Dental Age Estimation In Indonesian Population: A Literature Review

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Abstract

Age is one of the important parts of the identification process, which could be a requirement in legal framework, criminal investigation, and to provide significant information for diagnosis and treatment planning in health care. Age estimation is a major study in forensic, especially when the information related to the deceased is unavailable. Dental is one of the strong variables which could be used in estimating the age of living or deceased. Dental age estimation methods were mainly based on the changes in tooth development which influenced by diverse internal and external factor. Therefore, studies of dental age estimation of various population showed different discrepancies. This paper reviews about studies of dental age estimation, specifically in Indonesian population, including the population age, age estimation methods, study sample, and studies' findings.

Keywords: dental, age estimation, Indonesian population, forensic odontology

Introduction

Aging, or process of becoming older, is a complex phenomenon which is influenced by many factors in genome and environment[1–3]. Recently, it is become an evidence that epigenetic modifications play an equally essential role in growth development and this process is very susceptible to environmental changes[1]. Although sometimes there are discrepancies between biological age and chronological age due developmental variation, parameter such as dental development is reliable indicator for age[4]. Teeth undergo development process in several stages, therefore different morphological stages of mineralization correlate with the different developmental stages making dental as an important variable in age estimation[5].

Different studies of environmental influence on tooth development had also been conducted. Number of factor influenced the permanent teeth eruption, included nutrition and socioeconomic factors[3]. It also had been studied that environmental stress can lead to changes in dental morphology[2]. Considering the influenced, study of age estimation using dental parameter also had been conducted in different population[6–10]. Environmental influenced on dental development was proved by different variation of result discrepancies of dental estimated age between populations. The aim of present review is

to integrate researches involving age estimation methods based on dental development in Indonesian population.

Methodological Approach

Searches were conducted in electronic databases of Google Scholar using main search terms included dental, age, estimation, Indonesia, and population. Publication was selected based in criteria (1) written in English or Indonesian and (2) used dental development as variable(s) to estimate age or examine dental parameter(s) in correlation with age. All studies were included regardless of publication time and the relevant information from each study was gathered and summarized.

Dental Age Estimation in Indonesian Population

Studies of dental age estimation in Indonesian population were conducted by various discipline, not limited to dentist or forensic expert. There were 14 studies found from the conducted search, which summarized in Table 1. The age coverage of the most study was young adult and children (71%)[11–20]. Only three studies which involved age range more than 25 years[21–23]. The youngest age of population involved in the studies was 4 years and the oldest was 73 years[11,22,23]. There is one study which did not specifically mentioned the age range information[24].

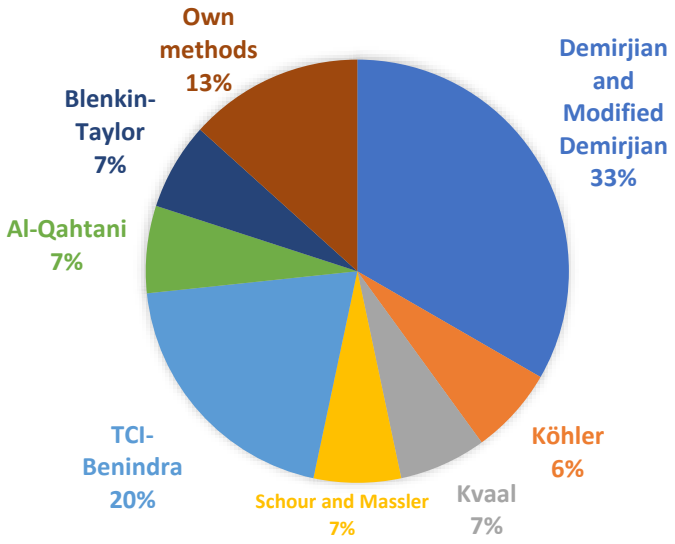

Figure 1. Distribution of the dental age estimation methods from the observed studies.

