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Interalar-to-Intercanine Distance Ratio in Sudanese Dentate Adults: Anthropometric Foundations for Anterior Teeth Selection in Edentulous Patients

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ABSTRACT

Background: For edentulous patients without pre-extraction records, selecting appropriate measurements for maxillary anterior teeth can be difficult.
Objective: To develop a reliable guideline for the Sudanese population, this study examines the relationship between interalar width (IAW) and intercanine distance (ICD).
Methods: A total of 114 Sudanese individuals with full natural dentition (45 men and 69 women) participated in a cross-sectional study. A digital caliper was used in a clinical setting to measure IAW, and dental casts were used to get ICD. Independent t-tests ($p < 0.05$) and Pearson correlation were used in the statistical analysis.
Results: The average IAW was 40.00 ± 3.8 mm ($p < 0.001$) for males (42.7 mm) and for females (38.3 mm). The average ICD was 35.93 ± 2.1 mm ($p = 0.003$), with males measuring 37.1 mm and females measuring 35.19 mm. Dividing the IAW by ICD gives a 1.1 ratio.
Conclusion: A robust association was found between IAW and ICD, endorsing the application of a 1.1 ratio as a dependable reference for choosing anterior teeth in edentulous Sudanese patients.

Keywords: Interalar width, intercanine distance, maxillary anterior teeth selection, Sudan.

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INTRODUCTION

Edentulous patients undergoing prosthetic rehabilitation require careful consideration of both function and appearance, especially when choosing maxillary anterior teeth. Clinicians must rely on facial anthropometry since they often come across instances with no pre-extraction information [1,2]. We focus on interalar width (IAW) because of its anatomically constant link with the maxillary arch [3], even though other measures, including interpupillary distance and bizygomatic width, have been studied [4, 5]. Although extensive research has been conducted among Asian and Caucasian communities, less is known about African populations. This gap interested our research team to establish standard values for interalar width (IAW) and intercanine distance (ICD) in Sudanese adults, evaluate the correlation between IAW and ICD, and calculate a clinically meaningful ratio to aid in anterior tooth selection.

METHODOLOGY

Study Design, Population, and Sample Size

This cross-sectional study was conducted at the Dental Clinic, University of Khartoum, Sudan. A total of 114 Sudanese individuals (45 men and 69 women), nationals between the ages of 19 and 60 who have a full natural dentition with an Angle's Class I occlusion and no history of facial trauma or orthodontic treatment, were selected conveniently. Exclusion criteria include craniofacial abnormalities, significant tooth wear, restorations, or periodontal disease.

Measurements

Interalar Width (IAW) is the distance between the ala of the nose from one side to the other side [6, 7]. IAW was measured as the linear distance between the most lateral points of the alae of the nose using a NAREX digital tin wrap with an accuracy of 0.01 mm. Participants were sitting in a vertical position, with relaxed lips. The caliper was carefully placed on the external convexity of each IAW without using pressure (Figure 1). This method has been widely confirmed in previous anthropometric studies [8–10].

Intercanine distance (ICD) is the straight line from the tip of the canine from one side to the other [7]. Measurements were performed between the tips of the right and left canine cusps using the same digital device (Figure 2). ICD was measured from the maxillary cast. The cast was prepared from alginate impressions and was poured into dental stone Class III. This method followed standard procedures documented in the prosthetic literature [10, 11–13]. All measurements were recorded three times by the same examiner (N.E.) to ensure consistency, and the mean values were used in the analysis.

Ethical Considerations

With ethical approval (IRB No. NRU-Dent/2020/014) from the Research Ethics Committee of the Faculty of Dentistry at the University of Khartoum, this cross-sectional study was conducted at Khartoum University Dental Clinic (2020–2021). Written consent was obtained from the patients, and they agreed to the publication of their photos.

Figure 1: Measuring the interalar width with an electronic digital caliper.

