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Original Communication

The applicability of Willems' method for age estimation in southern Turkish children: A preliminary study

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ABSTRACT

The aims of the present study were to evaluate the applicability and accuracy of Willems' method for assessing southern Turkish children and to analyze the practicability of this method in different age groups for both genders.

Panoramic radiographs of 756 children (378 females, 378 males) aged between 5 and 14.99 years were examined by one observer. This retrospective study involved a contemporary southern Turkish population. The chronological ages of the subjects were divided into 10 groups. These 10 groups consisted of children of the following ages 5 and 14.99. Relationships between continuous variables were examined using Pearson's correlation coefficient. The paired t-test was used to compare all data according to gender and age groups. A p-value of less than 0.05 was considered significant for all statistical data.

According to the results, a very high correlation was found for both girls ($r^2 = 0.946$) and for boys ($r^2 = 0.940$). Dental age (DA) and chronological age (CA) were consistent for girls in the four age groups (5–5.99, 6–6.99, 12–12.99, and 14–14.99) and for boys in the three age groups (5–5.99,13–13.99, 14–14.99).

The maturity score of Willems' Belgian samples of the DA was applicable to seven groups of the southern Turkish children. The present study reports that Willems' method is more accurate for girls than for boys.

1. Introduction

In the legal process, determining age is important in terms of both penalties and the law. It is particularly critical to determine whether the respective person is over 7, 12, 15, and 18 years of age in Turkey.[1,2] Knowing the person's age helps to determine his employment, school, and military recruitment status; whether he has penal and legal liability; and whether he is capable of understanding the legal meaning and consequences of the action he committed.[2]

If there is no accurate data for a person's age, then bones, height, and teeth can be used to determine their age.[3] Dental age (DA) assessment based on dental maturity, especially pediatric dentistry and orthodontics, is one of the most reliable indicators of chronological age (CA). It is the most widely used assessment in pediatric endocrinology and in forensic, legal, and clinical dentistry.[4,5]

There are various methods for establishing age based on dental tissues, including the following: morphological(dental attrition rate, tooth color changing), metrical(Carbon14 analysis, histological analysis), radiomorphological(Demirjian's methods), and radiometrical(Cameriere's methods, Mörnstaad' methods).[5,6] In terms of age estimation, teeth are divided into two main periods: primary teeth and permanent teeth.[7,8] Reliability is higher in the examination of primary teeth (formation of mineralization, neonatal line, and micrometric measurements, etc.) and thus age can be determined with low error rates.[7] During the childhood period, there is constant change in the jaw bone because of the loss of primary teeth and the eruption, mineralization, and formation of permanent teeth. During this period, age estimation is mostly done by

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comparing the drawings and tables of dentition development with radiographs.[9,10] Determining the age based on bone development is the most frequently used method.[11]

Dental tissues are less affected by endocrine disorders or by dietary differences compared to other tissues in the body.[12,13] If one of the teeth is fully mineralized, its form is stable, and developmental and retroactive variations in this status relate to CA.[3] Human growth is a complex process that is mainly genetically but also environmentally determined. The body growth due to the proliferation of tissues is regulated by several environmental factors. These factors can be affected adversely by increasing consumption of processed foods, additives, toxins and environmental pollution, insufficient sunlight exposure, and inactivity.[12] Adversely affected body balance and chronic diseases (diabetes, thyroid disorders, and heart disorders) that delay dental growth have been observed among very young children.

Methods involving teeth for age estimation among children were developed by Nolla in 1960,[14] by Moorrees in 1963,[15] by Haavikko in 1970,[16] and by Demirjian in 1973.[10] These methods are all based on morphological evaluation of dental growth. The most frequently used method to determine age according to dental growth is Demirjian's method.[4,10] Dental growth in this method is described in eight stages from A to H and evaluations are made on the left lower jaw on seven molar teeth (except the wisdom teeth). A total score out of 100 for dental growth is determined by checking the respective values of the table at the growth stage of each tooth, and DA can be estimated based on the standards that have been created. As the estimations using Demirjian's method began to give over estimation results than just the CA, Willems et al. revised the method.[17]

Demirjian's method is based on dental maturity. However, in the studies carried out in Turkey, particularly in regions that have hot climates (Mediterranean region, Aegean region, and Middle Anatolia), Demirjian's method is valid but not fully compatible.[2,18] There is a lack of contemporary DA estimation standards for the southern Turkish population. The aims of the present study were to evaluate the applicability and accuracy of Willem's method for assessing the ages of southern Turkish children and to analyze the practicability of this method in different age groups for both genders.

