

**ORIGINAL RESEARCH**

**Correlation between inner canthal distance, interalar width & inter canine distance in different maxillary arch forms- in vivo**

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**ABSTRACT:**

**Objective:** To study the correlation between inner canthal distance, interalar width and inter canine distance in different arch forms of maxilla and determine of relationship between the innercanthal dimension, interalar width and combined width of six anterior teeth.

**Material & Method:** 120 number of dentulous subjects, all subject between 18 to 40 years of age, Three measurements of each subject were made and the mean is calculated and correlation between inner canthal distance, interalar width and inter canine distance in different arch forms of maxilla and the determine of relationship between the inner canthal dimension, interalar width and combined width of six anterior teeth was done.

**Results:** Statistically significant correlation between Intra-alar width and inter-canine distance ( $r=0.822$ ;  $p<0.001$ ) was observed while correlation between inner canthal distance and intra canine width was moderate yet significant ( $r=0.665$ ;  $p<0.001$ )

**Conclusion:** Relation between Inter-Alar Width and Inter-Canine distance could be used as a guide for selection of maxillary anterior teeth.

**Key words:** Inter-Alar Width, Inter-Canine Distance, Innercanthal Dimension

**INTRODUCTION:** Artificial teeth of a proper size are essential for a natural looking denture. Various guidelines have been suggested for determining the width of the maxillary anterior teeth when pre-extraction records were not available. 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 must be provided. <sup>[1]</sup> A large number of individuals seek dental care because of esthetic reasons i.e, the desire to look more attractive by improving their smiles as said by Murell GA<sup>[2]</sup> and ,Dong JK et al. <sup>[3]</sup> In addition to other contributing factors responsible for a pleasing appearance, maxillary anterior teeth in particular play a very significant role as suggested by Dong, Mack, and Morley. <sup>[3,4,5]</sup> Apart from the esthetic value in complete dentures, maxillary anterior teeth are equally important for phonetics, lip support and to establish harmonious incisal guidance. But it is difficult to determine the dimensions of maxillary anterior teeth in an edentulous patient, when pre-extraction records are missing. <sup>[6]</sup> It is our duty as a dentist to preserve the dignity of nature while fabricating the prosthesis, with appropriate and careful selection and arrangement of teeth. Hence, this study has been conducted to determine the correlation between the Inter canthal distance, Inter-alar width and width of maxillary anterior teeth in different maxillary arches and whether these can be taken as a reliable predictor for the selection of anterior teeth for fabrication of esthetically pleasing dentures.

Hence this study was conducted to study the correlation between inner canthal distance, interalar width and inter canine distance in different arch forms of maxilla and the determine of relationship between the inner-canthal dimension, inter-alar width and combined width of six anterior teeth

**Materials & Methods:** This study was conducted in the Department of Prosthodontics and Crown & Bridge, Career Post Graduate institute of Dental Sciences and Hospital, Lucknow. 120 numbers of dentulous subjects, between 18 to 40 years of age, should have all permanent maxillary teeth up to first premolar, healthy with good oral hygiene. Depending upon the age, the dentulous subjects were divided into three groups,

**Each group consisted of 40 subjects (20 male,20 female), Group 1- 18-30 yrs, Group 2- 30-40 yrs and Group 3- 40 yrs and above.**

To determine inner canthal distance (ICD), and interalar width (IAW) using a digital vernier caliper. Measurements of the maxillary anterior teeth were made on the casts with the help of digital vernier caliper. The mesio distal measurements were recorded at the widest dimension (contact areas). Three measurements of each subject were made and the mean is calculated and correlation between inner canthal distance, interalar width,and inter canine distance in different arch forms of maxilla and the determine of relationship between the innercanthal

dimension, interalar width and combined width of six anterior teeth was done as mentioned our aim.

**RESULTS:** A total of 120 dentulous subjects belonging to either gender (both male and female) were included in the. They were divided into three groups based upon the age.

Out of 120 subjects enrolled in the study, maximum number of subjects (n=40; 33.33%) were aged 20-30 years, followed by aged 31-40 (n=40; 33.33%) and aged >40 (n=33.33; 26.67%). In Group I arch form of maximum subjects was tapered while in Group III ovoid arch form was most common and in Group II common arch forms were Square (32.50%) Despite proportional differences in arch forms above three groups (age groups) this difference was not found to be statistically significant (p=0.151).

Range of Intra-alar width of Group I was 30.33-40.29, of Group II was 28.86-40.29 and of Group III was 28.25-39.95. Maximum mean intra-alar width was found for Group I (35.19±2.73) followed by Group II (34.60±2.70) and minimum for Group III (33.80±3.00) . On comparing the difference of Intra-alar width among the groups was not found to be statistically significant (p=0.098).

