Radiographic Examination of Third Molar Development for Biological Age Assessment in Java Population, Indonesia

by Arofi Kurniawan

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Research Article

Radiographic Examination of Third Molar Development for Biological Age Assessment in Java Population, Indonesia

Fitri Rizki Amalia[1], Arofi Kurniawan[2]

[1]Magister of Forensic Science, Postgraduate School, Universitas Airlangga, Surabaya, Indonesia,
[2]Department of Forensic Odontology, Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Indonesia

Abstract

Background: The individual age as documented in the birth certificate shall be authorized as a chronological age. In several countries, falsification of documents relating to an individual age is becoming a major problem, since it is correlated with monetary, marriage, and education matter. Forensic dentistry works to minimize the possibility of individual age falsification by studying the tooth developmental stages. The objective of this study is to observe the applicability of the third molar development related to the biological age.

Materials and Methods: A total of 93 OPG (orthopantomogram) of subjects (16 – 23 years old) from the Java population were involved in this study. Third molar developmental stages of the mandibular were evaluated using the Demirjian et al. method. The statistical analysis was carried out using IBM® SPSS® Statistics version 23.0 (IBM, Armonk, NY, USA).

Results and Conclusion: The result showed that the average Java population reached the final stage at an average age of 21 ± 1,39 years in females and 20 ± 1,9 years in males. The present study indicates that the development of mandibular third molar is slightly earlier in males than in females. Besides, Demirjian's method is considered as a reliable method for dental age estimation in the Java population.

Keywords: *Age estimation, Demirjian method, forensic identification, java population, third molar*

Introduction

Age is one of the most important aspects of human life that has a significant means in individual identification. The chronological age as documented in the birth certificate shall be approved as an individual age. In several countries, falsification of a document relating to an individual age is becoming a major problematic issue. Human age falsification can be minimized by determining the biological age of bones and dentition using a variety of established methods.[1] Tooth development is one of the parameters that is commonly used for estimating the biological age as it shows less variability than other developmental features.[2] Dental age estimation can help to identify the individual by narrowing the age-based search data.

The usual method of estimating ages performed is a sequence of tooth eruptions teeth into the oral cavity. The tooth eruption process only lasts between the ages of 6 months and 14 years, so the estimated age over 14 years is not as easy as the forecast age of 14 years. After 14 years old, only the third molars have not yet fully erupted into the oral cavity. Thus for subjects over 14 years old, this can be done based on the changes in the clinical condition of the teeth, changes in the pulp chamber, and the development of the third molar.[3,4]

Corresponding author:
Arofi Kurniawan, DDS., Ph.D.
Department of Forensic Odontology Faculty of Dental Medicine, Universitas Airlangga
Jalan Mayjend. Prof. Dr. Moestopo 47 Surabaya, Indonesia, 60132, Tel. +62-31-5030255
e-mail: arofi.kurniawan@fkg.unair.ac.id

The radiographic assessment of dental age estimation has several advantages compared to the histological and biochemical methods. It is a non-invasive technique that can eliminate the need for tooth extraction or preparation for microscopic sectioning. Also, the radiographic examination is considered to be an efficient, simple, and reliable method for dental age estimation that can be applied to both living and dead individuals.[5–7]

Indonesia has various ethnic groups that have spread over the island, such as Javanese, Sunda and Betawi. **Javanese is the largest ethnic group in the Indonesia's population. According to a study by Khosronejad *et al*, 2017, ethnic differences between population groups have had an impact on the accuracy of the third molar measurement.[8] The present study was focused on the Javanese population which was classified as Mongoloid race, whereas the original method took place in the Caucasian population.**

Materials and Methods

This research was a cross-sectional retrospective study. A total of 101 conventional orthopantomograms (OPGs) of Javanese people, 16 – 23 years old, with known dates of birth were analyzed. OPGs have been obtained from the Department of Forensic Odontology, Faculty of Dental Medicine, Universitas Airlangga. The approval of the present study was obtained from The Ethical Committee of Faculty of Dental Medicine, Universitas Airlangga.

