

# Dinamika promjena izdvojenih linearnih kraniofacijalnih parametara tijekom rasta

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## Sažetak

Istraživanje dinamike rasta linearnih kraniofacijalnih parametara rasta provedeno je na uzorku od 200 rentgenograma, 106 ženskih i 94 muških ispitanika, koji su podijeljeni u pet dobnih skupina: 10 i 11, 12 i 13, 14 i 15, 16 i 17 te 18 i više godina.

Svrha istraživanja bila je utvrditi srednje vrijednosti linearnih varijabla za određene dobne skupine, opaziti njihove razlike prema spolu i registrirati dinamiku promjena tijekom rasta. Izvršena je procjena 5 linearnih kraniofacijalnih varijabli cjelokupnog uzorka eugnatih ispitanika: prednje kranijalne baze, maksilarne baze, mandibularne baze, prednja i stražnja visina lica.

Utvrđene su srednje vrijednosti i razlike prema spolu, te procjena intenziteta i dinamike rasta za svaku varijablu. Dobivene srednje vrijednosti predstavljaju standarde koji su namijenjeni kvantitativnim procjenama kraniofacijalnog rasta ortodontskih pacijenata.

Svi ispitivani linearni parametri veći su u muških ispitanika. Procjena dinamike pokazuje da većina ispitanih parametara intenzivnije raste u dobi između 10. i 11. te 12. i 13. godine, što se može tumačiti pubertetskom akceleracijom.

Kvantitativni pokazatelji koji su proizašli istraživanjem ovoga uzorka primjenjivi su u kliničkoj procjeni kraniofacijalnog rasta ispitanika naše populacije.

Ključne riječi: kraniofacijalni pokazatelji, rast

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## Uvod

Kraniofacijalna regija složeno je područje u kojemu se istodobno zbivaju različiti funkcijski procesi, a podatci o skeletnoj morfologiji i rastu te regije rutinski se primjenjuju u ortodontskoj kliničkoj praksi.

Podatci o rastu kraniofacijalnog sustava vrlo su važni u ortodonciji jer razlike u morfologiji mogu

biti uzrok malokluzijama, a kliničke promjene rasta i morfologija kostiju temeljna su baza za ortodontski tretman.

Pri prepoznavanju kraniofacijalnih posebnosti služi rentgenkefalometrija, mjerno analitička metoda koja vrjednovanjem rentgenograma glave daje podatke o rezultatu rasta u određenom trenutku, te o međuovisnosti kraniofacijalnih struktura (1).

Suvremena rentgenkefalometrijska dijagnostika datira od početka tridesetih godina (2,3), a od tada pa do danas u dijagnostički je postupak uvedeno mnogo raščlamba koje se temelje na mjerenju i usporedbi kutnih parametara (4-8), no rijetke su raščlambe koje sadrže i linearne varijable (9,10,11).

Linearne raščlambe temelje se na određivanju referentnih linija na koje se mogu projicirati okomice iz pojedinih referentnih točaka. Zatim se na referentnim linijama izmjere razmaci između pojedinih projekcija. Takve su, primjerice, De Costerova, Morreesova i raščlamba po Sassouniu (12,13,14).

Istraživanje je provedeno sa svrhom da se utvrde srednje vrijednosti za 5 linearnih kraniofacijalnih parametara u odabranih dobnih segmenata uzorka eugnatih ispitanika naše populacije izdvojeno prema spolu, da se registriraju moguće razlike između muških i ženskih ispitanika, razmotri intenzitet i dinamika rasta svakog parametra tijekom rasta viscerokraniuma od zadane početne do završne dobne skupine.

