Correlation of Inter-Canine Width of Maxillary Anterior Teeth with Interpupillary Distance and Inner Inter-Canthal Distance

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ABSTRACT

Introduction: The selection of proper sized maxillary anterior teeth poses a challenge and numerous efforts have been made to develop methods for estimating the inter-canine width of maxillary anterior teeth. In this clinical study, the objective was to investigate the correlation between interpupillary distance (IPD), inner inter-canthal distance (ICAD) and inter-canine width of maxillary anterior teeth (ICW).

Methods: 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. The parameters were measured using a digital caliper. To determine IPD, the midpoint of the pupils was marked and measured. Likewise, the width of ICAD was assessed by measuring between the medial angle of the palpebral fissure of the eyes. The inter-canine width of maxillary anteriors form the distal surface of left and right canines were measured with a dental floss, which was then sectioned and measured. Each parameter was measured thrice, and the average value was calculated and recorded.

Results: Mean IPD, ICAD and ICW were 60.8 mm, 31.5 mm and 49.7 mm respectively. Statistical analysis revealed a highly significant difference between IPD and ICW teeth of male and female respectively. Spearman's rho analysis showed statistically significant correlation between ICW and IPD (r=0.156, p =0.006). Similarly, Spearman's rho analysis in male group also showed statistically significant correlation between ICW and IPD (r= 0.374, p=0.00025).

Conclusion: This study concluded that there was significant correlation between interpupillary distance and ICW. The measurement of IPD can serve as a valuable reference for guiding the selection and placement of artificial maxillary anterior teeth.

Key words: Anterior Teeth, Complete Denture, Interpupillary Distance, Inter-Canine Width, Inter-Canthal Distance

INTRODUCTION

Achieving aesthetic outcomes during oral rehabilitation with dentures necessitates a primary focus on selecting the appropriate maxillary anterior teeth.[1-4] The task of selecting and positioning artificial teeth becomes challenging, especially in situations where pre-extraction records are unavailable.[1,4–6] Patient dissatisfaction and rejection of well-constructed, comfortable, and efficient dentures can frequently occur due to the improper selection of artificial teeth.[1,2,6]

During replacement of natural teeth, it is essential to carefully choose the appropriate size of anterior teeth to achieve optimal dentolabial relations that harmonize with the overall facial appearance.[1–8] Estimating the width of these teeth is often more challenging than determining their height.[9] Dental literature discusses the size and morphology of natural teeth, but there is a lack of consistent information available to assist in the selection of artificial teeth.[3,10]

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The aim of this study was to find a reliable mathematical relation between the IPD, ICAD and ICW, which can be used to select the suitable width of the maxillary teeth for those patients without pre-extraction records.

METHODS

It was a cross-sectional analytic study conducted in Kantipur Dental College and Hospital with the permission of IRC KDC Ref No 05/021 in June 2021, for duration of a month. Verbal consent was taken from the study population of 18-40 years old Nepalese population who visited outpatient Department of Kantipur Dental College and Hospital. Inclusion criteria were: patient >18 years old, with an Angle Class I molar relationship 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 and periodontal diseases; 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.

Sample size $(n) = \frac{2(Z_\alpha + Z_\beta)^2 s^2}{d^2}$

$Z\alpha$ = z deviate corresponding to the α error rate =1.96 for 95% reliability

$Z\beta$ = z deviate corresponding to the β error rate =1.28 at 90% power

s = standard deviation = (2.67+2.91)/2 = 2.79

d = mean difference between two groups = 32.94-31.91=1.03

n = sample size required per group = 154.2375 per group

N=2n=2*154.2375= 308.475

However, we included 310 patients in this study.