**So there was no significant association found between Inter Alar distances with Age.**

Range of inter-Canine distance in Group I was 45.04-55.96, in Group II was 44.22-55.26 and in Group III was 44.27-53.49. Inter Canine distance of Group I (50.65±2.66) was found to be maximum followed by Group II (50.45±2.67) and minimum for Group III (49.70±2.47). Difference in inter-Canine distance among the above three groups was not found to be statistically significant (p=0.264).

Range of Inner Canthal distance of Group I was 23.26-49.51, of Group II was 23.55-32.65 and of Group III was 22.55-36.84. Maximum mean inner-Canthal distance was found for Group I (28.52±4.24) followed by Group II (27.93±2.45) and minimum for Group III (27.48±3.22). On comparing the difference of Inner-Canthal distance among the groups was not found to be statistically significant (p=0.409).

**So there was no significant association found between Inner Canthal distance with Age.**

**Table 1: Comparison of Inter-Alar Width of Females and Males**

Gender	Number of subjects	Mean	Standard deviation	Minimum	Maximum
Female	60	33.50	2.04	28.25	39.95
Male	60	34.76	2.83	29.65	40.29
Total	120	34.62	2.83	28.25	40.29

't'=0.484; p=0.629

Though inter-alar width of males ( $34.76 \pm 2.84$ ) was found to higher than that of females ( $33.50 \pm 2.84$ ) and this difference in inter-alar width of males and females was found to be statistically significant.

**Table 2: Comparison of Inter-Canine Distance of Females and Males**

Gender	Number of subjects	Mean	Standard deviation	Minimum	Maximum
Female	60	49.07	2.50	44.22	53.65
Male	60	50.98	2.64	44.27	55.96
Total	120	50.33	2.62	44.22	55.96

't'=2.577; p=0.011 (Sig.)

Inter-Canine distance of males ( $50.98 \pm 2.64$ ) was found to be higher than that of females ( $49.07 \pm 2.50$ ) and this difference was found to be statistically significant (p=0.011).

**Table 3: Comparison of Inner-Canthal Distance of Females and Males**

Gender	Number of subjects	Mean	Standard deviation	Minimum	Maximum
Female	60	27.66	2.91	22.55	34.94
Male	60	28.09	3.99	23.08	39.51
Total	120	28.05	3.46	22.55	39.51

't'=0.454; p=0.181

Though inner-Canthal distance of males ( $28.09 \pm 3.99$ ) was found to be higher than that of females ( $27.66 \pm 2.91$ ) but this difference was not found to be statistically significant.

**Table 4: Comparison of Inter-alar width in different Arch Forms**

Arch Form	Number of subjects	Mean	Standard deviation	Minimum	Maximum
Ovoid	40	33.89	2.43	30.05	38.73
Square	40	35.17	2.68	29.65	40.29
Tapered	40	34.76	3.22	28.25	39.95
Total	120	34.62	2.83	28.25	40.29

$F=2.149$ ;  $p=0.121$

Mean inter-alar width of Square arch form ( $35.89 \pm 2.43$ ) was found to be higher than that of Tapered ( $34.76 \pm 3.22$ ) and Ovoid arch form ( $33.89 \pm 2.43$ ). It was also found that difference in intra-alar width among the groups was not found to be statistically significant ( $p=0.121$ ).

Mean inter-Canine distance of square arch form ( $51.20 \pm 2.47$ ) was found to be higher than that of Tapered ( $49.81 \pm 2.65$ ) and Ovoid arch form ( $49.95 \pm 2.58$ ). It was also found that **difference in inter-Canine distance among the groups was found to be statistically significant ( $p=0.031$ )**.

**Table 5: Comparison of Inter-Canine Distance between arch forms (Tukey-HSD test)**

Comparison	Mean	Standard Error	'p'
Ovoid Vs. Square	-1.24	0.57	0.082
Ovoid Vs. Tapered	0.15	0.58	0.966
Square Vs. Tapered	1.39	0.57	0.043

Inter Canine distance of Ovoid form was found to be lower than that of square form but the difference ( $1.24 \pm 0.57$ ) was not found to be statistically significant. Inter Canine distance of Ovoid arch form was found to be higher than that of Tapered arch form and the difference ( $0.15 \pm 0.58$ ) was not found to be statistically significant. Difference in Inter Canine distance of Square arch form was found to be significantly higher than that of tapered arch form.