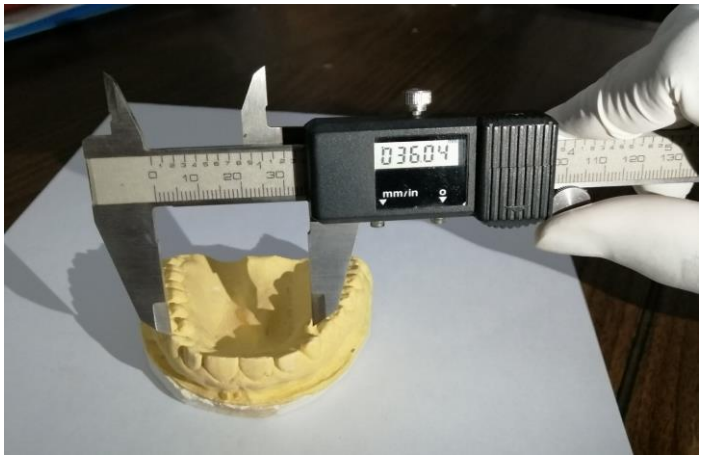

Figure 2: Measuring the maxillary intercanine distance with an electronic digital caliper from the cast.

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Data Analysis

Data were processed using SPSS V26.0. Pearson's correlation assessed the linear relationship between the IAW and ICD. Independent t-tests compared the means between the two independent gender groups (α=0.05).

RESULTS

Demographic Distribution

The sample in this study consisted of 114 Sudanese adults (45 men and 69 women) with a mean age of 34.2 ± 8.7 years. Participants were selected to represent a typical adult population in Sudan with natural dentition and balanced occlusion.

Descriptive Analysis of Interalar Width and Intercanine Distance

The mean interalar width (IAW) of the total sample was 40.00 ± 3.8 mm, with statistically significant gender differences (male: 42.7 ± 3.2 mm, female: 38.3 ± 3.5 mm, $p < 0.001$), as seen in Table 1.

The mean intercanine distance (ICD) was 35.93 ± 2.1 mm, also showing a significant gender-based difference (males: 37.1 ± 1.9 mm, females: 35.19 ± 1.7 mm, $p = 0.003$) (Table 1).

These results confirmed that IAW and ICD are significantly greater in males than in women.

Correlation Analysis

Pearson's correlation coefficient revealed a strong positive correlation between IAW and ICD across the sample ($r = 0.82$, $p = 0.007$).

Derived Predictive Ratio

A predictive ratio was calculated to assist in estimating the intercanine distance from the interalar width:

IAW/ICD ratio = 1.1 (95% CI: 1.07–1.13).

This suggests that, on average, the distance of the intercanine can be estimated by dividing the interalar width by 1.1 or equivalent (Table 1).

This ratio was found to be consistently reliable across the full sample, with no significant outliers.

Gender-Stratified Correlation

Gender analysis showed $r = 0.78$ ($p = 0.012$) for males and $r = 0.80$ ($p = 0.008$) for females.

This consistency across gender further supports the use of the IAW/ICD ratio as a population-specific guideline for the Sudanese demographic.

Table 1: The correlation between interalar width (IAW) and Intercanine (ICD) among the studied Sudanese population

Parameter	Overall (n = 114)	Males (n = 45)	Females (n = 69)	p-value
IAW (mm)	40.00 ± 3.8	42.7 ± 3.2	38.3 ± 3.5	<0.001
ICD (mm)	35.93 ± 2.1	37.1 ± 1.9	35.19 ± 1.7	0.003
IAW/ICD Ratio	1.1	1.15	1.09	–

IAW: Interalar Width. ICD: Intercanine Distance.

These results validate the hypothesis that interalar width is a reliable anatomical landmark for estimating the appropriate anterior tooth width in the Sudanese population. Given the significant correlation and consistency of the 1.1 ratio, this method may serve as a practical clinical tool, particularly in cases missing pre-extraction records.

