Determination of proportional relationships between maxillary intercanine distance and various facial dimensions: A cross sectional study

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Abstract

The study was conducted on 231 subjects (101 males and 130 females) ranged from 15 years to 69 years in age, with all natural upper anterior teeth present in mouth having no caries, severe attrition, erosion, fracture or restorations were selected. Intercanthal distance (ICthD), intermedialcanthal distance (IMCthD), interpupillary distance (IPD), interalar width (IAW), inter lip commissural distance (ICmD) and maxillary Intercanine distance from tip to tip (ICD) were measured with a venire caliper with an accuracy of 0.01 mm. Obtained data was entered into Microsoft excel program and various statistical calculations and tests were applied to find out correlation between above mentioned various facial measurements and maxillary intercanine distance in male and female subjects. The statistical results of this study showed that there was positive correlation between intercanthal distance and maxillary intercanine distance in both male and female subjects. Other facial measurements showed no statistically significant correlation with maxillary intercanine distance. Suggesting that the intercanthal distance can be used as a preliminary method to determine the width of the maxillary anterior teeth while constructing complete denture in edentulous patients.

Introduction

Selection of appropriate size of anterior teeth is extremely important in the success of denture prostheses. While constructing artificial denture the size, form, and colour of the teeth must be in harmony with the surrounding orofacial structures. When no pre-extraction records are available, selecting the proper anterior teeth size for edentulous patients can be difficult. A systematic approach is needed in such situations.

Several authors have attempted to identify normal tooth dimensions by conducting various studies and various anatomical measurements have been suggested including the interalar width (IAW), inter medial canthal distance (IMCthD), interpupillary distance (IPD), inter lip commissural distance (ICmD), intercondylar width (ICdD) and bizygomatic distance (BZD) to establish a method of estimating or determining the appropriate width of maxillary anterior teeth .

A number of studies have been conducted to determine if there is any relationship between the various facial measurements namely interalar width and intercanine distance (1),(2),(3),(4),(5),(6),(7),(8),(9) inter-pupillary distance and intercanine distance(10),(11),(9) inter-medial canthal distance and maxillary inter-canine distance(9),(12),(13) inter-commissural width and maxillary anterior teeth (14), bizygomatic distance

and intercanine distance (9), intercondylar distance and intercanine distance (15). Various results were found by various authors.

Some results showed that men have wider facial measurements such as nose(1),(3) (8),(9), interpupillary distance (9) bizygomatic distance(9) and intercanine distance (1),(3) (8),(9) as compared to women. However no significant difference was found between sexes with respect of intercanthal distance (9).

Some results showed that there was no demonstrable correlation between interalar width and intercanine distance (1),(2)., interpupillary distance and intercanine distance (9), intercommissural width and maxillary anterior teeth (14). Suggesting that the width of the nose , interpupillary distance, intercommissural width would not be a reliable guide for selecting artificial anterior teeth.

While results of some other studies showed significant correlation between interalar width and maxillary intercanine distance in both men and women (4),(5),(7),(8),(9),(15), nasal width and the intercanine distance in female subjects but not in male subjects (3), intermedialcanthal distance and maxillary anterior teeth dimensions (9),(12),(13) , interpupillary distance and the combined mesiodistal width of maxillary anterior teeth amongst both male and female subjects (9), (11). Intercondylar distance and maxillary Intercanine distance (15). Suggesting that interalar width, intermedialcanthal distance, interpupillary distance, Intercondylar distance can be used as a reliable guide for maxillary anterior teeth selection.

Aim
To determine maxillary intercanine distance by measuring facial measurements, namely, intercanthal distance, intermedialcanthal distance, interpupillary distance, interalar distance and inter lip commissural distance to construct esthetically acceptable artificial denture.

