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# The Relationship of Facial Measurements with the Mesiodistal Width of the Maxillary Anterior Teeth

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## **ORIGINAL ARTICLE**

# **The Relationship of Facial Measurements with the Mesiodistal Width of the Maxillary Anterior Teeth**

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## **ABSTRACT**

The relationship between facial measurements and the size of the maxillary anterior teeth in the Malaysian population is still a point of contention. **Objective:** The purpose of this study was to establish a relationship between facial measurements and the mesiodistal width of the maxillary anterior teeth (MDW), which could be used to guide the selection of anterior teeth for complete denture construction. **Methods:** The facial and dental measurements were obtained directly from 170 Malay adults aged between 19 to 35 who had morphologically normal permanent maxillary anterior teeth from canine to canine. The facial dimensions measured were interpupillary distance (IPD), intercanthal distance (ICD) and interalar distance (IAD). The facial dimensions were measured using a digital vernier calliper while the mesiodistal width of the maxillary anterior teeth was measured with a flexible ruler. The three facial dimensions were correlated with MDW for both genders. **Results:** The IPD and IAD were significantly ( $p > 0.001$ ) larger in males (IPD:  $68.30 \pm 4.24$ mm; IAD:  $39.60 \pm 2.54$ mm) than in females (IPD:  $65.93 \pm 3.91$ mm; IAD:  $36.96 \pm 2.29$ ). There was no significant correlation between any of the facial dimensions and MDW in males or females. **Conclusion:** For the studied population, the interpupillary, intercanthal, and interalar distances may not be used as reliable guides when determining the size of maxillary anterior teeth in complete denture construction.

**Key words:** complete denture, interalar distance, intercanthal distance, interpupillary distance, maxillary teeth

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## **INTRODUCTION**

The selection of the appropriate size of the maxillary anterior teeth is one of the most important aspects of complete denture construction. The size of the maxillary anterior teeth is imperative for an attractive dental, smile, and facial esthetics as they are the most visible in unstrained facial activity.<sup>1,2</sup> In order to achieve good overall facial esthetics and harmony for complete denture wearers, the selection of maxillary anterior teeth must be in proportion to the facial measurements.

Nevertheless, it is challenging to choose the appropriate size of artificial teeth for complete denture patients as the remaining teeth are not available for guidance. Pre-extraction records such as photographs with the anterior teeth visible or study models may help, but they are often unavailable.<sup>3</sup> As a result, the selection of anterior teeth during complete denture fabrication becomes arbitrary. Tooth sizes differ from person to person based on age, gender, and ethnicity,<sup>4</sup> further

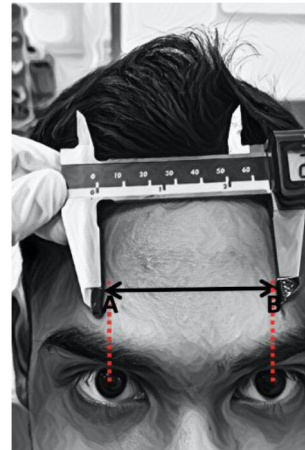
complicating the tooth selection procedure. The mesiodistal width of the maxillary anterior teeth, on the other hand, remains relatively constant regardless of the patient's age.<sup>5</sup>

Various horizontal facial parameters have been introduced to estimate the width of maxillary anterior teeth. Some facial measurements that have been suggested as reliable guides for tooth selection during oral rehabilitation include interpupillary distance,<sup>6,7</sup> intercanthal distance,<sup>6,8</sup> interalar distance,<sup>9,10</sup> and intercommissural width.<sup>9</sup> According to Hoffman et al.,<sup>11</sup> the intercanine distance is 1.6 times the interalar distance, while Kumar et al.<sup>8</sup> suggested that 1.61 times the intercanthal distance can be used as a reference in determining the width of the maxillary anterior teeth. Nonetheless, some researchers<sup>3,12-15</sup> have reported contradictory results. According to a recent systematic review, neither interalar nor intercanthal distances could be used to predict intercanine distances directly.<sup>16</sup> Isa et al.<sup>4</sup> reported a strong correlation between the interpupillary distance and a combination of interpupillary and interalar distance with the size of maxillary anterior teeth in Malaysian Malay and Chinese ethnic groups. However, neither gender nor ethnic analysis was performed in their study. Gender differences in some facial measurements,<sup>1,13,17,18</sup> have been reported to be significant, as has ethnicity.<sup>19</sup> Various techniques have been used to record facial measurements, namely, digital Vernier calliper, Boley's gauge, study models and image analysing software. Among these methods, the digital Vernier calliper is the most commonly used measurement tool due to its simplicity, low cost and high accuracy.<sup>9,14,15,18</sup>

The relationship between facial measurements and the size of maxillary anterior teeth remains controversial, and limited data is known for the Malaysian population. Therefore, the purpose of this study was to study the relationship between interpupillary distance, intercanthal distance and interalar distance with mesiodistal width of the six maxillary anterior teeth of fully dentate Malay female and male adults. Knowledge of this relationship is important because it will help with the teeth selection process in complete denture construction for this major ethnic group, which makes up the majority of patients seeking complete denture treatment at our facility.

