

# A Comparative Evaluation of the Relationship of Inner-Canthal Distance and Inter-Alar Width to the Inter-Canine Width amongst the Gujarati Population

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## Abstract:

**Objectives:** To determine the relationship of the Inner-Canthal distance with Inter-Alar width and the combined width of the maxillary six anterior teeth. **Methods:** 240 subjects who satisfied the inclusion and exclusion criteria were selected. The three parameters, Inner-Canthal Distance (ICD), Inter-Alar Width (IAW), and Inter-Canine Width (ICnW) of each subject were measured with digital Vernier caliper. **Result:** In males the average multiplication factor to estimate the ICnW from the mean was ICD 1.61 and for IAW was 1.40. No correlation was found in males while positive correlation was found in females. **Conclusion:** Measurements of ICD, IAW and ICnW of the maxillary anterior teeth were made on 240 subjects. Analysis of these measurements showed that the ICD may be used as a tentative predictor for the estimation of the ICnW of the maxillary six anterior teeth, and serve as a useful additional factor in tooth selection.

**Keywords:** Inner-Canthal Distance, Inter-Alar Width, Inter-Canine width.

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## Introduction:

Face, the most expressive part of the human body, determines an individual's social acceptance. Loss of teeth not only affects 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 should be provided<sup>1</sup>.

Over the years, norms, criteria and guidelines for esthetic tooth selection and arrangement have been suggested by the artisans of the dental profession. Success in this can often be related to the appearance of the teeth within the framework of the face<sup>2</sup>. In this era, where we shudder at the thought of ageing, a pleasing smile contributes significantly to that much sought after obsession of a youthful appearance<sup>3</sup>. However the selection and arrangement of maxillary anterior teeth for edentulous patients in a natural and esthetically pleasing form has remained an elusive and challenging endeavor.

Despite all efforts, no universally acceptable method has been established to meet this end. Dentists seek guidance from various techniques using their clinical expertise and esthetic sense to attain acceptable results. The rationale or criteria that should be followed for selection and arrangement of artificial teeth remains an area of prime concern in the Prosthodontic circle.

It is difficult to determine the dimensions of the maxillary anterior teeth for an edentulous patient when pre extraction records are not available. While various methods may enable dentists to select teeth that are generally suitable for the patient, the most esthetic result is probably obtained by the dentist who believes that anterior tooth selection is as much an art as it is a science.<sup>4</sup> <sup>5</sup> In the early part of this century, most methods involved “hunt and pick” or “trial and error” until the patient and dentist were satisfied with the particular size of teeth.<sup>6</sup> Later methods revealed a dependence on physical characteristics of the dento-facial form.<sup>7-11</sup> While numerous methods have been suggested for estimating the combined width of the maxillary anterior teeth and the central incisor, there seem to be few reliable guidelines and many conflicting views.<sup>12-17</sup>

In the construction of complete dentures, the estimation of the combined width of maxillary six anterior teeth is an important clinical procedure when pre-extraction records are not available. Several facial measurements, including bizygomatic width, inter-commissural width, interpupillary width and inter-alar width have been suggested to aid in the estimation of an overall width of the maxillary six anterior teeth. However, there seem to be conflicting views on the value of such estimations.

Authors have suggested that the width of the nose serves as a guide for the selection of width of maxillary anterior teeth. They stated that “parallel” lines extended from the lateral surface of the alae of the nose onto the labial surface of occlusal rim could be used to estimate the position of maxillary canine.<sup>18</sup>

It is a moral responsibility of Prosthodontist to preserve the natural dignity of advancing age while fabricating prosthesis, with appropriate and careful selection and arrangement of teeth. Further demographic variation may exist with repeat to anthropometric measurements. An extensive review of the literature revealed very few studies done in the Indian population and no such data existing for the Gujarati subjects. Hence, this study was conducted to determine the relationship of the inner canthal distance (ICD) with Inter-Alar width

(IAW) and the combined width of the maxillary six anterior teeth (CWAT).