Objectives
Objective of the study is to find if there is any proportional relationship between
A) Intercanthal distance (ICthD) and maxillary intercanine distance (ICD);
B) Intermedialcanthal distance (IMCthD) and maxillary intercanine distance (ICD);
C) Interpupillary distance (IPD) and maxillary intercanine distance (ICD);

D) Interalar width (IAW) and maxillary intercanine distance (ICD) and E) Inter lip commissural distance (ICmD) and maxillary intercanine distance (ICD) to provide a guide for upper anterior teeth selection while constructing artificial denture.

Material and method
The study was conducted on 231 subjects (101males and 130 females), from among the patients attending the OPD in the dental department, Lokmanya Tilak nursing home and Nirmaladevi Dighe dispensary, Thane Municipal Corporation, Thane, Maharashtra, India.

Criteria for case selection
Subjects with all natural upper anterior teeth present in mouth having no caries, severe attrition, erosion, fracture or restorations were selected. Cases of anadontia, orthodontically treated cases, midline shift cases, migrated teeth, cases with a history of congenital anomaly, orbital disease, trauma or facial surgery were excluded.

All subjects were explained about the procedure and purpose of the study. Written consent from the subjects was obtained prior to study. Various facial measurements, namely, Intercanthal distance (ICthD), intermedialcanthal distance (IMCthD), interpupillary distance (IPD), interalar width (IAW), inter lip commissural distance (ICmD) and Intercanine distance from tip to tip (ICD) were measured with a venire caliper with an accuracy of 0.01 mm. (see the dig.)

ICthD: Intercanthal Distance;
IMCthD: Intermedial canthal distance;
IPD: Interpupillary distance;
IAW: Inter alar width;
ICmD: Inter lip commissural distance;
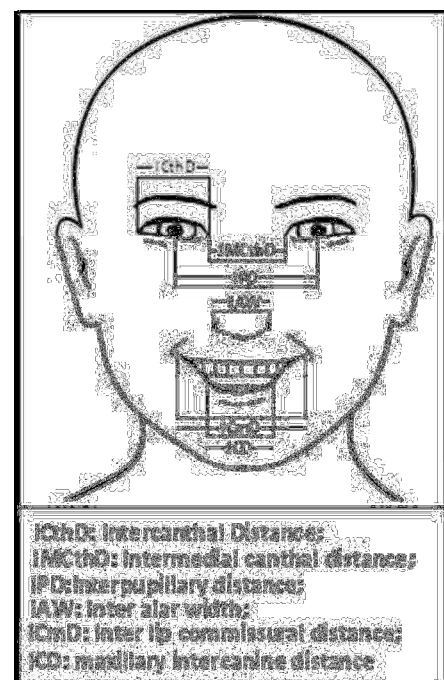ICD: maxillary intercanine distance

Fig. 1: showing various measurable distances on face

A) Intercanthal distance (ICthD) or width of eye was estimated by measuring distance between inner and outer canthus of eye.

B) Intermedialcanthal distance (IMCthD) was estimated by measuring distance between inner or medial canthi of two eyes.

C) Interpupillary distance (IPD) was estimated by measuring distance between the centers of the pupils of the two eyes.

D) Interalar width (IAW) or width of nose was estimated by measuring the external width of the ala of the nose at the widest point.

E) Inter lip commissural distance (ICmD) or length of lip was estimated by measuring distance between right and left lip commissar and

F) Intercanine distance (ICD) was estimated by measuring tip to tip distance of maxillary canines.

Collected data was entered into Microsoft excel program and various statistical calculations and tests were applied to find out correlation between above mentioned various facial measurements and maxillary intercanine distance in Indian male and female subjects.

Observations and discussion

Table 1. Distribution of subjects age wise

Sr No	Age Group	Male (%)	Female (%)	Total (%)
1	15-20	10 (9.9%)	13 (10%)	23 (9.95%)
2	21-30	24 (23.76%)	51 (39.23%)	75 (32.46%)
3	31-40	31 (30.69%)	35 (26.92%)	66 (28.57%)
4	41-50	13 (12.87%)	22 (16.92%)	36 (15.58%)
5	51-60	15 (14.85%)	5 (3.84%)	19 (8.22%)
6	61-70	8 (7.92%)	4 (3.07%)	12 (5.19%)
	TOTAL	101	130	231

