Section: Dentistry

Original Research Article

FACIAL METRICS AND DENTAL ESTHETICS: THE ROLE OF INNER CANTHAL WIDTH IN SELECTING MAXILLARY ANTERIOR TEETH

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ABSTRACT

Background: In the domain of prosthodontics, the precise choice of maxillary anterior teeth constitutes a pivotal aspect influencing both the esthetic appeal and functional efficacy of dental prostheses. A promising avenue for facilitating this selection process involves the assessment of the inner canthal width (ICW). This study aimed to explore the relationship between ICW and the combined mesio-distal widths of maxillary anterior teeth (MDWMAT) across both male and female participants. **Materials and Methods:** This cross-sectional study was conducted in the Department of Prosthodontics over an 11-month period (February 2019 to December 2019) at Liaquat University of Medical and Health Sciences (LUMHS), involving 115 participants. Measurements of ICW and combined MDWMAT were taken using a digital vernier caliper. Data were analyzed using SPSS version 26.0, employing descriptive statistics, independent sample t-tests, and Pearson correlation coefficient to assess the relationship between ICW and MDWMAT considering p value < 0.05. **Result:** The mean age of the individuals was 23.56 ± 2.92 years. Males exhibited a slightly lower mean ICW (32.33 ± 1.68 mm) compared to females (32.67 ± 2.11 mm), although this difference was statistically non-significant (p = 0.335). Similarly, there was no significant difference in the mean combined MDWMAT between males (47.96 ± 6.37 mm) and females (49.32 ± 6.18 mm) (p = 0.266). However, a strong positive correlation (r = 0.650) was observed between ICW and combined MDWMAT, with a highly statistically significant p-value (<0.001). **Conclusion:** This research suggests that ICW is a reliable anthropometric measurement for guiding the selection of maxillary anterior teeth (MAT) which may help in clinical practice.

INTRODUCTION

Among the different measurements used in dentistry, inner canthal width (ICW)—the distance between the inner corners of the eyes—has gained attention. Tooth loss, typically caused by gum disease or cavities, is a common global issue that can lead to complete toothlessness (edentulism).[1] Furthermore, tooth loss has consequences that go beyond just discomfort. It affects the ability to chew, hastens the loss of jaw bone, and weakens the supporting muscles of the face. This has an impact on the way an individual feels and looks in addition to their physical condition. A lot of people experience poor self-esteem and may avoid social situations.[2].

For dentures to function properly and appear natural, the maxillary anterior teeth (MAT), or upper front teeth, must be measured appropriately. Pre-extraction recordings, such as x-rays or dental models, are typically used by dentists to assist them in selecting the appropriate size. Nevertheless, a lot of patients lack these records, which complicates finding the ideal fit. This has brought attention to the necessity for more consistent standards and trustworthy

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techniques when choosing tooth sizes. With more advanced equipment, dentists can produce dentures that work better and seem more natural, which will eventually increase patient comfort and satisfaction.[3,4]

In the past, the process of selecting the right tooth size was often hit or miss, resulting in inconsistent outcomes.[5]. But research has shown that ICW can be a stable and dependable measurement for guiding the selection of maxillary anterior teeth (MAT). By the time a child reaches 1 year old, about 78% of their adult ICW is already in place, and by the age of 18, ICW is nearly fully developed in both females and males. Because of this stability, ICW can be a useful tool for dentists when choosing the size of the upper front teeth, especially in cases where no pre-extraction dental records are available. Using ICW as a reference helps dentists achieve better results in both the appearance and functionality of dentures.[6]

However, research on the relationship between ICW and the combined width of the MAT (measured from one canine to the other) has produced mixed results. Some studies suggest a weak positive correlation, while others show conflicting or inconclusive findings. This highlights the need for further research to clarify how ICW relates to tooth size and whether it can be consistently used in practice.[7-14]

