



## The significance of biometric parameters in determining anterior teeth width

Značaj biometrijskih parametara za određivanje širine prednjih zuba

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### Abstract

**Background/Aim.** An important element of prosthetic treatment of edentulous patients is selecting the size of anterior artificial teeth that will restore the natural harmony of one's dentolabial structure as well as the whole face. The main objective of this study was to determine the correlation between the inner canthal distance (ICD) and interalar width (IAW) on one side and the width of both central incisors (CIW), the width of central and lateral incisors (CLIW), the width of anterior teeth (ATW), the width between the canine cusps (CCW), which may be useful in clinical practice. **Methods.** A total of 89 subjects comprising 23 male and 66 female were studied. Their age ranged from 19 to 34 years with the mean of 25 years. Only the subjects with the preserved natural dentition were included in the sample. All facial and intraoral tooth measurements were made with a Boley Gauge (Buffalo Dental Manufacturing Co., Brooklyn NY, USA) having a resolution of 0.1mm. **Results.** A moderate correlation was established between the interalar width and combined width of anterior teeth and canine cusp width ( $r = 0.439$ ,  $r = 0.374$ ). A low correlation was established between the inner canthal distance and the width of anterior teeth and canine cusp width ( $r = 0.335$ ,  $r = 0.303$ ). The differences between the two genders were highly significant for all the parameters ( $p < 0.01$ ). The measured facial distances and width of anterior teeth were higher in men than in women. **Conclusion.** The results of this study suggest that the examined interalar width and inner canthal distance cannot be considered reliable guidelines in the selection of artificial upper anterior teeth. However, they may be used as a useful additional factor combined with other methods for objective tooth selection. The final decision should be made while working on dentures fitting models with the patient's consent.

**Key words:**  
jaw, edentulous; dental prosthesis; anthropometry;  
esthetics, dental; anatomy.

### Apstrakt

**Uvod/Cilj.** Važan element protetske terapije bezubih pacijenata je odabir veličine prednjih veštačkih zuba koji će povratiti prirodnu harmoniju dentolabijalnih struktura kao i harmoniju čitavog lica. Osnovni cilj ovog istraživanja bio je da se utvrdi korelacija između interkantalnog rastojanja (IKTR) i interalaravnog rastojanja (IAR) sa širinom oba centralna sekutića (ŠCS), širinom centralnih i lateralnih sekutića (ŠCLS), širinom prednjih zuba (ŠPZ), širinom između kvržice očnjaka (ŠKO) koji bi mogli biti korisni u kliničkoj praksi. **Metode.** Istraživanje je sprovedeno na 89 osoba sa očuvanom prirodnom denticijom, prosečne starosti od 25 godina (19–34 godina). Bilo je 23 pacijenata muškog pola i 66 pacijenata ženskog pola. Sva merenja na licu i intraoralno na Zubima izvršena su korišćenjem Bolejevog merača (Buffalo Dental Manufacturing Co, Brooklyn NY, USA) sa preciznošću od 0,1 mm. **Rezultati.** Utvrđena je umerena korelacija između interalaravnog rastojanja i širine prednjih zuba i širine kvržice očnjaka ( $r = 0,439$ ;  $r = 0,374$ ). Utvrđena je niska korelacija između interkantalnog rastojanja i širine frontalnih zuba i širine kvržice očnjaka ( $r = 0,335$ ;  $r = 0,303$ ). Utvrđena je značajna razlika za sve parametre među polovima ( $p < 0,01$ ). Merena facijalna rastojanja i širina prednjih zuba veće su kod muškaraca nego kod žena. **Zaključak.** Rezultati ove studije pokazuju da ispitivano interalarano i interkantalno rastojanje ne mogu biti pouzdani vodiči za selekciju prednjih gornjih veštačkih zuba. Ipak, ona se mogu koristiti u kombinaciji sa ostalim metodama za objektivnu selekciju veštačkih zuba, a konačna odluka, svakako, treba da se doneše nakon probe modela proteza uz saglasnost pacijenta.