Table 2: Difference between various facial measurements in male and female

Indicator	Male			Female			Std Error between M and F	Relative Deviate (Z value)	Significance of difference
	MEAN (SD)	MEDIAN	MODE	MEAN (SD)	MEDIAN	MODE			
ICthD	3.15 (0.15)	3.1	3	3.02 (0.1)	3	3	0.01732	7.5057	Significant
IMCthD	2.94 (0.22)	2.9	2.9	2.87 (0.25)	2.9	2.9	0.03129	2.2371	Significant
IPL	5.75 (0.39)	5.7	5.6	5.54 (0.29)	5.6	5.6	0.04638	4.5278	Significant
IAW	3.48 (0.3)	3.5	3.4	3.12 (0.28)	3.1	3	0.03865	9.0556	Significant
ICmD	4.92 (0.34)	4.9	5	4.57 (0.32)	4.6	4.5	0.04395	7.9635	Significant
ICD	3.17 (0.14)	3.2	3	3.03(0.099)	3	3	0.01395	10.0358	Significant

Since Z>2, therefore p<0.05 in all the facial measurements in male and female. Thus the difference in facial measurements in males and females is statistically significant.

The study was conducted on 231 subjects (101 males and 130 females) ranged from 15 years to 69 years in age. Most of the patients fall in 21 to 40 yr age group. (See the table 1.)

The observations showed that the mean intercanthal distance was 3.15 mm, standard deviation (SD) was 0.15, median was 3.1 and mode was 3 in males with range from 2.9 mm to 3.6 mm and The mean intercanthal distance was 3.02 mm,

standard deviation (SD) was 0.1, median was 3 and mode was 3 with range from 2.8 mm to 3.2 mm in females.

The ratio of averages between the mean maxillary intercanine distance (ICD) to mean intercanthal distance (ICthD) was 1:0.99 in both males in females.

The mean intermedialcanthal distance was 2.94 mm, standard deviation (SD) was 0.22, median was

2.9 and mode was 2.9 in males with range from 2.4 mm to 3.5 mm and The mean intermedialcanthal distance 2.87 mm, standard deviation (SD) was 0.25, median value was 2.9 and mode value was 2.9 with range from 2.3 mm to 3.9 mm in females.
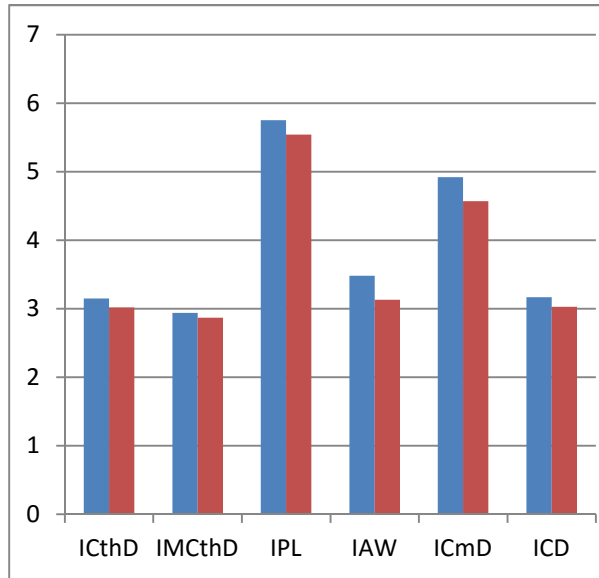
Graph 1: Comparison between mean of various facial measurements in male and female

The ratio of averages between the mean maxillary intercanine distance (ICD) to the mean intermedialcanthal distance (IMCthD) was 1:0.93 in males and the proportion or ratio of averages between the mean maxillary intercanine distance (ICD) to the mean intermedialcanthal distance (IMCthD) was 1:0.94 in females.

Mean interpupillary distance was 5.75 mm, standard deviation (SD) was 0.39, median was 5.7 and mode was 5.6 with range from 5 mm to 7 mm in males and The mean interpupillary distance was 5.54 mm, standard deviation (SD) was 0.29, median was 5.6 and mode was 5.6 with range from 4.8 mm to 6.3 mm in females.

