

SEMINARS IN MEDICINE SEMINARI IZ MEDICINE

COMPARISON OF DENTAL AND SKELETAL MATURITY IN GIRLS FROM VOJVODINA

POREĐENJE DENTALNE I SKELETNE ZRELOSTI KOD DEVOJČICA U VOJVODINI

Natalija ČOMIĆ, Nataša PUŠKAR, Danijela RADUMILO and Stojan IVIĆ

ORCID NUMBER
Natalija Čomić – 0009-0008-2227-7058
Nataša Puškar – 0009-0007-3028-5157

Danijela Radumilo – 0009-0002-3043-681X
Stojan Ivić – 0000-0002-7750-5854

University of Novi Sad, Faculty of Medicine Novi Sad

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Abstract

Introduction. Determining dental and skeletal maturity is highly important in planning orthodontic therapy. Due to possible discrepancies between dental and skeletal maturity, it is necessary to research this topic to improve orthodontic treatment. This study aimed to examine differences between dental and skeletal age of girls aged 9 to 11 years. **Material and Methods.** The study included medical records of 56 girls aged 9 to 11 years who were treated at the Department of Orthodontics, Clinic of Dental Medicine of Vojvodina. Dental age was determined using the Demirjian method on orthopantomographic images, while skeletal age was assessed using cephalometric radiographs by measuring cervical vertebrae. The results were statistically analysed for the entire sample and separately for age groups of 9, 10, and 11 years. Mean values, standard deviation, minimum and maximum values for chronological, dental, and skeletal age were calculated, along with statistical significance using the t-test. **Results.** A statistically significant difference between dental and skeletal maturity was found for the entire sample and for the 9- and 10-year age groups. For the 11-year age group, no statistically significant difference was observed. **Conclusion.** The results indicate that there is no consistent and reliable correlation between skeletal and dental maturity, which should be considered into account when planning orthodontic therapy.

Key words: Age Determination by Skeleton; Age Determination by Teeth; Child; Female; Orthodontics

Sažetak

Uvod. Precizna procena biološke zrelosti ima ključni značaj za pravilan izbor vremena i planiranje ortodontske terapije. Dentalna i skeletna starost predstavljaju najčešće korišćene pokazatelje, ali njihov međusobni odnos može varirati u zavisnosti od uzrasta i individualnih faktora. Cilj ovog istraživanja bio je da se ispita odnos između dentalne i skeletne starosti kod devojčica uzrasta od 9 do 11,9 godina u Vojvodini, kao i da se utvrdi postojanje statistički značajnih razlika između ovih parametara. **Materijal i metode.** Istraživanje je obuhvatilo medicinsku dokumentaciju 56 devojčica prosečnog uzrasta $10,7 \pm 0,92$ godine, lečenih na Odeljenju za ortopediju vilica Klinike za stomatologiju Vojvodine. Dentalna starost određena je *Demirjian* metodom na ortopantomografskim snimcima, dok je skeletna starost procenjena analizom trećeg i četvrtog cervikalnog pršljena na telerendgen snimcima. Statistička obrada obuhvatila je izračunavanje srednjih vrednosti, standardne devijacije i primenu t-testa za celokupan uzorak i pojedinačne starosne grupe (9, 10 i 11 godina). **Rezultati.** Prosečna hronološka, dentalna i skeletna starost iznosile su 10,27, 10,72 i 11,84 godine. Statistički značajna razlika između dentalne i skeletne starosti utvrđena je za celokupan uzorak ($p < 0,05$), kao i za uzraste od 9 i 10 godina. Kod jedanaestogodišnjakinja nije utvrđena statistički značajna razlika. Uočeno je smanjenje razlike između dentalne i skeletne starosti sa porastom uzrasta. **Zaključak.** Dentalna i skeletna starost nisu uvek u pouzdanoj korelaciji u mlađim uzrastima, što ukazuje na potrebu za individualnim pristupom u planiranju ortodontske terapije. U uzrastu oko 11 godina dentalna starost postaje pouzdaniji pokazatelj biološke zrelosti.

Ključne reči: skeletna starost; dentalna starost; dete; ženski pol; ortodoncija

Introduction

Timely and adequate orthodontic therapy has a significant impact on the growth and development of

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the entire orofacial system, as well as on the prevention of dental caries and periodontal disease. Understanding of the factors influencing growth is essential for proper diagnosis and timely, appropriate therapy [1].

Human growth begins at the moment of zygote formation and continues until approximately the age of 20, when active growth ceases. It is divided into two periods: prenatal and postnatal [1].

✉ Corresponding author: Natalija Čomić, E-mail: 905011d25@mf.uns.ac.rs, natasa.puskar@mf.uns.ac.rs

During growth, there are phases of increased intensity. The most significant growth spurts occur during the foetal period, in the first year of life, and later during prepubertal and pubertal periods.

Development follows growth and is reflected not only in achieving adult size and proportions, but also in tissue composition and functional capacity of organs. Biological maturation may precede or lag behind chronological age.

Successful orthodontic therapy requires thorough knowledge of the growth and development of the orofacial system [2]. Determining the optimal timing for initiating orthodontic treatment is directly related to identifying periods of accelerated growth and evaluating individual growth potential. In orthodontics, treatment timing plays a crucial role in determining the approach to correcting jaw and tooth development [3].

Each child or adolescent has an individual growth rate influenced by factors such as heredity, nutrition, hormonal status, and environmental factors. Determining individual growth rate before orthodontic treatment is essential, as it significantly affects treatment success [4].

