Age Estimation Based on Third Molar Classification: Modification of The Demirjian Method

Estimasi Usia Berdasarkan Klasifikasi Gigi Molar Tiga: Modifikasi Metode Demirjian

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ABSTRACT
Age estimation is an important factor in identifying a person, especially in forensic dentistry. One of the methods used in determining age estimation is based on the classification of third molar using the modified Demirjian method. This method can be performed on individuals who already undergoing the growth and development process of the third molars. The purpose of this research was to determine age estimation based on the classification of third molars at the Regional General Hospital of Rokan Hulu, Riau Province. This descriptive observational study involved 63 samples of ethnic Malay based on panoramic photos in medical records from June 2020 to August 2023. The results of this study showed that among males, 23 sample (92%) had a difference of less than one year between chronological age and estimated age. Among females, 28 samples (74%) had a difference of less than one year between chronological age and estimated age. It can be concluded that the estimated age closely approximates the chronological age in both males and females in Rokan Hulu Regency.
Keywords: Age estimation, third molar classification, modified Demirjian method, Malay ethnic

ABSTRAK
Estimasi usia merupakan faktor penting dalam mengidentifikasi seseorang, khususnya dalam kedokteran gigi forensik. Salah satu cara yang digunakan dalam menentukan estimasi usia adalah berdasarkan klasifikasi gigi molar tiga modifikasi metode Demirjian. Metode ini dapat dilakukan pada individu yang sudah ada proses pertumbuhan dan perkembangan gigi molar tiga. Tujuan penelitian ini adalah untuk mengetahui estimasi usia berdasarkan klasifikasi gigi molar tiga di Rumah Sakit Umum Daerah (RSUD) Rokan Hulu Provinsi Riau. Sebuah penelitian observasional deskriptif, dengan 63 sampel beretnik Melayu berdasarkan foto panoramik pada rekam medis dari bulan Juni 2020 hingga Agustus 2023. Hasil penelitian ini menunjukkan perbandingan usia kronologis dan usia estimasi pada laki-laki ditemukan sampel sebanyak 23 (92%) memiliki selisih usia kronologis dengan usia estimasi dibawah satu tahun. Sedangkan perempuan didapatkan sampel sebanyak 28 (74%) memiliki selisih usia kronologis dengan usia pestimasi di bawah satu tahun. Disimpulkan bahwa usia estimasi mendekati usia kronologis pada laki-laki maupun perempuan di Kabupaten Rokan Hulu.
Kata Kunci: Estimasi usia, klasifikasi gigi molar tiga, modifikasi metode Demirjian, etnik melayu

INTRODUCTION

Identification is an effort made with the aim of determining the identity of a person both alive and dead based on the characteristics found in that person.[1] The importance of the role of identification has been regulated in the regulations of Law No. 36 of 2009 concerning health article 118 paragraph 1, that every doctor must be willing to assist the victim identification process if requested by the investigator.[2]

Individual identification methods in forensics can be done by two methods, namely primary identification and secondary identification. Primary identification includes fingerprint analysis, dental comparison analysis, and DNA (deoxyribonucleic acid) analysis, secondary identification includes lip print patterns, palatine rugae, tattoos, scars, clothing and others.[3]

Age estimation methods use characteristics such as face, bones and teeth. The face, which distinguishes each person from others such as facial hair, eyebrows, wrinkles hair colour and provides a set of information such as identity, age, ethnic group, gender and posture. Skeletal growth indicates maturity, especially in the carpal bones, femur-tibia, and clavicle.

Teeth, the most unique part because it is the longest lasting until death and is an important means of assessing human maturity and dental development has several changes from childhood to death.[4] One of these methods is using third molar teeth, the reason can be one of the factors determining the chronological age of adolescents aged 17-25 years because it is the only tooth that is still in the stage of growth and development.[5,6,7]

Third molar teeth are useful in determining legal age, according to KBBI "legal age" means determining age limits in accordance with laws and regulations. Its function is to distinguish between juvenile and adult status in criminal law cases. Law No. 23 of 2002 concerning Child Protection as last amended by Law No. 35 of 2014 in article 1 paragraph 1, which reads: "A child is someone who is not yet 18 years old, including children still in the womb."[8,]

The development of the third molar can be assessed using panoramic and periapical radiographs.[10] Panoramic radiographs include visualisation of large areas of all tissues on film, including a portion of the facial bone and the maxillary and mandibular teeth. However, panoramic radiographs have the disadvantages of not being able to produce anatomical details as in periapical radiographs and geometric distortions often occur. Panoramic x-rays are more convenient than periapical x-rays as the film is not in the mouth.[11]

Age estimation is an important factor in identifying a person, especially in forensic dentistry. In general, there are 3 age estimation methods used, namely: The first method is the Demirjian method, which is based on the formation of crowns and roots of the first incisor to the second molar. Because this method can only be performed on individuals up to the age of 13 years, Sisman, Liversidge, Ajmal extrapolated or applied the Demirjian method but carried out on the third molar tooth, by categorising the developmental stages of the third molar tooth from crown formation to root canal closure.[8,12] The second method, based on the stage of eruption of the third molar tooth through the alveolar bone, was proposed by Olze.[13] This method observes the position of the third molar tooth through the alveolar bone until the complete eruption of the third molar tooth reaches the occlusal plateau. This method is influenced by tooth morphology, tooth position. The third method, based on the additional root length of the third molar, proposed by Thevissen[14], measures the root length of the second molar and third molar on the radiographic image of the teeth.

