

# Relationship between Inter Canine Width and Inter Alar Width, Inter Commissural Width, and Inter Canthal Distance: A Pilot Study

Grevisse Bindele Ndombolo<sup>1</sup>, Augustin Mantshumba Milolo<sup>1,2\*</sup>, Fidele Nyimi Bushabu<sup>2,3</sup>, Em Kalala Kazadi<sup>2,4</sup>, Pierrot Kumpanya Ntumba<sup>1,2</sup>, Jean Marie Kayembe Bukama<sup>5</sup>, Elias Lubadi Tshilumba<sup>1,2</sup>, Jean Paul Sekele Isouradi<sup>1,2</sup>

<sup>1</sup>Department of Prosthodontics, Teaching Hospital of Kinshasa University, Kinshasa, Democratic Republic of the Congo

<sup>2</sup>National Center of Research in Dental Sciences, Kinshasa, Democratic Republic of the Congo

<sup>3</sup>Department of Oral and Maxillofacial Surgery, Teaching Hospital of Kinshasa University, Kinshasa, Democratic Republic of the Congo

<sup>4</sup>Department of Periodontology, Teaching Hospital of Kinshasa University, Kinshasa, Democratic Republic of the Congo

<sup>5</sup>Department of Operative Dentistry, Teaching Hospital of Kinshasa University, Kinshasa, Democratic Republic of the Congo

Email: \*augustinmantshumba@gmail.com

**How to cite this paper:** Ndombolo, G.B., Milolo, A.M., Bushabu, F.N., Kazadi, E.K., Ntumba, P.K., Bukama, J.M.K., Tshilumba, E.L. and Isouradi, J.P.S. (2024) Relationship between Inter Canine Width and Inter Alar Width, Inter Commissural Width, and Inter Canthal Distance: A Pilot Study. *Open Journal of Stomatology*, 14, 279-290.

<https://doi.org/10.4236/ojst.2024.146022>

**Received:** February 27, 2024

**Accepted:** June 8, 2024

**Published:** June 11, 2024

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## Abstract

The aim of this study was to determine the relationship between inter canine width (ICW) and inter alar width (IAW), inter commissural width (ICoW), and inter canthal distance (ICaD) in Bantu population. **Materials and Methods:** It was a pilot study included all participants who were aged at least 18 years, without a history of orthodontics treatment from Prosthodontics Department, Faculty of Dental Medicine, University of Kinshasa. The Ethics committee of the National Center of Research for Dental Sciences in DR Congo approved the study protocol (CNRSB 1504.218). The participant's medical records were obtained from the interview and dental examination. Nature of the study was explained with participant information sheet, and an informed consent of all participants was obtained. The inclusion criteria were no missing maxillary and mandibular teeth, no diastema, and no anterior restorations, 18 years old before enrollment in the study. The exclusion criteria were inability to meet the above requirements, pregnancy, and refusal to participate in the study. The inter-canine width (ICW), inter alar width (IAW), inter canthal distance (ICaD) and inter-commissural width (ICoW) of each participant were measured with a digital Vernier caliper (Mitutoyo, UK Ltd.) (0.01 mm) three times and the average value was recorded. The inter canthal distance (ICaD) was measured without applying pressure by bringing the recording parts of the caliper just in contact with the medial angle. The inter alar width (IAW) was marked with a fine marked pencil on the widest outer

