

Comparison of Mesiodistal Width of Maxillary Anteriors with Arch Form in Various Malocclusions: A Retrospective Study

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ABSTRACT

Aim: This study was conducted for evaluating and comparing the mesiodistal width of upper anteriors in different malocclusions and its relation with various arch forms.

Materials and methods: In total, 60 subjects with different malocclusions were examined. Mesiodistal width was measured for the anterior teeth using digital vernier caliper. 3M Unitek arch form template and two-dimensional (2D) model were superimposed to find out primarily the relation of arch form in specific malocclusion to the sum the mesiodistal width of the maxillary of anterior teeth and secondarily the relation of sum of the mesiodistal width of the maxillary anterior tooth with different arch forms.

Results: The ovoid arch form was common in class I malocclusion with mean mesiodistal width of 50.43 mm. The tapered arch form was the common type in both class II and class III malocclusion with mean mesiodistal width of 49.96 and 45.15 mm, respectively.

Conclusion: The mean of anterior mesiodistal width for Angle's class III individuals was 45.15 mm considerably less than that of class II subjects and class I subjects, which signifies that the tooth material was more in the anterior region of the subject of class I followed by class II and class III malocclusions.

Clinical significance: The performed study presents various maxillary dental arch forms observed in various malocclusions (Angle's class I, class II, and class III). The ovoid and tapered arch forms exhibited the common occurrence, while the square form was the rarest.

Keywords: Arch form, Arch form template, Malocclusion, Maxillary anterior teeth, Mesiodistal width.

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INTRODUCTION

Younger generation nowadays is very concerned about their appearance, attractiveness, and beauty. Face plays a key role in attractiveness of an individual.¹ People perceive beauty by the size, arrangement, and appearance of anterior teeth in an individual.² The term "tooth size" refers to the mesiodistal width of the tooth. Tooth size and tooth arrangement vary among different individuals and different populations. Orthodontic literature has also supported the point that the tooth size and arrangement show a significant relation between genetic and environmental factors.³ Heredity, diseases, abnormal or premature birth, developmental defects, bone growth and tooth eruption pattern, environmental influences, function, and ethnic background have a great influence on the size and shape of dental arches.⁴⁻⁶ Tooth size measurement is performed by using manual or digital method. Plaster models are used to visualize the shape and form of the arches and are also used for measuring the tooth size, as well as to provide the three-dimensional model of the patient's occlusion.

It is observed that pattern of the supporting bone, perioral musculature force, and intraoral functional forces take part in the arch formation.⁷

Dental arch morphology has been described through different techniques starting from simple classification of arch shape⁸ by combination of linear dimension^{9,10} to compound mathematical equations.^{11,12} In 1932, the arch form concept was introduced by Chuck as square, ovoid, and tapered forms.¹³ Three types of arch forms can also be identified as narrow, normal, and wide clinically. Many researchers tried to identify the different shapes of the arch form with different malocclusions. The different malocclusions (classes I, II, and III) may also be the reason for changes in the relation to maxillary arch form and differences in its dimension.

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This study was considered essential as it provides information regarding the relation of mean mesiodistal width of upper anteriors to Angle's malocclusions and various arch forms.

This study was aimed to calculate the mean mesiodistal width of the maxillary anterior teeth and to evaluate its relation with the different malocclusions and arch forms.

MATERIALS AND METHODS

Samples

The study comprised randomly selected 60 maxillary study models of different malocclusions who sought orthodontic treatment in the Department of Orthodontics, Teerthanker Mahaveer Dental College and Research Centre, Moradabad. The age group was 16-25 years, and the total duration for the study was 3 months. The sample was further divided into three groups on the basis of malocclusion

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(Angle's class I, class II, and class III) comprising 20 individuals each. Each group was divided to have equal gender distribution.

The criteria for the selection were as follow:

- Permanent dentition.
- Absence of missing or supernumerary teeth (excluding third molars).
- Absence of proximal restorations.
- Subjects with no previous orthodontic treatment.