**Ključne reči:**  
bezubost; zubna proteza; antropometrija; zub, estetika;  
anatomija.

## Introduction

Loss of teeth, the anterior teeth in particular, leads to degradation of one's physical appearance and a esthetic qualities which can create an inferiority complex with all its consequences, often resulting in psychological trauma.

An important element of prosthetic treatment of edentulous patients is determination of size, shape and color of artificial anterior teeth that will restore the natural dentobial harmony, as well as the dentofacial structure disturbed by teeth loss. The obligation and responsibility are great for every doctor when restoring their patient's disturbed appearance. Smile design has long been considered a doctor's individual subjective skill.

It is a fact that in everyday practice various methods and indicators are used when determining the size of artificial anterior teeth for edentulous patients. Making the right choice is extremely important for both functional and physiognomic rehabilitation of these patients. It is therefore necessary to establish parameters that are as objective as possible in order to achieve optimal occlusion reconstruction in prosthetic treatment of edentulous patients.

Physiognomic prosthetics develops one's ability of observing space and one's sense of plastic restitution, necessary for all clinical and technical work. According to physiognomic standards, the visibility of anterior teeth is determined by their correlation with the upper and the lower lip. When talking and smiling, the visible row of anterior teeth represents an individually different, wider or more narrow, horizontal stripe accentuated by its light colour. An especially prominent and specific detail of this stripe is its lower edge which represents the "incisive line". The shape of this line and its specific setting are of great importance for facial expression, as much as the shape of one's eyebrows or the hairline. The position of the "incisive line" in relation to the upper lip determines the visibility of the upper anterior teeth. When considering artificial teeth and the correlation between denture and physiognomy, most authors identify the idea of beauty with natural, non-intrusive, harmonious appearance and the position of artificial teeth in comparison with the entire face<sup>1,2</sup>.

Defining the ideal teeth size is a difficult task considering the vast variety and individuality of features. In order to obtain the "magic numbers" clinical practitioners may apply, mathematical theorems were proposed, like the "golden ratio" based on elements of classic architecture and art. However, the first doctor who applied this formula to anterior teeth, Lombardi, discovered that it was too rigid for stomatology. Preston's<sup>3</sup> measurements confirm the unsustainability of the formula in this particular case. Numerous reports show that most beautiful smiles are not in correlation with the proportion of the golden ratio<sup>4-6</sup>.

Patient's morphological and constitution type, gender, age and individuality should be respected when considering the harmony of shapes, colour and size of every artificial tooth. The shape and size of anterior teeth need to be harmonized with the individual face type, especially their position and visibility while talking and smiling. They represent the

elements that, in the hands of a skillful prosthodontist can conjure up the patient's natural appearance, individual face expression and those tiny effects that are so specific and precious to all of us.

Namely, there is little scientific data in dental literature that could be used as objective guidelines for defining the appropriate size and shape of artificial anterior teeth and their interrelationships. In addition, the selection of width is a bigger problem than the selection of teeth length, especially in edentulous patients, when data on preextractional measurements of natural teeth are not available.

By comparatively analyzing the width of upper anterior natural and artificial teeth in complete denture wearers, Baer and Reynolds<sup>7</sup> conclude in their research that people prefer their artificial teeth's width to be less than their natural teeth's width. They also find out that the difference in width of anterior teeth between men and women is 2 mm.

Authors of many recent studies suggest observing people's facial measurements in order to obtain objective guidelines for anterior teeth width selection, and measuring distances between certain reference points of the face<sup>5, 8-22</sup>. These points are, as a rule, easily located, although their exact position is often defined differently by different authors. Some use digital photography and photogrammetry in their research to accurately measure distances between facial landmarks and compare them with the width of anterior teeth<sup>5, 14, 16, 17, 20</sup>.

The use of biometric guidelines represents a way of matching the width of anterior teeth in complete dentures as closely as possible to the original. In doing so, anthropometric parameters obtained from one's own population undoubtedly play a significant role.

It is not pointless to state how bionorms based on foreign populations can be applied to our population only for general assessment but that for more delicate analysis we must use data derived from our own population.