The ratio of averages between the mean maxillary intercanine distance (ICD) to the mean interpupillary distance IPD) was 1:1.81 in males and the proportion or ratio of averages between the mean maxillary intercanine distance (ICD) to the mean interpupillary distance (IPD) was 1:1.83 in females.

The mean interalar width was 3.48 mm, standard deviation (SD) was 0.3, median was 3.5 and mode was 3.4 with range from 2.7 mm to 4.2 mm in

males and the mean interalar width was 3.12 mm, standard deviation (SD) was 0.28, median was 3.1 and mode was 3 with range from 2.5 mm to 3.9 mm in females.

The ratio of averages between the mean maxillary intercanine distances (ICD) to the mean interalar width (IAW) was 1:1.09 in males and the proportion or ratio of averages between the mean maxillary intercanine distances (ICD) to the mean interalar width (IAW) was 1:1.03 in females.

The mean inter lip commissural distance was 4.92 mm, standard deviation (SD) was 0.34, median was 4.9 and mode was 5 with range from 4.1 mm to 5.8 mm in Indian males and the mean inter lip commissural distance was 4.57 mm, standard deviation (SD) was 0.32, median was 4.6 and mode was 4.5 with range from 3.6 mm to 5.5 mm in Indian females.

The ratio of averages between the mean maxillary intercanine distance (ICD) to the mean inter lip commissural distance (ICmD) was 1:1.55 in males and the proportion or ratio of averages between the mean maxillary intercanine distance (ICD) to the mean inter lip commissural distance (ICmD) was 1:1.51 in females.

The mean maxillary inter canine distance from tip to tip was 3.17 mm, standard deviation (SD) was 0.14, median was 3.2 and mode was 3 with range from 2.9 mm to 3.6 mm in males and the mean maxillary inter canine distance from tip to tip was 3.03 mm, standard deviation (SD) was 0.09, median was 3 and mode was 3 with range from 2.8 mm to 3.2 mm in females.

It was observed that all facial measurements were greater in males than in females. Data obtained was subjected to statistical analysis. Standard error of difference (SE) and relative deviate (Z value) were calculated. The result showed Z > 2, therefore difference between male and female values was statistically significant. (See table 2; graph 1)

It was observed that maxillary intercanine distance from tip to tip (ICD) and Intercanthal distance (ICthD) was equal in length in 35 male subjects (34.65%) and in 89 female subjects.(68.46%).

Maxillary Intercanine distance was greater than intercanthal distance (ICthD) in length in 35 male subjects (34.65 %) and in 22 female subjects. (16.92%)
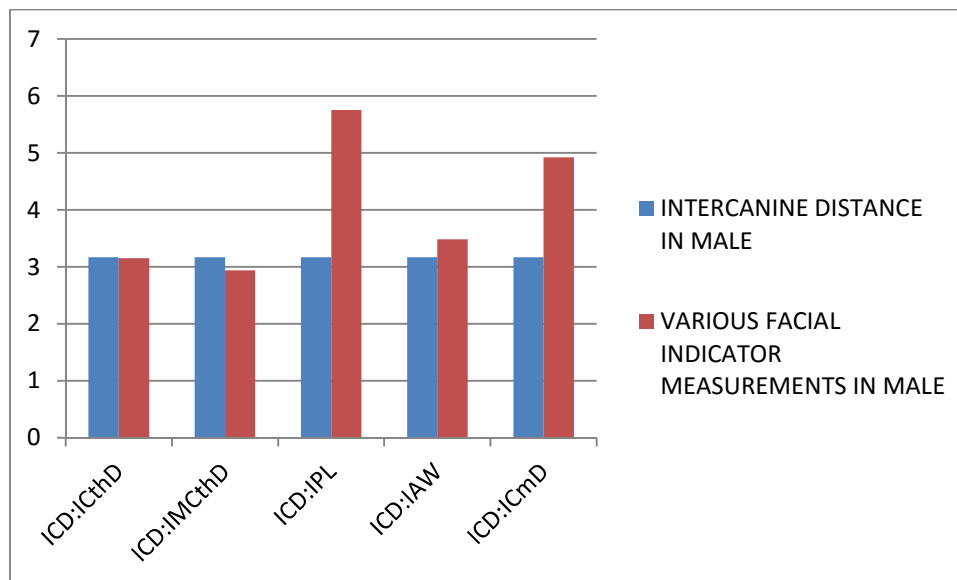
Maxillary intercanine distance was smaller than intercanthal distance (ICthD) in length in length in 31 male subjects (30.69%) and in 19 female subjects. (14.61%)

