IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 24, Issue 5 Ser. 2 (May. 2025), PP 37-47
www.iosrjournals.org

Comparison Of Mesiodistal Width Of Maxillary Anteriors With Lingual Arch Form In Various Angles Malocclusion: A Retrospective Study

Dr. Shashank Soni [1], Dr. Amitabh Kallury [2]
[1] (*Phd Scholar Of Department Of Orthodontics & Dentofacial Orthopedics, Peoples Dental Academy, Bhopal, M.P. India.)*
[2]*(Head Of Department Of Orthodontics & Dentofacial Orthopedics, Peoples Dental Academy, Bhopal, M.P. India.)*

Abstract
Orthodontics is a specialized field focused on diagnosing and treating dental and facial irregularities, primarily through the management of malocclusion—misalignments of teeth and jaws that can affect function and aesthetics. This study investigates the relationship between mesiodistal width of maxillary incisors and arch form across different classes of malocclusion, classified into Angle's system: Class I (normal), Class II (posterior positioning), and Class III (anterior positioning).
A retrospective analysis was conducted on orthodontic records of 60 patients aged 16-25, ensuring criteria such as permanent dentition and no prior orthodontic treatment. Mesiodistal width was measured using precision vernier calipers, and lingual arch forms were assessed via maxillary dental casts. Statistical analyses, including one-way ANOVA and Chi-square tests, were employed to evaluate the relationships among variables.
Results indicated significant differences in mesiodistal widths among malocclusion classes, with Class III demonstrating the smallest dimensions. However, no significant variations in arch form distributions were observed across malocclusion types. These findings underscore the importance of incorporating tooth size measurements into orthodontic treatment planning, particularly for Class III malocclusions, which may require tailored strategies due to their unique dimensional challenges.
While arch form remains relevant, its limited differentiation capability suggests a need for a comprehensive approach that considers individual tooth size and other factors. Future research should focus on larger, diverse samples and advanced imaging techniques to further explore the interplay between dental dimensions and malocclusions, ultimately enhancing orthodontic practices and patient outcomes.
Keywords:*Lingual Arch Form, Arch Form Template, Malocclusion, Maxillary Anterior Teeth, Mesiodistal Width.*

Date of Submission: 01-05-2025 Date of Acceptance: 10-05-2025

I. Introduction

Orthodontics is a specialized field of dentistry that focuses on diagnosing, preventing, and treating dental and facial irregularities. Central to orthodontics is the concept of malocclusion, which refers to misalignments of teeth and jaws that can negatively impact dental function and aesthetics. Understanding malocclusions is crucial for effective treatment planning and ultimately achieving optimal occlusion, where teeth meet correctly when the mouth is closed.[1]

Malocclusions are classified using Angle's classification system, which categorizes them into three primary classes: Class I (normal molar relationship), Class II (posterior molar positioning), and Class III (anterior molar positioning). Each class presents unique orthodontic challenges and requires tailored approaches to treatment. For instance, Class II malocclusions might necessitate methods to move the molars forward, while Class III may require techniques to retract them.[2]

In orthodontics, mesiodistal width is a critical measurement that refers to the distance from the front to the back of a tooth. This width is particularly important for assessing tooth alignment and spacing. Variations in mesiodistal width, especially among maxillary incisors, can lead to crowding or spacing issues. Therefore, precise measurements are essential for effective diagnosis and treatment planning.[3]

The shape of the dental arch, especially when viewed from the lingual (tongue) side, significantly affects tooth alignment and spacing. Key parameters of dental arch form include arch width, depth, and circumference. Arch width is measured as the distance between the most distal points on the upper and lower dental arches, where a narrow width can contribute to crowding, while a wider arch can facilitate proper alignment. Arch depth refers to the vertical distance from the incisal edge to the deepest point of the arch, which plays a crucial role in conditions like deep bite or open bite. Arch circumference measures the total length around the dental arch, providing insights into the available space for teeth.[4]

Understanding the relationship between mesiodistal width and arch form is essential for developing individualized treatment plans in orthodontics. Different Angle malocclusions exhibit varying patterns in these measurements, influencing orthodontic strategies. This study aims to enhance our understanding of how mesiodistal width and arch form correlate across different malocclusion classes, providing valuable insights for targeted treatment strategies.[5]

II. Materials And Methods

Sample Selection

The study involved a retrospective analysis of orthodontic records from 60 maxillary study models of patients aged 16-25 years. These samples were categorized into different classes of malocclusion, sourced from the Orthodontics Department Peoples Dental Academy at peoples University. The inclusion criteria were carefully defined to ensure the integrity of the sample.[6]

1. **Permanent Dentition**: Only patients with fully erupted permanent teeth were included to ensure accurate measurements.
2. **No Missing or Supernumerary Teeth**: Patients with missing or additional teeth (excluding third molars) were excluded to avoid skewed data.
3. **No Proximal Restorations**: The presence of restorations could affect tooth dimensions, thus excluded.
4. **No Previous Orthodontic Treatment**: Prior orthodontic interventions could alter tooth position and size, leading to inaccurate assessments.
5. **Intact Contact Points**: The absence of diastemas or open contacts ensured that the teeth were in their natural position.

