Original Article

A Comparative Evaluation of Mandibular Intercanine Arch Width Changes in Class I and Class II Division 1 Malocclusions Treated with Extraction—An Occlusogram Study

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ABSTRACT

Background: The most commonly observed skeletal discrepancy in the orthodontic population is class II. It has been observed that there are conflicting results in order to characterize the dental arch form of patients with Class II malocclusion. Therefore, this study was done to compare the effect of all four first premolar extractions on the mandibular intercanine arch width of orthodontically treated samples with Angle's Class I and Class II division 1 malocclusion using occlusograms.

Materials and method: Occlusograms of pre and post treatment mandibular study models of patients with Class I (n = 30) and Class II division 1 (n = 30) treated with extractions were included in the study. The data was analyzed by ANOVA followed by Tukey's multi comparison test.

Results: There was no statistically significant difference in the pre and post treatment mandibular intercanine arch width between the two groups. However in both groups a significant increase in mandibular intercanine arch width was observed post treatment which was 1.35 ± 0.76 mm in Group I and 1.44 ± 0.84 mm in Group II. Interestingly mean change in mandibular intercanine arch width of both the did not differ significantly (p = 0.667) though it was 6.2% higher in Group II as compared to Group I.

Conclusion: Since the change in mandibular intercanine arch width is significant in both Class 1 and Class II division 1 malocclusions, the tendency for relapse in such cases is high. Hence greater emphasis must be given upon planning the retention phase so as to prevent the increased tendency to relapse. The retention protocol has to be followed strictly in cases treated with extraction of premolars.

Key words: Mandibular intercanine width; Occlusogram; Extraction therapy, Class I malocclusion; Class II division 1 malocclusion.

INTRODUCTION

Transverse arch malrelationships such as crowding and local irregularities are common causes of Class I and Class II malocclusions. They are usually treated by extraction or non extraction modalities in the permanent dentition stage.[1] In extraction cases the canines could move to the buccal aspect if they were moved distally into the extraction sites, thereby occupying a wider part of the arch.[2] There is a general consensus within the orthodontic community that the arch form, especially of the lower jaw, should be maintained throughout the course of treatment since instability due to changes in arch form (especially the lower inter-canine distance) can lead to periodontal damage or crowding relapse.[3,4]

The Class II malocclusion has been proposed to be the most commonly observed skeletal discrepancy in the orthodontic population. Efforts to characterize the dental arch form of patients with Class II malocclusion have yielded conflicting results.It has been generally accepted by most studies that subjects with Class II div 1 malocclusion have a narrower maxillary dental arch than those with Class I normal or ideal occlusion or Class I malocclusion.[5,6] This may be attributed to the differing treatment modalities, malocclusion types, and

sample sizes.[7] Although the literature has provided information regarding the effects of extraction and non-extraction therapy, the findings on the amount of inter-arch changes of Class I and Class II extraction therapy display variation and has not been researched extensively.

Therefore this study was performed to compare the possible effect of all four first premolar extraction on the mandibular intercanine arch width (MICW) of Class I and Class II division 1 patients who underwent orthodontic treatment.

MATERIALS AND METHOD

This retrospective study was conducted on 60 mandibular study modelsof patients in the permanent dentition, whose treatment involved four first premolar extractions as part of a comprehensive orthodontic treatment plan. Patients with good and measurable dental record casts with mandibular anterior crowding of ≤ 3 mm treated with pre-adjusted appliance system (MBT prescription 3M, Unitek, Monrovia, Calif.) with a 0.022 × 0.028″ slot were selected. The sample excluded orthodontic study models of patients with any congenital anomalies or systemic conditions, with tooth agenesis or missing permanent teeth, patients in the mixed dentition period or whose who have been tested with Quad Helix, a functional appliance, or a rapid palatal expander used as part of their orthodontic treatment, any restorative treatment that could possibly affect the shape and size.

The sample was divided into groups based on the malocclusion: Group I: Class I malocclusion and Group I: Class II division 1 malocclusion.