**Table 6: Correlation of Inter-alar width and Inner Canthal distance with Intra-canine distance (n=120)**

SN	Parameter	No.	Mean	SD	Correlation with Maxillary Central Incisor width	
					"r"	"p"
1.	Inter Canine distance	120	50.33	2.62	–	–
2.	Intra-alar width	120	34.62	2.83	0.822	<0.001
3.	Inner Canthal Distance	120	28.05	3.46	0.665	<0.001

Mean inter canine distance was  $50.33 \pm 2.62$ , compared to intra-alar width was  $34.62 \pm 2.83$  and inner Canthal distance was  $28.05 \pm 3.46$ , thus showing that the mean values of intra-alar width and inner canthal distance cannot be directly used as a predictor and hence some correlation has to be traced to find out an association of these variables with Inter-canine width.

On assessment of correlation, a strong and statistically significant correlation between Intra-alar width and inter-canine distance ( $r=0.822$ ;  $p<0.001$ ) was observed while correlation between inner canthal distance and intra canine width was moderate yet significant ( $r=0.665$ ;  $p<0.001$ )

**Discussion:** In this study it was found that range of Inner-Canthal distance of Group I was 23.26-49.51, of Group II was 23.55-32.65 and of Group III was 22.55-36.84. Maximum mean inner-Canthal distance was found for Group I ( $28.52 \pm 4.24$ ) followed by Group II ( $27.93 \pm 2.45$ ) and minimum for Group III ( $27.48 \pm 3.22$ ). On comparing the difference of Inner-Canthal distance among the three groups, it was not found to be statistically significant ( $p=0.409$ ). So there was no significant association found between Inner-canthal distance with Age. Though inner-Canthal distance of males ( $28.51 \pm 3.99$ ) was found to be higher than that of females ( $27.66 \pm 2.91$ ) but this difference was found to be very small. So there was also no significant association found between between Inner-canthal distances with sex.

In a Bangladeshi study, it was observed that there was a gender based difference in ICD (males:  $32.59 \pm 2.1$  mm; females:  $30.77 \pm 2.1$  mm) and maxillary CIW (males  $9.68 \pm 0.5$  mm and females  $9.12 \pm 0.4$  mm). The mean ICD recorded for south Indian Population was also greater than that was recorded for Saudi Arabian population (males 28.69 mm and females 27.68 mm).

Range of Inter-alar width of Group I was 30.33-40.29, of Group II was 28.86-40.29 and of Group III was 28.25-39.95. Maximum mean Inter-alar width was observed for Group I ( $35.19+2.73$ ) followed by Group II ( $34.60+2.70$ ) and minimum for Group III ( $33.80+3.00$ ). On comparing the difference of Inter-alar width among the age was not found to be statistically significant ( $p=0.098$ ). So there was no significant association found between Inter-Alar distance with Age. Though Inter-alar width of males ( $34.76+2.84$ ) was found to higher than that of females ( $33.50+2.84$ ) but difference in Inter-alar width of males and females was not found to be statistically significant. Again there was no significant association found between Inter-Alar width with sex.

But higher mean inter alar width in males subject in comparison to females subject reveals the influence of male dominance factor. This is also seen in size of the jaws and teeth between the two sexes.

The mean nasal width dimensions in Pakistani population were  $35.46 \pm 5.6$  mm. This value is in correlation with the studies of **Smith**<sup>[7]</sup> (33.5mm), **Mavroskoufis**<sup>[6]</sup> and Ritchie (35.3mm) and **Scandrett et al**<sup>[8]</sup> (34.4 mm). However, Latta et al studying edentulous patients found the mean nasal width of 40 mm.

In contrast to the results obtained in the Pakistani study, few studies like **Scandrett FR (1982)**<sup>[8]</sup> and **Picard JR (1958)**<sup>[9]</sup> have suggested the nasal width as predictive factor. But the results of the Pakistani study just like other studies Liefer, Pleasure MA, Rosenthal LA (1962), **Mavroskoufis F**<sup>[6]</sup>, Ritchie(1981), Akeel R.(2003) have suggested that the nasal width method is not an accurate method for the selection. There is a general opinion that the inter-alar width is more or less similar to inter-canine distance and this observation is the criteria for the selection and placement of upper six anterior teeth. However this study showed that this standard approach is not to be followed as a general rule. The present study revealed that in both sexes, with square and ovoid arches, the Inter-alar distance corresponded to the selection of the width of the maxillary anterior teeth.

Mean inter-alar width of Square arch form ( $35.89+2.43$ ) was found to be higher than that of Tapered ( $34.76+3.22$ ) and Ovoid arch form ( $33.89+2.43$ ). It was also found that difference in intra-alar width among the age was not found to be statistically significant ( $p=0.121$ ).

