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Study of Facial Biometric Measurements on Indian Population for Selection of Maxillary Anterior Teeth

Dr. Manish Kumar[1*], Dr. Girish Kumar[2], Dr. Ranjan Mathur[3], Dr. Dushyant Pal Singh[4]
[1]Senior Resident, Department of Dentistry, S P Medical College and Hospital, Bikaner, Rajasthan, India
[2]Reader, Department of Prosthodontics & Crown and Bridge, Rajasthan Dental College and Hospital, Jaipur, India
[3]Professor and Head, Department of Dentistry, S P Medical College and Hospital, Bikaner, Rajasthan, India
[4]Research Fellow, NASI-ICMR Chair on Public Health Research, Rajasthan University of Health Sciences, Jaipur, India

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***Corresponding author**
Dr. Manish Kumar

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Abstract: The selection of appropriate size and shape of maxillary anterior teeth can be difficult when pre-extraction records are not available, as there is no universally accepted method that can be used reliably. The purpose of this study analyzed the clinical crown dimensions of maxillary anterior teeth to determine whether consistent relationships exist between tooth width and several facial measurements in a subset of the Indian population. 160 Indian dentate subjects were used to measure both facial and dental parameters. Intercanthal, interalar, inter commissure distance and width of six maxillary anteriors was directly measured using digital vernier caliper. Paired t-test and pearson correlation tests were performed to statistically analyze the data. Significant co-relations were found between all the facial parameters and combined mesio-distal width of six maxillary anterior teeth (P>0.01). another analysis by paired t-test showed that among all facial parameters used in this study, intercanthal distance was not significantly affected by age and gender parameters (P>0.05). Among all facial parameters, intercanthal distance can be used as a more accurate guide for selection of maxillary anterior teeth for prosthesis fabrication because it does not vary significantly with the gender and the age.
Keywords: Biometric**,** Teeth Selection, Facial Measurement

INTRODUCTION

Teeth selection is an important factor in the construction of complete dentures, which can be disappointing if they do not meet the expectations of patients. Error at this stage can often result in patient rejection of otherwise well-constructed, comfortable and efficient denture. The size, form, and color of the teeth must be in harmony with the surrounding oral and facial structures [1-5].

During the oral rehabilitation treatment, the patient demands comfort, followed by harmonious appearance, and lastly, efficiency [3].

Certain anthropometric measurements of the face have been suggested to determine the mesiodistal width of maxillary central incisors for edentulous patients. Young [6], House and Loop [7], and Berry [8] all reported a ratio of maxillary central incisor width to face size. The central incisor was said to be 1⁄6 that of the bizygomatic width. However, others [9-10], have shown that bizygomatic measurement may not be a reliable means of determining the width of maxillary central incisors.

The medial junction of the 2 eyelids is called the *medial angle* (medial canthus) [11]. The intercanthal distance (ICD) is the distance between the medial angles (canthi) of the palpebral fissure bilaterally. At 5 years of age, 93% of ICD growth has been achieved; maturity is reached between 8 and 11 years [12, 13]. The ICD is considered normal at a dimension of 28 to 35mm [14]. No differences related to sex [15], race [16-18] (black or white), or age [19] have been shown in the ICD. This makes ICD a reliable anatomic dimension that may provide a valid approach to anterior tooth selection. Abdullah etal [19] reported the ratio of ICD (32.0 mm) to the width of maxillary anterior teeth (43.0 mm) to be 1:1.35; however, no correlations were calculated to determine the significance of the relationship. Furthermore, the relationship of ICD to the central incisor and interlateral dimension was not determined.

The interalar (IA) width, when measured in bone structure, the nasal width showed equal or nearly equal measurements to the width of the four maxillary incisors in 93% of the skull analysed[3]. However, when

measured in soft tissue, the IA width is not correlated to the width of the four maxillary incisors but rather to the width of the six maxillary anteriors[20-22].On the other hand, Smith, in 1975, found that neither the nasal width nor the IA related to the width of the six upper anterior teeth [23].