The exclusion criteria were as follows:

- Missing permanent teeth.
- Cleft lip and palate.
- Syndromic patients.
- Mixed dentition.

Ethical clearance for the study was not needed as the study was retrospective in nature and done on the pretreatment collected orthodontic models of department. Models were not made solemnly for the purpose of study.

Anterior Mesiodistal Tooth Width

The measurement of mesiodistal tooth width was taken as described by Hunter and Priest. All measurements were done on the plaster pretreatment models of the patients. The beaks of the vernier caliper (aerospace 150 mm) were inserted from the facial surface of the anterior teeth and held perpendicular to the long axis of the tooth. The beaks were then closed to the contact point of the tooth, and the measurements were taken. The mean from descriptive measurements was calculated (Tables 1A to C), and the statistician analyzed the average mean of maxillary anteriors in all the three groups (Table 1D). After recording all the measurements of mesiodistal width of maxillary anterior teeth, their relation to arch form has been presented (Table 1E).

To evaluate the arch form, maxillary dental casts for all the subject were obtained. In a real-world scenario, an arch form is 2D, while a cast is 3D; to avoid any discrepancies arising as a result of dimensional difference, photocopy of cast was take on A3 size paper.

Overhead projector sheets was used to print all the 3M Unitek arch form templates on one sheet, and all the maxillary cast were

Table 1B: Class II malocclusion (all values are in mm)

Samples	Right			Left			Total value
	CI	LI	C	CI	LI	C	
01	10.0	7.5	8.5	10.0	7.5	8.5	52
02	10.5	7.0	9.5	10.5	7.0	10.0	54.5
03	10.5	8.5	9.0	10.5	8.5	9.0	56
04	9.8	6.5	8.5	10.0	6.5	8.2	49.5
05	10.0	7.0	8.0	9.5	7.4	8.0	49.9
06	9.0	6.0	8.0	9.0	6.0	8.0	46
07	10.5	6.0	8.0	10.5	6.0	8.0	49
08	10.0	7.0	8.0	9.5	7.5	8.0	50
09	10.5	8.5	9.0	10.5	8.5	9.0	56
10	9.5	7.0	8.0	9.5	7.5	8.0	49.5
11	10.0	7.5	9.0	10.0	7.5	9.0	53
12	9.0	7.0	7.5	9.0	7.5	7.5	47.5
13	9.5	7.0	8.5	8.5	6.5	8.6	48.6
14	9.5	7.0	8.5	8.8	7.0	7.8	48.6
15	10.0	7.2	8.0	9.3	7.0	8.0	49.5
16	10.0	6.0	9.2	9.5	6.0	8.5	49.2
17	8.6	6.3	7.2	8.6	6.3	6.9	43.9
18	9.5	6.0	8.0	9.5	6.0	8.0	47
19	10.0	8.0	9.2	10.0	8.2	9.2	45.6
20	10.0	5.5	8.5	10.0	6.2	8.5	48.7

Table 1A: Class I malocclusion (all values are in mm)

Samples	Right			Left			Total value
	CI	LI	C	CI	LI	C	
01	9.5	7.0	8.0	9.5	7.0	8.0	49
02	9.0	7.5	8.5	9.0	7.5	8.5	50
03	11.0	8.5	9.0	11.0	8.5	9.0	57
04	9.5	7.0	8.5	9.5	7.0	8.5	50
05	10.5	9.0	7.5	10.0	9.0	8.0	54
06	10.0	8.0	9.0	10.0	8.0	8.0	53
07	9.5	7.5	9.0	9.5	7.5	9.0	52
08	10.0	8.0	9.5	10.5	9.5	9.0	56.5
09	9.0	7.0	8.3	9.0	7.0	8.5	48.8
10	7.5	7.0	8.0	7.0	7.0	8.0	44.4
11	9.0	7.5	8.5	9.0	7.5	8.5	50
12	8.8	6.5	7.0	8.5	6.5	7.0	44.3
13	9.0	7.0	9.0	9.0	7.0	9.0	50
14	9.5	7.0	8.0	9.5	7.0	8.5	49.5
15	9.0	8.5	8.0	9.0	8.5	8.0	51
16	9.5	8.0	7.0	9.5	8.0	7.5	49.5
17	8.5	7.5	8.0	8.5	7.5	8.0	48
18	10.0	7.0	8.5	10.0	7.0	8.5	51
19	9.5	7.5	8.0	9.5	7.6	8.3	50.4
20	9.5	7.5	8.5	9.0	7.5	8.5	50.5