Measurement of Anterior Mesiodistal Tooth Width

The mesiodistal tooth width was measured using a precision vernier caliper (Aerospace 150mm), adhering to the methodology outlined by Hunter and Priest. The caliper's beaks were positioned perpendicularly to the long axis of the anterior teeth, from the facial surface to the contact point, ensuring accurate measurements. The mean values of mesiodistal widths for the maxillary anterior teeth across all groups were calculated for further analysis.[7]

Assessment of Lingual Arch Form

To assess the lingual arch form, maxillary dental casts were obtained. To standardize dimensional differences for analysis, photocopies of the casts were made on A3 paper. The arrangement patterns of arch forms were then analyzed for potential correlations with malocclusion classifications.[8]

Mesiodistal Width Analysis

The total mesiodistal width of the samples was recorded, with measurements ranging from 40mm to 57mm (a 17mm difference). These values were divided into three groups (45.6, 51.3, and 57mm) to facilitate the analysis of correlations between mesiodistal width and various maxillary lingual arch forms.[9]

Table 1. Class I Malocclusion

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 2. Class II Malocclusion

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 3. Class III Malocclusion

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

Statistical Analysis

Data were analyzed using SPSS (Version 20.0). Given the data collection methodology, a normal distribution was assumed for the parent population, although potential deviations in the sample distribution were recognized.[10] Both parametric and non-parametric methods were employed due to the ordinal/nominal and scalar nature of the measurements, applying a significance level of 0.05.

1. ***Chi-Square Test****:* This was utilized to test differences in attribute distributions across groups, calculated as:

   (Observed frequencies – expected frequencies)^2

   $$\chi^2 = \frac{\sum (\text{observed frequencies} - \text{expected frequencies})^2}{\text{Expected frequencies}}$$

   Where, ∑ denotes summation and

$$\text{Expected frequencies} = \frac{\text{Row total} \times \text{Column Total}}{\text{Grand total}}$$

where expected frequencies were determined based on total distributions.

2. **One-way ANOVA**: This method was applied to compare means across three or more groups, partitioning total sums of squares for analysis.
3. **Post-hoc Tests**: The Bonferroni test was conducted after ANOVA to adjust for multiple comparisons, ensuring the family-wise error rate remained at 0.05.
4. **Significance Levels**: Results were interpreted based on p-values:

○ p≥0.05p \geq 0.05p≥0.05: Non-significant
○ p<0.05p < 0.05p<0.05: Significant
○ p<0.01p < 0.01p<0.01: Highly significant
○ p<0.001p < 0.001p<0.001: Very highly significant

III. Results

Statistical Analysis

The results of the statistical analysis revealed significant differences in the mesiodistal widths among Classes I, II, and III malocclusions when compared using the one-way ANOVA test. Notably, Class III malocclusions exhibited the smallest mesiodistal widths compared to Class I and II. The Chi-square test, however, indicated no significant differences in arch form distributions across the malocclusion classes.

Table: I Comparison between class I, II and III malocclusion using One-way ANOVA test

	Total value				
	N	Mean	Std. Deviation	F-value	p-value
Class I malocclusion	20	50.43	3.15	15.662	0.000
Class II malocclusion	20	49.96	3.39		
Class III malocclusion	20	45.15	3.35		

One-way ANOVA test *** Significant difference**

The mean total value was compared between class I, II and III malocclusion using the **One-way ANOVA test**. There was a significant difference in mean total value between class I, II and III malocclusion.

Graph I :- Comparison between class I, II and III malocclusion using One-way ANOVA test

