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Spolni dimorfizam kod trajnih mandibularnih očnjaka: istraživanje provedeno na albanskoj populaciji na Kosovu

Sexual Dimorphism in the Permanent Mandibular Canines: A study in Albanian Population of Kosovo

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Sažetak
Svrha: Namjera je bila istražiti spolni dimorfizam trajnih mandibularnih, donjočeljusnih očnjaka u albanskoj populaciji na Kosovu. **Metode:** Uzorak su činila 204 studenta stomatologije, svi odabrani na Stomatološkom fakultetu Sveučilišta u Prištini. Meziodistalni (MD) i bukolingvalni (BL) promjeri mandibularnih kanina (očnjaka) digitalnim su mjeračem (Boss, Njemačka) izmjereni na sadrenim modelima. **Rezultati:** Nakon deskriptivne statistike i t-testa rezultati su pokazali da je u albanskoj populaciji na Kosovu meziodistalni i bukolingvalni promjer mandibularnih očnjaka veći kod muškaraca negoli kod žena te da je razlika statistički značajna (P<0,0001). Moramo istaknuti da je bukolingvalni promjer pokazao veći postotak spolnog dimorfizma (8,50 %) od meziodistalnoga (5,35 %). **Zaključak:** Ovim je istraživanjem potvrđen spolni dimorfizam u meziodistalnom i bukolingvalnom promjeru mandibularnih očnjaka među albanskom populacijom na Kosovu.

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Uvod

Zubi su građeni od mineraliziranog tkiva složenoga u strukture izvanredno otporne na truljenje i utjecaj vanjskih čimbenika (fizikalnih, termalnih, mehaničkih, kemijskih i bioloških) koji inače uzrokuju raspadanje ostalih tkiva u ljudskom tijelu (1). Zato su izvrstan materijal u živim i neživim jedinkama ako su potrebna antropološka, genetička, odontološka i forenzična istraživanja (2). Odontometrija je mjerenje i znanost o veličini zuba. Njihove standardizirane veličine koje se temelje na odontometrijskim istraživanjima mogu se iskoristiti u određivanju dobi i spola. Mjerenje zuba važno je u antropologiji i u istraživanjima spolnog dimorfizma (3,4). Na zubnim krunama standardno se mjeri meziodistalni (MD) i bukolingvalni (BL) promjer (5). Moramo reći da se meziodistalni promjer krune smanjuje interproksimalnim trošenjem i zato je mjerenje bukolingvalnog promjera sigurnije u slučaju određivanja spola (6).

Spolni dimorfizam odnosi se na razlike u veličini, strukturi i izgledu između muškaraca i žena istog godišta te se može primijeniti pri identifikaciji zubala zato što ne postoje dva jednaka (7). Osim toga izraženiji je u trajnoj denticiji nego-

Introduction

The teeth consist of mineralized tissues that are characterized by structures of extraordinary resistance to putrefaction and the effect of external agents (physical, thermal, mechanical, chemical or biological) that cause the destruction of the soft part of the body structures (1).

Hence, teeth provide excellent material in living and non-living populations for anthropological, genetic, odontologic and forensic investigations (2). Odontometrics is the measurement and study of tooth size. Tooth size standards based on odontometrics investigation can be used in age and sex determination. Dental measurements are important in anthropology and in studies of dental sexual dimorphism (3, 4). Tooth crown size is routinely measured by mesiodistal (MD) and buccolingual (BL) crown diameters (5). The mesiodistal crown diameters of the teeth are reduced by interproximal wear, and the buccolingual measurements may prove more useful for gender identification (6).

Sexual dimorphism refers to those differences in size, structure and appearance between male and female, at an

li u mliječnoj. Izraženost i uzorak spolnog dimorfizma, kad je riječ o veličini trajnih zuba, razlikuje se od populacije do populacije (8).

Mandibularni očnjaci u prosjeku izrastaju u dobi od oko 10,87 godina i manje su podložni parodontološkim bolestima negoli ostali zubi. Uzimajući u obzir godine, to su posljednji zubi koji se ekstrahiraju. Očnjaci zbog svojih svojstava lakše podnose traume, kao što su zrakoplovne nesreće, uragani ili spaljivanje. To upućuje na činjenicu da su *ključni* u slučaju identifikacije osoba (9 – 12). U mnogim istraživanjima potvrđeno je da od svih zuba mandibularni očnjaci imaju najveći stupanj spolnog dimorfizma (13).