Table 1C: Class III malocclusion (all values are in mm)

Samples	Right			Left			Total value
	CI	LI	C	CI	LI	C	
01	9.4	6.8	7.2	8.8	7.0	7.2	46.4
02	8.2	6.3	7.8	8.5	6.5	7.6	44.9
03	8.2	6.4	6.5	8.1	5.5	6.6	41.3
04	9.4	6.8	7.8	9.4	7.0	7.3	47.7
05	9.2	7.0	7.5	9.2	7.2	7.6	47.7
06	7.9	6.4	7.2	7.8	6.4	7.2	42.9
07	7.5	5.2	7.4	7.6	5.5	7.7	40.9
08	8.0	5.2	7.1	7.5	5.2	7.0	40
09	8.2	6.5	7.2	8.3	6.5	7.2	43.9
10	8.5	7.5	8.0	8.5	7.5	8.0	48
11	9.2	7.5	8.0	9.2	7.6	8.5	50
12	8.2	7.0	8.0	8.1	7.0	8.0	46.3
13	8.5	6.9	7.2	8.0	6.7	6.9	44.2
14	8.7	7.5	7.0	8.7	7.0	7.5	46.4
15	9.6	8.0	8.4	9.8	8.5	8.4	44.3
16	7.9	5.5	7.4	7.5	5.5	7.7	41.5
17	9.2	6.4	7.2	8.3	7.0	7.0	45.1
18	8.2	6.0	7.8	8.3	6.4	7.6	51.3
19	8.0	6.0	6.5	8.1	5.5	6.6	40.7
20	9.4	6.8	7.8	9.4	7.0	7.3	47.7



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Table 1D: Arch forms seen in various malocclusions

Sample	Class I	Class II	Class III
01	T	T	T
02	O	T	S
03	O	T	T
04	S	T	O
05	T	T	T
06	O	T	T
07	O	T	S
08	T	T	O
09	O	O	O
10	T	T	O
11	T	T	T
12	O	T	O
13	O	O	S
14	T	O	O
15	T	S	S
16	O	O	O
17	T	O	T
18	O	T	S
19	O	O	T
20	T	T	O

T, tapered; O, ovoid; S, square

Table 1E: Mesiodistal width of anterior teeth of maxilla and arch form relation (all values are in mm)

S. no	Malocclusion	Mean value	Arch form
01	Class III	40	O
02	Class III	40.7	T
03	Class III	40.9	S
04	Class III	41.3	T
05	Class III	41.5	O
06	Class III	42.9	T
07	Class III	43.9	O
08	Class II	43.9	O
09	Class II	44.2	O
10	Class I	44.3	O
11	Class III	44.3	S
12	Class I	44.4	T
13	Class III	44.9	S
14	Class III	45.1	T
15	Class II	45.6	O
16	Class II	46	T
17	Class III	46.3	O
18	Class III	46.4	O
19	Class III	46.4	T
20	Class II	47	T
21	Class II	47.5	T
22	Class III	47.7	O
23	Class III	47.7	O
24	Class III	47.7	T
25	Class I	48	T
26	Class III	48	O

Contd...

Contd...

