Volume: 4, Issue: 1
Page: 1 - 9
2023

ISSN: 2709-9911 (Online), ISSN: 2710-236X (Print)
International Journal of Medicine, Nursing & Health Sciences (IJMNHS) ® (IJMNHS.COM)

Applicability of Demirjian Method for Dental Age Estimation on Children with Down Syndrome

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Abstract:

Down syndrome is a genetic disorder that affects the calcification and eruption of teeth, roots, and alveolar bone. On average, people with Down syndrome experience delays in the growth and development of their teeth. This condition needs to be considered in actions both for research and clinical purposes such as pedodontics treatment, orthodontics, and age estimation in the forensic identification process. This study aims to analyze the application of the Demirjian method to children with Down syndrome. A descriptive analysis method was used in this study. 16 panoramic radiographic samples consisting of 6 male samples and 10 female samples with an age range of 7 to 17 years were used. All samples were calculated for chronological and dental age using the Demirjian method. The calculation results were then analyzed using the t-test. The result is that all dental age samples of men and women experience significant delays in maturation compared to their chronological age. So it was concluded that the application of the Demirjian method requires prior adjustments if it is applied to children with Down syndrome.

Keywords: Demirjian Method, Down Syndrome, Dental Age Estimation,

IJMNHS
Accepted 20 February 2023
Published 28 February 2023
DOI: 10.5281/zenodo.7701442

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Introduction

Age is an essential part of a forensic identification process, which can be a requirement in legal frameworks and criminal investigations. Age is also a means that can provide significant information for diagnosis and treatment planning in health services (Saputri, 2020). Chronological age is the age obtained by recording the date, month, and year of birth which is related to the length of one's life (Corral et al., 2010). Chronological age is used to monitor children's growth and development process (Berkovitz et al., 2009). Somatic development is related to chronological age which is the result of measurements of somatic maturation such as bone development, puberty, and height or weight. The development of dentition shows less variability compared to other developments and also lower variability related to chronological age (El-Yazeed et al., 2008). So that it can be used to evaluate the development of a child through the age of his teeth.

Several factors can cause variations in the age of a person's teeth. One of them is genetics which influences the variation in time and speed of tooth development (Blenkin, 2009). Genetic factors can be responsible for up to 82% of the rate of variation in tooth development (Merwin and Harris, 1998). Down syndrome is a genetic disorder that influences the process of calcification and eruption of teeth, roots, and alveolar bone. Down syndrome sufferers have orofacial features such as taurodontism, open bite, macroglossia, hypodontia, microdontia, anodontia, drooling, cracked tongue, malocclusion, low level of dental caries, poor oral hygiene, latent eruption, small upper jaw, retaining primary teeth (Al-Maweri et al., 2015). Down syndrome is a disorder caused by chromosomes, namely the presence of 47 chromosomes which causes chromosome 21 to fail to divide causing trisomy on chromosome 21 (Shilpa, 2021; MacLennan, 2019). The incidence of Down Syndrome ranges from 1 in 800 live births (Mundakel and Purushottam, 2022). In Indonesia, the prevalence of children with Down syndrome increased by 0.12% in 2010 to 0.13% in 2013 and then increased again to 0.21% in 2018 (Kemenkes RI, 2018). The average person with Down syndrome experience delays in the eruption of their teeth for 2-3 years (Duffhues et al., 2020). So this condition needs to be considered by a dentist in acting both for research and clinical purposes such as pedodontics treatment, orthodontics, and age estimation in an introduction process forensics.

Age estimation in a forensic identification process must consider several things, one of which is the use of a method to be applied. One of the most frequently used dental age estimation methods is the Demirjian method. This method is easier and more accurate because it uses dental maturation indicators, namely the stages of formation of permanent teeth from the formation of the crown to the closure of the tooth roots through panoramic photos. This method uses a scoring system called the Demirjian Maturation Score. The standard setting in this method uses a research sample of French-Canadian children belonging to the Caucasoid race. The use of the Demirjian method in several countries with different ethnic/racial results varies widely (Chaillet et al., 2005). There are still very few references regarding the use of the Demirjian method, especially in children with Down syndrome and there is a need to use this method for the benefit of the field of forensic odontology, it is necessary to conduct research regarding the use of the Demirjian method in children with Down syndrome.

