J Indian Prosthodont Soc (Oct-Dec 2014) 14(4):352–357
DOI 10.1007/s13191-013-0329-8

ORIGINAL ARTICLE

A Comparative Study on the Relationship Between Inter Alar Width, and Inter Commissural Width on Circumferential Arc Width of Maxillary Anterior Teeth in Different Age Groups

Anjana Kurien · K. P. Cherian · Shirley Mhatre · Renji George Tharakan

Received: 24 June 2013 / Accepted: 11 October 2013 / Published online: 18 October 2013

Abstract This study was done to determine the relationship between interalar width and inter commissural width on circumferential arc width of maxillary anterior teeth in dentulous subjects between the age groups of 20–50 years. The study involved 300 subjects, in whom measurements were made from the distal aspect of each maxillary canine, across the facial surfaces of the six anterior teeth, using brass wire and a Vernier calliper. Interalar and inter commissural width were recorded after placing two points and measured with a Vernier calliper. Results were statistically analyzed using unpaired *t* test, Kolmogorov-Smirnov and Pearson's correlation coefficient test. This study confirmed the reliability of interalar width to determine the circumferential arc width which can be used as a reference in edentulous patients.

Keywords Circumferential arc widths · Interalar width · Inter commissural width

A. Kurien
Department of Prosthodontics, Sri Ramakrishna Dental College and Hospital, SNR College Road, Nava India, Coimbatore 641 006, India

A. Kurien (✉)
154, GV Residency, Sowripalayam, Coimbatore 614 028, India
e-mail: anjanadr@yahoo.com

K. P. Cherian
Department of Prosthodontics, Azeezia College of Dental Sciences and Research, Meeyannoor, Kollam Dist. Kerala, India

S. Mhatre
Bhagwantrao Paralkar Margparel Village, Parel, Mumbai' 400012, India

R. G. Tharakan
Valliara Parayil House, Calicut Road, Manjeri, India

Introduction

The face and especially the smile is of a great concern to the individual, for therein lies a significant part of his self image. Edentulism is essentially a departure from normalcy. Most patients regard edentulism as mutilating and have a strong incentive to seek dental care for the preservation of a healthy dentition and socially acceptable appearance. The smile primarily involves the display of six maxillary anterior teeth which is a necessity for proper shape and size of anterior teeth for esthetic.

An attractive smile finds its focus in harmoniously arranged teeth, as its selection and positioning is of great importance in denture esthetics. It is difficult to determine the dimensions of the maxillary anterior teeth for an edentulous patient when the pre-extraction records are not available. To compensate for traumatic bone loss, the effects of aging, loss of support from periodontal disease, tooth loss, or other similar conditions clinicians strive to change the anteroposterior and vertical components of facial relationships [1]. Therefore to determine this size we try to use facial landmarks to obtain suitable dimensions of the anterior teeth to reach a close to normal appearance.

Different studies have been done to determine the width of the maxillary anteriors using various anatomic, hard tissues, soft tissues and radiographic land marks. These include studies done with relationship between the size and shape of the face, anthropological assessment, incisive papilla [2, 3], pupil of the eye [4], corners of the mouth and alae of the nose [5, 6]. Though some methods claim to predict the width of maxillary anterior teeth on the denture with a reasonable degree of accuracy, they are cumbersome and are based on varied population of different ethnic groups.

Many studies have established correlation between different anatomic structures and width of the maxillary anterior teeth [2–7]. No significant difference was found between interalar width and the distance between distal surfaces of the maxillary canines in females, but in males significant difference was analyzed in these structures [8]. However to apply this correlation clinically with no pre extraction records it would be easier to derive an equation using this correlation, so that calculation of the width of the maxillary anterior teeth is simplified.

In order to apply these relations regionally in dental clinics it would be more appropriate to derive and employ the relationship from and to a local population of same ethnic origin. The aim of the study was to analyze the relation of the circumferential arc width of maxillary anterior teeth to interalar width and inter commissural width in a section of south Indian population and to derive an equation to calculate maxillary anterior teeth width.

