

Comparison of Two Dental Age Estimation Methods: The London Atlas and the Schour & Massler Atlas in 3-23 Years Old Indonesian

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Abstract: Age estimation is an important process in forensic identification, especially when there is insufficient antemortem information. Tooth is one of the strong variables which could be used in estimating the age of living or deceases. Non-invasive age estimation methods, including dental radiographs, have the advantage of uncomplicated application without damaging the oral and surrounding tissues. The aim of this research was to compare two radiographic dental age estimation methods, the London Atlas by Al Qahtani and the Schour & Massler Atlas in 3-23 years old Indonesian population. Two hundred and fifty-three panoramic radiographs from 156 females and 97 males with age ranged between 3-23 years old were retrospectively collected from a Dental Hospital. Age estimation was performed on the radiographs using the London Atlas and the Schour & Massler Atlas. Mann-Whitney U test was used to compare the chronological age and estimated age from two methods. There was an insignificant difference between estimated age by both Atlases ($p > 0.05$). Furthermore, there was also insignificant differences between estimated age of both Atlases and the chronological age ($p > 0.05$). The performance of London Atlas and Schour & Massler Atlas were equivalent in estimating 3-23 years old Indonesian in present study population.


1 INTRODUCTION

Age is an important identity. It is a basic human right for an individual to know their dates of birth, hence their ages (Cameriere et al., 2007). Age is required for civil administration, such as school, registration, work application, and retirement. Individual age also plays a significant role in jurisdiction, such as cases of employment, age falsification, marriage, athletes, child custody, and immigration (Panchbhai, 2011). However, there are possibility that the chronological age of an individual is unknown because their documented identities is not available or there is an indication of falsification which required examination for age estimation (Putri et al., 2015).

The chronological age can be estimated by determining the physiological development of certain organs (Adams et al., 2014). Teeth were being used as a choice of age indicator because they are the

strongest parts of the human body, and can withstand external influences such as high temperatures, explosions, and other extreme conditions. Human teeth also tend to be stable and barely affected by other environmental factors such as socioeconomic status, nutrition, diet, and even endocrine factors. Therefore, teeth can be useful in the post-mortem examination (Kaur et al., 2013; Adams et al., 2014).

Dental age can be determined by the development of human teeth which occurs nearly one third of the human life period. Radiograph was often used for dental age estimation because of its non-invasive method and does not involve tooth extraction (Putri et al., 2015). One of the radiography techniques is atlas method which consist of diagrammatic pictures of developing teeth's structure with related eruption patterns (Senn, 2013). London Atlas by Al Qahtani and Schour & Massler Atlas were the most popular Atlas for dental age estimation which had not

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compared in Indonesia population. London Atlas by Al Qahtani has 31 diagrams that describe the development of teeth from 30 weeks of pregnancy to the age of 23.5 years. Eight of these diagrams only describe the development of third molars starting at the age of 16.5 years. Whereas in Schour & Massler Atlas, it describes 21 chronological steps of tooth development from 5 months of pregnancy to 21 years. Besides that, individual studies from these atlases in Indonesian population only had small number of samples, which was around 20 to 100 subjects. The estimated age scope from both atlases is relatively similar, which is around the prenatal age to 21 years, which would supplement the comparison results of both methods in different population (Senn, 2013; Ciapparelli, 1992; Schour et al., 1941). Therefore, this research aimed to compare the London Atlas by Al Qahtani and the Schour & Massler Atlas in Indonesian population.

2 METHODS (AND MATERIALS)

The panoramic radiographs of 253 individuals (males = 97, females = 156) aged 3-22.99 years old were retrospectively and anonymously collected from Maranatha Dental Hospital. The selected radiographs should meet the following inclusion criteria: data for male or female patients aged 3-22.9 years and right upper and lower jaw teeth were clearly visible on panoramic radiographs. While the exclusion criteria were missing tooth / no tooth seed and pathological structure of tooth and surrounding tissue in the region studied in the panoramic view, currently undergoing orthodontic treatment, having systemic complication, such as poor nutrition or congenital diseases.