Methods

Criteria and Sample Size

This research is an analytic descriptive study using panoramic radiograph samples available at the Forensic Odontology Laboratory, Faculty of Dentistry, University of Jember. The criteria for the study sample were that the radiograph was in good/proper condition with a complete picture of permanent teeth, and had complete data on sex, date of the month, and year of birth. The sample size used was the entire available sample consisting of 6 male samples and 10 female samples with ages ranging from 7 years to 17 years.

Calculating Chronological Age

Calculation of the chronological age of the research sample is based on the time of birth and the time of taking panoramic X-rays. The number of days from birth to take the panoramic x-ray is calculated and then divided by 365 days (Apriyono, 2020).

The Demirjian Method

The Demirjian method is a dental age prediction method that uses the stages of the development of the seven permanent teeth of the lower left jaw through panoramic radiographs. Demirjian method is based on simplified chronological age estimation by limiting the number of stages of tooth development to eight stages and scoring them from "A" to "H". These eight stages are the process of calcification of each tooth, starting from the calcification of the crown and root to the closing of the tooth apex. Demirjian used dental assessments which were converted into scores using tables for boys and girls respectively. All scores for each tooth are summed and a maturation score is calculated. The maturation score was then converted directly into dental age using published conversion tables. Each stage of maturation for the 7 left mandibular teeth has a different assessment weight (Demirjian et al., 1973).

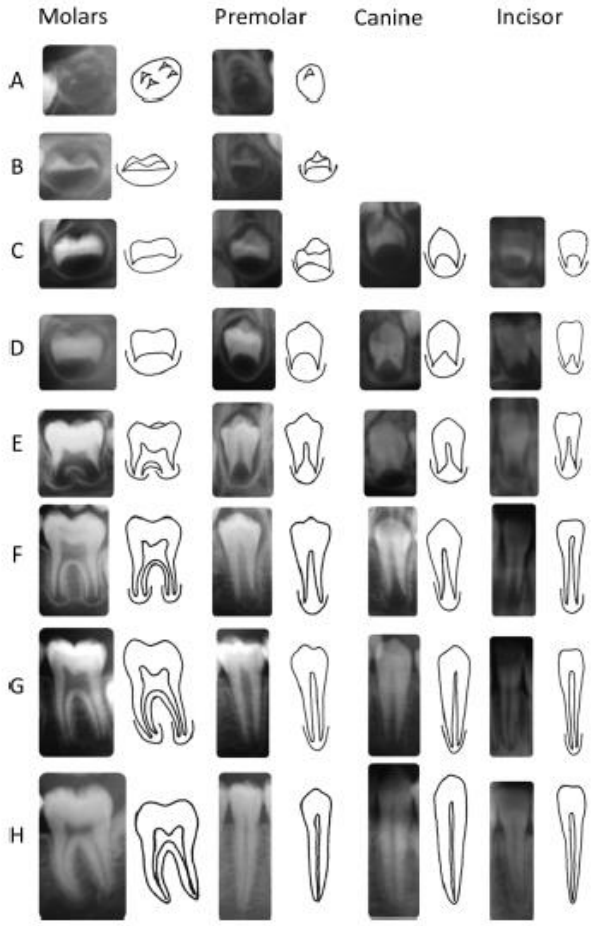
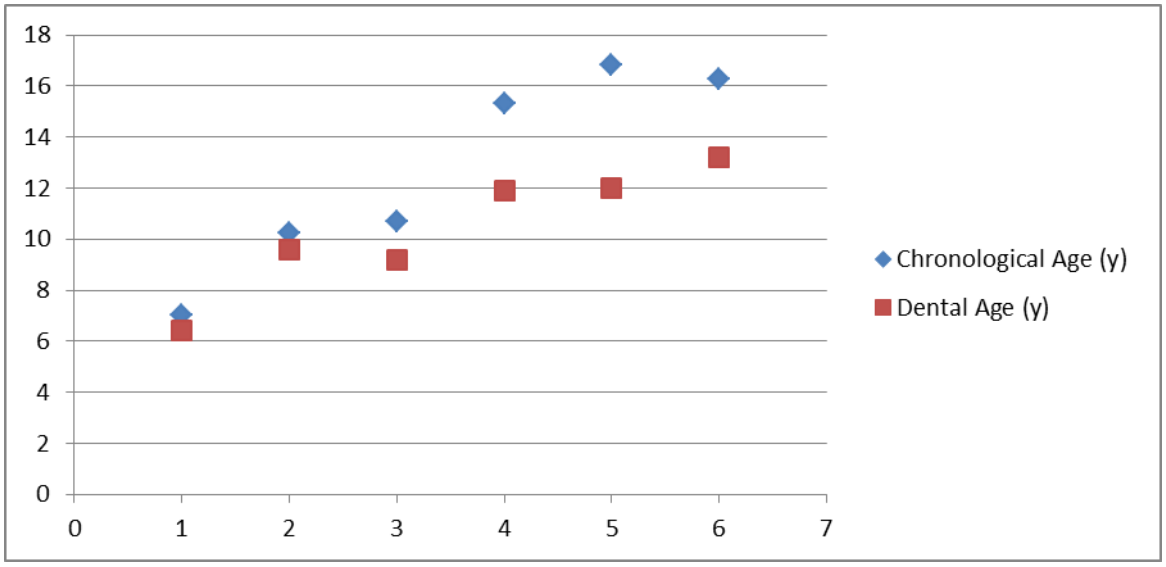


