
Age Estimation Using Schour-Massler Method Compared to the Demirjian Method

Estimasi Usia Menggunakan Metode Schour-Massler
Dibandingkan dengan Metode Demirjian

Trelia Boel*, Tiara Ayustin Bahri

Department of Dental Radiology
Faculty of Dentistry Universitas Sumatera Utara
Jl. Alumni No.2 Kampus USU Medan 20155
Telp. 061 8216131, Fax. 061 8213421

*Corresponding Author: trelia.boel@usu.ac.id

Abstract

Schour-Massler and Demirjian are methods used to estimate chronological age in dental radiographs by looking at the development of permanent teeth and the maturity of the dental age. Chronological age is based on date of birth. Dental age is the age based on the maturity of the teeth. Both methods have been widely used in previous studies but have never been compared. The purpose of this study was to determine whether there are differences in age estimation using the Schour-Massler and Demirjian methods. This study was an observational analytic study with a *cross sectional* design. The research subject was 46 patients who came to Rumah Sakit Gigi dan Mulut (RSGM) Universitas Sumatera Utara (USU) at the age of 10-16 years. This study was conducted at the Radiology Unit of the Faculty of Dentistry, Universitas Sumatera Utara. The results of this study indicate the p value of the Wilcoxon test results with the p value for Schour-Massler $p=0.090$ and Demirjian $p=1,000$. Both p values > 0.05 , there is no significant difference in assessing the estimated age using both methods, so H_a is accepted. In conclusion, the Schour-Massler and Demirjian methods provide estimates of age that is close to actual age, so there is no significant difference between the two methods.

Key words: Chronological age, Schour-Massler method, Demirjian method.

Abstrak

Schour-Massler dan Demirjian adalah metode yang digunakan untuk estimasi usia kronologis dalam radiografi kedokteran gigi dengan melihat perkembangan gigi permanen serta kematangan usia dental. Usia kronologis adalah usia berdasarkan tanggal kelahiran. Usia dental adalah usia berdasarkan kematangan usia gigi. Kedua metode ini sudah banyak digunakan dalam penelitian sebelumnya, namun belum pernah dibandingkan. Penelitian ini bertujuan mengetahui apakah terdapat perbedaan estimasi usia menggunakan metode Schour-Massler dan Demirjian. Jenis penelitian ini adalah analitik observasional, yaitu observasi dan estimasi usia dental dengan pendekatan *cross sectional*. Sampel penelitian ini adalah 46 pasien yang datang ke Rumah Sakit Gigi dan Mulut (RSGM) Universitas Sumatera Utara (USU) dengan usia 10 -16 tahun. Penelitian ini dilakukan di Unit Radiologi Fakultas Kedokteran Gigi, Universitas Sumatera Utara. Hasil penelitian ini menunjukkan nilai p dari hasil uji *Wilcoxon* dengan nilai p untuk Schour- Massler $p=0,090 > 0,05$ dan Demirjian $p=1,000$. Kedua nilai $p > 0,05$, maka tidak ada perbedaan yang signifikan dalam menilai estimasi usia menggunakan kedua metode tersebut, sehingga H_a diterima. Kesimpulannya metode Schour-Massler dan Demirjian memberikan hasil estimasi usia yang mendekati usia sebenarnya, sehingga tidak ada perbedaan yang signifikan antara kedua metode tersebut.

Kata kunci : usia kronologis, metode Schour-Massler, metode Demirjian.

INTRODUCTION

Identification is detecting and verifying a person's identity or who has been living based on the characteristics found in that person. One of identification process can be done by using teeth. Teeth are the biological material that is most resistant to envi-

ronmental changes. Of all the hard tissues in the human body, teeth have the advantage of being strong and not easily damaged. Therefore, teeth will greatly assist the identification process, which is to identify race, gender, and age.¹ Teeth as an indicator for esti-

maturing age of an individual experiences a stage of growth and development, as well as degenerative changes that occur from the age of intra uterine to adulthood. Therefore, teeth can provide information about an individual's identity because of its distinctive characteristics, especially information about age estimation.^{2,3}

Based on experience, teeth have a high contribution in determining a person's identity. In October 2002 Bali Bomb case, around 50% of victims could be identified based on their teeth. Since that incident, the Disaster Victim Identification has become an important activity and has been carried out on almost every event that involved many casualties.^{1,4,5} Forensic odontology is a branch of forensic discipline that uses teeth as a way to determine individual identity, where in practice there is a combination of dentist skills and dental knowledge. Examinations to determine ages in forensic odontology are clinical, radiological, histological and biochemical examinations.^{2,5}

