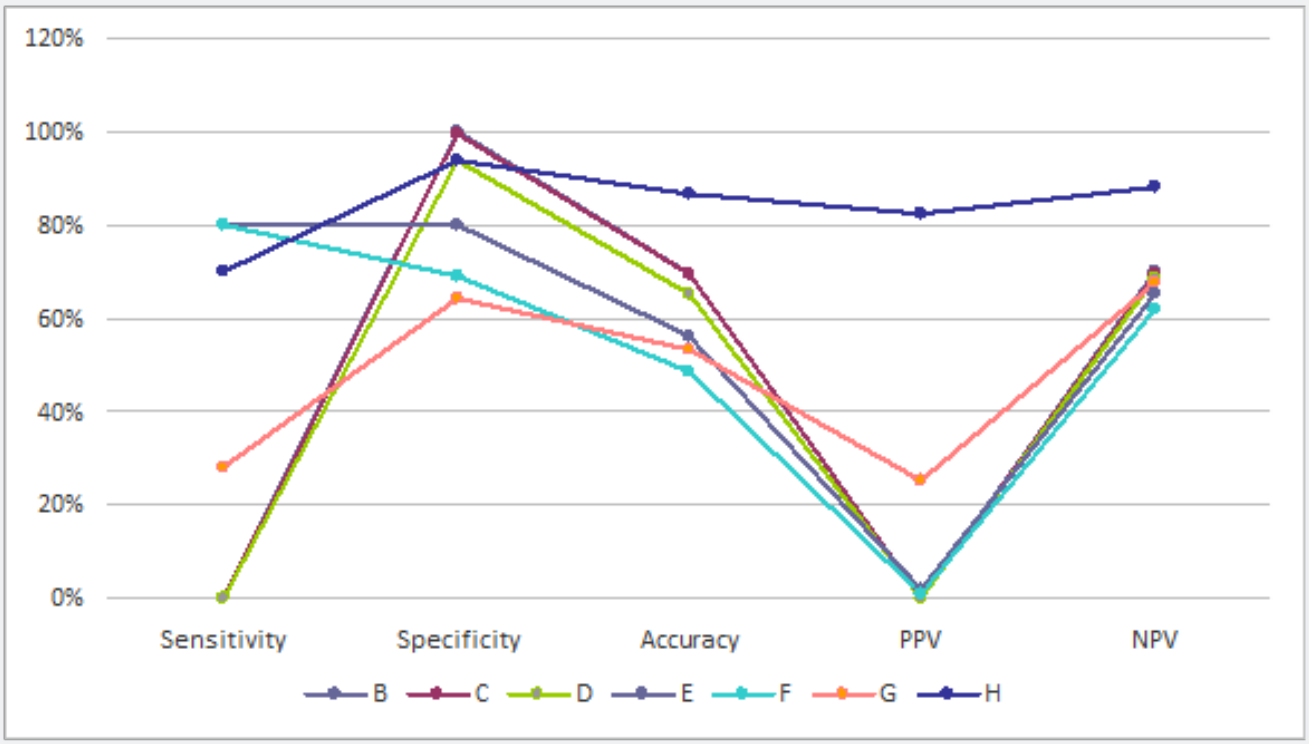

Figure 6: Predictive ability of Demirjian stages of premolars to detect age ≥ 15 years.

