

A Retrospective Evaluation of Treatment Outcomes Obtained with Two Orthodontic Appliance Systems in the Treatment of Class I Bimaxillary Dento-Alveolar Protrusion Patients

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ABSTRACT

Aim: The aim of the study was to retrospectively evaluate the dentofacial changes obtained with two orthodontic treatment systems in the treatment of Class I bimaxillary dento-alveolar protrusion patients. The objective was to find if there was any advantage of using any particular treatment system in treatment of Class I bimaxillary dento-alveolar protrusion.

Materials and Methods: The data for the study was obtained from pre and post-treatment lateral cephalograms of twenty patients, of whom ten each were treated with Begg light wire technique and pre adjusted edgewise appliance. Pre and post-treatment parameters on lateral cephalograms were compared using Wilcoxon Signed Ranks test.

Results: All linear and angular parameters pertaining to hard and soft tissues showed significant changes, indicating comparable retraction of upper and lower incisors, upper and lower lips, an increase in nasolabial angle and decrease in circumoral convexity.

Conclusion: In the present study, judicious use of mechanics and orthodontic forces gave good clinical results with comparable hard and soft tissue changes, following four first premolar extractions in bimaxillary dento-alveolar protrusion patients in both treatment systems. The study showed no significant changes except for a slight difference in treatment duration between these appliance systems.

Keywords: Bimaxillary dento-alveolar protrusion, cephalometric appraisal, orthodontic retraction, Begg Light wire appliance, PEA.

INTRODUCTION

Bi-maxillary dento alveolar protrusion is defined as the concomitant proclination of the upper and lower incisors with a Class I molar relation having an esthetic problem of prominence of lips and a convex profile. Bimaxillary dento-alveolar protrusion is a common malocclusion found in the Kerala population. It has a profound effect on the esthetic as well as psychological wellbeing of the

affected individual. First premolar extraction followed by orthodontic retraction seems to be the most favourable orthodontic solution to this malocclusion. The "Begg Differential force technique" is a versatile treatment philosophy using the differential tooth movement by application of light forces. This produces an efficient and effective anchorage control in the technique. It is one of the least time consuming appliances.

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A number of new treatment philosophies with pre-adjusted appliances are flooding the orthodontic field. Even in these circumstances, the Begg philosophy has a very relevant part in our treatment procedures due to firstly, the ease and speed of the treatment procedure and secondly, economics. Both of these are important in our way of medical care system. Even though the spotlight is now on pre-adjusted appliances, the Begg appliance is by no means inferior to other treatment philosophies.

The study is aimed at evaluating retrospectively the dentoalveolar and soft tissue profile changes following treatment in Angle's Class I bimaxillary dento-alveolar protrusion cases treated with four bicuspid extraction and the Begg light wire appliance/ McLaughlin, Bennett, and Trevisi (MBT) mechanics of the preadjusted edgewise appliance. Linear and angular measurements are made from pre and post-treatment lateral cephalograms of twenty patients, ten from each group, to evaluate the changes in the dentofacial complex.

AIMS AND OBJECTIVES

The primary objective of our study is a quantitative analysis of dentoalveolar and soft tissue profile changes following orthodontic treatment of the following parameters, using two different orthodontic treatment techniques:

- (a) Axial inclination of upper incisors
- (b) Axial inclination of lower incisors
- (c) Inter-incisal angle
- (d) Incisor mandibular plane angle
- (e) GoGn-SN
- (f) Apical base discrepancy
- (g) Linear and angular soft tissue parameters

Since the objective of treatment in bimaxillary dento-alveolar protrusion patients is achieving an esthetic profile, it is important to study the changes in the relationship of soft tissues to skeletal and dental structures that actually define the treatment outcome with orthodontic treatment.

MATERIALS AND METHODS

Approval for this study was obtained from the Institutional Ethics Committee. The dental, skeletal and soft tissue parameters were studied with the help of pre and post-treatment lateral

cephalometric radiographs of twenty patients, ten of whom were treated with the Begg technique and the other ten treated with PEA, in the Department of Orthodontics of a Dental College in Kerala. The malocclusion was classified as Angle's Class I bimaxillary dento-alveolar protrusion. All patients had full complement of teeth up to the second molars. The group consisted of twenty patients (9 males and 11 females) in the age group of 14-20 years with a mean age of 16.6 years. This was done to form a homogeneous group to avoid the differences if any in response to treatment between male and female patients. The patients were treated with four first premolar extractions followed by anterior retraction with either the Begg light wire appliance or the Pre-adjusted edgewise appliance (0.022" MBT). The treatment result at the time of removal of active appliance was judged to be satisfactory and all patients were given wrap-round retainers after the removal of the fixed appliance.

