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Sexual Dimorphism in Maxillary Canine Dimensions among Kosovo Population: A CBCT Analysis

Spolni dimorfizam u dimenzijama maksilarnih očnjaka u populaciji Kosova: CBCT analiza

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Abstract

Dental sexual dimorphism, particularly in maxillary canines, is one of the most reliable markers for sex determination in forensic and anthropological contexts. With the advent of cone beam computed tomography (CBCT), more accurate and population-specific morphometric data can be obtained. **Objective:** This study aimed to measure sexual dimorphism in maxillary canine crown sizes in the Kosovo population using cone beam computed tomography (CBCT) scans. It also assessed the potential for determining sex in forensic cases. **Materials and Methods:** A retrospective analysis was conducted on CBCT scans from 60 subjects (30 males, 30 females) aged 18-30 years at the University Clinical Center of Kosovo. Mesiodistal (MD) and vestibularoral (VO) crown dimensions were measured. Statistical analyses included descriptive statistics, independent t-tests, Cohen's d effect sizes, and sexual dimorphism percentages calculated using the Garn and Lewis formula. **Results:** All parameters showed significant sexual dimorphism ($p < 0.001$), with males exhibiting larger crown sizes. The highest dimorphism was observed in the left canine VO dimension (8.92%), followed by the right canine VO (8.87%). Average sex differences ranged from 0.597–0.724 mm, with large effect sizes (Cohen's d: 1.166–1.435). Bilateral correlations were strong for both MD and VO measurements ($r = 0.961–0.966$). **Conclusions:** Maxillary canines exhibit pronounced sexual dimorphism in the Kosovo population, with VO dimensions showing slightly greater discriminatory potential than MD. These findings highlight their value in forensic sex determination and provide population-specific reference data for Kosovo.

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Introduction

Dental sexual dimorphism refers to the differences in the size, shape, and other characteristics of teeth between males and females (1). In general, males tend to have larger teeth than females (2). Among all teeth, canines are consistently the most dimorphic and are significantly larger in males than in females (3,4). This occurrence has been linked to the impact of sex hormones during tooth development, particularly the effect of testosterone on crown formation in males, resulting in larger tooth sizes than in females (5,6). Because of its strong structure, delayed eruption, and resistance to environmental factors that could affect dental remains, the maxillary canine crown has garnered a lot of attention in forensic contexts (7,8).

Prior research has demonstrated that sexual dimorphism in tooth dimensions varies significantly across populations, thus underscoring the significance of having population-specific reference data (9,10). Despite its unique demographic characteristics and potential forensic uses, the population of

Uvod

Dentalni spolni dimorfizam odnosi se na razlike između muškaraca i žena u veličini, obliku i drugim obilježjima zuba (1). Općenito, muškarci imaju veće zube od žena (2). Od svih zuba očnjaci su dosljedno najdimorfiji i znatno su veći kod muškaraca nego kod žena (3, 4). Ta pojava povezana je s utjecajem spolnih hormona tijekom razvoja zuba, posebno testosterona na formiranje krunice kod muškaraca, što rezultira većim zubima nego kod žena (5, 6). Zbog svoje snažne strukture, odgođenog nicanja i otpornosti na čimbenike okoliša koji bi mogli utjecati na ostale zube, kruna očnjaka u gornjoj čeljusti privukla je mnogo pozornosti u forenzičkim kontekstima (7, 8).

U dosadašnjim istraživanjima autori su pokazali da se spolni dimorfizam u dimenzijama zuba značajno razlikuje među populacijama, što ističe važnost referentnih podataka specifičnih za populaciju (9, 10). Unatoč jedinstvenim demografskim obilježjima i potencijalnoj forenzičkoj upotrebi, populacija Kosova dobila je malo pozornosti u mnogim

Kosovo has received little attention in numerous studies that have looked at different ethnic groups. Dental morphometric analysis has been revolutionised by cone beam computed tomography (CBCT), which offers improved accuracy and consistency over traditional measurement methods (11,12). Through three-dimensional imaging with minimal distortion, low radiation dose, brief exposure time, and minimal artefact generation, CBCT offers precise measurements of dental structures (13,14).