To fabricate the occlusogram, an A4 sized paper was taken and a window of 4″ × 10″ was made. A 6-inch metal ruler was placed along the horizontal length of the window to test if any magnification was introduced by the photocopier itself (Xerox Work Center 7220, Xerox Corporation, US). The pre and post treatment mandibular dental casts were placed in the window with the base facing upwards and the teeth touching the glass surface. A 1:1 negative photocopy was made with the contrast at the darkest possible setting **(Figure 1)**.

Measurement of the MICW was done on the occlusogram-susing a sharp 0.3 mm graphite lead pencil to mark the most prominent labial aspect of the mandibular canines. The sharp ends of the digital caliper (with a resolution of 0.01mm, accuracy of ± 0.02mm/0/0.001″ and a repeatability of 0.01 mm/0/0.0005″, 0-300 mm, Masel Ortho, UK) were placed on the lead marks and at the best estimate of a right angle to a line bisecting the incisor segment in the mandibular arch to make the measurement **(Figures 2 and 3)**.

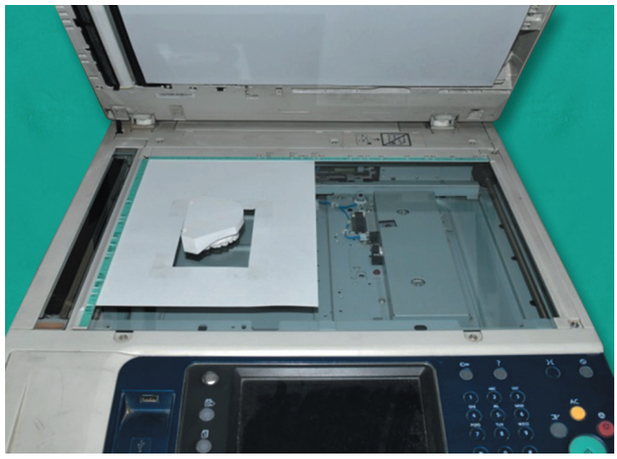


Figure 1 Fabrication of Occlusogram

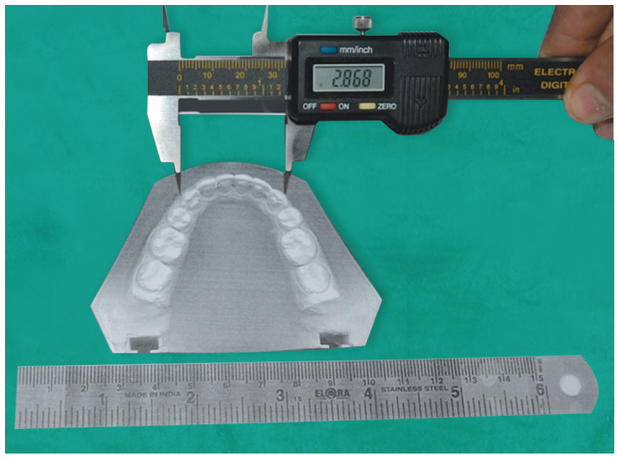


Figure 2 Measurement of intercanine width

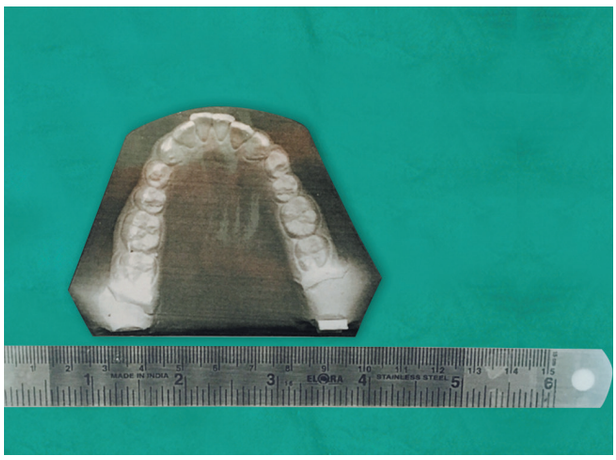


Figure 3 Occlusogram

Table 1

Comparison of MICW between the groups (Mean ± SD, *n* = 30)

Group	*Group I*	*Group II*	*p value*
Pre	29.65 ± 1.20	29.03 ± 1.76	0.320
Post	31.00 ± 0.90	30.46 ± 1.59	0.457

The reproducibility of the measurements was evaluated by analyzing the differences between 10 double measurements of intercanine distances, randomly selected and taken at different times.

