Saudi Dental Journal (2018) xxx, xxx–xxx

King Saud University

Saudi Dental Journal

www.ksu.edu.sa
www.sciencedirect.com

ORIGINAL ARTICLE

Dental age estimation of Omani children using Demirjian's method

S. Al Balushi [a,*], W.M. Thomson [b], L. Al-Harthi [c]

[a] Bachelor of Dental Surgery, School of Dentistry, The University of Otago, New Zealand
[b] Sir John Walsh Research Institute, School of Dentistry, The University of Otago, New Zealand
[c] Department of Periodontics, Military Dental Centre, Oman

Received 21 June 2016; revised 29 April 2018; accepted 29 April 2018

KEYWORDS

Forensic science;
Age assessment;
Demirjian's method;
Omani children

Abstract Dental age plays a significant role in forensic dentistry, orthodontics and paediatric dentistry, as well as in general diagnosis and treatment planning. Different methods have been developed to determine dental age. One of the most commonly used methods is Demirjian's method, which was developed in 1973 from research on a large number of French-Canadian children. It is based on the degree of tooth mineralisation by examining the radiological appearance of the lower mandibular left quadrant. The purpose of this study was to assess the dental age of Omani children using Demirjian's method and evaluate the applicability of the method in dental age estimation for Omani children. The sample consisted of 485 digital panoramic radiographs of children (264 males, 221 females) aged between 4.6 years and 16.5 years, and obtained from the records of the Military Dental Centre in Oman. The data were analysed using SPSS. Paired *t*-tests, intraclass correlation coefficients (ICC) and difference-against-mean plots were used to compare the dental age calculated by Demirjian's method with chronological age. A single examiner scored the radiographs, and intra-observer reliability was evaluated using Cronbach's alpha on data from rescoring one out of every 20 radiographs. For boys, the mean difference between chronological age and dental age for all age groups was 0.10 (95% CI −0.03 to 0.24). For girls, the mean difference between chronological age and dental age for all age groups was 0.05 (95% CI −0.11 to 0.22). Difference-against-mean plots showed no evidence of differential bias by age. For boys, the ICC was 0.896 (95% CI 0.869–0.917); for girls, it was 0.886 (95% CI 0.854–0.911). Difference-against-mean plots for boys (Fig. 1) and girls (Fig. 2) showed some evidence of differential bias by age. In conclusion, the extent of the observed differences was sufficient for doubt to be cast upon the utility of Demir-

* Corresponding author at: Al Azaiba, Way No. 6858, House No. 9351A, Oman.
E-mail addresses: albsh070@otago.student.ac.nz (S. Al Balushi), murray.thomson@otago.ac.nz (W.M. Thomson).

Peer review under responsibility of King Saud University.

Production and hosting by Elsevier

https://doi.org/10.1016/j.sdentj.2018.04.005

Please cite this article in press as: Al Balushi, S. et al., Dental age estimation of Omani children using Demirjian's method. Saudi Dental Journal (2018), https://doi.org/10.1016/j.sdentj.2018.04.005

jian's method for Oman, particularly when it is considered that the method's most likely application would be in age determination for minors in the workforce.

1. Introduction

The demand for age estimation in forensic science has increased. A plethora of disasters has resulted in an increase in the number of unidentified human remains, and that has underlined the need for accurate methods for age estimation. Moreover, the current geopolitical status of the world has resulted in a rise in the cases of children with no proof-of-identity documents such as a certificate of birth (Ritz-Timme et al., 2000). Different methods have been developed to estimate age; these include using skeletal age, morphological age, secondary sex characteristics age and dental age (Patnana et al., 2014). Of these methods, the latter is seen as the most valid method for age estimation (Bolanos et al., 2000). This is because teeth exhibit the least turnover of all body tissues, and their development is controlled by genes and is thus less susceptible to environmental influences (Panchbhai, 2011). Dental age is also used by orthodontists and paedodontists (Chen et al., 2010). It also helps to identify paediatric hormonal disturbances such as hyposecretion of growth hormones (Vallejo-Bolaños et al., 1999). Moreover, it provides orthodontists with clues to the appropriate time for initiating orthodontic treatment (Nik–Hussein et al., 2011).