Because individuals' facial features vary across different regions and populations, it's also important to conduct studies specific to different groups to determine whether ICW can be used universally as a predictor for tooth size. This study aims to investigate the relationship between ICW and the total width of the MAT to see if ICW can reliably guide the selection of the correct size for these teeth. If successful, this could lead to improved outcomes for patients who rely on dentures, both in terms of aesthetics and function.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Dept. of Prosthodontics, LUMHS, Jamshoro from Feb, 2019 to Dec, 2019. Ethical approval for the study was obtained from the research ethics committee (Ref # LUMHS/REC/743, date 21st Dec, 2024) of LUMHS, and informed consent was secured from all participants. The sample size was calculated using the Epi Tools online sample size calculator, considering the following parameters: a mean of 67.05 (Subnasal-menton measurement in females) with a standard deviation of 4.64, and a mean of 65.45 (Nasal-gnathion measurement in females) with a standard deviation of 4.27 reported by a study (15). A 95% confidence interval and 0.95 power were applied, with a 1:1 ratio between the two groups. The initial calculated sample size was 96. To enhance the generalizability of the results, a 20% increase was applied, resulting in a final sample size of 115 participants. The study population consisted of 115 patients, aged between 19 and 28 years, who were selected using a convenience sampling technique. These individuals sought care at the Prosthodontics Department of LUMHS. Inclusion criteria required patients to have six intact and unrestored natural MAT with no pre-existing facial deformities, no history of orthodontic treatment or maxillofacial trauma or surgery, and no systemic conditions affecting craniofacial morphology. Exclusion criteria excluded patients with restoration or artificial crowns on MAT, partial edentulism, congenital craniofacial anomalies, or conditions that might affect facial or dental measurements.

The ICW was assessed using a digital vernier caliper. To ensure consistency, measurements were obtained with the patient seated in an upright position, looking straight ahead, and with the head stabilized. Each measurement was repeated three times, and the average value was recorded to ensure accuracy. To measure the combined Mesio-distal width of MAT (MDWMAT), dental casts were created from alginate impressions of the upper arches of each patient. The impressions were poured with dental stone to produce accurate casts. The combined MDWMAT were then measured on these casts using the same digital vernier caliper. Each tooth measurement was taken at its widest point, repeated three times, and the average values were recorded to maintain precision.

Data were entered and examined using SPSS version 26.0. Descriptive statistics, including means and standard deviations (SD) for quantitative data presentation. Independent-samples t-tests was applied to compare means between groups (males and females), and the Pearson correlation coefficient was used to assess the relationship between ICW and the combined. P-value < 0.05 was considered statistically significant.

RESULTS

Of the 115 participants, 71 (61.7%) were male while 44 (38.3%) were female [Figure 1] ranging between 19-28 years with a mean age of 23.56 ± 2.92 years.

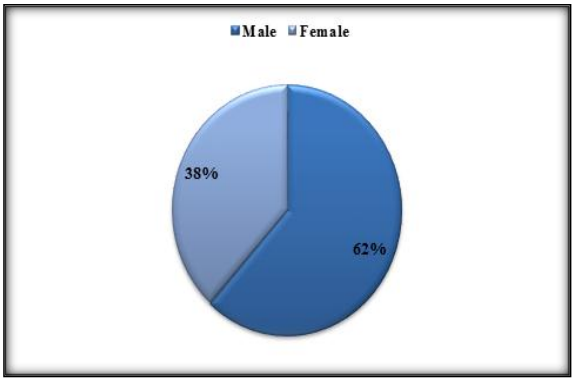

Figure 1: Gender Distribution

The mean age of male participants (23.32 ± 2.74 years) was slightly lower than that of female participants (23.95 ± 3.18 years) [Figure 2].