**Uzorak i postupci**

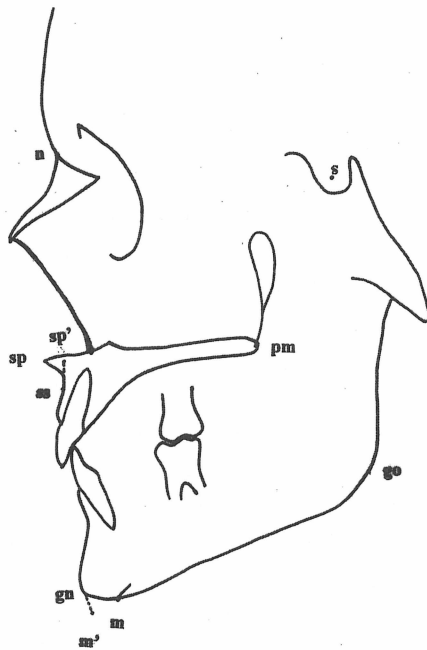
Za istraživanje je poslužila zbirka rentgenskih slika eugnatih ispitanika Zavoda za ortodontiju Stomatološkog fakulteta u Zagrebu.

Uzorak se sastojao od ukupno 200 rentgenograma; 106 ženskih i 94 muških ispitanika. Ispitanici su podijeljeni u pet dobnih skupina (Tablica 1).

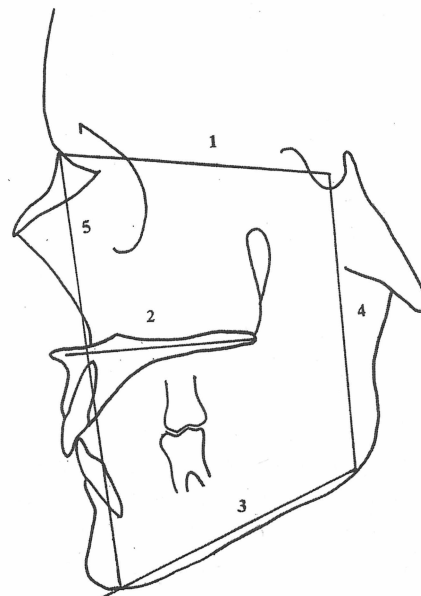
Rentgenske slike učinjene su prema klasičnim načelima rentgenkefalometrijske tehnike. Svaka slika precrtana je na pauspapir, a crtež je izrađen tehničkom olovkom.

Na crtežu je označeno 10 kefalometrijskih točaka: n-nasion, s-sela, sp-spina nasalis anterior, sp'-

spinale (okomica povučena sa ss na dužinu sp-pm), pm-pterigomaksilare, m'-menton (okomica povučena sa gn na dužinu m-go), go-gonion, ss-subspinale, gn-gnation, m-menton (Slika 1).



Slika 1. Primijenjene rentgenkefalometrijske točke  
Figure 1. Cephalometric landmarks



Slika 2. Odabrane linearne varijable  
Figure 2. Linear cephalometric variables

Tablica 1. Raspodjela uzorka prema dobi i spolu  
Table 1. Distribution of the sample according to age and sex

DOB	MUŠKI	ŽENSKI	UKUPNO
10 + 11 godina	21	19	40
12 + 13 godina	18	22	40
14 + 15 godina	19	21	40
16 + 17 godina	18	22	40
18 + 18 > godina	18	22	40
Ukupno	94	106	200

Za raščlambu je odabrano 5 linearnih varijabla (Slika 2):

1. n-s = dužina prednje lubanjske baze
2. sp'-pm = dužina maksilarne baze
3. m'-go = dužina mandibularne baze
4. s-go = stražnja visina lica
5. n-m = prednja visina lica

Varijable su mjerene u milimetrima s najvećom točnošću od  $\pm 0,5$ .

Podatci su statistički obrađeni izdvojeno po dobnim skupinama, po spolu, i u totalu. Izračunani su osnovni statistički parametri: aritmetička sredina, ra-

Testiranje razlike aritmetičkih sredina prema spolu za sve varijable s naznačenom znatnošću prikazano je u Tablici 3.

## Rasprava

Raščlambom rezultata vidljivo je da je nastao porast vrijednosti svih varijabli u razdoblju od 10. godine do odrasle dobi.