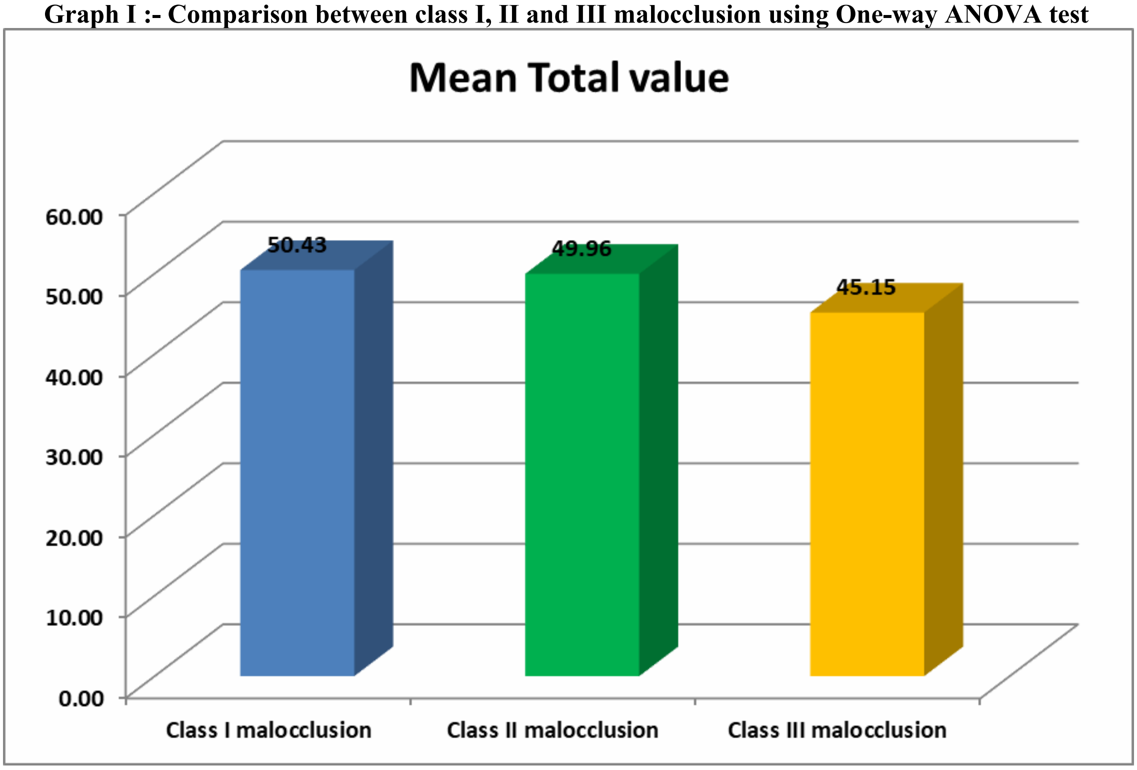

Table: II :- Compared between class I and II malocclusion using the post-hoc bonferroni test.

Groups	N	Mean	Std. Deviation	Mean Difference	p-value
Class I malocclusion	20	50.43	3.15	0.47	1.000
Class II malocclusion	20	49.96	3.39		

Post-hocbonferroni test **#Non-significant difference**

The mean total value was compared between class I and II malocclusion using the **post-hoc bonferroni test**. There was no significant difference in mean total value between class I and II malocclusion.

Graph II:- Compared between class I and II malocclusion using the post-hoc bonferroni test.

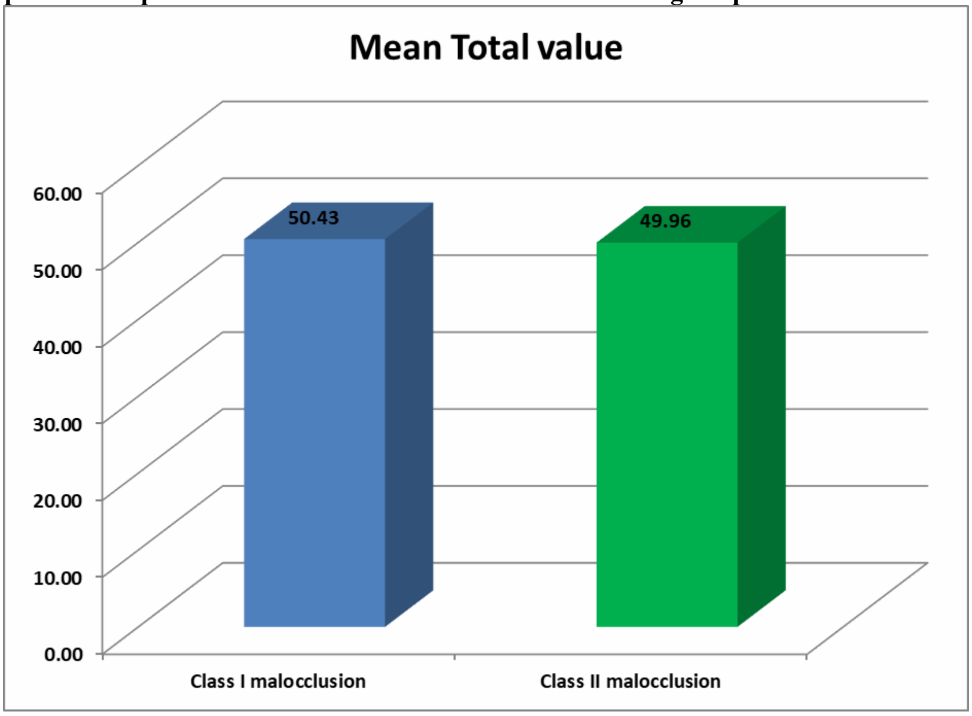

Table: III :- Compared between class I and III malocclusion using the post-hoc bonferroni test.

