

How to Cite:

Agrawal, P., Bagga, D. K., Jain, S., Aleemuddin, M. D., Singh, N., & Priya, K. (2022). Comparative evaluation of buccolingual inclination of posterior teeth in different malocclusions. *International Journal of Health Sciences*, 6(S6), 3101–3110. <https://doi.org/10.53730/ijhs.v6nS6.10024>

Comparative evaluation of buccolingual inclination of posterior teeth in different malocclusions

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Abstract---Objective: To compare the buccolingual inclination of maxillary and mandibular posterior teeth among Angle's Class I, Class II div 1 and class II div 2 malocclusion. Materials and methods: The sample comprised lateral Cephalometric radiographs and Dental Casts of 90 subjects in the age group of 15-25 years. The sample was divided into 3 groups of 30 samples each. The first group comprised of

records from 5 female and 25 male subjects with an average age of 20.67 years and showing Class I malocclusion. The second group comprised of records from 12 female and 18 male subjects with an average age of 20.03 years having Class II division 1 malocclusion and the third group of 18 male and 12 female subjects with an average of 20.63-years showing class II div 2 malocclusion. Results: Similar buccolingual inclination was seen in Class II div 1 and div 2 malocclusions for both maxillary and mandibular at premolar and molars. The buccolingual inclination in maxillary arch was found to be lowest in class I malocclusion for all the posterior teeth. The buccolingual inclination in the mandibular arch the buccolingual inclination at first premolar area was higher in class I malocclusion than class II div 1 and class II div 2. Conclusion: Buccolingual inclination is an important factor in the development of transverse discrepancy.

Keywords---buccolingual inclination, transverse discrepancy, crown inclination.

Introduction

Facial esthetics has been an objective of orthodontic treatment planning since the beginning of this specialty.¹It has been proven that the buccolingual inclination of posterior teeth have a significant impact on the attractiveness of the smile as well as on structural balance.² While a majority of studies focussed only on the inclination of anterior teeth, there can now be seen a slow rise in studies concerning the buccolingual inclination of posterior teeth. This can mostly be contributed to their role in proper occlusion along with smile attractiveness. According to Zachrisson, lingual inclination of premolars and molar lead to the visibility of dark buccal corridors thereby hampering smile esthetics. Buccolingual inclination is an important parameter to be considered in the factors affecting transverse occlusion.^{2,3} The greater buccal inclination of posterior teeth has been found to be correlated with increased lower anterior facial height. These cases also present with the lingual cusps being longer and more functional.^{4,5} In this study, the correlation between the buccolingual inclination of Angle's Class II malocclusions with Angle's Class I malocclusion was evaluated.

Aim & Objectives

The aim of this study is the evaluation and comparison of buccolingual inclination of teeth among Angle's Class I, Class II div 1 and class II div 2 malocclusion.

Objectives of the study

- To evaluate buccolingual inclination of posterior teeth in Angle's class I, class II div 1 and div 2 malocclusions.
- To make compare the buccolingual inclination among Angle's Class I, Class II div 1 and div 2 malocclusions.

Material and Method

The sample comprised of lateral Cephalometric radiographs and Dental Casts of 90 subjects in the age group of 15-25 years. The sample was divided into 3 groups of 30 samples each. The first group comprised of records from 5 female and 25 male subjects with an average age of 20.67 years and showing Class I malocclusion. The second group comprised of records from 12 female and 18 male subjects with an average age of 20.03 years having class II division 1 malocclusion and the third group of 18 male and 12 female subjects with an average of 20.63-years showing class II div 2 malocclusion.

Materials

The following material was used for the study:

- Lateral cephalometric radiographs and study models of 90 samples in the age group of 15-25 years.
- Universal Bevel Protractor (FORBES GOKAK LTD)
- Constructed glass plane.

Criteria for Selection

Lateral cephalogram and study models of the 90 subjects were grouped according to the following criteria:

- Group I- Angle's Class I malocclusion superimposed upon Class I skeletal base with ANB angle 0-4 °.
- Group II- Angle's Class II div. 1 malocclusion superimposed upon Class II skeletal base with ANB angle > 4°.
- Group III- Angle's Class II div. 2 malocclusion superimposed upon Class II skeletal base with ANB angle > 4 °.

Inclusion Criteria

Dental casts and lateral cephalogram of samples selected for this study was having following inclusion criteria:

- Subjects without previous history of orthodontic treatment.
- Posterior teeth in proper occlusion without any crowding or crossbite.
- Fully erupted teeth up to first molars.
- Absence of any abrasion or attrition.

Exclusion criteria

- Obscure lateral cephalograms.
- Study models with fractured teeth.