surface of the alae of the nose on either side or width. Those two points were measured without applying pressure by bringing the recording parts of the caliper just in contact with the outer surface. The participant was told to stop breathing shortly to avoid any change in shape of the nose. The inter-commissural width (ICoW) was determined by measuring the maxillary lip vermilion from commissure to commissure without the application of pressure on the tissue in the relaxed state. The inter-canine width (ICW) was measured indirectly using a dental floss. A dental floss was marked on one end prior to placement in the mouth. Using that point as reference, the dental floss was circumference along the curvature of the anterior dentition such that it passed along the contact point of all the teeth. The distal end of the canine teeth on both sides was then marked on the floss while it was stretched in the patient's mouth. Floss was marked on both sides with the marker pencil. The distance between the two proximal contact points was measured and recorded. Data, analysis and validation were performed by the SPSS software (version 22.0, IBM SPSS Statistics, Chicago, IL, USA). Unpaired t-test was used, of Kolmogorov-Smirnov test. Analysis of variance (ANOVA) test was used to test for comparability between socio-demographic characteristics dental measurements. Pearson's correlation coefficients test was calculated to determine the relationship between facial and dental parameters. Significance was set at  $p \leq 0.01$ . **Results:** Of 314 participants enrolled, 202 were included. The age ranged from 18 to 68 years, with a mean age of  $40.62 \pm 12.99$  years. Although the Pearson's correlation coefficients were negative. Ninety-three participants (46%) were men and one hundred and nine (54%) were women. The overall mean age was  $40.62 \pm 12.99$  years. Facial and dental measurements were greater in women than men with significant differences for ICW ( $p = 0.04$ ). However, no significant difference was seen between men and women for IAW, ICaD and ICoW ( $p = 0.44$ ,  $p = 0.23$ ,  $p = 0.31$  respectively). The correlation including Pearson's correlation coefficient and P-values for all participants is not demonstrated. **Conclusion:** Within the limitations of this study, the results suggest that IAW, ICaD and ICoW cannot be used as a preliminary method for determining the width of the maxillary for anterior teeth for edentulous patients.

## Keywords

Relationship, Inter-Canine Width, Inter Alar Width, Inter Canthal Distance, Inter Commissural Width

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## 1. Introduction

Replacing the missing teeth to restore all functions as well as the aesthetic expectations that would be in close resemblance to the persons' previous natural dentition has always been a great importance [1]. Choosing the size of the anterior teeth is one of the most important decisions to make when selecting maxillary anterior teeth. Selection of teeth can be very challenging especially to those

in the most natural and aesthetically pleasing form easily acceptable by the patient and the dentist when there are no pre-extraction records available [2]. The lower teeth are usually set up to complement the arrangement of the maxillary anterior teeth of paramount importance.

Patient's records and information before extraction are always the best guides that should be collected with all wisdom. These records could be facial photographs, radiographs, casts and even previous dentures available. If no records are available, selecting the proper anterior teeth for edentulous patients could be difficult and confusing work [3].

History has recorded several methods of determining tooth size from the use of dimensional measurements of the maxilla to the use or incorporation of facial or anthropological measurements [4].

Facial measurements are one of the most frequently used measures for estimating maxillary teeth size in edentulous patients especially when there are no pre-extraction records available. In absence of the records they are various guidelines, such as bizygomatic width (BZW), inter pupillary distance (IPD), inter alar width (IAW), inter canthal distance (ICD), inter commissural width (ICoW) and other anatomical structures [5] [6].

Different studies have been done to determine the width of the maxillary anterior using various anatomic, hard tissues, soft tissues and radiographic landmarks [7] [8] [9]. The anthropologic measurements have been proven useful in Caucasian population in selection of denture maxillary anterior; therefore, there is a need to investigate the Bantu population.

There are no studies conducted until now, which link inter-canine width and inter alar width, inter canthal distance or inter commissural width of Bantu, especially in DR Congo. Therefore, this study was undertaken to find credible evidence of the relationship between inter-canine width and inter alar width, inter canthal distance or inter commissural width in this population.

## 2. Materials and Methods

The Ethics committee of the National Center of Research for Dental Sciences in DR Congo approved the study protocol (CNRSB 1504.218).

**Study design:** It was a pilot study of 314 Congolese participants conducted in Prosthodontics Department, Faculty of Dental Medicine, University of Kinshasa. The participants' medical records were obtained from the interview and dental examination.