The objectives tested in the study were:

1. Comparison of relationship of interalar width to the width of maxillary anterior teeth in dentulous males and females of different age groups.
2. Comparison of relationship of inter commissural width to the width of maxillary anterior teeth in dentulous males and females of different age groups.
3. Comparison of interalar width and inter commissural width of males and females.
4. To obtain a clinical guideline to use the findings of the study for edentulous situations without any preextraction records.

Materials and Methods

A total of 300 (N) subjects were chosen for the study from the city of Mangalore, Karnataka, South India. The procedure was explained to the subjects and their written consent was obtained. Approval for the study was obtained from the ethical committee of the college. The subjects were grouped according to age (20–29 years, 30–39 years and 40–49 years) and sex (150 males and 150 females). Subjects included were students, staffs and out-patients of a Dental College & Hospital in Mangalore.

Subjects above 20 years of age and below 50 years were selected as they fulfilled the inclusion criteria with orthognathic jaws and six well aligned maxillary anterior teeth, devoid of dental caries, dental restorations, anatomical malformations, teeth wear and midline diastemas, were included in the study. Subjects with nasal and lip deformities like cases of cleft lip, patients with history of nasal and lip surgical procedures were excluded from this study.

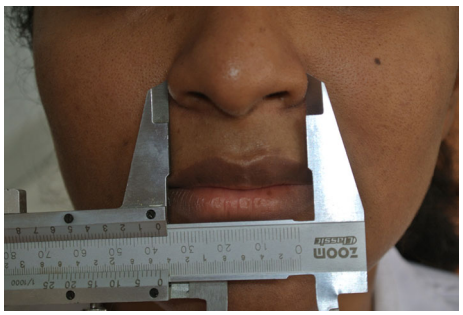


Fig. 1 Recording the inter alar width

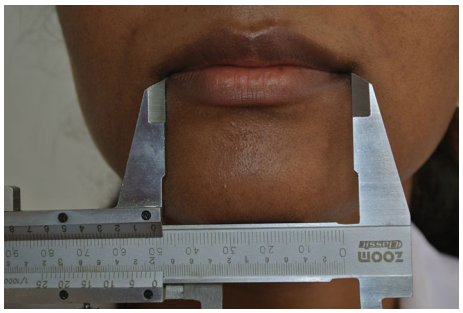


Fig. 2 Recording the inter commissural width

Method of Recording the Interalar Width from a Subject (Fig. 1)

The subject was advised to sit relaxed in an upright position on the dental chair with head unsupported. Two points were marked with a fine marker pen on the widest outer surface of the alae of the nose on either side and the width is measured with the Vernier calliper without using any pressure. The recording was repeated three times by the same examiners for consistency on different days and time. The average of the findings was calculated to establish the mean value to establish the consistency and reliability of the examiner.

Method of Recording the Inter Commissural Distance from a Subject (Fig. 2)

Two points were marked in the widest outer surface of the corner of the lip. This was recorded using the Vernier calliper passively. Readings were repeated three times by the examiner to get a mean value.

Method of Recording the Circumferential Arc Width from a Subject (Fig. 3)

A 0.020 inch brass wire (GAC Dentsply) was bent manually according to the arch width and distal points of the canines of the patient were marked using glass marking

Fig. 3 Recording the circumferential arc width

pencil. For each patient new wire was used. Following this the wire was straightened and the distance between the two marked points on the wire was measured using a Vernier calliper. Three readings were recorded by the examiners and the mean value was calculated.

Data were collected and statistically analyzed using student's unpaired *t* test, Kolmogorov-Smirnov [KS] Test and Pearson's correlation coefficient test, with p values > 0.05.