Groups	Mean	Std. Deviation	Mean Difference	p-value
Class I malocclusion	50.43	3.15	5.28	<0.001*
Class III malocclusion	45.15	3.35		

Post-hoc bonferroni test *** Significant difference**

The mean total value was compared between class I and III malocclusion using the **post-hoc bonferroni test**.The mean total value was significantly more among class I malocclusion in comparison to class III malocclusion.

Graph III: - Compared between class I and III malocclusion using the post-hoc bonferroni test.

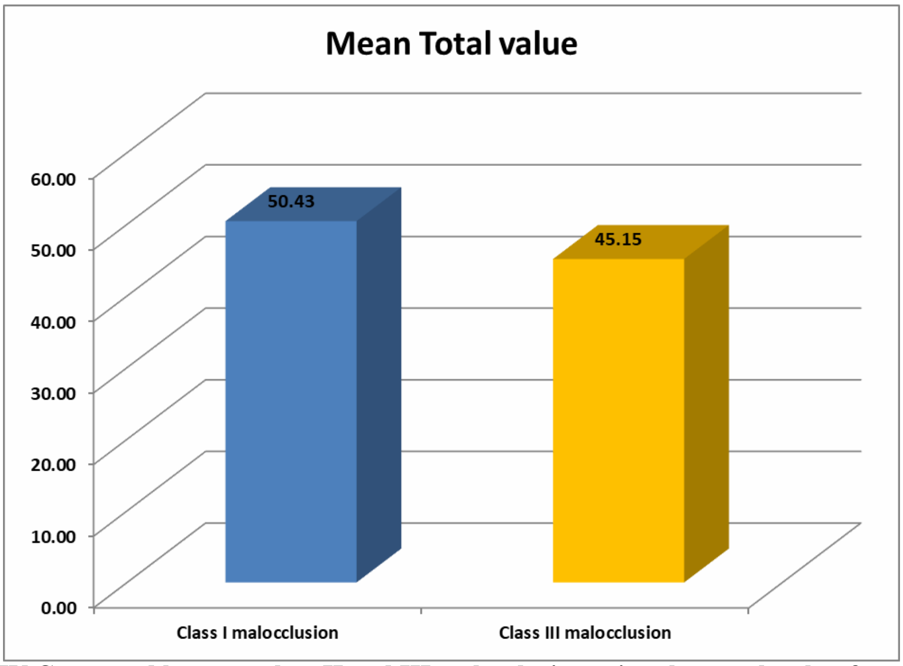

Table: IV Compared between class II and III malocclusion using the post-hoc bonferroni test.

Groups	Mean	Std. Deviation	Mean Difference	p-value
Class II malocclusion	49.96	3.39	4.81	<0.001*
Class III malocclusion	45.15	3.35		

Post-hoc bonferroni test *** Significant difference**

The mean total value was compared between class II and III malocclusion using the **post-hoc bonferroni test**.The mean total value was significantly more among class II malocclusion in comparison to class III malocclusion.

Graph:- IV Compared between class II and III malocclusion using the post-hoc bonferroni test.

