

Evaluation of the relationship between the inter-pupillary distance and mesiodistal width of maxillary anterior teeth in Nepalese population

Sapna Laxmi Tuladhar^{1*}, Pratik Manandhar¹, Neeta Thapa¹, Dilesh Pradhan², Umesh Parajuli³

¹Department of Prosthodontics and Maxillofacial Prosthetics, Gandaki Medical College Teaching Hospital and Research Center, Pokhara, Nepal, ²Department of Prosthodontics, Kathmandu Medical College, Kathmandu, Nepal, ³Department of Orthodontics, Teaching Hospital and Research Center, Pokhara, Nepal

ABSTRACT

Introduction: For pleasing aesthetic appearance, the maxillary anterior teeth must be in proportion to facial morphology. Among the different facial measurements used to determine mesiodistal width of maxillary anterior teeth, the inter-pupillary distance remains constant irrespective of age changes. The objective of this study was to determine the relationship between the inter-pupillary width and mesiodistal width of maxillary anterior teeth. **Methods:** This was a hospital-based cross sectional study conducted at outpatient department of College of Dental Surgery, Gandaki Medical College, Pokhara, Nepal. The study comprised of 199 participants of age group 18 to 35 years. The inter-pupillary distance and mesiodistal width from maxillary right canine to left canine (R3L3) were measured with a digital vernier caliper (Aero-space company, India) with accuracy of 0.01mm. Independent t-test was used to compare inter-pupillary distance and R3L3 between males and females while Pearson correlation was used to see the inter-relationship between these two parameters. Regression analysis was used to predict the mesiodistal width of right central incisor and R3L3. **Results:** The overall IPD was 66.09 ± 4.00 mm and R3L3 was 54.27 ± 4.47 mm. There were no significant differences in IPD and R3L3 in males and females. The IPD and R3L3 showed moderate positive correlation, $r=0.47$, p -value <0.001 . Prediction equation was calculated to predict the R3L3 and mesiodistal width of right central incisors. **Conclusions:** There was a positive correlation between inter-pupillary distance and mesiodistal width of maxillary six anterior teeth. Prediction equation will be useful to determine the mesiodistal width of the maxillary six anterior teeth based on inter-pupillary distance.

Keywords: Anterior teeth, central incisor, inter-pupillary distance, mesiodistal width.

*Correspondence:

Dr. Sapna Laxmi Tuladhar
Department of Prosthodontics and
Maxillofacial Prosthetics
Gandaki Medical College Teaching Hospital
and Research Center, Pokhara, Nepal
Email: drsapnalaxmituladhar@gmail.com

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INTRODUCTION

The human face plays an important role in defining individuality, identity, and personality. Esthetically and functionally successful restoration of teeth results in a positive effect on the patient's self-esteem and quality of life. Creating an aesthetically pleasing denture is always primary concern for prosthodontists. For pleasing aesthetic appearance, the maxillary anterior teeth must be in proportion to facial morphology.¹ A harmonious dentition of an individual has been found to be comprised of proper shape, size, and arrangement of maxillary anterior teeth. One of the most confusing aspects of complete denture prosthodontics is selection of appropriate sized maxillary anterior denture teeth.² According to McArthur,³ 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.³ Determination of the width of the maxillary anterior teeth for an edentulous patient becomes difficult in the absence of pre-extraction records.

Various techniques have been employed for selection of anterior teeth. These methods reveal a dependence on the physical characteristics of the dentofacial form. Facial landmarks such as bizygomatic width, circumference of head, facial height, inter-commissural width, inter-pupillary distance (IPD) and inter-alar width have been taken into consideration while deciding the mesiodistal dimensions of upper anterior teeth.⁴⁻⁷

There exists conflicting evidence in various techniques in the literature in selecting the tooth size.⁸ No universally accepted parameters currently exist for the selection of anterior teeth. Among the different facial measurements used to determine mesiodistal width of maxillary anterior teeth the IPD remains constant irrespective of age changes.⁹

Enough studies has not been done in Nepalese population to determine the mesiodistal width of maxillary anterior teeth base on facial measurements. The objectives of this study was to determine the mesiodistal width of central incisors amongst male and female, to determine the relationship between the inter-pupillary width and mesiodistal width of maxillary anterior teeth, if positively correlated to determine a regression equation to calculate the mesiodistal width of the anterior teeth and of right central incisor.