Pre and Post-treatment cephalometric radiographs were taken and tracings were done using transparent 0.003" acetate paper and 0.03 mm HB lead pencil. Each radiograph was manually traced by the same operator (Fig.1). The skeletal parameters measured were SNA, SNB, ANB and SN-GoGn. The dental parameters measured were upper incisors to maxillary & SN plane, lower incisors to mandibular plane, IMPA and the inter-incisal angle. To assess the soft tissue changes following incisor retraction, the angular and linear soft tissue parameters measured were the naso-labial angle and the Ricketts esthetic plane to upper and lower lips.

All angular measurements were made to the nearest 0.5° and linear measurements to 0.5 mm. To identify any intra-examiner error, ten radiographs were randomly picked up and retraced by the same investigator after an interval of two weeks. The intraclass correlation coefficient was used to evaluate the level of agreement and showed good agreement.

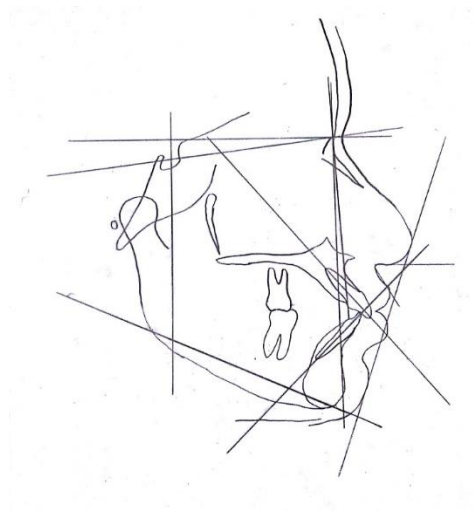


Fig 1: Shows the Skeletal & Dental Parameters measured in the study.

RESULTS

Pre and post-treatment cephalometric parameters were calculated separately for each patient and the data was entered in Microsoft Excel. For each parameter, the mean and standard deviation were calculated using the SPSS program version 16 (SPSS Inc, Chicago, Ill). The Mann-Whitney U test was used to assess whether the samples in both groups were similar with respect to the parameters selected and it was found that the samples exhibited no

significant differences at T0. The differences between the means were calculated using the Wilcoxon Signed Ranks test. This was used to evaluate the statistical significance of the differences between the mean values obtained for pre and post-treatment in each studied parameter, in the two techniques. The level of significance was set at $P < 0.05$.

The average duration of treatment in the Begg technique was slightly shorter than that of the Pre-adjusted edgewise appliance technique. However, there were no significant differences between the two techniques in terms of skeletal, dental and soft tissue parameters evaluated at T1.

On an average, the upper and lower lip prominence decreased by 4mm following 1st premolar extraction space closure and retraction of the upper and lower labial segments. The naso-labial angle showed a mean value change of 13.4° following upper incisor retraction in the Begg technique, and in the pre-adjusted edgewise technique it was 14.2° . The soft tissue profile exhibited almost similar angular and linear skeletal and dental changes post-treatment following 1st premolar extractions and incisor retraction in patients with bimaxillary dento-alveolar protrusion.

Table1: Cephalometric parameters used in the study.

Angular measurements

No	Parameters	Description
1	SN-GoGn	Sella-Nasion to mandibular plane angle
2	Nasolabial angle	Angle between line tangent to base of the nose and line tangent to upper lip
3	IMPA	Lower incisor to mandibular plane angle
4	U1-NA	Angulation of the long axis of U1 to NA line
5	L1-NB	Angulation of the long axis of L1 to NB line
6	U1-SN	Angle between the long axis of U1 to S-N plane
7	U1-L1	Angle between the long axes of U1 and L1
8	SNA	Angle between the SN plane and NA line
9	SNB	Angle between the SN plane and NB line
10	ANB	The difference between the angles SNA and SNB

Linear measurements

No	Parameters	Description
1	U1-NA	Horizontal distance from Is and line connecting hard tissue N to hard tissue point A
2	L1-NB	Horizontal distance from Li and line connecting hard tissue N to hard tissue

		point B
3	Upper lip to E-line	Horizontal distance from E line (line connecting tip of nose and soft tissue chin) to upper lip anterior
4	Lower lip to E-line	Horizontal distance from E line to lower lip anterior

