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Determination of Maxillary and Mandibular Arch Width in Angle's Class I Patients

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ABSTRACT

Introduction: The transverse dimension plays a key role in smile. Maintaining the pretreatment arch form is a key to obtaining stable results.

Objectives: The main aim of this study was to determine mean intercanine arch width and mean intermolar arch width in Angle's class I patients.

Methods: Seventy-six pretreatment casts were obtained from the records of patients who sought orthodontic treatment in Orthodontics and Dentofacial Orthopedics. Four parameters were used in this study namely; intercanine arch width and intermolar arch width in maxilla and mandible. Linear measurements were carried out with digital caliper. Kappa test was done for intra-observer reliability. Shapiro-Wilk test was done to determine the normal distribution of data. The Pearson Correlation test was done to assess the correlation between intercanine and intermolar arch width in maxilla and mandible. The independent t-test was used to compare between intercanine and intermolar arch width with male and female.

Results: Mean intercanine arch width in maxilla and mandible were 35.41±1.47 mm and 26.85±1.59 mm respectively. Mean intermolar arch width in maxilla and mandible were 53.82±2.82 mm and 51.71±2.60 mm respectively. Statistically significant difference was found between intercanine and intermolar arch width in maxilla and mandible between male and female. The intercanine and intermolar arch width in maxilla and mandible has significantly low correlation.

Conclusions: Intercanine and intermolar arch width in male and female were statistically significant and male has lager intercanine and intermolar arch width than female.

Keywords: Angle's Class I; arch width; intercanine; intermolar.

INTRODUCTION

The transverse dimension plays a key role in smile.[1-3]

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Intercanine and intermolar arch-width varies according to population under study and type of malocclusion.[4] When intercanine and intermolar width had been changed during orthodontic treatment there was strong tendency for these teeth to return to pre-treatment position.[5] Intercanine arch width in mandible should not be changed more than 1 mm except for some cases as lingually placed canine.[6,7] Intercanine arch width should not be changed more than 0-

1mm and intermolar arch width from 3 mm.[7] Many studies have noted difference in arch width measurement at canine and molar areas in different population.[7,8]

This study was aimed to determine mean intercanine arch width and mean intermolar arch width in Angle's class I patients. The secondary aims were to compare difference in intercanine and intermolar arch widths and determine correlation between intermolar and intercanine arch width in Angle's class I male and female samples of the study. The null hypothesis of the study was: there is no difference between intercanine and intermolar arch width between male and female samples of the study.

METHODS

This is a cross sectional observational study. Minimum sample size of 64 was required at 88% power of study and prevalence of Class I occlusion as 59% (Shrestha et al., 2012).[9] The power of study was set at 88% as the normal class I malocclusion samples seeking orthodontic treatment are difficult to enroll due to small number of samples seeking treatment and the duration of study was short. Convenience method of sampling was used to select the samples in the study meeting the inclusion criterion. The study was conducted from 2018 to 2019. Sample consists of seventy-six pairs of casts of Nepali adult patients with age range of 13-30 years (mean age of 18.5±3.49 years) from Orthodontics and Dentofacial Orthopedic Unit, Department of Dentistry, Tribhuvan University Teaching Hospital, Kathamandu, Nepal.

The samples were divided into two groups; maxillary and mandibular with equal number of male and female samples in each group. The ethical clearance for this study was approved by the Institutional Review Committee, Institute of Medicine, Kathamandu, Nepal. (Ref: 232(6-11-E)2/075/076.

Study cast with presence of all permanent teeth from first molar to first molar, upper and lower first molar fully erupted, good quality casts, canine within arch, no tooth agenesis or extraction, no large restoration or malformed teeth and mild crowding (< 3 mm). Exclusion criteria were previous orthodontic treatment, moderate to severe crowding, rotated canine or first permanent molar, pathology involving cusp tip, presence of deciduous, missing or ectopically erupted teeth and craniofacial anomalies or cleft lip and/or palate.