METHODS

This was a hospital-based cross-sectional study conducted at outpatient department of College of Dental Surgery, Gandaki Medical College from November 2022 to June 2023. The patients visiting outpatient department at College of Dental Surgery, Gandaki Medical College meeting the inclusion criteria were included in the study. Sample size calculation was based on 80% power and significance level of 5% and considering 0.50 as maximum tolerable error rate and based on standard deviation of 2.5. $N = [Z + (1 - \beta)]^2 \times SD^2 / L^2 = (1.96 + 0.84)^2 \times 2.5^2 / 0.5^2 = 196$, Where, Z=Confidence interval (95%, CI=1.96), β =probability of type II error=0.16, Standard Deviation=2.5, L= tolerable error=0.50, N=Sample size. The calculated sample size was 196; we had 199 samples in the study. The participants who were Nepalese, age group ranging between 18 to 35 years, class I molar and canine relationship, with full complement of teeth excluding third molars and without history of orthodontic treatment were included. The exclusion criteria were: dentition with artificial crown, restoration, attrition or spacing or missing on anterior teeth, defects in enamel or morphologically abnormal teeth, and patients with facial asymmetry. After receiving written consent, extra-oral and intra-oral examinations of subjects were done on dental chair with a mouth mirror and probe in an adequate illumination.

The subjects meeting the inclusion criteria were seated in a dental chair in the upright position. The inter-papillary distance and mesiodistal width of the maxillary right and left central incisor were measured with a digital vernier caliper (Aerospace company, India) with accuracy of 0.01mm. The mesiodistal width of six anterior teeth was measured from distal surface of right maxillary canine to distal surface of left maxillary canine with a brass wire and a digital vernier caliper. The measurements were done by a single examiner. To avoid examiner fatigue not more than ten subjects were examined in a day. The subject proforma was used to collect data. The data management was performed using Statistical Package for the Social Sciences (SPSS) software version 20.0. Independent t-test was used to compare IPD and mesiodistal width of maxillary anterior teeth between males and females. Pearson correlation was used to see the interrelationship between IPD and maxillary anterior teeth mesiodistal width. Regression analysis was used to predict the mesiodistal width of maxillary anterior teeth from right side canine to left side canine and mesiodistal width of maxillary central incisor from the IPD.

RESULTS

Out of 199 samples, 94 were males and 105 were female. The mean age of male samples was 24.46 ± 4.88 years, female was 23.76 ± 3.85 years. The mesiodistal width of right and left central incisor in male was 9.37 ± 0.70 mm and 9.43 ± 0.73 mm respectively. The mesiodistal width of right and left central incisor in female was 9.19 ± 0.63 mm and 9.18 ± 0.68 mm respectively. The overall IPD was 66.09 ± 4.00 mm and R3L3 was 54.27 ± 4.47 . The measurement of IPD and mesiodistal width of maxillary six anterior teeth (R3L3) has been tabulated in table 1. There were no significant differences in IPD and R3L3 in males and females (Table 1).

Table 1: Comparison of IPD and mesiodistal width maxillary anterior teeth (R3L3) between males and females

	Male(mm)	Female(mm)	p-value	CI
IPD	67.13 ± 4.06	65.15 ± 3.72	0.28	0.88-3.06
R3L3	54.92 ± 4.33	53.69 ± 4.53	0.89	-0.01-2.47

Independent t- test; level of significance p- value <0.05

The IPD and R3L3 showed moderate positive correlation ($r=0.47$), which was found to be statistically significant. (p -value <0.001) (Table 2).