Table 2: Table showing the Mean values of the linear and angular measurements in the

(a) Pre Treatment (**T0**) (b) End of Treatment (**T1**)

Variables	Begg Technique			PEA		
	T0	T1	Difference	T0	T1	Difference
Sagittal skeletal changes						
SNA(°)	83.65	82.15	1.5	84.2	83.1	1.1
SNB(°)	81.1	79.4	2.1	82.4	81.2	1.2
ANB(°)	2.55	2.75	0.2	1.8	1.9	0.1
Vertical skeletal changes						
SN-GoGn (°)	33.5	34.6	1.1	32.3	33.1	0.8
Dental changes						
U1-NA(°)	39.1	27.5	11.6	38.2	25.3	12.9
U1-NA(mm)	5.78	3.78	2.0	6.1	4.2	1.9
L1-NB(°)	47.2	28.1	19.1	45	27	18
L1-NB(mm)	7.52	5.51	2.01	7.78	5.64	2.14
U1-SN(°)	117.5	103.2	14.3	121	106	15
IMPA(°)	110.7	96.25	14.45	109	95	14
U1-L1(°)	100.2	128.5	28.3	98	127.6	29.6
Soft tissue changes						
E-line to Upper lip(mm)	+1.3	-4.3	5	+2.5	-1	3.5
E-line to Lower lip(mm)	+2.1	-2.3	4.2	+2	-2	4
Nasolabial angle	89	102.4	13.4	91	105.2	14.2

DISCUSSION

Bimaxillary dento-alveolar protrusion is the most prevalent malocclusion seen in the Kerala population due to its racial pattern (Dravidian); thereby causing significant aesthetic problems to the patients due to the convex profile and protrusion of lips. Management of this malocclusion usually involves extraction of four first premolars and orthodontic retraction. There are various fixed appliance techniques and the biomechanical principles involved in treatment differ in these techniques. Treatment with the Begg technique is more economical but requires more clinical skill and chairside time. However, overall treatment time is usually reduced in comparison with the pre-adjusted edgewise appliance (PEA) technique in the

management of bimaxillary dento-alveolar protrusion. The results by Sundareswaran¹ and Sharma² suggest that the Pre-adjusted Edgewise Appliance used in the treatment of individuals with bimaxillary protrusion produces a significant effect on the hard and soft tissues.

The investigation was done on twenty patients who had undergone treatment for the correction of Class I bimaxillary dento-alveolar protrusion with extraction of four first premolars using either the Begg light wire appliance or the Preadjusted Edgewise Appliance (PEA). It was a retrospective study and we were able to control and standardize many of the parameters during sample selection. Very few studies in the literature have compared the Begg technique³ and Pre-adjusted edgewise

appliance technique in terms of treatment efficacy and duration. In the present study, an effort has been made to compare the linear and angular parameters in the two treatment mechanics. Cephalometric evaluation of pre and post-treatment cephalometric radiographs obtained from the Records Section of the Department was done. Angular and linear cephalometric parameters considered in the study are given in Table 1. Table 2 shows the treatment results obtained in the two appliance systems.

Apical base:-

The SNA and SNB angle were found to be slightly decreased following orthodontic treatment in both treatment techniques. Looi and Mills⁴ in their study observed that skeletal parameters showed little change with tooth movement. Young & Smith⁵ also came to a similar conclusion that 1st premolar extractions caused insignificant to no skeletal changes with orthodontic treatment.

GoGn-SN angle:-

In the present study, the average value of GoGn-SN angle indicated a slight increase during treatment. This finding is in agreement to that of Cadman⁶ whose findings indicate an increase during treatment which reverts to the pre-treatment value during retention. This may again be due to changes in growth pattern in the cases under study. In agreement with the present study, Papaioannou-Maragou and Papaioannou⁷ also showed that both the Begg and edgewise methods were associated with a small increase in lower facial height. Solem⁸ and Trisnawaty⁹ have reported greater angular soft tissue changes in bi-maxillary protrusion treatment. On the other hand, the findings of Chhibber et al¹⁰ and Bravo¹¹ confirmed reduced vertical dimensions following treatment with first premolar extractions.