Studies on anthropometric facial characteristics and the jaw complex, as well as studies on their interrelations with natural teeth have given us knowledge of their mutual individual harmony. A great number of conducted studies on the human face prove the existence of significant variations in parameters among different races, nations and populations, as well as among individuals. One of the basic characteristics and laws of nature is the existence of an immense number of variations and intermediate forms, not uniformity or existence of a universal mold. Although all human faces are very similar, no two are the same.

There are several proposed anatomical parameters that would, in careful comparison with the widths of artificial teeth, lead to their correct selection. These anatomical parameters are: bizygomatic width (BZW)<sup>5, 10, 11</sup>, interpupillary distance (IPD)<sup>5, 8, 10, 11, 16</sup>, intercommissural distance (ICMD)<sup>19, 22</sup>, interalar width (IAW)<sup>5, 8, 11, 14, 16, 19-22</sup>, which is defined as the distance between the widest points of the ala of the nose, inner canthal distance (ICD)<sup>9, 10, 12-17, 22</sup> which is defined as the distance between the medial angles of the palpebral fissures, width of the upper lip philtrum (PHULW)<sup>9</sup> and nose length (NL)<sup>20-22</sup>.

This study was carried out to determine correlations and relationships between ICD and IAW with the mesiodistal width of upper anterior teeth, which may be useful in clinical practice. In relation with the main goal of this research, tasks are set on a representative sample to determine the average of inner canthal distance, interalar width, mesiodistal width of central incisors, mesiodistal width of the central and lateral incisors, mesiodistal width of six maxillary anterior teeth, and to conclude the significance of differences in the tested parameters between the genders, to compare the determined values of the mesiodistal tooth width with the measured facial distances.

### Methods

A total of 89 Serbian adults, 23 males and 66 females, between the age of 19 and 34 (the average age of 25) with no facial or dental deformity were selected. Subjects included dental students of the Faculty of Medicine, as well as regular patients of the Clinic for Dentistry of Vojvodina in Novi Sad. The selection criteria included: being part of the Serbian population of Vojvodina and age in which the craniofacial growth and development and tooth growth are already completed. All the subjects had a full complement of teeth with no history of orthodontic or prosthetic treatment, morphological deformity or any form of major conservative restoration, abrasion or attrition, diastema, postoperative periodontal treatment, signs of inflammation, hypertrophy or gingival recession, congenital or surgical defects of the face.

All measurements were made with a Boley Gauge (Buffalo Dental Manufacturing Co., Brooklyn NY, USA) having a resolution of 0.1 mm. Each parameter was measured three times and the average value was taken into account. All measurements were taken by one person. The subjects were seated with their heads in an upright position and looking straight ahead. While nose width measurements were taken, the subjects were instructed to inhale and exhale deeply and briefly stop breathing, as to avoid measuring the ala of the nose widespread.

The following face measurements were taken: ICD, measured between the medial angles of the palpebral fissures and IAW, measured between the widest points of the ala of the nose (Figure 1).

Teeth measurements included: the width between the two proximal contact points for a given distance, the width of both central incisors (CIW) – the distance between proximal contacts toward lateral incisors, the width of the central and lateral incisors (CLIW) – the distance between contact points of the lateral incisor and canine teeth, the width of anterior teeth (ATW) – the distance between contact points for canines and first premolars, the width between the canine cusp (CCW) – the distance between canine cusp (Figure 2).

Statistical analysis of the obtained data was performed by using computer programs Microsoft Excel 2000 and "SPSS 8.0 for Windows". For each of the studied parameters following values were calculated: minimum value (min) and maximum value (max), mean value ( $\bar{x}$ ), standard deviation (SD), standard error (SE), coefficient of variation (CV%) and

confidence interval (CI) representing the extent of those features that were found in 95% of cases within the selected sample.