S. no	Malocclusion	Mean value	Arch form
27	Class II	48.6	O
28	Class II	48.6	O
29	Class II	48.7	T
30	Class I	48.8	O
31	Class I	49	T
32	Class II	49	T
33	Class II	49.2	O
34	Class I	49.5	T
35	Class I	49.5	O
36	Class II	49.5	T
37	Class II	49.5	T
38	Class II	49.5	S
39	Class II	49.9	T
40	Class I	50	O
41	Class I	50	S
42	Class I	50	T
43	Class I	50	O
44	Class II	50	T
45	Class III	50	T
46	Class I	50.4	O
47	Class I	50.5	T
48	Class I	51	T
49	Class I	51	O
50	Class III	51.3	S
51	Class I	52	O
52	Class II	52	T
53	Class I	53	O
54	Class II	53	T
55	Class I	54	T
56	Class II	54.5	T
57	Class II	56	T
58	Class II	56	O
59	Class I	56.5	T
60	Class I	57	O

scanned and printed on the white paper. A midline was constructed on each individual 2D model. A clear printed arch form template was placed over the 2D model and then the prepared 2D models were visualized from the above so that the eye level was perpendicular to the 2D models and the printed arch form template. The arch form was thus obtained by direct visualization method and classified into square, ovoid, and tapered according to the arch form template (Orthoform, 3M Unitek).

The arrangement pattern of the three different arch forms within the groups was analyzed and noted to find out whether any relation exists in Angle's malocclusion and different arch forms. After calculating the mesiodistal width of 60 samples, the least obtained mesiodistal width was 40 mm, while the highest was 57 mm. To relate the mesiodistal width to the three types of arch form, the obtained difference was divided into three groups. The groups were 45.6, 51.3, and 57 mm. After obtaining these values, the arrangement pattern of the most common arch form was taken from each group. With the help of this process, the relation of the anterior mesiodistal width to the different arch forms was

Table 2A: Comparison between mean, mesiodistal width of maxillary anteriors in the three groups (analysis of variance)

Malocclusion	Number of samples	Mean (mm)	Standard deviation (mm)	p value
Class I	20	50.43	3.15	0.0000
Class II	20	49.96	3.39	0.0000
Class III	20	45.15	3.10	0.0000

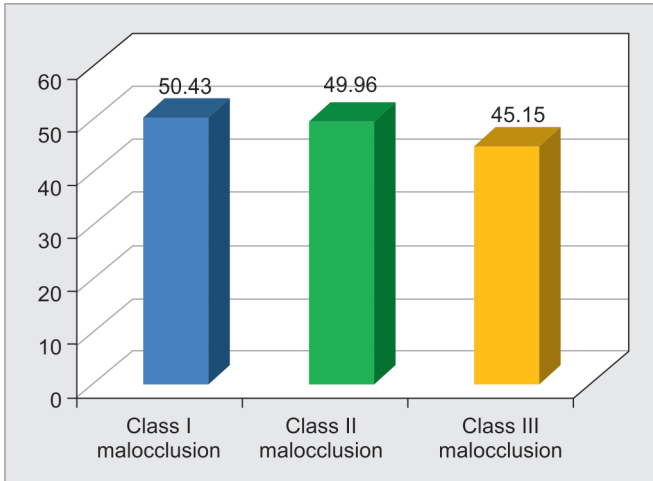


Fig. 1: Comparison between mean, mesiodistal width of maxillary anteriors in the three groups

recorded. The statistical analysis was done with the help of SPSS (version 20.0) software.

RESULTS

After calculating the mesiodistal width of 60 samples, the least obtained mesiodistal width was 40 mm, while the highest was 57 mm; so, the difference between these two values was calculated to be 17 mm. The three groups, namely 40 to 45.6 mm, 46 to 51.3 mm, and 52 to 57 mm, were formulated by dividing the 17-mm difference equally.

