

# A comparative study to find out the relationship between the inner inter-canthal distance, interpupillary distance, inter-commissural width, inter-alar width, and the width of maxillary anterior teeth in Aryans and Mongoloids

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**Background:** One of the most confusing and difficult aspects of complete denture prosthodontics is the selection of appropriately sized maxillary anterior denture teeth. Various guidelines have been suggested for determining the size of anterior teeth, but different opinions have been reported regarding their significance. In the study reported here, the relationships between facial measurements and the width of maxillary anterior teeth in two ethnic groups, namely Aryans and Mongoloids, were determined.

**Objective:** The aims of the study were to determine the inner inter-canthal distance (ICAD), inter-pupillary distance (IPD), inter-commissural width (ICOW), inter-alar width (IAW), and the combined width of maxillary anterior teeth (CW) in Aryans and Mongoloids and to determine the relationships between these measurements.

**Materials and methods:** Impressions of the teeth of 170 dentulous subjects (85 males and 85 females) were made with alginate then Type IV gypsum product was poured in. Measurements of the cast maxillary anterior teeth at their widest dimension (contact areas) were made with the Boley gauge. ICAD, IPD, ICOW, and IAW distances were also measured with a Boley gauge.

**Results:** For all 170 subjects, 85 Aryans and 85 Mongoloids, Pearson's correlation coefficient ( $r$ ) for IAW, IPD, ICOW, ICAD, and CW was calculated. In Aryans, highly significant ( $P < 0.001$ ) but weak correlations were found between CW and IAW, IPD, and ICOW. In Mongoloids, a highly significant ( $P < 0.001$ ) and weak correlation was found only between CW and IPD.

**Conclusion:** Within the limitations of this study, the results suggest that the IAW, IPD, and ICOW for Aryans and IPD for Mongoloids can be used as a preliminary method for determining the width of the maxillary anterior teeth in edentulous patients.

**Keywords:** maxillary anterior denture teeth, facial measurements, maxillary anterior teeth width, Nepal

## Introduction

In Nepal, the population aged 65 years or above increased from 6.2% in 1971 to 8.4% in 2001.<sup>1</sup> This implies that the demand for restoration of edentulous patients will remain high for the foreseeable future. One of the most confusing and difficult aspects of complete denture prosthodontics is the selection of appropriately sized maxillary anterior denture teeth.<sup>2</sup> Various guidelines have been suggested for determining the size of the teeth, but different opinions have been reported regarding their significance.<sup>3,4</sup>

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The width of the teeth is considered by some authors to be more critical than the length.<sup>2,5,7-10</sup> Shillingberg<sup>6</sup> reported that the combined width of maxillary central incisors occupied 37% of the circumferential arch distance between the distal surface of the canines. The combined width of the lateral incisors and canines accounted for 31% and 32% of the distance, respectively.<sup>6</sup>

According to McArthur,<sup>10</sup> patients' own natural teeth are the best guides, and records of these should be obtained whenever possible. Whenever there are pre-extraction records such as casts, radiographs, facial photographs, and previous dentures, it becomes easy for the practitioner to select the teeth,<sup>11</sup> but when there are no pre-extraction records, the size of the denture tooth has to be determined by various guides. Over the past several decades, various methods and/or guides have been topics of controversy.<sup>12</sup> However, most of the studies regarding the selection of complete denture teeth were conducted in Caucasian population samples,<sup>13</sup> and findings have been extrapolated to other ethnic groups. So in the study reported here, we wanted to determine the relationship between facial measurements and the width of anterior teeth in two ethnic groups, namely Aryans and Mongoloids. The findings may be helpful in establishing the relationship between these facial measurements and maxillary anterior teeth, and compared with the findings for other races and ethnic groups.

## Materials and methods

This hospital-based prospective observational study was conducted in 170 dentate subjects in the Department of Prosthodontics, College of Dental Surgery, BP Koirala Institute of Health Sciences, Dharan, Nepal. Out of the 170 subjects, 85 (50%) were Aryans and 85 (50%) were Mongoloids. The age of the patients in this study ranged from 19 to 48 years. The mean age  $\pm$  standard deviation was  $23.60 \pm 5.39$  years. Most of the patients – that is, 112 patients (65.9%) – were in the age group 21–30 years followed by 46 patients in the age group of  $\leq 20$  years.