## METHODS

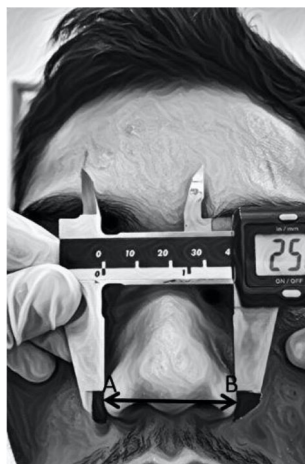
Ethical clearance was obtained from the Research Ethics Committee of Universiti Teknologi MARA, Malaysia (600-IRMI (5/1/6) REC/122/18). This study included dental patients who were registered with the Faculty of Dentistry and met the following inclusion criteria: Malay, as determined by the ethnic group stated on the subjects' parents' birth certificates;



**Figure 1.** Interpupillary distance was measured from midpupil to midpupil (from point A to point B)



**Figure 2.** Intercanthal distance was measured from the medial angle of palpebral fissures of one eye



**Figure 3.** Interalar distance was measured on the widest external width of the alae of the nose (from point A to point B)

aged 19 to 35 years; complete maxillary anterior teeth (two central incisors, two lateral incisors, and two canines) with normal morphology; no crowding, spacing, or attrition. Participants were excluded if they had received orthodontic treatment, had obvious facial asymmetry, or had anterior teeth restored with composite resins or full-coverage restorations. Before

being enrolled in the study, each participant gave their informed consent.

The work of Cohen<sup>20</sup> was referred to for the sample size calculation. A sample size of 170 subjects with 85 each for the male and female groups was required to achieve the power of 80% with a significance level of 0.05 and medium effect size. Direct facial measurements were obtained from each participant while they sat upright in natural head position and looked straight with their teeth in maximum intercuspal position and lips relaxed. The interpupillary distance was measured from midpupil to midpupil (Figure 1).<sup>21</sup> The intercanthal distance was measured from the medial angle of the palpebral fissures of one eye to the other eye (Figure 2).<sup>8</sup> Interlar distance was determined with the calliper in contact without pressure on the widest external width of the alae of the nose (Figure 3).<sup>15</sup> All three measurements were carried out by using the electronic digital Vernier calliper with 0.01 mm accuracy. For the measurements of maxillary anterior teeth, participants were instructed to grin and show their anterior teeth. The mesiodistal width of maxillary anterior teeth was then measured with a disposable flexible paper ruler between the distal surface of the maxillary canines at the proximal contact areas. All measurements in this study were repeated three times and the average of the readings was used for statistical analysis.<sup>22</sup>

All measurements were made by two authors, NIA and NCN. The inter- and intra-examiner's reliability and consistency of measurements were tested on 20 subjects. The second measurement was carried out at a 2-week interval.

### **Statistical analysis**

The correlation between the mesiodistal width of the maxillary anterior teeth and the three facial measurements for each group were assessed with the Pearson correlation test. The differences of measurements between genders were determined by using independent sample t-tests. Two-way Intraclass correlation (ICC) was used to assess inter- and intra-examiner reliability. All data analysis was performed using the SPSS Statistics software version 25.0 (Armonk, NY: IBM Corp, USA). A p-value of <0.05 was considered significant for all statistical tests performed.

## **RESULTS**

A total of 170 Malay adult participants (85 males and 85 females) have been recruited for this study. The mean age for males and females was 22.61 ( $\pm 1.46$ ) and 22.37 ( $\pm 3.04$ ) years old, respectively. The inter- and intra-examiner reliability for this study were high ( $k > 0.90$ ). The interpupillary distance ( $p < 0.001$ ) and interlar distance ( $p < 0.001$ ) of Malay males were significantly

wider than those of females. The intercanthal distance ( $p = 0.523$ ) and mediolateral width of maxillary anterior teeth ( $p = 0.074$ ) were also wider in Malay males, but not significant statistically (Table 1).

Despite the fact that the interpupillary, intercanthal, and interlar distances were found to be significantly correlated with each other in both genders, no significant correlations were found between all these measurements and the mesiodistal width of the maxillary canines (Table 2).