Chronological age represents the time elapsed from birth to the moment of assessment [2].

One of the most commonly used methods for assessing patient maturity is dental maturity, based on the degree of tooth calcification. This method is widely accepted because it shows less variation compared with methods for determining skeletal or sexual maturity [5]. Therefore, teeth are considered reliable biological indicators for assessing growth and development [5,6].

A strong correlation exists between tooth development and individual maturity [5–8].

The most commonly used method is the Demirjian method, developed in a French-Canadian population [7]. It evaluates the calcification stages of seven permanent teeth in the upper left quadrant for individuals up to 16 years of age.

Skeletal age, or bone maturity, is assessed from bone morphology and mineralisation. It is most commonly evaluated using hand-wrist radiographs and cervical vertebrae analysis [9]. Gnathometric analysis can also be used to assess the shape and development of the dental arches and jaws [10].

The development of cervical vertebrae follows a consistent pattern similar to other skeletal structures [11] and can be evaluated on lateral cephalograms [12].

In 1972, Lamparski introduced the use of cervical vertebrae for assessing skeletal maturity. He identified morphological characteristics visible on radiographs at different developmental stages and created a descriptive atlas. His method proved to be reliable,

valid, and clinically useful, comparable to hand-wrist radiography [13].

Hassel and Farman (1995), as well as Mito et al. (2002), further confirmed the reliability of cervical vertebrae analysis [12,14].

This study aimed to determine skeletal age in girls aged 9 to 11.99 years, compare it with dental maturity, and assess potential differences between skeletal and dental age across age groups.

We hypothesised that skeletal and dental age would correspond and that there would be no significant differences between them.

Material and Methods

The study was conducted at the Clinic of Dental Medicine of Vojvodina in December 2024. The sample consisted of medical records of 56 girls with a mean age of 10.27 ± 0.92 years (range: 9–11.99 years) who were treated at the Department of Orthodontics.

Participants were randomly selected from patient records. We used the most recent records available until we reached a total of 56 girls who met the inclusion criteria.

Inclusion criteria: Presence of the germs of all teeth; Visibility of the third and fourth cervical vertebrae on cephalograms; Age between 9.0 and 11.99 years

Exclusion criteria: Hypodontia; Hyperdontia; Cleft lip and palate; Congenital syndromes affecting the orofacial region (Apert, Crouzon, Treacher-Collins, etc.).

Dental maturity was assessed using the Demirjian method on orthopantomograms via the OnyxCeph software, which assigns scores based on developmental stages (A–H) of permanent teeth in the upper left quadrant.

Skeletal maturity was assessed by measuring anterior height (AH) and anteroposterior length (AP) of the third and fourth cervical vertebrae on cephalograms.

The formula used was:

Vertebral age = $1.3523 + 6.7691 \times AH3/AP3 + 8.6408 \times AH4/AP4$ [11]

Statistical analysis was performed using MS Excel 2007. Mean values, standard deviation, and minimum and maximum values were calculated for chronological, dental, and skeletal age. Differences were assessed using the t-test.

Results

The mean chronological age was 10.27 years, the mean dental age was 10.72 years, and the mean skeletal age was 11.84 years.

A statistically significant difference between skeletal and dental age was observed in the total sample.

The sample was divided into age groups:

9 years (9.0–9.99)

10 years (10.0–10.99)

11 years (11.0–11.99)

Dental age means:

9 years: 9.89

10 years: 11.16

11 years: 11.39

Skeletal age means:

9 years: 11.62

10 years: 12.09

11 years: 11.82

We found statistically significant differences between dental and skeletal age in the 9- and 10-year groups, but not in the 11-year group.

Discussion

Chronological age was expressed in years using a decimal system for statistical simplicity. Dental age was assessed using the Demirjian method, widely recognised in scientific research [2,4–8,11,15,16]. Skeletal age was determined using the Caldas method [15].

Skeletal age is considered a more reliable indicator of growth than chronological age [2,3].

A major advantage of cervical vertebrae analysis is that it does not require additional radiation exposure, unlike hand-wrist radiographs, since cephalograms are already part of routine orthodontic diagnostics.

Most studies focus on comparisons between chronological and dental or skeletal age, whereas fewer directly compare dental and skeletal maturity [2,4,16].

This study found no consistent correlation between dental and skeletal age. The greatest difference was observed in 9-year-olds, whilst a slightly smaller but still significant difference was observed in 10-year-olds. No significant difference was found in 11-year-olds.

In 9-year-olds, the difference reached up to 4 years (skeletal age higher), with a minimum of 2 months. In 10-year-olds, differences were similar, though dental maturity sometimes exceeded skeletal age by 2–8 months. In 11-year-olds, differences decreased to a negligible level. These findings align with studies by Macha et al., Palanisamy et al., Ramos et al., and Cortes et al. [2,4,5,16].

Dental age exceeded chronological age across all groups, consistent with previous findings [2,4,16]. This may reflect generational changes in growth, nutrition, and socioeconomic conditions, suggesting a need to update standard reference values.

The hypothesis was rejected because significant differences were found both overall and in younger age groups.

Conclusion

There is no consistent and reliable relationship between dental and skeletal age.

As age increases, the difference between them decreases. Around the age of 11, accelerated dental development occurs, making dental age a more reliable indicator.

Orthodontic treatment planning should always be individualised, taking into account both dental and skeletal age.

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