

Correlation Between Interlar Width and Size of Natural Maxillary Anterior Teeth

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ABSTRACT

Background and Objective: The maxillary anterior teeth are the key elements for dentofacial esthetics. A large number of patients seek dental care especially for anterior maxillary teeth due to any of the possible reasons. The study aims to determine the correlation between interlar width (IAW) and size of natural maxillary anterior teeth (NMAT) in a sample of Pakistani population for evaluating the reliability of use of nasal index as a guide in selection of artificial maxillary anterior teeth (AMAT).

Methods: Interlar width (IAW) measurements of 280 dental students were recorded directly from faces while intercanine width (ICWTTC, ICWDDC, ICWTTS) was measured from the stone cast and correlation was determined using computer software SPSS25.

Results: Results showed a significant correlation between nasal width and AMAT in the study sample. Using regression analysis the predicted values of size of natural maxillary anterior teeth of the entire sample showed no significant difference between recorded and predicted values of intercanine width (ICWDDC).

Conclusion: It was concluded that use of interlar width directly to determine the size of six maxillary anterior teeth can lead to selection of appropriate sized maxillary anterior artificial teeth. The validity of use of IAW in selection of AMAT and making of esthetically pleasing dentures can thus be reliably predicted.

KEYWORDS: Artificial teeth, Teeth selection, Esthetics, Pakistan, Interlar width, Completed dentures.

INTRODUCTION

Teeth whether they are natural or artificial are associated with a beautiful face and pleasant smile. The maxillary anterior teeth are the key elements for dentofacial esthetics.¹ A large number of patients seek dental care mainly for esthetic purposes, especially when anterior maxillary teeth are malformed, distorted or lost due to any of the possible reasons. The ultimate objective of selection of size, shape and shade of anterior teeth is to restore size, form, function and color of teeth in order to achieve good esthetics.²

When teeth are lost, overall body image, vitality and sexuality are affected. Fixed and removable prosthodontics, edentulous anterior areas must be restored with teeth exhibiting normality in their mesiodistal width independent from other esthetic criteria.³

Selection of artificial maxillary anterior teeth (AMAT) is an aspect of denture fabrication having profound effect on acceptance by the patient. The selection and arrangement of maxillary anterior teeth for edentulous patients in a natural and esthetically pleasing form has remained an artistically challenging endeavor for dentist.⁴ Pre-extraction records are a reliable guide for the selection of teeth however, in the

absence of pre-extraction records decision of size of AMAT becomes more complex.⁵

Various biometric guides/indices based on facial measurements that have been suggested to aid tooth selection for edentulous patient includes, bizogomatic width, nasal or interlar width (IAW), intercanthal distance, inter pupillary distance, width of mouth and philtrum.⁶ However, none of these guides have been concluded as a single accurate predictor for selection of AMAT.⁷ Many researchers have tried to devise a nasal index, by relating the IAW width to the width of natural maxillary anterior teeth (NMAT) to select appropriate AMAT for edentulous patients.⁸ Studies on different ethnic and racial samples have pointed out the variation in relation of natural tooth sizes and IAW width.⁹ Most of the studies so far have been carried on Caucasians, Japanese, Chinese and Negroid, and hence forth their samples exhibited distinct facial forms and features. Anthropometric studies on facial and morphologic norms among different groups could be useful indicators in helping dentist to obtain acceptable results for their particular patients.¹⁰ It is however, interesting to note that multiple statistical and clinical methods have been employed to use IAW width for the selection of AMAT by researchers.

Distance between parallel lines drawn on to the labial surface of maxillary occlusal rim from the lateral aspects of alae of nose has been suggested to be equal to the width of MAT (maxillary anterior teeth) as measured from tip of one canine to the other around the curve.¹¹ Mavroskoufis found that the straight line distance (ICWTTS) and the curved distance between the canine tips (ICWTTS) differs by 7mm.¹²

Despite availability of many studies on relationship of facial measurement with size of NMAT there still appears a gap on agreement of a reliable biometric guide for selection AMAT.¹³ The objectives of this study was to:

1. Determine the correlation between nasal width and width of six maxillary anterior teeth in a local sample of population.
2. Devise a nasal index to predict the width of six maxillary anterior teeth in edentulous patients.

