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A Cephalometric Appraisal of Changes in the Nasolabial Region when using two Retraction Force Delivery Systems with the Pre-Adjusted Edgewise Appliance

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ABSTRACT

Aim: The aim of the study was to retrospectively evaluate the dentofacial changes obtained with two force delivery systems for orthodontic retraction, in the treatment of Class I bimaxillary dento-alveolar protrusion using the preadjusted edgewise appliance(PEA).

Materials and Methods: The data for the study was obtained from pre and post-treatment lateral cephalometric radiographs of twenty patients. In ten patients, retraction was done with active laceback using elastomeric ligatures, while in the other ten patients, retraction was done with elastomeric chain. Pre and post-treatment parameters on lateral cephalometric radiographs were compared using Wilcoxon Signed Ranks test.

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

Conclusion: The study showed no significant differences in the results obtained when comparing two force delivery systems for retraction following four first premolar extractions in Angle's Class I bimaxillary dentoalveolar protrusion patients.

Keywords: Bimaxillary dentoalveolar protrusion, orthodontic retraction, Pre-adjusted edgewise appliance.

INTRODUCTION

Therapeutic extraction of teeth to gain space for the retraction of anteriors is an accepted procedure in orthodontic practice. The creation of space in the dental arch through extraction, requires effective mechanisms to close and consolidate this space to achieve the desired treatment objectives.[1] There are a variety of force delivery systems currently available that can produce optimum force levels to move teeth through the alveolar bone. These include coil springs, elastomeric chains and threads, active lacebacks and magnets.[2]

An optimal space closure system should give the highest possible rate of desirable tooth movement without irreversible damage to the periodontal ligament, the alveolar bone or the dental tissues. Cephalometric studies have revealed that the space gained by extraction is not completely utilized for the retraction of anteriors. Knowledge of the amount of space needed is important for proper treatment planning.[3] But there are very few studies giving us the amount of retraction possible with different retraction modalities which would help us to appropriately use the best possible modality for a particular anchorage situation.[4] So, there arises a need to estimate the amount of incisor retraction

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that can be achieved by different orthodontic retraction modalities in extraction cases. As bimaxillary protrusion constitutes a major racial feature of Kerala population, determination of the amount of incisor retraction possible that occurs with different retraction force delivery systems in PEA, will reveal the applicability of these modalities to this population in general. It was in this context that the study was undertaken, to identify and assess the effective retraction of anterior teeth obtained with two force delivery systems.

AIMS AND OBJECTIVES

The aim of the present study was to evaluate cephalometrically the extent of retraction of anteriors that occurred following the extraction of first premolars when using two different retraction modalities. It was also intended to cephalometrically appraise the changes in axial inclination of upper incisors, retraction of upper lip and changes in nasolabial angle that occurred during the treatment period with these two retraction modalities

MATERIALS AND METHODS

Approval for this study was obtained from the Institutional Ethics Committee. The samples for this study included twenty post-pubertal patients (7 males and 13 females) who were diagnosed as Angle's Class I malocclusion with bimaxillary dentoalveolar protrusion who required the extraction of all four first bicuspids and orthodontic retraction. In ten patients retraction was done with active lacebacks using elastomeric ligatures; while in the other group of ten patients, retraction was done with elastomeric chain.

Inclusion and Exclusion criteria

Inclusion criteria are

1. Age ranges from 17-25years with a mean age of 16.6 years.
2. Well-aligned arches with no crowding or minimal crowding ≤3mm.
3. Patients with Angle's Class I malocclusion who required orthodontic retraction of upper anteriors following therapeutic extraction of maxillary first premolars. All the patients in both groups were treated with Pre-Adjusted Edgewise Appliance 0.022" MBT Prescription.
4. 10 Patients, who had retraction done with active lacebacks and elastomeric ligatures, were assigned to Group 1.
5. 10 Patients, who had retraction done with elastomeric chain, were assigned to Group 2.
6. Pre and post-treatment cephalometric radiographs with good hard and soft tissue outlines and teeth in full occlusion.
7. All pre and post-treatment cephalometric radiographs were taken using the same machine in the standard position by the same operator.