Figure 1. Stages of calcification of permanent teeth (Demirjian et al., 1973)

Data analysis

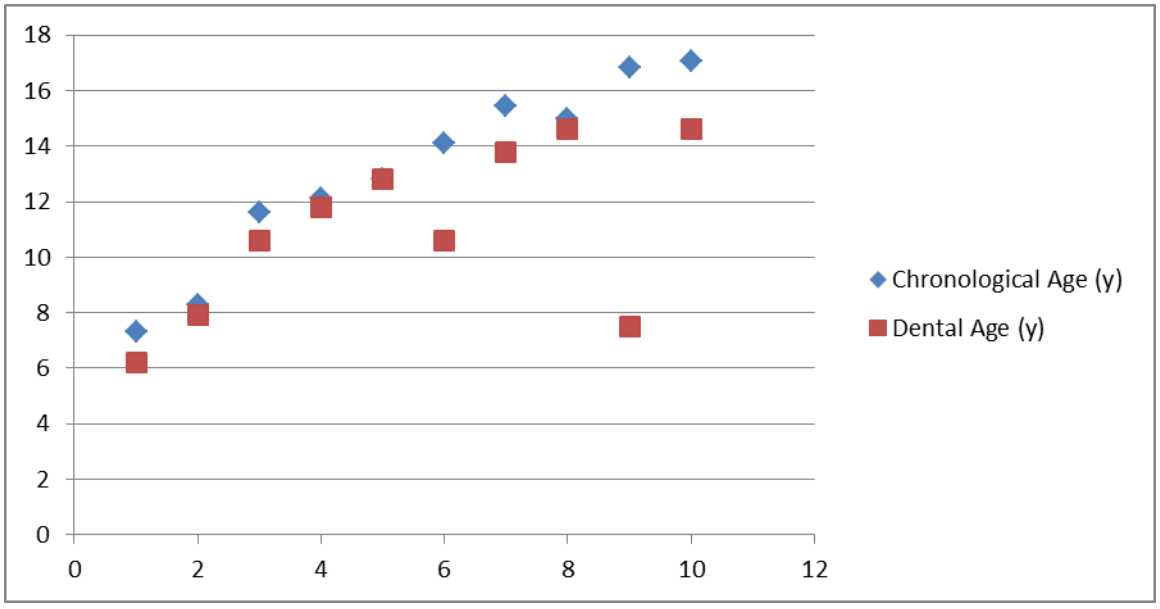
The data obtained from the dental age assessment were analyzed using the Paired t-test with the SPSS version 20 program to test the significance of the comparison of chronological age and dental age.