Angle's Class I occlusion group with molar and canine Class I in centric occlusion, normal overjet, normal overbite, with none to mild crowding and well aligned teeth in the arch were included. All the measurements were made with digital vernier caliper measuring within 0.01 mm (Precise Digimatic Vernier", Model PRECISE ECO Series No. 03148927 South, India. The measurements were done as Maxillary intercanine width (ICW-Mx) is the distance from cusp tip of permanent maxillary right canine to permanent maxillary left canine Figure 1(a); Mandibular intercanine width

(ICW-Md) is the distance from cusp tip of permanent mandibular right canine to permanent mandibular left canine Figure 1(b); Maxillary intermolar arch width (IMW-Mx) is the distance from mesiobuccal cusp of permanent maxillary right first molar to permanent maxillary left first molar Figure 1(a) and Mandibular intermolar arch width (IMW-Md) is the distance from mid of buccal groove of permanent mandibular right first molar to permanent mandibular left first molar Figure 1(b).

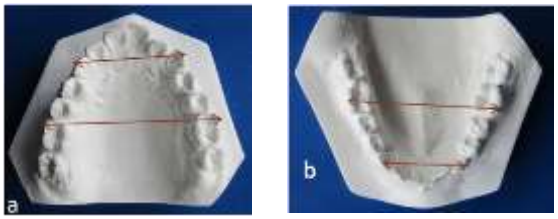

Figure1: Landmarks used for measurements of (a) ICW-Mx & IMW-Mx; (b) ICW-Md & IMW-Md

The data collected were exported to Excel 2010 software (Microsoft, Redmond, Wash) for analysis. The Statistical package for social science (SPSS Inc.V.26R, Chicago, Illinois, USA) was used for statistical analysis. Shapiro Wilk test was used to find the normality of data. Intraclass correlation coefficient was calculated to assess the intrapersonal reliability. Descriptive statistics were used to calculate mean, maximum, minimum, range and standard deviations. A Kappa measure of agreement was used to assess the intraobserver reliability. Shapiro-Wilk test was done to determine the normality of the data. Pearson correlation coefficient was calculated to determine correlation between maxillary ICW-Mx and IMW-Mx; and mandibular ICW-Md and IMW-Md. Differences in maxillary and mandibular arch width between males and females were tested using independent t-tests. P values < 0.05 were considered significant.

RESULTS

Shapiro Wilk test showed normally distributed data. To assess intraexaminer reliability, 25% of casts were measured again after two weeks. The intraclass correlation coefficients were .93 to 1 which showed excellent correlation. Dalhberg errors for linear measurement were 0.3 to 0.49 mm for all the measurements. Table 1 summarizes the mean, standard deviation, minimum, maximum and range of intercanine and intermolar arch width in maxilla and mandible. Variation in ICW-Mx was least in maxillary arch and variation in intermolar arch width was maximum in maxilla. Table 2 summarizes the mean and standard deviations of intercanine and intermolar arch width in maxilla and mandible. Table 3 summarizes the comparisons of intercanine and intermolar arch width between males and females. All the measurements are greater in male than female samples. The correlation between intercanine and intermolar arch width in maxilla and mandible was low with Pearson Correlation coefficient of .434 in maxilla and .341 in mandible.

Table 1: Mean and standard deviation for linear variables (ICW-Mx, ICW-Md, IMW-Mx, IMW-Md) for all the subjects

	N	Range	Minimum	Maximum	Mean	Std. Error	Std. Deviation	Variance
Intercanine Arch width in Maxilla	36	6.03	32.25	38.28	35.4114	.24660	1.47959	2.189
Intercanine Arch width in Mandible	36	7.01	23.89	30.90	26.8544	.26610	1.59660	2.549
Intermolar Arch width in Maxilla	36	10.39	48.65	59.04	53.8200	.47004	2.82023	7.954
Intermolar Arch width in Mandible	36	10.95	45.23	56.18	51.7147	.43381	2.60284	6.775
Valid N (list wise)	36							