Svrha ovog znanstvenoga rada jest istražiti spolni dimorfizam kod trajnih mandibularnih očnjaka u albanskoj populaciji na Kosovu.

Materijali i metode

Uzorak se sastojao od 204 studenta dentalne medicine odabrana na Stomatološkom fakultetu Sveučilišta u Prištini. Istraživanje je odobrilo Etičko povjerenstvo. Svakom sudioniku objašnjeno je značenje istraživanja i svi su verbalno pristali sudjelovati. Studenti su odabrani na osnovi sljedećih kriterija:

1. dob od 18 do 25 godina
2. zdrav parodont
3. zubi bez karijesa
4. intaktni zubi bez atricije
5. pravilan odnos maksilarnih i mandibularnih zuba bez nepravilanosti, dijastema i zbijenosti
6. bez kliničkih nalaza restauracija kruna, ortodoncije i traume

Limitiranje uzorka na pacijente s intaktnim zubima bez patoloških procesa i istrošenosti učinjeno je kako bi se dobili kvalitetni odontometrijski podaci. Promjeri MD-a i BL-a lijevih i desnih mandibularnih očnjaka izmjereni su na sadrenim modelima elektroničkim digitalnim mjeračem Boss (Njemačka) s preciznošću od ± 0,01 milimetar. Mjerenje je obavljeno prema provjerenoj metodi Moorreesa i Reeda (14). Meziodistalni promjer krune istodobno je i najveća meziodistalna dimenzija izmjerena paralelno s okluzalnom plohom. Bukolingvalni promjer krune, pak, najveća je udaljenost između bukalne (labijalne) i lingvalne (palatinalne) površine okomito na meziodistalni promjer.

Mjerenja je obavljao jedan ispitivač kako bi se izbjegle pogreške, svako je ponovljeno tri puta i na kraju se izračunala prosječna vrijednost.

equal age, which can be applied to dental identification, because no two oral cavities are alike (7). The sexual dimorphism is more pronounced in permanent dentition than in deciduous teeth. The magnitude and pattern of sexual dimorphism in the size of permanent teeth also differ from one population to another (8).

The mandibular canines have a mean age of eruption of 10.87 years and they are less affected by periodontal diseases than other teeth. With respect to age, these are the last teeth to be extracted. Canines are also more likely to survive severe trauma such as air disaster, hurricanes or conflagration. These findings indicate that canines can be considered as the "key teeth" for personal identification (9-12). Many studies have established that amongst all the teeth, the permanent mandibular canines are found to exhibit the greatest sexual dimorphism (13).

The aim of this study was to investigate the sexual dimorphism of the permanent mandibular canines in Kosovo Albanian population.

Material and Methods

The study sample consisted of 204 dental students, selected from Dental School, Faculty of Medicine at the University of Prishtina. The study was approved by the Institutional Ethics Committee, and a verbal explanation was given to each subject regarding the nature of the study, and oral consent was also obtained from each subject. The students were selected based on the following criteria:

1. Age 18-25 years
2. Periodontally healthy teeth
3. Non carious teeth
4. No attrition and intact teeth
5. Satisfactorily aligned maxillary and mandibular teeth, with no spacing or diastema and without crowding
6. No history or clinical evidence of crown restoration, orthodontic treatment and trauma.

The objective of limiting the sample of young adults was to ensure that dentitions were relatively intact, free of pathology and wear, thereby maximizing odontometric information. The MD and BL crown diameters of left and the right mandibular canines were measured in dental casts using electronic digital calliper (Boss, Germany), which had an accuracy ± 0.01 mm. The measurements were performed by recommended method by Moorrees and Reed (14). The mesiodistal crown diameter is the largest mesial-distal dimension, taken parallelly to the occlusal surface. The buccolingual crown diameter is the greatest distance between the buccal (or labial) and lingual (or palatinal) surfaces, perpendicular to the mesiodistal diameter.

The measurements were peformed by a single examiner to eliminate interobserver error. Each measurement was taken three times and the average of three values was obtained to minimize the intraobserver error.

Analiza podataka

Za mandibularne očnjake korištena je deskriptivna statistika (srednja vrijednost, raspon i standardna devijacija). Statistički značajne razlike srednjih vrijednosti promjera MD-a i BL-a između ispitanika i ispitanica izračunate su t-testom za nezavisne uzorke (p<0,01 i p<0,05).

