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Određivanje dentalne dobi postupkom prema Demirjianu kod djece od 5 do 14 godina u Bosni i Hercegovini

Dental Age Estimation Among Children Aged 5–14 Years Using the Demirjian Method in Bosnia-Herzegovina

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Sažetak
Određivanje dentalne dobi kod djece u razvoju važno je u pedodonciji, ortodonciji i forenzičnoj znanosti. Najčešće se primjenjuje postupak prema Demirjianu nastao na francusko-kanadskom uzorku djece 1973. godine na temelju Tanner-Whitehousova postupka (TW-a) procjene skeletne zrelosti. **Svrha:** Željela se ispitati točnost Demirjianova postupka za određivanje dentalne dobi kod djece u Bosni i Hercegovini (BiH). **Ispitanici i postupci:** Prilagođene Demirjianove tablice razvojnih stadija sedam zuba s lijeve strane mandibule iz 1976. godine ispitane su na ukupno 1106 panoramskih snimki bosansko-hercegovačke djece (597 djevojčica i 509 dječaka dobi od 5 do 14 godina). Nakon toga je T-testom za zavisne uzorke dentalna dob bila uspoređena s kronološkom. **Rezultati:** Razlika između dentalne i kronološke dobi bila je u rasponu od 0,60 do 2,17 godina kod djevojčica i 0,63 do 2,60 kod dječaka. Rezultati upozoravaju na precijenjenost dentalne dobi u usporedbi s Demirjianovim standardima iz 1976. **Zaključak:** Demirjianovi standardi za francusko-kanadsku djecu prema kojima se određuje dentalna dob nisu adekvatni za primjenu kod djece u Bosni i Hercegovini. Nužno je i dalje istraživati na većem uzorku i odrediti specifične standarde za određivanje dentalne dobi kod bosansko-hercegovačke djece.

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Uvod

Različiti su postupci za određivanje dentalne dobi kod čovjeka od natalne dobi pa do duboke starosti (1,2). Ako želimo znati dentalnu dob kod djece u razvoju, dva su različita pristupa - brojenje i analiza zuba u usnoj šupljini i analiza radioloških snimki zuba u razvoju. Panoramskim snimkama koristimo se u pedodonciji i ortodonciji kod praćenja promjene mliječnih u trajne zube, te tijekom praćenja trajnih zuba od početne mineralizacije kvržica do zatvaranja apeksa korijena zuba. Demirjian je objavio postupak određivanja dentalne dobi kod djece na temelju procjene razvojnih stadija sedam prvih zuba s lijeve strane donje čeljusti, ne uključujući treće kutnjake i to kod francusko-kanadske djece bjelačkog podrijetla (3). Kod postupka se koristio s osam stadija razvoja krune i korijena zuba, a označio ih je slovima engleskoga alfabeta (od A do H). Svakom razvojnom stadiju po-

Introduction

Various methods have been established for dental age assessment, from natal period of life until elderly age (1,2). Two main procedures were used for dental age assessment in children, clinical observation of teeth emergence and evaluation of dental radiographs. Panoramic radiographs commonly used in paedodontics and orthodontics make possible to follow the exchange of dentition, and the development of tooth which goes from first deposition of minerals until apex closure. Demirjian introduced most widely used method for dental age assessment in children based on ratings of first seven teeth from left side of mandible in French-Canadians of Caucasian origins (3). The method was based on eight stages (A through H) of crown and root calcification. Each stage designates a score and sum of these scores provides a dental maturity on a scale from 0 to 100, following the same

jedinog zuba odgovara adekvatna brojčana vrijednost. Zbroj odgovarajućih brojčanih vrijednosti za svih sedam zuba uspoređuje se s usporednim tablicama dentalne dobi u rasponu od 0 do 100 - posebno za djevojčice i posebno za dječake - prema sličnom postupku kao kada se prema Tanner-Whitehousu određuje skeletna zrelost (4). U nastavku istraživanja Demirjian je 1976. objavio prilagođeni sustav za određivanje dentalne dobi na temelju procjene razvoja sedam i četiri zuba iz tablice, te percentilne krivulje za djevojčice i dječake u dobi od 3 do 16 godina (5).

Točnost Demirjianove metode ispitana je na stanovnicima različitih europskih zemalja i etničkih zajednica te analizom pojedinih arheoloških nalaza (6-10). Rezultati upućuju na razlike ako ih uspoređujemo s francusko-kanadskim standardom.

Na temelju njih jasno je da je potrebno provjeriti točnost francusko-kanadskog standarda dobivenog pomoću Demirjianova postupka ili čak adaptiranim referentnim tablicama za svaku populaciju posebno.

Svrha ovog istraživanja bila je provjeriti pouzdanost Demirjianova postupka za određivanje dentalne dobi kod djece u Bosni i Hercegovini.

Ispitanici i postupci

Ispitanici

Za ovo istraživanje nasumce su bile odabrane panoramske snimke i dentalni kartoni 1106 djece, pacijenata Klinike za ortodonciju Stomatološkog fakulteta u Sarajevu i regionalnih stomatoloških centara u Banjoj Luci, Mostaru i Zenici, te u domovima zdravlja u Posušju, Ljubuškom, Čitluku i Orašju, ali i u privatnim specijalističkim ordinacijama u Bihaću i Čapljini. Snimljeni su u razdoblju od 2000. do 2009. godine sa svrhom da posluže u istraživanju djece iz cijele Bosne i Hercegovine.