Maxillary incisor inclination:-

In the present study, the pre-treatment average of U1 to SN was 117.5⁰ and the average at the end of treatment was 103.2⁰ in the Begg technique. Comparable retraction of the upper incisors was obtained with a difference of 14.3 and 15⁹ in the Begg technique and PEA technique respectively. There is a significant reduction in the maxillary incisor proclination at 0.5% level. Sharma¹² in his

study on retraction with the pre-adjusted edgewise appliance 0.022" Roth prescription found that Point A as well as the upper incisors were retracted with similar results ($P < .001$).

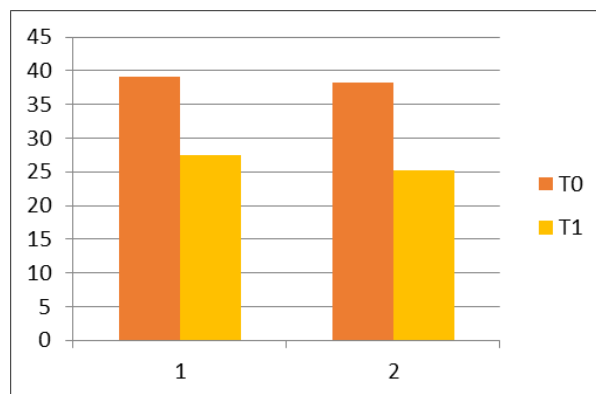


Fig 2 is a bar graph showing mean changes of the upper incisor to NA line in the two techniques where 1 and 2 represent Begg and PEA technique respectively.

Mandibular incisor inclination:-

Both linear as well as angular values of the lower incisor with respect to NB line reveal significant retraction of the lower incisors in both treatment techniques at 5% level. Xu¹³ and Tan¹⁴ in their studies, in bimaxillary protrusion patients following 1st premolar extractions, had concordant results with a reduction in cephalometric angular measurements of upper and lower incisors.

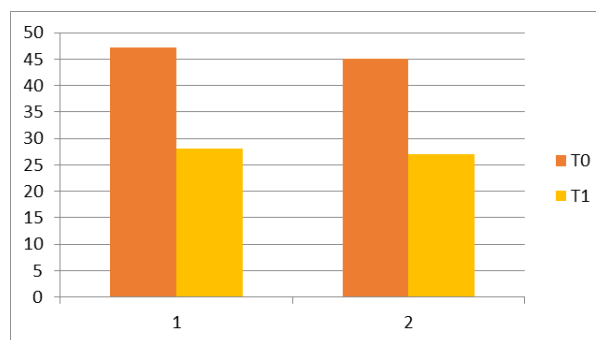


Fig 3 is a bar graph showing mean changes of the lower incisor to NB line in the two techniques where 1 and 2 represent Begg and PEA technique respectively.

Incisor mandibular plane angle:-

In the present study, IMPA is reduced in all the patients in both techniques. It is noteworthy that

the reduction in IMPA at the end of treatment ranged from -1° to 16° with a mean of 14.45° and 14° in the Begg technique and PEA technique respectively. Sharma¹² in 2011 also got a similar retraction of 14° following treatment with PEA.

Inter-incisal angle:-

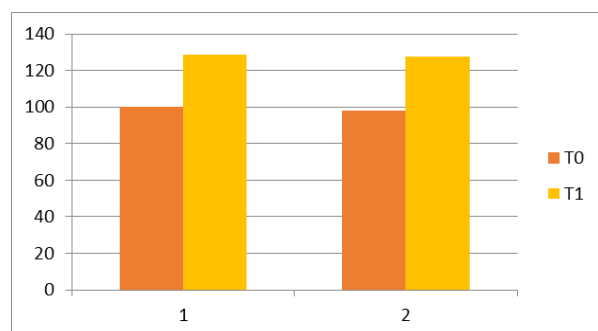


Fig 4 is a bar graph showing mean changes of the inter-incisal angle in the two techniques where 1 and 2 represent Begg and PEA technique respectively.

In the present study, the inter-incisal angle changed significantly at the end of treatment with a difference of 28.3° and 29.6° in the Begg technique and PEA technique respectively; the difference being significant at 0.1% level. Levin¹⁵ and Sharma¹² reported similar findings where there was a significant increase of interincisal angle following treatment. Sundareswaran and Vijayan¹ in 2017 using Pre-adjusted Edgewise Appliance 0.022" MBT prescription reported significant improvement in maxillary and mandibular incisor inclinations whereby the interincisal angle changed from 98.94° to 123.05° reflecting the effectiveness of the pre-adjusted edgewise appliance in the treatment of bimaxillary protrusion patients.

