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Changes in Lip Length and Strain after En-masse Retraction with Maximum Anchorage in Female Patients with Bimaxillary Protrusion

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ABSTRACT

Aim: The aim of the study is to evaluate the effect of en-masse retraction with maximum anchorage on the lip length, lip strain, and interlabial gap in adult female patients with bimaxillary protrusion. ***Materials and Methods:*** Thirteen patients underwent initial records including photographs, study casts, and cephalometric x-rays. En-masse retraction was performed using friction mechanics, with the use of temporary anchorage devices and power chains after the extraction of first premolars. The soft tissue was analyzed using lateral cephalometric radiographs before and after retraction. ***Results:*** The results showed that en-masse retraction had a significant effect on reducing lip strain, increasing lip length, and reducing interlabial gap. ***Conclusion:*** The findings suggest that en-masse retraction can be an effective tool in improving the soft tissue profile in patients with bimaxillary protrusion

1. INTRODUCTION

Achieving improved aesthetics is the primary reason adults seek orthodontic care[1]. One of the common chief complaints of orthodontic patients is protrusion of the upper teeth resulting in an increased lip procumbency, incompetent lips, excessive lip strain, and poor facial aesthetics. These problems are encountered in patients with bimaxillary protrusion. The most comprehensive study on the cephalometric traits of these cases was done on a Caucasian population by Keating[2], where the study clarified these soft tissue features. Orthodontic intervention of these cases involves the extraction of first premolars and retraction of the anterior teeth, for the improvement of the soft tissue profile.

There are two main techniques used to retract the anterior teeth into the extraction space: two-step retraction and en-masse retraction. In two step retraction, the canines and the incisors are retracted in two distinct steps. Initially, the canines are retracted until complete contact between the canines and the tooth distal to the extraction space is achieved. This step is followed by the incisor retraction, where the 4 incisors are retracted until complete space closure. This two-step procedure theoretically provides less load on the posterior segment, resulting in better anchorage control. However, It has been shown that while retracting the canines individually, they have a tendency to tip and rotate distally[3]. Furthermore, with the advent of temporary anchorage devices (TADs), the fear of posterior loading has been reduced. For this reason, en-masse retraction, where the 6 anterior teeth are retracted at once, has gained popularity in recent years[4]. This technique also has the added advantage due to its mechanical simplicity[3].

In the current literature, there are several studies on en-masse retraction regarding space closure[5–8]. However, there are limited number of studies analysing the overlying soft tissue while using en-masse mechanics, with absolute anchorage. Thus, the purpose of this study was to analyse the soft tissue, in regard to the lip strain, lip length, and interlabial gap, before and after retraction using en-masse retraction.

Sample Size Calculation:

Sample size calculation was done using the comparison of lip thickness between pre- and post-treatment with En-masse retraction in patients with bimaxillary protrusion. As reported in previous publication[9], the mean and standard deviation of lip thickness before treatment was 4.64 ± 1.19 mm, while after treatment it became 2.04 ± 1.14 mm. Accordingly, we calculated that the minimum proper sample size was 13 participants to be able to detect a real difference of 1 mm with 80% power at $\alpha = 0.05$ level using Paired t test for matched samples. Sample size calculation was done using PS Power and Sample Size Calculations Software, version 3.1.2 for MS Windows (William D. Dupont and Walton D., Vanderbilt University, Nashville, Tennessee, USA).

2. MATERIALS AND METHODS:

The current study was conducted using cephalometric radiographs from 13 adult female bimaxillary protrusion patients who underwent orthodontic treatment. Initially, patients were screened at Future university in Egypt, Orthodontic Clinic to ensure they fulfilled the inclusion and exclusion criteria. Inclusion criteria of the consisted of adult female patients that required first premolar extraction with maximum anchorage. Full set of permanent dentitions (excluding the third molars) were required. Patients that suffered from systematic diseases, parafunctional habits (tongue thrusting, mouth breathing, etc…), or craniofacial anomalies were excluded from the study.

Each recruited patient had initial records taken, which included photographs, study casts, and panoramic and lateral cephalometric x-rays. The initial cephalometric radiographs were considered T_0 (Fig. 1A). The same orthodontist managed each case with fixed orthodontic appliance (0.022" slot – American Orthodontics, Sheboygan, Wis.), followed by levelling and alignment until reaching 0.017X0.025" stainless steel wire. Prior to extraction of the first premolar, temporary anchorage devices (TADs) were added to each quadrant, placed between the first molar and the second premolar at the mucogingival junction. To reinforce the posterior anchorage, the TADs were ligated to the second premolar.