METHODS

This study was carried out in Fatima Memorial Hospital Shadman Lahore after the approval from ethical review board. A sample of 765 dental and medical students was examined over a period of 15 months to select 306 participants who satisfied the selection criteria. The subjects with healthy and intact six maxillary anterior teeth fully developed and healthy coral pink gingival morphology and skeletal class I jaw relation were included. Subjects with any missing, malformed, restored, carious tooth/teeth among six maxillary anterior teeth, presence of Crowding/overlapping, spacing were not included in the study. Participants in whom maxillary anterior teeth had been restored or showed any signs of erosion, abrasion or attrition, those who were undergoing orthodontic treatment or having obvious facial asymmetry and deformity were also excluded. Informed consent and approval was obtained from all participants.

Maxillary Impressions were made using an irreversible hydrocolloid impression material (Cavex Holl and B.V. P.O Box 852, RW Harlem, and Holland) in perforated stock trays. To reduce the possibility of air-blows, a small quantity of impression material was applied on the labial surfaces and interdental spaces in anterior area before the bulk of the material in the tray was inserted into the mouth. Impressions were poured in dental stone (Zharmack Italy).

Maxillary cast of each selected participant was coded for date time, number, name and sex and were preserved carefully in boxes assuring no damage to the casts. Tip of the canine cusp and the most distal point on the labial surface of maxillary canine, were marked with a fine lead 0.1mm pencil on the prepared casts. Care was taken not to abrade the contact points during this procedure. Dentaurum flexible millimeter ruler was used to record the following measurements on the cast:

1. Curved distance around labial surface of NMAT from tip of right canine to tip of left canine ICWTTC (Fig. 1).
2. Curved distance around labial surface of NMAT from distal most point of right canine to distal most point of left canine ICWDDC (Fig.1).
3. Straight line distance between tips of right and left canine ICWTTS (Fig. 1).

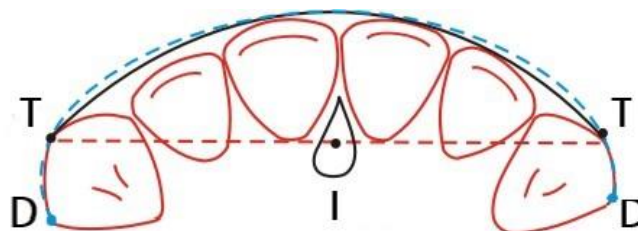


Fig. 1: Intercanine width measurements, ICWTTC, ICWDDC & ICWTTS.

TT = (ICWTTC): Tip to tip intercanine distance around the labial surface of anterior teeth.

DD = (ICWDDC): Intercanine distance from distal aspect of one to the other canine, around the labial surfaces of anterior teeth.

TIT = (ICWTTS): Straight line tip to tip intercanine distances.

I = Incisive papilla.

A vernier caliper having a vernier scale reading to 0.05 mm was used to measure nasal width/interalar width (IAW) directly from the face of each subject. Measurement was performed with the participants in an upright and relaxed position. Nasal width was measured bringing the forks of gauge into contact with the outer surfaces of alae ensuring that no pressure was applied.

All the procedures from impression taking, cast pouring, trimming and measurements were made by the principal investigator to minimize error. First thirty measurements were made thrice in a random order to determine the statistical reliability ($r = 0.096$, P value $< .05$). Three participants were rejected due to accidental breakage of cast. The measurements data of 23 female subjects were excluded by random selection to round of the male female ratio to 1:1.

STATISTICAL ANALYSIS

Data collected from 280 participants was analyzed using Statistical Package for Social Sciences (SPSS) version 25 for windows.

RESULTS

The study sample consisted of 280 participants with 1:1 male to female ratio Table 1 shows the age range of the sample. The descriptive statistics of the recorded measurements for all participants and separately for males and females are shown in (Table-1). The values were greater for men than for women with significant differences ($P < 0.001$).

The Pearson correlation was found to be significant between IAW width and each of intercanine width

ths i.e. ICWTTC, ICWDDC & ICWTTS. When female and male participants were analyzed separately, the correlation between variables of interest was however,

Table -1: Interalar IAW and Inter canine Widths (ICWTTC, ICWDDC, ICWTTS) of Natural Teeth. (mm).

Gender	Age (Yrs) Mean ± S.D	IAW Mean ± S.D	ICWTTC Mean ± S.D	ICWDDC Mean ± S.D	ICWTTS Mean ± S.D
Females(140)	21.3 ± 1.5	34.25 ± 1.87	42.48 ± 2.5	52.18 ± 2.8	34.61 ± 1.9
Males (140)	21.5 ± 1.6	37.85 ± 2.5	44.87 ± 2.09	54.09 ± 2.5	35.73 ± 2.09
N(280)	21.4 ± 1.5	36.055 ± 2.8	43.67 ± 2.6	53.13 ± 2.8	35.17 ± 2.1

Yrs. = Years, IAW = Interalar Width, ICWTTC = Tip to tip intercanine width around the arc, ICWDDC = Inter canine width from distal aspect of one canine to the other, ICWTTS = Straight line intercanine width from tip to tip, N = Total, ± = Standard deviations.

not found significant (Table- 2).

