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Dental age in Central Poland

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Abstract

Precise evaluation of the developmental stage of a child is an integral part of both diagnosis and treatment of pediatric patients; it is also essential in forensic medicine and dentistry. Among radiological methods for dental age estimation in children the Demirjian's method is widely used, however original standards elaborated for the French–Canadian population are mostly not suitable for other populations. The aim of the study was to compare the dental age of children from the region of Mazovia (Central Poland) with the developmental standards presented by Demirjian, to analyse sexual dimorphism of dental age in the studied group and to estimate validity of the Demirjian's standards for the studied Polish population. The material consisted of clinical files and panoramic X-ray images of 994 children aged from 6 to 16 in good general health, without development impairments. Chronological ages of the patients were established. Next dental ages were estimated by means of the Demirjian method based on developmental maturity of seven left mandibular permanent teeth. It was found that the standards were significantly different from the chronological ages in the studied population, which means that dental development was considerably accelerated. The most significant acceleration was observed in girls aged 11 and 12, as well as in 13-year-old boys; in both groups a considerable acceleration of the dental age was seen in 6-year-olds. No statistically significant differences between dental ages of girls and boys were observed in particular age groups. There were devised gender-specific equations allowing for adaptation of original Demirjian's scores for estimation of dental age in the population of Mazovia (Central Poland). In conclusion, the developmental standards used by Demirjian are not suitable in the case of the population of children of Central Poland. Therefore, it is necessary to establish new tables for this population.

Keywords: Dental age; Panoramic radiography; Score system

1. Introduction

Precise evaluation of the developmental stage of a child is an integral part of both diagnosis and treatment of pediatric patients; it is also essential in forensic medicine and dentistry [1]. The most commonly used developmental indicators include skeletal maturity (skeletal age), body height and weight (morphological age), sexual development (sexual age), as well as tooth development and eruption (dental age) [2].

Dental maturity evaluation based on examining the developmental stage of teeth in comparison with chronological age is regarded very useful and the least dependant on the influence of external and internal factors [2,3]. Among the methods of evaluating the dental age it is the radiological evaluation of dental maturity that is regarded the most accurate and resulting in minimal assessment mistakes. Radiological methods are based on evaluation of development of teeth on X-ray images (extraoral or intraoral radiograms), i.e. assessing of the extent of tooth mineralization from the moment when radiopaque spots become visible before tooth calcification until the tooth apex is closed. The method enables continuous evaluation of tooth development at different stages of human life, from the birth until the end of the process of development of third molar teeth [3].

Many researchers have been analysing possibilities offered by the method of radiological evaluation of the dental age, focusing on either the qualitative aspect of calcification of the crown or the root or on the shape of mineralised tooth parts (crown, root, pulp chamber, canal and the root tip). Among radiological methods for dental age assessment in children the Demirjian's method deserves special attention [2–6]. This

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technique, commonly used worldwide, is based on estimating both the extent of mineralized dental tissues and the shape of the chamber of seven left permanent mandibular teeth. In order to evaluate the dental age by means of the Demirjian's method panoramic radiographs are used. Each evaluated tooth is given a mark indicating a developmental stage (ranging from A to H; there is also an additional stage marked 0, meaning no signs of mineralization). Each of the stages is assigned a specific numeral value taken from tables prepared separately for boys and girls by Demirjian and co-workers [5,6]. The values obtained for the seven analysed teeth are then summed up. The obtained total score is the basis of assessment of the dental age derived from standard tables or special centile charts.

An inherent limitation of the described method is simultaneous evaluation of seven left mandibular teeth therefore it cannot be applied in children with lacking teeth—inborn or acquired [7–9]. Although Demirjian and Goldstein [5] had constructed two other systems of assessment of dental age basing on X-ray images of four teeth only, they are not widely used.

Evaluation of dental development on a panoramic radiograph is considered an unquestionable benefit of the method because it is based on assessment of a developmental stage of a tooth using its shape and proportions and not dimensions [9]. Consequently shortening or elongation of radiographic image of a tooth coming from projection geometry or known magnification related to the type of panoramic X-ray machine, do not affect the result of assessment of the dental age [10].