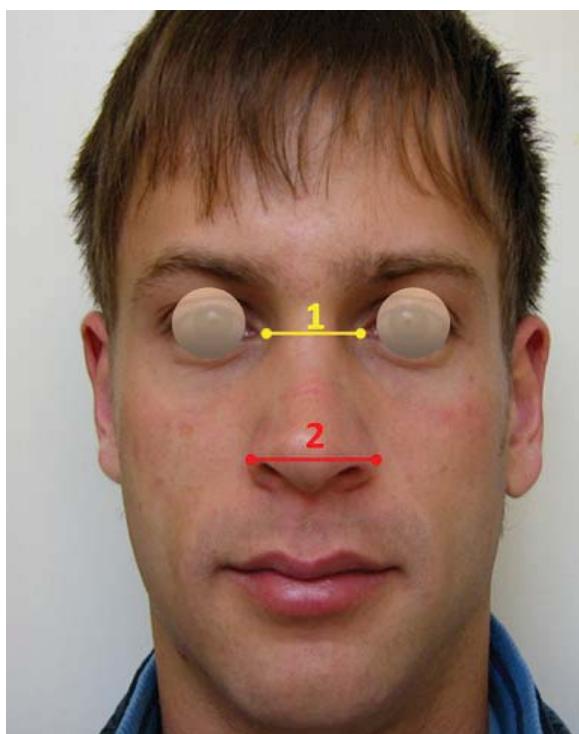


Fig. 1 – Inner canthal distance (ICD) – 1,  
Interalar width (IAW) – 2.



Fig. 2 – Both central incisors width (CIW) – 1; Central and lateral incisor width (CLIW) – 2; Anterior teeth width (ATW) – 3; Canine cusps width (CCW) – 4.

The interconnection between the measured parameters was determined by linear correlation analysis (Pearson's correlation analysis) and summarized numerically with the linear correlation coefficient ( $r$ ).

In this study a statistical significance was determined by using the  $t$ -test (a test performed on two samples assuming unequal variance – heteroscedastic two-way test – used to assess whether the means of the two groups are statistically different from each other).

## Results

CIW for women ranged from 14.5 mm to 18 mm ( $\bar{x} = 16.3$  mm). In females, the width of both central incisor ranged from 15.91 mm to 16.69 mm in 95% of cases. CLIW in females ranged from 25 mm to 32 mm in 95% of cases ( $\bar{x} = 27.9$  mm). ATW in females ranged from 34 mm to 43.5 mm ( $\bar{x} = 37.1$  mm). In females, ATW ranged 35.93 mm to 38.27 mm in 95% of cases. In females CCW ranged from 28.5 mm to 37 mm ( $\bar{x} = 32.1$  mm), and the distance between canine cusps ranged from 30.93 mm to 33.27 mm in 95% of cases. IAW in females ranged from 26 mm to 37 mm ( $\bar{x} = 31.49$  mm). In females, the interalar width ranged from 30.51 mm to 32.47 mm in 95% of cases. ICD in females ranged from 24 mm to 38 mm ( $\bar{x} = 30.47$  mm). The inner canthal distance in 95% of cases in females ranged from 29.49 mm to 31.45 mm. All the results are showed in Table 1.

The width of both central incisors in males ranged from 15 mm to 19 mm ( $\bar{x} = 17$  mm). In males, the width of both central incisor ranged from 15.6 mm to 18.37 mm in 95% of cases. CLIW in males ranged from 25.5 mm to 31 mm ( $\bar{x} = 28.8$  mm). In males, the width of central and lateral incisor ranged from 27.42 mm to 30.17 mm in 95% of cases. ATW in males ranged from 35 mm to 42 mm ( $\bar{x} = 38.8$  mm). In males, ATW ranged from 35.46 mm to 42.13 mm in 95% of cases. The distance between canines cusps ranged from 31 mm to 38 mm ( $\bar{x} = 33.7$  mm) in males (the width between canines cusps ranged from 30.76 mm to 36.64 mm in 95% of

cases). IAW in males ranged from 31 mm to 40 mm ( $\bar{x} = 35.5$  mm). The interalar width in males ranged from 32.37 mm to 38.63 mm in 95% of cases. The inner canthal distance ranged from 24 mm to 35 mm ( $\bar{x} = 32$  mm) in males (the inner canthal distance ranged from 29.06 mm to 34.94 mm in 95% of cases). The results are showed in Table 1.

