GROWTH INDICATORS IN ORTHODONTIC PATIENTS: CERVICAL BONE AGE VS CHRONOLOGICAL AGE

INDIKATORI RASTA KOD ORTODONTSKIH PACIJENATA: SKELETALNA DOB NASPRAM HRONOLOŠKE DOBI

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ABSTRACT

Many maturational indexes are used in order to evaluate the growth or physiologic maturation of orthodontic patients. Given wide variations among patients in the chronological timing of pubertal growth spurt, chronological age is unreliable in predicting the pubertal spurt. Currently, cervical vertebrae analysis is widely used by orthodontists to evaluate skeletal bone age. The aim of the present study was to investigate the association between chronological and skeletal bone age of orthodontic patients.

Material and methods: This investigation included 100 examinees (50 males and 50 females) aged from 9-17 years. The lateral cephalogram was made for all examinees. In cervical spine region we traced the second, third and fourth cervical vertebrae followed by evaluation of the bone maturity CVMS I to V performed according to original Bacceti et all method. The obtained data were compared to known chronological age. Accuracy was tested by Pearson coefficient of correlation. On 15 lateral cephalograms, within two weeks time distance, CVM stadium from 1-5 was determined again by the same examiner. Results: The greatest difference between chronological and bone age was recorded at female examinees aging from 10-11 and 12-13 years. At male examinees, the greatest difference aged from 12-13 and 14-15 years respectively. The Pearson correlation coefficient between two measurement periods was .893.

Conclusion: Chronological age is not an accurate indicator of developmental status of orthodontic patients. Determination of the cervical vertebrae level of maturation is better indicator of biological age.

Keywords: chronological age, skeletal age, orthodontics

SAŽETAK

Za procjenu rasta i fiziološkog sazrijevanja ortodontskih pacijenata, koriste se brojni indeksi maturacije. Zbog velike razlike među pacijentima u hronološkom vremenu postizanja pubertetskog ubrzanja rasta, hronološka dob je nepouzdan indikator za predviđanje nastupajućeg puberteta. U posljednje vrijeme se među ortodontima sve više upotrebljava analiza vratnih pršljenova za procjenu koštane zrelosti. Cilj ove studije bio je ispitati povezanost između hronološke i skeletne dobi kod ortodontskih pacijenata.

Materijal i metode: U istraživanju je učestvovalo 100 ispitanika (50 muških i 50 ženskih) dobi od 9 do 17 godina. Za svakog ispitanika urađen je lateralni cefalogram. U području vratne kičme, na cefalogramu su iscrtani drugi, treći i četvrti vratni pršljen, te je procjena koštane zrelosti CVMS I do V, urađena prema originalnoj metodi Bacceti i sar. Dobiveni podaci su komparirani sa poznatom hronološkom dobi. Pouzdanost mjerenja testirana je Pearsonovim koeficijentom korelacije. Na 15 lateralnih cefalograma, sa razmakom od dvije sedmice, ponovno je određen CVM stadij od 1 do 5, od istog ispitivača.

Rezultati: Najveća razlika između hronološke i koštane dobi uočena je kod ženskih ispitanica u dobi 10-11 i 12-13 godina. Kod muških ispitanika najveća razlika između hronološke i koštane zrelosti je u dobi 12-13 i 14-15 godina. Pearsonov koeficijent korelacije između dva perioda mjerenja iznosio je 0,893

Zaključak: Hronološka dob nije dovoljno precizan indikator razvojnog statusa ortodontskih pacijenata. Određivanje stepena maturacije vratnih pršljenova je bolji pokazatelj biološke dobi.

Ključne riječi: hronološka dob, skeletalna dob, ortodoncija

Introduction

Understanding of growth is important in the practice of clinical orthodontics. Maturational status has considerable influence to diagnosis, treatment goals, treatment planning, and the possible outcome of orthodontic treatment. Prediction of both, the times and the amounts of active growth of the craniofacial complex, would be useful to the orthodontist. This is especially true for treatment considerations based strongly on the facial growth such as the use of extra oral traction, functional appliances, selection of orthodontic retention and orthographic surgery [1, 2, 3].

Many researchers indicated that chronological age is not a reliable indicator to evaluate maturity of a child. As such, maturity of a child is best estimated in relation to specific stages of physiologic maturity [4, 5]. Physiologic age can be estimated by somatic, sexual, skeletal, and dental maturity [6, 7, 8, 9].

Skeletal bone age refers to the degree of ossification development in bone. During the growth, each bone passes through a series of changes that can be seen radiological. The ossification in the cervical vertebrae begins during the fetal life and continues until adulthood. Therefore, maturational changes can be observed in the vertebrae during this period coinciding with the start of orthodontic treatment.