Table 3: Difference between various facial measurements and maxillary intercanine distance (ICD) in male

Indicator	Mean	SD	Median	Mode	Std. Error (SE) bet other indicator and ICD	Relative Deviate (Z Value)	Significance of Difference
ICthD	3.15	0.15	3.1	3	0.02	1	Insignificant
IMCthD	2.94	0.22	2.9	2.9	0.025	9.2	Significant
IPL	5.75	0.39	5.7	5.6	0.04123	62.57	Significant
IAW	3.48	0.3	3.5	3.4	0.03162	9.8	Significant
ICmD	4.92	0.34	4.9	5	0.03659	47.82	Significant

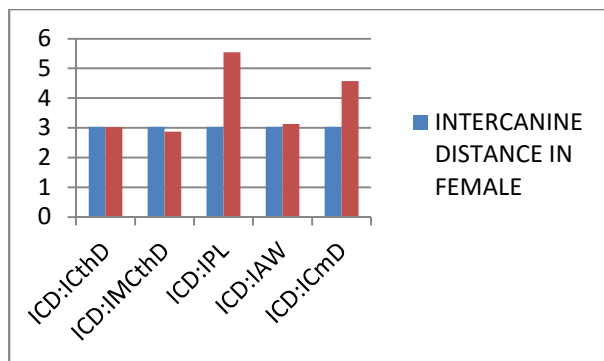Mean (ICD) = 3.17; SD (ICD) = 0.14; Median (ICD)= 3.2 ; Mode (ICD) =3 & n=101

Graph2: Comparison between mean of various facial measurements with maxillary intercanine distance in males.

Table 4: Difference between various facial measurements and maxillary intercanine distance (ICD) in female

Indicator	Mean	SD	Median	Mode	Std. Error (SE) bet other indicator and ICD	Relative Deviate (Z Value)	Significance of Difference
ICthD	3.02	0.1	3	3	0.008813	1.1346	Insignificant
IMCthD	2.87	0.255	2.9	2.9	0.02236	7.1556	Significant
IPL	5.54	0.29	5.6	5.6	0.02544	98.6635	Significant
IAW	3.13	0.28	3.1	3	0.02449	4.0832	Significant
ICmD	4.57	0.32	4.6	4.5	0.02807	54.8628	Significant

Mean (ICD) = 3.03; SD (ICD) = 0.01; Median (ICD)= 3 ; Mode (ICD) =3 & n=130

Graph3: Comparison between mean of various facial measurements and maxillary intercanine distance in females.

The Mean, standard deviation, standard error of difference (SE) and relative deviate (Z value) were

calculated between various facial measurements and maxillary intercanine distance in male and female subjects. The result showed Z>2, therefore p<0.05 in all the facial measurements except intercanthal distance in males and in females, indicating that the difference in all facial measurements except intercanthal distance in males and females is statistically significant.