Table 1. Studies of Dental Age Estimation in Indonesian Population

Authors	Age range (years)	Sample size (Female+ Male)	Teeth Examined	Age Estimation Methods (stages)	Summary of Research Finding(s)
Yunus and Wardhani[11]	4-9	30 (18+12)	Seven left mandibular permanent teeth, except of third molar on panoramic radiograph.	Demirjian (8)	Significant over estimation of dental age compared with the chronological age.
Luthfi et al.[21]	13-29	100 (70+30)	All third molars on panoramic radiograph.	Modified Demirjian (8)	Chronological age of each Demirjian's stage. Discrepancy of age between gender.
Nawawi et al.[12]	6-14	22 (Down syndrome children: 11; Normal children: 11)	Seven left mandibular permanent teeth, except of third molar on panoramic radiograph.	Demirjian (8)	Under estimation of dental age in down Syndrome children, however no significant difference between dental age in down Syndrome children and normal children.
Marjianto et al.[13]	6-12.99	117 (53+64)	All permanent teeth except for third molar clinical eruption.	N/A	Chronological age of each permanent tooth eruption.
Hidayat et al.[22]	13-73	41 (22+19)	Canine on Cone Beam Computed Tomography (CBCT).	Pulp Chamber Volume and Age Correlation	Regression formula of age estimation based on change of pulp chamber volume.
Kasuma et al.[14]	16-21	600 (300+300)	Third molar clinical eruption.	N/A	Chronological age of maxillary and mandibular third molar eruption.

Firdaus et al.[15]	8-25	407 (222+185)	Third molars on panoramic radiograph.	Modified Demirjian (8)	Regression formula of age estimation for one and combination of third molars.
Holman and Jones[24]	-	468	Deciduous teeth clinical eruption.	N/A	Proportion of emerged teeth by the age and chorological age of deciduous teeth eruption.
Amiroh et al.[16]	15-22 and 15-25	100 (50+50)	Third molars on panoramic radiograph.	Modified Demirjian (8 and 10)	Eight stages of Demirjian showed smaller deviation of age estimation than ten stages.
Hidayati et al.[17]	15-25	100 (50+50)	Maxillary and mandibular second and third molars on panoramic radiograph.	Gleiser and Hunt (37) and modified by Köhler et al. (10) (mentioned by Thevissen methods)	Significant over estimation of dental age for age range 15-25 and no significant over estimation for age range 15-22
Farahyati et al.[18]	16-21	34	Mandibular first premolars on periapical, permanent teeth on panoramic, and lateral cephalometric radiographs.	Kvaal, Schour and Massler, Tooth Crown Index (TCI) Benindra	No significant difference between age estimation of TCI-Benindra in panoramic and periapical radiograph. Significant difference found between age estimation of TCI-Benindra on periapical radiograph and Kvaal method on panoramic, TCI-Benindra on panoramic radiograph and Schour and Massler on lateral cephalometric radiographs.

Nurfitria et al.[19]	16-21	34	Mandibular first molar on periapical, permanent teeth panoramic, and lateral cephalometric radiographs.	Al-Qahtani, Blenkin-Taylor, TCI-Benindra	No significant difference found between age estimation of TCI-Benindra with Al-Qahtani's method and Blenkin-Taylor's method.
Yulianti et al.[20]	9-21	70 (35+35)	Mandibular premolar on panoramic radiographs.	TCI-Benindra	Insignificant over estimation of dental age using TCI-Benindra
Yuniarti et al.[23]	50-73	31 (30+1)	Maxillary central and lateral incisors, maxillary second premolar, mandibular lateral incisor, mandibular canine, and mandibular first premolar on panoramic radiographs.	Tooth length and age correlation	Regression formula of age estimation based on highest correlation with lengths of teeth (mandibular canine). Developed automatic age estimation system based on the derived regression formula to estimate age on panoramic radiography.

The age's range and sample options are related to which age estimation method should be used in the studies. The most age estimation method applied in Indonesian population was Demirjian's method, with or without modification (35.71%)[11,12,15,16,21], followed by TCI-Benindra's method (21.42%)[18–20], and the other methods (7.14%-13%), as presented in Figure 1. Panoramic radiograph was the most used sample for the studies (53%)[11,12,15–21,23], followed by clinical examination (17%)[13,14,24], periapical radiograph (12%)[18,19], lateral cephalometric radiograph (12%)[18,19], and CBCT (6%)[22] (Figure 2).