Varijabla kojom se određuje dužina prednje kranijalne baze, n-s, povećava se od prve dobne skupi-

Tablica 2. Osnovni statistički parametri linearnih varijabla za sve dobne skupine

Table 2. Basic statistics from the linear variables according to age

			VARIJABLE / VARIABLES																			
			n-s				sp'-pm				m'-go				s-go				n-m			
Dob	N	Spol	x	sd	min	max	x	sd	min	max	x	sd	min	max	x	sd	min	max	x	sd	min	max
10+11	21	M	71.33	2.85	66	78	48.05	2.79	43	53	72.99	3.79	66	80	72.48	5.55	63.5	84	114.98	6.05	107	127
	19	Ž	68.84	3.35	61	78	36.97	2.48	42	52	71.89	4.59	64	81	71.03	5.19	62	79	109.71	4.86	99	117
12+13	18	M	74.56	3.18	66.5	80	49.86	2.42	45	53	76.39	4.40	67	87	78.28	4.96	70	90	120.75	6.92	110	138
	22	Ž	71.63	2.77	69	76.5	48.68	2.25	45	54	72.91	2.85	67	79	74.43	2.84	70	82	115.95	4.67	106	126
14+15	19	M	73.13	3.36	66	78.5	50.16	2.76	45	55.5	78.47	5.58	67	90	80.32	3.99	74	88	121.79	5.95	111	134
	21	Ž	71.45	3.21	65	77.5	48.12	1.99	44	51	76.83	3.35	71	85	75.40	6.06	65	87	119.36	5.00	109	126
16+17	18	M	75.33	2.87	69.5	79	52.19	2.39	48	56	82.89	5.84	72	94	82.72	6.36	76	98	127.11	5.35	118	139
	22	Ž	71.91	3.03	66.5	79	49.25	2.43	43.5	54.5	77.16	3.64	70	86	76.75	4.84	65	88	118.80	6.01	109	132.5
18+18>	18	M	76.64	2.05	73	80	52.31	2.51	46	57	83.97	3.39	76.5	90	87.53	5.18	76	97	130.11	4.61	121	140
	22	Ž	72.52	2.70	67	78.5	49.89	2.89	44	56	79.11	4.48	71	89	81.55	6.75	70	102	120.70	7.61	108	141.5
Total	94	M	74.10	3.45	66	80	50.43	3.05	43	57	78.75	6.24	66	94	80.02	7.29	63.5	98	122.68	7.91	107	140
	106	Ž	71.31	3.25	61	79	48.64	2.63	42	56	75.67	4.68	64	89	75.97	6.29	62	102	117.08	6.89	99	141.5

špon i standardna devijacija. Testirane su znatnosti razlika aritmetičkih sredina svih varijabla prema spolu.

## Rezultati

Aritmetičke sredine (X), standardne devijacije (SD), minimalne (MIN) i maksimalne (MAX) vrijednosti za sve varijable, izdvojeno prema spolu i prema dobnim skupinama u totalu prikazane su u Tablici 2. U Tablici 2 odvojeno su prikazani osnovni statistički parametri za linearne varijable u sagitalnoj i u okomitom dimenziji.

Promjenljivost srednjih vrijednosti svih 5 varijabla prema dobnim skupinama (izraženo u mm) prikazana je grafički u Slikama 3 do 7 izdvojeno za oba spola.

Tablica 3. Testiranje znatnosti razlika aritmetičkih sredina varijabli muških i ženskih ispitanika

Table 3. Significance of the differences between mean values of males and females

Varijabla	N	Spol	x	SD	P	t
n-s	94	M	74.10	3.45	0.05*	5.798
	106	Ž	71.34	3.25		
sp'-pm	94	M	50.43	3.05	0.05*	4.420
	106	Ž	48.64	2.69		
m'-go	94	M	78.75	6.24	0.05*	3.904
	106	Ž	75.67	4.86		
s-go	94	M	80.02	7.29	0.05*	5.281
	106	Ž	75.97	6.29		
n-m	94	M	122.68	7.90	0.05*	5.303
	106	Ž	117.08	6.89		