Age estimation was performed on the radiographs using the London Atlas by Al Qahtani and the Schour & Massler Atlas (Al Qahtani et al., 2014; Schour et al., 1941). The inter-rather reliability between two examiners was 76%. Mann-Whitney U test was used to compare the chronological age and estimated age from two methods. Ethical clearance was granted by Faculty of Medicine, Maranatha Christian University Research Ethic Committee (006/KEP/II/2021).

3 RESULTS AND DISCUSSION

3.1 Study Population

The percentage of sex in this study displayed in Table I. From 253 respondents the highest chronological

age (11%) was between 5.0 and 5.99 years, then 8% was between 19.0 to 19.99 years, and at least 1% of respondents have the chronological age between 22.0 and 22.9 years (Figure 1).

Table 1: Number and Percentage of Study Population by Sex.

Sex	Amount (n)	Percentage
Male	97	38%
Female	156	62%
Total	253	100%

3.2 Comparison between Chronological Age and Two Dental Estimation Methods

Analysis by Kolmogorov-Smirnov test showed that chronological age, age estimation of London Atlas by Al Qahtani method, and age estimation of the Schour & Massler method were not normally distributed ($p < 0.01$). Therefore, Mann-Whitney U test was performed. There was an insignificant difference between the age estimation results of London Atlas by Al Qahtani method and the age of the Schour & Massler method. Moreover, there was also an insignificant different between two methods with chronological age (Table 3).

Table 2: Statistical p-value between Chronological Age, Al-Qahtani Atlas Method, and Schour & Massler Method.

	London Atlas by Al Qahtani Method	Schour and Massler Method
Chronological Age	0.982	0.575
London Atlas by Al Qahtani Method		0.574

3.3 Discussion

There are different methods in estimating the age in forensic dentistry, including the London Atlas by Al Qahtani method and the Atlas Schour & Massler method. London Atlas by Al Qahtani method and the Schour & Massler method are often used because they are uncomplicated, costs effective, and mostly not invasive, which do not damage dental tissue (Alshihri et al., 2015). However, the Atlas methods also have limitations, such as the inability to represent all cases and the variability of development in tooth

formation time and tooth eruption stages and the inability to differentiate between sexes (Alshihri et al., 2015). In estimating dental age, crown and root development, and eruption status in the specimens, the diagram of London Atlas by Al Qahtani method and the Schour & Massler Atlas method was adjusted. This study was conducted to compare the accuracy in estimating dental age with the London Atlas by Al Qahtani method and Schour & Massler Atlas method on panoramic radiographs (Alshihri et al., 2015).

A study by Al Qahtani et al. (2014) has compared three methods in estimating age between the Schour & Massler, Ubelaker and London Atlas (Al Qahtani) methods in Portugal, Netherlands, United States, Canada and France, which resulted that the Al Qahtani Atlas method is the most accurate method compared to other methods. The differences between previous and this study was Al Qahtani et al. study did not use the third molars for age estimation (Al Qahtani et al., 2014), which included in this study. A study conducted by Pavlovic et al (2017) who examined the Al Qahtani Atlas method in 498 women and 238 men in Portugal and found no significant difference between chronological age and age estimation using the London Atlas (Al Qahtani) in the female sample only (Pavlović et al.,2017). The drawback of this study is that it does not differentiate between sex and the results only showed that there is an insignificant difference in mixed sexes.

The differences in the results of previous studies were also possible because of different study population of each country. Racial differences could lead to differences in the timing and sequence of eruption of permanent teeth (Indriati E, 2001). Study in Indonesia population had conducted by Fitri et al (2016), which studied the age estimation using the Al Qahtani method and identified 94 samples, and there were 66 samples (70.21%) which showed similar result between Al Qahtani age estimation method and the chronological age (Rusydiaana et al.,2016). It was in agreement with present study result which demonstrated that the Al Qahtani method has insignificant differences with chronological age. Another study which in the agreement with current study was study by Nurfitria et al (2018) which used the Atlas Al-Qahtani method, as a method of estimating age and found that the difference in dental age and chronological age was very small and could be used in the population in Indonesia (Nurfitria et al.,2018).