In light of the lack of thorough information on sexual dimorphism in the Kosovo population and the growing demand for forensic databases tailored to a particular population, this study has used CBCT to measure sexual dimorphism in maxillary canine dimensions. The Kosovo region, which lacks a dedicated forensic anthropology department and might profit from evidence-based identification methods, consider the creation of such reference data particularly important.

Materials and Methods

Study Design and Ethical Approval

This retrospective cross-sectional study was conducted at the University Clinical Center of Kosovo following approval from the institutional ethics committee (Reference No: 7133). All procedures were performed following the Declaration of Helsinki and local ethical guidelines.

Sample Selection

The study sample included 60 participants (30 males and 30 females) aged 18-30 years, selected from patients who underwent CBCT examinations for various clinical reasons between 2020 and 2024. All of the subjects were permanent residents of Kosovo.

Inclusion criteria required participants to be aged 18 to 30 years and be permanent residents of the Republic of Kosovo. Participants were excluded if they had acquired or developmental deformities, marked facial asymmetry, a history of mandibular fractures, or missing teeth in the intercanine region. Exclusion criteria also included individuals with teeth affected by extensive proximal caries, attrition, abrasion, or erosion, as well as those with periodontal disease, cysts or tumors in the maxillary region, rheumatoid arthritis, or prognathism. Patients with prosthetic restorations were also excluded.

All CBCT scans were obtained using a standardized protocol. Patients were positioned upright with the Frankfurt horizontal plane parallel to the floor, using VO3 image type with 14.179 seconds exposure time. Image reconstruction was performed using Galileo software (Version 1.9.6872.26418, Sirona Dental Systems GmbH; software engineering by SICAT GmbH & Co. KG) with isotropic voxel resolution suitable for accurate linear measurements.

Morphometric Measurements

The parameters measured for both maxillary canine crowns (teeth 13 and 23) included mesiodistal (MD) diameter, defined as the distance between the most mesial and dis-

studijama u kojima su proučavale različite etničke skupine. Konusno-snopna kompjutorizirana tomografija (CBCT) revolucionirala je analizu dentalne morfometrije koja omogućuje poboljšanu točnost i konzistentnost u usporedbi s tradicionalnim metodama mjerenja (11, 12). Trodimenzionalnim snimanjem s minimalnim izobličenjem, niskom dozom zračenja, kratkim vremenom ekspozicije i minimalnim stvaranjem artefakata, CBCT precizno mjeri dentalne strukture (13, 14).

S obzirom na nedostatak detaljnih informacija o spolnome dimorfizmu u populaciji Kosova i sve veću potražnju za forenzičkim bazama podataka prilagođenim određenoj populaciji, ova studija koristi se CBCT-om za mjerenje spolnog dimorfizma u dimenzijama maksilarnih očnjaka. Regija Kosova, kojoj nedostaje poseban odjel za forenzičku antropologiju i koja bi mogla imati koristi od metoda identifikacije na temelju dokaza, smatra stvaranje takvih referentnih podataka posebno važnim.

Materijali i metode

Dizajn studije i etičko odobrenje

Ova retrospektivna presječna studija provedena je u Sveučilišnome kliničkom centru Kosova nakon odobrenja institucionalnoga Etičkog povjerenstva (referentni broj: 7133). Svi postupci provedeni su u skladu s Helsinškom deklaracijom i lokalnim etičkim smjernicama.

Odabir uzorka

Uzorak studije bio je 60 ispitanika (30 muškaraca i 30 žena) u dobi od 18 do 30 godina, a odabrani su pacijenti koji su bili podvrgnuti CBCT pregledima iz različitih kliničkih razloga između 2020. i 2024. Svi ispitanici bili su stalni stanovnici Kosova.

Kriteriji za uključivanje zahtijevali su da sudionici budu u dobi od 18 do 30 godina i da su stalni stanovnici Republike Kosova. Ispitanici su bili isključeni ako su imali stečene ili razvojne deformacije, izraženu asimetriju lica, anamnezu prijeloma mandibule ili su im nedostajali zubi u interkaninoj regiji. Kriteriji za isključivanje također su obuhvaćali osobe sa zubima zahvaćenima opsežnim proksimalnim karijesom, atricijom, abrazijom ili erozijom te one s parodontnom bolešću, cistama ili tumorima u maksilarnoj regiji, reumatoidnim artritisom ili prognatizmom. Pacijenti s protetičkim nadomjestcima također nisu mogli sudjelovati.