Results

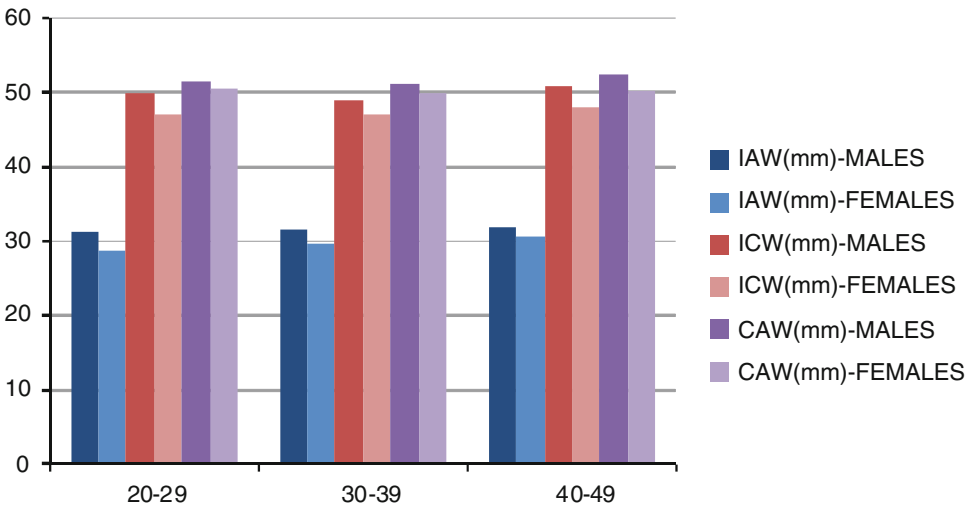
Table 1 shows the average values of interalar, inter commissural and circumferential arc widths according to age and sex. Kolmogorov–Smirnov test was employed to test the nature of the population from which the sample data was drawn Table 2 and calculate the cumulative frequencies of the observations. It signifies whether the sample comes from normal probability distribution or not. Since p values were > 0.05 the assumption that this sample represents the population that has been accepted.

The Pearson's correlation statistical analysis revealed a highly significant correlation between interalar width and circumferential arc width in all groups. (male of all age at 1 % and, female 20–29, 40–49 at 1 % and female 30–39 at 5 %).

Since all p values are greater than 0.05(5 %), it was accepted for all the groups except males with age group 40–49 that inter commissural width had no significant relation with circumferential arc width.

Table 1 Mean value of interalar width, inter commissural width, circumferential arc width using Kolmogorov–Smirnov test and graph mean values

Age	Interalar width (mm)	Intercommisural width (mm)	Circumferential arc width (mm)
Male			
20–29	31.38	49.80	51.55
30–39	31.39	49.06	51.25
40–49	31.80	50.89	52.57
Female			
20–29	28.82	46.98	50.56
30–39	29.73	46.98	49.86
40–49	30.62	48.10	50.24



IAW inter alar width, *ICW* inter commisural width, *CAW* circumferential arc width

Table 2 Model summary

Model	R	R square	Adjusted r square	Std. error of the estimate
1	0.602(a)	0.363	0.360	1.5778

Predictors A: (Constant), Inter-Alar Width

Table 3 Model summary

Model	R	R square	Adjusted r square	Std. error of the estimate
1	0.622(a)	0.386	0.382	1.5506

Predictors: (Constant), Inter commissural, Inter-Alar Width

A positive correlation between circumferential arc width, interalar width and inter commissural width was noted.

The average interalar width of males (31.5234) mm was greater than females (29.7213) mm and the average inter commisural width of males (49.9153) mm were greater than females (47.3533) mm and t-test revealed that this was statistically significant.

Since interalar width correlated with circumferential arc width, a regression equation was obtained. Pearson's correlation coefficient test (Table 3) revealed that inter alar width also correlated with circumferential arc width and based on this a regression equation was obtained. Predicting a variable, keeping other variables independent, a relationship between the variables is modelled by linearity assumption method of least square. It is a method used to estimate a regression co efficient (constants), based on the data parts plotted with the 300 subjects. Formula was established through an in built computer software.

$$\text{Circumferential arc width} = 33.453 + 0.573 \times \text{inter-alar width}$$

Discussion

Patients expect their first dentures to appear aesthetically, as similar to their natural teeth. Therefore, the correct selection of artificial teeth is essential to achieve a pleasant esthetic outcome. The mesiodistal width is a harder aspect to estimate than the proper height of the anterior artificial teeth [9].