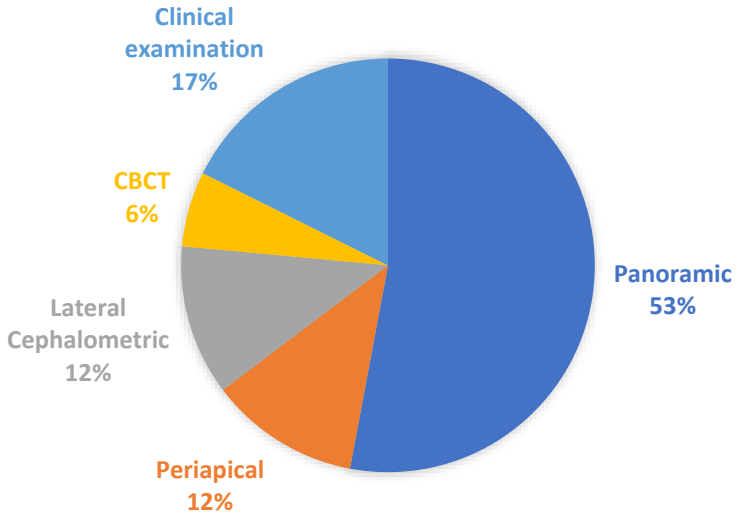

Figure 2. Distribution of the sample from the observed studies

Panoramic radiographs able to showed development of upper and lower jaw dentition, which should be observed for certain methods such as Demirjian's method, Köhler's method, Schour and Massler's method, and AlQahtani's method. Demirjian's method used seven left permanent mandibular teeth for age predictor which can be observed from panoramic radiographs[25]. When all the seven left permanent mandibular teeth had reached the highest stage, the age prediction from these methods could only give the least age from individual of 16 years[25]. Considering number evidences with permanent teeth had reach the highest stage, which could predict that the least age of individuals were 16 years, the age estimation should be taken from the combination of third molar. Köhler's method of age estimation used parameter of third molar development stages[26]. Therefore, this method could apply to individual with developing third molar, until around 23 years.

Schour and Massler's method and AlQahtani's method was atlases with schematic drawing of upper and lower teeth from right region to estimate the age applied to the panoramic radiographs[27,28]. Unlike AlQahtani's atlas, Schour and Massler's does not have

details diagram for third molar development and only can estimated the oldest age of 21 years old.[27] While in AlQahtani's atlas, development of third molar is included up till 23.5 years old which preferable when all the seven permanent teeth have reached the complete development[28]. Blenkin-Taylor's atlas was a modification of Uberlaker's atlas for Australian population which also incorporate the third molar and can estimate the age up to 25 years[29].

There are studies which developed their own methods to estimate the age by measuring certain morphological changes related with aging, such as pulp chamber volume and tooth length. Previous method using tooth length and pulp length also had been developed by Kvaal which provided non-destructive methods for single tooth or combination of teeth, which also can be used for attached teeth on the individual[30]. Because of the limitation of age estimation from method which used development of deciduous and permanent teeth, Kvaal's method is an option to estimate individual with age more than 23 years[30].

Three studies observed clinical eruption of deciduous and permanent teeth in correlation with chronological age[13,14,24]. Eruption of teeth is one of the parameters which can be observed easily among the various dynamic development changes occurred from the formation of teeth to the final maturation. The most widely used dental eruption age method was the overview from American Dental Association (ADA)[31]. However, tooth eruption or gingival emergence represents only one stage in the continuous whole process of dental development and maturity[25].

Recommendation

Dental age estimation research in Indonesian population had involved various methods, however, it is still of mainly focused on children until young adult. Therefore, more studies are needed for the adult age range, which examined morphological changes in teeth after 23 years old, such as Kvaal's method. As the development of technology, it is also important to compare the present age estimation method on advanced dental radiograph, such as 3D imaging. Research with combination of different dental age estimation methods also can be examined further. The long-term goals and concerns of dental age estimation studies in Indonesian population are to develop, verify, assist the progress and application of the most accurate methods.

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