The aim of the study was to investigate correlation between skeletal bone age (determined by CVM method) and the chronological age of orthodontic patients.

Material and methods

This study was conducted in Department of Orthodontics (Faculty of Dentistry, University of Sarajevo). Study is approved by Ethical Committee approval number 09-53-3/2012. This examination included 100 examinees (50 males and 50 females) aging 9-17 years. All examinees were of the Bosnian origin, and were not previously treated orthodontic. All examinees were divided into 5 stages of chronological age: stage 1(8-9 years), stage 2 (10-11 years), Stage 3(12 -13), stage 4(14-15) and stage 5(16-17).

The chronological age of each examinee was calculated as: date of examination – date of birth.

The lateral cephalogram was made for each of examinee. During the exposure, all examinees were properly protected, wearing protective collar. Radiographs of high resolution and good contrast were used. The lateral cephalograms were traced on matte acetate foil with 0.5 mm diameter pencil, using radiographic illuminator. In cervical spine region, we traced three cervical vertebrae: the second, third and fourth as recommended by original method of Bacceti et all. [10] (**Figure 1.**).

Cervical vertebrae development of the sample was evaluated by the Bacceti and associates method. Baccetti *et al.* (2002) presented new CVM method with five maturational stages: Cervical Vertebral Maturation Stage (CVMS) I through (CVMS) V, instead of CVMS I through CVMS VI in the former CVM method (Original Lamparski method, modified by Hassel and Farman).

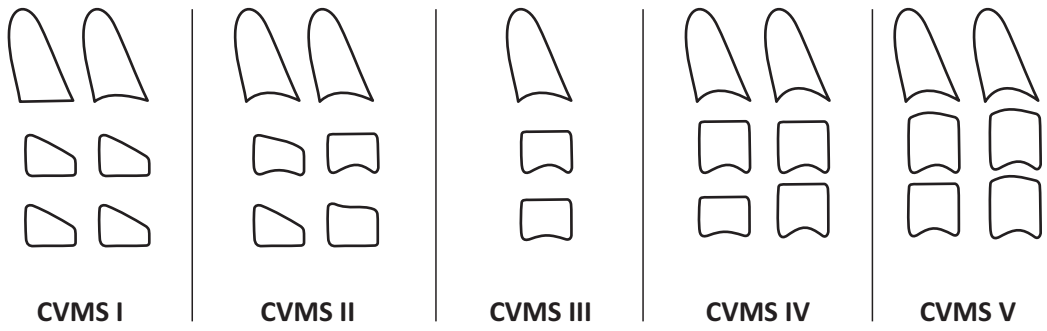

Figure 1.
Five stages of cervical vertebral maturation

According to the Baccetti, definition of five cervical vertebral maturation stages is as it follows:

CVMS I:

The lower borders of the vertebrae C2,C3 and C4 are flat, with possible exception of a concavity at the lower border of C2 in almost half cases. The bodies of the both C3 and C4 are trapezoid in shape. The peak in mandible growth will occur only one year after this stage.

CVMS II:

Concavities at the lower borders of C2 and C3 are present. The bodies of C3 and C4 may be either trapezoid or rectangular horizontal in sha-pe. The peak in mandible growth will occur within one year after this stage.

CVMS III:

Concavities at the lower borders of C2, C3 and C4 now are present. The bodies of the both C3 and C4 are rectangular horizontal in shape. The peak in mandible growth occurred within one or two years before this stage.

CVMS IV:

The concavities at the lower borders of C2, C3 and C$ still are present. At least one of the bodies of C3 and C4 is squared in shape. If not squared, the body of the other cervical vertebrae is still rectangular horizontal. The peak in mandible growth occurred one year before this stage.

CVMS V:

The concavities at the lower borders of C2, C3 and C4 still are evident. At least one of the bodies of C3 and C4 is rectangular vertical in shape. If not rectangular vertical, the body of the other cervical vertebra is squared. The peak in mandible growth occurred two years before this stage.

On the lateral cephalograms of 100 examinees we determined the maturity stage (1-5) of cervical vertebrae, by the Bacceti and associates method [10]. The obtained data were compared with known chronological age (**Figure 2.**).

Figure 2.
Lateral cephalogram

Results

In this study, we compared chronological age of examinees with their individual cephalometric measurements on the cervical vertebrae as the indicator of skeletal bone age. Our results show a wide variation between chronological age and skeletal age. The chronological age showed large differences in comparison to CVMS.

Examinees in all aged groups demonstrated wide variation in their maturational status, especially in the group aging from 10-11 and 12-13 at females (**Figure 3.**).

At males group, the largest differences between chronological age and CVMS was in the groups aging from 12-13 and 14 -15 (**Figure 4.**).