T-test analysis established a statistically significant difference in the values of the measured parameters between the male and female subjects. By testing the statistical significance between genders a significant difference was established for the width of both central incisors (CIW,  $p = 0.003$ ). A statistically significant difference between genders was also established for the parameter of width of central and lateral incisors (CLIW,  $p = 0.020$ ). The tested difference between genders was highly significant for the parameters of ATW ( $p = 0.0002$ ). A significant difference between genders was established for the parameter of distance between canines cusps (CCW,  $p = 0.001$ ). A highly significant difference between genders was established for the parameter of interalar width (IAW,  $p = 0.000$ ). A significant difference between genders was also established for parameter of inner canthal distance (ICD,  $p = 0.01$ ). The results are showed in Table 1.

The investigated parametral interconnection was analyzed by linear correlative analyses (Pearson's analysis) and numerically presented by the linear correlation coefficient ( $r$ ) in Table 2. Linear correlative analysis resulted in a moderate correlation between interalar width and anterior teeth width

**Table 1**  
**The results of the investigated parameters in females and males**

Parameter	Female			Male			$p$ (t-test)
	$\bar{x} \pm SD$ (min – max)	CV (%)	95% CI	$\bar{x} \pm SD$ (min – max)	CV (%)	95% CI	
CIW (mm)	16.3 ± 0.225 (14.5–18)	13.8	15.91–16.69	17 ± 0.372 (15–19)	21.88	15.62–18.37	0.003
CLIW (mm)	27.9 ± 0.379 (25–32)	13.58	27.11–28.6	28.8 ± 0.63 (25.5–31)	21.87	27.42–30.172	0.02
ATW (mm)	37.1 ± 0.49 (34–43.5)	13.2	35.93–38.27	38.8 ± 0.84 (35–42)	21.64	35.46–42.13	0.0002
CCW (mm)	32.1 ± 0.47 (28.5–37)	14.92	30.93–33.27	33.7 ± 0.75 (31–38)	22.25	30.76–36.64	0.001
AIW (mm)	31.49 ± 0.452 (26–37)	14.35	30.51–32.47	35.5 ± 0.78 (31–40)	21.97	32.37–38.63	0.000
ICD (mm)	30.47 ± 0.449 (24–38)	14.73	29.49–31.45	32 ± 0.74 (24–35)	23.12	29.06–34.94	0.01

CIW – central incisors width; CLIW – central and lateral incisors width; ATW – anterior teeth width; CCW – canine cusps width; IAW – interalar width; ICD – inner canthal distance; min – minimal value; max – maximal value;  $\bar{x}$  – mean value; SD – standard deviation; CV – coefficient of variation; CI – confidence interval.

**Table 2**  
**Correlation coefficients between the investigated parameters**

Parameter	CIW	CLIW	ATW	CCW	AIW	ICD
CIW	1	0.749	0.605	0.514	0.122	0.134
CLIW	0.749	1	0.738	0.690	0.235	0.232
ATW	0.605	0.738	1	0.787	0.439	0.335
CCW	0.514	0.690	0.787	1	0.374	0.303
AIW	0.122	0.235	0.439	0.374	1	0.410
ICD	0.134	0.232	0.335	0.303	0.410	1

CIW – central incisors width; CLIW – central and lateral incisors width; ATW – anterior teeth width; CCW – canine cusps width; IAW – interalar width; ICD – inner canthal distance.

and canine cusps width ( $r = 0.439$  and  $r = 0.374$ , respectively). A low level of correlation between inner canthal distance and anterior teeth width and canine cusps was established ( $r = 0.335$  and  $r = 0.303$ , respectively).

## Discussion

In case of absence of preextraction records, selection of upper anterior artificial teeth for edentulous patients is difficult. A very important aspect in the upper anterior teeth selection for complete dentures is selecting the appropriate mesiodistal width of the six maxillary anterior teeth.