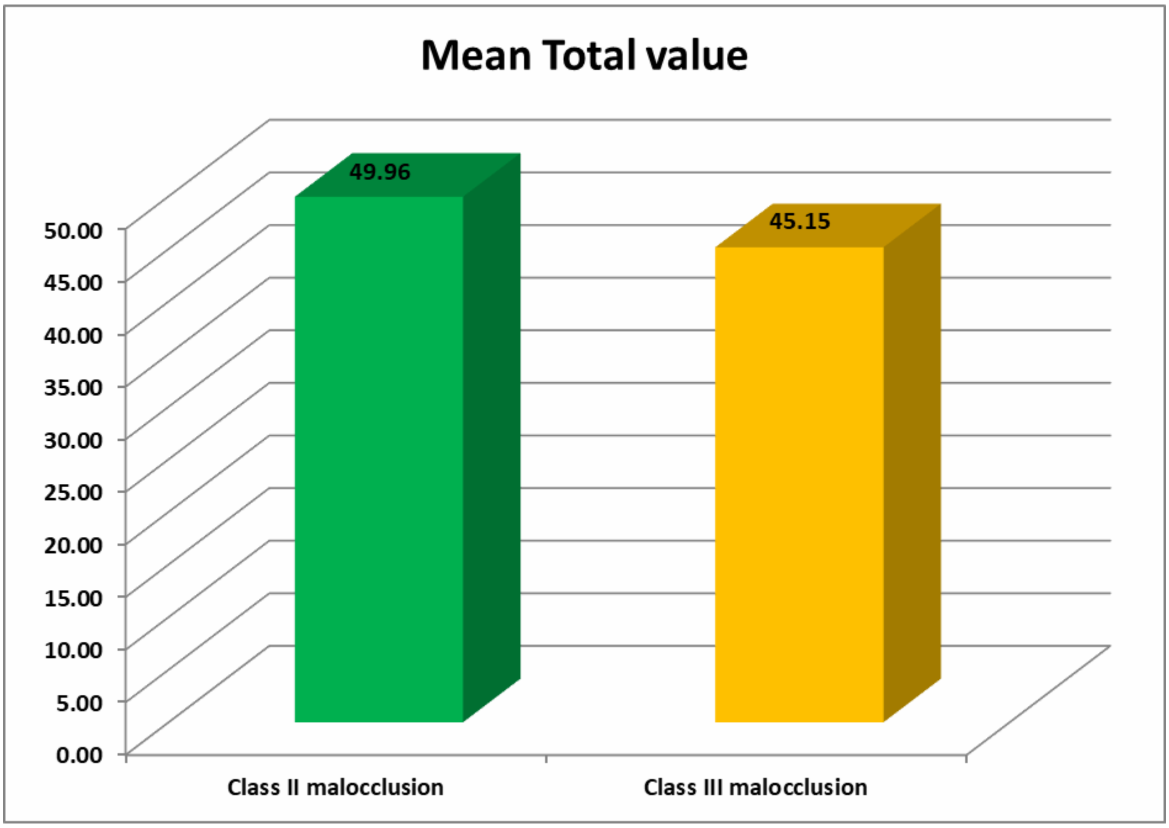

Table: V Comparison of distribution of arch form was compared between class I, II and III malocclusion using the Chi-square test.

Arch form	Class I malocclusion	Class II malocclusion	Class III malocclusion	Total
Ovoid	10	6	9	25
	50.0%	30.0%	45.0%	41.7%
Square	1	1	5	7
	5.0%	5.0%	25.0%	11.7%
Tapered	9	13	6	28
	45.0%	65.0%	30.0%	46.7%
Total	20	20	20	60
	100.0%	100.0%	100.0%	100.0%
Chi-square value = 8.254, p-value = 0.083				

Chi-square test **#Non-significant difference**

The comparison of distribution of arch form was compared between class I, II and III malocclusion using the **Chi-square test**. There was no significant difference in distribution of arch form between class I, II and III malocclusion.

Graph:- V Comparison of distribution of arch form was compared between class I, II and III malocclusion using the Chi-square test.

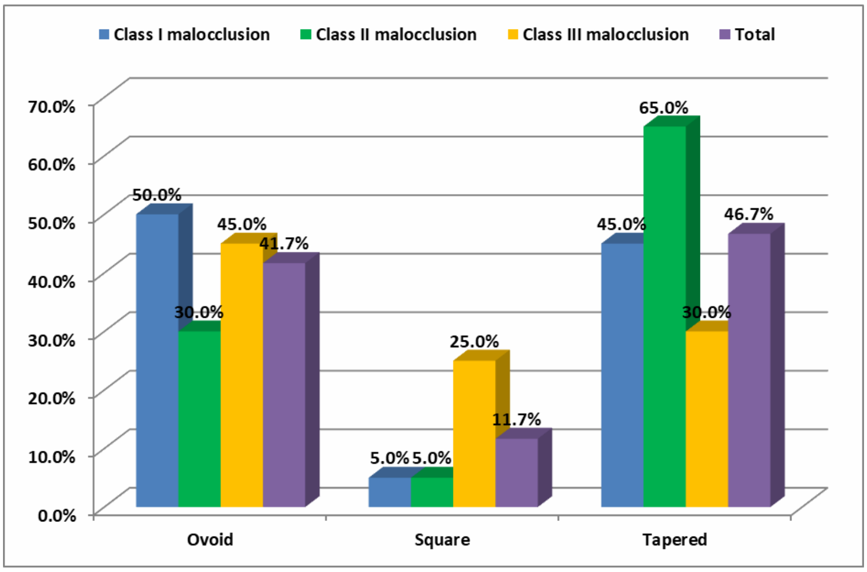

Table: VI Comparison of distribution of labial arch form was compared between class I, II and III malocclusion using the Chi-square test.

Labial	Class I malocclusion	Class II malocclusion	Class III malocclusion	Total
Ovoid	10	6	9	25
	50.0%	30.0%	45.0%	41.7%
Square	1	1	5	7
	5.0%	5.0%	25.0%	11.7%
Tapered	9	13	6	28
	45.0%	65.0%	30.0%	46.7%
Total	20	20	20	60
	100.0%	100.0%	100.0%	100.0%
Chi-square value = 8.254, p-value = 0.083				

Chi-square test **#Non-significant difference**

The comparison of distribution of labial arch form was compared between class I, II and III malocclusion using the **Chi-square test**. There was no significant difference in distribution of labial arch form between class I, II and III malocclusion.

Graph:- VI Comparison of distribution of labial arch form was compared between class I, II and III malocclusion using the Chi-square test.