Various techniques have been employed for selection of anterior teeth. These materials reveal a dependence on the physical characteristics of dentofacial form.

Anthropological assessment as of today shows that the greatest bizygomatic width of the skull divided by 16 corresponds to the width of the upper central incisor, and the bizygomatic width divided by 3.3 corresponds to the overall width of the upper six anterior teeth arranged on a curve [2]. Schiffman P [3] used a method to determine the size of the artificial maxillary teeth by using the incisive papilla and the cuspid eminence. Ricketts [4] advocated drawing a perpendicular through the pupil of the eye. The corners of the mouth fell half way between this line and the outer limits of the alae portion of the nose. Mean values from a study by Shillingburg et al. [5] indicated that as a percentage of circumferential arc distance between the distal surface of canines, the combined width of the central incisors would occupy 37 % of the distance, with the combined widths of the lateral incisors occupying 31 % of the distance and the combined widths of the canines 32 % of the distance. Silverman [6] pointed out that the mesiodistal dimension of anterior teeth can be related to the distance between the corners of the mouth.

In the present study 300 subjects (150 males and 150 females) were grouped according to age (GP I—20–29 years, GP II—30–39 years and GP III—40–49 years). The significance of grouping the subjects age wise was to rule out the influence of age related functional proximal tooth wear on the circumferential arc width measurement.

The average interalar width of males (31.5234) mm was greater than females (29.7213) mm and the average intercommisural width of males (49.9153) mm was also greater than females (47.3533) mm (Table 1). Others studies [10, 11] have shown similar results revealing an influence of sex on these measurements.

It was seen that a highly significant correlation existed between interalar width and circumferential arc width in all groups (male of all age at 1 % and, female 20–29, 40–49 at 1 %and female 30–39 at 5 %). This finding is consistent with that of others [10, 12–18] in literature but dissimilar to that of Smith [19] who found no significant relationship between the intercanine distance and the interalar width of the nose. However the method used in his study was radiographic and did not use any clinical measurements. The interalar width measured in North Americans had a mean of 41.22 mm in edentulous patients [20], from Iran a mean of 37.00 mm with a significant difference in gender [21] and Mavroskoufis [15] recorded a mean of 35.30 mm in 64 white subjects and the authors calculated a mean of 30.62 mm. Variation for the measurements may be due to the different ethnic groups of the population studied.

Gomes et al. [9] measured a mean distance of 53.67 mm between the distal surface on the cast which was similar to McArthur [22] mean value of 53.70 mm which measured the circumferential distance on cast with flexible millimetre ruler and the mean value calculated by the data collected by the authors was 51.00 mm.

The nose develops from the frontonasal process where in the four maxillary anterior teeth also develop from. As the interalar width is closely related to circumferential arc