Discussion

In the female examinees, chronological age and CVM stage showed very good similarity in the group aging from 8-9. At this stage, 80 % of female examinees showed CVM stage I, and 20% of them showed CVM stage II. In the group aging 10 -11 and 12-13 of female examinees, we found wide range of variations between chronological and skeletal age: In the group aging 10 -11, 30% girls showed CVMS I, 40% girls showed CVMS II, and 30% girls showed CVMS III. In the group aging 12-13, 10% girls showed CVMS II, 40% girls showed CVMS III, 40% girls showed CVMS IV and 10 % girls showed CVMS V. In older female aging groups: 14-15 and 15-16, similarity was increased. In the age group 14-15, 50% girls showed CVMS IV and 50 % of them showed CVMS V. In the age group 16-17, congruence between chronological and skeletal age was complete thus 100% girls shows CVMS V. Similar results were seen in the study of Mito et all., done among Japanese girls [11].

In male examinees, congruence between chronological and skeletal age was complete in the group aging 8-9. At this stage 100% male subjects showed CVMS I. At other male age groups, we noticed wide range of variations between chronological and skeletal age, with general tendency to chronological age exceeding biological (skeletal) age. In the age group 10 -11, 50% male subjects show CVMS I and the other 50% CVMSII respectively. Large discrepancy was found in the group aging from 12-13. At this stage, 10% boys showed CVMS I, 70% CVMS II and only 20% CVMSIII respectively. At the next age groups, similarity between chronological and skeletal age was increased, in the group aging from 14-15, 50% boys showed CVMS III and 50% CVMS IV. In the group aging from 16-17, 80% of male examinees showed CVMS V, and only 20% CVMS IV. These results are in accordance to the results of similar examinations

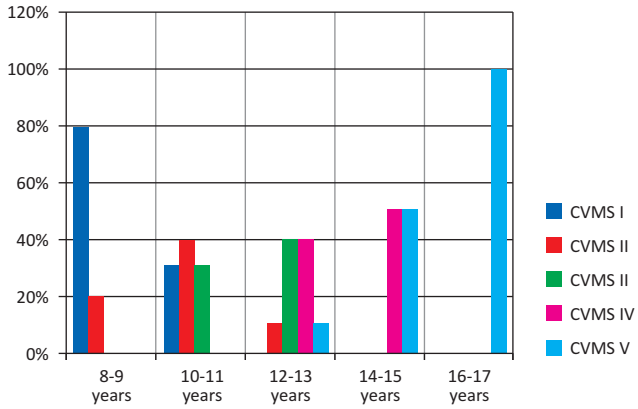

Figure 3.
Distribution of CVMS according to age group among female examinees (N=50)

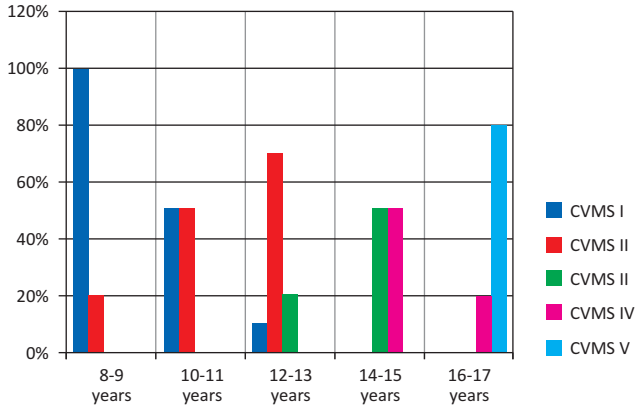

Figure 4.
Distribution of CVMS according to age group among male examinees (N=50)

among Saudi boy. They concluded that boys achieve their skeletal maturity later than is their chronological age [12].

Orthodontic management of skeletal discrepancies often includes growth modification therapy. Correction of skeletal discrepancies and treatment prognosis are strongly influenced by growth, and it is crucial to know the stage of growth and development in orthodontic patients. Cervical vertebral analysis is valid as the hand wrist bone analysis, with advantage of reducing the radiation exposure of examinees still growing. When CVMS I diagnosed in the individual patient with mandible deficiency, the clinician can wait at least one additional year for a radiographic reevaluation aimed to start treatment with a functional appliance. CVMS II represents the ideal stage to begin functional orthopedics [4, 10].

Conclusion

On the basis of the results of this study, we can conclude that the chronological age is not an accurate indicator of developmental status of orthodontic patients. Determination of cervical vertebrae maturity provides reliable data about actual biological age of the orthodontic patients. The advantage of CVM method is in the elimination of additional radiation exposure for orthodontic patients, because lateral cephalograms are routinely used in daily orthodontic praxis.

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