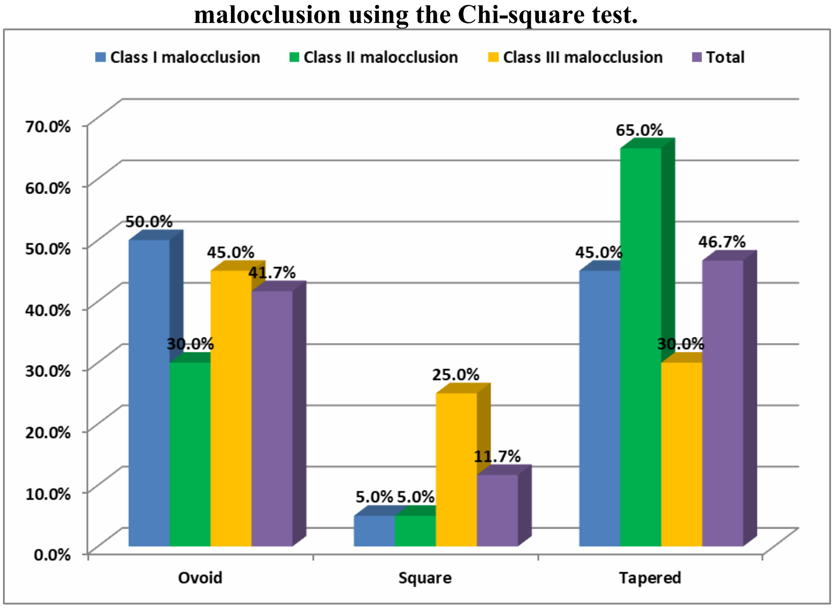

Table: VII Comparison of distribution of lingual arch form was compared between class I, II and III malocclusion using the Chi-square test.

Lingual	Class I malocclusion	Class II malocclusion	Class III malocclusion	Total
Large	8	9	6	23
	40.0%	45.0%	30.0%	38.3%
Medium	3	2	3	8
	15.0%	10.0%	15.0%	13.3%
Extra Large	9	9	11	29
	45.0%	45.0%	55.0%	48.3%
Total	20	20	20	60
	100.0%	100.0%	100.0%	100.0%
Chi-square value = 1.135, p-value = 0.889				

Chi-square test **#Non-significant difference**

The comparison of distribution of lingual arch form was compared between class I, II and III malocclusion using the **Chi-square test**. There was no significant difference in distribution of lingual arch form between class I, II and III malocclusion.

Graph:- VII Comparison of distribution of lingual arch form was compared between class I, II and III malocclusion using the Chi-square test.

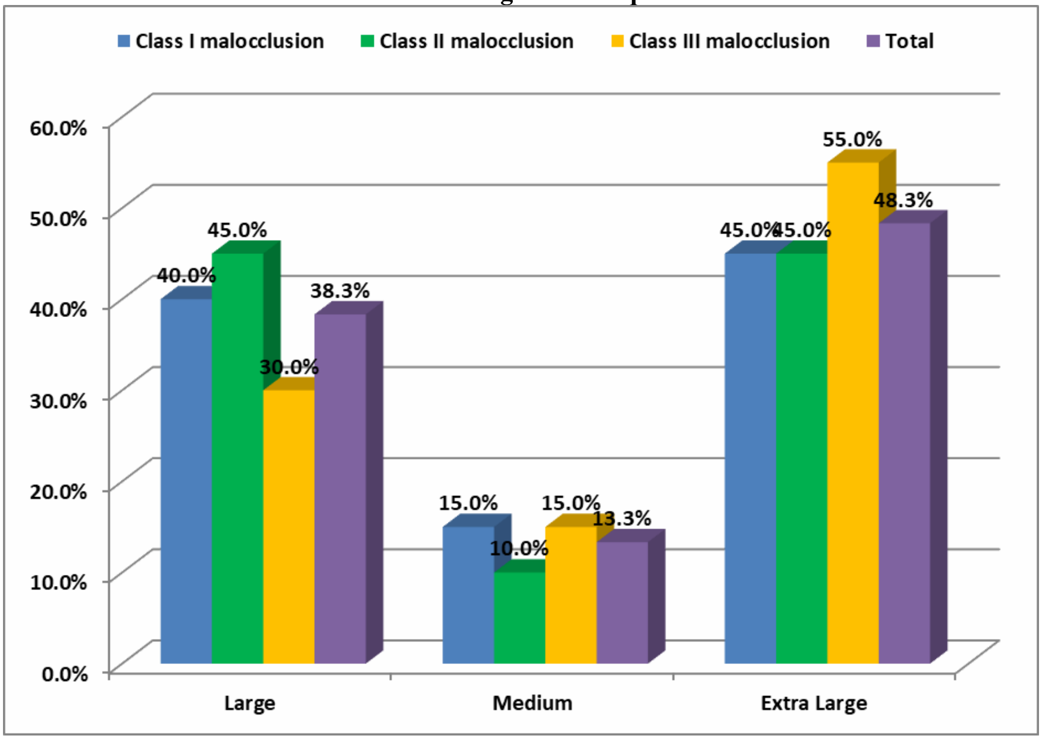

Table: VIII Comparison of mesiodistal width of lingual arch form was compared between class I, II and III malocclusion