Results



Graph 1: Distribution of chronological age and dental age of the male sample

Graph 1 shows that all the dental ages of the male sample experience delayed maturation compared to their chronological age.



Graph 2: Distribution of chronological age and dental age of the female sample

Graph 2 shows that all dental age samples of women experience maturation delays compared to their chronological age.

Table 1: Results of the average chronological age, the average dental age, the average age difference, and the t-test.

Sample	n	Average Chronological Age±SD (Years)	Average Dental Age±SD (Years)	Average Age Difference±SD (Years)	Sig.(2-tailed)
Male	6	12.73±3.99	10.38±2.48	- (2.35±1.72)	.020
Female	10	13.06±3.33	11.04±3.03	- (2.02±2.79)	.048

Table 1 shows a significant difference in dental age, in both male and female samples. The minus sign (-) indicates the age of the teeth is slower than the chronological age.

Discussion

Chronological age and dental age have an important role in age prediction. Chronological age reflects dental age and vice versa. Dental age estimates must have an accurate tooth age range. Therefore, it is necessary to have an age estimation method that has the lowest possible standard deviation and has been validated in certain population groups (Apriyono, 2020).

The results of this study obtained the estimated dental age of the male sample with Down syndrome of 2.35 years, which means there is a delay in the growth and development of the teeth of boys with Down syndrome. This is to the research by Lamfon et al., (2015) and Aldossary (2017), which stated that people with Down syndrome experience delays in the process of calcification and eruption of teeth for two to three years. The causes of delayed calcification and eruption processes in children with Down syndrome are still not known for certain due to an incomplete understanding of the factors involved in the normal eruption process. However, it seems that this is influenced by genetic factors. In normal individuals, the process of bone resorption occurs less than in people with Down syndrome. There is also evidence that the rate of eruption is influenced by the periradicular vascularity of the conjunctive tissues. Insufficient peripheral circulation may be one of the contributing factors to the delay in the eruption process. In addition, this can also be caused by factors that delay growth and development in the maxilla and mandible (Pacurar et al., 2018).

The results of this study also obtained an estimated dental age of a sample of women with Down syndrome of 2.02 years, which means there is a delay in the growth and development of the teeth of girls with Down syndrome. This is to the research by Diz et al., (2011) which states that the use of the Demirjian method in girls experiences a delay of between 2-3 years. This delay can be caused by various factors such as regional differences, differences in the structure of the trial groups, local factors, and general factors (Pacurar et al., 2018). During the period of tooth growth and development, each individual will experience a variety of tooth eruption processes, for example, variations in time. Genetic factors are one of the factors that play an important role in the process of tooth calcification and eruption. Genetic factors can affect the speed of eruption of the teeth. The influence of these genetic factors can cause the eruption of the teeth to be faster or slower. The most common event is delayed tooth eruption as happened in this study sample (Putri et al., 2013;

Choukroune, 2017; Alshukairi, 2019). This is often associated with low body weight during the birth process (Yuanyuan et al., 2015).

Conclusion

From the results and discussion above, it can be concluded that the application of the Demirjian method to children with Down syndrome results in a slower estimate of dental age than their chronological age, for both male and female samples. So it requires adjustments if the Demirjian method is applied to people with Down syndrome.

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Cite this article:

Author(s), **Dwi Kartika Apriyono, (2023).** "Applicability of Demirjian Method for Dental Age Estimation on Children with Down Syndrome", **Name of the Journal:** International Journal of Medicine, Nursing & Health Sciences, (IJMNHS.COM), P, 1 –9. DOI: www.doi.org/10.5281/zenodo.7701442 , Issue: 1, Vol.: 4, Article: 1, Month: February, Year: 2023. Retrieved from https://www.ijmnhs.com/all-issues/

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