Al-Qahtani et al (London) in 2014 conducted a study using the Schour-Massler, Ubelakar, and The London Atlas methods to see the accuracy of age estimation using teeth on developing stage. Panoramic radiography was performed on 649 men and 674 women, and 933 people aged 3-16 years. The results of this study indicate that the Schour-Massler method can be used to determine the estimated age, but a more significant result is to use The London Atlas.⁶

A study in Romania by Jurca et al in 2014 conducted a dental age assessment using the Demirjian method in children from Central Romania. This study used X-rays in 285 children between 6-13 years old. Dental age was determined based on the calcification level of the seven left mandibular teeth, and T test was used to assess the difference between dental age and chronological age. The results show that the Demirjian method can be used to assess dental age, but this method has limitations, i.e. this standard only applies to certain age groups.⁷

A retrospective study by Pratyusha et al (India) in 2017 applied the Demirjian method and the Modified Camiere method for children's age estimation. This study was carried out on Orthopantomograms (OPG) data from 60 children of West Godavari district with an age group between 9 to 14 years. Age estimation is carried out based on the canine calcification stage according to the Demirjian method and measurement of seven left mandibular permanent teeth using the Camiere method. The results of this study show an insignificant difference between the Demirjian method and the Camiere method.⁸

George et al. (India) in 2018, from the University in Karnataka, used the Schour-Massler method for forensic studies which is done on 62 secondary panoramic radiographic data. The number of male and female subjects is balanced, and the study is done only on good quality radiographic results. The results of the study showed that there was no statistically significant difference between chronological age and dental age with the Schour-Massler method assessment.³

The same study in 2018 at Rajasthan was conducted by Mankel et al (estimated dental age) using the Demirjian method by choosing 7 mandibular left teeth and compared to the Modified Demirjian method by using 8 mandibular left teeth. The total of research subjects were 431 people consisting of ages 6-18 years, 219 people were males and 212 people were females. This study found that the Demirjian method can be used in determining age estimation, but the results obtained are better with the Modified Demirjian method.⁹

The Schour-Massler and Demirjian methods can be used to determine the estimated age of an individual. Each of these methods has been widely used in previous studies, but the two methods have never been compared. This research was conducted to test the accuracy of age estimation between the Schour-Massler methods and compared with the Demirjian method.

MATERIAL AND METHOD

The study is observational analytic, by observing and estimating dental age using the Cross-Sectional Approach which is carried out in the Radiology Unit of RSGM in USU. Subjects of this study were patients aged 10-16 years old, who came to RSGM USU, who fit the inclusion and exclusion criteria. The study began by filling in the informed consent of subjects who had met the inclusion criteria after the ethical clearance was obtained from the USU Faculty of Medicine Ethics Commission. The intraoral examination was performed on subjects using tweezers, probes, and dental mirror, and was analysed based on inclusion criteria. Then the subjects were asked to fill out a questionnaire including name, date of birth, and gender. Thus, identify the patient's age through the date of birth on the questionnaire given by the researcher. Then the subject was recorded in panoramic photographs with good quality results and followed by measurement of age estimation from the results of the panoramic radiographs. In the Schour-Massler method the radiographic results are compared directly with the standard steps made by Schour-Massler. Whereas in the Demirjian method

the researchers first assessed the left mandibular teeth and compared it with the calcification stage made by Demirjian. These stages have values that are listed in the dental age maturity table which are distinguished between men and women. Then the value of each tooth in the age maturity table will be accumulated entirely and the result is converted into a chronological age estimation table that corresponds to each sex.

Data results are analyzed using a computerized system. Normality test is conducted to see the data distribution and Paired T test is used to see whether there is age estimation difference using Schour-Massler method and Demirjian method, if the present study obtained abnormal data distribution, it was continued by using Wilcoxon nonparametric test.

RESULT

Table 1 shows the frequency of subjects at each age of the subject who have participated in this study at the Radiology Unit of Faculty of Dentistry USU from ages 10 to 16 years.

Table 1. Subject's age distribution

Age	Frequencies	Percentage
10	7	15.2
11	11	23.9
12	8	19.6
13	9	17.4
14	6	13.0
15	3	6.5
16	2	4.3
Total	46	100.0

Table 2 shows that the average chronological age is 12.261 with standard deviation of 1.679, the average estimated age with Schor-Massler method is 12.109 with standard deviation of 1.754, and the average estimated age with Demirjian method is 12.261 with standard deviation of 1.705.