According to professional sources, a scientific and universally accepted method for accurately determining the mesiodistal width of anterior artificial teeth has not yet been found<sup>22</sup>.

Discussions on this topic are very present in the contemporary professional literature<sup>2, 7, 8, 11-22</sup>. Reviews of the recent scientific literature reveal studies that were carried out using different methodology and sample size, different face and natural teeth parameters<sup>8, 10, 11-13, 15, 19, 20</sup>, casts<sup>5, 16-18, 21, 22</sup>, or photographs<sup>5, 14, 16, 17, 20</sup>, as well as various types of gauges which makes the comparison of results very difficult. Various face parameters such as bizygomatic<sup>5, 10, 11</sup>, interpupillary<sup>5, 8, 10, 11, 16</sup>, interalar<sup>5, 8, 11, 14, 16</sup> and inner canthal distance<sup>9, 10, 12-17, 22</sup>, intercommissural distance<sup>19, 22</sup>, width of the upper lip filtrum<sup>9</sup> and nose length<sup>20-22</sup> have all been proposed as objective guidelines for solving this problem. In the most recent scientific literature, there are different views about the true value of these methods<sup>5-22</sup>.

No theory is good enough to help to select the size of artificial teeth, except when extracted natural teeth or casts of exist<sup>19</sup>.

This study attempts to present the latest views and research in this area and investigate the possibility of using individual biological parameters in prosthetic diagnosis and treatment of our population.

This research was carried out as an attempt to better understand and analyze biometric parameters of our population. Until now there have been no similar studies conducted on our population.

The purpose of this research was to establish whether the width of upper anterior teeth is in correlation with the interalar width and the distance between the medial angle of the palpebral fissure on a representative sample of our own population, as well as to determine interrelations between these parameters that could be useful in clinical treatment of our population.

By conducting statistical analysis of Arab population, al-el Sheikh and al-Athel<sup>8</sup> found a significant correlation between the interalar width ( $\text{♂}^*\bar{x} = 35.54 \text{ mm}$ ,  $\text{♀}^{\dagger}\bar{x} = 31.60 \text{ mm}$ ) and the combined width of anterior teeth ( $\text{♂}\bar{x} = 54.87 \text{ mm}$ ,  $\text{♀}\bar{x} = 50.28 \text{ mm}$ ). The authors recommend to increase the measured value of interalar width by the statistically derived magnification factor (1.56). This method is suggested as a guideline for choosing the width of anterior artificial

teeth in combination with other methods. The existence of a significant difference in the examined parameters between the genders was also established.

After performing various facial and interalar measurements on members of Arab population, Al Wazan<sup>10</sup> determined a significant correlation ( $p < 0.0001$ ) between the inner canthal distance ( $\text{♂}\bar{x} = 32.94 \text{ mm}$ ,  $\text{♀}\bar{x} = 31.91 \text{ mm}$ ) and the 4 anterior incisors ( $\text{♂}\bar{x} = 30.62 \text{ mm}$ ,  $\text{♀}\bar{x} = 29.52 \text{ mm}$ ). No difference in the inner canthal distance between genders was established<sup>10</sup>. A low correlative coefficient between the interalar width ( $\text{♂}\bar{x} = 39.50 \text{ mm}$ ,  $\text{♀}\bar{x} = 36.11 \text{ mm}$ ) and the intercanine distance was established. Researchers recommend using facial measurements as the initial step in determining the width of anterior artificial teeth for edentulous patients<sup>11</sup>.

While exploring the interdependence of the inner canthal distance ( $\text{♂}\bar{x} = 28.7 \text{ mm}$ ,  $\text{♀}\bar{x} = 27.9 \text{ mm}$ ) and the width of central incisors ( $\text{♂}\bar{x} = 8.87 \text{ mm}$ ,  $\text{♀}\bar{x} = 8.68 \text{ mm}$ ) Abdullah<sup>12</sup> and Abdullah et al.<sup>13</sup> measured facial parameters on a sample of Arab population and determined the possibility of using this distance as a guide for selection of central incisors but only after multiplying the obtained values with the coefficient of geometric progression (0.618) and then dividing the result by two.