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The t-test showed no significant difference in age across gender (t(81.042) = -1.088, p = 0.280). The mean ICW was 32.45 ± 1.86 mm with a range of 28.80 – 37.00 mm. There was a minor difference in mean ICW between males (32.33 ± 1.68 mm) and females (32.67 ± 2.11 mm) [Figure 2]. The t-test indicated no significant difference in ICW between both groups of the participants (t(113) = -0.968, p = 0.335). The mean combined MDWMAT was 48.48 ± 6.31 mm with a range of 33.70 – 63.00 mm. The mean combined MDWMAT for males (47.96 ± 6.37) was comparable to that of females (49.32 ± 6.18) [Figure 2]. The t-test revealed no significant difference in combined MDWMAT between gender (t(113) = -1.117, p = 0.266) [Table 1].

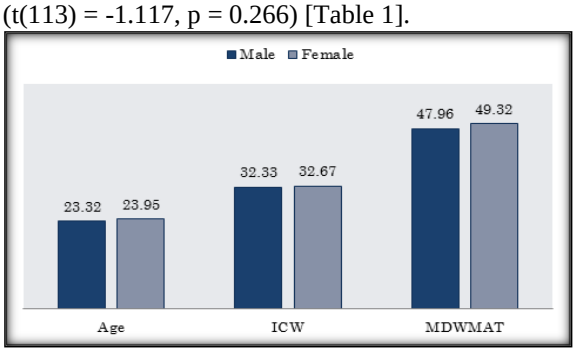

Figure 2: Means of Age, ICW and combined MDWMAT between Male and Female.

Table 1: Comparison of Mean Differences for Age, ICW, and MDWMAT with p-values

	Mean Difference	95% CI		p-value*
		Lower	Upper	
Age	-0.63060	-1.78417	0.52296	0.280
ICW	-0.34597	-1.05399	0.36206	0.335
MDWMAT	-1.35144	-3.74737	1.04449	0.266

*Independent t test
ICW: Inner Canthal Width, MDWMAT: Mesio-Distal Width of Maxillary Anterior Teeth

The results indicated a strong positive correlation (r = 0.650) between the ICW and the combined MDWMAT, with a highly significant p-value (p < 0.001) [Table 2].

Table 2: Analysis of the Relationship Between MDWMAT and ICW

		MDWMAT
ICW	Pearson Correlation	0.650**
	Sig. (2-tailed)	0.000
	N	115

Pearson Correlation Test
** Correlation is significant at the 0.01 level (2-tailed)
ICW: Inner Canthal Width

The scatterplot demonstrated a positive relationship between ICW and MDWMAT, with the upward slope of the trendline indicating that as ICW increases, MDWMAT also tends to increase. The R^2 value of 0.422 suggested that approximately 42.2% of the variance in MDWMAT can be explained by ICW, indicating a moderate linear relationship [Figure 3].

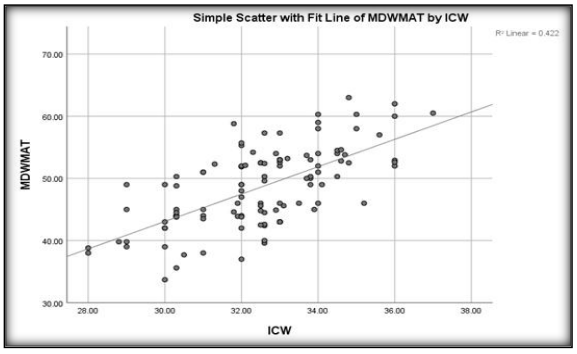

Figure 3: Scatterplot showing the positive linear relationship between ICW and MDWMAT with a fitted trendline (R^2 = 0.422)

DISCUSSION

In prosthodontics, the selection of maxillary anterior teeth (MAT) plays a pivotal role in achieving successful outcomes, as it significantly impacts both esthetic appearance and functional efficiency of dental restorations. Patients today have heightened esthetic expectations, demanding natural-looking replacements for missing teeth. However, replicating the size, shape, and position of natural teeth poses a significant challenge, particularly in cases where pre-extraction records are unavailable.