A simple linear regression was performed after fulfilling all the assumptions, to predict the value ICWDDC based on correlation with IAW. A highly significant regression equation ($P < 0.0001$) was found which showed that predicted value of ICWDDC equals to **44.802 + 0.231 (IAW)** when IAW is measured in millimeters. Sum of the residuals were also obtained which showed a sum of zero. For Further verification of the results paired sample t test was applied to the predicted and original values of the ICWDDC which clearly showed that there is no statistical significant difference between

Table- 2:Correlation Coefficient for Interalar Width (IAW) with Inter canine Width (ICWTTC, ICWDDC, ICWTTS).

	IAW:ICWTTC r	IAW:ICWDDC r	IAW:ICWTTS r
All subjects – 280	0.306**	0.229**	0.17**
Female – 140	0.015	0.064	0.066
Male – 140	0.038	-0.001	0.005

IAW = Interalar Width, ICWTTC = Tip to tip intercanine width around the arc, ICWDDC = Inter canine width from distal aspect of right canine to the left canine. ICWTTS = Straight line intercanine width from tip to tip, N = Total, r = correlation co-efficient, ** = significant @ 0.001

Table -3: Review of IAW, ICWTTC, ICWDDC, ICWTTS Measurements Reported in Similar Studies.

Yr.	Researchers	N = M + F	Age	IAW=M/F	ICWTTC	ICWDDC=M/F	ICWTTS=M/F
1975	Smith BJ ¹⁶ .	80	20-70	34	31.7-33.7		
1981	Mavroskoufis F ⁹	64		35.3			34.3
1986	Hoffman W Jr ¹⁹	340	13-82	34.5		44.8	36.35
2009	Gomes VL ³⁴	81 = 37+44	17-33	41.2 = 43.1/38.7		53.6 = 54/53.5	37.4=38/37
2010	RAI R ³⁶	300 = 150+150	13-25	34.3 = 35.8/32.7		36.6 = 37.5/35.7	
2014	Kurien A ²⁸	300 = 150+150	20-49	30.5 = 31.5/29.7		51.1 = 51.5/50.6	
2015	Deogade SC ³⁷	600 = 300+300	19-30	38.5 = 40.9/35.6		43.86 = 44.19/43.5	
2017	Miranda GA ²⁷	200 = 100+100	20-30	36.2 = 38.5/33.9	43-7	38 = 39/37	34-5=35/34
2017	Bushan Bangar ³⁸	250 = 125+125	20-35	69.4 = 34.5/34.6		49.8 = 50.2/49.3	
2019	Present study	280 = 140+140	18-24.1	36.1 = 37.8/34.3	43.7	53.1 = 54.1/52.2	35.2=35.7/34.6

Yr. = Year, N = M + F = Total number of subjects = Male + Female, IAW = Interalar Width, ICWTTC = Tip to tip intercanine width around the arc, ICWDDC = Inter canine width from distal aspect of one canine to the other, ICWTTS = Straight line intercanine width from tip to tip, M/F = Male/Female, Blank & colored areas = values not recorded in the study.

two variables P-value 0.96.

DISCUSSION

All the subjects in this study were of Pakistani origin. The sample was almost homogenous in age distribution therefore, the result of this study are more applicable to the population being evaluated. The present study comprising of a group of male and female subjects showed that gender dimorphism existed between the sizes of male and female teeth on an average by 7mm (Table- 1).