The curve distance between corners of the mouth (ICM), which supposedly represents the curve distance between the distal surfaces of the maxillary canine [24]. Previous studies [25] have attempted to evaluate the relationship between the corner of mouth and the distal of the canine but showed no significant relationship. However, most of studies were conducted in Caucasian population samples, with little noted about other races, in 1992 Johnson [26] pointed out that the knowledge of racial norms for facial appearance might aid practitioners, since the treatment given would be in harmony with the facial appearance for patients of different races. The purpose of this study is to evaluate the reliability of various facial measurements for selection of maxillary anterior teeth to achieve dental and facial esthetics.

MATERIAL AND METHODS

Dental student volunteers from the Faculties of Dentistry, *K.V.G .Dental College and Hospital*, were solicited by a written announcement to participate in the study. The study protocol was approved by the local Ethics Committee and Informed consent was obtained from all subjects prior to their participation.

The inclusion criteria of the subjects limited the cohort to those with Angle class I maxilla-mandibular relationship, natural maxillary teeth in good alignment, no restoration or tooth loss in the maxilla, and no history of orthodontic treatment. The exclusion criteria of the subjects included were interdental spacing or crowding and apparent loss of tooth structure, any congenital anomaly, orbital defect, trauma or facial surgery. The volunteers were examined by one of the investigators of the study. One hundred and sixty volunteers (100 women, 60 men) were chosen by drawing from the students who met the inclusion criteria. The ages of the subjects ranged between 19 and 24 year.

A digital vernier caliper with a 0.01-mm precision level (500-196-20, Mitutoyo Ltd, Kawasaki, Japan) to the nearest tenth of a millimeter was used for all the measurements (fig-1).

Fig-1: Digital vernier caliper

The ICD is defined as the distance between the median (inner) angles (canthi) of the palpebral fissure (fig-2). The external width of the alae of the nose was recorded at the widest point to establish the interalar width (fig-3). To measure ICM, Maxillary impressions were made on subjects using irreversible hydrocolloid impression material (Tulip, CavexHolland, Haarlem, Netherlands) and stock trays (Teknikdis Rostfrei, Istanbul, Turkey). The stone casts were obtained using ADA type III dental stone (Gilidur, FachbereichDental, and Ludwigshafen, Germany). Damaged stone casts were also excluded from the study. Two removable screens were fabricated with silicon, covering canine and extended on lateral incisor and first premolar. The location of corner of mouth was marked on buccal surface of screens with a pointer. The screens were removed from the mouth and positioned on the cast. The distance between the marks corresponding to the corner of mouth (CM) was measured using a dental tap placed at the greatest curvature of the arch. For each cast, the maximum Coronal widths of each of the maxillary anterior six teeth were measured with a digital caliper and added to give a total width for the six anterior teeth (fig-4). All measurements were recorded in mm.

Fig-2: Measurement of intercanthal distance

Fig-3: Measurement of interalar distance

Fig-4: Measurement of width of maxillary anterior teeth

RESULTS

The samples were divided according to gender and all facial parameters were recorded (table-1).According to table-1, SD was minimum for ICD, it indicate that ICD parameter is least deviated from its mean value than compare to other biometric parameters.

Individual anterior teeth were measured for all the samples and added to get the total mesiodistal width of six maxillary anterior teeth (Table-2 and Fig-5).

Pearson correlation test was done to see the relation between facial parameters and combined width of six maxillary anterior teeth (table-3). Correlation test also indicated consistency of ICD and suggested that ICD can be used as a guidance to select maxillary anterior teeth more reliably (Fig-6) As all the facial parameter were significantly related with combined width of six maxillary anterior teeth (table- 4). The p=0.007 for ICD indicate the consistency of ICD parameter.

