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ORIGINAL ARTICLE

Dental age assessment of 4–16 year old Western Saudi children and adolescents using Demirjian's method for forensic dentistry

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Abstract *Aim:* Developing teeth are used to assess maturity and estimate age in several disciplines such as pediodontic, orthodontic, pediatric endocrinology and forensic odontology. The aim was to determine the statistical adjustment needed when dental age is estimated using Demirjian's method for Western Saudi children and adolescents between ages 4 and 16 years of age. Also, to compare a Western Saudi population sample with the original French-Canadian.

Methods and materials: The most common standard for forensic age estimation or analysis of children and sub-adults of Demirjian et al. (1973) was used, with a total of 198 individuals (boys = 88 and girls = 110). The panoramic radiographs were used to score the seven left mandibular teeth.

Results: The mean difference was 1.44 to 0.64 in girls and from 0.66 to 0.77 in boys. Among girls there was a statistically significant difference for 7, 11, and 15 years ($P < 0.05$). There was a statistically significant difference ($P < 0.05$), in boys for age groups 8 and 13 only. On average for all ages, Western Saudi Arabia girls were 0.059 (sd = 1.26) years and the boys 0.66 (sd = 1.14) years ahead of the French-Canadian children.

Conclusion: New tables were developed in order to convert dental maturity calculation according to Demirjian's method into estimated age of contemporary Western Saudi population (significant overestimation). For future research, increase in the sample size for all age ranges to establish new maturity scores and logistic curves for the studied population group and comparison with other Saudi children in rural communities found in other regions in Saudi Arabia would be ideal.

1. Introduction

Estimation of dental age is usually based on the maturation of dentition. The process of dental maturation (the degree of calcification) is correlated to different mineralization morphological stages that can be observed radiographically. The process

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of maturation is much more uniform, progressive, sequenced, and continuous than tooth eruption, and is less affected by endocrine disease, dietary deficiency states, and environmental changes.[1,2] For these reasons, a series of age estimation techniques have been developed based on the mineralization stage of tooth germs.

Forensic odontology takes advantage of the techniques to aid in the process of identifying unknown individuals. Moreover, dental aging is also a very important measure in the management of immigration to assist in determination of the chronological age in the absence of proper documents. These techniques have also been employed to decide when a child can start schooling, the earliest age a person can marry, or even go to prison.[3]

All age evaluation methods based on dental maturation follow the same systematic approach in which estimating age merely implies having oral radiographies, which can be used in live subjects, cadavers, and skeletal remains.[4] Currently, the most studied method is the method of Demirjian et al.[5] for forensic age estimation of children and sub-adults. In addition, many authors have reported different standards of dental maturation, using Demirjian's standard for age estimation (e.g. Australian – Peiris et al.[6] Brazilian – Lucio et al.[7] Chinese – Zhao et al.[8] Pakistani – Rashna et al.[9] and South Africa – Phillips et al.[10]) In the majority of studies the comparisons have been made between determined values of the studied population and French-Canadian standards as reported by Demirjian's. It was recommended that adaptations would be necessary in order to use this technique in other population groups.[5]

In Saudi Arabia, a study has been conducted on a sample of individuals from the city of Riyadh (Middle Region).[11] However, no studies have been conducted to establish dental development studies for forensic age estimation and forensic application in Western Saudi Arabia. The purpose of this study is to assess the use of Demirjian's method for age estimation in Western Saudi children (4–16 years old) and to assess its applicability.

2. Materials and methods

2.1. Materials

In this study, panoramic radiographs and clinical records of 198 Western Saudi children of known chronological age and gender were obtained, which included a total of 88 boys and 110 girls, with age ranging from 4 to 16 years. Digital panoramic radiographs were used. The panoramic radiographs were collected from patients attending dental clinics (from the dental center of King Fahd Hospital, Jeddah-Western of Saudi Arabia) and all radiographs formed a part of the patient's routine dental treatment (from the clinic of Paedodontics-Orthodontics of health Saudi individuals). No panoramic radiographs were taken primarily for this research project. According to Demirjian the presence of pathology, anatomical obstructions and potential radiographic distortion can be of potential concern when doing age estimation. Therefore all radiographs were checked to ensure these factors were not present.

2.2. Methods

The assessment of dental age was performed according to Demirjian's method.[5] This method is e based on eight stages of tooth mineralization, from calcification of the cusp to closure of the apex, on the seven left mandibular teeth and each tooth is given a score based on its phase of calcification. All panoramic radiographs were scored by the author using the criteria set by Demirjian et al.[5] without the knowledge of patient's chronological age. The mandibular seven left teeth were scored excluding the third molar. Each tooth was rated on an 8-stage scale ranging from A to H depending on the stage of calcification. Each stage of the seven teeth was then allocated a score, and the sum of the scores gave a calculation of subject's dental maturity. Demirjian's developmental stages and self-weighted scores were used to allocate a tooth stage to the seven left mandibular teeth and the maturity scores calculated; then conversion tables were used to convert the maturation score to a dental age.

The chronological age was determined by subtracting the date of birth from the date the panoramic radiograph was taken. Chronological ages were sorted according to age groups which assisted with classification. Each age group was assigned the same range, for example; age group 4 corresponded to an age range of 3.5–4.5 years of age. Age group of 16 years old was not analyzed because all the children in the group reached a dental score of 100 and the dental age could not be computed.

All data analyses including calculation ratios, were completed using the Excel (Version: 2003, Microsoft, Redmont, USA). The detailed statistical analysis was completed using the IBM SPSS (Version 19).

2.3. Reliability – inter-examiner

Paired *t*-tests were used to determine the significance of differences between chronological and estimated ages, for all age groups. Statistical significance was set at $P < 0.05$. Statistical significance using Wilcoxon Matched Pairs Test for examiner reliability was calculated and found to be 0.740368. This value is not significant and operator calibration was considered reliable.

3. Results

The panoramic radiographs of 198 children were included in the study, and analysis was completed according to age category and gender. Each age category included a 12-month range of ages. A paired *t*-test was used to assess the significance of the difference between chronological age [the real age] and the dental age [the estimation age] according to the method of Demirjian et al.[5] (Table 1). The mean difference between the chronological age found in Western Saudi Arabian children, compared to the dental age found in French-Canadian children, ranged from 1.44 to 0.64 in girls and from 0.66 to 0.77 in boys (Table 1).

In girls, differences were either negative or positive, depending on age group. The negative values demonstrate age groups 5–8 and 11–12 were advanced in growth when compared to the French-Canadian children. Among girls there was a statisti-