

Correlation between Intercanthal, Interpupillary, Interalar, and Intercommissural Distance with the Mesiodistal Width of the Maxillary Anteriors: An *in vivo* Study

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ABSTRACT

Aim: This study was conducted for the selection of artificial teeth for edentulous patients with the help of extraoral facial measurement.

Materials and methods: The intercanthal distance, interpupillary distance, interalar distance, intercommissural distance, and width of maxillary six anteriors from a total of 250 subjects were measured clinically. The measurements were made with the help of a digital caliper. Student's t-test was used to find the significance of parameters between male and female. Pearson correlation has been used to find the relation of the parameters.

Results: The total mean of 125 male subjects for intercanthal distance, interpupillary distance, interalar distance, intercommissural distance, and intercanine width was 31.58, 62.27, 34.77, 48.87, and 50.22 mm respectively. However, the total mean of 125 female subjects for intercanthal distance, interpupillary distance, interalar distance, intercommissural distance, intercanine width was 30.58, 61.48, 34.58, 48.20, and 49.34 mm respectively. The paired t-test showed highly significant results in relation to intercanthal distance and width of maxillary six anteriors. However, interalar distance was found to be nonsignificant and interpupillary and intercommissural distance was significant.

Conclusion: It can be concluded that although various methods for the selection of teeth are used, the applicability can vary due to the ethnic differences between populations. The multiplication factor for intercanthal distance, interpupillary distance, interalar distance, intercommissural distance was 1.6, 0.8, 1.4, and 1 in order to obtain the mesiodistal width of maxillary six anteriors respectively, in males and females. The values were greater for men than for women. No significant differences were found between sexes with respect to intercanthal distance.

Clinical significance: Although there are ethnic differences between populations, the proportions/relationships of anatomical landmarks to the teeth remain the same, which helps in the selection of artificial teeth for edentulous patients.

Keywords: Interalar distance, Intercanthal distance, Intercommissural distance and width of maxillary six anteriors, Interpupillary distance.

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INTRODUCTION

The human face, the most expressive part of the body, determines an individual's social acceptance.¹ Loss of teeth not only affects the facial appearance, but also creates psychological trauma to the person. Hence, it is essential that an esthetically pleasing and functionally comfortable replacement of the missing teeth be provided.² The patient who wears a complete denture for the first time wants its resemblance as of natural teeth. The esthetic rehabilitation of the edentulous patient improves the self-esteem and self-confidence of a patient.³

Pre-extraction records guide the selection of appropriate tooth molds for each individual.⁴ These include diagnostic casts, photographs, roentgenograms, extracted teeth, etc. The unavailability of pre-extraction records makes the selection of appropriate anterior teeth size difficult for the edentulous patient.⁵ Various anatomical measurements have been suggested, such as intercanthal distance, interpupillary distance, outer-canthal distance, interalar distance, bizygomatic distance, intercommissural distance, intracodylar width, and philtrum to overcome these circumstances. All these relations may be used in combination and utilized as reference for determining the width of the maxillary anteriors, although the measurements may be different considering race and gender differences.⁶ Several anatomic landmarks bear fixed positional relationships to some natural teeth. These landmarks serve as reliable guides in replacing natural teeth with artificial teeth.⁷ However; no universally accepted parameter currently exists for selection of anterior teeth in the local population.

This study was conducted to determine the proportional corelationship between the width of maxillary six anteriors with the interpupillary distance, intercanthal distance, and interalar and intercommissural distances in

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MATERIALS AND METHODS

Inclusion Criteria

- Angle's class I molar relation
- No missing maxillary or mandibular teeth
- Absence of gingival or periodontal pathology
- Absence of anterior restorations of any kind or caries
- No history of orthodontic treatment
- No interdental spacing or crowding

Exclusion Criteria

- Evidence of gingival alteration or dental irregularities
- Apparent loss of tooth structure due to attrition, fracture, caries, or restorations
- Obvious problems that could disfigure or otherwise affect the face and dentition

Materials

Digital Vernier calipers, dental floss, marker pen, indelible pencil were necessary. This study was conducted in the Department of Prosthodontics, MIDSR Dental College and Hospital, Latur, India. The subjects were students, residents, and patients belonging to different parts of Latur district. The sample size calculation was done based on the mean and standard deviation of pilot samples. A total of 250 subjects were selected. The subjects were separated into two groups:

- Group I (125 males)
- Group II (125 females)

The ages ranged from 20 to 35 years. Informed consent was obtained from all subjects prior to their participation.

Each subject was seated in a dental chair with the head upright supported by the head rest, so that they look forward at the horizon and the occlusal plane of the maxillary teeth is parallel to the floor. Different measurements relevant to this study were taken. All measurements were made and recorded by one operator. Each parameter was measured three times and the average value was computed and recorded in a predesigned proforma. All measurements were carried out using an electronic digital caliper, to the nearest tenth of a millimeter.