While examining the correlation between interpupillary, bizygomatic and interalar distances ( $\text{♂}\bar{x} = 66.5 \text{ mm}$ ,  $\text{♀}\bar{x} = 62.9 \text{ mm}$ ) in digital photographs and intercanine distance ( $\text{♂}\bar{x} = 60.6 \text{ mm}$ ,  $\text{♀}\bar{x} = 62.8 \text{ mm}$ ) on casts on a Turkish population sample, Hasanreisoglu et al.<sup>5</sup> found a proportional relationship between the intercanine distance and the interalar width in women and determined a significant difference in dimensions of the upper central incisors and canine teeth between the sexes ( $p < 0.05$ ,  $p < 0.01$ ). According to their results interalar width can be used to determine the width of maxillary anterior artificial teeth, especially in women.

By analyzing facial and dental distances on a sample of Brazilian population in digital photographs and casts, Gomes et al.<sup>14</sup> conclude that the inner canthal distance ( $\text{♂}\bar{x} = 32.94 \text{ mm}$ ,  $\text{♀}\bar{x} = 31.91 \text{ mm}$ ) and interalar width ( $\text{♂}\bar{x} = 34.78 \text{ mm}$ ,  $\text{♀}\bar{x} = 33.76 \text{ mm}$ ) have a high correlation ( $p = 0.000$ ) with intercanine distance, in photographs ( $\text{♂}\bar{x} = 43.10 \text{ mm}$ ,  $\text{♀}\bar{x} = 41.77 \text{ mm}$ ) as well as in casts ( $\text{♂}\bar{x} = 54 \text{ mm}$ ,  $\text{♀}\bar{x} = 53.50 \text{ mm}$ ). No difference in inner canthal distance was found between the genders.

By analyzing statistical data obtained from an Indian population sample Tandale et al.<sup>15</sup> established a biometric ratio of 1 : 0.271 and 1 : 1.428 by comparing inner canthal distance ( $\text{♂}\bar{x} = 32.16 \text{ mm}$ ,  $\text{♀}\bar{x} = 31.59 \text{ mm}$ ) and intraoral measurements of the width of four incisors ( $\text{♂}\bar{x} = 31.62 \text{ mm}$ ,  $\text{♀}\bar{x} = 30.15 \text{ mm}$ ) and all the 6 anterior teeth ( $\text{♂}\bar{x} = 45.81 \text{ mm}$ ,  $\text{♀}\bar{x} = 45.13 \text{ mm}$ ). Significant differences between genders were found for all the measured parameters ( $p < 0.0001$ ), except for inner canthal distance which showed no statistically significant difference between the genders. The authors conclude that the inner canthal distance can be used as a preliminary method for determining the width of the anterior teeth.

Within a Malaysian population sample Isa et al.<sup>16</sup> analyzed interpupillary distance, inner canthal distance ( $\bar{x} = 34.36$

\*♂ – male; †♀ – female

mm) and interalar width ( $\bar{x} = 39.36$  mm) on digital photographs. Individual widths of the 6 anterior teeth (central incisor  $\bar{x} = 8.54$  mm, lateral incisor  $\bar{x} = 7.09$  mm, canine  $\bar{x} = 7.94$  mm) were measured on casts using a digital gauge. The authors conclude that by using regression analysis the width of anterior teeth can be predicted by combining analyzed facial parameters.

On a Brazilian population sample Lucas et al.<sup>17</sup> used digital photography to measure the inner canthal distance ( $\bar{x} = 34.42$  mm) and the distance between the maxillary canines tips ( $\bar{x} = 37.45$  mm) and their distal surfaces ( $\bar{x} = 42.15$  mm). They also measured the curved distance between the tips of maxillary canines ( $\bar{x} = 43.66$  mm) and their distal surfaces ( $\bar{x} = 53.45$  mm) on casts. A significant correlation was established between all determined variables ( $r = 0.476$ ,  $r = 0.467$ ,  $r = 0.285$ ,  $r = 0.302$ ). The authors conclude that inner canthal distance, when determined by photogrammetry, can be a reliable guideline for selecting the anterior teeth<sup>17</sup>.