Exclusion criteria are

1. Patients who have any syndrome, cleft lip or cleft palate
2. Patients with history of trauma
3. Patients who have history of previous orthodontic treatment or orthognathic surgery

Two different force delivery systems were evaluated. They were:

1. Elastomeric ligatures-Clear 0.110" Green, Ormco. Ormco Corporation 1717 West Collins Avenue Orange, CA 92867.
2. E-chains-closed space. Clear Generation II power chain. Ormco. Ormco Corporation 1717 West Collins Avenue Orange, CA 92867.

Based on the force delivery systems used for retraction, the samples were divided into two groups:

•Group 1—Active laceback using Elastomeric ligatures
• Group 2—E-chain

In the group using active laceback and elastomeric ligatures for space closure (Group 1), active lacebacks were placed in all four quadrants. In Group 2, the elastic chain used was the short-spaced variety from the Ormco Company. Initial force levels ranged between 100-120 gms. Studies have revealed a force degradation of 50 to 75% in the first 24 hours.[5-8] The force applied at each visit was recorded with a Dontrix gauge and applied by the same operator, to be as close to the selected value and to minimize operator error. At each visit, the active laceback with elastomeric ligatures and elastic chains were replaced. The amount of incisor retraction brought about by the force delivery

systems in Groups 1 and 2 were evaluated from pre and post-treatment lateral cephalometric radiographs. The radiographs were taken and tracings were done manually using transparent 0.003" acetate paper and 0.03 mm HB lead pencil by the same operator (Fig.1).

The rate of retraction of the canines was defined as the distance travelled divided by the time interval needed for closure of the extraction space. The calculation done for the rate of retraction in this study was the distance travelled divided by the number of 30-day intervals until the canines were in the proper position; ie, the finish date for the retraction was when the extraction space was closed.[9]

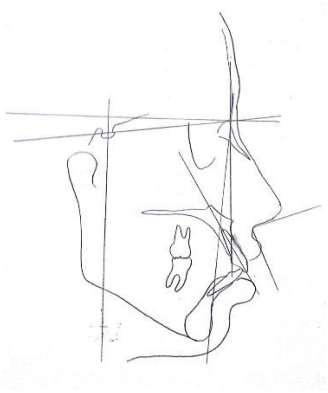


Fig 1: shows the Skeletal & Dental Parameters measured in the study.

Table 1: Cephalometric Landmarks used in the study.

Hard tissue landmarks:		
1	Nasion(N)	Most anterior point on the frontonasal suture in the midsagittal plane
2	Sella (S)	Geometric centre of the pituitary fossa located by visual inspection.
3	Point A (A)	The deepest point in the concavity between the Anterior nasal spine and the Prosthion.
4	Incision superius incisalis(Isi)	The incisal edge of the maxillary central incisor.
5	Incision superius apicalis(Isa)	The root apex of the most anterior maxillary central incisor.
Soft tissue landmarks		
6	Soft tissue Nasion (N')	Point of maximum concavity of the soft tissue contour of the root of nose.
7	Subnasale (Sn)	Point where the lower border of the nose meets the outer contour of the upper lip.
8	Labrale superius (Ls)	Median point in the upper margin of the upper membranous lip.
Reference planes		
9	SN Plane	Anteroposterior extent of anterior cranial base
10	The horizontal reference line (HRL)	This was determined by drawing a line 7º to the Sella-Nasion plane (S-N) through N.
11	The vertical reference line (VRL)	A perpendicular line to the horizontal reference plane (HP) at the Sella point will be used as the vertical reference plane.

Table 2: The Following Cephalometric parameters were evaluated in this study.

No	Parameter	Description
Skeletal And Dental		
1	SNA(º)	Angle between the SN plane and NA line
2	U1 (Isi) to VRL(mm)	Horizontal distance from the tip of the upper incisor crown (Isi) to the vertical reference line (VRL).
3	U1(Isa) to VRL(mm)	Horizontal distance from the apex of the upper incisor (Isa)to the vertical reference line plane (VRL).
4	Point A to VRL(mm)	Horizontal distance from point A to the vertical reference line (VRL).

5	U1 to NA (º)	Angulation of the long axis of U1 to NA line
6	U1 to NA (mm)	Horizontal distance from Is and line connecting hard tissue N to hard tissue point A
Soft Tissue		
1	Nasolabial angle(º)	Angle between line tangent to base of the nose and line tangent to upper lip
2	Subnasale to VRL(mm)	Horizontal distance from Subnasale(Sn) to the Vertical reference line (VRL).
3	Labrale superius to VRL(mm)	Horizontal distance from Labrale superius(Ls) to the Vertical reference line (VRL).