Inclusion and Exclusion Criteria

The inclusion criteria of the present study were:

- **Clear and good quality OPGs**
- **Age group between 16 – 23 years old, males and females.**
- Known the date of birth and the date of x-ray examination.

Exclusion criteria:

- OPGs with poor radiograph quality.
- Third molar with anomaly or pathological condition.
- Agenesis of the mandibular third molar

All available information of each subject includes sex, date of birth, and the OPG's date were recorded. The chronological age was calculated based on the date of birth and the date of radiographic examination. In the process of OPGs selection, eight photos were excluded due to third molar agenesis. 93 OPGs (48 females and 45 males) were considered to be the total samples that met the inclusion criteria. Each third molar calcification stage was assessed according to the Demirjian *et al* (1973) method, stages A to H (Figure 1). Demirjian *et al* (1973) explained that the formation of the crown (from the cusp calcification to the complete crown) had been described in stages A – D, and the root formation (from the initial radicular bifurcation to the apical closure) had been described in stages E – H.[9] The statistical analysis was carried out using IBM® SPSS® Statistics version 23.0 (IBM, Armonk, NY, USA).

Result and Discussion

The samples of this study were categorized into sex and age (Table 1), then the Demirjian scoring was assigned for each mandibular third molar, both left and right (Table 2 & Table 3). The result of the present study shows that the tooth development stage A–C of the third molar could not be observed in all subjects.

Table 4 shows that most of the female subjects reached the stage D of tooth development between the ages of 17±1,5 and 21±1,3 years old. Whereas the male subjects have reached the final stage of the third molar at 20±1,9 years old.

These results reveal that both male and female subjects reached stage F of the third molar development at 17+0.5 and 17+2.0 years old respectively. In the stage G, it can be observed that male subjects have reached the current stage significantly earlier than females. The final stage of tooth development showed that female subjects reached stage H on average at 21±1.9 years old and males at 20±1.9 years old. This result suggests that the development of the third molars at stage G and H would strongly indicate that the biological age is over 18 years old. Besides, the tooth development of stage E and F would suggest that the biological age is less than18 years old.

The result of the present study shows a consistent finding with the previous study by Luthfi *et al,* 2017,

which stated that the average Indonesian population reaches the final stage of tooth development at 22.5 ±3.0 years old in males and 23.5 ±3.6 years old in females. It is suggested that the development of the mandibular third molar in males had slightly preceding than in females.[7,10,11]

A study by Arany *et al.*, 2004, in Japan stated that Japanese juveniles reached the final stage of third molar development at an average of 21 years old.[12] Lewis *et al.*, 2010, was performed a review study in the American population and found that the final stage of third molar development has been reached at 20+1.48 years old.[13] Another study in India's population showed that the average age of male and female to reach the maturity stage of the third molar was 21±2.56 years old.[4,14–16]

Another study that involved German, Japanese, and South Africa population by Olze *et al*, 2004, showed that the mineralization of the third molar in Negroid (South Africa) population had significantly earlier compared to Caucasian (German) and Mongoloid (Japanese) populations. However, it is stated that the ethnic origin seemingly has no significant influence on the velocity of ossification for a certain age group. On the other hand, the socio-economic status of a population was thought that had a significant impact on skeletal maturity. The delayed tooth development is relatively correlated with low socio-economic status of a population, and it may cause the underestimation of the biological age of an individual.[17–19]

The overall result of the present study suggests that the assessment of tooth calcification stages through the radiographic examination is the most reliable method for estimating the dental age. Tooth calcification can be accurately observed from the radiographs with minimum discrepancies caused by local factors such as lack of space or retention of the deciduous teeth. Also, it is suggested that the assessment of the third molar using the calcification stage by Demirjian is an applicable method for dental age estimation in Javanese population.[9,11,20–22]

Table 1: Distribution of sex and age of the subjects.

Gender	Age								
	16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**TOTAL**
Female	6	4	6	6	5	8	6	7	48
Male	4	4	4	6	7	6	8	6	45
Total	10	8	10	12	12	14	14	13	93

Table 2: Frequency of the Demirjian's stages of mandibular third molar in female.