### **Methodology:**

A survey was carried out within 572 subjects which happen to be the total number of students spread over the five years of BDS in K M Shah Dental college and Hospital. Out of this 240 subjects (120 males and 120 females, with their age range from 18 to 28 (mean 21.75 years), were selected according to the following inclusion-exclusion criteria. The subjects included should be above 18 years of age, have completely dentulous permanent dentition with ideal arch form and alignment, absence of morphological developmental anomalies (peg lateral, supernumerary teeth, mesiodens, retained deciduous teeth). Patients with history of orthodontic treatment or extraction, congenital facial defects, presence of class III or class IV caries, presence of restoration, presence of crowding, diastema, rotation, proclination or retroclination and gingival inflammation or hypertrophy were excluded from the study.

Ethical clearance was obtained from the institutional ethics committee. Nature of the study was explained with subject information sheet and an informed consent of all the subjects was obtained.

The three parameters, Inner-Canthal Distance (ICD), Inter-Alar Width (IAW), and Inter-Canine Width (ICnW) of each subject was measured with digital vernier caliper having a resolution of 0.01mm.

### **Determination of Inner-Canthal Distance (ICD)**

The subjects were seated comfortably on the dental chair in a relaxed state in an upright position with the head resting firmly against the head rest. The ICD was measured from the medial angle to the medial angle of the palpebral fissure. The distance between these two points was measured using a digital vernier caliper without the application of pressure by bringing the recording parts of the caliper just in contact with the medial angle of the palpebral fissure. (Fig. 1)

### **Determination of Inner-Alar Width (IAW)**

The subjects were seated comfortably on the dental chair in a relaxed state in an upright position with the head resting firmly against the

head rest. The IAW was determined by using the external width of the nose at the widest point. The distance between these two points was measured using a digital vernier caliper without the application of pressure by bringing the recording parts of the caliper just in contact with the outer surface of the nose. While measuring, the patient was asked to stop breathing momentarily to avoid any change in shape of the nose. (Fig. 2)

#### Determination of Inter-Canine Width (ICnW)

The subjects were seated comfortably on the dental chair in a relaxed state in an upright position with the head resting firmly against the head rest. New dental floss and new beads were used for every participant.

A dental floss of approximately 10 cm was taken and beaded at one end. This was then be inserted between the contact of right first and second premolars. The bead facing palatally was help in securing the floss in position. (Fig. 3a) The floss was circumferenced along the curvature of the anterior dentition such that it passed along the contact point of all the teeth. This was then passed

through the contact between the left first and second premolar (Fig. 3b). The distal end of the canine teeth on both sides was then marked on the floss while it was taut in the patient's mouth (Fig. 3c and d). Floss was marked on both the distal sides with the marking pen and kept in to the povidone iodine solution for disinfection. The distance between the two proximal contact points was measured by using vernier caliper (Fig. 3e) and recorded as the ICnW. For each subject, each parameter was measured two times and the average value was computed and recorded separately by two calibrated investigators. The total of the measurements made by the two investigators were averaged up to get individual value of ICD, IAW, ICnW. These observations were tabulated & subjected for t-test at  $p < 0.05$

#### OBSERVATIONS AND RESULTS

Two investigators measured the three parameters independently for each subject two times. Table-1 and Table-2 show mean IAW, ICW and ICnW values recorded for male and female subjects