STATISTICAL ANALYSIS

Intra class co-relation (ICC) analysis was done to assess the reliability of the measurements (variables).

Data were summarised as Mean ± SD (standard deviation). Pre and post data of two groups were compared together by two factor analysis of variance (ANOVA) and the significance of mean difference within (inter) and between (intra) the groups was done by Tukey's HSD (honestly significant difference) post hoc test. Two independent groups were compared by Student's *t* test. A two-tailed ($\alpha = 2$) $p < 0.05$ was considered statistically significant.

RESULTS

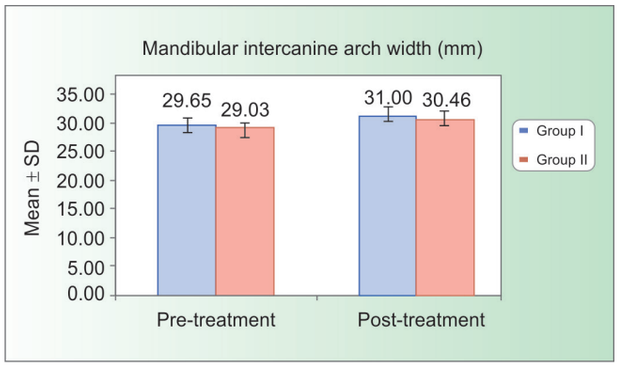
The pre and the post treatment MICW width of two groups are summarized in **Table 1** and **Graph 1**.

In Group I, the mean pre treatment MICW was (± SD) 29.65 ± 1.20 mm while in Group II, itwas (± SD) 29.03 ± 1.76 mm.The pre treatment mean MICW did not differ significantly between the groups ($p = 0.320$) **(Table 1 and Graph 2)**.

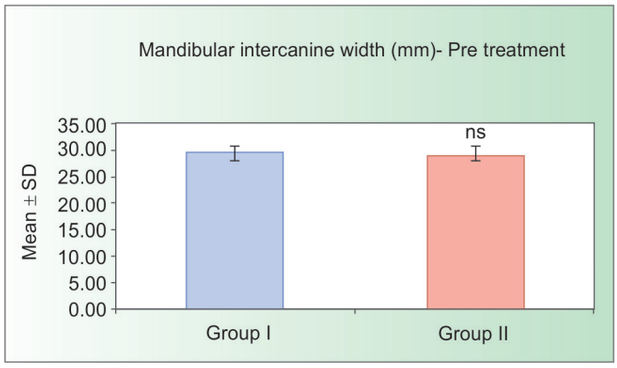
In Group I, the mean post treatment MICW was (± SD) 31.00 ± 0.90 mm while in Group II it was (± SD) 30.46 ± 1.59 mm. The post treatment mean MICW did not differ significantly between the groups ($p = 0.457$) **(Table 1 and Graph 3)**.

Both the groups showeda significant increase in MICW in the post treatment (29.65 ± 1.20 vs. 31.00 ± 0.90, $p < 0.001$) and (29.03 ± 1.76 vs. 30.46 ± 1.59, $p < 0.001$) respectively. **(Table 2 and Graphs 4, 5)**.

In Group I, the post treatment change in MICW (i.e. mean change from pre to post) was (± SD) 1.35 ± 0.76 mm, while in Group II it was (± SD) 1.44 ± 0.84 mm. Student's t test showed similar change between the two groups (1.35 ± 0.76 vs. 1.44 ± 0.84, $t = 0.43$, $p = 0.667$) though it was 6.2% higher in Group II as compared to Group I **(Table 3 and Graph 6)**.