Sve CBCT snimke dobivene su korištenjem standardiziranoga protokola. Pacijenti su bili uspravno postavljeni s frankfurtskom horizontalnom ravninom paralelnom s podom, a primijenjen je VO3 tip slike s vremenom ekspozicije od 14,179 sekunda. Rekonstrukcija slike obavljena je u softveru Galileo (verzija 1.9.6872.26418, Sirona Dental Systems GmbH; softversko inženjerstvo tvrtke SICAT GmbH & Co. KG) s izotropnom rezolucijom vokselu pogodnom za točna linearna mjerenja.

Morfometrijska mjerenja

Parametri izmjereni za obje maksilarne krunice očnjaka (zubi 13 i 23) uključivali su meziodistalni (MD) promjer definiran kao udaljenost između najmezijalnije i distalne toč-

tal points of the crown measured parallel to the occlusal and vestibular surfaces. In addition, the vestibularoral (VO) diameter was recorded as the greatest vestibularoral distance at the level of the tooth cervix (Figure 1).

Statistical Analysis

Statistical analysis included means, standard deviations, and ranges for all measurements, while the Shapiro-Wilk test was used for estimating the normality of data distribution.

Independent samples t-tests were used to compare measurements between males and females, with Cohen's d calculated for effect sizes (small: 0.2, medium: 0.5, large: 0.8). Sexual dimorphism percentage was calculated using the Garn and Lewis formula:

$$\text{Sexual dimorphism (\%)} = \left(\frac{\text{Male mean}}{\text{Female mean}} - 1 \right) \times 100 \quad (15).$$

Pearson correlation coefficients were computed to evaluate bilateral symmetry and inter-measurement relationships. Statistical significance was set at $p < 0.05$, with 95% confidence intervals calculated for mean differences.

Measurements were performed by V.A., and their reliability was assessed using an Intraclass Correlation Coefficient (ICC) test.

ke krunice mjerene paralelno s okluzalnim i vestibularnim površinama. Uz to, vestibulooralni (VO) promjer zabilježen je kao najveća vestibulooralna udaljenost na razini vrata zuba – slika 1.

Statistička analiza

Statistička analiza uključivala je srednje vrijednosti, standardne devijacije i raspone za sva mjerenja, a Shapiro-Wilkov test korišten je za procjenu normalnosti distribucije podataka.

Za usporedbu mjerenja između muškaraca i žena korišteni su t-testovi neovisnih uzoraka, pri čemu je Cohenov d izračunat za veličine učinka (mali: 0,2, srednji: 0,5, veliki: 0,8). Postotak spolnoga dimorfizma izračunat je Garn-Lewisovom formulom:

$$\text{Spolni dimorfizam (\%)} = \left(\frac{\text{Muška srednja vrijednost}}{\text{Ženska srednja vrijednost}} - 1 \right) \times 100 \quad (15).$$

Pearsonovi koeficijenti korelacije izračunati su za procjenu bilateralne simetrije i odnosa među mjerenjima. Statistička značajnost postavljena je na $p < 0,05$, s 95-postotnim intervalima pouzdanosti izračunatima za srednje razlike.

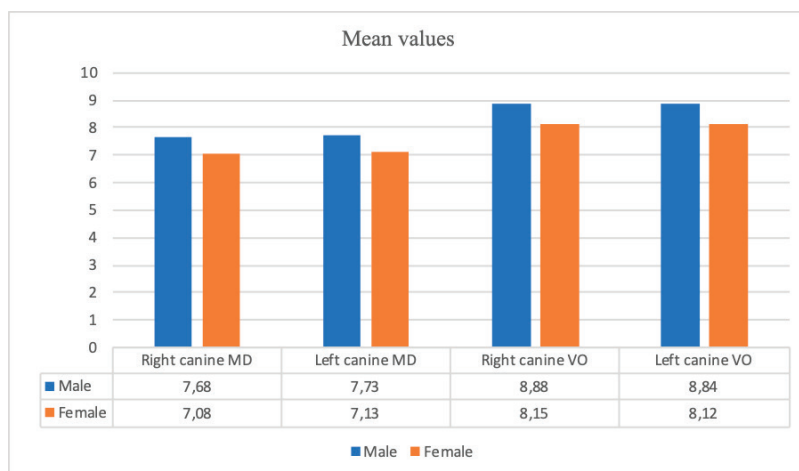
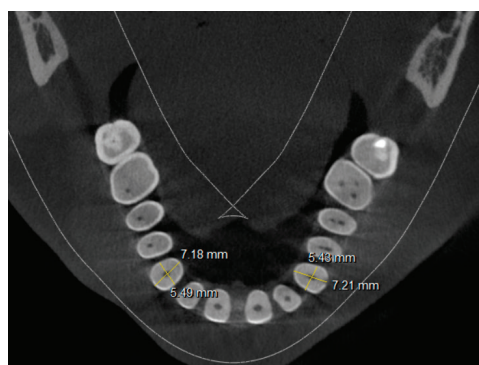