Measurements of the parameters were done using a digital caliper that has a fine-pointed end that fit interdentally. 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. For the measurement of interpupillary distance (IPD), the midpoint of the pupils was marked on a wooden tongue spatula and measured (Fig 1 and 2). The inner inter-canthal distance (ICAD) was measured as a distance between the medial angle of the palpebral fissure of the eyes (Fig 3). The inter-canine width of maxillary anterior teeth (ICW) was measured from the distal surface of left and right canines with a dental floss, which was then sectioned and measured (Fig 4 and 5). Each parameter was measured three times and the average value was computed and recorded. Collected data were entered into Microsoft® Excel 2007 software and converted into SPSS (version 11.5) for statistical analysis.

RESULTS

Statistical analysis using student t-test revealed a highly significant difference between interpupillary distance (IPD) of male and female (t-value = 4.31 and p =0.000023). However, did not show significant difference between the inter-canine width of maxillary anterior teeth (ICW) and inner inter-canthal distance (ICAD) of male and female respectively (t-value = 1.28 and p=0.728), (t- value = 0.964 and p =0.336).

Spearman's rho analysis showed statistically significant correlation between inter-canine width of maxillary anterior teeth (ICW) and interpupillary distance (r=0.156, p =0.006). However, showed statistically insignificant negative correlation between inter-canine width of maxillary anterior teeth (ICW) and inner inter-canthal distance (ICAD) (r= -0.017, p=0.766).

Similarly, Spearman's rho analysis in male group also showed statistically significant correlation between inter-canine width of maxillary

anterior teeth (ICW) and interpupillary (IPD) (r= 0.374, p=0.00025). However negative correlation between c inter-canine width of maxillary anterior teeth (ICW) and inner inter-canthal distance (r= -0.022, p=0.835) did not meet statistical significance in male group.

Moreover, Spearman's rho analysis in female group did not show statistically significant correlation between inter-canine width of maxillary anterior teeth (ICW) and both interpupillary distance (IPD) (r=0.022, p =0.749) and inner inter-canthal distance (ICAD) (r=-0.026, p =0.69).
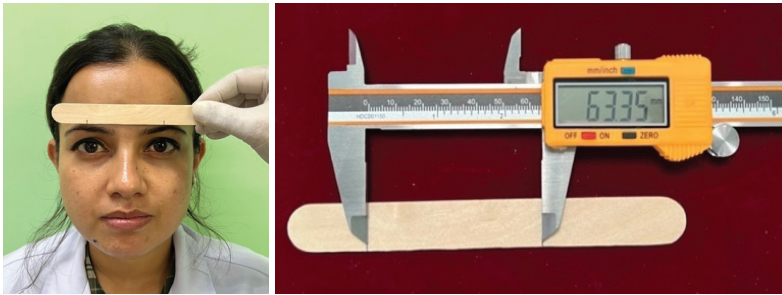

Figure 1 and 2: *Measurement of interpupillary distance.*

Figure 3: *Measurement of inner inter-canthal distance.*

Figure 4 and 5: *Measurement of inter-canine width of maxillary anterior teeth.*

Table 1: Facial and maxillary anterior teeth measurement

	Total (N=310)			Male (n=94)			Female (n=216)		
Parameters	**Minimum**	**Maximum**	**Mean (SD)**	**Minimum**	**Maximum**	**Mean (SD)**	**Minimum**	**Maximum**	**Mean (SD)**
Inter-canine width of maxillary anterior teeth (ICW)	37.93	60.02	49.7 (3.3)	38.12	60.02	50.5 (3.7)	37.93	58.8	49.36 (3.09)
Inner inter-canthal distance (ICD)	22	39.86	31.5 (3.2)	26.01	39.27	31.96 (2.8)	22.06	39.8	31.31 (3.3)
Interpupillary distance (IPD)	45.9	70.04	60.8 (3.9)	49.77	70.04	62.40 (3.8)	45.9	69.3	60.15 (3.8)

Table 2: Correlation between inter-canine width of maxillary anterior teeth (ICW) and both inner inter-canthal (ICAD) and interpupillary width (IPD)