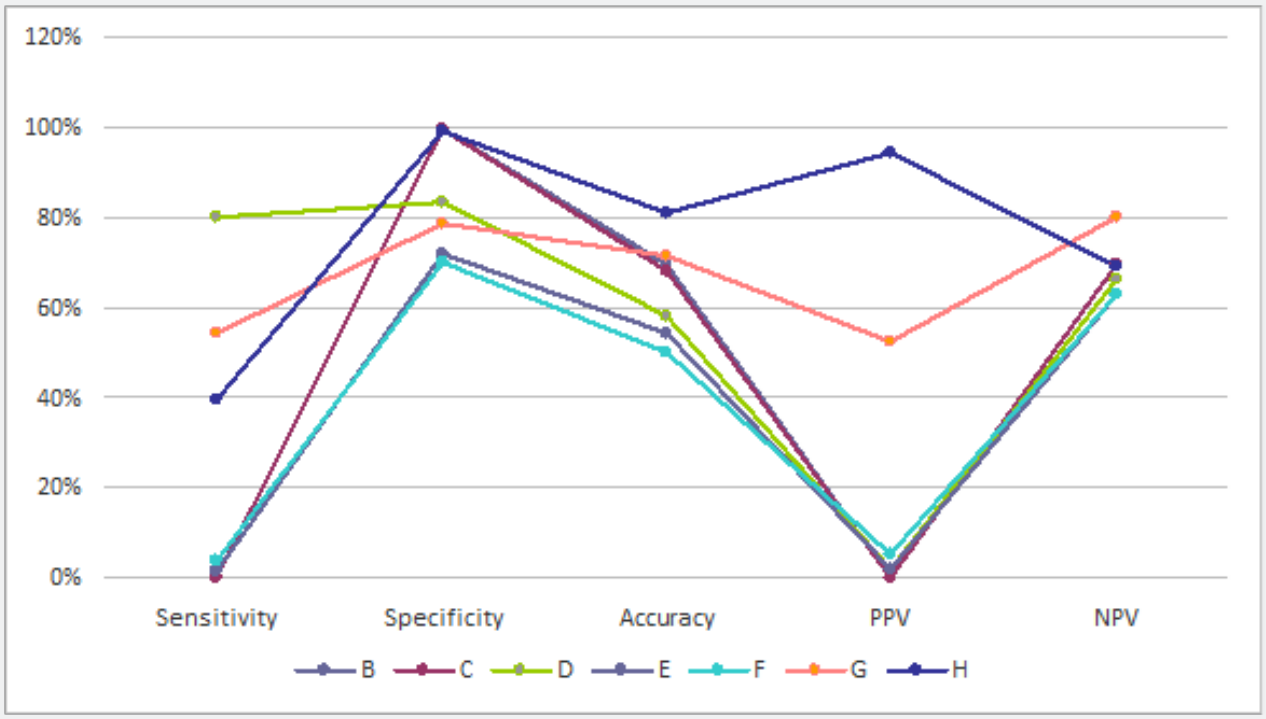

Figure 7: Predictive ability of Demirjian stages of molars to detect age ≥ 15 years.

How to cite this article: Eman A, Amal A El-B, Mohammad Abd-El-Same'e El-K. Dental Age Estimation in Egyptian Children Using Demirjian Method: Comparison of Three Mandibular Permanent Teeth. J Forensic Sci & Criminal Inves. 2025; 19(4): 556016. DOI: 10.19080/JFSCI.2025.19.556016

Conclusion

The current study findings demonstrated that the age 12 and 15 years could be possibly indicated in Egyptian children by using Demirjian's method based on the evaluation of three mandibular permanent teeth (canine, second premolar and second molars) with a good diagnostic accuracy. Therefore, this method could be used in clinical applications when information about third molar tooth is lost or missed for interpretation.

Authors' contributions

All the authors worked together to complete this work. The final manuscript was read and approved by each author. Eman Abdelrazik shared in the rating of panoramas, collecting of the data, the statistical analysis and shared in writing and publishing the article. Amal El-Bakary contributed to the idea of research and study design, rating of panoramas, and writing the article. Finally, Mohammad El-Kattan managed the literature research and revised the final manuscript. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

Availability of data and materials

Data supporting our findings can be found with the corresponding author. Data will not be shared, as it contains personal information. Please contact the author for data requests.

Ethics approval and consent to participate. This study was conducted in Mansoura University, Egypt, and approved by Mansoura University IRB (code: R.21.10.1499).

Consent for publication

This study does not include publishing personal data.

Acknowledgement

I wish to show my appreciation to Ahmed E. Elsukary for proper reading, revising and interpretation of the statistical data of the study.