Figure 1 Mesiodistal and vestibularoral diameter of the maxillary canines' crown

Slika 1. Meziiodistalni i vestibulooralni promjer krune maksilarnih očnjaka

Figure 2 Mean mesiodistal (MD) and vestibularoral (VO) dimensions (mm) of maxillary canines in males and females

Slika 2. Srednje meziiodistalne (MD) i vestibulooralne (VO) dimenzije (mm) maksilarnih očnjaka muškaraca i žena

Results

Sample Characteristics

The sample consisted of 60 subjects with equal sex distribution ($n = 30$ per group). Figure 2 and Table 1 present the statistical analysis for all measured parameters.

All measured parameters demonstrated statistically significant differences between males and females ($p < 0.001$). Intra-examiner reliability was excellent for all measurements, with ICC values of 0.90 for 13 BO, 0.89 for 13 MD, 0.87 for 23 MD, and 0.91 for 23 BO. The results of comparative analysis are presented in Table 2.

The vestibularoral crown dimensions showed slightly higher sexual dimorphism percentages compared to mesio-

Rezultati

Značajke uzorka

Uzorak se sastojao od 60 ispitanika s jednakom distribucijom spolova ($n =$ po 30 u skupini). Na slici 2. i u tablici 1. statistička je analiza za sve izmjerene parametre.

Svi izmjereni parametri pokazali su statistički značajne razlike između muškaraca i žena ($p < 0,001$). Rezultati komparativne analize nalaze se u tablici 2.

Vestibulooralne dimenzije krune pokazale su nešto veće postotke spolnog dimorfizma u usporedbi s meziiodistalnim mjerenjima. Sve veličine učinka klasificirane su kao velike prema Cohenovim kriterijima, što upućuje na golemo praktično značenje izvan statističke značajnosti.

Table 1 Range of mesiodistal and vestibularoral dimensions (mm) for maxillary canines in males and females.**Tablica 1.** Raspon meziodistalnih i vestibulooralnih dimenzija (mm) za maksilarne očnjake kod muškaraca i žena.

Parameter	Male Range	Female Range
Right canine MD	6.71-8.82	6.25-8.27
Left canine MD	6.77-9.01	6.19-8.41
Right canine VO	8.10-9.89	7.09-9.09
Left canine VO	7.44-9.75	7.09-9.02

Table 2 Statistical comparison of maxillary canine dimensions between sexes**Tablica 2.** Statistička usporedba dimenzija maksilarnih očnjaka između spolova

Parameter	Mean Difference	(95% CI)		t-value	p-value	Cohen's d	Dimorphism (%)
		Lower Limit	Upper Limit				
Right canine MD	0.60	0.33	0.86	4.52	<0.001	1.17	8.43
Left canine MD	0.60	0.34	0.87	4.58	<0.001	1.18	8.45
Right canine VO	0.72	0.46	0.98	5.56	<0.001	1.43	8.87
Left canine VO	0.72	0.45	1.00	5.24	<0.001	1.35	8.92

distal measurements. All effect sizes were classified as large according to Cohen's criteria, indicating substantial practical significance beyond statistical significance.

Bilateral Symmetry and Correlations

Bilateral measurements of vestibularoral dimensions ($r = 0.966$, $p < 0.001$) and mesiodistal dimensions ($r = 0.961$, $p < 0.001$) showed strong positive correlations. These significant correlations demonstrate excellent bilateral symmetry, indicating that measurements from either side can be used to assess sexual dimorphism.