The mean value of maxillary anterior was compared among the three groups of malocclusions using the one-way analysis of variance (ANOVA) test. Mesiodistal widths of maxillary anteriors in class I, class II, and class III were compared. The results were found to be significant. A *p* value of ≤ 0.05 was considered statistically significant (Table 2A).

In class I group, the mean was found to be 50.43 mm. In class II group, the mean was found to be 49.96 mm. In class III group, the mean was found to be 45.15 mm. The *p* value was 0.0000, which was found to be statistically significant. *Post hoc* Bonferroni test was also done to confirm the results of ANOVA (Table 2A and Fig. 1).

The distribution of arch form was compared among various malocclusion groups (classes I, II, and III) using the Chi-square test. The *p* value was 0.003, which was found to be statistically significant (Fig. 2 and Table 2B).

The mode of arch form was compared on the basis of mesiodistal width of the anteriors in the three groups. Samples had more ovoid arch form with 40 to 45.6 mm anterior mesiodistal width and 46 to 57 mm anterior mesiodistal width existed with tapered arch form. In 46 to 57 mm anterior mesiodistal width, the ovoid

Table 2B: Comparison of distribution of arch form and malocclusion (class I, class II, and class III)

Arch form	Class I	Class II	Class III	Total
Ovoid	10	6	9	25
	50%	30%	45%	41.7%
Square	1	1	5	7
	5%	5%	25%	11.7%
Tapered	9	13	6	28
	45%	65%	30%	46.7%
Total	20	20	20	60
	100%	100%	100%	100%

Chi-square value = 8.254, *p* value = 0.003

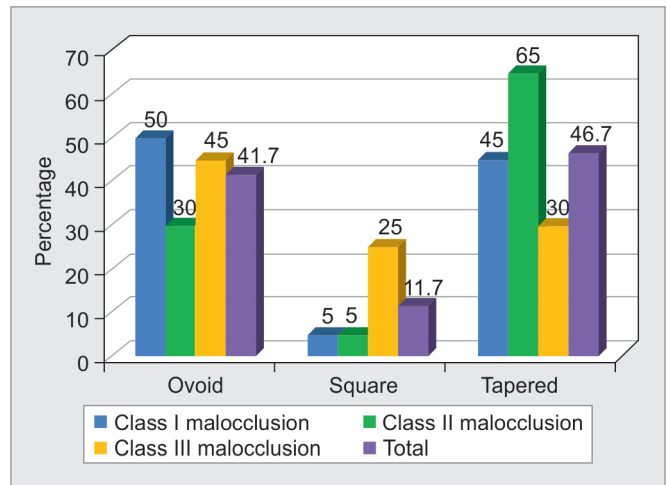


Fig. 2: Comparison of distribution of arch form and malocclusion (class I, class II, and class III)

arch form was second most found. The square arch form was least in all the three groups (Fig. 3 and Table 2C).

DISCUSSION

Mesiodistal tooth width, arch form, and growth pattern have an anthropological significance. These have revealed important information about individuals' dietary habits and family lineage. Arch form, arch type, and teeth size are also much desired by forensic odontology experts while solving criminal cases.

This study provides important information regarding the mesiodistal width of maxillary anterior teeth and maxillary arch form with different malocclusions. Regarding class I malocclusion, the mean mesiodistal width was calculated to be 50.43 mm, which was correlating with the ovoid arch form. The tapered arch form was the common type in both class II and class III malocclusions with a mean mesiodistal width of 49.96 and 45.15 mm, respectively.

The result of this study also showed the relation of anterior tooth size of the upper arch in different malocclusions with different arch forms by using 3M Unitek arch form template. The outcome revealed that the sum of the anterior mesiodistal tooth size of maxilla if present below the 45.7 mm showed a relation with the ovoid arch form, while the value more than 45.8 to 57 mm was in a relation with the tapered arch form in different malocclusions.