2. Material and methods

In this study, 756 children were selected, including 378 males and 378 females. The panoramic radiographs were selected from child patients referred to the Faculty of Dentistry of Mustafa Kemal University in Hatay, Turkey. This retrospective study involved a contemporary Turkish population.

The inclusion criteria were as follows: aged between 5 and 14.99 years old; the quality of the panoramic radiographs was good and clear; and the subjects are free of systemic disorders, experienced a normal eruption of teeth, and have no pathological structure related jaw bone. Participants were selected from among Turkish citizens born in Hatay, Turkey. The exclusion criteria were children with congenital anomalies; cases of serious illness and dental trauma; a history of previous orthodontic treatment; dental deformities; absent lower teeth (except for the third molar); any pathological condition related to alveolar jaw bone (odontoma, cysts); systemic diseases; and unclear radiographs. All radiographs were obtained using Planmeca Promax (Helsinki, Finland), performed at 66–70 kV, 11–14 mA, 6.2 s exposure time, pulse X-ray.

The CA of each patient was calculated according to Willems' method score and converted into decimal ages. The date of birth of each child was not known to the researcher to avoid bias during the analyses of the dental stages. Dental maturity of the entire sample was accessed according to Willems et al.'s scoring method.[17]

The chronological ages of the subjects were divided into the following 10 age groups: (1) 5–5.99 years, (2) 6–6.99 years, (3) 7–7.99 years, (4) 8–8.99 years, (5)9–9.99 years(6) 10–10.99 years, (6) 11–11.99 years, (7) 12–12.99 years, (8) 13–13.99 years, (9) 14–14.99 years.

After calculation and calibration, all radiographs were assessed by the second author. The test of the practicability and reproducibility of the applied methods involved 70 radiographs (10% from each age category), which were selected and reassessed by the same author six months after the first assessment. Therefore, to evaluate intra-observer agreement, Cohen's Kappa test was applied. Ethics committee approval was not required for the present study.

2.1. Statistical analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) for Windows 21.0 software. Relationships between continuous variables were examined using Pearson's correlation coefficient. The paired t-test was used to compare all data according to gender and age groups. A p-value of less than 0.05 was considered significant for all statistical data.

3. Results

The present study included 756 healthy southern Turkish children, including 378 females (50%) and 378 males (50%). Age and gender distributions in the present study population are shown in Table 1. According to the results, a very high correlation was determined for both females ($r^2 = 0.946$) and males ($r^2 = 0.940$). Dental age was overestimated by 0.34 when using Willems' method. The mean differences between the chronological and dental ages ranged from −0.29 to +0.82 years for females and from −0.02 to +0.90 years for males in Table 2. The figures written in bold font in Table 2 indicate p values larger than 0.05. The individuals in this age group have similar dental and chronological ages, where DA and CA were consistent for females in four age groups (5–5.99, 6–6.99, 12–12.99, and 14–14.99) and for males in three age groups (5–5.99,13–13.99 and 14–14.99). Dental and chronological ages were significantly different for males and females in other age groups.

4. Discussion

The city of Hatay, where the present study was conducted, is one of the oldest settlements of Turkey and is on the Eastern Mediterranean region. The city has a typical Mediterranean climate, with a hot and dry summer season and a warm and rainy winter season.

Table 1
Distribution of age and gender in study population.

Age (Years)	Female	Male	Total
5–5.99	29	31	60
6–6.99	27	23	50
7–7.99	39	41	70
8–8.99	37	30	67
9–9.99	47	50	97
10–10.99	48	52	100
11–11.99	46	55	101
12–12.99	43	44	87
13–13.99	29	34	63
14–14.99	33	18	51
Total	378	378	756