Moderate to strong correlations between dimensional measurements on the same teeth were also observed ($r = 0.690$ - 0.705), suggesting coordinated patterns of crown development.

Discussion

This study provides the first comprehensive analysis of sexual dimorphism in maxillary canine crown dimensions in the Kosovo population using CBCT technology. The aim was to determine whether significant differences exist between males and females in mesiodistal and vestibularoral canine dimensions. This research provides population-specific data that can serve both forensic and clinical applications.

The findings have established significant sexual dimorphism in all measured parameters, with males consistently showing larger crown dimensions than females, in accordance with global patterns reported in the dental anthropological literature (15,16).

Vestibularoral measurements showed somewhat greater sexual dimorphism than mesiodistal measurements, which is consistent with earlier studies suggesting that crown width may be more sensitive to hormonal influence than crown length (17,18).

The large effect sizes (Cohen's $d > 1.1$) observed across all measurements indicate both statistical significance and substantial practical relevance. These results demonstrate substantial sexual dimorphism in this population, exceeding

Bilateralna simetrija i korelacije

Bilateralna mjerenja vestibulooralnih dimenzija ($r = 0.966$, $p < 0.001$) i meziodistalnih dimenzija ($r = 0.961$, $p < 0.001$) pokazala su jake pozitivne korelacije. Te značajne korelacije pokazuju izvrsnu bilateralnu simetriju, što upućuje na to da se mjerenja s obje strane mogu koristiti za procjenu spolnoga dimorfizma.

Također su uočene umjerene do jake korelacije između dimenzijskih mjerenja na istim zubima ($r = 0.690$ - 0.705), što upućuje na koordinirane modele razvoja krunice.

Rasprava

U ovoj studiji prva je sveobuhvatna analiza spolnoga dimorfizma u dimenzijama krune maksilarnih očnjaka u populaciji Kosova, a korištena je CBCT tehnologija. Cilj je bio utvrditi postoje li značajne razlike između muškaraca i žena u meziodistalnim i vestibulooralnim dimenzijama očnjaka. Ovo istraživanje pruža podatke specifične za populaciju koji mogu poslužiti i za forenzičku i za kliničku primjenu.

Nalazi pokazuju značajan spolni dimorfizam u svim izmjerenim parametrima, pri čemu muškarci dosljedno imaju veće dimenzije krune od žena, u skladu s globalnim modelima zabilježenima u dentalnoj antropološkoj literaturi (15, 16).

Vestibulooralna mjerenja pokazala su nešto veći spolni dimorfizam od meziodistalnih mjerenja, što je u skladu s ranijim studijama u kojima se sugerira da širina krune može biti osjetljivija na utjecaj hormona nego duljina krune (17, 18).

Znatne veličine učinka (Cohenov $d > 1.1$) uočene u svim mjerenjima upućuju i na statističku značajnost i na značajnu praktičnu relevantnost. Ovi rezultati pokazuju velik spolni dimorfizam u ovoj populaciji koji premašuje onaj uočen u mnogim dosadašnjim studijama (19, 20). S obzirom na ta-

sexual dimorphism which was observed in many previous studies (19,20). Given these large effect sizes, these parameters could be used to accurately determine sex.

High bilateral correlations ($r > 0.96$) confirm the remarkable symmetry in maxillary canine development, thus supporting the use of unilateral measurements when bilateral study is not feasible. This finding is particularly valuable for fragmentary remains where only some dental components can be examined.

Research on various ethnic groups has found that canine dimensions exhibit sexual dimorphism ranging from 3% to 12% (21,22). Compared to this global range, the percentages of sexual dimorphism observed in this study (8.43–8.92%) fall at the higher end. These results from the Kosovo population sample point to notable sex-related variations that might be caused by developmental, environmental, or genetic factors specific to this group.

Instead of depending on broad reference standards that might not adequately reflect regional biological traits, these variations highlight the necessity of population-specific databases.