The study population was established in April 2022, composed of participants aged at least 18 years, who did not present with a history of orthodontic treatment. In all, 314 participants firstly enrolled for this study, 202 edentulous were selected until August 2022 for this study.

**Population selection:** Participants were selected from Prosthodontics Department of University of Kinshasa. They ranged in age from 18 to 68 years. All participants Congolese had maxillary anterior teeth present without any caries, restorations, crowding, diastema or severe attrition were included. Those par-

ticipants with a congenitally abnormal, orbital disease, trauma, facial surgery, or pregnancy were excluded.

**Data collection:** Nature of the study was explained with participant information sheet, and an informed consent of all participants was obtained.

The inter-canine width (ICW), inter alar width (IAW), inter canthal distance (ICaD) and inter-commissural width (ICoW) of each participant were measured with a digital Vernier caliper (Mitutoyo, UK Ltd.,) (0.01 mm) (**Figure 1**). Those parameters were divided in two categories:

**1) Facial measurements:** Facial parameters measured included:

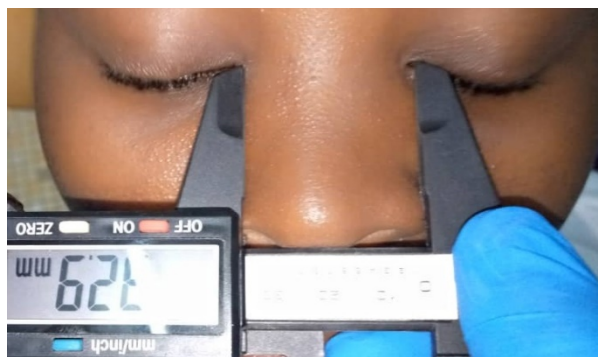
The inter canthal distance (ICaD) is the distance between the median (inner) angles (canti) of one eye to the other. This distance was measured with a digital Vernier caliper without applying pressure by bringing the recording parts of the caliper just in contact with the medial angle (**Figure 2**). For each participant, the ICaD was measured three times, and the average value was recorded.

The inter alar width (IAW) is the distance between the alae of the nose at the widest point. Two points were marked with a fine marked pencil on the widest outer surface of the alae of the nose on either side or width. Those two points were measured using a digital Vernier caliper without applying pressure by bringing the recording parts of the caliper just in contact with the outer surface. The participant was told to stop breathing shortly to avoid any change in shape of the nose (**Figure 3**). For each participant, the IAW was measured three times, and the average value was recorded.

The inter-commissural width (ICoW) was determined by measuring the maxillary lip vermilion from commissure to commissure using a digital Vernier caliper without the application of pressure on the tissue in the relaxed state (**Figure 4**). For each participant, the ICoW was measured three times, and the average value was recorded.



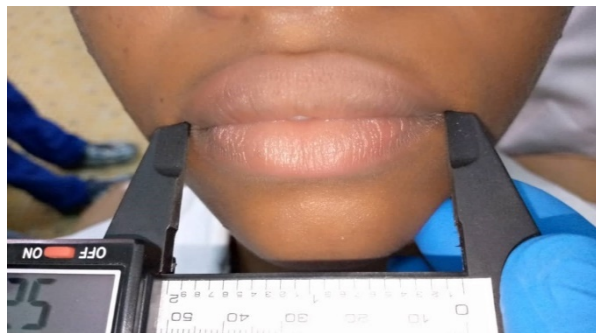
**Figure 1.** Electronic digital caliper.



**Figure 2.** Inter-Canthus distance.



**Figure 3.** Inter-Alar width.



**Figure 4.** Inter-commissural width.

**2) Dental measurements:** Dental parameter to be measured is the inter-canine width (ICW). The ICW is the distance between the distal contact points of one canine to the other. It was measured indirectly using a dental floss. A dental floss was marked on one end prior to placement in the mouth. Using that point as reference, the dental floss was circumference along the curvature of the anterior dentition such that it passed along the contact point of all the teeth. The distal end of the canine teeth on both sides was then marked on the floss while it was stretched in the patient's mouth. Floss was marked on both sides with the marker pencil. The distance between the two proximal contact points was measured using a Vernier caliper and recorded (**Figure 5**). For each participant, the ICW was measured three times, and the average value was recorded.