N = broj ispitanika

X = aritmetička sredina

SD = standardna devijacija

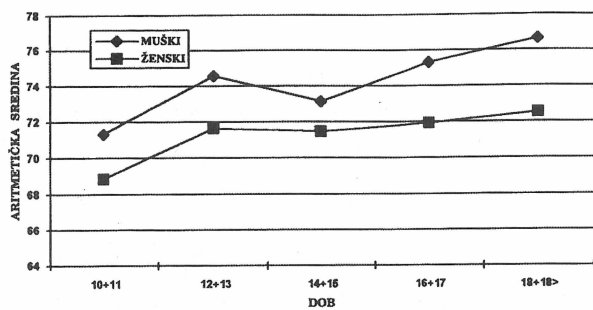
t = granična vrijednost

\* $p < 0.05$  = znatna razlika

ne do odrasle dobi za 5,3 mm u muških i 3,7 mm u ženskih ispitanika (Tablica 2).

Broadbent sr., Broadbent jr. i Golden (15) u istom razdoblju bilježe porast od 5,9 mm za muške i 3,3 mm za ženske ispitanike, što je gotovo identičan nalaz, dok Droschl (16) registrira porast između 10. i 15. godine u iznosu od 4,1 mm u muških i 2,8 mm u ženskih ispitanika.

Raščlamba dinamike rasta linije n-s pokazuje znatan porast između prve dvije promatrane dobne skupine, što se može pripisati prepubertetskom i pubertetskom općem porivu rasta. Muški ispitanici nastavljaju ponešto intenzivnijim rastom i u poslijeadolescentno doba (Slika 3).



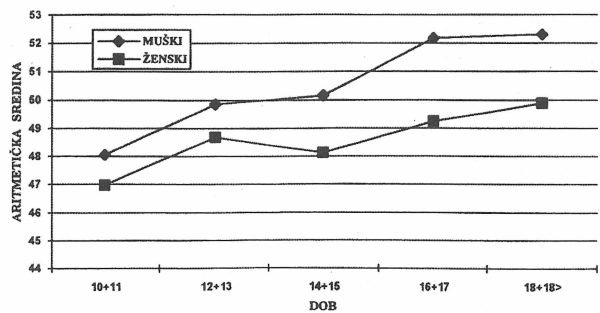
Slika 3. Kretanje aritmetičkih sredina varijable n-s izražene u mm po dobnim skupinama

Figure 3. Change in the mean values of variable n-s according to age groups

Porast dužine maksilarne baze: sp-pm iznosi 4,26 mm u muških i 3,12 mm u ženskih ispitanika. Broadbent, Broadbent i Golden (15) iznose znatno veće razlike prema istim dobnim skupinama (7,7 mm u muškaraca i 5,0 mm u žena), što je vjerojatno posljedica različitih metodskih pristupa. Schwartz (17) navodi prosječnu vrijednost, dužine maksile 47 mm, što je tek nešto niže od vrijednosti registrirane u ovome radu (47,54 mm).

Dinamika porasta vrijednosti ove varijable od 1. do 2. dobne skupine u oba spola pokazuje znatan i usporedan porast, što se može tumačiti intenzivnijim pubertetskim rastom, a kasniji je intenzivniji porast bio registriran i u adolescentnoj i poslije adolescentnoj dobi (Slika 4).