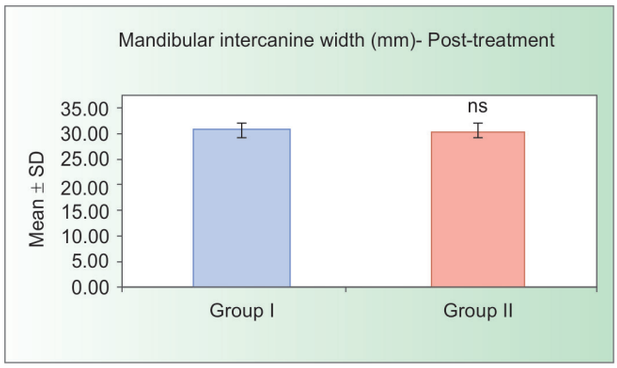


Graph 1 Pre- and post-MICW of Group I and II



ns$p > 0.05$ - as compared to Group I

Graph 2 Comparison of pre-treatment MICW between Group I and II



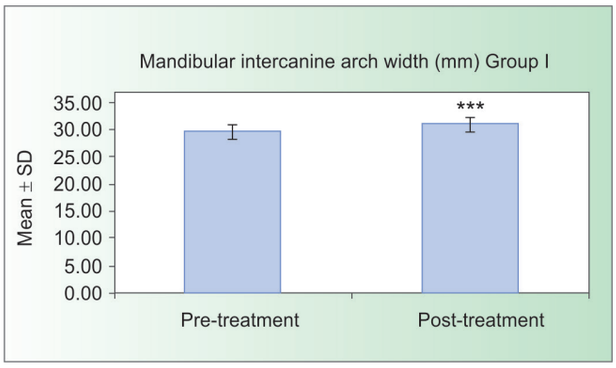
ns$p > 0.05$ - as compared to Group I

Graph 3 Comparison of post-treatment MICW between Group I and II

Table 2

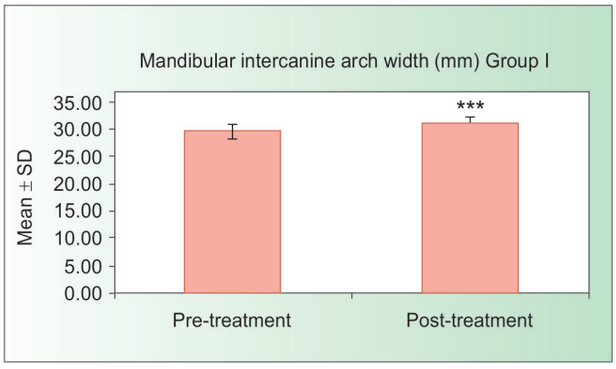
Comparison of pre- and post-MICW within the groups (Mean ± SD, *n* = 30).

Group	*Pre*	*Post*	*p value*
Group I	29.65 ± 1.20	31.00 ± 0.90	<0.001
Group II	29.03 ± 1.76	30.46 ± 1.59	<0.001



***p < 0.001 - as compared to Pre-treatment

Graph 4 Comparison of pre- and post-MICW of Group I



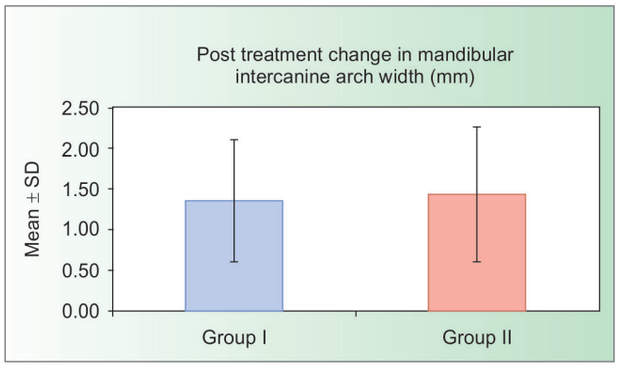
***p < 0.001 - as compared to Pre-treatment

Graph 5 Comparison of pre- and post-MICW of Group II

Table 3

Post-treatment change in MICW (Mean ±SD, *n* = 30) of two groups

Group I	*Group II*	*p value*
1.35 ± 0.76	1.44 ± 0.84	0.667



Graph 6 Comparison of post-treatment change in MICW between Group I and II

DISCUSSION

The Class II malocclusion has been proposed to be the most commonly observed skeletal discrepancy in the orthodontic population.[9] The generally accepted concept is that subjects with Class II division 1 malocclusion have a narrower maxillary dental arch than those with Class I normal or ideal occlusionor Class I malocclusion. Consensus on the mandibular arch form is more fleeting with inconsistent results. Therefore there was a need for further investigation of the mandibular intercanine width of subjects with Class II div I malocclusion as compared to class I malocclusion and the possible effects of all 1st premolars extractions on the intercanine widths.[6]

The age range of the subjects in the present study was between 13 to 20 years of age. Bishara et al.[10] suggested that only limited changes in arch width occurred between 13 and 25 years of age. Therefore, it was assumed that the arch width of the subjects selected in the present study were stable.

