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Correlation between the Bizygomatic Distance and the Width of the Upper Central Incisor in the Cameroonian Melanoderma Adult

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Abstract

Bizygomatic distance is a relevant reference used to assist and to guide the choice of antero superior prosthetic teeth, especially when no information about the natural teeth was available. The aim of the present paper was to determine the distance between the canine tips from a bizygomatic distance and to estimate the width of the upper central incisor in normal-dental-facial indices of Cameroonians. **Materials and methods:** A cross-sectional study of 900 normal Cameroonians of both sexes was conducted. Measurements of bizygomatic distance, distance between the two upper pointers and the mesio-distal width of the upper central incisor were made with a manual and a digital caliper respectively. The equation for calculating the distance of higher canine pointers from the bizygomatic distance was DCT = 0.081 (BZD) + 26.201. The width prediction of the central incisor was obtained by the following formula: WUCI = 6.252 + 0.019 (BZD) + 0.035(DCT) + 0.062 (Reg cul) + (−0.479) sex. Reg.cul represents the cultural region of origin. **Results:** Female sex was represented by 56.6% against 43.30% males. The average age was 37± (32 SD) years. The average value of the bizygomatic distance was 130.23 mm, the width of the upper central incisor was 9.39 mm while the distance between the two upper canine pointers was 36.70 mm. Significant correlations between bizygomatic distance, the distance between the two canine pointers, and the width of the upper central incisor were found (P = 0.000). **Conclusion:** The width of the central incisor and the distance between the two upper canine pointers may be determined by the non-invasively method of the bizygomatic distance in the perspective of choosing the teeth for dental prosthesis.

1. Introduction

The practice of the dental surgeon in prosthesis seems to be dotted with several pitfalls, especially the choice of teeth, when there is a lack of reliable craniofacial parameters adapted to the toothless of the African population. In the theoretical courses of our school, some authors claimed that there is a relationship between facial landmarks and anterior-maxillary or mandibular teeth for Europeans and Asian populations. However, no consensus has been reached on these anatomical benchmarks [1] [2] and no mathematical formula has been demonstrated worldwide between all races [3]. Anterior-maxillary teeth are the key and utmost important elements that contribute to the aesthetic of dento-facial beauty [4]. The dimensions, shade, morphology, and position of the front teeth are the different factors, which may play an essential role in the realization of aesthetics for a complete prosthesis [5].

In the negroids, body mass as well as dento-craniofacial architecture appears to be different from other races [6]. Therefore, the dentist should perform several random touch-ups when choosing and mounting prosthetic teeth. The aims of the present study were [1] to determine the correlation between bizygomatic distance and the width of the upper central incisor in the Cameroonian melanoderma adult, [2] to determine the relationship between bizygomatic distance (BZD) and width of the upper central incisor (WUCI), bizygomatic distance and distance Canine tip (DCT), and [3] to investigate the WUCI equation as a function of variables.

2. Materials and Methods

The present study was a cross-sectional conducted in six health structures in Cameroon: Bangangté District Hospital and the Mountain Clinic, SA'A District Hospital, and Notre Dame de la Merci Health Center. A health structure has been chosen for each cultural region. The study population was subjects of Cameroonian origin. The inclusion criteria were those Cameroonian of father and mother, to be at least 18 years old, to have given consent, to go to one of the health facilities mentioned above, having all the healthy central incisors, to be in normal occlusion, to have the entire bizygomatic arch (DZA); the margin of the distance canine tip (DCT), the constitutional type and the region using a foot of the cutaneous zygion. Ten millimeters (mm) were removed from the cutaneous BZD [7] in order to obtain the bone BZD. The impression was taken using a standard impression holder in the maxilla with alginate.

The impression was poured using the orthodontic hard plaster. The digital

coulisse foot was used to measure the width of the upper central incisor (WUCI), and the DCT on the study model. The data were stripped, processed, codified, and entered into a database on Microsoft Excel 2013. The data was used on SPSS software version 20.0. The Pearson test was used to analyze the correlation at a significance level of 0.001. The linear regression line between the WUCI and the BZD, and between the DCT and the BZD resulted in the multivariate equation of the WUCI determined.

