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DETERMINATION OF MAXILLARY ANTERIOR TEETH WIDTH FOR A COMPLETELY EDENTULOUS PATIENT: PART I COMPARATIVE STUDY IN DENTATE ARAB SUBJECTS WITH DIFFERENT ARCH FORMS

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ABSTRACT

Aim: this study was conducted to determine the distance between the mesio-incisal angles of maxillary central incisors along the midline to a line running between the tips of the maxillary canines (IC line) in Arab population with different arch forms.

Materials & Methods: 226 stone casts for selected dentate Saudi students were categorized, according to their morphological description, into three groups (ovoid, tapering, and square) arch forms. Using a digital caliper, the distances between the mesio-incisal angles of the maxillary central incisors along the midline to the IC line (AB distance) and to the midpoint between fovea palatine (AC distance) were measured. The data were collected and statistically analyzed.

Results: One way analysis of variance (ANOVA) showed that the mean of AB distance was affected significantly by change of the arch form and also for the AB: AC ratio where $p < 0.001$.

Conclusion: The fundamental results of this study can serve as a guide for determining the mesio-distal width of the maxillary anterior teeth in different arch forms.

KEY WORDS: Arch form, determination, maxillary anterior teeth, Size.

INTRODUCTION

Esthetics is a crucial concern for patients seeking prosthodontic treatment. The size and form of the maxillary anterior teeth are primarily significant for the overall acceptance of the complete denture. The main goal is to keep the harmony of the facial appearance after restoring the edentulism. In the absence of pre-extraction records, selection of the proper anterior teeth size and proper positioning antero-posteriorly would demand artistic skill in addition to scientific knowledge. Till the present day, according to my knowledge, there are no rules of thumb for determining the mesio-distal width of the maxillary anterior teeth. However,

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inter-alar width[1-3], interpupillary distance, the inter-canthus distance [4-6], the inter-commissural width[7] are mainly used in the literature as a reliable guide for selecting the size of the maxillary anterior teeth. On the other hand, proper positioning of the maxillary anterior teeth should be functional as well as esthetically pleasing to enhance the psychology of the patient. Unfortunately, it can be argued that there is no 100 % reliable guide. The most obvious landmark, however, is the incisive papilla[8] appears to have survived intact from the dentate state and received a great deal of attention [9]. The studies suggested various points for measurement from the incisal edge of the maxillary central incisors to the incisive papilla: one group of scholars have adopted the center of the papilla as a reference point for measurement[10-13], while other authors have preferred to end at the posterior border of papilla. The differences between scholars were not confined only to the determination of the point of reference but extended to the measurements as well. Adopting the center of the papilla as the reference point of the measurements, Harper[10] suggested 5-8 mm; McGee[11] preferred 7.7 mm; while Hickey et al.[12] and Martone[13]suggested 8-10 mm. On the other hand, taking the posterior border of papilla as the point of reference, Erlich and Gazit reported an average of 12-13 mm[14], while Solomon and Arunachalam reported 11.9mm[15].

In an attempt to correlate the coronal position of the canine cusp tips to the incisive papilla, and to the antero-posterior position of the maxillary anterior teeth, watt et al[16] and Zarb et al[17] suggested that the canines should be located in a coronal plane passing through the posterior border of the incisive papilla. It should be noted, however, that other investigators have suggested that the IC line should pass through the center of the incisive papilla[18,19]. It can be said that these studies had introduced a new correlation between the line passing through the canine tips and the incisive papilla. This correlation had been enhanced by a number of studies including that of Solomon and Arunachalam which reported that 93% of the tested subjects have the IC line pass through the incisive papillae, while 7% of the subjects were 1.5 mm anterior or posterior to the incisive papillae[15]. Among these subjects, the IC line passed through the middle of the incisive papilla in 78%, along the base of the incisive papilla in14.1% and in 0.4% at its anterior border. In a study of 298 young Jordanians[19], 50% of the subjects were reported to have the IC line passing 1.2 mm to the midpoint of the incisive papilla. On the other hand, a study on four racial groups reported no coincidence between the center of the incisive papilla and the IC line[20]. This means that the incisive papilla does not have a definite correlation to the IC line.

The present study was conducted to measure the distances between the mesio-incisal angles of the central incisors along the midline to the IC line and perpendicular to it (AB) and to the midpoint between fovea palatine (AC) in different arch forms (ovoid, tapering, and square) to extrapolate AB distance as a guide in the determination of the mesiodistal width of the maxillary anterior teeth in complete dentures.

MATERIALS AND METHODS

The subjects of the study were 226 dentate Saudi students with normal teeth alignment and angle class-I arch relationship (109 males and 117 females). Selection of the subjects was based on specific criteria including: full complement of teeth, class-I molar relation, normal horizontal and vertical overlap, symmetrical arch form, absence of diastema and previous orthodontic treatment and with age between 22-25 years. Impressions of the upper arches were made using irreversible hydrocolloid impression material, and were poured using type-1 dental stone (Glastone, Dentsply, USA). The casts were trimmed with the cast trimmer having the occlusal plane set parallel to the cast base using a water balance.