Za istraživanje su bili odabrani ortopantomogrami zdrave djece te se u njihovim dentalnim i medicinskim kartonima nije mogla pronaći povijest sistemskih bolesti koja je mogla djelovati na rast i razvoj zuba, a isključene su bile snimke mandibularnom hipodoncijom - ne računajući treće kutnjake, ortopantomograme loše tehničke kvalitete, nekompletne dentalne i medicinske povijesti.

Ispitanici su bili podijeljeni prema kronološkoj dobi na ukupno deset skupina. Kronološka dob svakog sudionika iskazana je kao realan broj godina s dvjema decimalama - razlika između datuma snimanja i datuma rođenja. Prvu skupinu činila su petogodišnja djeca kronološke dobi od 5,00 do 5,99 godina. U sljedećoj skupini bili su šestogodišnjaci i tako redom. Ukupan uzorak sastojao se od 597 djevojčica i 509 dječaka u dobnim skupinama od 5 do 14 godina. Raspodjela snimki ispitanika prema dobi i spolu prikazana je u Tablici 1.

Postupak provedbe istraživanja

Svaki ortopantomogram bio je snimljen digitalnim fotografskim aparatom Kodak EasyShare Z812-IS. Nakon toga su digitalizirane snimke bile obrađene i pohranjene grafičkim alatom Corel Draw (Corel Draw v.12.0, 2003, Corel Corpo-

principle which has been used for measurement of Tanner-Whitehouse (TW) skeletal maturity (4). An updated system for dental maturity was used, based on seven and four teeth where scores and percentile standards were given separately for girls and boys for the age range 3-16 years (5).

The accuracy of Demirjian's method has been considered recently on many European populations, ethnic groups and archaeological samples (6-10). Results suggested some differences comparing with French-Canadian standards.

These reports demonstrate the necessity of testing accuracy of French-Canadian standards on Demirjian method or establishing reference data representative to each population. It was therefore the aim of this cross-sectional study to test the reliability of Demirjian's method of age estimation when used for children in Bosnia-Herzegovina.

Subjects and methods

Subjects

In this study, panoramic radiographs (OPG) and clinical records of 1106 children were randomly selected from Department of Orthodontics – School of Dental Medicine in Sarajevo, regional dental clinics in Banja Luka, Mostar, Zenica, Posušje, Ljubuški, Čitluk and Orašje and private dental practices in Bihać and Čapljina from year 2000 to 2009 in order to include different regions of Bosnia and Herzegovina.

The OPGs of healthy children, excluding history of systemic diseases which can affect development of teeth, mandibular hypodontia except of third molars, low quality of radiographs and incomplete dental and medical history, were selected. All the subjects were divided into 10 groups according to their chronological ages. The chronological age of each subject was calculated by subtracting the date of the radiograph from the date of birth. The first group, consisting of 5-year-olds, included patients of ages ranging from 5.00 to 5.99. The next group included 6-year-olds and so on. In total, 597 girls and 509 boys (age ranging from 5 to 14 years) were included. The distribution by age and gender of panoramic radiographs was given in Table 1.

Assessment of the study sample

Each OPG was photographed using a Kodak EasyShare Z812-IS Digital Camera. The computer images were stored in and reviewed using Corel Draw software package (Corel Draw v.12.0, 2003, Corel Corporation, Ottawa, Canada).

Tablica1. Raspodjela uzorka prema spolu i dobnim skupinama - podaci prikazani kao N (%)
Table 1 Age groups and sex distribution of children, data presented with N (%).

Chronological age - Kronološka dob	Gender - Spol		Total - Ukupno
	Girls - Djevojčice	Boys - Dječaci	
5.00–5.99	1(0,09)	4(0,36)	5(0,45)
6.00–6.99	19(1,72)	22(1,99)	41(3,70)
7.00–7.99	55(4,97)	34(3,07)	89(8,04)
8.00–8.99	99(8,95)	72(6,50)	171(15,46)
9.00–9.99	132(11,93)	104(9,40)	236(21,33)
10.00–10.99	101(9,13)	100(9,04)	201(18,17)
11.00–11.99	95(8,58)	84(7,59)	179(16,18)
12.00–12.99	66(5,97)	63(5,69)	129(11,66)
13.00–13.99	24(2,17)	19(1,71)	43(3,88)
14.00–14.99	5(0,45)	7(0,63)	12(1,08)
	597(53,98)	509(46,02)	1106(100)

ration, Ottawa, Kanada). Prvi autor očitao je razvojne stadije sedam trajnih zuba s lijeve strane donje čeljusti.

Određivanje dentalne dobi

Za određivanje dentalne dobi bio je odabran Demirjanov postupak s adaptiranim tablicama iz 1976. godine (5). Razvoj svakoga zuba s lijeve strane donje čeljusti, ne uzimajući u obzir treće kutnjake, bio je bodovan jedim od osam razvojnih stadija (A-H). Uvjeti koje mora zadovoljiti razvoj svakog zuba detaljno su objašnjeni (3). Zatim se, očitavanjem s priloženih tablica, pojedinim razvojnom stadijima svih sedam zuba priključuje odgovarajući broj bodova. Ukupan zbroj daje dentalnu zrelost ispitanika u rasponu od 0 do 100. Dentalna zrelost konverzijski se tablicama prevodi u dentalnu dob.