All angular measurements were made to the nearest 0.5^0 and linear measurements to 0.5 mm. Table 1 and 2 describes the cephalometric parameters used in this study. To identify any intra-examiner error, ten radiographs were randomly picked and retraced by the same examiner after an interval of two weeks. The intraclass correlation coefficient was used to evaluate the level of agreement and showed good agreement.

STATISTICAL ANALYSIS

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 $P < 0.05$. Table 3 describes the Mean values of the linear and angular measurements in Group 1 and 2 in the (a) Pre Treatment (**T0)** (b) End of Treatment (**T1).** The mean values of the changes obtained in the linear and angular measurements in Group 1 and 2 are shown in Table 4.

Table 3: Table showing the Mean values of the linear and angular measurements in Group 1 and 2 in the (a) Pre Treatment (T0) (b) End of Treatment (T1)

No	**Variable**	**Group 1**				**Group 2**			
		T0		**T1**		**T0**		**T1**	
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
1	SNA(º)	84.02	2.124	82.98	2.762	83.94	2.244	82.18	2.646
2	U1 (Isi) to VRL(mm)	76.78	5.145	67.34	4.442	77.88	6.422	69.04	5.644
3	U1 (Isa) to VRL(mm)	65.78	4.464	62.96	5.348	66.18	5.126	64.24	4.298
4	Point A to VRL(mm)	69.46	4.24	67.06	3.76	68.78	4.98	66.46	4.64
5	U1 to NA (º)	34.32	6.453	23.45	5.446	33.75	7.133	24.42	6.234
6	U1 to NA (mm)	8.12	2.14	4.78	2.64	6.98	2.76	5.12	2.02
7	Nasolabial angle(º)	88.09	3.02	98.32	4.94	90.15	4.76	99.12	4.48
8	Subnasale to VRL(mm)	78.98	3.98	76.46	4.16	80.24	3.84	77.28	3.78
9	Labrale superius to VRL(mm)	84.58	5.58	80.26	5.42	85.68	4.96	81.02	5.02

Table 4: Table showing the Mean values of the changes obtained in linear and angular measurements in Group 1 and 2.

No	Variable	Group 1	Group 2
1	SNA(º)	1.04	1.76
2	U1 (Isi) to VRL(mm)	9.44	8.84
3	U1 (Isa) to VRL(mm)	2.82	1.94
4	Point A to VRL(mm)	2.4	2.32
5	U1 to NA (º)	10.87	9.33
6	U1 to NA (mm)	3.34	1.86
7	Nasolabial angle(º)	10.23	8.97
8	Subnasale to VRL(mm)	2.52	2.96
9	Labrale superius to VRL(mm)	4.32	4.66
10	Rate of Retraction(mm/30days)	1.00	1.25

DISCUSSION

Bimaxillary dentoalveolar protrusion is one of the most prevalent malocclusions seen in the Kerala population and is characterized by proclined upper and lower incisors and protrusive upper and lower lips.[10] Therapeutic extraction of teeth to correct malocclusion is an accepted procedure in orthodontic practice. Scientific advancements now enable us to choose from a variety of space closure mechanics. Furthermore, in treatment where the primary objective is to retract the anterior units into the extraction space using molars as anchorage units, the relative movements of these two units using the different modalities is important.

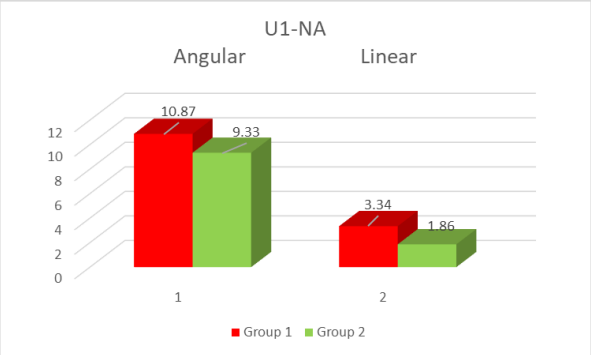
This investigation was done on twenty post-pubertal patients with the samples being thirteen females and seven males. The patients had undergone treatment for the correction of Class I bimaxillary dentoalveolar protrusion with the extraction of first premolars and using the pre-adjusted edgewise appliance. In Group 1, retraction was accomplished with the help of active lacebacks and elastomeric ligatures, whereas in Group 2, elastomeric chain was utilized for space closure. Notable weaknesses of other studies in this field included use of multiple operators. A preliminary report from a statistician indicated that a minimum of six patients per group should be studied in order to eliminate ∞-error at 0.05.