In each cast the cusp tips of the maxillary canines and the fovea palatine were marked (Fig. 1).

The casts were categorized, according to their morphological description, into three groups (ovoid, tapering, and square) arch forms (Table 1).

Using digital poly gauge (precision level at 0.01mm), two measurements were made on each cast:

1. The distance from the mesio-incisal angles of the maxillary central incisors (along the mid-line) to the IC line and perpendicular to it (AB). IC line is the anterior border of a ruler passing through the marked canine cusp tips (Fig. 2).
2. The distance from the mesio-incisal angles of the maxillary canines to the midpoint between fovea palatine (AC) (Fig. 1).
3. The AB: AC ratio was also calculated.

Data were collected and statistically analyzed using SPSS. Descriptive statistics were used to find the mean and standard deviation (±SD). The harmonic mean of the group size was used, as the group sizes were unequal. Tukey test (HSD) was performed when ANOVA test was found significant for the comparison between the different groups.

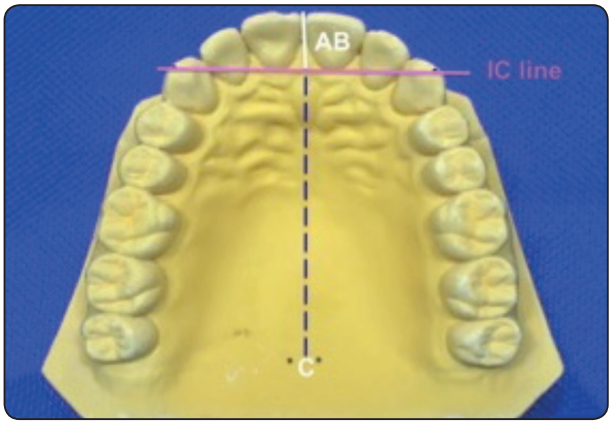

Fig. (1) Illustration of the measured variables

Fig. (2) Measuring the AB distance using digital poly gauge.

RESULTS

TABLE (1) Grouping and categories of the studied subjects

Arch Form (NO.) (%)	Gender	
	F No. (%)	M No. (%)
Ovoid (108) 47.7%	38 (35.2%)	70 (64.8%)
Tapering (84) 37.2%	61(72.6%)	23 (27.4%)
Square (34) 15.1%	18 (52.9%)	16 (47.1%)
Total	226	

F: female, M: male.

The mean differences of AB distance measured from the mesio-incisal angles of the maxillary central incisors to the IC line are 9.82(±1.27) and 9.78 (±1.28) respectively for females and males of all casts with insignificant difference p= (0.807) (Table 2).

One way analysis of variance (ANOVA) showed that the mean of AB distance was affected significantly by change in shape or form of the arch and also for the AB: AC ratio where p< 0.001. (Table 3).

TABLE (2) Comparisons between females and males at the measured variables in all studied subjects

Variables	Gender		t-test	p-value
	F	M		
	Mean ± SD	Mean± SD		
AB (mm)	9.82±1.27	9.78±1.28	0.245	0.807
AC (mm)	52.91±2.69	53.76±2.91	2.288	0.023*
AB: AC	18.57±2.25	18.22±2.39	1.135	0.258

F: Female, M: Male, P*<0.05. AB is the distance from the mesio-incisal angles of the maxillary central incisors to the IC line. AC is the distance from the mesio-incisal angles of the maxillary central incisors to the midpoint between fovea palatine.

TABLE (3) Comparison of the mean difference of the measured variables between arch forms

Variable	Arch Form	Mean ± SD	F	p-value
AB (mm)	Ovoid	9.88±0.90	125.935	0.000**
	Taper	10.55±0.93		
	Square	7.73±0.63		
AC (mm)	Ovoid	53.55±2.90	1.867	0.157
	Taper	53.35±2.79		
	Square	52.49±2.58		
AB: AC	Ovoid	18.47±1.67	117.225	0.000**
	Taper	19.80±1.74		
	Square	14.74±1.10		

**** < 0.05, < 0.001***

Tables 4, 5, 6 show insignificant difference between females and males within each group p>0.05. In addition, the arch length showed insignificant difference between females and males within each group except at the square arch form where p-value =0.019 (Table 6).

Comparing AB: AC distance ratio at different arch forms (ovoid, tapering, and square) of the casts using Tukey post hoc test showed a significant difference between the studied arch forms p = 0,000 (Table 5).