Table 4 Kolmogorov-Smirnov Test for Normality

One-sample Kolmogorov–Smirnov test						
Gender	Age			Inter alar width (mm)	Inter commissural width (mm)	Circumferential arc width wire (mm)
Male	20–29	N		50	50	50
		Normal parameters (a,b)	Mean	31.3800	49.7960	51.5460
			SD	2.25615	3.61962	1.96907
		Most extreme differences	Absolute	0.095	.061	.090
			Positive	0.095	.050	.049
			Negative	−0.072	−0.061	−0.090
		Kolmogorov–Smirnov Z		0.673	0.432	0.635
		Asymp. Sig. (2-tailed)		0.755	0.992	0.814
	30–39	N		50	50	50
		Normal parameters (a,b)	Mean	31.3922	49.0640	51.2520
			SD	1.34628	3.09415	1.27955
		Most extreme differences	Absolute	0.110	0.126	0.114
			Positive	0.110	0.075	0.075
			Negative	−0.069	−0.126	−0.114
		Kolmogorov–Smirnov Z		0.775	0.891	0.804
		Asymp. Sig. (2-tailed)		0.586	0.405	0.537
	40–49	N		50	50	50
		Normal Parameters (a,b)	Mean	31.7980	50.8860	52.5720
			SD	1.83275	3.15317	2.06971
		Most extreme differences	Absolute	0.108	0.094	0.098
			Positive	0.108	0.070	0.098
			Negative	−0.065	−0.094	−0.073
		Kolmogorov–Smirnov Z		0.766	0.668	0.694
		Asymp. Sig. (2-tailed)		0.600	0.764	0.722
Female	20–29	N		50	50	50
		Normal parameters (a,b)	Mean	28.8180	46.9840	50.5600
			SD	1.95549	3.11536	2.04261
		Most extreme differences	Absolute	0.107	0.081	0.102
			Positive	0.052	0.072	0.084
			Negative	−0.107	−0.081	−0.102
		Kolmogorov–Smirnov Z		0.758	0.574	0.721
		Asymp. Sig. (2-tailed)		0.613	0.896	0.677
	30−39	N		50	50	50
		Normal parameters (a,b)	Mean	29.7300	46.9800	49.8580
			SD	1.53467	2.64483	1.47967
		Most extreme differences	Absolute	0.106	0.121	0.082
			Positive	0.061	0.121	0.082
			Negative	−0.106	−0.087	−0.080
		Kolmogorov–Smirnov Z		0.751	0.858	0.577
		Asymp. Sig. (2-tailed)		0.625	0.453	0.894
	40–49	N		50	50	50
		Normal parameters (a,b)	Mean	30.6160	48.0960	50.2400
			SD	1.74208	3.25426	1.60687
		Most extreme differences	Absolute	0.132	0.122	0.179
			Positive	0.072	0.122	0.179
			Negative	−0.132	−0.096	−0.121
		Kolmogorov–Smirnov Z		0.931	0.863	1.268
		Asymp. Sig. (2-tailed)		0.352	0.446	0.080

a test distribution is normal, *b* calculated from data

width (Table 3) in our study a regression equation was formed to use this clinically in edentulous situations.

$$\text{Circumferential arc width} = 33.453 + 0.573 \times \text{inter-alar width.}$$

Inter commisural width of almost all age groups showed no correlation to circumferential arc width and thus the inter commisural width cannot be considered reliable in predicting the width of anterior teeth. This is in contrast to the findings by Silverman [6] who pointed out that the mesiodistal dimension of anterior teeth can be related to the distance between the corners of the mouth.

However when all three parameters were considered together there was a positive correlation existing between circumferential arc width, inter-alar width and inter commissural width as shown (Table 4), a multiple regression equation was derived.

$$\text{Circumferential arc width} = 30.558 + 0.518 \times \text{inter-alar width} + 0.095 \times \text{inter commissural width.}$$

Scandrett et al. [16] used multiple regression equations to calculate the width of the maxillary anterior teeth and found the best model of predictor variables as interalar width, inter-commissural width, age and inter buccal frenum distance.

These equations can be used by the clinicians to estimate the combined width of maxillary anterior teeth selected for complete denture patients to restore a pleasant smile. Teeth give individuality for dentition and one must be careful while selecting this to create a pleasing esthetics to achieve harmony with the facial appearance. Giving prominence to central incisors and then to lateral and canines in decreasing width. One should also keep in mind the race, gender, facial morphology and psychological factors [23].

Further studies are necessary to evaluate the individual selection of size of each tooth to offer variance and individuality to the denture.

Summary and Conclusions

Within the limits of the study the following conclusions were drawn:

1. Interalar width showed a significant relationship with circumferential arc width and thus nose width was more consistent in selecting the width of six maxillary anterior teeth.
2. The dimensions were more in male population and this should be considered while selecting teeth for different sexes.
3. The prediction formulations will aid in applying the findings of this study clinically in edentulous situations in South Indian Population.

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