Table 2: Inter-relationship between IPD and mesiodistal width of maxillary anterior teeth (Pearson correlation)

	IPD	R3L3	p-value
IPD	1	0.472	<0.001*

* $p < 0.05$ signifies statistical significance

The results of linear regression and derivation of equations to predict the R3L3 and width of right central incisors has been shown in table 3 and 4. The mesiodistal width of maxillary anterior teeth as derived from IPD with regression equation was 54.89 mm and 53.69 mm for male and female respectively. Similarly, mesiodistal width of right central incisor from inter-pupillary distance was 9.37 mm in male and 9.17 mm in female.

Table 3: Regression equation to determine mesiodistal width of maxillary anterior teeth from inter-pupillary distance (R3L3)

	Regression equation	R3L3(mm)
Overall(male and female)	$Y=0.378 \times \text{IPD}(66.09)+29.26$	54.24
Male	$Y=0.163 \times \text{IPD}(67.13)+43.95$	54.89
Female	$Y=0.575 \times \text{IPD}(65.15)+16.23$	53.69

Table 4: Regression equation to determine mesiodistal width of right central incisor from inter-pupillary distance

	Regression equation	Right Central incisor(mm)
Overall(male and female)	$Y=0.028 \times \text{IPD}(66.09)+7.403$	9.25
Male	$Y=0.023 \times \text{IPD}(67.13)+7.831$	9.37
Female	$Y=0.0255 \times \text{IPD}(65.15)+7.537$	9.17

DISCUSSION

The selection of size of anterior teeth in complete denture treatment is very important to give good esthetics to patient. When we don't have the pre-extraction records it becomes challenging to select the teeth size.^{4,5}

Various anthropometric parameters can be considered to derive the width of maxillary anterior teeth but not all are accurate. Anthropometric measurements like inter-alar distance, inter-commissural distance, inter-zygomatic distance are age-related and affected by tonicity and thickness of soft tissue.¹⁰ The IPD is relatively constant.⁸

In this study there was no significant difference between male and female in IPD and R3L3. Mishra et al.⁶ found ethnic variation in IPD and R3L3 amongst Aryan and Mongoloids in eastern Nepal. In the same study the IPD was 61.92 mm in Aryans and 57.50 mm in Mongoloids while it was 66.09 mm in our study. Similarly, the R3L3 was 46.95 mm in Aryans and 45.54 mm in Mongoloids while it was 54.27 mm in our study. These differences could be attributed to the differences in measurement methodologies and variation of ethnicity. Mishra et al.⁶ in a study done in Nepalese population showed weak correlation between intra-alar width and R3L3 but a strong correlation between IPD and R3L3. Our study was in unison with this study, with moderate correlation between them. Similar findings were observed in Bangladeshi population.¹¹ On contrary, Wazzan

et al.¹² and Ellakwa et al.¹³ found no significant correlation between these measurements.

The present study had done a linear regression and derived an equation to determine the mesiodistal width of maxillary six anterior teeth and right central incisor. The mesiodistal width of maxillary anterior teeth as derived from IPD with regression equation was 54.89 mm and 53.69 mm for male and female respectively. In a study by Rathanchand et al.⁷ the mesiodistal width of maxillary anterior teeth as derived from IPD was 42.90 mm and 55.99 mm for male and female respectively. There was differences seen in derivation of mesiodistal width of right central incisor as well; in our study it was 9.37 mm in male and 9.17 mm in female while in the study by Rathanchand et al.⁷ it was 9.20 mm for male and 8.73 mm for female. These differences could be attributed to the measuring techniques and ethnic variations in the studies.

The limitation of the study is that ethnicity of the samples had not been considered. We recommend further studies in different ethnicities of Nepal. Further studies can be done to observe the esthetics achieved in complete denture patients in whom the selection of anterior teeth could be done based on the prediction equation determined by this study.

CONCLUSIONS

There was positive correlation between IPD and mesiodistal width of maxillary six anterior teeth.

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