Measurements

- Intercanthal distance from the inner canthus of one eye to inner canthus of the other
- Interpupillary distance from midpupil to midpupil
- Interlar width from external width of the ala of the nose recorded at the widest point

- Intercommissural width in relaxed state
- Mesiodistal dimension of maxillary six anterior teeth measured with the help of dental floss passing through the distal surface of canine

The patient was requested to sit in a dental chair in an upright position with the head straight. The patient was asked to close the eyes and relax before the intercanthal distance was measured with the help of a digital caliper (Fig. 1A). For measuring the interpupillary distance, the participants were asked to look straight. The measurements were made from the midpupil of one eye to the midpupil of the other eye using a digital caliper (Fig. 1B). Interlar distance is the external width of the alae of the nose; it is recorded at the widest points of the alae using a digital Vernier calipers. Interlar measurement is taken in a relaxed state (Fig. 1C). Intercommissural distance is the distance from one angle of the mouth to the other angle of mouth using digital Vernier calipers. Intercommissural distance is recorded during the relaxed state (Fig. 1D). Mesiodistal dimension of maxillary six anterior teeth was measured with the help of dental floss passing through distal surface of the canine. Dental floss was placed at the greatest curvature of the maxillary teeth, and a mark on each side was placed at the distal surface of the canines (Fig. 1E). Dental floss was sectioned at the markings, made straight, and the distance was measured between the marks using digital caliper.

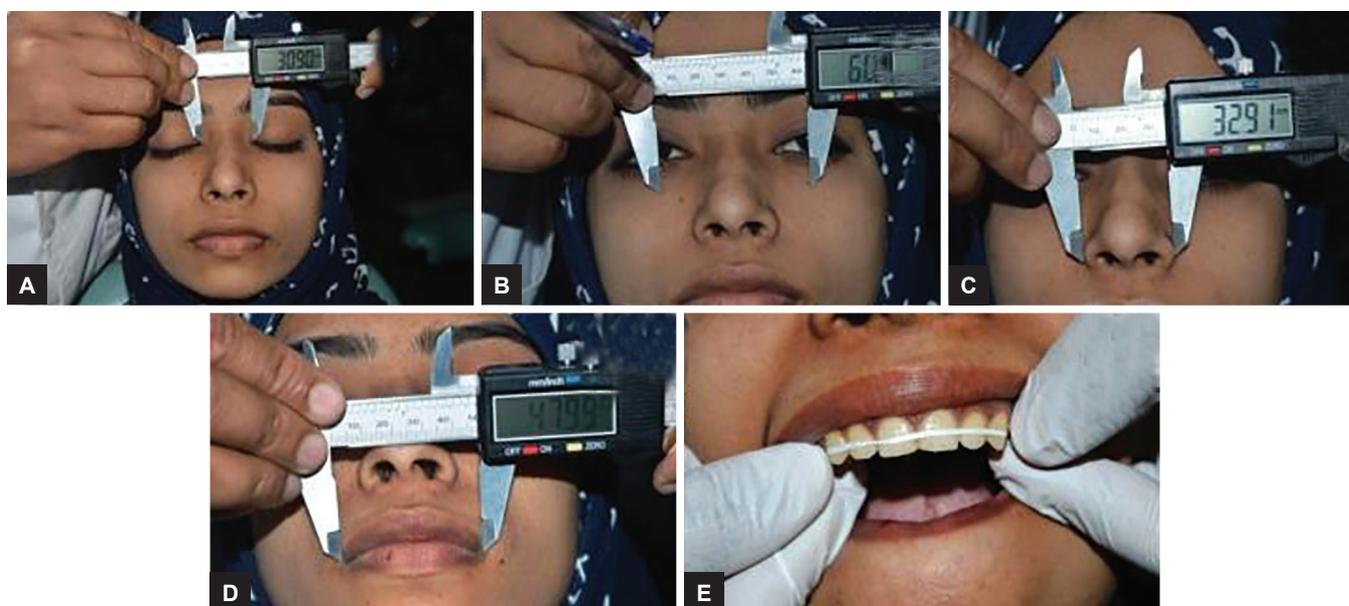
RESULTS

The total mean of 125 male subjects for intercanthal distance, interpupillary distance, interlar distance, intercommissural distance, and intercanine width was 31.58, 62.27, 34.77, 48.87, and 50.22 mm respectively. However, the total mean of 125 female subjects for intercanthal distance, interpupillary distance, interlar distance, intercommissural distance, and intercanine width was 30.58, 61.48, 34.58, 48.20, and 49.34 mm respectively. The values were greater for men than for women. No significant differences were found between sexes with respect to intercanthal distance. The paired t-test showed highly significant results in relation to intercanthal distance and width of maxillary six anteriors. However, interlar distance was found to be nonsignificant, and interpupillary and intercommissural distances were significant (Table 1 and Graph 1).