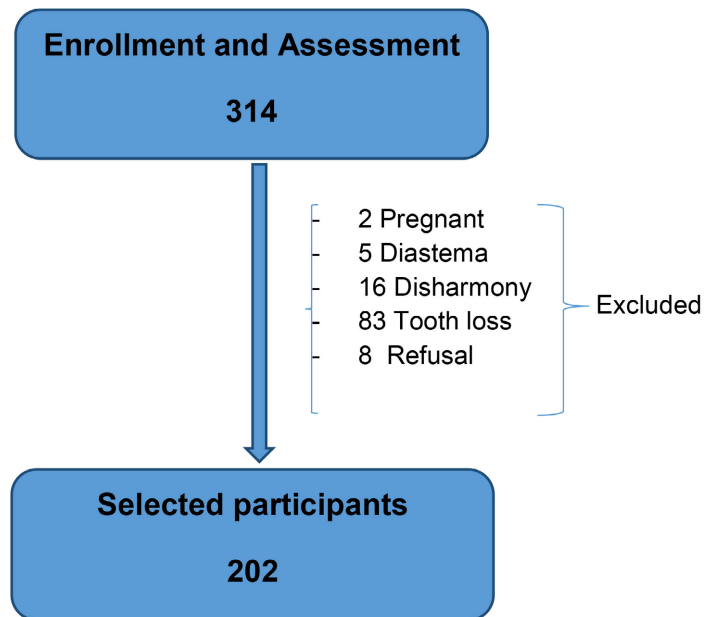
**Statistical analysis:** Data, analysis and validation were performed the SPSS software (version 22.0, IBM SPSS Statistics, Chicago, IL, USA). Unpaired t-test was used, Kolmogorov-Smirnov (KS) test. Analysis of variance (ANOVA) test was used to test for comparability between socio-demographic characteristics dental measurements. Pearson's correlation coefficient test was employed to determine the level of correlation between facial and dental parameters. Significance was set at  $P \leq 0.01$ .

### 3. Results

Of 314 participants who were enrolled in this study, only 202 were included (**Figure 6**) and constituted the final sample, from which the data were collected



**Figure 5.** Inter-Canine width.



**Figure 6.** Flow chart of participants enrolled and the exclusion reason in the study.

and statistically analyzed. Ninety-three (46%) participants were men and one hundred and nine (54%) were women (**Table 1**). The age average was between 18 - 68 years old. The overall mean age was  $40.62 \pm 12.99$  years. The different variables were higher for women than for men.

The descriptive statistics including mean, standard deviation, and values of recorded measurements grouped by sex are listed in **Table 2**. Facial and dental measurements were greater in women than men with significant difference for ICW ( $p = 0.04$ ). However, no significant difference was seen between men and women for IAW, ICaD and ICoW ( $p = 0.44$ ,  $p = 0.23$ ,  $p = 0.31$  respectively) (**Table 3**).

The correlation including Pearson's correlation coefficient and P-values for all participants is demonstrated in **Table 4**. For whole participants, none of the facial measurements showed significant correlation with ICW ( $p > 0.01$ ) (**Table 5**).

