Evaluation of Dental Arch Widths In Different Malocclusion Groups

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ABSTRACT

Introduction: Information regarding dental arch dimensions in human populations is important in different specialties including orthodontics. Arch shape and size affect stability of the dentition and plays important role in diagnosis and treatment planning.

Objective: The purpose of this study was to evaluate differences in dental arch morphology among different malocclusion groups.

Materials and Method: The sample consisted of 180 pretreatment orthodontic study casts. The subjects were classified into three groups according to Angle's classification of malocclusion with each group consisting of 60 pairs of samples. Inter-canine width, inter-premolar width, inter-molar width, and intra-alveolar width were measured in each dental cast using digital caliper. ANOVA test followed by post-hoc Tukey test were done to compare among the different groups of malocclusion. Ratio of inter-molar to inter-canine width was also calculated and compared with the Williams' ratio.

Result: Arch width measured at ten different locations were found to be significantly larger in Class III samples, followed by Class I and Class II malocclusion groups except maxillary inter-alveolar width, mandibular inter-molar width and mandibular inter-alveolar width which were found to be least in Class I samples. Inter-molar to inter-canine width ratios were approximately 13:9 in upper arch and 15:9 in lower arch in Class I samples.

Conclusion: Significant difference was observed in arch widths among different malocclusion groups. Inter-molar to inter-canine ratio was found to vary in Nepalese samples as compared to Caucasian norms. Maintaining these newly devised ratios in orthodontic treatment would ensure stability.

Keywords: Alveolar width; arch width; dental arch; malocclusion; ratio.

INTRODUCTION

Arch dimensions are important in orthodontic diagnosis.[1] Shape of the dental arch results from genetic and environmental influences during growth, which vary individually.[2,3] Treatment considerations like expansion and extraction are largely determined by pre-treatment arch dimensions.[4,5] Arch dimensions of different malocclusions assist in reaching predicted structural, functional and aesthetic outcome.[6]

Considerable variations occur in arch widths among different malocclusion groups.[7] Staley et al found larger maxillary widths in normal occlusion than in subjects with malocclusion.[8] However, Patel et al found widest mandibular arch in Class III malocclusion, and narrowest maxillary arch in Class II malocclusion.[9] Kumari found significantly wider arch widths in Class III and Class I malocclusions than Class II group.[10]

Williams suggested 'inter-molar width to inter-

canine width ratio' as 14:9; which must be maintained for a stable dental arch. In case of narrow arches, expansion shall take place at cuspid region with a corresponding amount of expansion on molars.[11]

Data on arch form, arch width and circumference are available on Nepalese;[3,12–14] however studies comparing the arch widths among malocclusion groups are scarce. Hence this study attempts to compare inter-canine, inter-premolar, inter-molar and inter-alveolar widths among malocclusion groups. The ratios between inter-canine and inter-molar widths are also devised.

MATERIALS AND METHOD

An observational, descriptive cross-sectional study was carried out on dental casts of patients seeking orthodontic treatment at Kantipur Dental College, Kathmandu, Nepal. The study was carried out during September 2019-January 2020 after getting ethical approval from Institutional Review Committee.

Measurements were done on pre-treatment maxillary and mandibular casts of the subjects aged 14-35 years. The sample was classified into three groups according to Angle's Classification of malocclusion as Class I, Class II (including division 1 and division 2) and Class III malocclusion.

Sampling technique used was convenient, non-probability sampling. Sample size was calculated with reference to the study done by Baral,[15] according to following formulae: $n = (z^2pq)/L^2$ where z = 1.96 from probability table when sample are normally distributed, p (prevalence of malocclusion)[15] = 0.04, q = 0.96, L (precision of the estimate) = 0.05. According to the above formula, n = 59. Hence we took 60 samples in each group of malocclusion, and the total sample was 180.

Inclusion criteria were: Dental casts with Class I, II or III canine and molar relations, presence of all permanent teeth (excluding third molars), without any history of trauma, without previous orthodontic or prosthodontic treatment. Exclusion criteria were: damaged casts, duplicated casts, cleft lip/palate cases or syndromic patients. The clinical conditions were learnt from patient's corresponding case record.

Measurements were taken for inter-canine width, inter-premolar widths, inter-molar width, and intra-alveolar width using digital caliper up to the nearest 0.01 mm with reference to Burris and Harris method.[16] A total of ten measurements were made on maxillary and mandibular dental arches.