Study population	Distance	Inter-canine width of maxillary anterior teeth	Inner inter-canthal	Interpupillary
Total (n=310)	Inner inter-canthal	-0.017	1	0.177
	Interpupillary	0.156	0.177	1
	Inter-canine width of maxillary anterior teeth	1	-0.017	0.156
Male (n=94)	Inner inter-canthal	-0.022	1	-0.045
	Interpupillary	0.374	-0.045	1
	Inter-canine width of maxillary anterior teeth	1	-0.022	0.374
Female (n=216)	Inner inter-canthal	-0.026	1	0.23
	Interpupillary	0.022	0.23	1
	Inter-canine width of maxillary anterior teeth	1	-0.026	0.022

DISCUSSION

In the present study, all the three dimensions were significantly larger in men than in women. This is consistent with previously reported studies. [1,11–16] The mean ICAD (31.5 mm) of all the subjects is similar with the values reported by Abdullah et al.[11] (32.0 mm), Freihofer[17] (31.2 mm), Al Wazzan et al.[1] (31.92 mm). The values are more than Laestadius et al.[18] (30.0 mm), Deogade et al.[19](26.22 mm) and less than Murphy and Laskin[20] (33.9 mm) as reported in their studies. The mean ICD was found to be higher in men (31.9 mm) compared to women (31.31 mm). The measurements being recorded in the population of different countries might be the reason for the variation in the values.

The mean IPD (60.8 mm) of all the subjects was similar with the values reported by Al Wazzan et al.[21] (60.92 mm) and Mishra et al.[22](59.71 mm) and more than Ellakwa et al. [23](62.01). The mean ICD was found to be higher in men (62.4 mm) compared to women (60.1 mm). The measurements being recorded in the population of different countries might be the reason for the variation in the values.

The mean ICW (49.7 mm) of subjects was higher than the values reported by Abdullah et al.[11] (42.0 mm), Freihofer[17] (31.2 mm),), Ibrahimagic et al.[15] (37.08 mm) Al Wazzan et al.[21] (45.16 mm), Al Wazzan et al.[1] (45.23 mm), Shillingburg et al.[24] (45.8 mm) and Hoffman et al.[13] (44.85 mm) but was smaller than the values reported by Scandrett et al.[25] (53.61 mm). The mean ICW in the present study supports the findings of Abdullah et al.[11](43.0 mm). The variation in the values can be attributed to the differences in measuring techniques and in the ethnicities of the population studied. The mean ICW in men (44.19 mm) was little higher than women (43.54 mm). This may be due to the differences in the size of the arch and teeth in the two genders as supported by Lieb et al.[26] To some extent, the variations may be explained by differences in measuring techniques and in the ethnicities of the populations studied.

The results showed that the mean IPD was higher in men compared with women and the difference between them was statistically significant (t-value = 4.31 and p =0.000023). Whereas, the difference between mean ICAD and ICW of men and women was not significant (t-value = 1.28 and p=0.728), (t- value = 0.964 and p =0.336) respectively.

Spearman's rho analysis showed statistically

significant correlation between inter-canine width of maxillary anterior teeth (ICW) and Interpupillary distance (r=0.156, p =0.006) in total population and specially in males (r= 0.374, p=0.00025). Similar results were obtained in the study done by Mishra et al.[22] and Shivhare et al.[27] but contradictory to the finding of Wazzan et al.[21] and Ellakwa et al.[23] who found no significant correlation.

However, the results of this study showed statistically insignificant negative correlation between inter-canine width of maxillary anterior teeth (ICW) and inner inter-canthal distance (ICAD) (r= -0.017, p=0.766). Similar results were obtained in the study done by Wazzan at al.[1], Ellakwa et al.[23] and Attokaran et al.[28]

CONCLUSION

The study's findings suggest that the interpupillary distance can be valuable guide for determining the width of maxillary anterior teeth but not the inner inter- canthal distance. Therefore, multiple parameters should be considered during selection of anterior teeth. However, the operator should keep in mind that the patient must always be involved in the decision-making for positive results. Final decisions about tooth selection should be made during the trial insertion stage of the denture and should be confirmed through consultation with the patient.

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