Development stage		Left third molar						Right third molar					
		D	E	F	G	H	Total	D	E	F	G	H	Total
Age	16	2	2	1	1		6	1	1	3	1		6
	17			4			4		1	2	1		4
	18	1		2	3		6	1		2	2	1	6
	19	1			2	3	6		1		1	4	6
	20				2	3	5				2	3	5
	21				2	6	8				2	6	8
	22			1	1	4	6					6	6
	23				1	6	7				1	6	7
	Total	4	2	8	12	22	48	2	3	7	10	26	48

Table 3: Frequency of the Demirjian's stages of mandibular third molar in male.

Development stage		Left third molar						Right third molar					
		D	E	F	G	H	Total	D	E	F	G	H	Total
Age	16		1		2	1	4		1		2	1	4
	17			3		1	4			3		1	4
	18	1		1	1	1	4			2	1	1	4
	19				1	5	6				2	4	6
	20				3	4	7				2	5	7
	21				2	4	6					6	6
	22				1	7	8				1	7	8
	23					6	6					6	6
	Total	1	1	4	10	29	45		1	5	8	31	45

Table 4: Mean age of third molar development stages (years).

Gender	Regio	Stage D		Stage E		Stage F		Stage G		Stage H	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Female	Left	17,00	1,41	17,33	1,53	17,57	2,15	19,30	2,11	20,96	1,70
	Right	17,25	1,50	16,00		17,57	1,83	19,58	1,97	21,32	1,39
Male	Left			16,00		17,33	0,52	18,75	2,05	20,93	1,72
	Right	18,00		16,00		17,25	0,50	19,30	2.05	20,76	1,92

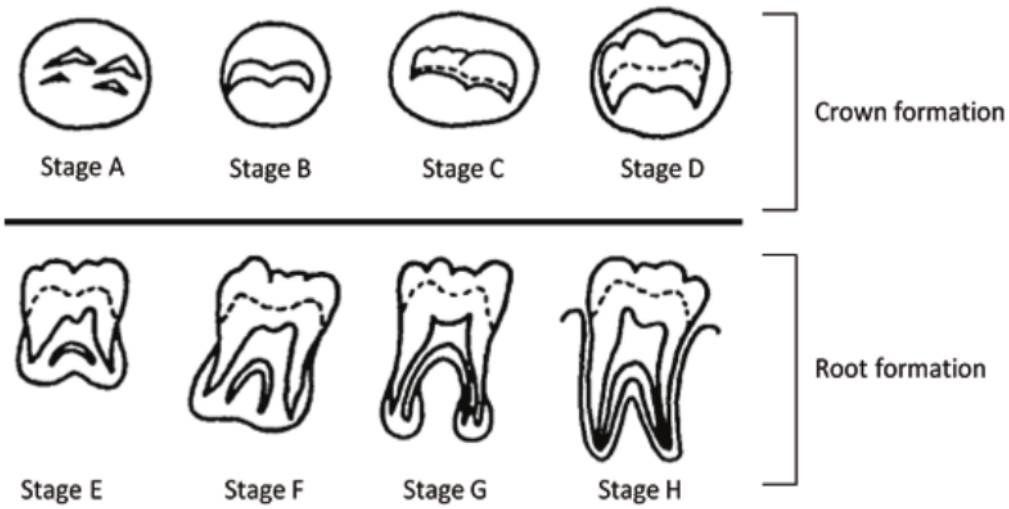

Figure 1. **Developmental stages of molar teeth (modified form Demirjian et al., 1973)**

Conclusion

Javanese peoples reached the end stage of calcification of third molar at the mean age 21 ± 1,39 years in female and 20 ± 1,9 years in male. The present study suggests that the development of mandibular third molar slightly earlier in males rather than in females. Assessing third molar by Demirjian's method is applicable for age estimation in Java population.

Conflict of Interest: The authors have no conflicts of interest to declare.

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PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6