References

1. Wahdan A, Lashin H, Elborae M (2017) 'Estimation of Age Using Mandibular Permanent First Molars in Panoramic Radiographs in a Sample of Egyptian Population', Mansoura Journal of Forensic Medicine and Clinical Toxicology 25(2): 1-12.
2. Hachem M, Mohamed A, Othayammadath A, Gaikwad J, Hassanline T (2020) 'Emerging Applications of Dentistry in Medico-Legal Practice-Forensic Odontology', International Journal on Emerging Technologies 11(2): 66-70.
3. Abu Asab S, Noor SN, Khamis MF (2011) 'The accuracy of demirjian method in dental age estimation of Malay children', Singapore Dent J 32(1): 19-27.
4. Mardiati E, Komara I, Halim H, Kurnia D, Maskoen AM (2021) 'Sensitivity and Specificity of Mandibular Third Molar Calcification at Chronological Age and Hand Wrist Maturation Stage to Discriminate Between Female and Male at Pubertal Growth Period', The Open Dentistry Journal15: 551-557.
5. Demirjian A, Goldstein H (1976) 'New systems for dental maturity based on seven and four teeth'. Ann Hum Biol 3(5): 411-421.
6. Nathalie Bernard-Maugiron (2021) 'Custody and the Best Interests of the Child in Egyptian Courts'. ABDOU FILALI-ANSARY OCCASIONAL PAPER SERIES pp: 20-29.
7. Law no. 12 of 1996 promulgating the child law amended by law no. 126 of 2008,
8. Lee SS, Kim D, Lee S, Lee UY, Seo JS, et al. (2011) "Validity of Demirjian's and modified Demirjian's methods in age estimation for Korean juveniles and adolescents". Forensic Sci Int 211(1-3): 41-46.
9. Demirjian A, Buschang PH, Tanguay R, Patterson DK (1985) 'Interrelationships among measures of somatic, skeletal, dental and sexual maturity', Am J Orthod 88(5): 433-438.
10. Schmeling A, Grundmann C, Fuhrmann A, Kaatsch HJ, Knell B, et al. (2008) 'Criteria for age estimation in living individuals'. Int J Legal Med 122(6): 457-460.
11. Marroquin TY, Karkhanis S, Kvaal SI, Vasudavan S, Kruger E, et al. (2017) 'Age estimation in adults by dental imaging assessment systematic review'. Forensic Sci Int 275: 203-211.
12. Bjørk MB, Kvaal SI (2018) 'CT and MR imaging used in age estimation: a systematic review', J. Forensic Odontostomatol 36 (1): 14-25.
13. Lopes LJ, Nascimento HAR, Lima GP, Santos L, Queluz DP, et al. (2018) 'Dental age assessment: which is the most applicable method?, Forensic Sci Int 284: 97-100.
14. El-Bakary AA, Hammad SM, Mohammed F (2010) 'Dental age estimation in Egyptian children, comparison between two methods'. J Forensic Legal Med 17(7): 363-367.
15. Zaher JF, Fawzy IA, Habib SR, Ali MM (2011) "Age estimation from pulp/tooth area ratio in maxillary incisors among Egyptians using dental radiographic images". J Forensic Leg Med 18(2): 62-65.
16. El Morsi D, Rezk H, Aziza A, El-Sherbiny M (2015) 'Tooth coronal pulp index as a tool for age estimation in Egyptian population'. J Forensic Sci Crimino 3(2): 201-208.
17. Amal A El-Bakary, Somaia M El-Azab, Heba M Abou El Atta, Luz Andrea Velandia Palacio, Roberto Cameriere (2019) Accuracy of the cutoff value of the third molar maturity index: an Egyptian study'. Egypt J Forensic Sci 9: 52.
18. Marques MR, Pereira Md L, Caldas IM (2015) 'Forensic age estimation using the eruption of the second permanent mandibular molar: determining age over 14 years old'. Aust J Forensic Sci 47(3): 306-312.
19. Asif MK, Ibrahim N, Al-Amery SM, John J, Nambiar P (2019) 'Juvenile versus adult: A new approach for age estimation from 3-dimensional analyses of the mandibular third molar apices'. J Forensic Radiol Imaging 19: 100347.
20. Tomás LF, Mónico LS, Tomás I, Varela-Patiño P, Martin-Biedma B (2014) "The accuracy of estimating chronological age from Demirjian and Nolla methods in a Portuguese and Spanish sample". BMC oral health 14: 160.
21. Uysal T, Sari Z, Ramoglu SI, Basciftci FA (2004) 'Relationships between dental and skeletal maturity in Turkish subjects'. Angle Orthod 74(5): 657-64.
22. Krailassiri S, Anuwongnukroh N, Dechkunakorn S (2002) 'Relationship between dental calcification stages and skeletal maturity indicators in Thai individuals'. Angle Orthod 72(2): 155-166.
23. Trakinienė G, Smailienė D, Kučiauskienė A (2016) 'Evaluation of skeletal maturity using maxillary canine, mandibular second and third molar calcification stages' Eur J Orthod 38(4): 398-403.

How to cite this article: Eman A, Amal A El-B, Mohammad Abd-El-Same'e El-K. Dental Age Estimation in Egyptian Children Using Demirjian Method: Comparison of Three Mandibular Permanent Teeth. J Forensic Sci & Criminal Inves. 2025; 19(4): 556016. DOI: 10.19080/JFSCI.2025.19.556016

24. Pinchi V, Pradella F, Vitale G, Rugo D, Nieri M, et al. (2016) 'Comparison of the diagnostic accuracy, sensitivity and specificity of four odontological methods for age evaluation in Italian children at the age threshold of 14 years using ROC curves'. Med Sci Law 56 (1): 13-18.

DOI: 10.19080/JFSCI.2025.19.556016

How to cite this article: Eman A, Amal A El-B, Mohammad Abd-El-Same'e El-K. Dental Age Estimation in Egyptian Children Using Demirjian Method: Comparison of Three Mandibular Permanent Teeth. J Forensic Sci & Criminal Inves. 2025; 19(4): 556016. DOI: 10.19080/JFSCI.2025.19.556016