Although Demirjian's classification is a universal tool, knowledge of physiological and pathological factors affecting tooth development (determining genetic factors and unquestionable influence of environmental factors) forces one to prepare special tables that can be used in particular populations. Moreover, development lability, which is a commonly observed feature, made it necessary to constantly update the development standards used.

So far Polish authors have not dealt with verifying the standards presented by Demirjian or preparing the development evaluation standards for the population of the region of Mazovia in Central Poland. For that reason the present original research was carried out, aimed at

1. Comparing the dental age of a studied group of children from the region of Mazovia (Central Poland) with the developmental standards presented by Demirjian for the French–Canadian population.
2. Analysis of sexual dimorphism of dental age in the studied group.
3. Stating whether the Demirjian's standards can be used to evaluate the dental age in population of Polish children.

2. Materials and methods

The material consisted of clinical files and panoramic X-ray images of children aged from 6 to 16 (Table 1). The subjects were city dwellers, of white Caucasian origin, monitored or treated in the Department of Orthodontics at Warsaw Regional Dental Centre in the years 1995–2004. The clinical files were analysed first, in order to select patients in good general health, without development impairments, neither physical nor mental. Patients with agenesis of teeth, distinctive retardation of dental development (excluding third molars) and systemic diseases were excluded from the study.

Table 1
Number of subjects per age group and gender

Age (years)	Number of subjects		
	Girls	Boys	Total
6	20	7	27
7	50	30	80
8	59	52	111
9	56	62	118
10	81	47	128
11	59	59	118
12	93	53	146
13	52	50	102
14	45	24	69
15	69	26	95
Total	584	410	994

Only good quality panoramic radiographs of patients with buds of all permanent teeth were analysed. All the radiographs were taken using a Planmeca Proline PM unit. In total 994 pantomographic images were chosen and evaluated, including 584 images of girls and 410 images of boys (58.8% and 41.3%, respectively).

Chronological ages (CA) of the patients were established basing on the time from the child's birth to the day of taking a panoramic radiogram. The obtained values were rounded down (i.e. a given patient on the day of taking the panoramic radiograph was of a certain chronological age and could not be in the next possible chronological age group) and noted in years and decimal parts. The data collected in this way enabled comparison of the chronological age of a patient with the dental age resulting from the standard tables of Demirjian. All the patients were divided into 10 groups according to their chronological ages. The first group, consisting of 6-year-olds, included patients of ages ranging from 6.0 to 6.9. The next group included 7-year-olds and so on. Since the analysed patients were aged from 6 to below 16, the values of the chronological age of the patients ranged from 6.0 to 15.9.

In order to evaluate the dental age (DA) by means of the Demirjian's method each panoramic radiogram was assessed twice by the same person to minimise the evaluation error. The first evaluation was carried out using a light-box and the development stages of particular teeth, achieved in this way, were entered into tables in a computer database. Then the images were scanned and stored in a computer database, owing to which the calcification evaluation was carried out on a computer screen. This method enabled magnification of selected regions of interest in order to achieve more accurate evaluation of tooth developmental stages. The results obtained during the second evaluation were compared with those recorded during the first trial. The differences between the first and the second evaluation regarding any given tooth never exceeded one developmental stage. When disparities occurred, a lower development stage was always chosen.

In accordance with the rules of the Demirjian's method the development of seven left permanent mandibular teeth was evaluated [5,6]. The teeth evaluated included the central incisor, the lateral incisor, the canine, the first and second premolar teeth and the first and second molar teeth. An eight-grade scale was used and each tooth was assigned an appropriate value representing the developmental stage (Fig. 1). Next, using standard tables (separate for boys and girls aged from 3 to 16), each evaluated stage was assigned an appropriate numeral value. The values were then summed up, and the obtained total score indicated the dental age derived from standard tables.

Afterwards a difference between the score resulting from the evaluation of the studied population and the scores obtained by means of the Demirjian's method was calculated. At the same time the difference between the dental age obtained by means of the Demirjian's method and the chronological age of each patient was calculated. A value below zero meant delayed dental development, the zero value meant that dental age and chronological ages were identical,