Ponavljanje mjerenja i statistička raščlamba

Za provjeru je bilo odabrano 10 posto snimki (n=111) i to slučajnim odabirom te su ponovno očitane nakon dva mjeseca. Za usporedbu mjerenja upotrijebljen je Cohenov kappa (ϰ) test. Podaci su analizirani s pomoću statističkog programa MedCalc (*MedCalc,* Version 10.2.0.0, Mariakerke, Belgija). Rezultati statističke analize smatrani su značajnima uz p<0,05. Statistička obrada podataka bila je obavljena za sve ispitanike te posebno prema spolu i dobi (djeca u kronološkoj dobi od 5,00 do 5,99 godina pripadaju skupini petogodišnje djece). T-testom za povezane uzorke provjeravala se točnost Demirjianova postupka iz 1976., uz hipotezu da se dentalna dob ne razlikuje od kronološke. Rezultat t-testa za nezavisne uzorke pokazao je kako nema statističke razlike u kronološkoj dobi među spolovima (p=0,373).

Rezultati

Cohenov kappa test iznosi 0,82 za ponovljeni postupak određivanja dentalne dobi, što je prema Altmanovu mišljenju (6) vrlo dobro. Na Tablici 2. predstavljena je dentalna dob (DA) prema Demirjianu, kronološka dob (CA) i razlike između dentalne i kronološke dobi (DA-CA) djece obaju spolova i svih dobnih skupina.

The stages of the seven left mandibular permanent teeth were assessed from the computer monitor by first author without knowledge of chronological age and gender.

Dental age assessment method

Dental age assessment was performed according to the Demirjian's method with adopted tables from 1976 (5). The development of each left permanent mandibular tooth, except the third molar, was rated on an 8-stage scale from A to H, and the criteria for the stages were given for each tooth separately (3). Each stage of the seven teeth was allocated a score, and the sum of the scores gave an evaluation of the subject's dental maturity, measured on a scale from 0 to 100. Score of each subject was then converted to dental age by using standard tables which were given separately for each gender.

Reproducibility and statistical analysis

To evaluate reproducibility, 10% of radiographs (N=111) were randomly selected and re-assessed 2 months after the initial assessment by observer. Cohen's Kappa test was performed to calculate the intra-examiner agreement.

The data were analyzed and stored using statistical software MedCalc (*MedCalc,* Version 10.2.0.0, Mariakerke, Belgium) and MS Excel (Microsoft Office, Windows XP, 2007, USA). When the p-value was less than 0.05, the results were considered statistically significant. Analyses were made for the entire group as well as for each gender and cohort (i.e. children between 5.00 and 5.99 years of age would be included in the 5year cohort). Paired samples t-test was applied for determining the accuracy of the Demirjian method from 1976, with the null hypothesis that dental age would not differ from chronological age. The results of the independent sample t-test showed no statistically significant difference between the chronological ages of the genders: p = 0.373.

Results

The result of the Cohen's Kappa test of the intra-examiner agreements for the assessment of the dental age was 0.82 which was very good according to Altman (6). The dental age (DA) applying the Demirjian method, the chronological age (CA) and differences between dental age and chronological age (DA-CA) to both genders and age groups were presented in Table 2.

Tablica 2. Kronološka dob (CA) i dentalna dob (DA) prema Demirjianu te razlika između dentalne i kronološke dobi (DA-CA) kod bosansko-hercegovačke djece
Table 2 Chronological age (CA), dental age (DA) according to Demirjian and difference between dental and chronological age (DA-CA) among the BH children.

		Mean (S.D.)								
Age Group	**Gender**	**CA**	**DA**	**DA–CA**	**95% CI DA–CA**	**Median DA-CA**	**Q1 DA-CA**	**Q3 DA-CA**	**IQR DA-CA**	***p*-Value†**
5.00–5.99	F	5,74	7,50	1,76	1,76-1,76	1,760	-	-	-	-‡
	M	5,61(0,24)	7,05(0,95)	1,44(0,82)	0,14-2,73	1,495	0,915	1,965	1,050	P = 0,039‡
6.00–6.99	F	6,60(0,31)	7,86(1,06)	1,27(1,13)	0,72-1,81	1,020	0,812	1,282	0,470	P = 0,001
	M	6,57(0,34)	7,70(0,61)	1,12(0,50)	0,89-1,34	1,045	0,750	1,270	0,520	P < 0,001
7.00–7.99	F	7,6(0,29)	8,20(0,59)	0,60(0,53)	0,46-0,74	0,490	0,277	0,800	0,523	P < 0,001
	M	7,50(0,38)	8,34(0,70)	0,85(0,65)	0,62-1,07	0,700	0,550	1,190	0,640	P < 0,001
8.00–8.99	F	8,51(0,30)	9,20(1,17)	0,69(1,15)	0,46-0,92	0,370	-0,067	1,045	1,112	P < 0,001
	M	8,52(0,29)	9,15(1,04)	0,63(0,94)	0,41-0,85	0,350	-0,005	1,090	1,095	P < 0,001
9.00–9.99	F	9,46(0,27)	10,21(1,30)	0,75(1,21)	0,54-0,96	0,560	-0,135	1,410	1,545	P < 0,001
	M	9,51(0,29)	10,43(1,11)	0,93(1,08)	0,72-1,14	0,825	0,190	1,460	1,270	P < 0,001
10.00–10.99	F	10,46(0,26)	11,90(1,46)	1,43(1,40)	1,16-1,70	1,230	0,237	2,612	2,375	P < 0,001
	M	10,52(0,31)	11,85(1,20)	1,33(1,12)	1,10-1,54	1,435	0,530	1,980	1,450	P < 0,001
11.00–11.99	F	11,50(0,30)	13,66(1,18)	2,17(1,14)	1,94-2,40	2,280	1,500	2,997	1,497	P < 0,001
	M	11,45(0,29)	13,75(1,47)	2,31(1,39)2	2,00-2,60	2,435	1,270	3,315	2,045	P < 0,001
12.00–12.99	F	12,51(0,29)	14,66(0,85)	2,15(0,81)	1,95-2,35	2,386	1,710	2,700	0,990	P < 0,001
	M	12,48(0,28)	15,08(1,10)	2,60(1,04)1	2,34-2,86	2,920	1,990	3,330	1,340	P < 0,001
13.00–13.99	F	13,37(0,28)	14,93(0,64)	1,56(0,57)	1,32-1,80	1,655	1,315	2,005	0,690	P < 0,001
	M	13,44(0,28)	15,64(0,51)	2,21(0,42)3	2,00-2,41	2,280	2,010	2,510	0,500	P < 0,001
14.00–14.99	F	14,55(0,38)	15,38(0,46)	0,83(0,73)	-0,07-1,73	0,700	0,340	1,470	1,130	P = 0,064‡
	M	14,21(0,13)	15,80(0,34)	1,59(0,35)	1,27-1,91	1,710	1,357	1,810	0,453	P < 0,001‡
Total	F	10,06(1,79)	11,33(2,56)	1,27(1,27)	1,17-1,38	1,110	0,260	2,220	1,960	P < 0,001
	M	10,18(1,84)	11,65(2,66)	1,46(1,26)	1,35-1,57	1,360	0,550	2,392	1,842	P < 0,001