Pearson's correlation test demonstrated positive correlation between interpupillary distance, intercanthal distance, interlar distance, and intercommissural and mesiodistal width intercanine distances. The same pattern was observed for both the sexes (Table 2 and Graph 2).

DISCUSSION

The goal was to rehabilitate an edentulous patient having



Figs 1A to E: (A) Intercanthal distance; (B) interpupillary distance; (C) interalar distance; (D) intercommissural distance; and (E) width of maxillary six anteriors

Table 1: Correlation between intercanthal, interpupillary, interalar, and intercommissural distances with the mesiodistal width of the maxillary anteriors

	Sex	n	Mean	Std. deviation	t-value	df	p-value	Inference
Intercanthal distance	Male	125	31.58	1.37	5.35	248	0.0001 (<0.001)	HS
	Female	125	30.58	1.58				
Interpupillary distance	Male	125	62.27	2.29	2.82	248	0.005 (<0.05)	S
	Female	125	61.48	2.15				
Interalar distance	Male	125	34.77	1.35	1.06	248	0.291 (<0.05)	NS
	Female	125	34.58	1.46				
Intercommissural distance	Male	125	48.87	1.85	3.00	248	0.003 (<0.05)	S
	Female	125	48.20	1.67				
Width of maxillary six anteriors	Male	125	50.22	2.38	3.24	248	0.001 (≤0.001)	HS
	Female	125	49.34	1.90				
IC/MS	Male	125	0.63	0.04	2.26	248	0.024 (<0.05)	S
	Female	125	0.62	0.03				
IP/MS	Male	125	1.24	0.07	-0.58	248	0.562 (>0.05)	NS
	Female	125	1.25	0.06				
IA/MS	Male	125	0.69	0.04	-1.71	248	0.089 (>0.05)	NS
	Female	125	0.70	0.03				
ICO/MS	Male	125	0.97	0.04	-0.86	248	0.390 (>0.05)	NS
	Female	125	0.98	0.03				

HS: Highly significant; S: Significant; NS: Not significant; IC: Intercanthal; MS: Maxillary six anteriors; IP: Interpupillary; IA: Interalar; ICO: Intercommissural

the maxillary anterior teeth with optimal dentolabial relations in harmony with the overall facial appearance. However, there are certain fixed biological factors that guide in defining the proper size and shape of anterior teeth or determining normal relationships between them.

Al Wazzan⁸ investigated the width of central incisor and the combined widths of the six anterior teeth with the biometric ratios of 1:0.267 and 1:1.426 respectively. In this study, the mean of intercanthal distance was found to be 31.50 mm for males and 30.58 mm for females, and multiplication factor was 1.6 for both males and females to get a combined width of maxillary six anteriors. Similar results was obtained by Al Wazzan⁸ (31.92 mm), Laesta-

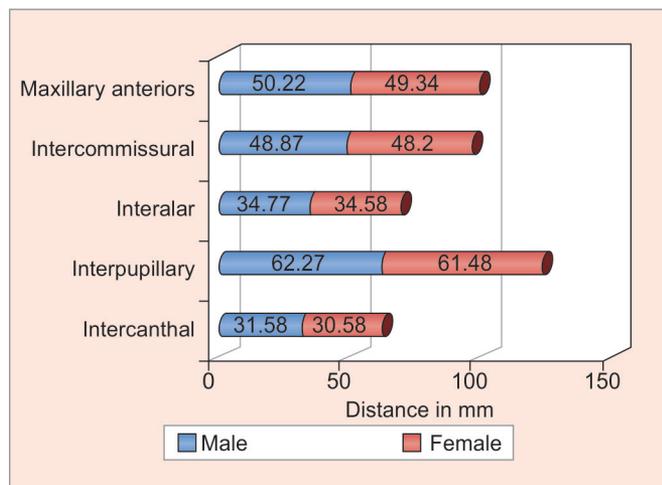
dius et al⁹ (30.00 mm), Aleem Abdullah et al¹⁰ (32.00 mm), and Freihofer¹¹ (31.20 mm), which were smaller than the mean value reported by Murphy and Laskin¹² (33.90 mm).