Prosječna vrijednost dužine mandibularne baze: m'-go cijelog uzorka bez obzira na dob je 78,75 mm u muških i 75,67 mm u ženskih ispitanika. Rakosi (18) navodi dužinu od 68 mm u dobi od 8 godina s



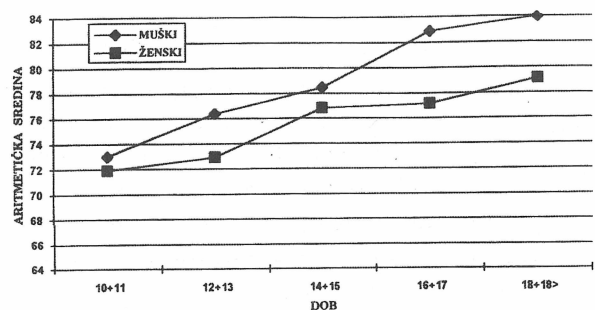
Slika 4. Kretanje aritmetičkih sredina varijable sp'-pm izražene u mm po dobnim skupinama

Figure 4. Change in the mean values of variable sp'-pm according to age groups

godišnjim prirastom od 2 mm za dječake i 1,4 mm za djevojčice. U tome istraživanju zabilježena je vrijednost od 72,47 mm u prvoj dobnj skupini (10+11 god.) koja se povećava na 81,30 mm u odraslih što iznosi ukupno 11,5% (od prve dobne skupine). Buschang, Nass i Walker (19) za isti raspon dobi navode vrijednost od 71,32 mm kao početne vrijednosti koje u skupini osamnaestogodišnjaka porastu na 79,8 mm, što je vrlo slično našim nalazima.

Raščlamba dinamike rasta pokazuje jednoličan prirast u muških ispitanika do skupine od 16 i 17 godina, dok je u ženskih ispitanika zabilježen izraziti porast između skupina 12 i 13 godina i 14 i 15 godina, nakon čega se rast usporuje (Slika 5). Ovakvi nalazi slažu se s rezultatima longitudinalne studije rasta mandibule koje su objavili Björk i Skillerova (20).

Varijabla kojom se procjenjuje stražnja visina lica: s-go u promatranom dobnom rasponu pokazuje



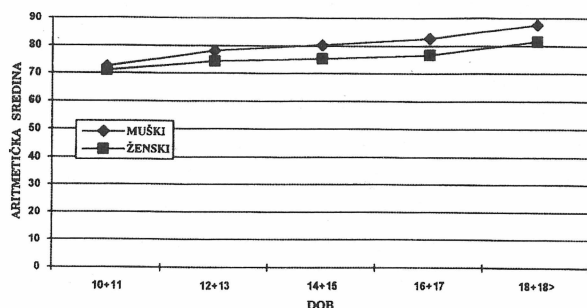
Slika 5. Kretanje aritmetičkih sredina varijable m'-go izražene u mm po dobnim skupinama

Figure 5. Change in the mean values of variable m'-go according to age groups

ukupni porast od 12,3 mm ili 14,5%, ali valja napomenuti da su apsolutne vrijednosti i prirast znatno veći u dječaka (16,8%), nego u djevojčica (12,8%) (Tablica 2).

Droschl (16) nalazi znatniji porast te ove varijable u dječaka između 10. i 15. godine, kada on iznosi 13% a u djevojčica 11,8%.

Dinamika porasta stražnje visine lica prilično je homogena u odnosu prema dobnoj skupini, gdje se samo u dječaka opaža veće ubrzanje između skupine 10+11 i 12+13 godina. Oba spola pokazuju usporodnu krivulju rasta, osim u navedenoj dobi. (Slika 6).



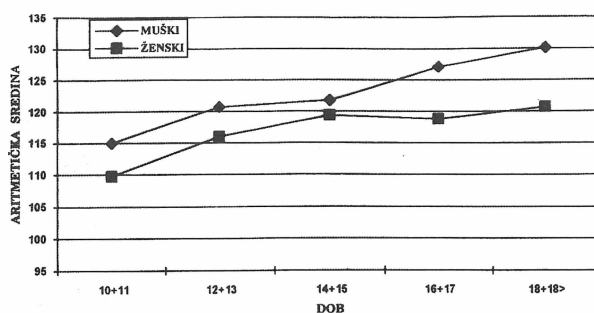
Slika 6. Kretanje aritmetičkih sredina varijable s-go izražene u mm po dobnim skupinama