Common age estimation methods are based on the stage of growth and development of teeth in the mouth. According to Firdaus' (2014) research at the Faculty of Dentistry-University of Indonesia, there is a very strong correlation between chronological age and the development of third molar teeth in Indonesians.[15] Reinforced by Mieke Sylvia Margaretha's (2023) research, Airlangga University Dental Hospital in Surabaya evaluated the application of the Demirjian method for age assessment of Chinese children. This study found that the Demirjian method was effective for estimating the dental age of Chinese children in Surabaya.[16]

This study focused on the Malay Ethnic group, specifically in the Rokan Hulu region, Riau Province, Indonesia. Based on the 2010 Indonesian Population Census data, Riau is the province with the largest Malay population in Indonesia, reaching 34.09% of the total population.[17] The research location was conducted at the Rokan Hulu Regional General Hospital (RSUD) owned by the Rokan Hulu Regency Government, Riau. This study generally aims to determine the age estimation based on the classification of third molar teeth modified by Demirjian method in Rokan Hulu Regional General Hospital, Riau.

RESEARCH METHODS

This type of research is descriptive observational. Descriptive observational study is a

study that observes its sample members and does not intervene in its sample members.[18] The population in this study was all panoramic photo data of patients with Malay ethnicity totalling 63 data samples in medical records from June 2020 to August 2023 at the Regional General Hospital of Rokan Hulu Regency. The sample in this study were panoramic x-rays of patients with ethnic Malay ages 9-25 years at the Regional General Hospital (RSUD) of Rokan Hulu Regency.[19] The sample size collected in this study was 63 data samples based on inclusion and exclusion criteria.

The sampling technique used is non-probality sampling technique with total sampling method. After grouping the inclusion and exclusion criteria, the sample size of this study was 63 photos. The tools and materials in this study used research instruments in the form of panoramic radiographs of patients from June 2020 to August 2023, a flashdisk to transfer existing radiographs to a computer or laptop as a viewer and data processor.

The research work carried out by the author begins with asking permission from the Rokan Hulu Regency Regional General Hospital which is the research location and obtaining an ethical clearance letter number 001/KEPK-FKGUNBRAH/09/01/2024 from the Faculty of Dentistry, Baiturrahmah University. Beginning with looking for data on patients who have done panoramic x-rays at the radiology installation at the Rokan Hulu Regency Hospital from June 2020 to August 2023. The results of panoramic x-rays were transferred with a flashdrive to the author's computer.

Selection of patient data included in the inclusion criteria of the research sample sample, namely panoramic rontgent photos in the Regional General Hospital of Rokan Hulu Regency. Inclusion criteria include the age of patients in the radiology unit data of the Regional General Hospital between 9-25 years old.[19] there is at least one third molar tooth seed on panoramic radiographs; there is no disturbance of tooth growth and development. Continued measurement of the presence or absence of growth and development of third molar teeth in each jaw, as well as classification of growth and development of third molar teeth based on a modified table of the Demirjian method.

Data obtained from dental age assessment were analysed using Microsoft Excell to determine the comparison between chronological age and dental age.

RESULT

Table 1 Distribution of Growth and Development of Third Molar Teeth by Gender

Gender	N	%
Male	25	40%
Female	38	60%
Total	63	100%

Table 1 shows the distribution of growth and development of third molar teeth based on gender. The results indicate that 25 male samples and 38 female samples. This finding suggests that the number of panoramic dental X-ray patient visits to Rokan Hulu Hospital was dominated by females, accounting for 60% of total 63 panoramic radiography patients.

Table 2: Distribution of Growth and Development of Third Molar Teeth Based on Chronological Age and Gender

Age Category	Gender				N	%
	Male	%	Female	%		
Kindergarten (6,00–11,99 years)	2	8%	4	11%	6	10%
Early Adolescents (12,00–16,99 years old)	7	28%	20	53%	27	43%
Late Adolescence (17,00–25,99 years old)	16	64%	14	37%	30	48%
Total	**25**	**100%**	**38**	**100%**	**63**	**100%**

Table 2 presents data on the distribution of growth and development of third molar teeth based on chronological age in men and women at Rokan Hulu Regional Hospital. According to the study results, the growth and development of third molar teeth in males are mostly observed in the late adolescent age category, with 16 samples (64%), while the least are found in the childhood age category, with a proportion of 8%.