In a study, Lavelle et al. concluded that class III individuals had remarkably smaller upper teeth than other groups.⁴ Our study

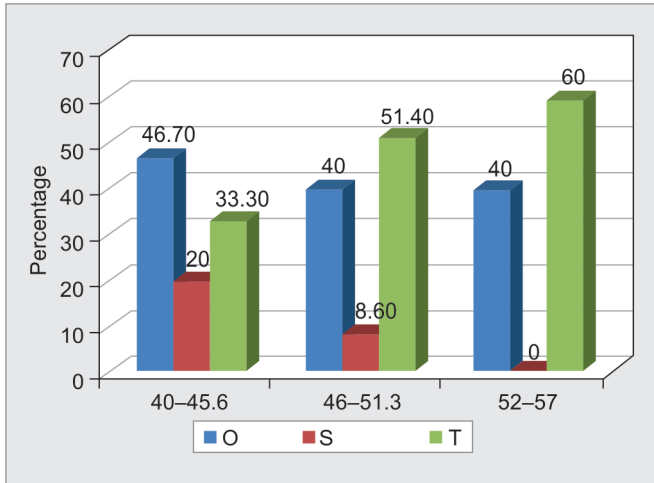


Fig. 3: Comparison in the variation of mode of the arch form among mesiodistal width from all the samples (T, tapered; O, ovoid; S, square)

also showed that class III malocclusion had a remarkably lesser mesiodistal width of anterior teeth than other groups.

The result of this study showed disagreement with Nie and Lin,¹⁴ Araujo and Souki,¹⁵ and Fattahi,¹⁶ who suggested that there are statistical differences in tooth size ratios among various groups. They reported that subjects with class III malocclusion always present with greater tooth size.

This study revealed that ovoid was the common arch form in class I and tapered was the followed arch form, whereas in class II groups, the most common arch form was tapered. These findings indicate that orthodontist should consider the ovoid arch form while treating class I, and for class II, tapered arch form wire should be selected.

This study was also supported by Murshid et al.¹⁰

This study showed that for class III samples, the arrangement pattern square form was more when compared with the three groups. The findings of this study were supported by Kook et al.¹⁷

Data from this study revealed that there is a relation between arch form and various malocclusions. The most stable arch form has been ovoid because it was seen maximum in class I cases. Hence, while ending up a class II or class III case, the final arch form for the patient should be ovoid, as it is the most stable retentive arch form. Also, this study can be used by forensic teams while inspecting decayed dead bodies to evaluate the type of arch form and type of malocclusion of the deceased by obtaining the MD width of the upper anteriors.

Although age and gender were taken as the inclusion criteria for the sampling, this study does not provide any comparison or relation data between age and gender of the subjects studied. This study was solemnly carried out to relate the arch form and mesiodistal width of maxillary anterior teeth with the malocclusion.

FUTURE SCOPE

Such studies should be carried out in different ethnic groups and population samples. The sample size should be increased, with gender specification and age specifications to obtain more significant results. Dental anomalies in tooth size, number, or shape and habit of the individuals should also be taken into measurement along with the mesiodistal and buccolingual proportion. The intra and interexaminer calibration should be developed to provide

Table 2C: Comparison in the variation of mode of the arch form among mesiodistal width from all the samples

Arch form	Mesiodistal width (mm)			Total
	40-45.6	46.51.3	52-57	
Ovoid	7 46.7%	14 40%	4 40%	25 41.7%
Square	3 20%	3 8.6%	0 0.00%	6 10%
Tapered	5 33.3%	18 51.4%	6 60%	29 48.3%
Total	15 100%	35 100%	10 100%	60 100%

more reliable results. A digital intraoral scanner can be used to obtain the accurate arch form in all the malocclusion groups with gender specification.

CONCLUSION

The mean of anterior mesiodistal width for Angle’s class III individuals was considerably less than that of class II subjects and class I subjects, which signifies that the tooth material was more in the anterior region of the subject of class I followed by class II and class III malocclusions. The frequency of ovoid arch form was common among class I samples, while tapered was the common arch form in class II and class III individuals.

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