Figure 6. Change in the mean values of variable s-go according to age groups

Varijabla prednja visina lica: n-m jedna je od najznačajnijih jer izravno pokazuje intenzitet okomitoga rasta viscerokraniuma. U ovome radu porast vrijednosti te varijable iznosi 9,9% (od 112,48 mm do 124,94 mm), što je slično nalazu Droschla (16) koji od 10. do 15. godine nalazi porast od 8,45% za muške i 7,4% za ženske. Broadbent, Broadbent i Golden (15) iznose porast od čak 13,6%. Rakosi (18) navodi raspon vrijednosti od 112,8 mm u desetogodišnjaka do 126,8 u šesnaestogodišnjaka. Bishara, Peterson i Bishara (21) navode slične vrijednosti, u desetogodišnjaka 102,4 mm, te u odraslih 116,8 mm. Foley i Mamandras (22) upozoravaju na ponešto veći raspon ukupne stražnje visine lica u usporedbi s prednjom, što je registrirano i u ovome radu.

Jones i Meredith (23), Jarabak i Fizzel (24) iznose proporcionalni odnos stražnje i prednje visine lica indeksom 62, dok je u našoj populaciji 64,5, što ukazuje na neke etničke razlike (25).

Povećanje prednje visine lica podudarno je i intenzivno u oba spola između 10+11 i 12+13 godina, što slijedi blaži porast u muških između 14+15 i 16+17 godina s akceleracijom do odrasle dobi, a u ispitanica nakon 14+15 slijedi stagnacija rasta i neznatan rast u zadnjoj fazi sazrijevanja (Slika 7).



Slika 7. Kretanje aritmetičkih sredina varijable n-m izražene u mm po dobnim skupinama

Figure 7. Change in the mean values of variable n-m according to age groups

Razlike aritmetičkih sredina ukupnog uzorka između muških i ženskih ispitanika statistički su znatne na razini vjerojatnosti od 5% za sve varijable (Tablica 3).

## Zaključci

Iz provedenog istraživanja mogu se utvrditi sljedeći zaključci:

- srednje vrijednosti svih 5 ispitivanih parametara utvrđene na uzorku eugnatih ispitanika predstavljaju standarde za našu populaciju, koji su namijenjeni kvantitativnim procjenama kraniofacijalnoga rasta ortodontskih pacijenata u pet različitih razvojnih dobi: 10 i 11, 12 i 13, 14 i 15, 16 i 17, te 18 i više godina;
- testiranje razlika aritmetičkih sredina između muških i ženskih ispitanika pokazalo je da su svi ispitivani linearni parametri veći u muških ispitanika;
- intenzitet porasta ispitivanih parametara u definiranom razdoblju je različit; procjena dinamike pokazuje da većina ispitivanih parametara intenzivnije raste u doba između 10. i 11. te 12. i 13. godine, što se može tumačiti pubertetskom akceleracijom.

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# Dynamics of Linear Craniofacial Parameter Changes during Growth

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## Summary

Research into the dynamics of linear craniofacial parameter changes during growth was conducted on a sample of 200 lateral cephalometric radiographs: 106 were of female and 94 of male subjects. The subjects were divided into five age groups: 10 and 11, 12 and 13, 14 and 15, 16 and 17 and 18 years and over.

The aim of this study was to determine the mean values of linear craniofacial variables for the chosen age groups, to observe possible differences according to sex, and to register the dynamics and intensity of the changes during growth of the viscerocranium. An estimate was made on five linear craniofacial variables of the total sample of eugnathic subjects: anterior cranial base, maxillary base, mandibular base, anterior and posterior face height.

The means of the variables and differences according to sex were established, as well as the intensity and dynamics of growth for each variable.

The means represent the standards intended to enable quantitative assessments of the craniofacial growth in orthodontic patients.

The male subjects exhibited higher values for all linear parameters. Appraisal of the dynamics shows that the majority of tested parameters have a more intensive growth at ages between 10 and 11, and 12 and 13 years, which can be attributed to puberty acceleration.