Data on the distribution of growth and development of third molar teeth were also observed in the female gender, with the majority found in early adolescence, totaling 20 samples (53%), and the least in the childhood age category (11%). Furthermore, Table 3 presents a comparison of chronological age and estimated age based on the sample panoramic radiographs of third molar teeth of male and female patients.

Table 3. Comparison of Chronological Age and Estimated Age in Panoramic Radiograph Samples of Male Patients

Sample	Chronological Age (Decimal)	Estimated Age	Difference
1	9.88	12.69	2.81
2	10.47	8.67	-1.80
3	13.03	12.69	-0.34
4	13.50	13.89	0.39
5	14.63	14.49	-0.14
6	15.41	15.69	0.28
7	15.99	15.09	-0.90
8	16.75	16.29	-0.46
9	16.90	16.89	-0.01
10	17.03	16.89	-0.14
11	17.36	17.49	0.13
12	17.77	18.09	0.32
13	18.19	18.09	-0.10
14	18.25	18.09	-0.16
15	18.28	18.09	-0.19
16	18.28	18.69	0.41
17	18.41	18.69	0.28
18	18.99	18.09	-0.90
19	19.29	19.29	0.00
20	19.66	19.29	-0.37
21	20.25	19.90	-0.35
22	21.91	21.09	-0.82
23	22.59	21.69	-0.90
24	22.76	22.29	-0.47
25	23.09	22.29	-0.80

Table 3 compares the chronological age and estimated age in the third molar X-ray samples of 23 male patients at Rokan Hulu Regional Hospital. Meanwhile, Table 4 shows that among the female patients, 28 samples had a chronological age difference with an estimated age of less than one year. This indicates that the estimated age is close to the chronological age.

Table 4. Comparison of Chrondological Age and Estimated Age in Panoramic Radiograph Samples of Female Patients

Sample	Chronological Age (Decimal)	Estimated Age	Difference
1	10.53	11.49	0.96
2	11.04	10.89	-0.15
3	11.49	11.49	0.00
4	11.68	10.29	-1.39
5	12.46	12.09	-0.37
6	12.74	12.69	-0.05
7	12.84	12.69	-0.15
8	13.01	11.49	-1.52
9	13.28	12.95	-0.33
10	13.47	12.95	-0.52
11	13.96	16.29	2.33
12	14.72	13.89	-0.83
13	14.75	15.09	0.34
14	14.97	14.49	-0.48
15	15.01	15.09	0.08
16	15.37	15.09	-0.28
17	15.79	16.29	0.50
18	15.89	13.89	-2.00
19	15.93	15.69	-0.24
20	15.94	14.49	-1.45
21	16.19	16.89	0.70
22	16.49	15.90	-0.59
23	16.71	16.29	-0.42
24	17.29	17.49	0.20
25	17.84	16.89	-0.95
26	18.46	18.09	-0.37
27	19.01	19.29	0.28
28	19.02	18.69	-0.33
29	19.26	19.89	0.63
30	19.58	19.29	-0.29
31	20.5	20.49	-0.01
32	20.76	20.49	-0.27
33	21.12	21.09	-0.03
34	22.73	21.09	-1.64
35	23.22	20.69	-2.53
36	23.26	20.49	-2.77
37	23.83	22.29	-1.54
38	24.09	22.29	-1.80