**Table-1: descriptive statistics of measurements (male and female)**

PARAMETER	AGE (YEARS)		INNERCANTHAL DISTANCE (MM)		INTER-ALAR WIDTH (MM)		INTER WIDTH OF MAXILLARY ANTERIOR CANINE TEETH (MM)	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
MEAN	21.65	20.90	33.10	31.75	38.18	34.16	53.51	50.73
SD	2.39	2.88	2.28	2.76	2.71	2.54	3.74	2.15
MIN	18	18	29.73	25.61	34.11	30.09	48.97	46.52
MAX	26	28	37.64	34.85	43.66	38.42	62.35	54.21
MEAN DIFFEREN	0.75		1.35		4.02		2.78	
NCE	(±0.86)		(±0.82)		(±0.85)		(±0.99)	
	0.87 <sup>NS</sup>		1.64 <sup>NS</sup>		4.72 <sup>***</sup>		2.80 <sup>**</sup>	

SD = Standard Deviation

MIN= Minimum

MAX= Maximum

TEST APPLIED: "t" test

NS:  $P > 0.05$  Non- Significant

\*\* :  $P < 0.01$  Significant

\*\*\*:  $P < 0.001$  Highly Significant

**Table-2: Descriptive statistics of measurement for male and female**

PARAMETER	AGE (YEAR)		INTER-CANTHAL DISTANCE (MM)		INTER-ALAR WIDTH (MM)		INTER CANINE WIDTH OF MAXILLARY ANTERIOR TEETH (MM)	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
<b>COEFFICIENT OF VARIATION</b>	10.76%	13.44%	6.73%	8.50%	7.10%	7.43%	6.82%	4.14%
<b>CONFIDENCE LIMITS 95%</b>	16.97(min) ↓ 26.33(max)	15.26(min) ↓ 26.54(max)	28.63(min) ↓ 37.57(max)	26.34(min) ↓ 37.16(max)	32.87(min) ↓ 43.49(max)	29.18(min) ↓ 39.14(max)	46.18(min) ↓ 60.84(max)	46.52(min) ↓ 54.94(max)
<b>99%</b>	15.48(min) ↓ 27.82(max)	13.47(min) ↓ 28.33(max)	27.22(min) ↓ 38.98(max)	24.63(min) ↓ 38.87(max)	31.19(min) ↓ 45.17(max)	27.61(min) ↓ 40.71(max)	43.86(min) ↓ 63.16(max)	45.18(min) ↓ 56.28(max)

The mean age of male was 21.65 (2.39) years with a range of 18-26 years, While the mean age of female was 20.90 (2.88) years with a range of 18-28 years. **(Graph-1)** The difference between the means of the two groups was statistically not significant ( $p>0.05$ ). The mean ICD was 32.43 mm ( $\pm 2.52$ ) with a range of 22.61-37.64 mm. The mean IAW was 36.17 mm ( $\pm 2.63$ ) with a range of 30.09-43.66 mm. The mean ICnW was 52.12 ( $\pm 2.95$ ) mm with a range of 46.52-62.35mm. **(Graph-2)**

The mean of ICD in males was 33.10 ( $\pm 2.28$ ) mm with a range of 29.73 –37.64 mm. The mean ICD of female was 31.75 ( $\pm 2.76$ ) mm with a range of 25.61 – 34.85 mm. The difference between the means of the two groups was statistically non-significant.  $t = 1.64$  ( $p>0.05$ ). The mean of IAW of male was 38.18 ( $\pm 2.71$ ) mm with a range of

34.11– 43.66 mm. The mean IAW of female was 34.16 ( $\pm 2.54$ ) mm with a range of 30.09 – 38.42 mm. The difference between the means of the two groups was statistically highly significant.  $t = 4.72$  ( $p<0.001$ ).

The mean of ICnW of male was 53.51 ( $\pm 3.74$ ) mm with a range of 48.97 – 62.35 mm. The mean ICnW of female was 50.73 ( $\pm 2.15$ ) mm with a range of 46.52–54.21 mm. The difference between the means of the two groups was statistically significant.  $t = 2.80$  ( $p<0.01$ ). In males the average multiplication factor to estimate the ICnW from the mean ICD was 1.61 and from IAW was 1.40 (Table-3, Graph-3). In females the average multiplication factor to estimate the ICnW from the mean ICD and IAW was 1.59 and 1.48 respectively (Table-3).