The exclusion criteria of this study were patients should not have poor nutrition and a history of systemic and congenital diseases, which in-line with the study of Eshitha et al (2014) who estimated the age of 25 children aged 5-16 years in good health in a population in India using the Schour & Massler method. From the study was found that the intraclass correlation coefficient was 0.938 which indicates a

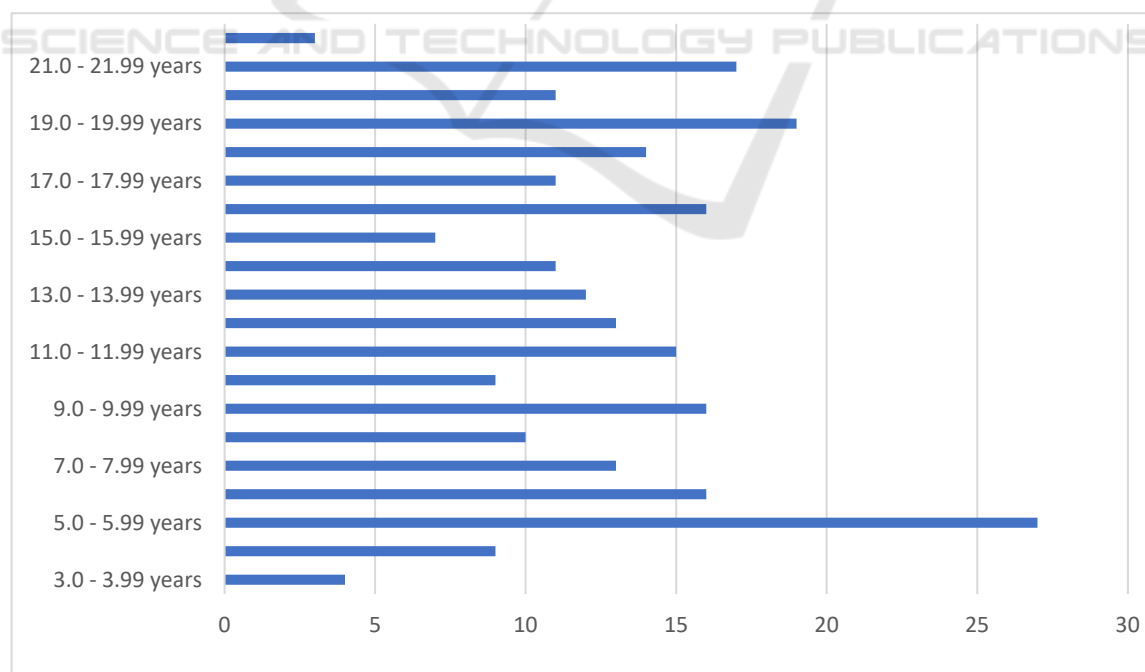


Figure 1: Number of study population per age category.

high correspondence between chronological age and dental age according to Schour & Massler, so it could be concluded that the Atlas Schour and Massler method can be applied to mentioned population (Eshitha E et al., 2014). In addition, study by Trelia et al. (2019) estimated age using the Atlas Schour & Massler and Demirjian method with sample of 46 patients with the age range of 10-16 years at the RSGM University of North Sumatra and showed that age estimation results were similar to the actual age, so there was no significant differences between two methods (Trelia et al., 2019). This study is in agreement with Trelia et al. research that the Schour & Massler method is proven to be able to estimate dental age in Indonesia population.

Besides there is no sex distinction, the disadvantages of current study were uneven distribution of the age range and there was no specific analysis for each gender. Therefore, future research should aim for enlarging the research population with even sample per age range, and perform sex-specific analysis.

4 CONCLUSIONS

It could be concluded that the performance of London Atlas and Schour & Massler Atlas were equivalent in estimating present study population.

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