*Abbreviations: F - female; M - male; CI - confidence interval;
S.D. - standard deviation; Q1 – first quartile; Q3 – third quartile; IQR - interquartile range
†Paired samples t-test
‡Small sample for test

Srednja razlika dentalne i kronološke dobi iznosila je za djevojčice 1,27 (median =1,110; IQR=1,960; S.D.=1,27), a za dječake 1,46 (median=1,360; IQR=1,842; S.D.=1,26).

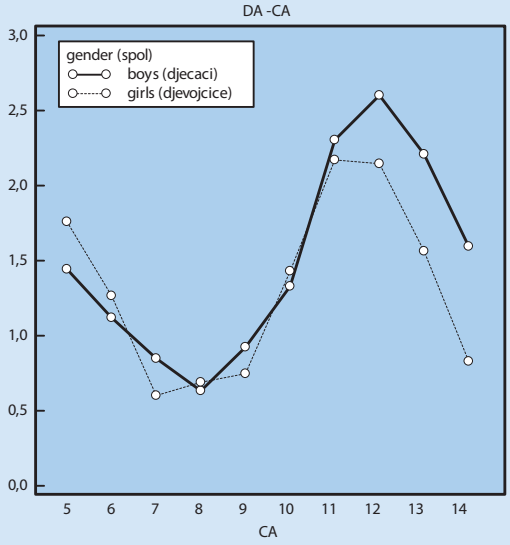
Dakle, u prvoj skupini kod petogodišnje djece i četrnaestogodišnjih djevojčica nema statistički značajne razlike između dentalne i kronološke dobi.

Najveći prebačaj u dobi bio je kod jedanaesto- i dvanaestogodišnjih djevojčica, a slijede skupine trinaesto- i desetogodišnjakinja. Kod dječaka je najveći prebačaj zabilježen kod dvanaesto- i jedanaestogodišnjaka, a njih slijede trinaesto- i četrnaestogodišnjaci. Podbačaj dobi uočen je samo kod četrnaestogodišnjih djevojčica. Srednja vrijednost razlike dentalne i kronološke dobi smanjivala se kod djevojčica u dobnim skupinama od pet do sedam godina, a razlika se povećavala i dosegnula vrhunac kod djevojčica od 11 i 12 godina. Kod sljedećih dobnih skupina razlika se smanjivala.

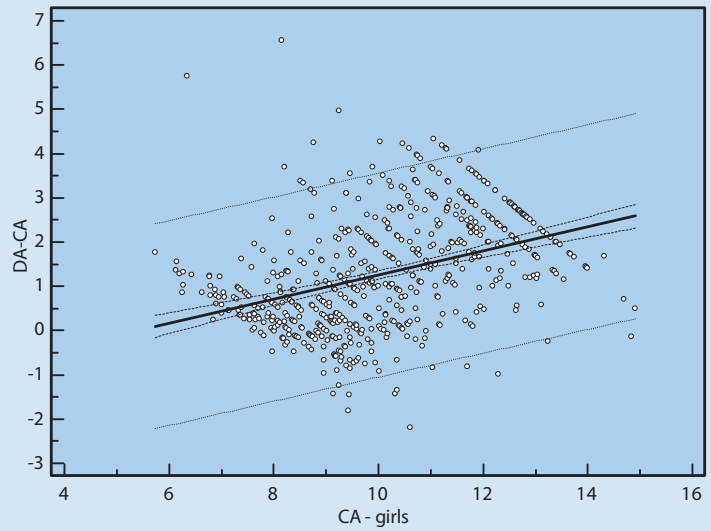
Kod dječaka se razlika dentalne i kronološke dobi smanjivala do skupine osmogodišnjaka, a zatim se povećavala i bila najveća kod dvanaestogodišnjaka. Kod većih dobnih skupina bilo je zabilježeno smanjenje razlike (Slika 1.). Razlika (otklon) dentalne i kronološke dobi u odnosu prema kronološkoj dobi prikazana je za djevojčice na Slici 2., a za dječake na Slici 3. Vrijednosti ispod nule upućuju na djecu kod koje postoji podbačaj dentalne dobi u odnosu prema kronološkoj.