When the ICD width was multiplied by 1.45(increased by 45%), it calculated that value was equal to the mesiodistal width of six maxillary anterior teeth.

Table-1: it showed mean and SD for various biometric facial measurements

Measurement		Maximum	mean	Minimum	SD
ICD	Male	38.94	32.52	27.84	2.13
	Female	36.77	31.93	26.55	2.13
	All	38.96	32.19	26.53	2.13
IA	Male	44.42	37.38	33.46	2.64
	Female	41.76	33.83	31.87	1.95
	All	44.45	35.17	31.81	2.87
ICM	Male	52.19	44.94	39.68	2.77
	Female	47.43	41.66	37.79	2.54
	All	52.15	42.95	37.76	3.27

Table-2: Mean and SD for central incisor, lateral incisor and canine. It also show the mean and SD for combined mesiodistal width of six maxillary anterior teeth

Measurement		Maximum	Mean	Minimum	SD
CI	Male	10.93	9.08	8.65	0.38
	Female	10.34	8.43	7.64	0.33
	All	10.92	8.72	7.65	0.42
LI	Male	6.69	7.23	8.53	0.43
	Female	6.37	6.93	7.92	0.45
	All	6.68	7.12	7.91	0.54
CA	Male	9.15	8.44	7.34	0.43
	Female	8.98	7.57	6.67	0.32
	All	9.14	7.73	6.68	0.41
CW	Male	53.44	48.54	43.36	2.23
	Female	51.85	45.65	41.75	1.82
	All	53.48	46.73	41.74	2.31

Table-3: PEARSON CORRELATION test to see the relation between facial parameters and combined width of six maxillary anterior teeth

Measurement	P value	Relation
ICD	<0.01	***1.1. (+)ve***
IA	<0.01	(+)ve
ICM	<0.01	(+)ve
CW	<0.01	(+)ve

Table-4: Paired-t test to evaluate the consistency of facial parameters

Paired-t test	ICD	IA	ICM	Combined width
P value	0.07	0.000	0.000	0.000

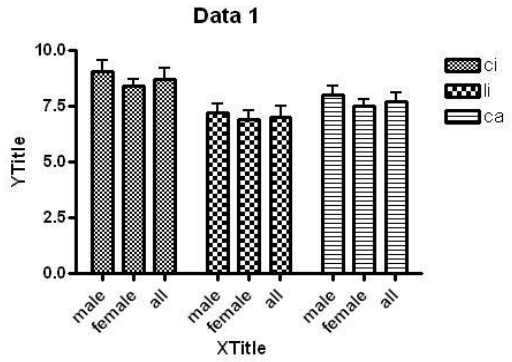

Fig-5: Mean and SD for central incisor, lateral incisor and canine. It also show the mean and SD for combined mesiodistal width of six maxillary anterior teeth

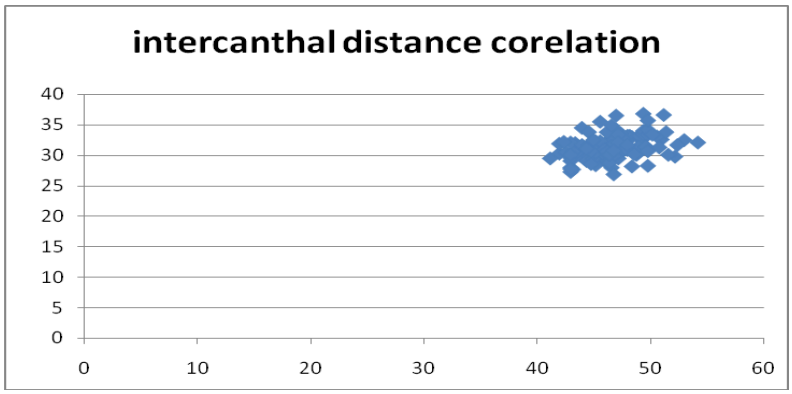

Fig-6: indicated consistency of ICD and suggested that ICD can be used as a guidance to select maxillary anterior teeth more reliably