After extraction, crimpable hooks, 9mm in length to approximate the centre of resistance[4], were placed on the final arch wire, distal to the lateral incisor. Power chains with 200 gm of force were used, extending from the miniscrew to the crimpable hooks for retraction (Fig. 2). The case was considered complete when the extraction space was closed and class I canine relationship was achieved. Post-retraction lateral cephalometric radiographs were taken, denoted as T_F (Fig. 1B).

The soft tissue analysis was performed on WebCeph by a single outcome assessor. The landmarks and the measurements made are present in table 1 and 2, respectfully.

Table (1)

Landmarks	Abbreviations	Definition
Soft Tissue A Point	A'	Most posterior point of the curvature of the maxillary sulcus
Subnasale	Sn	The point between the columella nasi and the philtrum of the upper lip
Labralis Superios	Ls	Most prominent point of the upper lip
Stomion Superius	Stms	The most inferior point of the upper lip
Stomium Inferius	Stmi	The most superior point of the lower lip

Table (2)

Measurement	Definition
Lip thickness at A point	Distance measured between A' to A point
Lip thickness at upper Lip	Distance measured between Ls and labial surface of upper incisor
Lip strain	Lip thickness at Labralis Superius minus Lip thickness at A point in millimetres
Lip length	Distance from Sn to Stms in millimetres
Interlabial gap	Vertical distance between upper and lower lips, from Stms to Stmi in millimeters

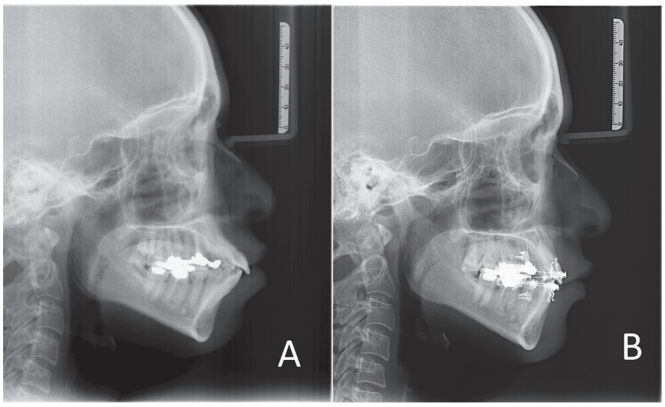

Figure (1) — Lateral cephalometric radiographs (A) Pre-retraction (B) Post-retraction

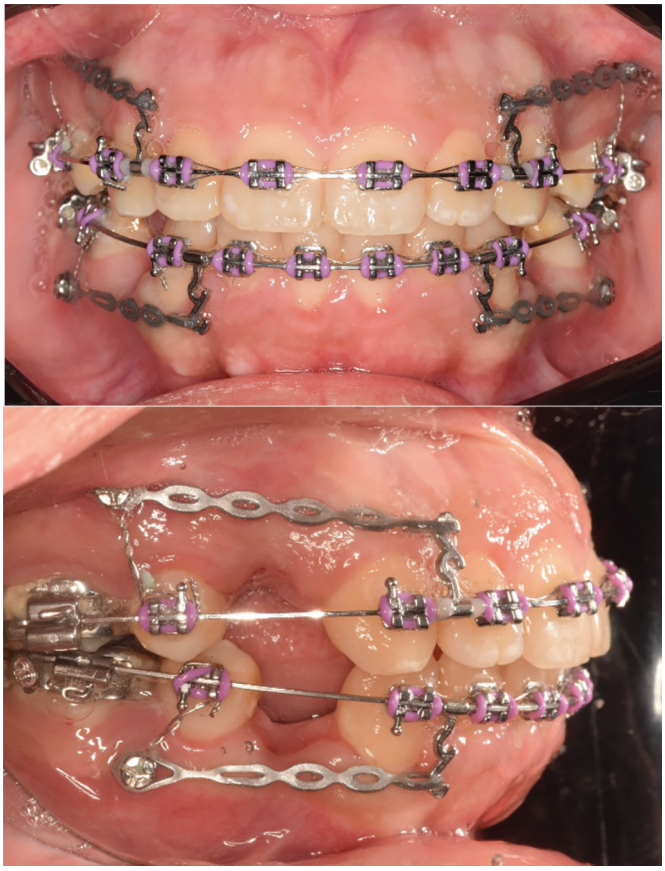

Figure (2) — Intraoral Photographs of Friction mechanics

Statistical Analysis and Data Presentation

Data were statistically described in terms of mean±standard deviation (±SD). Comparison between the study groups was done One Way Analysis of Variance (ANOVA) test. Two-sided *p* values less than 0.05 was considered statistically significant. IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows was used for all statistical analyses.