The mean age difference was 1.27 (median = 1.110; interquartile range = 1.960; S.D. = 1.27) in girls, and 1.46 (median = 1.360; interquartile range = 1.842; S.D. = 1.26) in boys. It should be noted that, in the first 5-year-old group and 14-year-olds in girls there were not statistically significant differences between the DA and the CA. These results can be ascribed to subject number in these age groups so this issue is to taken into account.

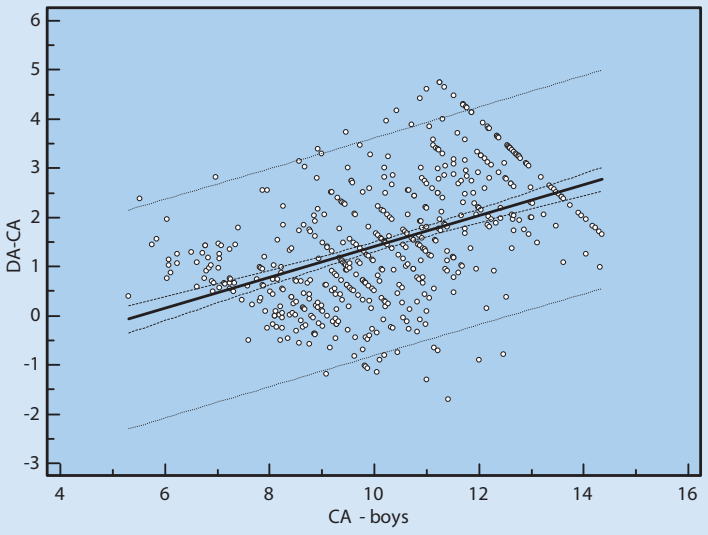
The greatest overestimation in girls was found in the 11- and 12-year-old age group, followed by overestimations in the 13- and 10-year-old age groups. The greatest overestimation in boys was in the 12- and 11-year-old age group, followed by the 13- and 14-year-old age groups. Underestimation of age was seen only in the 14-year-old age group in girls. The mean DA-CA in girls decreased between the ages of 5 and 7, than increased and reached peak at ages of 11 and 12. In further age groups mean DA-CA decreased. In boys the mean DA-CA decreased continuously until the age of 8, than increased until the age of 12. From that point mean DA-CA in boys decreased, Figure1. The difference between DA and CA (DA–CA) is plotted against CA for girls and boys in Figure 2 and Figure 3. The values above zero refer to children whose dental ages were overestimated. The regression lines of the entire age groups of girls and boys shows



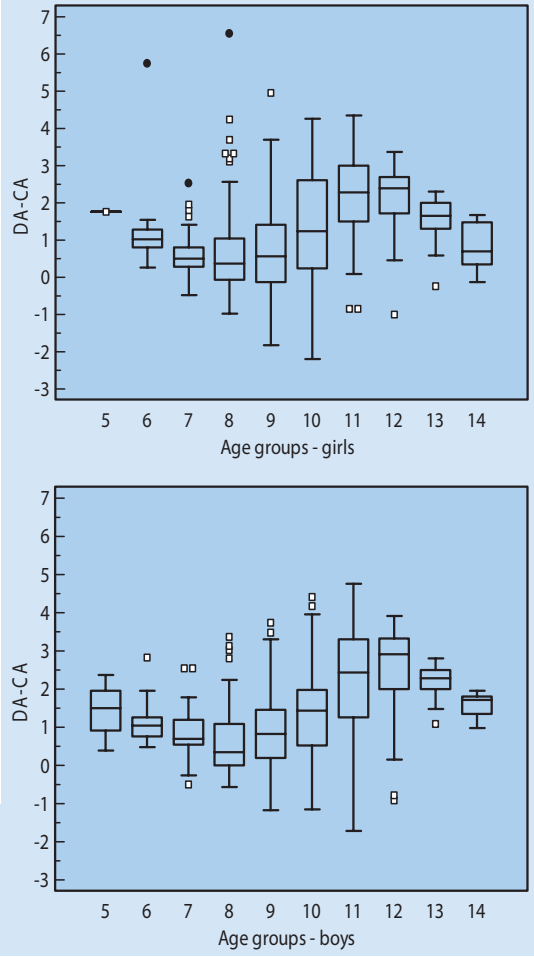
Slika1. Srednje vrijednosti DA-CA za dječake i djevojčice prema dobnim skupinama
Figure 1 Mean DA–CA for girls and boys for each age group.



Slika 2. Dijagram raspršenosti rezultata i regresijski pravac s 95% granicama pouzdanosti i predikcije razlikovanja dentalne i kronološke dobi (DA-CA) u odnosu prema kronološkoj dobi za djevojčice
Figure 2 Scatter diagram and regression line with 95% confidence and 95% prediction curves for difference between estimated dental age and chronological age (DA–CA) against the chronological age (CA) for girls.



Slika 3. Dijagram raspršenosti rezultata i regresijski pravac s 95% granicama pouzdanosti i predikcije razlikovanja dentalne i kronološke dobi (DA-CA) u odnosu prema kronološkoj dobi za dječake
Figure 3 Scatter diagram and regression line with 95% confidence and 95% prediction curves for difference between estimated dental age and chronological age (DA–CA) against the chronological age (CA) for boys.



Slika 4. Box-plot dijagram DA-CA - horizontalna linija predstavlja medijan svih vrijednosti, visina okvira predstavlja interkvartilni raspon (IQR); krajevi označavaju raspon
Figure 4 Boxplots of DA-CA. Horizontal lines inside boxes are located at median of data; height of boxes gives interquartile range (IQR); whiskers indicate range, dots indicate far out values.