3. Results

The study focused on 900 Cameroonians aged between 18 and 79 from the five major cultural regions of Cameroon. Of 900 students recorded, 509 (56.60%) were female and 394 (43.40%) males with an average age of 37.32 years. The population of the western plateaus was the most represented with 27.30% (Figure 1). The average of BZD, WUCI, and DCT was a little high for males than for females (Table 1). The digestive and muscle types have the highest averages of BZD, DCT and WUCI (Table 2). Only, the people of the western plateaus have the highest averages of BZD compared to other regions, and DCT for values of 137.3 mm and 37.04 mm. Table 3 showed that as for the average WUCI, the people of the northern regions had a high average (9.47 mm). The WUCI was equal to the BZD divided by 13.88 and the DCT equal to the BZD divided by 3.55 (Table 4). With regard to the estimation of WUCI and DCT through the knowledge of bizygomatic distance, we assumed that the DCT is proportional to the BZD and thus obtained the following equation DCT = 0.081 (BZD) + 26.201 (Table 5). According to the calculation method allowing the estimation of WUCI and DCT through the knowledge of bizygomatic distance. We had assumed that the WUCI is proportional to the BZD and we got the following equation: WUCI = 0.025 (BZD) + 6.161 (Table 6). From the later equation (WUCI = 0.025 (BZD) + 6.161), we represented the linear regression line of WUCI as a function of BZD (Figure 2). Figure 3 shows the equation DCT = 0.081 (BZD) + 26.201, we have thus represented the linear regression line of DCT as a function of BZD. The highlighted slopes of each variable with their degree of significance and highlighted the formula of the equation for predicting the width of the upper central incisor were detailed in this equation: WUCI = 6.252 + 0.019 (BZD) + 0.035 (DCT) + 0.062 (Reg cul) + (−0.479) sex (Table 7).
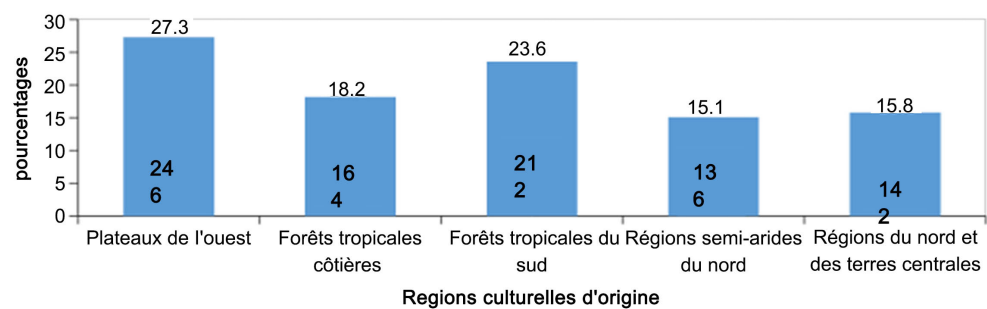

Figure 1. Distribution of the study population by cultural region of origin.

Table 1. Averages of BZD, WUCI and DCT by gender.

Variables	Sex	Number	Average	Standard deviation	P-value
BZD (mm)	Male	391	**133.08**	7.30	0.001
	Female	509	128.03	6.31	
WUCI (mm)	Male	391	**9.74**	0.26	0.001
	Female	509	9.12	0.25	
DCT (mm)	Male	391	**37.44**	1.98	0.001
	Female	509	36.29	1.55	

Table 2. Averages of BZD, WUCI and DCT according to constitutional type.

Variables	Statistics	Cerebral	Digestive	Muscular	Respiratory
BZD (mm)	Average.	127.03	133.52	133.19	128.77
	SD	7.15	6.38	6.57	6.47
WUCI (mm)	Average.	9.32	9.44	9.45	9.39
	SD	0.43	0.35	0.40	0.39
DCT (mm)	Average.	36.38	37.12	37.09	36.71
	SD	1.74	2.18	1.84	1.70

Table 3. Averages of BZD, DCT and WUCI by cultural region of origin.