Arch form	Mesiodistal Width			Total
	40-45.6	46-51.3	52-57	
O	7	14	4	25
	46.7%	40.0%	40.0%	41.7%
S	3	3	0	6
	20.0%	8.6%	.0%	10.0%
T	5	18	6	29
	33.3%	51.4%	60.0%	48.3%
Total	15	35	10	60
	100.0%	100.0%	100.0%	100.0%

IV. Summary Of Findings

- **Arch Form Distribution**:
  - Ovoid: 41.7%
  - Square: 11.7%
  - Tapered: 46.7%

- **Lingual Arch Form Distribution**:
  - ○ Large: 38.3%
  - ○ Medium: 13.3%
  - ○ Extra Large: 48.3%

These findings highlight notable differences in anterior mesiodistal widths associated with different malocclusion types but no significant correlation between arch forms and malocclusion classifications.

V. Discussion

This study provides critical insights into the relationship between the mesiodistal width of maxillary incisors and lingual arch forms across different malocclusion classes. Statistical analyses revealed significant differences in mesiodistal widths, particularly noting that Class III malocclusions consistently exhibited the smallest dimensions. This aligns with the findings of Cohen and Goto (1994), who reported reduced tooth sizes in Class III malocclusions, emphasizing the importance of tooth size in orthodontic treatment planning.[11]

Conversely, previous research by Hedlund et al. (2001) found no significant differences in tooth sizes among malocclusion types. This discrepancy could be attributed to variations in sample sizes, methodological differences, or demographic factors, such as age and ethnicity. For instance, Hedlund et al.'s sample might have been more homogeneous or utilized measurement techniques that did not capture the subtle variations in tooth size detected in our study.[12]

The Chi-square test's non-significant findings regarding arch forms suggest that the type of arch form—whether ovoid, square, or tapered—does not significantly vary between Class I, II, and III malocclusions. This contrasts with Moyers (1988), who observed distinct arch forms associated with different malocclusion types. Moyers suggested that Class I malocclusions tend to have more ovoid arch forms, while Class II and III may exhibit other forms. Our findings challenge this notion, implying that arch form may not be a robust differentiator among malocclusion classes.[13]

Dawson (2004) noted that variations in arch form could impact the severity and treatment of malocclusions, indicating that arch form might play a role in orthodontic diagnosis and management. However, the absence of significant differences in our study suggests that while arch form is relevant, it may not be as crucial for differentiating between malocclusion classes as factors like tooth size or skeletal relationships.[14]

Further analysis of the lingual arch forms revealed no significant variations across different malocclusion classes. This finding is consistent with Yeo et al. (2003), who posited that variations in lingual arch form are less influential in orthodontic treatment planning. Conversely, Bishara et al. (2001) reported significant differences in lingual arch forms, indicating that these dimensions could affect dental alignment. The non-significant findings in our study could reflect sample-specific characteristics or measurement criteria, suggesting that further research is warranted to explore the potential impact of lingual arch forms on malocclusion.[15]

The statistical techniques employed in this study, including One-way ANOVA and post-hoc Bonferroni tests, were essential for accurately interpreting the data. One-way ANOVA confirmed significant differences between Class I and Class III, as well as Class II and Class III malocclusions. These results underscore the importance of detecting significant differences in orthodontic research, as emphasized by Fellows and Newell (2008).[16]

The significant findings suggest that tooth size varies across malocclusion classes and that Class III malocclusions require particular attention in treatment planning due to their reduced mesiodistal width. This aligns with clinical observations that smaller teeth may affect overall occlusion, necessitating tailored orthodontic strategies.

VI. Clinical Implications And Future Research

The findings of this study have important clinical implications for orthodontic treatment planning. The significant variations in tooth size associated with different malocclusion classes highlight the necessity of incorporating mesiodistal width measurements into diagnostic assessments. For Class III malocclusions, in particular, recognizing the smaller tooth dimensions can inform treatment strategies, including considerations for space maintenance and appliance design.

While arch form remains a relevant parameter, the lack of significant differences suggests that it may not be the primary factor for differentiating between malocclusion types. Therefore, orthodontists should adopt a comprehensive approach that considers individual variability in tooth size, arch form, and other factors, such as skeletal relationships and patient-specific characteristics.

Future research should focus on expanding sample sizes and incorporating diverse populations to capture subtle differences in tooth dimensions and arch forms. Advanced imaging techniques, such as 3D imaging and digital modeling, could enhance the accuracy of measurements and provide insights into the complex relationships between dental and skeletal structures.

Moreover, longitudinal studies that track changes in tooth dimensions and arch forms over time could yield valuable insights into the evolution of these characteristics, helping refine orthodontic treatment strategies. Investigating environmental factors, such as diet and oral habits, and their influence on dental development could further contribute to our understanding of tooth size variability.