#### 4. Discussion

The main goal of this study was to determine the relationship between facial

**Table 1.** Socio-demographic characteristics of the sample.

Sex	n	%
<b>Gender</b>		
Male	93	46.04
Female	109	53.96
<b>Age category (years)</b>		
18 - 29	56	27.7
30 - 41	46	22.8
42 - 53	60	29.7
≥54	40	19.8

**Table 2.** Descriptive statistics of facial and dental measurements.

Variables	n	Minimum	Maximum	Mean	SD
IAW	202	34.17	53.59	43.7078	5.52822
ICaD	202	29.62	58.84	39.9661	8.87073
ICoW	202	31.22	96.20	59.1739	6.43614
ICW	202	42.99	91.92	56.8297	5.82604

Legend: ICoW: Inter-Commissural Width, ICaD: Inter-Canthus Distance, IAW: Inter-Alar Width, ICW: Inter-Canine Width.

**Table 3.** Facial anthropometric and dental measurements according to the sex.

Parameters	Sex	n	Mean	SD	P*
IAW (mm)	M	93	43.3873	5.59241	0.448
	F	109	43.9812	5.48381	
ICaD (mm)	M	93	39.1663	8.91138	0.238
	F	109	40.6485	8.83625	
ICoW (mm)	M	93	64.1002	9.44845	0.316
	F	109	54.9707	8.12346	
ICW (mm)	M	93	55.9442	5.21287	0.048*
	F	109	57.577	6.22326	

\*ANOVA. Legends: ICoW: Inter-Commissural Width, ICaD: Inter-Canthus Distance, IAW: Inter-Alar Width, ICW: Inter-Canine Width.

**Table 4.** Facial anthropometric and dental measurements according to the age.

Parameters	Age (years)	n	Mean	SD	P*
ICaD (mm)	18 - 29	56	40.7788	9.1909	0.070*
	30 - 41	46	37.692	7.3740	
	42 - 53	60	39.3172	8.0967	
	≥54	40	42.4171	9.4071	

## Continued

ICoW (mm)	18 - 29	56	71.0464	8.1492	0.444
	30 - 41	46	55.663	8.5598	
	42 - 53	60	53.097	8.2288	
	≥54	40	55.7053	7.7483	
ICW (mm)	18 - 29	56	56.3749	5.2317	0.356
	30 - 41	46	56.2578	7.5357	
	42 - 53	60	56.7207	4.8919	
	≥54	40	58.2738	5.6220	
IAW (mm)	18 - 29	56	42.7359	4.8392	0.380
	30 - 41	48	43.6933	5.9608	
	42 - 53	60	44.6997	5.7593	
	≥54	40	43.5973	5.5153	

\*Legend: ICoW: Inter-Commissural Width, ICaD: Inter-Canthus Distance IAW: Inter-Alar Width, ICW: Inter-Canine Width.

**Table 5.** Correlation between inter-canine width and anthropometrics parameters.

Parameters	Mean	r*	P
IAW/ICW	43.70	-0.09	0.200
ICaD/ICW	39.9	0.01	0.842
ICoW/ICW	59.17	-0.07	0.285

\*Correlation is weak; r = Pearson correlation coefficient. Legends: ICW: Inter-Commissural Width, ICaD: Inter-Canthus Distance, IAW: Inter-Alar Width, ICW: Inter-Canine Width.

measurements and maxillary anterior teeth width in Bantu population. The mean widths of six maxillary anterior teeth are wider for women than men, as supported by previous studies [5] [10]. However, many studies on the others population have shown contrasting results [11] [12] [13].

The average distance between the distal surfaces of maxillary canines is (56.82 mm ± 5.82) (**Figure 5**), which is higher than the values reported by Omotayo *et al.* (55.15 mm ± 3.63), Arigbede *et al.* (47.4 mm), Deograde *et al.* (43.86 mm), Esan *et al.* (36.1 mm) [4] [14] [15] [16]. The minor variations may be attributed to differences in measurements methods and difference of the populations.

The study showed a statistically significant difference between sex and ICW (p = 0.048). This is similar to results gotten from previous studies [15] [17]. The higher values seen in women may be due to the influence of young women dominance factor, which also accounts for larger size of long bones and height differences seen between women and men in this study. Although the mean ICW is slightly higher in women (57.57 mm ± 6.22) than men (55.94 mm ± 5.21), this difference is not significant. In contrary, the previous studies reported the higher values in men than women [4] [9].