Forensic and Clinical Consequences

A significant gap in forensic dentistry databases will be filled with the collection of population-specific data for the Kosovo population. Because of the region's complicated past and current identification difficulties, especially with regard to victims of conflict, these findings offer important information for forensic anthropological applications in cases where skeletal remains are fragmented or incomplete. The dimensions of maxillary canines can help with forensic identification because they are among the strongest teeth and frequently withstand postmortem damage. When other morphological markers are unavailable, this is especially helpful for identifying victims of disasters, conducting archaeological research, and other situations (23, 24).

Comparisons of Populations

The population of Kosovo exhibits distinct patterns when compared to data from neighbouring regions, thus underscoring the need for population-specific reference standards.

Studies conducted in Croatia and other Balkan countries have revealed varying degrees of sexual dimorphism, demonstrating the diversity found even in seemingly similar regions (4,25,26).

120 dental casts from patients ages 11 to 25 were examined by Croatian researchers to check for sexual dimorphism in the mandibular and maxillary canines. Males had higher mean values than females when the diameter of maxillary canines was measured. The right maxillary canine's (tooth 13) mesiodistal mean width was 7.89 mm for males and 7.52 mm for females, while the buccolingual width was 8.47 mm for males and 8.12 mm for females. For the left maxillary canine (tooth 23), the mean mesiodistal width was 7.92 mm in males and 7.64 mm in females, and the buccolingual width was 8.43 mm in males compared to 8.10 mm in females (4).

Research analyzing 200 plaster casts of permanent dentition from Serbian individuals aged 18–25 years measured

ko velik učinak, ovi parametri mogli bi se koristiti za točno određivanje spola.

Visoke bilateralne korelacije ($r > 0.96$) potvrđuju izvanrednu simetriju u razvoju maksilarnih očnjaka, čime se podržava korištenje unilateralnih mjerenja kada bilateralna studija nije izvediva. Ovaj nalaz posebno je vrijedan za fragmentarne ostatke na kojima se mogu ispitati samo neke zubne komponente.

Istraživanja na različitim etničkim skupinama otkrila su da dimenzije očnjaka pokazuju spolni dimorfizam u rasponu od 3 do 12 % (21, 22). U usporedbi s ovim globalnim rasponom, postotci spolnoga dimorfizma uočeni u ovoj studiji (8,43 – 8,92 %) na gornjoj su granici. Ovi rezultati iz uzorka populacije s Kosova upućuju na značajne varijacije povezane sa spolom koje bi mogle biti prouzročene razvojnim, okolišnim ili genetskim čimbenicima specifičnim za ovu promatranu skupinu.

Umjesto oslanjanja na široke referentne standarde koji možda ne pokazuju odgovarajuće regionalne biološke osobine, ove varijacije ističu potrebu za bazama podataka specifičnim za populaciju.

Forenzičke i kliničke posljedice

Značajna praznina u bazama podataka forenzičke stomatologije bit će popunjena prikupljanjem podataka specifičnih za populaciju Kosova. Zbog složenih prošlih i sadašnjih poteškoća u identifikaciji u regiji, posebno kad je riječ o žrtvama sukoba, ova otkrića nude važne informacije za forenzičku antropološku primjenu u slučaju kada su skeletni ostatci fragmentirani ili nepotpuni. Dimenzije maksilarnih očnjaka mogu pomoći u forenzičkoj identifikaciji jer su to jedni od najjačih zuba i često podnose postmortalna oštećenja. Kada drugi morfološki markeri nisu dostupni, ovo je posebno korisno za identifikaciju žrtava katastrofa i za arheološka istraživanja te u drugim sličnim postupcima (23, 24).

Uspoređivanje populacija

Stanovništvo Kosova pokazuje različite modele u usporedbi s podacima iz susjednih regija, što ističe potrebu za referentnim standardima specifičnim za populaciju.

Studije provedene u Hrvatskoj te u drugim balkanskim zemljama otkrile su različite stupnjeve spolnog dimorfizma, pokazujući raznolikost pronađenu čak i u naizgled sličnim regijama (4, 25, 26).