**Table-3: Multiplication factor of intercanthal width and interalar width to obtain intercanine width.**

GROUPS	FACTOR		%RATIO (WITHIN SEX)
	ICD/ICnW	IAW/ICnW	
MALE	1.61	1.40	+ 0.215 (15.33)%
FEMALE	1.59	1.48	+ 0.113 (7.6)%
TOTAL	1.60	1.44	+0.166 (11.52)%
<b>% RATIO</b>	+0.019	-0.083	
<b>MALE / FEMALE</b> <b>(BETWEEN SEX)</b>	(1.19%)	(5.76%)	

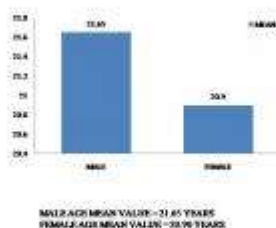
The average multiplication factor as a whole to estimate the ICnW from the mean ICD was 1.60 and from IAW was 1.44 (**Table-3**).

No correlation found in males (almost near to zero) while positive correlation found in females (**Table-4**).

**Table-4: correlation factor of inter canthal distance and inter alar width with inter canine width in males and females**

	MALE	FEMALE
ICD/ICnW	-0.002 t = 0.009 NS	+0.41 T = 1.91 NS
IAW/ICnW	-0.096 T = 0.42 NS	+0.26 T = 1.14 NS

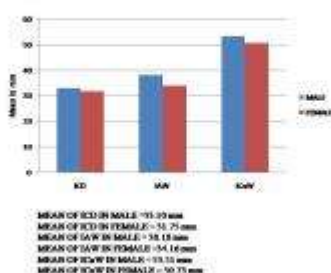
GRAPH 1  
MEAN VALUE OF MALE AND FEMALE



GRAPH 2  
MULTIPLICATION FACTOR OF ICD AND IAW TO OBTAIN ICnW



GRAPH 3  
MEAN OF ICD, IAW AND ICnW IN MALE AND FEMALE



## Discussion:

With an aim to determine the relationship of the inner canthal distance, inter-alar width and the combined width of the maxillary six anterior teeth, this study measured and compared the width of the nose with the curvature of the anterior dentition such that it passes along the contact point

of all the teeth from maxillary canine to canine, and measured relation of nasal width with total width of maxillary anterior teeth.

Also the inner canthal distance was measured and calculated from the medial angle to the medial angle of the palpebral fissure with the curvature of the anterior dentition such that it passes along the contact point of all the teeth from maxillary canine to canine, relation of nasal width with total width of maxillary anterior teeth.

To evaluate the relationship of inner canthal distance and inner alar width with the combined width of the maxillary six anterior teeth, measurements from 240 subjects (120 males and 120 females) were obtained. Their age ranged from 18 years and above. Nature of the study with subject information sheet was explained. Information consent of all the subjects was obtained.

Two investigators measured three parameters independently for each subject two times to get as much as accurate mean value (kappa value 0.80).

The mean value of Inter-Canthal distance was 33.10 mm in male subjects and 31.75 mm in females was reported in this study (Table-4). Bozkir M. G<sup>19</sup> (2003) in his Turkish study found the mean value of inter canthal distance was  $30.7 \pm 3$  mm in males and  $30 \pm 2.6$  mm in females. The mean inner canthal distance in this study (32.43 mm) was greater than the value reported by Laestdius et al<sup>20</sup> in 1969 (30.00 mm). The measurements being recorded in population of different countries might be the reason for variation in the value.

The mean Inter-Alar width in males was 38.18 mm and in females was 34.16 mm in this study (Table-4). This distance was greater than the value reported by Hoffman et al<sup>21</sup> in 1986 (4.18 mm). The greater Inter-Alar width seen in males reveals the influence of male dominance factor, as is also appreciable by the difference in size of jaws and teeth between the two sexes.