Ibrahimagic et al.<sup>19</sup> conducted a research within Croatian population in order to determine the correlation between the width of upper incisors, the width between the upper canines tips or incisor and canine width and the interalar width or the intercomisural width. The results show a statistically significant difference between males and females for all the measured variables ( $p < 0.01$ ), and that the recorded values were higher among males. The obtained mean value for interalar width is 30.9 mm for females and 33.63 mm for males. The width between canines cusps in women is 31.021 mm and for males is 32.44 mm. Width of the nose approximates to the width between the tips of canines (1.08 : 1). The calculated values for the studied population may help in choosing the size of upper anterior teeth and their preferences in complete dentures.

Varjão and Nogueira<sup>21</sup> found out that the average value of interalar width for the white Brazilian male is 35.28 mm and the mean value of intercanine tooth width for the same population is 33.55 mm (measured on casts). The calculated Pearson's correlation coefficient was 0.238, which is a weak correlation between these two parameters. The authors conclude that the method of measuring the width of the base of the nose is not an accurate guideline for selecting the width of artificial teeth.

While conducting research within Croatian population, Knezovic et al.<sup>22</sup> conclude that using facial measurements such as face, nose and upper lip length, inner canthal, interalar and intercomisural distance for selecting anterior artificial teeth are generally inaccurate. The indexes of width/height were determined for central incisors, lateral incisors and canines. For interalar width ( $\text{♂ } \bar{x} = 33.9$  mm,  $\text{♀ } \bar{x} = 30.20$  mm) a statistically significant difference related to gender ( $p < 0.0001$ ) was obtained, while the inner canthal distance ( $\text{♂ } \bar{x} = 15.41$  mm,  $\text{♀ } \bar{x} = 15.31$  mm) showed no difference.

Comparing the results of a previous researches in relation to one's own, differences rooted primarily in ethnic

and morphological characteristics are observed. Given the great individual variability in human physiognomy and values of morphological parameters, the use of inaccurate standards in diagnosis and treatment planning would not only lead to wrong conclusions about the existence and severity of deviations but also to unsatisfactory results of denture therapy, both in terms of esthetics and the aspect of planning the artificial occlusion complex. Therefore, the results of specific relations of anatomic determinants and width of anterior teeth must be perceived as distinctive features of the population on which the study was performed.

Most studies, including ours, established the existence of significant differences in all values of facial and dental parameters between the genders, and show that male subjects have higher values than females. This research determines that there is very little significant difference in inner canthal distance between genders while some studies find no difference in this parameter between the two sexes whatsoever<sup>14, 15, 22</sup>. By taking measurements on samples of their own population, some authors do not find any significant correlation between facial and dental parameters and therefore conclude that inner canthal distance and interalar width are not reliable parameters for selecting the size of upper anterior teeth for dentures<sup>21, 22</sup>. Considering that no research, including ours, confirms a high correlation between facial and dental parameters, most authors recommend using this method as a guideline in choosing the width of anterior artificial teeth but only combined with other methods.

## Conclusion

The analyzed values of facial and dental parameters in our population are moving in the biometric standards contained in the relevant literature. The determined differences arise from ethnic and morphological characteristics. A moderate correlation between the interalar width and anterior teeth width and canine cusps width was established. A low correlation between the inner canthal distance and width of anterior teeth and canine cusps width was established. By testing the statistical significance between genders significant differences for all the parameters was found. The measured facial distances and anterior teeth width had higher values for men than for women.

The results of this study indicate that the investigated interalar width and inner canthal distance cannot be reliable guidelines for the selection of upper anterior artificial teeth. However, they can be used in combination with other methods for the selection of artificial teeth but the final decision should be made while testing prosthetic denture models and with patient's consent. Selection of artificial anterior teeth should be based on finding a harmonious relationship between the size and shape of teeth in relation to gender and individual constitutional characteristics.

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