In this study, the mean of interpupillary width was found to be 62.27 mm for males and 61.48 mm for females. Similarly, Cesário and Latta¹³ showed a mean interpupillary value of 59.16 mm, Sharma et al¹ showed that mean of interpupillary width was 59.77 mm in males and 57.56 mm in females, with males having greater measurements than females similar to the results in this study.¹ Hasanreisoglu et al¹⁴ stated that multiplying the interpupillary distance by a factor of 7.7 and 7.5 can help in estimating the combined width of the maxillary six

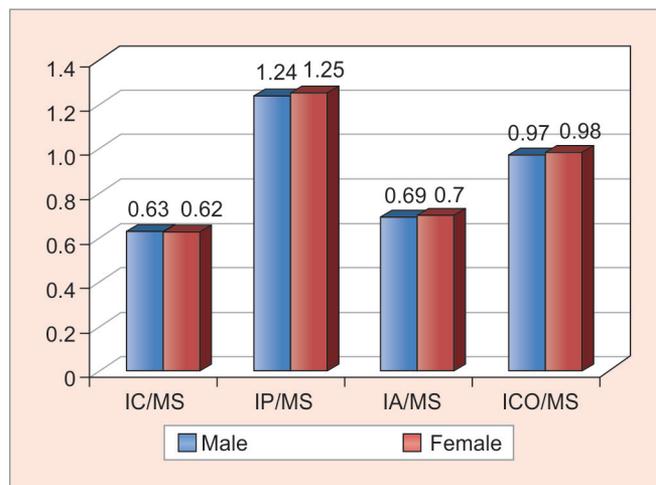
Table 2: Pearson's correlation for all subjects

		<i>Interpupillary distance</i>	<i>Interalar distance</i>	<i>Intercommissural distance</i>
Intercanthal distance	Pearson correlation	0.462	0.417*	0.469*
	p	0.0001	0.0001	0.0001
	Inference	HS	HS	HS
Interpupillary distance	Pearson correlation		0.263*	0.251*
	p		0.0001	0.0001
	Inference		HS	HS
Interalar distance	Pearson correlation			0.354*
	p			0.0001
	N			HS

HS: Highly significant; *Not significant



Graph 1: Mean intercanthal, interpupillary, interalar, intercommissural distance and width of the maxillary anteriors



Graph 2: Correlation between intercanthal, interpupillary, interalar, and intercommissural distance with the mesiodistal width of the maxillary anteriors

anterior teeth values for men and women respectively. In this study, the ratio obtained between width of maxillary six anteriors to interpupillary distance was 0.80 for males and females.

Hoffman et al¹⁵ obtained the combined width of the maxillary six anterior teeth by multiplying the interalar width by a factor of 1.31. The multiplication factor was 1.26 in a study conducted by Aleem Abdullah et al,¹⁰ while 1.35 was the multiplication factor in this study. Latta et al¹⁶ found in edentulous patients a mean of 43.93 mm, with a range from 29.00 to 63.00 mm.¹³ In this study, the mean of interalar distance was found to be 34.77 mm for males and 34.58 mm for females. Mavroskoufis and Ritchie¹⁷ found that the combined width of maxillary anteriors and interalar width correlated. Gomes et al¹⁸ found a ratio of 1:1.03 in Brazilian dentate subjects. Hoffman et al¹⁵ suggested that interalar distance increased by 3% to get the combined width of maxillary six anteriors.

The intercommissural width during the relaxed state provides a more accurate relationship to the combined width of maxillary anteriors. This study showed that the mean intercommissural width at the relaxed state was 48.87 mm in males and 48.20 mm in

females. Similar results were found by Deogade et al¹⁹ and Mahesh et al.⁴

Differences in the appearance of male and female teeth exist in relation to length, width, and axioincisal line angle. Gillen et al²⁰ reported that the maxillary anterior teeth were wider and longer in male as compared with women. Similarly, Sterrett et al²¹ reported the mean width and length of the maxillary anterior teeth of men to be significantly greater in women in a white population. Also, the axioincisal angle is sharp in males and rounded in females. Results obtained in the study revealed the mean mesiodistal width of maxillary six anteriors for men (50.22 mm) was significantly greater than the corresponding dimensions for women (49.34 mm). These findings are in agreement with the results of related studies and the values were statistically significant.

CONCLUSION

Within the limitations of the present study, the following conclusions were drawn:

- All the facial and dental measurements were greater for men than for women. However, no significant

differences were found between sexes with respect to intercanthal distance.

- There was positive correlation between interpupillary distance, intercanthal distance, interalar distance, intercommissural distance, and intercanine width and the values are highly significant. The same pattern was observed for both the sexes.
- The multiplication factor for intercanthal distance, interpupillary distance, interalar distance, intercommissural distance was 1.6, 0.8, 1.4, and 1 in order to obtain the mesiodistal width of maxillary six anteriors respectively, in males and females. It can be concluded that although various methods of selection of teeth are used, the applicability can vary due to the ethnic differences between populations.

Hence, these measurements can be used for determining the width and position of the maxillary anterior teeth. In the future, studies should be carried out with greater sample sizes to extrapolate the use of these parameters for selection and arrangement of maxillary anterior teeth and make sure that we provide "incredible smiles" with naturalistic-looking dentures.

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