		CULTURAL REGIONS OF ORIGIN				
Variables	Statistics	Western Plateaus	Coastal tropical forests	Southern Tropical Forests	Semi-arid regions	Northern and Central Lands Regions
BZD (mm)	Average	**137.30**	130.13	131.41	120.76	125.38
	SD	5.06	5.10	3.84	3.19	4.99
WUCI (mm)	Average	9.42	9.33	9.45	9.24	**9.47**
	SD	0.36	0.45	0.30	0.42	0.42
DCT (mm)	Average	**37.04**	37.00	36.91	36.09	36.61
	SD	2.23	1.71	1.73	1.44	1.56

Table 4. Average ratio between BZD/WUCI and BZD/ DCT.

Variables	BZD/WUCI	BZD/DCT
Average	**13.88**	**3.55**
Standard deviation	0.73	0.22
Maximum	16.63	4.40
Minimum	12.08	2.96
Staff	900	900

Table 5. Linear regression of DCT for the study population.

	Coefficientsª				
Model	Non-standardised coefficients		Standardized coefficients	t	Sig.
	Has	Standard error	Beta		
1 (Constant)	26.201	1.054		24.865	0.000
Bi zygomatic distance	0.081	0.008	0.318	10.063	0.000

Table 6. Linear regression of WUCI for study population.

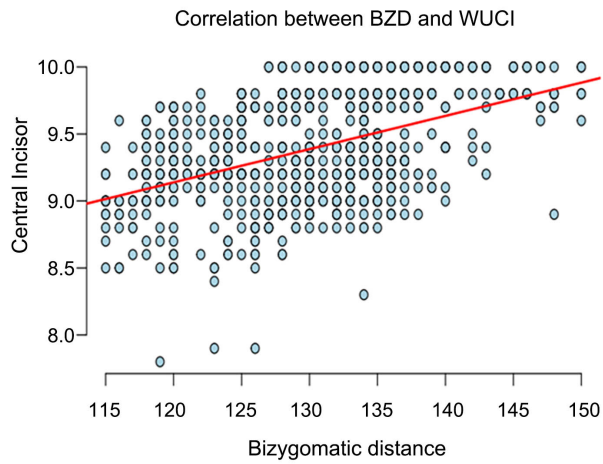|	Coefficientsª				
Model	Coefficients no Standardized		Standardized coefficients	t	Sig.
	Has	Standard error	Beta		
1 (Constant)	6.161	0.216		28.541	0.001
Slope of the BZD	0.025	0.002	0.447	14.993	0.001

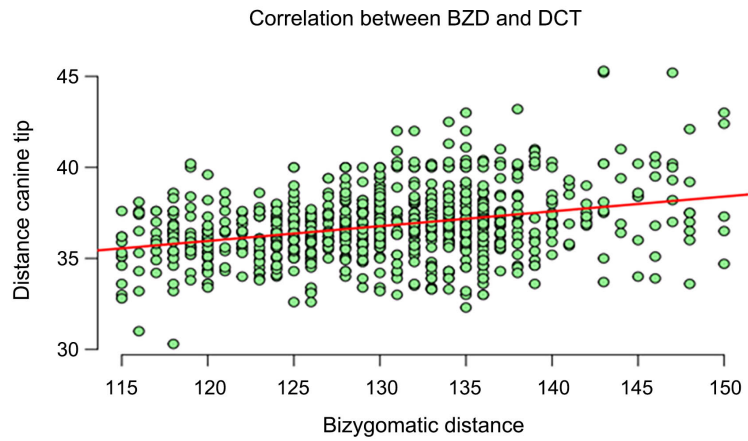Figure 2. WUCI regression line as a function of BZD.

Figure 3. DCT regression line as a function of BZD.

Table 7. Estimation of the slopes of each variable and the constant for the study population.