In the present study, the average of ICaD was found to be  $39.96 \text{ mm} \pm 8.87$  for the whole study group and found to be  $39.16 \text{ mm} \pm 8.91$  and  $40.64 \text{ mm} \pm 8.83$  for men and women respectively. The part in which this variation is most significant, studies reported that ICaD is attained mostly by the first year and there is no difference between young and older groups in the inter canthal distance. Our result is similar to that obtained by Omotayo, Esan and Arigbede in their studies among the Nigerian for the whole participants that may indicate a similar ethnic background [4] [14] [16]. However, it is higher than the result obtained by others authors [9] [18] [19]. In the previous study, Bouhadana *et al.* demonstrate that the intercanthal distance varies significantly across different ethnicities and genders [20]. Participants from African backgrounds had higher ICaD values than their counterparts, and women had higher ICaD than men across ethnicities.

Additionally, the IAW in this work showed a mean of  $43.70 \text{ mm} \pm 5.52$ , with statistically non-significant differences between men and women, which is similar to the findings of Alshamri *et al.* [12], but contrasts with some published investigations [6] [21] [22]. The IAW differ among different ethnicity. Studies proposed that climate plays a role in determining the IAW. The nasal aperture becomes much wider in hot climate than cold. The wider nasal aperture existing in all African and Asian ethnic groups in both genders (Figure 3) [23]. This study showed that the IAW was larger in women than men. This is similar to result from other study [24].

When considering the ICoW of participants, it was found to be ( $59.17 \text{ mm} \pm 6.43$ ) for the whole study group and found to be  $64.10 \text{ mm} \pm 9.44$  and  $54.97 \text{ mm} \pm 8.12$  for men and women respectively. The mean ICoW was higher than values reported for other ethnic groups by Omotayo *et al.* ( $57.85 \pm 4.59$ ), Arigbede *et al.* ( $53.3 \text{ mm}$ ), and Hamid *et al.* ( $46.84 \pm 5.8$ ) [4] [14] [21], but lower than values reported by Esan *et al.* ( $74.6 \text{ mm} \pm 4.59$ ) [16]. This variation may be due to different method used or it may indicate a multiple ethnic origin among population.

The Pearson's correlation coefficient ( $r$ ) between ICW and IAW, ICW and ICoW were negative with respectively ( $r = -0.09$ ,  $p = 0.2$ ) and ( $r = -0.07$ ,  $p = 0.28$ ). The correlation between ICW and ICaD were no significant ( $r = 0.014$ ,  $p = 0.84$ ).

This present study did not find any significant correlation between ICW and other facial measurements. In similar previous studies in Nigerian population, any significant correlation was reported [14] [16].

Facial and dental measurements exhibit variations across age, sex, race, geographic locations, climate conditions, and the historical backgrounds of different subjects; these measurements are closely associated with human DNA, such as facial shape and features [25].

Although this research was carefully prepared, there were some unavoidable limitations.

First, the sample size is only limited to 202 participants who were attending at

teaching hospital. The second limitation was the geographical region that this study was conducted. The sample was only taken from the teaching hospital of Kinshasa University, thus the sample cannot be the representative of the rest of the population.

## 5. Conclusion

Within the limitations of this study, the results suggest that IAW, ICaD and ICoW cannot be used as a preliminary method for determining the width of the maxillary for anterior teeth for edentulous Bantu population (DR Congo).

## Acknowledgements

This study received support from the National Center of Research in Dental Sciences, Kinshasa, Democratic Republic of the Congo. The authors would like to thank Professor Joke Duyck and Doctor Philippe Vuylsteke from KU Leuven University for their support and collaboration.

## Conflicts of Interest

The authors declare no conflicts of interest in this work.

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