Dumančić i suradnici (4) pregledali su 120 zubnih odljeva pacijenata u dobi od 11 do 25 godina kako bi provjerili spolni dimorfizam mandibularnih i maksilarnih očnjaka. Muškarci su imali veće srednje vrijednosti od žena pri mjerenju promjera maksilarnih očnjaka. Meziodistalna srednja širina desnoga maksilarnog očnjaka (zub 13) bila je 7,89 mm za muškarce i 7,52 mm za žene, a bukolingvalna širina bila je 8,47 mm za muškarce i 8,12 mm za žene. Za lijevi maksilarni očajnik (zub 23) srednja meziodistalna širina bila je 7,92 mm za muškarce i 7,64 mm za žene, a bukolingvalna širina 8,43 mm za muškarce u usporedbi s 8,10 mm za žene (4).

Filipović i suradnici analizirali su 200 gipsanih odljeva trajnih zuba srpskih pojedinaca u dobi od 18 do 25 godi-

buccolingual and mesiodistal dimensions of maxillary and mandibular canines using digital calipers. Sexual dimorphism was 3.96% in maxillary canines mesiodistal diameter and 5.04% in buccolingual diameter (25).

Another study conducted in Bulgaria, southern Europe, examined 169 patients aged 20-40 years for sexual dimorphism in canines. Parameters including mesiodistal diameter, buccolingual diameter, cervicoincisor diameter, intercanine width, and canine indices were measured directly on patients using a dental sliding vernier caliper. The mean dimensions of the maxillary canines were higher in males compared to females. The right maxillary canine had mesiodistal diameter 8.72 mm in males and 7.95 mm in females, while the vestibulolingual diameter 8.02 mm in males and 7.98 mm in females. Similarly, for the left maxillary canine, the mesiodistal diameter was 8.72 mm in males and 7.95 mm in females, and the vestibulolingual diameter measured 8.02 mm in males and 8.00 mm in females. Findings showed significant differences in mesiodistal diameter of maxillary canines but there were no significant differences in vestibulolingual diameter (26).

Study Limitations and Future Directions

This research focused solely on crown measurements, hence future studies could explore other morphological characteristics, such as root measurements, cervical line configurations, or crown morphological indices, to enhance discriminative capacity. Integrating these findings with other dental and skeletal parameters could enhance the overall accuracy of forensic sex determination methods (27,28).

Conclusions

This study demonstrates significant sexual dimorphism in maxillary canine dimensions in the Kosovo population, with statistically significant differences between males and females across all measured parameters. The results showed that males consistently exhibited larger crown dimensions in all maxillary canine measurements. Sexual dimorphism ranged between 8.43% and 8.92%, with large effect sizes confirming substantial practical relevance. Bilateral symmetry supported the validity of unilateral measurements, and the patterns observed in the Kosovo population diverged from those reported in other ethnic groups.

These findings provide crucial baseline data for forensic applications in the Kosovo region and contribute to the growing body of population-specific morphometric data in dental anthropology. A pronounced sexual dimorphism which was observed in this study suggests that maxillary canines are reliable markers for sex determination in this population.

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na te izmjerili digitalnim kaliperima bukolingvalne i meziodistalne dimenzije maksilarnih i mandibularnih očnjaka. Spolni dimorfizam iznosio je 3,96 % u meziodistalnom promjeru maksilarnih očnjaka i 5,04 % u bukolingvalnom promjeru (25).

U drugoj studiji provedenoj u Bugarskoj, Harizanova i suradnici (26) analizirali su spolni dimorfizam očnjaka 169 pacijenata u dobi od 20 do 40 godina. Parametri koji uključuju meziodistalni promjer, bukolingvalni promjer, cervikoincizalni promjer, interkaninu širinu i indekse očnjaka mjereni su izravno na pacijentima s pomoću kliznoga kalipera za zube. Prosječne dimenzije maksilarnih očnjaka bile su veće kod muškaraca u usporedbi sa ženama. Desni maksilarni očnjak imao je meziodistalni promjer 8,72 mm kod muškaraca i 7,95 mm kod žena, a vestibulolingvalni promjer bio je 8,02 mm kod muškaraca i 7,98 mm kod žena. Slično tomu, za lijevi maksilarni očnjak meziodistalni promjer bio je 8,72 mm kod muškaraca i 7,95 mm kod žena, a vestibulolingvalni promjer iznosio je 8,02 mm kod muškaraca i 8,00 mm kod žena. Nalazi su pokazali značajne razlike u meziodistalnom promjeru maksilarnih očnjaka, ali ne i u vestibulolingvalnom promjeru (26).