DISCUSSION

The most influential factors contributing to a harmonious anterior dentition are the size, shape, and arrangement of the maxillary anterior teeth, particularly the maxillary central incisors as viewed from the front [27]. Lombardi was the first to emphasize the importance of order in dental composition, with a recurring ratio noted between all teeth from the central incisor to the first premolar. Levin [28] and, more recently, other authors [18, 27] indicated that the most harmonious recurrent tooth-to-tooth ratio was that of the ‘‘golden proportion’’. Conflicting reports indicate that the majority of beautiful smiles did not have proportions coinciding with the golden proportion formula [28-30]. Recently, the ‘‘recurring esthetic dental proportion’’ concept was introduced, stating that clinicians may use a proportion of their own choice, as long as it remains consistent, proceeding distally in the arch.

The ICD showed a mean of 32.19 mm, ranging from 26.53 to 38.96mm (Table-1). Abdullah found a mean of 28.30mm and Al Wazzan, measured from 25.00 to 39.00mm, with a mean of 31.92mm.This result is in contrast the range adopted as normal (from *28.00* to *35.00*mm) by Freihofer (Switzerland, in1980), while studying a sample of 100 subjects, ranging from 14 to 76 years of age.(6,21,23) The ICD showed correlation(rs- 0.466; *p = 0.000)*, both when associated to combined width of six maxillary anterior teeth(CW). Al Wazzan also has shown high probabilities of these structures being correlated. In this study also (+)ve correlation has found between ICD and CW(table-3).

The IA showed a mean of 35.17, ranging from 44.45 to 31.81(table-1). The IA was significantly correlated to CW (table-3). Mavroskoufis and Rltchie also found the IA and the distance between the tips of maxillary canines correlated.

The width of the nose, when measured in bone structure, showed equal or nearly equal measurements to the width of the four maxillary incisors-in 93% of the skulls analyzed. However, when measured in soft tissue, the IA is not correlated -to the width of the four maxillary incisors but rather to the width of the six maxillary anteriors [20, 22]. On the other hand, Smith, in 1975, found that neither the nasal width nor the IA correlated to the width of the six upper anterior teeth [23].

In this study mean of ICM was found 42.95, ranging from 52.15 to 37.76(table-1). Clapp and Tench published that the distal surfaces *of* the maxillary

canines should be located at the commissural of the mouth, but Al Wazzan and colleagues found no correlation between the width of the mouth and the mesiodistal width of the upper anterior teeth. After measurement they found that the mean value of 34.28 mm to the IA, 35.35 mm to the distance between tips of maxillary canine, and 44.85mm to the circumferential arch distance between the distal surfaces. Author concluded that when IA was multiplied by 1.31(or increased by 31%), the calculated value was equal to the circumferential arch distance between the distal surfaces of canine. When the IA width was multiplied by 1.03 (increased by 3%), the results was equal to the distance between the tips of maxillary canine.

Latta, Weaver, and Conkin, after measuring edentulous patients, found a mean of 53.74mm for ICM, ranging from *36.00* to*68.00* mm, with a significant difference relative to gender. Also, the ICM distance presented a higher value for males *(59.09mm)* than for females (54.83 mm).

The paired t-test showed (P=*0.07)*, indicating more consistent finding in ICD for male and female patients (table-4).

CONCLUSION

Within the limitation of this present study, the following conclusion were drawn-

- The dimensions of the maxillary central incisors and canines varied in men and women, with the lateral incisor exhibiting the greatest gender-based differences.
- All facial measurements ICD, IA and ICM correlated to the mesiodistal width of maxillary anterior teeth.
- The ICD was the only facial segment that did not show significant differences to gender(*P*=0.07)
- The ICD, when multiplied by a factor of 1.45 (or increased by 45%), can suggest the mesiodistal distance of six maxillary anterior teeth.

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