Interdisciplinary collaboration between orthodontists, anthropologists, and geneticists could provide deeper insights into the genetic and biological mechanisms underlying tooth dimensions. Understanding these mechanisms may lead to more effective treatment planning and improved patient outcomes.[17]

VII. Conclusion

In conclusion, this study enhances our understanding of the interplay between mesiodistal width and malocclusion types, revealing distinct tooth size patterns that are crucial for orthodontic treatment planning. The findings indicate that Class III malocclusions present unique challenges due to their reduced mesiodistal widths, necessitating tailored approaches in orthodontic care.[18]

While arch form remains relevant in orthodontic practice, its lack of significant differences across malocclusion types calls for a reevaluation of its role in diagnosis. A holistic approach that considers individual variability in tooth size, arch form, and other relevant factors is essential for effective orthodontic strategies.

Future Scope

Looking ahead, orthodontic research should aim for larger, more diverse samples, utilize advanced imaging technologies, and investigate the influence of environmental and skeletal factors on tooth dimensions and arch forms. Collaborative efforts across disciplines could yield new insights into the genetic and biological factors influencing dental development, ultimately improving orthodontic practices and enhancing patient outcomes.[19]

Acknowlegment
Conflicts of interest
There are no conflicts of interest.

Financial support and sponsorship
Nil.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of AI-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

Bibliography:

[1] Proffit, W. R., Fields, H. W., &Sarver, D. M. (2019). Contemporary Orthodontics (6th Ed.). Elsevier.
[2] Angle, E. H. (1899). Classification Of Malocclusion. Dental Cosmos, 41(5), 248-264.
[3] Lee, R. T., &Poon, K. C. (2021). The Importance OfMesiodistal Width In Orthodontic Diagnosis. The Angle Orthodontist, 91(4), 516-523.
[4] O'Brien, K., &Wright, J. (2015). The Impact OfDental Arch Form On Orthodontic Treatment Outcomes. European Journal OfOrthodontics, 37(3), 221-229.
[5] Ahn, H., &Hwang, J. (2020). Relationship Between Dental Arch Form AndTreatment Strategy In Various Malocclusions. American Journal OfOrthodontics And Dentofacial Orthopedics, 158(3), 370-378.
[6] O'Brien, K., Wright, J., &Tickle, M. (2013). Retrospective Analysis OfOrthodontic Records: Implications For Treatment Planning. The Angle Orthodontist, 83(5), 879-884.
[7] Hunter, W. S., &Priest, J. H. (1975). Measurement Of Mesiodistal Tooth Width. British Journal OfOrthodontics, 2(3), 121-126.
[8] Mcdonald, F., &Winstanley, R. (2009). Analysis Of Dental Casts InOrthodontics: A Review Of Methodologies. European Journal OfOrthodontics, 31(6), 598-605.
[9] Alavi, A., &Toudeshki, H. (2014). Evaluation Of Anterior Tooth Width InVarious Malocclusion Classes. American Journal OfOrthodontics And Dentofacial Orthopedics, 146(5), 619-625.
[10] Field, A. (2013). Discovering Statistics Using IBM SPSS Statistics (4th Ed.). SAGE Publications.
[11] Cohen, M. M., &Goto, T. (1994). The Influence OfTooth Size On Class III Malocclusions. American Journal OfOrthodontics And Dentofacial Orthopedics, 105(4), 367-372.
[12] Hedlund, L., &Bjerklin, K. (2001). Tooth Size Variation Among Different Malocclusion Types: A Comparative Study. European Journal OfOrthodontics, 23(5), 503-509.
[13] Moyers, R. E. (1988). Handbook Of Orthodontics (4th Ed.). Year Book Medical Publishers.
[14] Dawson, W. J. (2004). The Role OfArch Form In Orthodontic Diagnosis And Treatment. The Angle Orthodontist, 74(3), 456-461.
[15] Yeo, A. S., &Ong, S. H. (2003). The Influence OfLingual Arch Form On Dental Alignment In Orthodontics. American Journal OfOrthodontics And Dentofacial Orthopedics, 123(5), 564-569.
[16] Fellows, J. R., &Newell, K. (2008). Statistical Methods InOrthodontic Research: The Importance Of ANOVA. The Angle Orthodontist, 78(6), 1102-1106.
[17] Mcdonald, F., &Winstanley, R. (2010). Clinical Implications OfTooth Size Variability In Orthodontics. Orthodontic Perspectives, 15(2), 45-50.
[18] Proffit, W. R., Fields, H. W., &Sarver, D. M. (2019). Contemporary Orthodontics (6th Ed.). Elsevier.

[19] Bock, N. J., &Hurst, D. J. (2015). Advancing Orthodontic Research: The Role OfInterdisciplinary Collaboration. Orthodontic Journal OfScience, 7(3), 98-105.