Table 2. Chronological age and estimated dental age distribution using Schour-Massler method and Demirjian method

Age	N	Mean±Sd	Max	Min
Chronologic age	46	12.261±1.679	16.00	12.26
Schour-Massler	46	12.109±1.754	15.00	9.00

Demirjian	46	12.261±1.705	15.00	8.00
-----------	----	--------------	-------	------

Table 3 is the normality testing using the Shapiro-Wilk test which aims to find out whether the data is normally distributed or not. If the data is normally distributed, then the test is continued by using paired t-test, however if the data is not normally distributed, the test is continued using the Wilcoxon nonparametric test. The results obtained are abnormally distributed data.

Table 3. Normality Test Results using Shapiro-Wilk Test

Age	Shapiro-Wilk test
Chronologic age	p=0.007
Schour-Massler	p=0.000
Demirjian	p=0.044

Table 4 shows the difference between chronological age and Schour-Massler is 0.15217, whereas on the Wilcoxon test results obtained p value for the Schour-Massler method p = 0.090 (>0.05) and Demirjian method p = 1.000 (>0.05). Because both values are p > 0.05, it can be concluded that there is no significant difference in assessing the age estimation using the Schour-Massler method and the Demirjian method. However, the results of the statistical analysis of Demirjian show more accurate results than Schour-Massler, because it produces the lowest difference value of 0.000.

Table 4. Comparison of the average difference in chronological age and estimated age using the Schour-Massler and Demirjian methods

Comparison	Mean Difference	p-Value (Wilcoxon test)
Chronologic age and Schour-Massler	0.15217	p=0.090
Chronologic age and Demirjian	0.00000	p=1.000

DISCUSSION

This study uses panoramic radiography and the results of the panoramic photo are analyzed by the Schour-Massler and Demirjian methods. The subjects used were individuals with age ranging between 10-16 years. The number proportion of men and women is not determined. Both of these methods are suitable for use in this age group because the age range in both methods include between the ages of 10-16 years. Ages 10-16 provide convenience because they can be cooperative subjects in this study.



Figure 1. Panoramic radiographs on subjects aged 11 years (personal documentation).

Teeth is one part of the body that is generally used to estimate age because its superiority can be applied to individuals from prenatal age to adulthood.^{5,12} In estimating the age by using teeth, it can be obtained by examining the maturity of dental age and tooth eruption. Dental age is the age of a person based on dental maturity. Tooth maturity is one of the most reliable indicators of chronological age estimation method used for criminal, forensic, and anthropological purposes.¹⁰

After proceeding with the Wilcoxon test as in table 9, the results show that the chronological and Schour-Massler age ratio have a value of $p = 0,000$ and the chronological age comparison with Demirjian has a value of $p = 1,000$. Both methods have $p > 0,05$, it is showed that there is no significant difference in assessing the estimated age using the Schour-Massler method and the Demirjian method. Each of these methods can be used in estimating chronological age, but the more accurate is the Demirjian method with a value of $p = 1,000$, which is near perfect, because Demirjian has detailed scores and separate assessments between men and women.

The study conducted by George et al. (India) in 2018 stated that there was no statistically significant difference between chronological age and dental age analysed by the Schour-Massler method. This method is often used because it is considered practical.

However, this method has a limitation that there is no separate diagram based on gender differences, and there are gaps in the order of age categories.³

A study conducted by Jurca et al in 2014 in Romania stated that the Demirjian method can be used for age estimation analysis.⁷ The Demirjian method has results that are almost accurate or the same as the chronological age, because the analysis of the Demirjian method is carried out on the maturity of the dental age which has detailed scores and separate assessments between men and women. The score on this method is obtained from 8 stages of tooth calcification from stages A to H on panoramic radiography.⁸ This assessment is done on central incisors, lateral incisors, canines, first premolars, second premolars, first molars, and lower left second molars.^{11,12} Each tooth has its own score from the stage of calcification and the values differ between men and women. The total score of the 7 permanent teeth becomes tooth maturity value which is then converted to an estimated chronological age.^{9,13}

The calcification stages of the Demirjian method start from stage A with the picture of single or more root teeth, the teeth calcification stage starts from the highest part of the crypt. Stage B has picture of the cusp tip undergoing fused calcification and begins to show occlusal surface patterns. At stage C, enamel formation is complete on the occlusal surface, visible expansion and meeting in the cervical part of the tooth, dentinal deposits begin to appear, and the pulp chamber pattern appears to be in the form of lines at the occlusal boundary. The picture in stage D shows that the crown formation is complete and there is an expansion towards the cemento-enamel junction, the upper edge of the pulp chamber in a single rooted tooth shows a clear boundary and the pulp horn projection gives an umbrella-like and trapezoidal shape to the molar teeth, and the tooth roots began forming. Stage E on a single rooted tooth has a picture of the pulp chamber wall appearing as a straight line whose continuity is cut off due to the presence of pulp horns and the tooth root length is less than the crown of a tooth, whereas in molar teeth there is a picture of the initiation of root bifurcation formation and the tooth root length is less than the crown of a tooth. Stage F on a single rooted tooth has picture of the pulp chamber wall looking like an isosceles triangle and the root tip like a funnel and the root length is equal to or longer than the height of the crown, whereas in the molar teeth there is a picture of calcification in the bifurcation having an expansion, the shape of the roots is more apparent and the root tip looks like a funnel and the root length is