SD= Standard Deviation

Table 2: Linear measurements ICW-Mx, ICW-Md, IMW-Mx and IMW-Md in male and female

			Statistic	Std. Error
Intercanine Arch width in Maxilla	Female	Mean	34.4822	.30842
		Std. Deviation	1.30850	
	Male	Mean	36.3406	.23175
		Std. Deviation	.98322	
Intercanine Arch width in Mandible	Female	Mean	26.2806	.32966
		Std. Deviation	1.39862	
	Male	Mean	27.4283	.37967
		Std. Deviation	1.61078	
Intermolar Arch width in Maxilla	Female	Mean	52.5650	.62192
		Std. Deviation	2.63859	
	Male	Mean	55.0750	.58108
		Std. Deviation	2.46531	
Intermolar Arch width in Mandible	Female	Mean	50.5278	.66699
		Std. Deviation	2.82982	
	Male	Mean	52.9017	.40529
		Std. Deviation	1.71952	

Table: 3 Independent Sample t-test for ICW-Mx, ICW-Md, IMW-Mx and IMW-Md with gender male and female

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Intercanine Arch width in Maxilla	Equal variances assumed	2.317	.137	-4.817	34	.000	-1.85833	.38578	-2.64233	-1.07433
	Equal variances			-4.817	31.557	.000	-1.85833	.38578	-2.64458	-1.07209

	not assumed									
Intercanine Arch width in Mandible	Equal variances assumed	.003	.956	-2.283	34	.029	-1.14778	.50281	-2.16962	-.12594
	Equal variances not assumed			-2.283	33.344	.029	-1.14778	.50281	-2.17036	-.12520
Intermolar Arch width in Maxilla	Equal variances assumed	.039	.845	-2.949	34	.006	-2.51000	.85114	-4.23972	-.78028
	Equal variances not assumed			-2.949	33.844	.006	-2.51000	.85114	-4.24002	-.77998
Intermolar Arch width in Mandible	Equal variances assumed	2.030	.163	-3.042	34	.005	-2.37389	.78048	-3.96001	-.78777
	Equal variances not assumed			-3.042	28.048	.005	-2.37389	.78048	-3.97250	-.77528

DISCUSSION

Sinclair and Little's method of measuring arch width was used in this study.[10] Age above 13 years in female and 16 years in male was included in the study as intercanine and intermolar arch widths showed minimal change after age 13 years in female subjects and age 16 years in male subjects.[11-15]The size and shape of the maxillary and mandibular arches have considerable

implications in orthodontic diagnosis and treatment planning affecting the space available, dental esthetics and stability of and periodontal health of dentition.[7,13] Dental arch size and arch form vary among different individuals according to tooth size and position craniofacial growth

pattern, genetic, environmental, function, ethnicity, etc. [16,17]

In this study normal Angle's class I occlusion is defined as class I molar and canine relationship with overjet less than 4 mm, overbite less than 40% and crowding and spacing less than 3 mm with no crossbite, no openbite, and no midline shift. Though crowding and spacing might affect the measurement and determination of intercanine and intermolar arch width it has been found that some degree of crowding is acceptable and patients without crowding are difficult to find and many studies have been conducted considering same or more amount of crowding in the literature some of which include study by Robert N. Staley et al., (1985)[18], Peter Buschang (2009)[19], Ala Rastegar-Lari T (2012)[20], Islam MM (2012)[21], Dolly Patel (2015)[22]for similar measurements in their sample population. So in this study, crowding or spacing of less than 3 mm was accepted as

normal occlusion. The crowding and spacing was measured as arch length tooth material discrepancy.