Following measurements were made as demonstrated in Figure 1 and Figure 2:

1. Inter-canine width (ICW): Distance between cusp/incisal tips of canine or estimated cusp tips in cases of wear facets.
2. First inter-premolar width (IPW1): Distance between buccal cusp tips of first premolar or estimated cusp tips in cases of wear facets.
3. Second inter-premolar width (IPW2): Distance between buccal cusp tips of second premolar or estimated cusp tips in cases of wear facets.
4. Inter-molar width (IMW): Distance between mesio-buccal cusp tips of first molar or

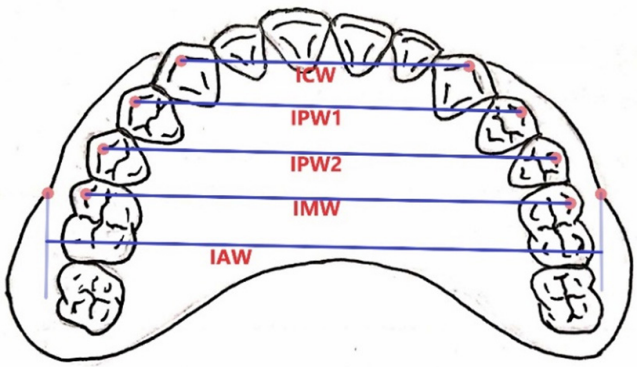

Figure 1: Arch widths and alveolar width in maxillary arch.

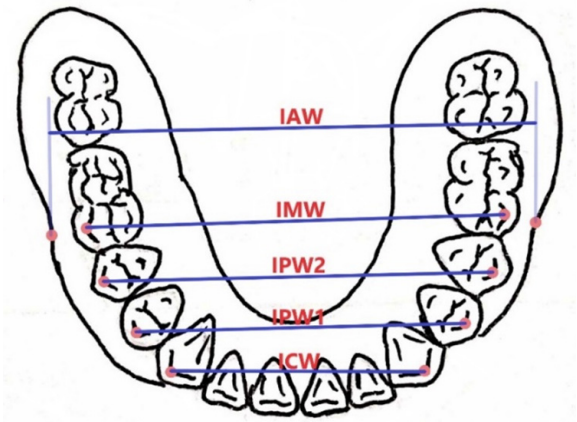

Figure 2: Arch widths and alveolar width in mandibular arch.

estimated cusp tips in cases of wear facets.

5. Inter-alveolar width (IAW): Distance between two points at the mucogingival junctions above the mesio-buccal cusp tip of first molars

Ratio between inter-molar width (IMW) and inter-canine width (ICW) was calculated in both maxillary and mandibular arches by dividing the inter-molar width by inter-canine width according to William's ratio.[11]

Twenty percent of the total samples were randomly selected and arch dimensions were re-measured after seven days from the initial measurement to check the intra-examiner variation. Statistical analysis was done using SPSS software Version 21. Data was normally distributed as checked with Kolmogorov-Smirnov test.ANOVA test followed by post-hoc Tukey test were performed to check the difference in arch dimensions among different groups of malocclusions. Statistical level was set at $p \leq 0.05$ for significance.

RESULT

Kappa test showed perfect intra-observer agreement for all measurements as kappa value for each measurement was above 0.75.

Comparison of maxillary arch widths among skeletal malocclusions showed significant difference in all variables(Table 1). Post hoc Tukey test showed that the parameters ICW, IPW1 and IPW2 were significantly different between Class I and Class II, Class II and Class II whereas IMW and IAW were significantly different between Class I and Class III, Class II and Class III samples (Table 2).

Comparison of mandibular arch widths among skeletal malocclusions showed significant difference in all variables except ICW (Table 3). Post hoc Tukey test showed that the parameter IPW1 was significantly different between Class II and Class III, IPW2 was significantly different between Class I and Class II, Class II and Class III, and IMW and IAW were significantly wider

Table 1: ANOVA test for maxillary arch widths among malocclusion groups (mm).