A review of measurements as reported in similar studies is given in (Table-3). In the present study the mean width of maxillary natural anterior teeth from distal aspect of one canine to the other (ICWDDC) found to be 54.1mm for males and 52.05mm for females. These findings were consistent with those reported by McArthur who found the mean ICWDDC equal to 54.5mm for males and 52.3mm for females while using a similar measuring techniques as is used in this study.¹³ Hofman et al.¹⁴ have reported a smaller circumferential arc distance of 48mm in his study sample of 304 subjects where crowding or overlapping of maxillary anterior teeth was not excluded. LaVere et al.¹⁵ found out the mean value for the intercanine dimension to be 53.5mm for males and 51.4mm in female. Alwazzan reported a mean width of ICWDDC to be 45.23 mm in his sample of Saudi subjects.¹⁶ The difference between measurements recorded in present study and of previously reported studies may be explained by difference in the ethnicity of the population studied. IAW width in the present study was found to be 35.27 mm for the whole sample, 37.5mm for males 34.1mm for females. Rai found IAW to 34.25mm and ICWDDC to be 36.6mm in a sample of south Indian subjects. However, Rai measured ICWDDC in a straight line instead of around the curve. All these studies were similar in respect the mean IAW for males was greater than female subjects.¹⁷

The measurement techniques used in some of the studies done recently adopted a non-standardized method of using dental floss ordinary metal wrought wire for recording the dental measurements.⁹ The measurement reported in these studies may not be accurate due to dimensional instability of the tools used and lack of standardized calibrations in millimeters.

A significant correlation was found between IAW and intercanine distance ICWTTC, ICWDDC and ICWTTS in the present study (Table- 2). These findings are not in agreement with Alwazzan who found that nasal width could not be relied on for use in selection of size of AMAT.¹⁶ Mavroskoufis stated that although IAW and straight line tip to tip intercanine width (ICWTTS) were not equivalent there exist sufficient evidence to use IAW increased by 3% and 31% for determining ICWTTS/ICWDDC.¹² This strategy was used on the data collected for present study but the values derived by this method did not predicted the value of ICWTTS

or ICWDDC.

The regression analysis was performed only for ICWDDC because this is the dimension provided by almost all the artificial tooth manufacturers on the size guides and teeth strips for maxillary anterior teeth. The correlation was found to be more significant for females than male subjects which indicated that gender influences the correlation between IAW and all three intercanine measurement. However further insight in to study design sample size and statistics of data is needed to explore the effect.

It cannot be emphasized enough that each patient is unique despite transformed gradually with age, visual and intellectual perceptions and personality. Knowledge and applications of anthropometry and proportions of physical measurements only provide a guideline and reference for the start line of esthetics. It is important to remember what we are looking for when selecting teeth for those without any pre-extraction record of their tooth sizes. We need esthetically pleasing treatment outcome by selecting tooth sizes which enhance the patient appearance, confidence and function. It is to be understood that patient natural teeth or facial structures may have morphological anomalies like peg laterals, missing or supernumerary teeth, disproportionate tooth or nose sizes and shapes etc. It's obvious that patients or dentist would not like to replicate those abnormal features of the natural dentition in replacement teeth. Therefore our prime objective is not to find exact sizes and arrangement of lost natural teeth but to select dimensions of AMAT that look harmonious and pleasing and works equally well in function and appearance. It will be therefore, better to rely on more than one method to select esthetically pleasing anterior teeth for a particular patient.

The data collected in this study could be beneficial for orthodontist, prosthodontist, manufacturers of artificial tooth moulds and cosmetic surgeon. Selection of maxillary anterior teeth without understanding the morphological changes that take place under the denture bases can end up in dissatisfaction and unsuccessful esthetic outcomes. The quantitative measurements used in selection and placement of maxillary anterior teeth should only be used as guides but not absolute values.

CONCLUSION

It is concluded that the IAW can be used for selection of anterior maxillary artificial teeth for edentulous patients with a knowledge to correlate two dimensions in a specified demographic and racial settings using the equation $ICWDDC = 44.802 + 0.231 (IAW)$. Furthermore, projects could be designed to apply the data for facial measurement collected in this study to select artificial maxillary anterior teeth for edentulous patients evaluating their esthetic outcome.

LIMITATIONS OF STUDY

One of the limitations of the study may be accuracy of the dimensions of teeth which can be criticized at two stages – one during impression making and the other during cast making. This could have been avoided if the teeth were measured intraorally but the subjects' comfort would have been compromised in addition to infection and injury risk. Facial measurements were done on soft-tissue landmarks and operator variation may have resulted due to inconsistent pressure during measuring. A photographic method with calibration could have been used to avoid this problem. Furthermore, study recommends the use of interalar distance as a preliminary and in the selection of maxillary anterior teeth in Pakistani population in the absence of pre-extraction guides. However, research with greater sample size covering a larger area and with different parametric combinations may be preferable.

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AUTHOR'S CONTRIBUTION

MZ: Conception, acquisition, analysis of data, drafting the article and final approval of the article.

CONFLICT OF INTEREST

None to declare.

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None to disclose.

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