There is a general opinion that the Inter-Alar width is more or less similar to Inter-Canine distance, and this observation is one of the criteria for the selection of the maxillary anterior teeth. However, this study has shown that this approach cannot be applied as a gold standard in all cases. From the current study it may be stated that a proportional relationship exists between the widest part of the nose and the front of the dental arch as was presented in past studies.<sup>18</sup>

This study brings to light that the Inter-Alar width and the Inter-Canine tooth width are not always equivalent. However there is sufficient correlation to use the Inter-Alar width to obtain the approximate Inter-Canine width while selecting the maxillary anterior teeth for complete dentures. Furthermore, the reference of Inter-Alar width can also be a valid counter check in association with bizygomatic width, angle of mouth and interpupillary distance for selection of maxillary anterior teeth where pre-extraction references are not available.

In this study the mean combined width of the maxillary six anterior teeth was 53.51 mm in male and 50.73 mm in female (Table-4). McArthur<sup>22</sup> in

1985 reported the mean of combined width of maxillary six anterior teeth was 54.6 mm in male and the mean value of inter canthal distance was 52.3 mm in female. The mean combined width of the maxillary six anterior teeth (52.12mm) was more than the means reported by Hoffman et al<sup>21</sup> in 1986 (44.85mm), Shillingburg et al<sup>23</sup> in 1972 (45.8mm) as they measured from the tip of right and left maxillary canines. However the width was almost equal to the mean reported by Scandrett et al<sup>12</sup> in 1982 (53.61mm).

The subjects were divided into two groups of male and female to determine the effect of both the sex on these dimensions. The results showed that the difference between the mean IAW of male and female was highly significant ( $p < 0.0001$ ), whereas, the difference between mean ICD of male and female was not significant ( $P < 0.01$ ).

Furthermore, when the ratio between the ICD and ICnW in male and female were compared with the ratio of IAW and the ICnW in both the groups, the ratio of the former was marginally higher, suggesting that there is a difference between ICD and IAW values respect to both the sex.

Hoffman et al<sup>21</sup> in 1986 found that the ICnW may be estimated by increasing the IAW by 31% or multiplying it by a factor of 1.31. Abdulla M A et al<sup>24</sup> in 1997 studied a Saudi population and stated that the multiplying factor of IAW was 1.26 and for ICD 1.35. In the present study, the multiplying factor of IAW was 1.45 and for ICD was 1.61 (Table 4). The existence of the factor suggests that ICD may be used as a tentative predictor for the estimation of the ICnW. In such cases, for example when IAW cannot be used due to obliteration of the nose in cleft lip patients. Additional studies are required to replicate the present findings so as to confirm the relationship among the anthropometric parameters investigated. Art is an invention of esthetics, which in turn is a selective recreation of reality, and since nothing real remains static, these formulae must be modified according to the age, sex and personality of the patient so as to give an individualized appearance.

The limitation of this study was resiliency of the soft tissue. Further this study was done



within the institutional set up and subjects of the age group between 18 to 28 years were only evaluated. Hence the results may be applicable to just a small population in the said age range. The study can be more complete if variety of age and variety of Indian sub population groups are considered. This study is one step towards achieving the goal.

The result of the study should be validated by including a large population size spread over the entire Indian subcontinent. This would help to generate multiplication factor for various anthropological measurements for use limited to the Indian population.

### Conclusion:

Analysis of the measurements showed that the Inner-Canthal distance or the Inter-Alar distance may be used as a tentative predictor for the estimation of the Inter-Canine width of the maxillary six anterior teeth, when multiplied by a respective ratio of 1.61 and 1.45. Both can serve as a useful additional factor in tooth selection. No significant correlation was found between the Inter-Alar distance and total width of the maxillary anterior teeth. Inter-Alar distance can be used as the anatomical landmark to select the maxillary anterior teeth in the absence of the pre-extraction records.

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