DISCUSSION

The selection of maxillary anterior teeth in edentulous patients remains a critical issue for prosthetic prostheses, especially when pre-extraction records are not available prior to exclusion. A strong correlation was conducted between interalar width (IAW) and intercanine (ICD) ($r = 0.82$, $p = 0.007$). This confirms the hypothesis that interalar width (IAW) as a reliable predictor of the mesiodistal width of the anterior teeth in Sudanese populations is useful [10,12].

These findings are in agreement with numerous earlier studies. For example, Mahmood et al. [10] conducted research in Pakistan and discovered a

notable correlation between IAW and the size of anterior teeth, concluding that IAW can serve as a reference for selecting anterior teeth within their demographic [10]. Likewise, Ayub et al. reported a similar correlation between nasal width and the combined mesiodistal width of the six anterior teeth in dentate individuals residing in Peshawar [14].

Our suggested ratio (IAW/ICD = 1.1) corresponds with the values observed in Arab populations (1.1), and is marginally lower than those documented for Caucasians (1.15), while being higher than the figures for Asian populations (1.05) [10,12,15]. This highlights the necessity for ethnicity-specific guidelines in denture aesthetics. Additionally, Attokaran et al. (Kerala, India) identified a robust relationship between IAW and ICD, especially among females [15].

The gender differences identified in our research reflect universal trends. Males verified more interalar and intercanine measurements, aligning with the results stated by Pisulkar et al. and Ghimire et al. [11,12]. Such variances advocate for the implementation of gender-adjusted standards in tooth selection to recover esthetic results. Nevertheless, there is a contrasting suggestion. Qamar et al. [16] and Varjão & Nogueira [18] concluded that interalar width (IAW) is not a reliable predictor across different populations, revealing a weak or nonexistent correlation between IAW and the width of anterior teeth [16,18]. These results underscore the geographic and racial diversity in craniofacial anatomy and emphasize the importance of utilizing population-specific data.

Recent publications challenge the universality of IAW as a predictive tool. Ndombolo et al. [18] found no significant IAW-ICD correlation in a Bantu population, concluding that IAW alone is unsatisfactory for teeth selection [18]. Likewise, Ali Hameed et al. noted that IAW correlated with ICD only in tapered arch forms, suggesting dental arch morphology influences these associations [7]. Wang et al. [9] highlighted that while IAW, intercanthal distance (ICD), and intercommissural width (ICW) correlate with ICD, they cannot directly predict tooth width without accounting for age and gender differences [9].

Improvements in machine learning offer promising alternatives. Ramachandran et al. [23] established a random forest model that accurately predicted maxillary central incisor width using facial anthropometric data, achieving 96% precision [23]. Such AI-driven approaches could complement old-style methods, particularly in diverse populations where anatomical variability limits single-parameter reliability.

Limitations

This research took place at a singular location using a limited participant pool (n = 114), which restricts its generalizability. Moreover, only individuals with teeth present were assessed. Although the relationship between IAW and ICD was significant, it remains unclear if this applies to completely edentulous or elderly groups, where bone resorption may modify the foundational arch dimensions [7, 8].

Recommendations

Forthcoming research should involve edentulous individuals to confirm if the suggested 1.1 ratio is appropriate in cases of complete dentures [7]. A larger, multi-center study about various regions of Sudan is essential to improve the representativeness of the conclusions [9]. Furthermore, a proportional analysis of extra facial indices such as intercommissural width, intercanthal distance, or bizygomatic distance may support the development of a multifactorial approach for selecting anterior teeth [8,19,22,23]. Furthermore, incorporating AI-driven facial investigation systems could improve accuracy and simplify personalized treatment planning [4].

CONCLUSION

The significant relationship between IAW and ICD endorses the application of a 1.1 ratio as a dependable reference for choosing anterior teeth in edentulous patients from Sudan. This research delivers important anthropometric evidence that enhances prosthodontic studies in less-represented groups.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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