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3. RESULTS

Every measurement in this study is represented in table 2. The lip strain was measured as the difference between two measurements – one at labialis Superius and one at A point. A Large difference between the two measurements is indicative of excessive lip strain caused by proclined incisors. In this study, the lip strain decreased significantly with the en-masse retraction of the anterior teeth, from 2.8 mm to 0.27 mm.

Lip length was the distance measured between the subnasale and the stomium superius of the upper lip. The lip length increased significantly after retraction by 1.32 mm.

Finally, the interlabial gap, measured as the distance between stomium superius and inferius, decreased significantly after retraction by 1.49 mm. The results can be summarized in table 3.

Table (3)

Soft Tissue results

	Pre (n = 13)	Post (n = 13)	Mean diff.	95%CI	p value
	Mean (SD) (mm)	Mean (SD) (mm)			
Lip Strain	2.8(1.5)	0.27(1.6)	2.56	1.19 , 3.93	0.002*
Lip Length	21.4(1.9)	22.7 (2.2)	1.32	0.76 , 1.89	< 0.001*
Interlabial Gap	2.8(2.0)	1.3(0.80)	1.49	0.67 , 2.31	0.002*

*Mean: Arithmetic mean; SD: standard deviation; CI: confidence interval, * = Statistically significant*

4. DISCUSSION

Lip aesthetics is by far one of the most important aspects of orthodontic treatment. The lips are supported by the underlying teeth, and their position determines the soft tissue lip support. Thus, the present prospective clinical trial evaluated the variations in soft tissue lip form following orthodontic management of patients with bimaxillary protrusion and class II division 1 cases treated through the extraction of the first premolars and followed by the retraction of the 6 anterior teeth.

When treating maxillary protrusive cases, anchorage control is vital to achieve proper soft tissue results[10]. To reinforce anchorage, several techniques can be used, including headgears, Nance appliance, intermaxillary elastics, and so on. Recently, temporary anchorage devices (TADs) have been a successful alternative in regards to anchorage[11]. In this study, skeletal anchorage was used to ensure maximum retraction of the anterior teeth into the extraction space. Skeletal anchorage for the retraction of anterior teeth has been advocated in several studies[6,12–14]. When looking at it from a soft tissue perspective, a systematic review by Mohan et al.[15] evaluated the evidence researching skeletal anchorage in relation to soft tissue changes. They found that, although the evidence was low quality, using mini-implant anchorage may significantly change the nasolabial angle, upper and lower lip procumbence, and facial convexity angle compared to conventional anchorage.

In this study, lateral cephalometric radiographs were taken before retraction and immediately after retraction was completed. These radiographs were taken in order to measure the lip strain, lip length, and the interlabial gap before and after retraction.

In terms of the lip strain, the results of this study showed that the strain decreased significantly after retraction of the 6 anterior teeth, from 2.8mm to 0.27mm. Significant correlation between retraction and patients with high lip strain was reported in a pre and post cephalometric study by Oliver[16]. However, Rains and Nanda[17] found a negligible correlation between the two.

After retraction, the lip length of the patients studied increased significantly. Pre-retraction, the lip length was 21.4mm. Retraction of the six anterior teeth led to an elongation of the upper lip by 1.32mm. A significant increase in the lip length was also found in a study by Alqahtani et al.[18], where the mean difference between pre and post retraction was 1.1mm. These results were unlike the study made by Talaas et al.[19], where they found that the length of the upper lip did not increase with orthodontic treatment.

Finally, the interlabial gap significantly decreased by 1.49mm when comparing pre to post retraction measurements. Similar significant difference was also noted in the study by Alqahtani et al.[18], where the interlabial gap decreased from 5.6mm to 3mm post retraction. These results were concurrent with a study by Marzouk and Kassem[20], where the interlabial gap also decreased significantly after retraction.

5. CONCLUSION

Following premolar extraction and the retraction of the 6 anterior teeth, the upper lip strain decreased, the lip length increased, and the interlabial gap decreased. From this limited study, we can conclude that, with en-masse retraction with maximum anchorage, the soft tissue profile of the upper lip significantly changes post retraction. Thus, en-masse retraction with the use of miniscrews produces satisfactory soft tissue profile of the upper lip.

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