In the present study the mean intercanine arch width in maxilla was 35.41±1.47 mm which was similar to study by Akan et al.,[23] Ahmed,[8] Shu et al.,[4]Staley et al.,[18] Study by Hossein and Mostafavi et al.,[24] Rastegar-Li et al.,[20] TancanUsyal. et al.,[25] Van der Liden et al.,[26] and Hassim et al.,[27] found smaller intercanine compared to the present study. The mean intercanine arch widths in maxilla in this study were 34.48±1.30 mm and 36.34±0.98 mm respectively for female and male. The mean intercanine arch width in maxilla for male and female in a study by Staley et al.,[18] Dolly Patel et al.,[22] Bishara et al.,[28] Islam and Hossain[21] Martina Slaj et al.,[29] and Rastegar-Li et al.,[20] which shows males have significantly larger intercanine arch width than females.

The mean intercanine arch width in mandible was 26.85±1.59 mm. Many studies have shown similar results to present study Staley et al.,[18] Moorrees et al.,[14] in Caucasians (American), Van der Liden et al.,[26] Akan et al.,[23] Hassim et al.,[27], RM. Shrestha[30], Rastegar-Li et al.,[20] and TancanU. et al.,[25] which is in accordance with this study, Hossein and Mostafavi et al.,[24] Shu et al.,[4] Luca Lombardo et al.,[31] and Muge Aksu and IlkenKocadereli,[32] which in contrast to this study were larger than the present study. The mean intercanine arch width in mandible in this study were 27.42±1.61 mm and 26.28±1.39 mm respectively for male and female in mandible similar findings were found in their study on intercanine arch width in mandible for male and female in a study by Staley et al.,[18] Dolly Patel et al.,[22] Bishara et al.,[28] Martina Slaj et al.,[29] RM Shrestha,[30] and Rastegar-Li et al.,[20] which also showed males have larger Intercanine arch width in mandible than the females.

The mean intermolar arch width in maxilla was 53.82±2.82 mm when measured at mesiobuccal cusp tip of maxillary first molar. Staley et al.,[18] which were in accordance with the present study. Greater mean intermolar arch width in maxilla than in current study was found in study by Shu R et al.,[4] Luca Lombardo et al.,[31], MugeAksu and IlkenKocadereli.[32] In the present study the intermolar arch width in maxilla were 55.07±2.46 mm and 52.56±2.63 mm respectively in male and female which were statistically significant difference between male and female. Study by Staley et al.,[18] Dolly Patel et al.,[22] Bishara et al.,[28] support that the intermolar arch width in maxilla were greater in males as compared to females as found in the present study.

The intermolar arch width measured at mid of buccal developmental groove in mandible at first molar mandible was 51.71±2.60 mm similar finding was reported by Tancan U. et al.,[25] Akan et al.,[23] Rastegar-Li et al.,[20] and RM. Shrestha[30]. In contrast, many studies have reported smaller arch width than the present study by Shu et al.,[4] Hossein and Mostafavi et al.,[24] Muge Aksu and IlkenKocadereli.[32] The mean intermolar arch width in this study was 52.90±1.371 mm and

50.52±2.82 mm respectively for male and female in mandible similar to study by Staley et al.,[18] Dolly Patel et al.,[22] Bishara et al.,[28] Islam and Hossain[21] and Martina Slaj et al.[27]

The arch width measured in this study in different Angle's Classes of malocclusion will help the clinician in diagnosis, planning of treatment of patients with different malocclusion, in choosing and stocking preformed archwires, impression trays, size of artificial teeth.[25] Pretreatment intercanine and intermolar arch width is important factor and should be considered during all phases of treatment. The main limitation of the study was that it was conducted in a single center with small number of samples in only normal class I malocclusion group.

CONCLUSIONS

The intercanine and intermolar arch width in maxilla and mandible in male and female were statistically significant with males having greater measurement than females. There was statistically low correlation between intercanine and intermolar arch width in maxilla and mandible in male and female.

Conflict of Interest: None.

NJHS

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