Inclusion criteria were  $>18$  years old; either Aryan or Mongoloid; born in Nepal; with an Angle Class I molar relationship, pleasing profile, and intact morphologically normal permanent dentition up to the second molar. Subjects with a history of orthodontic treatment; a Class II or Class III molar relationship; gingival inflammation and hypertrophy in the upper anterior region; severe attrition; crowns or proximal restorations placed in the anterior teeth; and a history of congenital anomaly, orbital disease, trauma, or facial surgery were excluded.



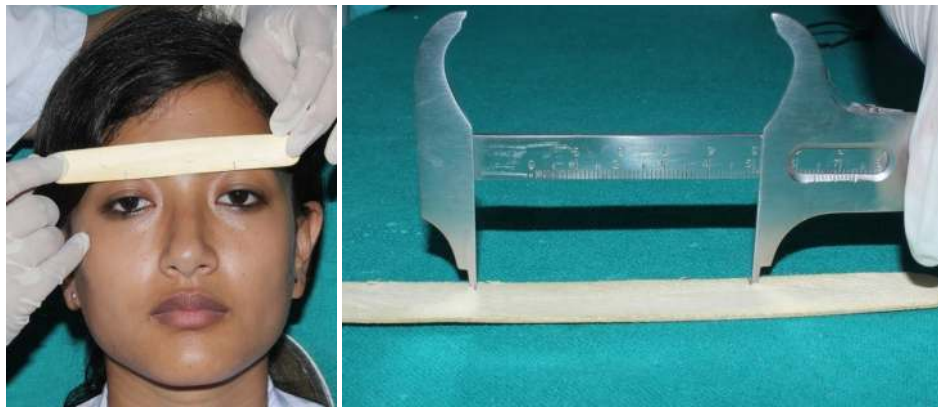
**Figure 1** Measurement of mesiodistal width of central incisor.

Approval for the study was obtained from Institutional Ethic Review Board BPKIHS, Dharan, on December 4, 2013. The subjects provided written informed consent. The study was conducted from December 2013 to July 2014.

The subjects were comfortably seated on a dental chair in a relaxed state in an upright position with the head resting firmly against the headrest. Maxillary impressions of selected subjects were made with an irreversible hydrocolloid impression material tray (Zelgan<sup>®</sup>2002 Dustfree Alginate Impression Material, DENTSPLY DeTrey GmbH, Konstanz, Germany)



**Figure 2** Measurement of inter-alar width.



**Figure 3** Measurement of interpupillary distance.

and poured into a Type IV die stone (Kalrock, Kalabhai Karson Pvt Ltd, Mumbai, India). The mesiodistal width of the maxillary anterior teeth was measured from the casts with a Boley gauge (Taurus 811-2, SS Medident Instruments [Pvt] Ltd, Sialkot, Pakistan) as shown in Figure 1.

### Determination of the combined width of the maxillary anterior teeth (CW), interalar width (IAW), interpupillary distance (IPD), inter-commissural width (ICOW), and inner inter-canthal distance (ICAD)

The IAW was measured as the distance between the widest points on the outer surface of the alae of the nose on either

side (Figure 2). For the measurement of IPD, the midpoint of the pupils was marked on a wooden tongue spatula (Figure 3). The ICOW was determined by measuring the maxillary lip vermilion from commissure to commissure (Figure 4). The ICAD was measured as a distance between the medial angle of the palpebral fissure of the eyes (Figure 5). Distances were measured using a Boley gauge without the application of pressure.

### Statistical methods

Collected data were entered into Microsoft® Excel 2007 software and converted into SPSS (version 11.5) for statistical analysis. Descriptive statistics were calculated (mean and standard deviation) and also tabular presentation was done. For inferential statistics, Pearson's correlation coefficient was



**Figure 4** Measurement of inter-commissural width.



**Figure 5** Measurement of inner inter-canthal distance.

applied to find out significant correlations between the groups at a 95% confidence interval, where  $P=0.05$ .

## Results

The mean values of CW, IAW, IPD, ICOW, and ICAD in Aryans and Mongoloids are presented in Table 1.