Method of collection of data

Duplicate casts were made for the pretreatment records. A glass plane was constructed for determining the posterior occlusal plane. The posterior occlusal plane (POP) was established according to the rules set by Janson et al and Ross et al. A glass plane was placed so that there was at least three-point contact, i.e., two molars and one premolar cusp. The glass plane was kept in position with two-point contact on the lateral wall of the model base and the cusp in contact was noted on both sides (Figure 1). The model bases were trimmed so that they became parallel to the posterior occlusal plane. The facial axis of the clinical crown (FACC) was marked on the buccal surface of each tooth and its midpoint was determined. The angle between this midpoint called the facial-axis point (FA point) and the posterior occlusal plane was measured. The buccolingual inclination of the maxillary and mandibular first and second premolars and first molars was measured in this way. A modified Universal Bevel Protractor (FORBES GOKAK LTD) was used for measuring the buccolingual inclination (Figure 2). The study models were placed on the platform of the device and the measuring arm was placed tangent to the FA point along the facial axis of the clinical crown (FACC) (Figure 3). The readings were repeated thrice and their average value was determined.



Figure 1. The identification of the three points for base trimming with glass plate

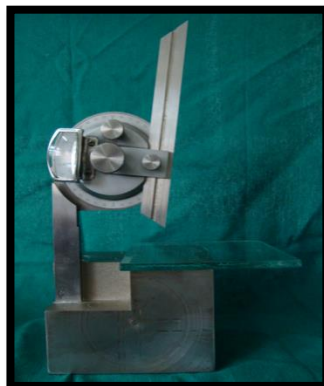


Figure 2. Apparatus for inclination measurement



Figure 3. Measurement of buccolingual inclination

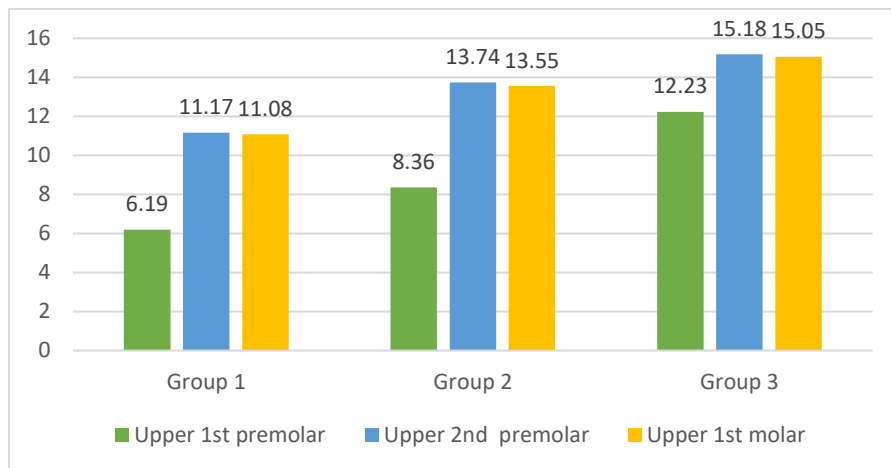
Results

Buccolingual Inclination of Maxillary Arch

The mean of buccolingual inclination standard deviation and range of maxillary arch for all groups 1-3 are shown in table 1 and their graphical representation is shown in graph 1.

Table 1
Mean of buccolingual inclination standard deviation and range of maxillary arch for all groups 1-3 (n=30)

		Mean in °	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Upper 1 st premolar	Group 1	6.19	2.02	0.37	5.44	6.95	3.75	14.00
	Group 2	11.17	3.21	0.59	9.97	12.37	5.00	18.25
	Group 3	11.08	2.94	0.54	9.98	12.17	4.50	15.50
Upper 2 nd premolar	Group 1	8.36	2.62	0.48	7.38	9.33	5.00	14.25
	Group 2	13.74	2.17	0.40	12.93	14.55	10.00	19.25
	Group 3	13.55	3.85	0.70	12.11	14.99	6.75	19.00
Upper 1 st molar	Group 1	12.23	3.11	0.57	11.06	13.39	3.25	16.00
	Group 2	15.18	1.78	0.32	14.52	15.85	11.00	18.50
	Group 3	15.05	2.49	0.46	14.12	15.98	9.00	19.00



Graph 1. Mean buccolingual inclination of maxillary arch for all groups (in °)

Comparison of Buccolingual Inclination of Maxillary Arch in Different Groups

The buccolingual inclination of maxillary arch of all three groups 1-3 at three different teeth i.e. (first premolar, second premolar and first molar) were evaluated and compared with each other as shown in Table 2. In Table 2, group 1 showed a statistically significant difference ($p < 0.05$) and large effect size by means of Cohen's d value at first premolar, second premolar and first molar when compared with all groups and there was a statistically insignificant difference of buccolingual inclination between group 2 and group 3 and Cohen's d value also suggested small effect size between these group at first premolar, second premolar and first molar.