Whereas Z<2, therefore p>0.05 in intercanthal distance and maxillary intercanine distance in males and in females, indicating that the difference between intercanthal distance and maxillary intercanine distance is statistically insignificant. (Refer table 3 and table 4)

Table 5: Observed Proportion of intercanine distance with various facial measurements, in males and females

Variants	Male (n=101)			Female (n=130)		
	ICD = 0 (%)	ICD > 0 (%)	ICD < 0 (%)	ICD =0 (%)	ICD > 0 (%)	ICD < 0 (%)
ICthD	35 (34.65%	35 (34.65%)	31 (30.69%)	89 (68.46%)	22 (16.92%)	19 (14.61%)
IMCthD	6 (5.94%)	75 (74.25%)	20 (19.80%)	21 (16.15%)	89 (68.46%)	20 (15.38%)
IPL	0	0	101 (100%)	0	0	130 (100%)
IAW	12 (11.88%)	10 (9.90%)	79 (78.21%)	23 (17.69%)	45 (34.61%)	62 (47.69%)
ICmD	0	0	101(100%)	0	0	130 (100%)

It was observed that average difference between maxillary Intercanine distance (ICD)and intercanthal distance (ICthD) was 0.02 mm with range from -0.3 mm to 0.2 mm in male subjects (r=0.6) and average difference between maxillary Intercanine distance (ICD)and intercanthal distance (ICthD) was 0.002 mm with range from -0.2 mm to 0.2 mm in female subjects (r=0.78).

It was observed that maxillary intercanine distance was bigger than length of eye in cases with diastemas; wide U or squarish arch; missing posterior causing distal displacement of anterior teeth and persons with small eyes, while maxillary intercanine distance was lesser than intercanthal distance in cases with crowding or narrower arch and v shaped arch.

The maxillary intercanine distance from tip to tip (ICD) and Intermedialcanthal distance (IMCthD) was equal in length in 6 male subjects (5.94 %) and in 21 female subjects (16.15%).

Maxillary Intercanine distance was greater than Intermedialcanthal distance (IMCthD) in length in 75 male subjects (74.25 %) and in 89 female subjects (68.46 %).

Maxillary Intercanine distance was smaller than Intermedialcanthal distance (IMCthD) in length in 20 male subjects (19.80 %) and in 20 female subjects (15.38 %).

It was observed that average difference between Intercanine distance (ICD) and intermedialcanthal distance (IMCthD) 0.22 mm with range from -1.2 mm to 0.3 mm in male subjects (r=-0.01)and average difference between Intercanine distance (ICD) and intermedialcanthal distance (IMCthD) was 0.15 mm with range from -0.8 mm to 1 mm in female subjects (r=-0.063).

Interpupillary distance (IPD) was greater than maxillary Intercanine distance (ICD) in length in all 231 subjects (100 %).

The average difference between maxillary intercanine distance (ICD) to Interpupillary

distance (IPD) was 2.58 with range of difference of 1.9 to 3.6 mm in male subjects. (r=0.33) and the average difference between Maxillary intercanine distance (ICD) to Interpupillary distance (IPD) was 2.51 mm with range of difference of 1.7 mm to 3.2 mm in female subjects (r=0.13).

Maxillary intercanine distance from tip to tip (ICD) and Interalar width (IAW) was equal in length in 12 male subjects (11.88 %) and in 23 female subjects. (17.69%)

Maxillary intercanine distance was greater than Interalar width (IAW) in length in 10 male subjects (9.90 %) and in 45 female subjects. (34.61 %)

Maxillary intercanine distance was smaller than Interalar width (IAW) in length in 79 male subjects (78.21 %) and in 62 female subjects (47.69 %).

It was observed that average difference between Intercanine distance (ICD) and interalar width (IAW) was 0.3 mm with range from -0.6 mm to 1.1 mm in male subjects (r= 0.09) and average difference between Intercanine distance (ICD) and interalar width (IAW) was 0.09mm with range from -0.5 mm to 0.8 mm in female subjects (r=0.23).

Inter lip commissural distance (ICmD) was greater than Maxillary Intercanine distance (ICD) in length in all 231 subjects (100 %).

The average difference between maxillary intercanine distance (ICD) and Inter lip commissural distance (ICmD) was 1.75 mm with range of difference of 0.9 mm to 2.6 mm in male subjects. (correlation coefficient, r=0.25) and the average difference between maxillary intercanine distance (ICD) and Inter lip commissural distance (ICmD) was 1.54 mm with range of difference of 0.5 mm to 2.4 mm in female subjects (r=0.17).