Parameters involving the changes in the axial inclination of incisors following retraction showed a significant change with respect to Upper incisor to NA line after retraction with the active laceback with elastomeric ligatures (Group 1). Similar values were obtained for retraction of upper incisors with respect to the vertical reference line, with Group 1 patients exhibiting a marginally greater retraction of both the incisal edge as well as the apex of the maxillary incisors. Bennett et al reported that space closure would continue for several months with module ligature tieback even if the patient failed to turn up.[11]

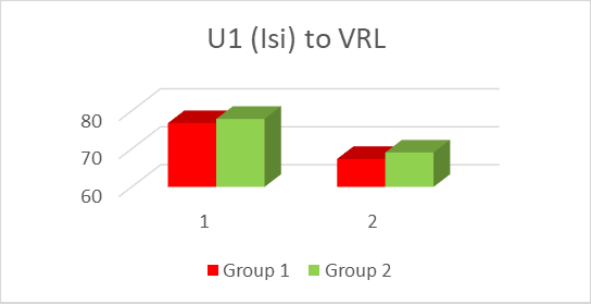
In the present study, there was a significant retraction of Point A and Subnasale following incisor retraction. Point A retracted 2.4mm and 2.32mm in Group 1 and 2 respectively. Subnasale retracted 2.52 and 2.96 mm in Group 1 and 2 respectively. The upper incisors were retracted significantly in both groups; though Group 1 showed slightly more retraction of incisors as evident from the U1-NA values (both angular and linear), significant at $P<0.05$ as evident in Graph 1. The incisal edge of the upper incisor retracted by 9.44mm and the apex of the lower incisor retracted by 2.82mm following treatment in Group 1 which was marginally higher than the values in Group 2 (Graph 2). The statistically significant correlation between these points indicated that with the backward movement of the skeletal points A and B, the soft tissue overlying these osseous points followed them, thus contributing to changes in the lip positions at the bases. Mitra et al reported concordant results with module with ligature tieback as a better alternative to E-chain for extraction space closure.[12] The upper lip retracted almost similarly in Group 1(4.32mm) and Group

2(4.66mm) with respect to the vertical reference line.

The mean rates of space closure were 1.00 mm and 1.25 mm/30 days in the upper arch and for Groups 1 and 2 respectively.



Graph 1 showing the Mean values of the changes obtained in linear and angular measurements in Group 1 and 2 for the parameter Upper incisor to NA line.



Graph 2 showing the Mean values of the linear measurements in Group 1 and 2 in the (a) Pre Treatment (T0), shown as 1, (b) End of Treatment (T1), shown as 2, of the incisal edge of upper incisors to the vertical reference line.

In the final analysis of the data, the behavior of Group 2 was such that the rate of retraction was much greater than Group 1 which used the active laceback with elastomeric ligatures. Thus, in minimum anchorage situations, elastomeric chain would be ideal for extraction space closure with its increased rate of tooth movement. The different rates of space closure provided by the two different force delivery systems could be used to close different amounts of space on either side of the same arch. They also could be used to maintain or move the midline when used in the same arch with different space closure requirements on either side.[1]

CONCLUSION

The present study was an attempt to evaluate cephalometrically the influence of two different retraction modalities namely, the active laceback with elastomeric ligatures and elastomeric chain. Skeletal and dental parameters were comparatively assessed. This was done to identify and assess the use of a particular force delivery system for appropriate anchorage situations.

The following conclusions were obtained from the study:

1. The active laceback with elastomeric ligatures were found to produce significantly greater changes in both the linear as well as angular measurements for retraction of upper incisors.

2. The rate of closure was greater in Group 2 with Elastomeric chains.

Future studies can be done by increasing the sample size to compare the efficacy of retraction when using different types of force delivery systems with the preadjusted edgewise appliance. The different retraction modalities can be used on the contralateral sides of the same patient in those studies to rule out other parameters that may affect the results. Other relevant parameters like patient discomfort, chairside time, root resorption for the different methods of retraction, rate of retraction with self-ligating brackets, as well as anchorage loss can also be studied.

CONFLICT OF INTEREST

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

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