Pearson's correlation coefficients between CW, IAW, IPD, ICOW, and ICAD for the total population, Aryans, and Mongoloids are presented in Tables 2, 3, and 4, respectively. A highly significant but weak correlation between CW and IAW at the 0.001 level (two-tailed) was found in the total population and Aryans, and a significant correlation at the 0.05 level (two-tailed) was found in Mongoloids. A highly significant correlation between CW and IPD was found in the total population, Aryans, and Mongoloids at the 0.001 level. Pearson's correlation coefficient of CW and ICOW was found to be highly significant and negative in Aryans, while no correlation was found in the total population or Mongoloids. Significant correlation between CW and ICAD at the 0.05 level (two-tailed) was found in the Mongoloids and no correlation was found in the total population and Aryans.

## Discussion

Scandrett et al<sup>14</sup> evaluated bizygomatic distance, inter-alar width, inter-commissural width, sagittal cranial diameter, inter-buccal frenulum distance, philtrum width, and age as predictors of the width of the maxillary anterior teeth and central incisors. The investigators concluded that no single

predictor was accurate enough for clinical application. Therefore, it appears that more than one variable is needed to predict the width of the maxillary anterior teeth. So this study was conducted to determine the relationship of facial measurements, ie, ICAD, IPD, ICOW, and IAW of the maxillary anterior teeth.

In the study presented here, Pearson's correlation coefficient for CW and IAW was found to be weak, negative (except in Aryans), and highly significant at the 0.001 level in the total population and Aryans. A significant correlation at the 0.05 level (two-tailed) was found in Mongoloids. Ellakwa et al<sup>15</sup> found a weak relationship between IAW and CW, similar to our study, in which Pearson's correlation coefficient was 0.38 for the total population. Patel et al,<sup>15</sup> Wazzan et al,<sup>16</sup> Scandrett et al,<sup>17</sup> and Sinavrat et al<sup>18</sup> found no significant correlation between IAW and CW. Pearson's correlation coefficient for CW and IPD was found to be 0.439 at the 0.001 level (two-tailed) in our study. A highly significant correlation was found in the total population, Aryans, Mongoloids at the 0.001 level (two-tailed), which is contradictory to the finding of Wazzan et al<sup>16</sup> and Ellakwa et al,<sup>14</sup> who found no significant correlation.

We also found that Pearson's correlation coefficient for CW and ICOW was highly significant in Aryans at the 0.001 level (two-tailed). No significant correlation was found in the total population. Wazzan et al,<sup>16</sup> Hussain et al,<sup>19</sup> Scandrett et al,<sup>17</sup> Ellakwa et al,<sup>14</sup> and Sinavrat et al<sup>18</sup> similarly found no significant correlation between ICOW and CW.

**Table 1** Group statistics of CW, IAW, IPD, ICOW, and ICAD, comparing ethnicities

Ethnicity	N	Mean $\pm$ SD	Minimum–maximum	P-value	Remark
CW					
Aryan	85	46.95 $\pm$ 3.37	41.00–53.50	0.010	Significant
Mongoloids	85	45.54 $\pm$ 3.62	37.50–56.00		
IAW					
Aryan	85	40.56 $\pm$ 5.16	32.50–60.50	<0.001	Significant
Mongoloids	85	37.41 $\pm$ 4.83	21.00–48.00		
IPD					
Aryan	85	61.92 $\pm$ 5.85	46.00–75.00	<0.001	Significant
Mongoloids	85	57.50 $\pm$ 7.23	39.00–72.00		
ICOW					
Aryan	85	50.76 $\pm$ 6.34	30.00–61.10	<0.001	Significant
Mongoloids	85	45.82 $\pm$ 7.96	30.00–63.00		
ICAD					
Aryan	85	34.12 $\pm$ 5.10	24.00–56.00	0.370	Not significant
Mongoloids	85	33.49 $\pm$ 3.95	22.00–43.00		

**Note:** P-value significant at  $\leq 0.05$  level.

**Abbreviations:** CW, combined width of maxillary anterior teeth; IAW, inter-alar width; ICAD, inter-canthal distance; ICOW, inter-commissural width; IPD, interpupillary distance; SD, standard deviation.