Regresijski smjerovi DA-CA kod djece obaju spolova pokazuju trend povećanja s obzirom na ukupnu raspodjelu prema dobi. Slika 4. pokazuje medijan i interkvartilni raspon (IQR) te uočene vrijednosti DA-CA koje odstupaju.

Rasprava

Postupci određivanja dentalne dobi kod djece imaju primjenu u kliničkoj i forenzičnoj dentalnoj medicini. Rast zuba može se vrjednovati različitim postupcima - od procjena na temelju dogovorenih stadija razvoja zuba, pa do mjerenja dužine krune, korijena i promjera apeksnih otvora ili pulpe (7). Iako postoji više pristupa u određivanju dentalne dobi, još nema univerzalnog postupka i formule koja bi se primijenila s istim uspjehom kod pripadnika svih naroda i skupina.

Svrha ovog retrospektivnog presječnog istraživanja bila je odrediti dentalnu dob kod djece u Bosni i Hercegovini, koristeći se do danas najčešće rabljenom Demirjianovom metodom (5) i njegovim standardom postavljenim prema bjelačkom uzorku francusko-kanadske djece. Posebnost u odnosu prema mnogim dosadašnjim istraživanjima jest u tome što smo slučajnim odabirom u istraživanje uključili panoramske snimke iz različitih znanstvenih i stručnih ustanova - od stomatološkog fakulteta i regionalnih specijalističkih ustanova do privatnih ordinacija iz cijele države.

Općenito, kod djece u Bosni i Hercegovini dentalna je dob precijenjena u usporedbi s francusko-kanadskim normativom. Rezultati potvrđuju dosadašnja slična istraživanja kod više europskih i drugih naroda (8-15). Najprecjenjeniju dentalnu dob u primjeni Demirjianova postupka pronašli su Koshy i Tandon (16) kod djece iz južne Indije. Bila je precijenjena u prosjeku za 2,82 godine kod djevojčica te 3,03 godine kod dječaka. Upozorili su također da je precijenjenost dentalne dobi općenito bila veća kod starijih dobnih skupina, što je slično našim rezultatima (Slika 1.) Izražena precijenjenost dentalne dobi kod starijih dobnih skupina može nastati zbog promjena između predpubertalne i pubertalne dinamike te svojstava rasta tijekom toga razvojnog razdoblja (16). Nyarady i suradnici (8) uočili su da je dentalna dob kod djece iz jugozapadnoga, podunavskog dijela Mađarske približno godinu dana precjenjenija u usporedbi sa šesto- do osmogodišnjim francusko-kanadskim vršnjacima. Kod viših dobnih skupina razlika se smanjivala. Kod neke djece razlike su bile i do dvije godine.

Kod djece od šest do petnaest godina u srednjoj Poljskoj, Rozylo-Kalinowska i njezini kolege (15) dobili su bitnu razliku u usporedbi s francusko-kanadskim standardom. Najveća precijenjenost bila je kod jedanaesto- i dvanaestogodišnjih djevojčica - 1,5 godina, odnosno 1,1 godina, te kod trinaestogodišnjih dječaka - 1,4 godina. Najmanje odstupanje bilo je kod 15-godišnjaka - 0,2 godine kod djevojčica i 0,4 godine kod dječaka.

Istraživanje valjanosti francusko-kanadskih normi u Norveškoj obavio je Nykänen sa suradnicima (9) na longitudinalnom uzorku od 133 djevojčice i 128 dječaka. Kod djevojčica je dentalna dob bila precijenjena od 0 do 3,5 mjeseca kod mlađe dobne skupine (5,5-9,0 godina), a 4,5 do 7,5 mjeseci

increasing difference with chronological age. Medians, interquartile ranges (IQR), far out values of DA-CA were shown in Figure 4.

Discusion

Dental age assessment methods in children have importance in clinical and forensic dental practice. Growth of tooth can be quantified in several ways, including evaluation of maturity indicators or measuring length or ratios of crown, root, apices or pulp dimensions (7). Regardless of the existence of different methods, an integral system has not yet been created to address differences in ethnical and racial groups. The objective of this retrospective cross-sectional study was to determine the dental age of children in Bosnia and Herzegovina by applying mostly used method by Demirjian et al. (5), which was originally applied to a Caucasian French-Canadian population. The advantage of this study is that subjects represent more general population; all subjects were selected at random of patients who had been treated at different dental institutions; from dental school, regional community dental clinics and private practices from different parts of the country.

Overall, children in Bosnia and Herzegovina showed a more advanced dental age compared with French–Canadian standards. This is in agreement with the findings for different European and worldwide populations (8-15). Most advanced overestimation of Demirjian's method was found by Koshy and Tandon (16) in South Indian children. Girls were 2.82 years and boys were 3.04 years delayed in dental maturity. They also found that, generally, overestimation was more pronounced in older age groups; which are in agreement with our results, Figure 1. Overestimation in older age groups could be explained with pre-pubertal or pubertal growth changes pertinent during this age period (16).

Nyarady et al. (8) found that south-west Transdanubian girls and boys from Hungary, aged 2.9 to 17.5 years, were approximately one year ahead of the French-Canadian children at the age of 6-8-years. At older age groups, the difference decreased. Individual variances were up to 2 years. Rozylo-Kalinowska et al. (15) studied the group of children age 6-15 from central Poland. The difference between French-Canadian standards and chronological age in years was the biggest in 11- and 12-year-old girls and equaled 1.5 and 1.1 years, respectively, as well as in 13-year-old boys and equaled 1.4 years. The lowest difference concerned the highest studied age group, i.e. 15-year-olds: 0.2 years in girls and 0.4 years in boys.