TABLE (4) Comparisons of the measured variables between females and males having ovoid arch form

Variable	Gender		t-test	p-value
	Mean ± SD F	Mean ± SD M		
AB (mm)	9.83±0.57	9.90±1.03	0.418	0.677
AC (mm)	53.16±3.00	53.77±2.83	1.049	0.296
AB: AC	18.53±1.15	18.43±1.90	0.350	0.727

TABLE (5) Comparisons of the measured variables between females and males having tapering arch form

Variable	Gender		t-test	p-value
	Mean ± SD F	Mean ± SD M		
AB (mm)	10.46±0.98	10.77±0.76	1.348	0.181
AC (mm)	53.17±2.69	53.80±3.06	0.923	0.358
AB: AC	19.70±1.77	20.06±1.66	0.861	0.392

< 0.05*

TABLE (6) Comparisons of the measured variables between females and males having square arch form

Variable	Gender		t-test	p-value
	Mean ± SD F	Mean ± SD M		
AB (mm)	7.63±0.56	7.85±0.70	1.030	0.311
AC (mm)	51.47±1.27	53.64±3.19	2.550	0.019*
AB: AC	14.83±1.09	14.65±1.15	0.461	0.648

**** < 0.05 ** < 0.001***

TABLE (7) Multiple comparisons of AB distance in ovoid, tapering and square arches

Arch Shape		Mean	p-value
Ovoid	Tapering	0.67	0.000*
	Square	2.14	0.000*
Tapering	Square	2.82	0.000*

**** Significant at p-value < 0.05***

DISCUSSION

Due to the fundamental importance of the maxillary anterior teeth for esthetics and speech throughout the literature, scholars attempted to provide a definite guide for the maxillary anterior teeth size determination. In the same line, this study was conducted in order to define the distance between the mesio-incisal angles of the maxillary central incisors to the IC line and perpendicular to it regardless of the relation to the incisive papilla. It is noteworthy that the incisive papilla tends to be used for positioning of the maxillary central incisors; although up to date there is no definite correlation between the IC line and the incisive papillae. Some authors documented that the IC line of dentate subjects pass through the posterior border of the incisive papilla[21-23]; while others suggested that it passed through the center of incisive papillae[24]. Moreover, Varjao et al reported no coincidence between the center of the incisive papilla and the IC line[20]. Up to date, there is no consensus among scholars as to the existence of a definite guide point of reference to measure the distance from the maxillary central incisors to the incisive papilla.

This study was conducted on 226 Saudi students who reflect a diverse mix of Arab populations as a result of immigration and settlement in Saudi Arabia[25]. In this study, the IC line, rather than the line joining the most distal points of the canines, was used for measurements. The reason behind this was the fact that the most distal point of the canines was not found to be any easier to locate than the tip of the canines. The findings of this study manifested that the mean AB (±SD) distance for all studied casts was 9.82 (±1.27), and 9.78 (±1.28) mm for females and males respectively, which falls within the range of Schiffman's study who reported that the maxillary central incisors fall approximately 8–10 mm anterior to the point of intersection of mid-palatal line perpendicularly through the incisive papilla that extends outward approximately through the mid of the maxillary canines[26]. Compared to the current study, Solomon and Arunachalam reported an estimated distance of 11.9 mm, with 14.1% out of 93% of the studied casts having the IC line passing through the base of the incisive papilla (point of measurements)[15]. This estimated distance is around 2 mm above the estimated distance reported by this study, namely, 9.82 and 9.78 mm for females and males respectively. However, the fact that the majority of the percentage in Solomon and Arunachalam's study (78.1%) have the IC line passing anterior to the measurement point would more likely enhance the estimated distance suggested by the current study, and hence the validity of using the IC line as a point of reference.

It should be noted, however, that Solomon and Arunachalam's estimated distance applies only to 14.1% out of the percentage that manifested a correlation between IC line and the base of the incisive papilla whereas the majority would report a smaller distance since they fall anterior to the measurement point. The findings of the current study can be further supported by Khalaf 's study which examined Iraqi and Yemeni subjects[27]. Khalaf's findings illustrated that 58% of the studied Iraqi subjects have the distance between the maxillary central incisors and the IC line (which passes through the middle third of the incisive papilla – the point of measurements) as 8.90±0.87mm, which is around 1mm less than the distance reported in this study; while 60% of Yemeni subjects having an estimated distance between the maxillary central incisors and the IC line (which passes through the base of the incisive papilla – the point of measurements) as 9.92 ±1.07 mm, which is closely approximating the one in the current study.

The current study reported that the AB distance for females exceeds that for males, though with an insignificant difference. This is in accordance with other studies[19, 27,28]. Concerning the arch forms, the AB mean distance was 9.88±0.90, 10.55±0.93, and 7.73±0.63 for ovoid, tapering, and square arch forms respectively, with high significant differences between groups. This explains that the flatter the premaxillary alignment, the shorter the distance from the maxillary central incisors to the IC line [28]. In addition, the AB mean distance reported insignificant differences between genders within each group, which agrees with some studies[18,20] and contrasts with others[28]. It should be noted that the present study reported the presence of a high significant difference between the mean of AB distances at different arch forms, which enhances the possibility of using these results as a guide for determining the maxillary anterior teeth size.

CONCLUSION

Within the limitations of the current study, the following conclusions were drawn a significant difference between the AB distances of the studied arch forms (9.88, 10.55, and 7.73 mm for ovoid, tapering, and square arch forms respectively).

In sum, the biometric analysis of the distance from the mesio-incisal angles of the maxillary central incisors, along the midline, to the IC line in dentate subjects can serve as a guide for the determination of the mesiodistal width of the maxillary anterior teeth in different arch forms and the positioning of the incisors depending mainly on the current situation of each patient.

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