Spolni dimorfizam mandibularnih očnjaka izračunat je prema jednadžbi Garna i Lewisa (15):

$$\text{Spolni dimorfizam} = [\,\text{Xm/Xf}\,] - 1 \times 100$$

gdje je
Xm = srednja vrijednost za muškarce; Xf = srednja vrijednost za žene

Statistička analiza obavljena je u programu SPSS 18 za Windowse (SPSS Inc. Chicago, Illinoiss, SAD) i u MS Excellu (Microsoft Office, Windows 2007., SAD).

Rezultati

Rezultati istraživanja predstavljeni su u tablicama (tablica 1., 2. i 3.). Uočena je statistički značajna razlika u meziodistalnom promjeru mandibularnih očnjaka. Kod muškaraca je srednja vrijednost promjera iznosila 6,88 0,36 milimetara, a kod žena 6,53 0,34 milimetra (p<0,0001) (tablica 1.).

Zabilježena je i statistički značajna razlika u bukolingvalnom promjeru mandibularnih očnjaka. Kod muškaraca je iznosila je 8,04 ± 0,53 milimetra, a kod žena 7,41 ± 0,46 milimetara (p<0,0001), (tablica 2.).

Bukolingvalni promjer mandibularnih očnjaka pokazao je veći stupanj spolnog dimorfizma – 8,50 posto, nego što je meziodistalni promjer istih zuba – 5,35 posto (tablica 3.).

Data analysis

The descriptive statistics was calculated (mean, range and standard deviation) for mandibular canines. The statistical significance of differences in mean in MD and BL diameters between males and females was calculated using t test for independent samples with p<0.01 and p<0.05.

Sexual dimorphism in mandibular canines was calculated according to the formula given by Garn and Lewis (15), as follows:

$$\text{Sexual dimorphism} = [\,\text{Xm/Xf}\,] - 1 \times 100$$

where;
Xm = mean value for males; Xf = mean values for females

Statistical analysis was made using the SPSS 18 for Windows (SPSS Inc., Chicago, Illinoiss, USA) and MS Excel (Microsoft Office, Windows 2007, USA).

Results

The study results are presented in table form (Table 1, 2 and 3). There was a statistically significant difference in the mesiodistal diameter of the mandibular canines. In males the mean value was 6.88 0.36 mm, and in females 6.53 0.34 mm (p<0.0001), (Table 1).

There was a statistically significant difference in the buccolingual diameter of the mandibular canines. In males the mean value was 8.04 ± 0.53 mm, and in females 7.41 ± 0.46 mm (p<0.0001), (Table 2).

The buccolingual diameter of mandibular canines was found to exhibit greater sexual dimorphism 8.50 % than mesiodistal diameter of the same tooth, 5.35 % (Table 3).

Tablica 1. Osnovna deskriptivna statistika meziodistalnog promjera krune mandibularnih kanina
Table 1 Basic descriptive statistics of mesiodistal crown diameter of mandibular canines

Spol • Gender	N	Prosjek ± SD • Mean ± SD (mm)	Raspon • Range	95%CI	CV%	p-vrijednost • p-value
Muški • Male	101	6.88 0.36	6.03 - 7.91	6.81 - 6.94	5.18	t = 7.14 p<0.0001
Ženski • Female	103	6.53 0.34	5.57 - 7.44	6.46 - 6.59	5.21	
Ukupno • Total	204	6.70 0.39	5.57 - 7.91	6.63 - 6.78	5.79	

Tablica 2. Osnovna deskriptivna statistika bukolingvalnog promjera krune mandibularnih kanina
Table 2 Basic descriptive statistics of buccolingual crown diameter of mandibular canines

Spol • Gender	N	Prosjek ± SD • Mean ± SD (mm)	Raspon • Range	95%CI	CV%	p-vrijednost • p-value
Muški • Male	101	8.04 ± 0.53	6.63 - 9.62	7.94 - 8.14	6.60	t=9.07 p<0.0001
Ženski • Female	103	7.41 ± 0.46	6.30 - 8.70	7.32 - 7.50	6.19	
Ukupno • Total	204	7.72 ± 0.59	6.30 - 9.62	7.61 - 7.84	7.59	

Tablica 3. Spolni dimorfizam meziodistalnog i bukolingvalnog promjera mandibularnih kanina
Table 3 Sexual dimorphism in mesiodistal and buccolingual diameter of mandibular canines