Table 2
One-way ANOVA test, post hoc tukey's test of buccolingual inclination of maxillary arch in different groups 1-3 (n=30)

Dependent Variable	Group	Mean Difference in °	Std. Error	P value	95% Confidence Interval		Cohen's d	Pooled sd.
					Lower Bound	Upper Bound		
Upper premolar 1 st	1vs 2	4.98000	.71576	.000*	6.6867	3.2733	1.86	2.68
	1vs3	4.88333	.71576	.000*	6.5900	3.1766	1.93	2.52
	2vs3	.09667	.71576	.990	1.6100	1.8034	0.032	3.08
Upper premolar 2 nd	1vs 2	5.38667	.76625	.000*	7.2138	3.5596	2.236	2.41
	1vs3	5.19167	.76625	.000*	7.0188	3.3646	1.576	3.29
	2vs3	.19500	.76625	.965	2.0221	1.6321	0.06	3.13
Upper molar 1 st	1vs 2	2.95833	.65107	.000*	4.5108	1.4059	1.16	2.53
	1vs3	2.82667	.65107	.000*	4.3791	1.2742	1	2.82
	2vs3	.13167	.65107	.978	1.4208	1.6841	0.06	2.16

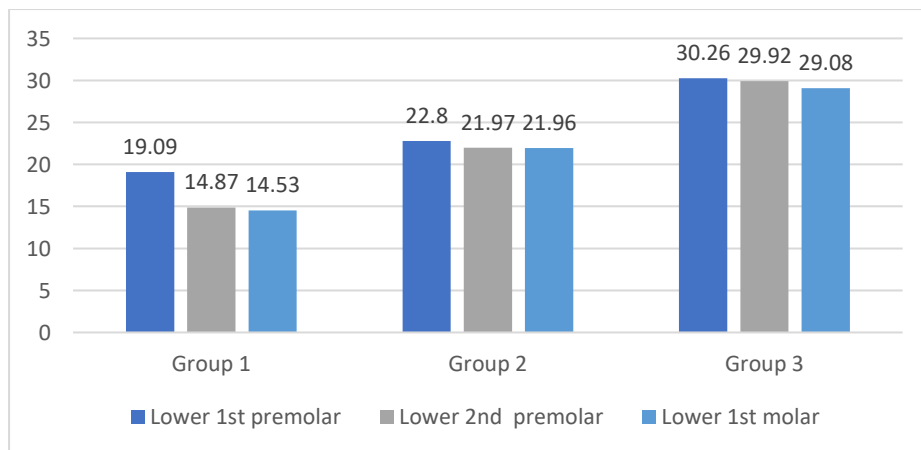
P < 0.05 Significant, p < 0.001 highly significant, p < 0.0001 very highly significant
Cohen's d is 0.2 = small effect size, 0.5 = moderate effect size, 0.8 = large effect size

Buccolingual Inclination of Mandibular Arch

The mean of buccolingual inclination standard deviation and range of mandibular arch for all groups 1-3 were shown in Table 3 and their graphical representation is shown in graph 2.

Table 3
The mean of buccolingual inclination standard deviation and range of lower arch for all groups 1-3 (n=30)

		Mean in °	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Lower 1 st premolar	Group 1	19.09	3.60	0.66	17.75	20.44	11.25	24.00
	Group 2	14.87	3.59	0.66	13.53	16.21	9.50	22.00
	Group 3	14.53	2.61	0.48	13.56	15.50	9.00	19.75
Lower 2 nd premolar	Group 1	22.80	2.78	0.51	21.76	23.84	15.50	27.00
	Group 2	21.97	2.03	0.37	21.21	22.72	18.50	27.00
	Group 3	21.96	7.11	1.30	19.30	24.61	13.50	54.75
Lower 1 st molar	Group 1	30.26	3.35	0.61	29.00	31.51	24.25	35.25
	Group 2	29.92	2.43	0.44	29.01	30.82	24.75	33.75
	Group 3	29.08	4.04	0.74	27.57	30.59	20.75	34.00



Graph 2. Mean of buccolingual of mandibular arch for all groups (in °)

Comparison of Buccolingual Inclination of Mandibular Arch in Different Groups

Buccolingual inclination of mandibular arch of all groups 1-3 at three different teeth i.e. (first premolar, second premolar and first molar) were evaluated and compared with each other as shown in Table 4. In Table 12. Group 4 showed a statistically significant difference ($p < 0.05$) and large effect size by means of Cohen's d value at first premolar, when compared with all groups. There was statistically insignificant difference of buccolingual inclination between group 1

and other two groups and Cohen's d value also suggested small effect size at second premolar and first molar region. There was statistically insignificant difference of buccolingual inclination between group 2 and group 3 and Cohen's d value also suggested a small effect size between these groups at first premolar, second premolar and first molar.