In the present study, Inter-Canine distance of males ( $51.98+2.64$ ) was found to be higher than that of females ( $50.27+2.50$ ) and this difference was found to be statistically

significant ( $p=0.011$ ). McArthur 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>[10]</sup> in 1986 (44.85mm), Shillingburg et al<sup>[11]</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>[9]</sup> (1982) (53.61mm). Al Wazzan et al<sup>[12]</sup> calculated the value of the intercanine distance recorded from the stone cast & showed a mean value of  $(46.01 \pm 7.31 \text{ mm})$  to the total sample. This was significantly higher in male compared to female casts. They also found the inter-canine distance mean value of  $(45.16 \pm 3.28 \text{ mm})$ . They also suggested the difference of the values in gender ( $45.16 \pm 3.52 \text{ mm}$ ) for male group and  $(43.93 \pm 3.22 \text{ mm})$  for female group.

In an Egyptian and Saudi study, most subjects (66% Egyptians, 70% Saudis) showed medial location of the canine distal aspect to the commissures. This was in agreement with the study performed by **Al Wazzan et al (2001)**<sup>[12]</sup> which showed a narrower distance between the canine distal aspect than that between the commissures of the mouth in Saudi population ( $45.16 \pm 3.28$  and  $50.79 \pm 5.09$ ), respectively, and only 40% of the subjects had the inter-canine distance within 4 mm of the width of the mouth Al Wazzan et al (1997). However, Lieb et al. (1967) reported that the maxillary canine distal aspect was  $\pm 4 \text{ mm}$  distal or medial to the commissures. Mean inter-Canine distance of Square arch form ( $51.20 \pm 2.47$ ) was found to be higher than that of Tapered ( $49.81 \pm 2.65$ ) and Ovoid arch form ( $49.95 \pm 2.58$ ). It was also found that difference in inter-Canine distance among the groups was found to be statistically significant ( $p=0.031$ ).

On Comparison of Inner-Canthal Distance in different Arch Forms it was found that Inner-Canthal distance in square arch form ( $28.63 \pm 2.64$ ) was found to be slight maximum followed by Tapered arch form ( $28.00 \pm 3.10$ ) while that of Ovoid form was found to be minimum ( $27.49 \pm 4.42$ ). The assessment of arch forms has been done by their geometrical description in the present as well as previous literature. **Despite difference in Inner Canthal distance of above three arches difference was not found to be statistically significant ( $p=0.338$ )**. Correlation of mean of Inter-alar width and Inner-Canthal distance with Inter-canine distance in 120 patients showed inter-canine distance was  $50.33 \pm 2.62$ , compared to Inter-alar width was  $34.62 \pm 2.83$  and inner-Canthal distance was  $28.05 \pm 3.46$ , thus showing that the mean values of Inter-alar width and inter-Canine distance cannot be directly used as a predictor and hence some correlation has to be traced to find out an association of these

variables with Inter-canine width. **On assessment of correlation, a strong and statistically significant correlation between Inter-alar width and inter-canine distance ( $r=0.822$ ;  $p<0.001$ ) was observed while correlation between inner canthal distance and inter canine width was moderate yet significant ( $r=0.665$ ;  $p<0.001$ )** Hence we can say that there was a higher significant correlation between inner-canthal and inter-alar and inter-canine distance in the male. While less correlation was found in the females. This support the statement produced by **Boucher and et al (1975)** that with respect to inter-alar width tooth selections made by these procedures must be considered as being very tentative.

Instead of giving multiplication factor in other studies like **H.m. al-el-sheikh<sup>[13]</sup>** to estimate the width of the maxillary anterior teeth using Inter alar width was 1.54 for male, 1.59 for female and 1.57 for both sexes, while it was 1.31 and 1.26 of the studies made by **Hoffman et al<sup>10</sup>** and **Aleem et al<sup>[12]</sup>**, respectively ,we have given the equation according to different arches to estimate tentative inter canine distance. But this can be justified on the large number of sample size in the study .there is general opinion that Inter alar width is more or less similar to Inter canine distance, and this observation is one of the criteria for selection of the maxillary anterior teeth, however this study has shown that this approach cannot be applied as a gold standard in all case. Denture esthetics is the effect produced by a dental prosthesis that affects beauty and attractiveness of a person. <sup>[14]</sup> The prediction formulae discussed in this study may be used for various purpose. But the first of these,it is to establish a relation between the ICD with ICnD and IAW with ICnD in different arch form.

**Conclusion:** There was no significant association found between Inter-Alar Distance with Age. Difference in inter-Canine Distance among the above three groups was not found to be statistically significant ( $p=0.264$ ).There was no significant association found between Inner-Canthal distances with Age. Relation between Inter-Alar Width and Inter-Canine distance could be used as a guide for selection of maxillary anterior teeth with mean 34.76 for Male and 33.50 for Female.

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