Ograničenja studije i budući smjerovi

Ovo istraživanje usredotočilo se isključivo na mjerenja krune; u budućim studijama mogle bi se istražiti druga morfološka obilježja, poput mjerenja korijena, konfiguracije cervikalne linije ili morfoloških indeksa krune, kako bi se poboljšala sposobnost razlikovanja. Integriranje ovih nalaza s drugim dentalnim i skeletnim parametrima moglo bi poboljšati ukupnu točnost forenzičkih metoda za određivanje spola (27, 28).

Zaključci

U ovoj studiji istaknut je veliki spolni dimorfizam u dimenzijama maksilarnih očnjaka u populaciji Kosova, sa statistički značajnim razlikama između muškaraca i žena u svim mjerenim parametrima. Rezultati su pokazali da su muškarci dosljedno imali veće dimenzije krune u svim mjerenjima maksilarnih očnjaka. Spolni dimorfizam kretao se između 8,43 i 8,92 %, s golemim veličinama učinka koje potvrđuju značajnu praktičnu relevantnost. Bilateralna simetrija podržala je valjanost unilateralnih mjerenja, a modeli uočeni u populaciji Kosova razlikovali su se od onih zabilježenih u drugim etničkim skupinama.

Ovi nalazi daju ključne osnovne podatke za forenzičku primjenu u regiji Kosova i pridonose sve većoj količini morfometrijskih podataka specifičnih za populaciju u dentalnoj antropologiji. Uočeni spolni dimorfizam sugerira da su maksilarni očnjaci pouzdani biljezi za određivanje spola u ovoj populaciji.

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Author's contribution: V.A. and J.R.A. conceived and designed the study. V.A. collected and measured the data, and drafted the manuscript. J.R.A. supervised the study, revised the manuscript, and approved the final version for publication.

Doprinos autora: V. A., J. R. A. – osmišljavanje i dizajn studije; V. A. – prikupljanje podataka, mjerenje i pisanje teksta; J. R. A. – nadzor, revidiranje teksta i odobrenje konačne verzije.

Sažetak

Dentalni spolni dimorfizam, posebno kad je riječ o maksilarnim očnjacima, jedan je od najpouzdanijih biljega za određivanje spola u forenzičkom i antropološkom kontekstu. Pojavom konusno-snopne kompjutorizirane tomografije (CBCT) mogu se dobiti točniji i populacijski specifični morfometrijski podatci. **Cilj:** Cilj ove studije bio je izmjeriti spolni dimorfizam u veličinama krunica maksilarnih očnjaka u populaciji Kosova korištenjem konusno-snopne kompjutorizirane tomografije (CBCT). Također je procijenjen potencijal za određivanje spola u forenzičkim slučajevima. **Materijali i metode:** Retrospektivna analiza obavljena je na CBCT snimkama 60 ispitanika (30 muškaraca i 30 žena) u dobi od 18 do 30 godina u Sveučilišnome kliničkom centru Kosova. Mjerene su meziodistalne (MD) i vestibulo-oralne (VO) dimenzije zubnih kruna. Statističke analize uključivale su deskriptivnu statistiku, neovisne t-testove, Cohenov d-efekt veličine i postotke spolnoga dimorfizma izračunate Garn-Lewisovom formulom. **Rezultati:** Svi parametri pokazali su značajan spolni dimorfizam ($p < 0,001$), pri čemu su muškarci imali veće krune. Najveći dimorfizam uočen je u VO dimenziji lijevoga očnjaka (8,92 %), a zatim u VO-u desnoga očnjaka (8,87 %). Prosječne razlike među spolovima kretale su se od 0,597 do 0,724 mm, s golemim efektima veličine (Cohenov d: 1,166 – 1,435). Bilateralne korelacije bile su jake i za mjerenja MD-a i za VO ($r = 0,961 - 0,966$). **Zaključci:** Maksilarni očnjaci pokazuju izraženi spolni dimorfizam u populaciji Kosova, s dimenzijama VO-a koje pokazuju nešto veći diskriminacijski potencijal od MD-a. U tim se nalazima ističe njihova vrijednost u forenzičkom određivanju spola i pružaju referentne podatke specifične za populaciju Kosova.

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