



ORIGINAL ARTICLE

Correlation between skeletal maturation and developmental stages of canines and third molars among Saudi subjects

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Received 21 May 2017; revised 29 October 2017; accepted 22 November 2017

Available online 28 November 2017

KEYWORDS

Cervical vertebral maturation;
Nolla;
Demirjian;
Developmental stages;
Cephalometric;
Canines;
Third molar

Abstract *Aims:* The present study was designed to evaluate the efficacy of using the developmental stages of the canines and third molars to predict the timing of skeletal maturity in the Saudi population.

Material and methods: The lateral cephalometric radiographs and orthopantomograms of 239 Saudi patients, 106 males and 133 females, aged 9 to 21 years, were collected from several dental centers. Orthopantomograms were used to assess the developmental stages of the upper and lower canine teeth and third molars using two popular methods: that of Nolla and that of Demirjian. Cervical vertebral maturation (CVM) stage was assessed on the lateral cephalometric images according to the method of Baccetti et al. Trained observers with no knowledge of patient age or gender performed assessments. Data were analyzed with Spearman's rank correlation coefficient at a significance level of $P \leq .05$.

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Peer review under responsibility of King Saud University.



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Result: Skeletal CVM stages III and IV had a stronger correlation with mandibular left canine developmental stage than with maxillary canine developmental stage in the two methods used (correlation with Nolla stage 10 and Demirjian stage H: root completely formed with apex closed), especially for male patients ($r = 0.700$, $P < .001$). In contrast, the maxillary third molars at Nolla stages 5 and 7 (crown completed to 1/3 of the root formed) showed an association with CVM stages III and IV ($r = 0.540$ for females and $r = 0.639$ for males, $P \leq .001$ for both) and with Demirjian stages D, E, and F. Males had slightly higher correlation values than females ($r = 0.578$ and 0.5010 , respectively; $P \leq .001$) at CVM stages III and IV. Interestingly, canine teeth showed a stronger correlation than third molars with skeletal maturation in Saudi children.

Conclusion: Dental developmental stages were highly correlated with CVM stages III and IV among Saudi subjects.

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1. Introduction

Many questions have been raised by researchers investigating whether dental age can be used to determine chronological age or if skeletal age estimation is a more reliable procedure. These questions include whether dental age can be used to plan the proper timing for orthodontic intervention and if dental age works as guidance in forensics.

Since the establishment of the strong correlation between tooth development and skeletal maturation, investigators have tried to determine whether dental age assessment is preferable to skeletal age assessment in estimating chronological age (Flores-Mir et al., 2005; Lamons and Gary, 1958; Sierra, 1987; Parbhakar et al., 2002; Gulati et al., 1990). Some researchers believe that the developmental stages of teeth are less affected than bone mineralization by variation in nutritional and endocrine status, as well as local factors. If tooth maturation can be considered a better indicator of chronological age than bone mineralization, then orthodontic intervention can be performed without further clinical investigation.

Orthodontists have suggested a strong relationship between pubertal growth and acceleration in the growth of the craniofacial skeleton. This relationship is very important in predicting future growth potential to have successful results when planning orthodontic treatment. Several indicators of skeletal maturation have been described in the literature to predict the pubertal growth spurt. The standard method for determining skeletal maturation is hand-wrist radiography. To avoid taking additional radiographs, Lamparski (1972) suggested using the cervical vertebrae as seen on routine lateral cephalometric radiographs. Later, many researchers, including Baccetti et al. (2005) and Hessel and Farman (1995) modified Lamparski's method. Unfortunately, little is known about the correlation between the pubertal growth spurt and dental development. Some published studies (Anderson et al., 1975; Lewis and Garn, 1959) have found little relationship between tooth development and indicators of growth, while others (Lamons and Gary, 1958; Engstrom et al., 1983; Green, 1961; Krogman, 1967) have found positive correlations between third molar development and skeletal maturation. A stronger correlation has been found between skeletal maturation and the development of the mandibular canine than other teeth (Sierra, 1987; Engstrom et al., 1983; Khan and Ijaz, 2011; Coutinho et al., 1993; Chertkow, 1980).

Although dental eruption is considered an easy method to determine dental maturation, it has more variability in its timing than skeletal maturation (Moorrees et al., 1960). Multiple methods have been described for assessing dental age using different types of radiographs, such as oblique jaw radiography (Lewis and Garn, 1959), intraoral radiography (Nolla, 1960), and orthopantomography (Hegde and Sood, 2002).

Engstrom et al. (1983) used the stages of third molar development described by Bjork and Helm (1967) to clearly differentiate between its stages. However, the dental classification method of Nolla (1960) and the scoring system developed by Demirjian et al. (1973) are the easiest and most valid techniques used worldwide. The ease and validity of these techniques have been confirmed in many studies in various populations. Previous studies have found that third molar development and canine calcification stages are strongly correlated with skeletal maturity, which was investigated separately (Engstrom et al., 1983; Khan and Ijaz, 2011; Chertkow, 1980; Taher and Foda, 2001; Suma et al., 2011).

The present study was designed to evaluate the correlation between the maturational stage of the canine teeth and third molars and cervical vertebral maturity (CVM). If a strong association exists between dental and skeletal maturity, dental calcification stages may be used as a sole method to estimate the timing of the pubertal growth spurt in Saudi subjects.

2. Materials and methods

Ethical approval was obtained from the College of Dentistry Research Centre of King Saud University (CDRC NO. IR0055) prior to conducting this study. This retrospective study was performed on a sample selected with purposive sampling technique, and collected from the Department of Orthodontics at King Saud University College of Dentistry, King Khaled Hospital, King Abdulaziz Hospital, and the orthodontic clinic at Asir Central Hospital. Patients' ages ranged from 9 to 21 years for both genders. This range was intentionally selected because it corresponds with the period of developmental formation of the canine teeth and third molars. The entire study sample was taken from the files of patients with no history of previous orthodontic treatment, no missing teeth (in particular, maxillary and mandibular right and left canines and third molars), and no history of trauma or injury to the head and neck region. Poor-quality radiographs and

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