## **DISCUSSION**

This cross-sectional study was conducted to determine the reliability of using interpupillary, intercanthal, and interlar distances as the guidance for anterior teeth selection for complete denture construction in Malay adults. It was found that these distances were significantly correlated with each other, but not with the mesiodistal width of the maxillary anterior.

Various facial dimensions have been suggested to have good correlations with the maxillary anterior teeth in different ethnic groups to reliably guide tooth selection in complete denture construction. However, only the interpupillary distance, intercanthal distance and interlar distance were chosen for this study as these facial measurements were shown to have the strongest correlations in previous studies.<sup>1,4,9,18,23</sup> Previous studies have reported that the interpupillary,<sup>24</sup> and intercanthal distances<sup>25</sup> are stable in adults. Furthermore, the interlar distance has been suggested as a reliable guide for the width of maxillary anterior teeth for the reason that the nose and maxillary incisors were both developed from the frontonasal process and therefore share the same embryonic origin.<sup>26</sup>

The digital Vernier calliper was used in this study instead of a Boley's gauge due to its high accuracy of up to 0.01 mm compared to the latter which has an accuracy of up to 0.1 mm only. In the present study, the mesiodistal width of maxillary anterior teeth was measured directly in the mouth using a flexible paper ruler instead of indirectly on the study model. The indirect method is time-consuming, incurs additional costs, and possibly introduce dimensional errors due to shrinkage and expansion of the impression and gypsum materials.

The interpupillary distance and interlar distance in males were found to be significantly larger than females in this study. This is in line with the studies conducted by Cesario and Latta<sup>21</sup> and Thalib and Saputri.<sup>3</sup> Nonetheless, Jain et al.<sup>7</sup> found that Indian males have significantly wider interpupillary and maxillary central incisor widths than females. However, no statistically significant gender difference was found between the

**Table 1.** Interpupillary distance, intercanthal distance, interalar distance and mesiodistal width of maxillary anterior teeth in Malay females and males

	Female Mean (SD)	Male Mean (SD)	p-value
Interpupillary distance (mm)	65.93 (3.91)	68.30 (4.24)	>0.001
Intercanthal distance (mm)	32.27 (2.86)	32.55 (2.85)	0.523
Interalar distance (mm)	36.96 (2.29)	39.60 (2.54)	>0.001
Mesiodistal width of maxillary anterior teeth (mm)	53.76 (3.34)	54.63 (2.79)	0.074

**Table 2.** The correlations between interpupillary distance, intercanthal distance and interalar distance with mesiodistal width of maxillary anterior teeth in Malay females and males

	ICD <i>r</i> (p-value)	IAD <i>r</i> (p-value)	MDW <i>r</i> (p-value)
<b>Female</b>			
IPD	0.623* (>0.001)	0.364* (0.001)	0.039 (0.721)
ICD	-	0.469* (>0.001)	-0.116 (0.291)
IAD	-	-	-0.134 (0.222)
<b>Male</b>			
IPD	0.558* (>0.001)	0.272* (0.015)	0.182 (0.108)
ICD	-	0.238* (0.035)	0.156 (0.171)
IAD	-	-	0.063 (0.583)

IPD: interpupillary distance; ICD: intercanthal distance; IAD: interalar distance; MDW: mesiodistal width of maxillary anterior teeth

average intercanthal distance and the mesiodistal width of the maxillary anterior teeth, supported by the study of Kumar et al.<sup>8</sup>

Females have statistically significant correlations between interpupillary<sup>15</sup>, interalar<sup>15</sup>, and intercanthal<sup>18</sup> distances and mesiodistal width of maxillary anterior teeth. On the other hand, AL-Kaisy and Garib<sup>23</sup> have suggested that the use of intercanthal distance to estimate the width of central incisors and the use of interalar distance for mesiodistal width of maxillary anterior teeth are applicable only to males. In contrast to the findings of Thalib et al.<sup>3</sup> and Parciak et al.,<sup>12</sup> the current study found no statistically significant relationship between all three measured facial dimensions and the mesiodistal width of the maxillary anterior teeth in both genders.

The main limitation of this study was that the participants' Malay ethnicity could not have been accurately determined because their lineage could only be traced back to their parents. According to Townsend et al.,<sup>27</sup> genetic factors account for 64 percent of the total variability in permanent tooth size, so ethnic-based analysis is critical in this type of correlation study.

## CONCLUSION

Although the interpupillary distance, the intercanthal distance, and the interalar distance are significantly correlated, they may not be a reliable guide when selecting maxillary anterior teeth for complete denture construction in the studied population.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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