equal to or higher than the height of the crown. In stage G the root canal wall looks parallel, but the apical end is still open. Finally, the H stage with the apical tip closed.¹⁴

The detailed score possessed by the Demirjian method greatly influences the results of the study, because the results are accurate and almost near perfect. But study using the Schour-Massler method has also accurate results. So, there is no significant difference when compared between the Schour-Massler method and the Demirjian method. Although there is no statistically significant difference between the two methods, the Demirjian method has almost perfect accuracy, because the Demirjian method is based on an analysis of dental age maturity and its assessment is differentiated by sex.

Schour-Massler and Demirjian method methods have never been compared. This study was found that both of these methods can be used to estimate chronological age well. The researcher also wants to explain that the Schour-Massler method and the Demirjian method are useful in the field of Forensic Dentistry for age estimation of individuals who died due to accidents or natural disasters, as well as living individuals correlated with criminal cases. Dentistry practitioners can consider that both methods can help determine the age of an individual in a forensic case.

Based on the results of the study it was found that the Schour-Massler method and the Demirjian method provide age estimation that are close to real age, so there is no significant difference between the two methods.

REFERENCES

1. Apriyono D.K. Metode penentuan usia melalui gigi dalam proses identifikasi korban. CDK-236 2016; 43(1): 71.
2. Divakar K.P. Forensic odontology: the new dimension in dental analysis. Int J Biomedical Sci 2017; 3(1): 1-2.
3. George J, Chatra L, Shenoy P, Veena K.M, Prabhu R. V, Dan Kumar V. Age determination by Schour and Massler method: a forensic study. Int J Forensic Odontol 2018; 3(1): 36-7.
4. Prawesteningtyas E, Algozi AM. Identifikasi forensik berdasarkan pemeriksaan primer dan sekunder sebagai penentu identitas korban pada dua kasus bencana massal. J Ked Brawijaya 2009; 25 (2): 87-8.
5. Putri AS, Nehemia B, Soedarsono N. Prakiraan usia individu melalui pemeriksaan gigi untuk kepentingan forensik kedokteran gigi. J PDGI 2013; 62 (3): 56-61.
6. Al-Qahtani S.J, Hector M.P, Liversidge H.M. Accuracy of dental age estimation charts: Schour and Massler, Ubelakar, and the London atlas. American J Phy Anthropol 2014; 154: 71-4.
7. Jurca A, Lazar L, Pacurar M, Bica C, Chibelea M, Bud E. Dental age assessment using Demirjian's method - a radiographic study. ESJ 2014; 10 (36): 53-4.
8. Pratyusha K, Prasad MG, Radhakrishna AN, Saujanya K, Raviteja NVK, Chandrasekhar S. Applicability of Demirjian's method and modified Cameriere's methods for dental age assessment in children. JCDR 2017; 11(2): 40-3
9. Mankel H, Gupta C, Ghosh A. Dental age estimation using Demirjian's 7 teeth and 8 teeth method applying in Rajasthan (Kota) population. EPH-Int J Med and Health Sci 2018; 4 (6): 39.
10. Adams C, Carabott R, Evans S, eds. Forensic odontology: an Essential guide. India. Laserwords Private Limited, 2014: 138-40, 152.
11. Priyadarshini C, Puranik MP, Uma SR. Dental age estimation methods: a review. Int J of Advanced Health Sci 2015; 12(1): 20-2.
12. Ebrahim E, Rao PK, Chatra L, Shenai P, Veena KM, Prabhu RV, et al. Dental age estimation using Schour and Massler method in South Indian children. Sch J of App Med Sci 2014; 2(5C):1669-74.
13. Blenkin MRB, Evans W. Age estimation from the teeth using a modified Demirjian system. J Forensic Sci 2010; 55(6): 1504-8.
14. Duangto P, Janhom A, Prasitwattanaseree S, Mahakanukrauh P, Iamaroon A. Age estimation methods in forensic odontology. J of Dent Ind 2016; 23(3): 74-80.