Quantitative indicators resulting from the research on this sample can be used for clinical estimates of craniofacial growth in subjects of the Croatian population.

Key words: craniofacial parameters, growth

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## Introduction

The craniofacial system is a very complex area that involves different functional processes. Data on its skeletal morphology and growth are often used in orthodontic clinical practice.

Differences in craniofacial morphology can lead to different kinds of malocclusion. Therefore, it is important to understand the growth of the craniofacial system which is crucial for orthodontic treatment.

Roentgenocephalometry is an analytical method of measuring that serves for establishing craniofacial characteristics. It gives information about the results of growth at a certain moment and the correlations of craniofacial structures (1).

Modern roentgenocephalometry began in 1930 (2,3), since when many diagnostic procedures for measuring and comparing angular parameters have been established (4-8). However, analyses comprising both angular and linear measurements are rare (9,10,11).

Linear measurements have been established by defining referent lines on which the perpendiculars from different landmarks can be projected.

Subsequently the distances between the projections can be measured. Such analyses are performed by De Coster, Morrees and Sassouni (12,13,14).

The aim of this study was to determine the mean values of five linear craniofacial variables for chosen age and sex groups of an eugnathic sample of our population, to observe possible differences according to sex and to register the dynamics and intensity of changes during growth of the viscerocranium from the first to the last investigated age group.

## Subjects and methods

The research was conducted on a collection of radiographs of eugnathic patients from the Orthodontic Department of the School of Dental Medicine in Zagreb.

The sample consisted of 200 lateral cephalometric radiographs: 106 were of female and 94 of male subjects. The subjects were divided into five age groups (Table 1).

Radiographs were made by the conventional roentgenocephalometric procedure. All radiographs were traced on acetate paper. Ten cephalometric points were marked on the tracings: n-nasion, s-sella, sp-spina nasalis anterior, sp'-spinale (perpendicular from ss to sp'-pm), pm-pterygomaxillare, m'-menton (perpendicular from gn to m-go), go-gonion, ss-subspinale, gn-gnation, m-menthon (Figure 1).

An estimate was made on 5 linear variables (Figure 2):

1. n-s = the length of the anterior cranial base
2. sp'-pm = the length of the maxillary base

3. m'-go = the length of the mandibular base

4. s-go = posterior face height

5. n-m = anterior face height.

The variables were measured in mm with precision of  $\pm 0.5$ .

Statistical analyses were performed according to age and sex as well as in total. Basic statistics were calculated: mean values, minimum and maximum values and standard deviation. The significance of the differences between the means of all variables were calculated according to sex.

## Results

Mean values ( $\bar{x}$ ), standard deviations (SD), minimum (MIN) and maximum (MAX) values for all variables, divided (classified) according to sex, age groups and in total are shown in Table 2. In Table 2 basic statistical parameters for linear parameters in sagittal and vertical dimension are presented separately.

The statistical differences of the mean values between the sexes for all variables with their significances are illustrated in Table 3.

The changes of the mean values of all five variables according to age groups are shown graphically in Figures 3 to 7 separately for both sexes.

## Discussion

The results show an increase in the values for all variables from the age of 10 to adult age.

Parameter n-s that defines anterior cranial base increases from the first investigated age group to adult age by 5.3 mm in males and 3.7 mm in females (Table 2).

In the same time interval Broadbent, Broadbent and Golden (15) found an increase of 5.9 mm in male and 3.3 mm in female subjects, which is almost identical to our findings, while Droschl (16) registered an increase of 4.1 mm in male and 2.8 mm in female subjects between 10 and 15 years of age.

An appraisal of the dynamics of the parameter n.s shows more intensive growth between 10 and 11, and 12 and 13 years of age, which can be attri-



buted to prepuberty and puberty acceleration. More intensive growth in male subjects was observed in the adolescent age (Figure 3.).