Parameter		Class I		Class II		Class III		f-Value	p-Value
		Mean	SD	Mean	SD	Mean	SD		
Maxillary	ICW	34.86	2.68	33.05	4.23	35.19	3.12	6.86	0.001*
	IPW1	41.64	3.41	39.18	3.52	42.51	3.71	14.15	0.000*
	IPW2	47.26	2.91	44.74	3.64	48.28	4.02	15.71	0.000*
	IMW	49.80	4.42	49.12	3.41	54.21	3.97	29.27	0.000*
	IAW	54.19	4.03	54.44	3.41	59.05	4.73	32.77	0.000*

Table 2: Post hoc Tukey test for significantly different parameters of maxillary arch

Parameter		Class I vs Class II	Class I vs Class III	Class II vs Class III
Maxillary	ICW	0.011*	0.857	0.002*
	IPW1	0.001*	0.379	0.000*
	IPW2	0.000*	0.258	0.000*
	IMW	0.615	0.000*	0.000*
	IAW	0.940	0.000*	0.000*

Table 3: ANOVA test for mandibular arch widths among malocclusion groups (mm).

Parameter		Class I		Class II		Class III		f-Value	p-Value
		Mean	SD	Mean	SD	Mean	SD		
Mandibular	ICW	26.16	2.34	25.86	3.83	26.71	2.86	1.16	0.316
	IPW1	34.46	2.51	33.41	4.48	35.06	3.93	3.00	0.052*
	IPW2	39.81	3.14	37.96	4.81	40.62	3.39	7.46	0.001*
	IMW	42.36	3.88	43.39	2.92	46.43	3.55	22.26	0.000*
	IAW	47.35	4.64	50.93	3.67	55.19	5.09	45.36	0.000*

Table 4: Post hoc Tukey test for significantly different parameters of mandibular arch.

Parameter		Class I vs Class II	Class I vs Class III	Class II vs Class III
Mandibular	IPW1	0.271	0.660	0.044*
	IPW2	0.025*	0.490	0.001*
	IMW	0.231	0.000*	0.000*
	IAW	0.000*	0.000*	0.000*
	IAW	0.940	0.000*	0.000*

Table 5: Inter-molar to inter-canine width ratios in different malocclusions.

Malocclusion	Maxillary IMW / ICW	Ratio	Mandibular IMW / ICW	Ratio
Class I	1.43±0.13	12.9 : 9	1.63±0.20	14.7 : 9
Class II	1.51±0.26	13.6 : 9	1.71±0.24	15.4 : 9
Class III	1.54±0.12	13.9 : 9	1.75±0.19	15.7 : 9

in Class III when compared to Class I and Class II samples (Table 4).

Ratios of inter-molar to inter-canine widths were calculated on different groups of malocclusion (Table 5).

DISCUSSION

Measurements were done on the pre-treatment casts of the subjects aged 14-35 years with completely erupted permanent dentition. It is believed that, after eruption of the permanent dentition little or no changes occur in arch widths.[17,18]

Maxillary and mandibular arch widths of the present study were found to be similar to the report of Islam et al in Bangladeshi sample.[19] It was noted that the arch widths were lesser in Class II compared to Class I subjects in both studies. Another study that compared dental arch and alveolar base widths of untreated Class II with normal occlusion using similar methodology found maxillary arch widths to be lesser in Class II malocclusion.[20]

The narrower maxillary arch widths in Class II and wider arch widths in Class III are in accordance with the findings of Hashim et al[1] and Adil et al.[6] Similarly, mandibular inter-canine widths not significantly different in various classes of malocclusion was in accordance with the study of Staley et al[8] and Basaran et al.[21]

The ratios of inter-molar to inter-canine width in both maxillary and mandibular arches were found to be lowest in Class I, followed by Class II and then Class III group. The maxillary ratio in Class I (12.9:9) was found to be different from the ratio proposed by Williams.[11] Whereas the maxillary ratios in Class II (13.9:9) and Class III (13.9:9) were similar to William's ratio 14:9. All mandibular ratios were higher compared to the original William's ratio. The present study recommends to use newly devised ratios in Nepali orthodontic patients.

CONCLUSION

Following conclusions can be derived from the present study: i) With the exception of mandibular inter-canine width, every measurements of arch widths were found to be significantly different among various groups of malocclusion; ii) Most of the arch width measurements are largest in Class III, followed by Class I and Class II samples, except maxillary inter-alveolar width, mandibular inter-molar width and mandibular inter-alvoelar width, which were smallest in Class I samples; iii) The unique William's inter-molar to inter-canine ratio is lesser in maxillary arch and higher in mandibular arch in all classes of malocclusion among Nepali samples.

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Conflict of Interest: None.

JNDA

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