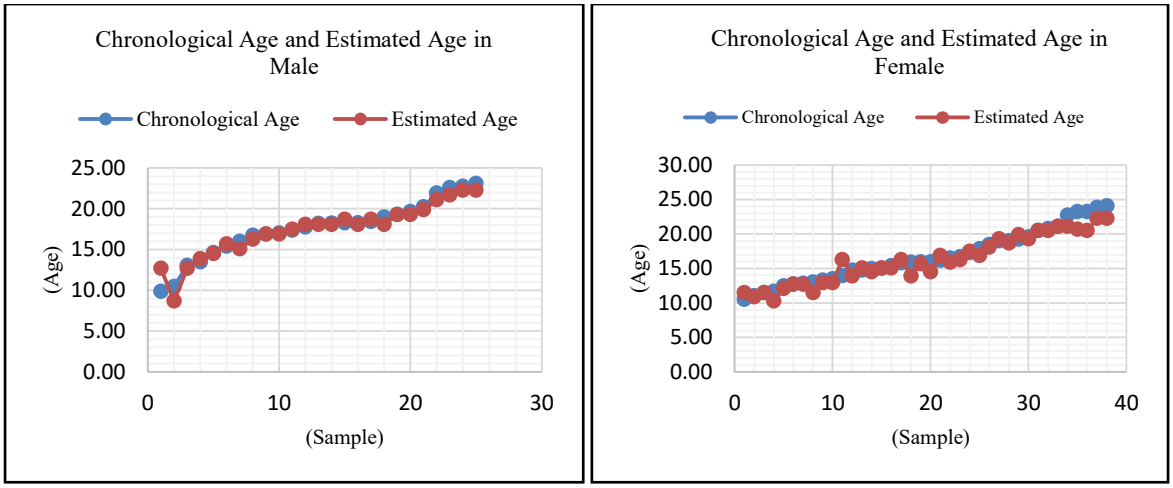

Figure 1. Comparison of Chronological Age and Estimated Age Based on Third Molar Teeth in Male and Female Patients

DISSCUSSION

Age estimation research based on the classification of third molar teeth in the ethnic Malay population at Rokan Hulu Regional Hospital obtained data on the distribution of growth and development of third molar teeth from a total of 63 individuals, consisting of 25 males (40%) and 38 females (60%). The data on the distribution of growth and development of third molar teeth based on chronological age indicate that females have a faster growth and development rate of third molar teeth compared to males. This is likely due to the fact that hormones in females mature faster than in males. These findings are consistent with previous research, which suggests that gender is closely related to the timing of third molar teeth growth.[20]

The data on the number of samples of third molar teeth growth and development showed that females outnumbered males, based on visits to Rokan Hulu Hospital. The results indicated that dental growth and development in females were faster than in males. This can be explained by the differences in the timing of tooth growth and development between males and females.

Previous research has found that permanent teeth in women typically grow approximately 16 months faster than in men.[1] This is supported by the findings of Olze, A., in a study on the African population, which showed that dental growth and development in women is generally 1.5 years faster than in men.[20]

Local factors contributing to the development of gingivitis are also highly prevalent. The majority of respondents (94.1%) had dental plaque, indicating low oral hygiene levels, which is a leading cause of gum irritation and inflammation. Additionally, 76.5% of pregnant women have dental caries.

Analysis of chronological age and estimated age in third molar teeth among males, based on the data presented in Table 3, shows that 2 samples (8%) exhibit a difference between chronological age and estimated age of greater than or equal to 1 year. Meanwhile, 23 samples (92%) have a chronological age difference with an estimated age of less than 1 year. The reason why the estimated age is greater than or equal to one year from the chronological age is challenging to determine with certainty. This is because the researchers utilized secondary data as the analysis material, making it difficult to ascertain detailed information about the patient's condition, including habits, genetics, diet, and potential abnormalities in the third molar tooth.

Table 4 presents data on the comparison of chronological age and estimated age in females. It is observed that 10 samples (26%) showed a difference between chronological age and estimated age of greater than or equal to 1 year. Meanwhile, 28 samples (74%) had a difference between chronological age and estimated age of less than 1 year. These results, as illustrated in Graph 1, show the correlation between chronological age and estimated age, indicating that the points are relatively close. This suggests that the estimated age is close to the chronological age in both males and females.

The results of the analysis of estimated age based on age category in males show that the majority of the estimated age is faster than the chronological age. In contrast to the findings of Mieke S.M. (2023) in Chinese children, a study at the Airlangga University Dental Hospital in

Surabaya found that the majority of estimated ages exceeded chronological age. This discrepancy may be attributed to various factors, including nutritional intake, daily habits, and growth hormones.[16] This research is supported by Enlow and Hans, as well as Rahayu's study, which identifies several factors that can influence the timing of dental growth, including race, nutrition, growth hormones, and gender.[21,22]

The analysis of estimated age based on age category in females revealed that the majority of estimated ages were faster than chronological ages. This is likely due to the faster growth and dental development rate in females. These findings are consistent with the research by Woroprobosari N.R. (2021), which states that the growth and development process in females is faster than in males, resulting in earlier tooth eruption in girls compared to boys.[23] This study identified a new pattern in age estimation among males, differing from previous studies. The application of the modified Demirjian method to the ethnic Malay population revealed a tendency for faster age estimation compared to chronological age.

This difference can be attributed to genetic or racial influences. Additionally, ethnicity may also contribute to variations in dental growth and development, as each ethnic group has distinct physical characteristics, including teeth. According to Himawan and Sylvia, the growth and development of teeth are significantly influenced by genetic or racial factors. These differences in physical characteristics also affect the growth of the head and neck, resulting in unique facial shapes, jaw characteristics, growth patterns, and tooth sizes among different ethnic groups.[24]

CONCLUSION

Based on the study's findings, it can be concluded that the estimated age is close to the chronological age in both males and females when using the modified Demirjian method for third molar teeth classification at Rokan Hulu Regional Hospital. Furthermore, there is a tendency for the estimated age to be faster than the chronological age in patients of predominantly Malay ethnicity.

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