Mandibularni očnjaci • Mandibular canine	Muškarci • Males	Žene • Females	% dimorfizma • % Dimorphism
MD* promjer • MD* diameter	6.88	6.53	5.35%
BL* promjer • BL* diameter	8.04	7.41	8.50 %

MD = meziodistalno • Mesiodistal; BL = bukolingvalno • Buccolingual

Rasprava

Zubi su najotpornije mineralizirano tkivo u ljudskome tijelu (16). Očnjaci se razlikuju od ostalih zuba jer su izdržljiviji i prezentiraju spolne karakteristike. Te se razlike najvjerojatnije temelje na njihovoj posebnoj funkciji tijekom evolucije. Kod mesoždera (karnivora) i većine primata oni nisu povezani sa žvakanjem (mastikacijom) nego s prijetnjom i agresijom.

U ovom istraživanju nije uočena razlika između izmjerenih očnjaka s lijeve i desne strane mandibule, što je u skladu s ostalim istraživanjima. Statistički nespecifična razlika u mjerenju trajnih zuba lijeve i desne strane mandibule zabilježena je u istraživanjima na uzorku triju populacija iz Egipta, Meksika i Sjedinjenih Država (17) te Saudijske Arabije (18, 19) i Brazila (20). Ipak, postoji i studija u kojoj su dobivene razlike u dimenziji lijevih i desnih očnjaka (21). Prema našim rezultatima, možemo zaključiti da se kod albanske populacije na Kosovu može izmjeriti samo jedna strana mandibularnih zuba te bi trebala bila reprezentativna i za drugu stranu.

Prema našim rezultatima, može se reći da postoji statistički velika razlika između muškaraca i žena u promjeru MD-a i BL-a mandibularnih očnjaka, pa su naši rezultati u skladu s ostalim istraživanjima u kojima je uočeno da muškarci imaju veće zube od žena (22 – 26). Ovom studijom ustanovljen je statistički značajan spolni dimorfizam mandibularnih kanina. Y-kromosom odgovoran je za veličinu zuba kontrolirajući debljinu dentina, a X-kromosom nadzire debljinu cakline. Spolni dimorfizam, kad je riječ o zubima, može se objasniti razmjerno većom debljinom dentina kod muškaraca (27).

Kako ističu Alt i njegovi suradnici (28), promjer vrata zuba daje bolje informacije negoli promjer krune. Ti stručnjaci smatraju da cervikalni dio zuba nije pod utjecajem trošenja i zato je korisniji u arheološkim istraživanjima. Prednost nije toliko važna za bukolingvalne promjere, ali jest za meziodistalne, posebice kod prednjih zuba (5).

Bukolingvalni promjer mandibularnih očnjaka pokazao je veći stupanj spolnog dimorfizma (8,50 %) negoli njihov meziodistalni promjer (5,35 %). Kanini najčešće pokazuju najveći stupanj spolnog dimorfizma. Isto tako su se u mnogim istraživanjima pokazali kao najčešći dimorfni zubi (22, 29, 30). Postotak spolnog dimorfizma bio je manji kod meziodistalnog promjera negoli kod bukolingvalnog u današnjoj grčkoj populaciji te kod tajvanskih Kineza i Egipćana (30 – 32). Postotak spolnog dimorfizma mandibularnih očnjaka među albanskom populacijom na Kosovu bio je razmjerno visok. Izračunata je razlika od tri do devet posto (7) spolnog dimorfizma između muškaraca i žena. Postoji kompleksna interakcija između genetskih čimbenika i djelovanja okoliša koja utječe na magnitude razlika spolnog dimorfizma između muškaraca i žena. Tako različite populacije imaju različite stupnjeve spolnog dimorfizma. U nekima je više izražen. Spolni dimorfizam u veličini zuba specifičan je za svaku populaciju (33) i različit za svaku etničku skupinu (8).

Discussion

Teeth are known to be unique organs made of the most enduring mineralized tissues in the human body (16). Canines differ from other teeth with respect to survival and sex dichotomy. These differences are probably related to their function, which differs from other teeth on an evolutionary basis. In carnivores and most primates, the main function of the canines is not mastication, but is related to threat of aggression. Survival was dependant the functional activity of the canines.