One of the commonly used methods for calculation of dental age is Demirjian's method (Panchbhai, 2011), which uses the radiographic appearance of the seven mandibular teeth on the left side. Each tooth is allocated an ordinal code between A and H, according to the criteria published in Demirjian's article, and then this is converted to a score. The seven scores are summed to give a maturity score that can then be converted to an age, using sex-specific tables originally constructed using a large sample of French-Canadian children (Demirjian et al., 1973). The clinical interpretation of age assessment indicates whether the child is dentally advanced, average or delayed relative to the reference value from Demirjian's original French-Canadian sample (Liversidge, 2012). A recent systematic review (Jayaraman et al., 2013) found that using the Demirjian approach tended to over-estimate children's ages.

Dental age assessment has been undertaken for populations such as New Zealand children (TeMoananui et al., 2008), Malaysian children (Nik–Hussein et al., 2011), Chinese children (Chen et al., 2010), Indian children (Warhekar et al., 2011), Turkish children (Tunc and Koyuturk, 2008), Romanian children (Ogodescu et al., 2011), Saudi children (Al-Emran, 2008), and, Emirati children (Altalie et al., 2014). However, there are no published data from dental age assessments of Omani children. Oman has a unique population consisting mostly of Arabs, but also including Balochis, Lawatis, Swahili and Persians (Peterson, 2004). Oman, as with many other countries, has recently become more aware of the significance of age assessment practices. The legal age in Oman is considered to be eighteen and anyone younger than eighteen is considered to be a minor. The laws and penal codes in Oman that are associated with children are set at certain age thresholds. Examples of those are the Oman labour law, the child abduction penal code and the human trafficking law. The Oman labour law specifies the minimum age for employment to be fifteen years. Courts in Oman require medical practitioners to assess the age of the individual when his/her age is unknown (Smith and Brownlees, 2011). Custodial and fine penalties are greater when the victim is a minor in cases of human trafficking and abduction (Bureau of International Labor Affairs, 2006). Accordingly, it is important to have a reference dataset specific to use for the age assessment of Omani children. Accordingly, the aim of the study was to evaluate the applicability of Demirjian's method for dental age estimation in Omani children.

2. Materials and methods

This cross-sectional study was conducted at the Military Dental Centre in Oman. Ethical approval was obtained from the Omani Ethics Committee. The data were observed from 485 panoramic radiographs of 264 males and 221 females, ranging in age from 4.6 to 16.5 years (Table 1).

The radiographs were taken directly from the Digora™ radiograph database at the Military Dental Centre and saved as JPEG images. Windows Live Photo Gallery was used to view the radiographs and adjust the size, contrast and brightness for better quality. The radiographs were excluded in cases of radiographic distortion affecting the staging of the left mandibular teeth, dental developmental abnormalities, gross pathology or significant medical history that has a direct influence on teeth development (such as a history of treatment for childhood leukaemia). A single examiner collected and assessed the radiographs. The date of birth and the date on which the radiograph was taken were used to calculate the chronological age. Age and sex were unknown to the examiner

Table 1 Age group by sex.

Age group	Boys	Girls	Both (%)
4.6–5.5	0	2	2 (0.4)
5.6–6.5	8	2	10 (2.1)
6.6–7.5	9	5	14 (2.9)
7.6–8.5	28	32	60 (12.4)
8.6–9.5	39	32	71 (14.6)
9.6–10.5	38	27	65 (13.4)
10.6–11.5	33	24	57 (11.8)
11.6–12.5	30	25	55 (11.3)
12.6–13.5	29	15	44 (9.1)
13.6–14.5	26	18	44 (9.1)
14.6–15.5	13	22	35 (7.2)
15.6–16.5	11	17	28 (5.8)
Total	264 (54.4%)	221 (46.6%)	485 (100.0)