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Age assessment based on dental calcification in individuals with Down syndrome

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ABSTRACT

It is important to estimate both chronological age (CA) and maturational age of an individual, in order to perform orthopedic treatment or surgery, and in cases of lost documentation. Use of dental age (DA) for these purposes has been widely studied; however, the literature is scarce with regard to individuals with Down syndrome (DS), a prevalent condition worldwide. In this study the chronology of dental maturation was evaluated by analyzing the DA of individuals with DS based on the Chronological Mineralization Table proposed by Nolla (1960). Thus, second molars were evaluated in 57 panoramic radiographs of male and female individuals with DS, between 5 and 16 years-old. These data were compared with a control group of 191 nonsyndromic individuals of the same age group. Correlation between CA and DA was ascertained using Pearson's correlation coefficient (r), and the difference between these variables was measured using Student's t-test for paired samples and the method proposed by Bland and Altman. The difference between DA and CA was compared between the control and DS groups using Student's t-test for independent samples ($\alpha = 0.05$). DA was slightly lower than the CA; however, this difference was only significant for females. The difference between DA and CA was not significant between individuals with DS and control group (both genders, $p = 0.945$; males, $p = 0.542$; females, $p = 0.381$). We concluded that dental maturation in individuals with DS occurs similarly to that of nonsyndromic individuals.

1. Introduction

Down syndrome (DS) is a genetic disorder that affects more than 5.8 million individuals and occurs in approximately one in every 700 live births, being the most prevalent genetic disorder in the world (Scully, 1975). It is characterized by numerous mental and physical changes, and mental deficiencies occur in all individuals (Oliveira, Paiva, Campos, & Czeresnia, 2008). Numerous oral abnormalities are found in DS, such as macroglossia, fissured hypotonic and protruding tongue, and angular

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cheilitis. The literature indicates low prevalence of caries (Johnson, Young, & Gallios, 1960; Shore, Lightfoot, & Ansell, 2010), high incidence of periodontal disease (Johnson & Young, 1963; Reuland-Bosma, van der Reijden, & van Winkwlhof, 2001; Shore et al., 2010), malocclusion and open bite (Cohen & Winer, 1965; Jensen, Cleall, & Yip, 1973; Oliveira et al., 2008). Dental anomalies are common in both deciduous and permanent dentition (Seagriff-Curtin, Pugliese, & Romer, 2006).

As the development of individuals with DS is delayed in most aspects, dental eruption in both dentitions is usually late (Roche & Barkla, 1967; Ondarza, Jara, Munoz, & Blanco, 1997). Nevertheless, the sequence of this eruption is similar to that of nonsyndromic individuals (Jara, Ondarza, Blanco, & Valenzuela, 1993). As regards dental maturation, however, in the literature it is not clear whether the chronology is delayed in DS.

The chronology of dental maturation has been used in maturity assessments and to determine chronological age (CA) (Demirjian, Goldstein, & Tanner, 1973; Haavikko, 1970; Hagg & Matson, 1955; Nolla, 1960). The estimation of CA by assessment of dental age (DA) is used as an auxiliary identification method and in forensic science (Bolaños, Manrique, Bolaños, & Briones, 2000; Miloglu, Celikoglu, Dane, Cantekin, & Yilmaz, 2011; Oliveira, Capelozza, Lauris & Bullen, 2012). The DA can be helpful in cases of lack of documentation, and can determine the probability that an individual has reached legal majority (Oliveira et al., 2012). In pediatrics, orthopedics, and orthodontics it can be used to establish the ideal time to start orthodontic treatment or perform surgical interventions (Diz et al., 2011).

Dental maturation is estimated based on tooth mineralization, eruption, and the number of teeth present in oral cavity. However, eruption does not reflect the true state of maturation, because it can vary due to the influence of several factors, such as climate, nutrition, race, and genetic inheritance (AbouEl-Yazeed, Abou Zeid, & Tawfik, 2008; Beunen, Rogol, & Malina, 2006; Kurita, Menezes, Casanova, & Haiter-Neto, 2007; Miloglu et al., 2011), whereas mineralization follows an independent process (Beunen et al., 2006). Another advantage of tooth mineralization is that it can be evaluated at any time during the active development of teeth; in contrast, it is not possible to determine the exact time of occurrence of a clinical emergence (Gleiser & Hunt Jr., 1955). Mineralization and eruption are separate processes and do not necessarily correspond to chronological age (CA) (Brauer & Bahador, 1942).

In addition to DA, other parameters can be used to assess human development and individual maturation, such as chronological, biological, mental, morphological (i.e., weight, height, and secondary sex characteristics) and skeletal age (i.e., cervical bone, vertebral bone) (Beunen et al., 2006). Among these, CA is not the best biological indicator. Environmental and systemic factors exert more influence on skeletal than on dental maturation (Cardoso, 2007). Furthermore, individuals with DS reach bone maturation earlier (by age 15) compared with the nonsyndromic population, in which bone maturation occurs at approximately 18 years (Moraes, Tanaka, Moraes, Medici Filho, & Castilho, 2008). DA assessment is considered the best method of determining CA because it most closely approximates this index (Bolaños et al., 2000).

Dental age is based on the evaluation of tooth formation stages by radiographic analysis, which is a simple, quick, inexpensive and noninvasive method. Several radiographic methods have been created to determine DA considering sequential events and the period when mineralization occurs (Panchbhai, 2011). Nolla (1960), Demirjian et al. (1973) and Schour and Massler (1940) created the most used DA estimation methods. The Nolla method has been widely used in clinical practice, teaching, and research because it is more reliable than the others (Bolaños et al., 2000; Kurita et al., 2007; Miloglu et al., 2011). Moreover, it presents two more degrees of mineralization than the Demirjian method.

Given the various developmental abnormalities in individuals with DS and the limited research with regard to dental maturation in these individuals, the aim of this work was to evaluate the chronology of dental maturation in individuals with DS by the Nolla method, comparing it with a control group from the nonsyndromic population.

2. Materials and methods

The local research ethics committee approved this study (Protocol Number 089/2011-PH-CEP).

2.1. Sample

An initial sample of 136 medical records of individuals with DS was obtained. We selected panoramic radiographs from 57 records (32 males and 25 females aged between 5 and 16 years). A total of 229 panoramic radiographs were evaluated from nonsyndromic individuals, as the control group, and of these, 191 were selected (97 males and 94 females matched for age). Table 1 shows sample distribution according to chronological age, DS status and gender. The evaluated teeth were the maxillary and mandibular second permanent molars on both sides. The samples belonged to the Radiology Clinic, Faculty of Dentistry, UNESP, São José dos Campos, Brazil.

The selection criterion was the presence of second molars, and the exclusion criterion, the occurrence of image distortions in the relevant region. In cases of doubt during the analysis, the record was deleted from the sample. Another exclusion factor was age, because we only selected radiographs that showed the second molar during its root formation period (up to 16 years). The decision to research these teeth was based on the fact that they cover approximately the entire period of dental development, ranging from 4 years old (when the first evidence appears) to approximately 15 years old (complete mineralization). Some radiographs showed the third molar in formation, and although the Nolla table allows the evaluation of these teeth, we chose not to use them, thus only the second molars were evaluated.