Increase of the length of the maxillary base: sp'-pm was 4.26 mm in male and 3.12 mm in female subjects. Broadbent, Broadbent and Golden (15) found significantly higher values in the same age groups (7.7 mm in males and 5.0 mm in females), probably because of a different methodological approach. Schwarz (17) for the mean value of the length of the maxillary base quotes 47 mm, which is slightly lower than that found in our investigation (47.54 mm).

The dynamics of the growth of this variable from the first to the second investigated age group shows a significant and parallel increase in both sexes, which can be attributed to puberty acceleration. More intensive growth was also detected later in the adolescent and postadolescent age (Figure 4).

The mean value for the length of the mandibular base: m'-go for the whole sample was 78.75 mm in male and 76.67 mm in female subjects.

Rakosi (18) recorded the length of 68 mm at an age of 8 years with an increase of 2 mm in males and 1.4 mm in females per year. In our investigation we recorded 72.47 mm in 10 and 11 year groups and 81.30 mm in adults, which is an increase of 11.5%. For the same age interval Buschang, Nass and Walker (19) found value of 71.32 mm in the first age group with an increase of 79.8 mm in the 18-year old group, which is almost identical to our findings.

The analysis showed a uniform increase of the growth dynamics up until 16 and 17 years, while in females a more intensive increase was found between the 12 and 13 and 14 and 15 year old groups, after which the growth showed down. These findings are similar to those obtained by Björk and Skillerova (20) in their longitudinal study of mandibular growth.

The variable which represents the posterior face height: s-go in the investigated age interval shows an increase of 12.3 mm or 14.5%. The absolute values as well as the increase are significantly higher in males (16.8%) than in females (12.8%) (Table 2).

Droschl (16) registered a significant increase of this parameter in boys between the ages of 10, and 15 (13%) in comparison to girls (11.8%).

The dynamics of posterior face height is homogenous with regard to the age groups. Higher values of growth were found only in the 10 and 11 and 12 and 13 years old male groups. Both genders exhibited a parallel curve of growth, except the above mentioned age groups (Figure 6).

The anterior face height variable: n-m is one of the most important because it directly reflects the intensity of the vertical growth of the viscerocranium. In our investigation an increase of 9.9% was found (from 112.48 mm to 124.94 mm) which is similar to Droschl's (16) findings. In the age group of 10 to 15 years, he found an increase of 8.45% in male and 7.4% in female subjects. Broadbent, Broadbent and Golden (15) found an increase of almost 13.6%. Rakosi (18) registered a value of 112.8 mm in 10 year old and 126.8 in 16 year old subjects.

Bishara, (21) found similar values, 102.4 mm in 10 year old subjects and 116.8 mm in adults.

Foley and Mamandras (22) point to a slightly higher range of total posterior in comparison to anterior face height, which was also recorded in our investigation.

Jones and Meredith (23), stated that the index ratio between anterior and posterior face height is 62, while in our population it is 64.5, which displays an ethnical difference (25).

The increase in the anterior face height is more intense and concordant in both sexes at ages between 10 and 11, and 12 and 13 years, followed by less intensive growth in male subjects between 14 and 15 years with a growth acceleration until adolescence. In female subjects, after the ages of 14 and 15 years there is a growth stagnancy and just a little growth potential in the last stage of development (Figure 7).

The differences in the mean values between male and female subjects in the whole sample are significant with the level of probability of 5% for all variables (Table 3).

## Conclusions

The results of our investigation point to these conclusions:

- the means of 5 linear variables of the total sample of eugnathic subjects represent the standards for our population, intended to enable quantitati-

- ve assessments of the craniofacial growth in orthodontic patients in five age groups: 10 and 11, 12 and 13, 14 and 15, 16 and 17 and 18 years and over;
- the significance of the differences between the means of male and female subjects show that the male subjects exhibited higher values for all linear parameters;

- the intensity of the increase of the investigated parameters in the defined age range is not balanced;
- appraisal of the dynamics shows that the majority of tested parameters have more intensive growth at ages between 10 and 11, and 12 and 13 years, which can be attributed to puberty acceleration.