Nykänen et al. (9) studied validity of the French-Canadian standards for Norwegian children on longitudinal sample comprised 133 girls and 128 boys. Dental age was advanced in girls, from 0 to 3.5 months in the younger age groups (5.5 to 9.0 years) and from 4.5 to 7.5 months in the age groups 9.5 years and above. Among the boys the mean difference between dental age and chronologic age varied in the different age groups from 1.5 to 4.0 months. Nyström et al. (17) studied semi-longitudinally group of 248 children ages of 2.5-16.5

kod dobnih skupina iznad 9,5 godina. Kod dječaka je srednja vrijednost razlike imala raspon od 1,5 do 4,0 mjeseca.

Nyströmova (17) je pratila semilongitudinalnu skupinu od 248 djece iz Helsinkija u rasponu od 2,5 do 16,5 godina, s ukupno 738 panoramskih snimki. Kod Finkinja je dentalna dob bila prosječno precijenjena 3,5 mjeseci u usporedbi s francusko-kanadskim rezultatima kod dobnih skupina od 4 do 9 godina, te precijenjena 9 mjeseci kod dobnih skupina od 10 do 14 godina. Precijenjenost kod dječaka iznosila je 4,5 mjeseca kod dobnih skupina od 5 do 10 godina i 7 mjeseci u dobi od 11 do 12 godina. Leurs i njegovi kolege (13) dobili su prosječnu precijenjenost dobi od 0,4 godine kod nizozemskih dječaka, uz raspon razlika od -0,68 do 1,28 godina, a kod djevojčica 0,6 godina uz raspon razlika od 0,06 do 1,23 godine. Još veća precijenjenost ustanovljena je kod djece iz sjeverne Turske, a prema istraživanju Tunca i Koyuturka (14). Raspon precijenjenosti u usporedbi s francusko-kanadskom djecom bio je 0,50-1,44 godine za djevojčice i 0,36-1,43 godine za dječake.

Mörnstad i kolege (11) pokazali su kod švedskih djevojčica precijenjenost dobi u rasponu od 0,5 do 1,8 godina, a kod dječaka 0,4 do 1,8. Rezultati su u skladu s prijašnjim istraživanjem Staafa i suradnika (12). Oni su izvijestili o prosječnoj precijenjenosti od 0,89 godina kod djevojčica i 0,81 kod dječaka. Cameriere i suradnici (18) usporedili su pojedine dentalne postupke za određivanje dobi kod djece na uzorku hrvatske, talijanske i španjolske djece (401 djevojčica i 355 dječaka od 5 do 15 godina). Demirjianov postupak pokazao je najmanju preciznost uz srednju precijenjenost dobi od 1,13 godine kod djevojčica i 1,01 godine kod dječaka. Ćuković-Bagić i suradnici (19) te Borčić i suradnici (20) ispitali su u Hrvatskoj preciznost Demirjianova postupka kod pacijenata Stomatološkog fakulteta Sveučilišta u Zagrebu. Precijenjenost dobi bila je prosječno 12 mjeseci kod djevojčica i 11 mjeseci kod dječaka.

Iranski znanstvenik Bagherpour i njegovi suradnici (21) u nedavnoj su studiji, koja je uključivala 170 djevojčica i 141 dječaka, ustanovili precijenjenost od 0,34 godine kod djevojčica i 0,25 dječaka u usporedbi s francusko-kanadskim uzorkom. Chen i kolege (22) također su kod 445 djece iz Sichuana (228 djevojčica i 217 dječaka) pokazali precijenjenost dobi u usporedbi s francusko-kanadskim standardom. Razlika je varirala od 0,0071 do 1,25 godina kod djevojčica te -1,00 do 1,30 kod dječaka.

Usporedba Demirjanovih tablica iz 1976. godine i Chailettovih međunarodnih tablica na bjelačkoj populacija španjolske djece i venezuelskih djevojčica i dječaka američko-indijanskog podrijetla, pokazala je precijenjenost dentalne dobi kod španjolske djece u rasponu od 0,21 do 0,88 godina, ovisno o spolu i korištenim tablicama (33). Suprotno općoj tendenciji, kod venezuelske djece američko-indijanskog podrijetla precijenjenost je bila uočena samo kod djece mlađe od osam godina, a kod one starije bila je izražena podcijenjenost dentalne dobi kod obaju spolova u rasponu -0,1 do -0,61 godine.

Moguće objašnjenje za velike razlike između bosansko-hercegovačkih i drugih europskih skupina i istraženih skupina s različitih kontinenata i francusko-kanadskih standarda iz 1976., mogu biti sekularne promjene u rastu i razvoju u posljednjih 35 godina.

years from Helsinki, where 738 panoramic radiographs were taken. In Finish girls the dental ages were on an average 3.5 months ahead of French-Canadian girls at the age of 4-9 years and 9 months ahead in the age groups 10-14 years. In boys the difference was about 4.5 months at the age of 5-10 years and about 7 months at the age of 11-12 years. Leurs et al. (13) found that the mean overestimation for Dutch boys was 0.4 years, ranged from -0.68 to 1.28 years, and for Dutch girls 0.6 years, ranged from 0.06 to 1.23 years. More advanced overestimation was found in northern Turkish children in study provided by Tunc and Koyuturk (14). The average differences between French-Canadian standards and chronologic ages of northern Turkish girls and boys varied from 0.50-1.44 years for girls and 0.36 to 1.43 years for boys.