Model		Coefficients[a]				
		Non-standardised coefficients		Standardized coefficients	T	GIS.
		Has	Standard error	Beta		
1	(Constant)	6.252	0.278		22.506	0.001
	DCT	0.035	0.004	0.161	7.850	0.001
	Cultural region of origin	0.062	0.008	0.220	7.875	0.001
	BZD	0.019	0.002	0.337	11.131	0.001
	Sex	−0.479	0.018	−0.595	−26.442	0.001

4. Discussion

The population of the study consisted of 900 subjects of which 43.4% were male and 56.6% female, with a sex ratio of 0.77. The present results are similar to the study of the Cameroonian population [8] which found sex ratio of 0.98. The female predominance could be explained by the fact that women were the most available in the survey. The Western Peoples region was the most represented with 27.3% of subjects, followed by the southern rainforest peoples with 23.6% of subjects. On the other hand, the semi-arid region of the North completed only 15.1% of the subjects. The most common age group was between 21 and 40 years. This could be due to the fact that young subjects insist on the preservation of their frontal teeth for aesthetic reasons; and their appearance.

The average bizygomatic distance (BZD) was 130.23 mm ± 7.20, almost similar to those of Bamba *et al.* [6] in 2006 with an average of 129.18 mm ± 6.82 in Ivorian melanodermas. However, the by study of Gueye *et al.* (2014) [9] in Senegal, and Rawat *et al.* (2015) [10] in India; found an extreme average of 137.8 mm respectively ± 5.72 and 118.5 mm. The particularity of our study is that a subtraction of 10 mm was performed to obtain the bone BZD. The male BZD has a value of 133.08 mm ± 7.30 mm than the female (128.03 mm ± 6.31); either a difference of 5.05 mm. Our results are consistent with those of Gueye *et al.* (2014) [9] in Senegal who found an average BZD value of 138.84 mm in male and 132; 44 mm for female with a significant difference according to sex. Maxillofacial and stature growth has a greater amplitude and duration in male subjects [11].

From Table 3, it was noted that the Western plateaus region includes more people of the constitutional muscular and digestive type with the highest BZD. This would explain why the BZD is larger among the peoples of the western plateaus.

The average distance Canine Tip (DCT) value of the study was 36.79 mm ± 1.84. Our results are close to that of Gueye *et al.* (2014) [9] in Senegal, Bamba *et al.* (2006) [6] in Côte d'Ivoire, and Gomes *et al.* (2006) [12] in Brazil; who found

an average of 36.88 mm ± 2.097; 37.36 mm and 37.44 mm respectively for DCT. However, the studies carried out by Merz *et al.* in 1991 [13], and Rupashri *et al.* in 2020 [14] reported a successive average of the DCT of 32.95 mm and 45.04 mm in leukoderma subjects. The race may be explaining the difference between melanoderma and leukoderma measurements. The average DCT was 37.44 mm ± 1.98 for male; and 36.29 mm ± 1.55 mm for female in this study. Gueye *et al.* (2014) [9] found an average of 36.98 mm for males and 36.35 mm for females. Male subjects had a high DCT than female with a significant difference. This could be due to the presence of bone basis and sex; which are the factors involved in the morphogenesis of dental arches. However, the development of the dental arch is shorter and less wide in women compared to men [15].

The average width of Upper Central Incisor (WUCI) value of population was 9.39 mm. The result was similar with the results of Magne *et al.* (2003) [16], Pesson *et al.* (2001) [17], and Gueye *et al.* (2014) [9] who found an average of 9.20 mm; and 9.19 mm and 9.14 mm for WUCI. In contrast, Ellakwa *et al.* (2011) [18], and Lassere *et al.* (2008) [19] found an average of 8.39 mm and 8.50 mm. Continental or racial affiliation could justify the outcome. The results of WUCI for male (9.74 mm ± 0.26) and female (9.12 mm ± 0.25 mm) corroborated with the study by Hanan (2009) [20], but different with the result of Hanan's (2009) [20]. Sexual differences in position, orientation [21] and morphology [22] at the level are irrefutable evidence.

A correlation exists between BZD and WUCI, BZD and DCT, and DCT and WUCI whose respective correlation coefficient (r) is: 0.447; 0318 and 0. 424. These results are comparable to the study by Gueye *et al.* (6); who found a correlation between BZD and WUCI (r = 0.068), BZD and DCT (r = 0.155), and DCT and WUCI (r = 0.525). The DCT and WUCI can be determined from the BZD; despite the low correlation coefficient of these.