In response to the challenge of selecting appropriately sized teeth for denture fabrication, clinicians have increasingly relied on anthropometric measurements as a potential guide. Among these measurements, the ICW has emerged as a particularly promising parameter. Its stability over time, combined with its potential correlation with the dimensions of MAT, renders it an attractive candidate for facilitating tooth selection in prosthodontic procedures. The aim of this study was to investigate the relationship between the ICW and the combined MDWMAT, while also examining the differences between male and female participants of the study.

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Our findings revealed a subtle discrepancy in mean ICW values between genders, with males showing slightly lower values compared to females. Specifically, males had a mean ICW of 32.33 mm, while females had a mean ICW of 32.67 mm. This observation contrasts with prior research.[9,10,13,16-18] which indicates that males typically possess larger facial dimensions, including ICW. For example, some studies indicate that male participants generally exhibit larger facial metrics due to genetic and hormonal factors that contribute to facial growth patterns. The mean combined MDWMAT values in our study were slightly lower for males and higher for females than those reported in some other studies.[14,18-20] This could be due to differences in sample demographics, including age and ethnic background. However, our findings are consistent with other research that has found no significant gender differences in these measurements, suggesting that ICW and MDWMAT may not be heavily influenced by gender,[10,16,21] where as Baleegh et al,[11] found significant differences between males and females.

Several studies have reported varying degrees of correlation between ICW and the combined MDWMAT. Our study, however, found a strong positive correlation (r = 0.650) between ICW and combined MDWMAT, with a highly significant p-value of <0.001. This finding is consistent with the studies conducted by Manek et al,[12] Lucas et al,[22] and Alshamri et al,[23] described significant positive correlations between ICW and the combined MDWMAT. These studies proposed various formulas and multipliers for estimating tooth dimensions based on ICW, highlighting its potential utility in clinical settings. However, some studies have indicated that there is a weak correlation between MDWMAT and ICW. There was a weakly positive correlation found between these factors in the studies by Kumari et al,[15] Al Wazzan et al,[23] and Elakwa et al.[7]. This suggests that while ICW may offer important information, it should not be used as the sole criterion to consider when deciding a tooth size. Additionally, Abdullah et al,[17] proposed specific multipliers for ICW to determine the combined MDWMAT based on research conducted among Saudi citizens. On the other hand, there was no indication of a meaningful correlation between MDWMAT and ICW in Chaudhary et al.[24] investigation. This variance in outcomes could be due to variation among study participants, methodology, and assessment techniques. For example, studies involving different racial and ethnic groups have reported varying degrees of correlation, indicating that anatomical differences may influence the relationship between ICW and tooth dimensions.[8]

Given the stability and ease of measurement of ICW, it presents a valuable tool for prosthodontists, particularly in cases where pre-extraction records are unavailable. The ability to predict tooth dimensions accurately can significantly enhance the esthetic and functional outcomes of dentures, improving patient satisfaction. However, the potential variability across different populations necessitates region-specific studies to confirm the universal applicability of ICW as a predictor for tooth dimensions.

The limitations of this study should be acknowledged. The sample size, though adequate for preliminary analysis, may not capture the inconsistency within the broader population. Additionally, longitudinal studies tracking the stability of ICW and its correlation with dental dimensions over time would provide more considerations into its reliability as a predictive measure.

CONCLUSION

This study reinforces the potential of ICW as a useful anthropometric measurement for estimating the combined MDWMAT. The strong positive correlation observed in our sample suggests that ICW can aid in selecting appropriately sized maxillary anterior teeth for complete dentures. By integrating ICW into the prosthodontic assessment process, clinicians can enhance the esthetic and functional outcomes of dentures, thereby improving patient satisfaction and overall quality of life. However, the application of ICW should be tempered with clinical judgment and supplemented by other measurements to account for individual anatomical variations. Continued research in this area will further refine the guidelines for tooth selection, contributing to the advancement of prosthodontic practice and the well-being of edentulous patients.

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