The most prominent labial aspect of the buccal surfaces of the mandibular canines was considered for easy reproducibity and relative stability of the point when seen on a two dimensional front to determine the widest possible widths of the arches and to prevent confusion when selected cusps tips were not distinct. Gianelly[8] andAksu[1] considered the most prominent labial aspect of the buccal surface of the canines as has been done in our study.

Investigators have used different methods and devices for the measurement of the intercanine widths. Schirmer and Wiltshire[12] and Champagne[13] compared measurements made manually on casts with those made on digitized casts obtained from a photocopier. On the other hand, Bhatia and Harrison[14] studied the performance of the traveling microscope. Further,

Martensson and Ryden[15] investigated a holographic system for measuring dental casts. Several authors have proposed the use of occlusograms for establishing space requirements.[16] In this study occlusograms were made by photocopying mandibular study casts with a metallic millimeter rulers placed to control parallax and magnification. The method used in the present study was found to be easy, precise, and more practical.

It was observed in the study that the difference in the pre treatment MICW between Group I and Group II was not significant. Similar findings have been reported by few studies[17-19] where there was no significant difference. Braun et al[20] used beta function curves to describe the Class II division 1 mandibular arch form as having a smaller arch width and depth than the Class I mandibular arch form. In contrast many studies[5,9,21] argued that mandibular intercanine width is greater in Class II division 1 arches compared with Class I arches. Most studies suggest that the maxillary arch is narrow and tapered in Class II division 1 malocclusion. So it is expected that the mandible should follow the maxillary arch and be narrow and constricted as well when compared to the Class I malocclusion. However, Staley et al[18] stated that patients with Class II div 1 malocclusion had a narrower maxillary intercanine, intermolar and alveolar widths. Their findings revealed a posterior cross bite tendency in the Class II group suggestive of a narrower maxillary arch as compared to the mandible.

It was observed in the study that there was a significant increase in MICW in post treatment, which was statistically significant. Numerous researchers[1,3,8,10-22] have also said the same. The range of increment was reported between 0.51 mm and 2.2 mm. This larger increase observed in the group treated with extractions is justified by the retraction of the anterior teeth to a wider region of the arch (premolar region). This result is in agreement with Gianelly[8], who also observed changes in the MICW (1.39 mm) emphasizing that the arches were approximately 1 mm wider in the mandibular intercanine region after the treatment with extraction of four first premolars. King[23] believed that if the canines are moved distally into the extraction spaces they may be expanded buccally, but for this expansion the limits of their new distal location must be appreciated. Luppanapornlarp and Johnston[24] reported a change of 3 mm in the intercanine arch width in Class II div 1 patients treated with extractions. Boley et al[25] observed an increase of 1.7 mm in the mandibular intercanine arch width in Class I patients treated with extractions. BeGole et al[26] observed that the mandibular intercanine widths increased 1.58 mm in an extraction sample. Vaden and Harris[27] reported an increase of 1.07 mm in an extraction sample. It was also observed that the difference in the post treatment MICW between Group I and Group II was not significant.

Both groups showed similar change in the MICW post-treatment though the change in Group 2 was 6.2% higher than in Group 1. This indicates that post extraction, the canines are retracted to a similar amount in Class I and Class II division 1 malocclusion that was statistically not significant.

It is evident from our study that the MICW changes are significant in the subjects who are treated with the extraction of all four first pre-molars since the canines are retracted into a wider portion of the arch. The amount of expansion is not dependent upon the malocclusion.

CONCLUSION

The study showed a statistically significant increase in the mandibular intercanine width in both groups post treatment. This change was similar for both the groups suggesting that this increase is not dependent on the malocclusion. Since the change in mandibular intercanine arch width is significant in both Class 1 and Class II division 1 malocclusions, the tendency for relapse in such cases is high. Hence greater emphasis must be given upon planning the retention phase so as to prevent the increased tendency to relapse. The retention protocol has to be followed strictly in cases treated with extraction of premolars.

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