Results
The data obtained from 231subjects (101 males and 130 females) was subjected to statistical analysis and the results obtained are as follows:

A) The mean of intercanthal distance was slightly smaller than the mean of maxillary intercanine distance in both males (mean 3.15 mm and 3.17 mm, respectively) and in female (mean 3.02 mm and 3.03 mm, respectively). The difference between intercanthal distance (ICthD) and maxillary intercanine distance (ICD) was statistically insignificant (Z < 2) in both males and females.

B) The mean of intermedialcanthal distance (IMCthD) was smaller than the mean of maxillary intercanine distance in males (mean 2.94 mm and 3.17 mm, respectively) and in female (mean 2.87 mm and 3.03 mm, respectively).

The intermedialcanthal distance (IMCthD) in 5.94% of male and 16.15% of female cases showed positive correlation with maxillary intercanine distance (ICD), however no statistically significant correlation between intermedialcanthal distance (IMCthD) and maxillary intercanine distance (ICD) was found (Z > 2).

C) The mean of interpupillary distance (IPD) was greater than the mean of maxillary intercanine distance in males (mean 5.75 mm and 3.17 mm, respectively) and in female (mean 5.54 mm and 3.03 mm, respectively).

The difference between interpupillary distance (IPD) and maxillary intercanine distance (ICD) was statistically significant in both males and females, thus statistically significant correlation between interpupillary distance (IPD) and maxillary intercanine distance (ICD) was not found. (Z > 2)

D) The mean of interalar width (IAW) was greater than the mean of maxillary intercanine distance in males (mean 3.48 mm and 3.17 mm, respectively) and in female (mean 3.12 mm and 3.03 mm, respectively).

The Interalar width (IAW) in 11.88% of male and 17.96% of female cases showed positive correlation with maxillary intercanine distance (ICD), however no statistically significant correlation between The Interalar width (IAW)and maxillary intercanine distance (ICD) was found. (Z > 2).

E) The mean of inter lip commissural distance (ICmD) was greater than the mean of maxillary intercanine distance in males (mean 4.92 mm and 3.17 mm, respectively) and in female (mean 4.57 mm and 3.03 mm, respectively)

The difference between inter lip commissural distance (ICmD) and maxillary intercanine distance (ICD) was statistically significant, (Z > 2), thus statistically significant correlation between interpupillary distance (IPD) and maxillary intercanine distance (ICD) was not found.

The results of the study showed a significant correlation between intercanthal distance and maxillary intercanine distance in almost all

subjects indicating Maxillary intercanine distance may be estimated by measuring intercanthal distance and vice versa.

These results could be used as a helpful guide for the selection of upper anterior teeth while constructing esthetically acceptable artificial complete denture and also in the field of forensic sciences for facial reconstruction by using existing dental guidance.

Clinical application
1. Construction of complete denture in dentistry.
2. Facial reconstructions in forensic sciences.

Conclusion
The statistical results of this study showed that there was positive correlation between intercanthal distance and maxillary intercanine distance in both male and female Indian subjects. Though intermedialcanthal distance and Interalar width in 27 % and 35% of total cases respectively, showed positive correlation with maxillary intercanine distance. However, no statistically significant correlation between intermedial canthal distance and maxillary intercanine distance and between Interalar width and maxillary intercanine distance could be demonstrated.

Also no demonstrable correlation between the interpupillary distance and maxillary intercanine distance as well as inter lip commissural distance and maxillary intercanine distance was found, suggesting that the interpupillary distance and inter lip commissural distance are not reliable guides for determining maxillary intercanine distance for edentulous patients.

Within the limitations of this study, the results suggest that intercanthal distance can be used as a preliminary method to determine the width of the maxillary anterior teeth for construction of complete denture in edentulous patients.

Further studies on large scale are required in different Indian racial groups, to determine differences in measurements in them to reinforce the results in the present study.

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