Nasolabial angle:-

The mean value of nasolabial angle was taken as $100^{\circ} \pm 5^{\circ}$, as in several studies^{16,17}, the ideal nasolabial angle had a range of 90° to 120° for patients with bimaxillary dento-alveolar protrusion. The nasolabial angle showed almost similar differences from pre-treatment to post-treatment in both treatment techniques. The greater the maxillary incisor retraction, the greater was the increase in nasolabial angle.¹⁸ Thus the soft-tissue profile followed closely the underlying skeletal framework. The treatment results can therefore help in

predicting any changes in nasolabial angle due to retraction following orthodontic treatment in either technique. Our results are in concordance with Moseling¹⁹ who have also shown linear and angular soft tissue profile changes in bimaxillary protrusion cases.

Linear Soft Tissue Measurements:-

Ricketts Esthetic plane²⁰ was used in the present study as a linear measurement to evaluate post-treatment changes to the upper and lower lip. The upper lip was retracted by a mean of 5mm in the Begg technique and 3.5mm in the pre-adjusted edgewise appliance technique revealing a slightly greater retraction of the upper lip; while the lower lip demonstrated a mean difference of 4.2 and 4mm change post-treatment in the two techniques following treatment. The findings of Chung et al²¹ and Caplan²² also showed lip retraction with 1st premolar extractions. As evident, the upper lip showed a slightly greater retraction in the Begg technique as compared to the pre-adjusted edgewise appliance technique. On the other hand, Kachiwala²³ and Bilodeau²⁴ in their studies concluded that protruded lower lips were retracted more when compared to the upper lip.

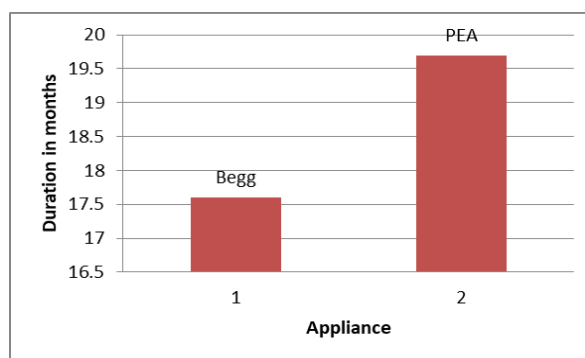


Fig 5 is a bar graph showing mean duration of treatment in the two techniques where 1 and 2 represent Begg and PEA technique respectively.

Duration of treatment:-

In the present study, the mean duration of orthodontic treatment in the Begg technique was found to be marginally shorter than the pre-adjusted edgewise appliance technique. The average duration of treatment in Begg technique (17.6 ± 1.2 months) was slightly shorter than that of the Pre-adjusted edgewise appliance technique

(19.7 ± 1.3 months). The Begg technique follows the principle of initial tipping followed by uprighting and this can be attributed to the slightly shorter treatment duration as reported in the literature.^{15,25} Longer treatment duration can cause root resorption, decalcification and caries.²⁶

Limitations

Loss of anchorage was not assessed in this study. Factors such as lip musculature, which may affect treatment changes, have not been considered. Variations may be seen when comparing the present findings with those findings reported in the literature. Therefore, a study with a greater sample size in both techniques would provide more information.

CONCLUSION

The present study using cephalometric radiographs was mainly confined to some morphologic changes in the dentition and jaws. Judicious use of mechanics gave profound soft-tissue changes which accompanied retraction of the anterior teeth with both treatment modalities. This study failed to show any significant difference in results between the two orthodontic treatment techniques when comparing the linear and angular parameters. Our findings are consistent with the previous studies indicating that both techniques were associated with significant reduction of the maxillary and mandibular incisor inclination during the treatment period. The mandibular plane to SN angle increased slightly during treatment. The inter-incisal angle increased considerably during the treatment period in both treatment mechanics.

Further studies with a larger sample size to assess the dento-skeletal and soft tissue changes would be useful so that the nature and extent of changes could be standardized for the Kerala population. The findings of the present study indicated that the Begg technique might be associated with a slightly shorter duration of treatment but soft tissue and hard tissue responses were almost comparable in both treatment techniques.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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