In this study, there was no significant difference between measurements of the canines on the left and right sides, which complied with several studies. A non significant difference of the measurements of permanent teeth between right and left sides was reported in a study of samples of three populations from Egypt, Mexico and United States (17), in Saudi Arabian (18,19) and in Brazilian population (20). Nevertheless, there is a study with opposite findings where a significant difference between the left and right mandibular canines was observed (21). From our findings, it could be concluded that in Kosovo-Albanian population the measurement of one side could be representative when measurement of the other side was unobtainable.

According to the results obtained in our study, statistically significant differences between males and females in MD and BL diameters of mandibular canines were found and these results were in agreement with other studies in which it was observed that the males have larger teeth than females (22-26). The present study establishes the existence of the definitive statistically significant sexual dimorphism in mandibular canines. The Y chromosome is responsible for the size of the teeth by controlling the thickness of dentine, whereas the X chromosome seems to be responsible for modulating thickness of enamel. The sexual dimorphism in tooth is attributable to the presence of relatively more dentine in the crowns of male teeth (27).

According to Alt et al. (28), the dental cervix diameter proved to be more useful than crown diameters. Consequently, the cervical diameters are not affected by wear until most of the crown has been lost, so they have a big advantage for archaeological purposes. This advantage is less important for buccolingual diameters, but it is crucial for mesiodistal diameters, especially in anterior teeth (5).

The buccolingual diameter of mandibular canines showed a greater percentage of sexual dimorphism (8.50%) than mesiodistal diameter of mandibular canines (5.35%). Canines traditionally showed the highest degree of sexual dimorphism. They were usually the most dimorphic teeth in various studies (22, 29, 30). The percentage of sexual dimorphism was smaller in the mesiodistal diameters than in the buccolingual in present Greek population, Taiwan Chinese, and Egyptian population (30-32). The percentage of sexual dimorphism in mandibular canines in Kosovo Albanian population was relatively high. It was found that the difference between males and females in the percentage of dental sexual dimorphism ranged from 3-9% (7). There can be a complex interaction between a variety of genetic and environmental factors that is responsible for the variation in the magnitude

of dimorphism. Different human populations may show different expressions of sexual dimorphism. In some populations, this dimorphism may be more developed than in others. Sexual dimorphisms in tooth size are population specific (33) and varied among different ethnic groups (8).

Zaključak

Meziodistalni i bukolingvalni promjer mandibularnih očnjaka bio je veći kod muškaraca negoli kod žena. Razlika je statistički značajna (p<0,0001).

Ovo istraživanje potvrdilo je dentalni dimorfizam mandibularnih očnjaka i statistički značajan spolni dimorfizam meziodistalnog i bukolingvalnog promjera mandibularnih očnjaka u albanskoj populaciji na Kosovu. To je ujedno prvo odontometrijsko istraživanje u toj populaciji i zahvaljujući toj studiji antropolozi, odontolozi i forenzičari moći će dobiti potrebne informacije za svoja istraživanja.

Conclusion

The mesiodistal and buccolingual diameter of the mandibular canines was larger in males than in females and the difference was statistically significant (P<0.0001).

The present study confirmed the presence of dental dimorphism in mandibular canines, which has been established by the existence of statistically significant sexual dimorphism in mesiodistal and buccolingual diameter of mandibular canines in Kosovo Albanian population. This is also the first odontometric study in this population which will be useful in anthropological, odontologic, and forensic investigations.

Zahvala

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Sukob interesa

Sukob interesa nije postojao.

Conflict of interest

No conflict of interest.

Abstract

Aim: The purpose of this study was to investigate the sexual dimorphism of the permanent mandibular canines in Albanian population of Kosovo. **Methods:** The study sample consisted of 204 dental students, selected from Dental School, Faculty of Medicine at University of Prishtina. The mesiodistal (MD) and buccolingual (BL) diameters of the mandibular canines were measured in dental cast using electronic digital calliper (Boss, Germany), which has an accuracy ± 0.01 mm. **Results:** The descriptive statistics and t-test were used. The results showed that in Kosovo-Albanian population mesiodistal and buccolingual diameter of the mandibular canines was larger in males than in females and the difference was statistically significant (P<0.0001). The buccolingual diameter of mandibular canines showed greater percentage of sexual dimorphism (8.50%) than mesiodistal diameter (5.35%). **Conclusion:** The present study confirmed sexual dental dimorphism in mesiodistal and buccolingual diameter of mandibular canines in Kosovo Albanian population.

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Key words
Cuspid; Mandible; Odontometry; Sex Characteristics; Kosovo

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