Mörnstad et al. (11) showed that Swedish girls overestimated by 0.5 to 1.8 years and the boys by 0.4 to 1.8 years which was in concordance with previous Swedish research by Staaf et al. (12), who reported average overestimation by 0.89 years for girls and 0.81 years for boys. Cameriere et al. (18) were tested different dental age assessment methods on Croatian, Italian, and Spanish children (401 girls and 355 boys, ages 5-15). Demirjian method from 1973 was the least accurate; average overestimation was 1.13 and 1.01 for girls and boys, respectively. Čuković-Bagić et al. (19) and Borčić et al. (20) tested in Croatia accuracy of Demirjian's method among patients of the School of Dental Medicine University of Zagreb. Overestimation was 12 months and 11 months for girls and boys, respectively. Bagherpour et al. (21) in their recent Iranian study involving 170 girls and 141 boys showed overestimation in boys by 0.34 years and girls by 0.25 years compared with French-Canadian standards. Study provided by Chen et al. (22) on 445 Western Chinese children in Sichuan (228 girls and 217 boys) also showed general trend of overestimation of dental age when French-Canadian standards were used. Differences were ranged from 0.0071 to 1.25 years in girls and from –1.00 to 1.30 years in boys.

Comparative study of Demirjian scores from 1976 and Chailett's international scores in Spanish Caucasian and Venezuelan Amerindian children showed that in Spanish Caucasian children dental age was overestimated, ranged from 0.21 to 0.88 years, depending on the sex and on the used scores (33). Contrary to general tendency, in Venezuelan Amerindian children, the overestimation was only found in children under 8-year old, while dental age in older children were underestimated in both sexes, ranged from –0.1 to –0.61 years.

A possible explanation for the differences between the Bosnian-Herzegovian as well as for different European and populations from different parts of World and French–Canadian standards from 1976 might be a result of secular trends in growth and development during the last 35 years but also might be attributed to the diversity and specificity among nations and ethnic groups (23, 24, 33). As a result, many authors established specific tables and standards for Demirjian's method for using in specific population (13, 15, 25-29).

Regardless of the obtained results, it is important to remember that the difference in chronological age and dental ages can be also attributed to different factors, including

sljednjih 35 godina, ali i raznolikosti i posebnosti pojedinih naroda i etničkih skupina (23, 24).

Kao rezultat, mnogi su istraživači za primjenu u ciljanim skupinama odredili specifične tablice i norme za Demirjianovu metodu (13,15,25-29). Neovisno o rezultatima, potrebno je znati da na razliku između kronološke i dentalne dobi mogu utjecati različiti čimbenici, kao što su preciznost metode, vještina i iskustvo istraživača, veličina i raspodjela uzorka te statistička obrada (19,30) Maber i suradnici (31) usporedili su više postupaka u određivanju dentalne dobi na uzorku od 455 djevojčica i 491 dječaka, malih Bangladežana i Britanaca bjelačkog podrijetla. Najpreciznija je bila revidirana Demirjianova metoda prema Willemsu i suradnicima (25). Cemeriere i suradnici (32) opisali su drugačiji pristup u određivanju dobi kod djece – oni su mjerili otvorene apekse trajnih zuba. Istraživanje na panoramskim snimkama talijanske, španjolske i hrvatske djece pokazalo je da je njihova metoda preciznija od Demirjianove s francusko-kanadskim standardima iz 1973. i Willemsove (18).

Zaključak

Rezultati pokazuju da Demirjanove norme za francusko-kanadsku djecu nisu prikladne za procjenu dentalne dobi kod djece u Bosni i Hercegovini, posebice kod dobnih skupina 11-,12-13-godišnje djece. Potrebno je proširiti istraživanje i ispitati više djece te izraditi posebne norme za djecu u Bosni i Hercegovini te istražiti i druge postupke.

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the accuracy of the method, examiner's training and experience, sample size and distribution, and statistic approach to the obtained results (19, 30). Maber et al. (31) tested various dental age estimation methods on sample of 455 girls and 491 boys of Bangladeshi and British Caucasian origin. Most accurate method was revisited Demirjian's technique by Willems et al. (25). Cameriere et al. (32) introduced different concept of age estimation in children by measurement of open apices in permanent teeth. Cameriere's research on panoramic radiographs of Italian, Spanish, and Croatian children showed that his method was more accurate comparing with Demirjian's using French-Canadian standards from 1973 and Willems's (18).

Conclusions

The results showed that use of the Demirjian's standards for French-Canadian children may be not appropriate for assessment of the dental age of children in Bosnia-Herzegovina, especially for those within the age groups of 11-, 12-, and 13-years-old. Further research is needed involving a greater number of cases and creation of new standards specific to the children in Bosnia-Herzegovina and evaluation of other available methods.

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Abstract

Dental age assessment in developing children has importance in pediatric dentistry, orthodontics and forensic science. Demirjian method, based on French-Canadian children, described in 1973 and based on Tanner-Whitehouse (TW) skeletal maturity technique, was mostly used. **Aim:** To evaluate the validity of Demirjian's method for dental age estimation in Bosnian-Herzegovian (BH) children. **Subjects and Methods:** Adopted (Demirjian dental) development scores from 1976 of the seven left mandibular teeth were tested on panoramic radiographs of 1106 children (597 girls and 509 boys, ages 5-14). The paired samples t-test was used to compare a dental and chronological age. **Results:** The mean difference in each age group between the dental age and chronological age ranged from 0.60 to 2.17 years in girls and from 0.63 to 2.60 years in boys. The results showed that the BH children demonstrated a more advanced dental age compared to Demirjian's standards from 1976. **Conclusion:** The Demirjian's standards of dental age assessment for French-Canadian children are not suitable for BH children. Further research, including greater sample should result a specific, BH based standards of dental age assessment for children.

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