Table 4
One-way ANOVA test, post hoc Tukey's test of buccolingual inclination of mandibular arch in different groups 1-3 (n=30)

Dependent Variable	Group	Mean Difference in °	Std. Error	P value	95% Confidence Interval		Cohen's d	Pooled Sd.
					Lower Bound	Upper Bound		
Lower 1 st premolar	1vs 2	4.22500	.85166	.000*	2.1942	6.2558	1.173	3.6
	1vs3	4.56167	.85166	.000*	2.5309	6.5924	1.45	3.14
	2vs3	.33667	.85166	.918	2.3674	1.6941	0.08	3.14
Lower 2 nd premolar	1vs 2	.83000	1.1772	.761	1.9772	3.6372	0.34	2.43
	1vs3	.83833	1.1772	.757	1.9689	3.6455	0.298	5.4
	2vs3	.00833	1.1772	1.000	2.8155	2.7989	0.001	5.23
Lower 1 st molar	1vs 2	.33833	.86187	.919	1.7168	2.3934	0.114	2.92
	1vs3	1.17167	.86187	.367	.8834	3.2268	0.317	3.71
	2vs3	.83333	.86187	.600	2.8884	1.2218	0.25	3.33

P < 0.05 Significant, p < 0.001 highly significant, p < 0.0001 very highly significant
Cohen's d is 0.2 = small effect size, 0.5 = moderate effect size, 0.8 = large effect size

Discussion

According to various studies conducted over the years, Class II malocclusion has been determined to be the most prevalent skeletal discrepancy. Ever since Andrews described the inclination of teeth in his six keys, the majority of research was carried out on the labiolingual inclination of anterior teeth as they were considered to influence facial esthetics.³ However, with further research it has now come to light that the buccolingual inclination of posterior teeth affects both the smile attractiveness as well as occlusion. According to Zachrisson, the negative buccal corridor increased with an increase in the lingual inclination of posterior teeth. This would negatively affect the smile esthetics. The buccolingual inclination is an essential component of transverse occlusion and hence proper focus should be given to this characteristic in posterior teeth.^{6,7}

This study evaluated and compared the buccolingual inclination of teeth at first premolar, second premolar and first molar among Angle's Class I, Class II div 1 and Class II div 2 malocclusion. In the maxillary arch, the buccolingual inclination was seen to be higher for premolars and the first molar in Class II div 1 and div 2 malocclusion when compared to Class I. In the mandibular arch, the first premolars showed a more lingual inclination for Class I malocclusion in comparison to Class II div 1 & div 2. There was no significant difference in the

buccolingual inclination of the mandibular second premolar and first molar between Class I, Class II div 1 and div 2 malocclusions.

A similar study was conducted by J Guilherme in which he compared the buccolingual inclinations of posterior teeth in subjects with vertical and horizontal growth patterns.⁸ The sample of horizontal patterns consisted of class II malocclusion and the vertical pattern consisted of class I and class II malocclusion. He found that the maxillary molars and premolars in subjects with vertical growth patterns had a statistically significant greater buccal inclination as compared to those with horizontal growth patterns. No difference was seen in the inclination of the mandibular posterior teeth between the horizontal and vertical growth patterns.

In this study we found that the maxillary premolars and molars were palatally inclined with a buccolingual inclination of 4-5 degrees while the mandibular posterior teeth did not present with any significant difference. On comparison of Class II div 1 and Class I occlusion the sample comprising of Class II div 1 malocclusion showed greater palatal inclination as compared to Class I cases. These findings were in accordance with the results of a study by Shu et al for comparing the buccolingual inclination of teeth between Class II division 1 malocclusion and Class I occlusion.² The present study could be improved by increasing number of the sample size which can give more significant results and also this study should be done with an additional class III malocclusion. Also, further studies could be done by use of a digital scanner which can save time and be more reliable.

Conclusion

The following conclusions can be drawn from the study:

- Similar buccolingual inclination was seen in Class II div 1 and div 2 malocclusions for both maxillary and mandibular at premolar and molars.
- The buccolingual inclination in maxillary arch was found to be lowest in class I malocclusion for all the posterior teeth.
- The buccolingual inclination in mandibular arch the buccolingual inclination at the first premolar area was higher in class I malocclusion than in class II div 1 and class II div 2.

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