**Table 2** Correlation matrix for combined width of maxillary anterior teeth (CW) with inter-alar width (IAW), interpupillary distance (IPD), inter-commissural width (ICOW), and inter-canthal distance (ICAD) in total population

Variable	Pearson's correlation coefficient value (P-value)				
	CW	IAW	IPD	ICOW	ICAD
CW	1	–	–	–	–
IAW	–0.201 (0.009)	1	–	–	–
IPD	0.439 ( $<0.001$ )	–0.033 (0.669)	1	–	–
ICOW	0.004 (0.958)	0.294 (0.000)	0.252 (0.001)	1	–
ICAD	0.146 (0.057)	0.170 (0.027)	0.018 (0.819)	–0.047 (0.544)	1

Note: P-value significant at  $\leq 0.05$  level.

Pearson's correlation coefficient for CW and ICAD was significant at the 0.05 level (two-tailed) in Mongoloids in our study, but no significant correlation was found in the total population or Aryans. Gomes et al<sup>20</sup> found a significant correlation of ICAD and CW to the combined mesiodistal width of six teeth using Spearman's rank correlation coefficient. They found Spearman's rank correlation coefficient for ICAD and IAW to be 0.232 and 0.205, respectively. Lucas et al<sup>21</sup> found correlation between ICAD and CW where the value of Pearson's correlation coefficient was 0.302 (P-value 0.006).

## Limitations

This study has several limitations. First, only two ethnic groups were included so the findings cannot be extrapolated to other ethnic groups. Second, the accuracy in determining the dimensions of teeth was compromised in two stages – one

**Table 3** Correlation matrix for combined width of maxillary anterior teeth (CW) with inter-alar width (IAW), interpupillary distance (IPD), inter-commissural width (ICOW), and inter-canthal distance (ICAD) in Aryans

Variable	Pearson's correlation coefficient value (P-value)				
	CW	IAW	IPD	ICOW	ICAD
CW	1	–	–	–	–
IAW	–0.342 ( $<0.001$ )	1	–	–	–
IPD	–0.380 ( $<0.001$ )	–0.119 (0.276)	1	–	–
ICOW	–0.337 (0.002)	0.411 ( $<0.001$ )	–0.356 ( $<0.001$ )	1	–
ICAD	0.071 (0.518)	0.087 (0.431)	–0.116 (0.291)	–0.104 (0.342)	1

Note: P-value significant at  $\leq 0.05$  level.

**Table 4** Correlation matrix for combined width of maxillary anterior teeth (CW) with inter-alar width (IAW), interpupillary distance (IPD), inter-commissural width (ICOW), and inter-canthal distance (ICAD) in Mongoloids

Variable	Pearson's correlation coefficient value (P-value)				
	CW	IAW	IPD	ICOW	ICAD
CW	1	–	–	–	–
IAW	–0.217 (0.046)	1	–	–	–
IPD	0.425 ( $<0.001$ )	–0.167 (0.127)	1	–	–
ICOW	0.136 (0.213)	0.056 (0.612)	0.501 ( $<0.001$ )	1	–
ICAD	0.218 (0.045)	0.256 (0.612)	0.111 (0.312)	–0.046 (0.673)	1

Note: P-value significant at  $\leq 0.05$  level.

during impression making and the other during cast making. This could have been avoided if the teeth were measured intra-orally but the patients' comfort would have been compromised. Facial measurements were done on soft-tissue landmarks and intra-operator variation in reading was observed with the same patients because of inconsistent pressure during measuring. A photographic method with calibration could have been used to avoid this problem.

## Conclusion

For all 170 subjects, Pearson's correlation coefficient for IAW, IPD, ICOW, ICAD, and CW were calculated for the total population, Aryans, and Mongoloids. Pearson's correlation coefficient for CW and IAW was found to be a highly significant but weak correlation at the 0.001 level (two-tailed) in the total population and Aryans. Pearson's correlation coefficient for CW and ICOW was found to be highly significant in Aryans at the 0.001 level (two-tailed). A highly significant correlation was found between IPD and CW in the total population, Aryans, and Mongoloids at the 0.001 level (two-tailed). For Aryans, IAW, IPD, and ICOW can be used to determine anterior teeth widths. For Mongoloids, IPD can be used to determine anterior teeth widths.

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## Disclosure

The authors report no conflicts of interest in this work.

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