4.1. Determination of the Distance between the Canine Tips

- **Determination of the DCT according to the BZD without the constant.**

Several authors have proposed various theories and methods for determining DCT.

Benelaid and Postaire (1995) [15] suggest the determination of DCT by BZD should be divided by 3.6 for male and by 3.7 for female. This method was applied in our study found the DCT to be equal to the BZd/3.5. Our results are similar with the study of Gueye *et al.* (2014) [9] that found DCT equal to BZD/3.7. Race is the only valid justification for the similarity between these two studies.

- **Determination of the BZD according to the DCT with the constant.**

The literature does not provide information on the determination of the DCT according to the BZD according to the BZD with a constant. Nevertheless, we had found an equation in the form of linear regression; to express the DCT value from a constant (b) and a slope (a): Y = ax + b. Knowing that y = DCT, a = slope

is 0.081, x is the BZD measured on the patient, and b = constant is 26.01. The equation becomes: DCT = 0.081 (BZD) + 26.201.

4.2. Determination of the Width of the Upper Central Incisor

In the absence of pre-extractional documents, bizygomatic distance is one of the most widely used anatomical elements to determine the width of the central incisor.

4.3. Determination of the WUCI without Constant

The WUCI of the population is equal to the BZD divided by 13.88. These results corroborate with the respective studies of N'dindin *et al.* in 2002 [23] (in Senegal); Bamba *et al.* in 2006 [6] (ivory side); and Gueye *et al.* [9] in 2014 in Senegal. On the other hand, the studies of Hasanreisoglu *et al.* (2005) [24] in Turkey, Mohamed *et al.* (2017) [25]. In Saudi Arabia and Ewa *et al.* (2017) [26] in the United States had found a respective value of (women), (male and female) and in women and in men between WUCI and BZD. The population between WUCI and BZD is greater than sixteenth in most African works. Therefore, the choice of artificial anterior teeth in Caucasian subjects should not apply in African melanoderma subjects.

- Determination of the WUCI with a constant

No study has been found so much in the literature regarding the determination of the WUCI from the BZD with a constant. An equation in the form of linear regression was used to express the value of the WUCI as a function of a constant (b) and a slope (a): y = ax + b. Knowing that y = WUCI, a = loss is 0.025, x is the measurement of the BZD on the patient, and b = constant is 6.161. The equation becomes by replacing the letters with numbers: WUCI = 0.025 (BZD) + 6.161.

- Determination of the WUCI according to the variables analyzed.

A preaching formula was sought by including all significant variables of the study; to determine the WUCI. Non-standardised coefficient values were assigned for each parameter, including the constant. These were multiplied and added together; in order to obtain the WUCI in the form of linear regressions.

This equation only applies to Cameroonians residing in one of the different regions. The value of the WUCI would be estimated if the variables in the equation are coded and calculated with the dental and facial parameters.

S = 6.252 + 0.019 (BZD) + 0.035 (DCT) + 0.062 (Cultural Region) + (−0.479) sex.

The codes used in the equation are as follows: Male = 1, Female = 2, Western Region = 1, Coastal Tropical Forest Region = 2, Southern Tropical Forest Region = 3, Semi-Arid Region = 4 and Central Land Region = 5.

5. Conclusions

In a complete removable prosthesis, the choice of teeth represents an important

step during which communication between the practitioner and the patient on the one hand, and the practitioner and the prosthetist on the other hand, is essential. This work shows that:

- The averages of BZD, DCT and WUCI are high in men than in women; and larger in melanoderms than in leukoderma.
- The peoples of the Western Plateaus have the highest averages of BZD and DCT.
- The WUCI depends on gender, the cultural region of origin, facial width and DCT.
- The DCT and WUCI can be determined from the BZD. The formula for WUCI in Cameroonian melanoderms is as follows: WUCI = 6.252 + 0.019 (BZD) + 0.035 (DCT) + 0.062 (Reg cul) + ($-$0.479) sex.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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