Soft tissue changes following orthodontic treatment of bi-maxillary protrusion
(A clinical and photographic study)

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ABSTRACT
Background: Bi-maxillary protrusion is considered as one of the important causes to seek the orthodontic treatment to get better esthetic. This study aimed to test the effect of orthodontic treatment in improvement the facial esthetics.

Materials and methods: Ten Iraqi Arab females having bi-maxillary protrusion based on Class I malocclusion were treated with fixed orthodontic appliance and extraction of the maxillary and mandibular 1st permanent premolars. Pre and post-treatment facial profile photographs were taken for each patients and the effect of treatment was tested in comparison with the pre-treatment photographs using seven angular measurements.

Results: After treatment, the upper and lower lip projections were decreased significantly, the naso-labial and mento-labial angles were increased significantly.

Conclusion: Treatment of bi-maxillary protrusion with fixed orthodontic appliances and extraction of four premolars improve the facial esthetics of the patients by decreasing the lip projection and increasing the naso-labial and mento-labial angles.

Key words: Bi-maxillary protrusion, facial esthetics, photographs.

INTRODUCTION
Bi-maxillary dentoalveolar (Bi-alveolar) protrusion is defined as an anterior position and labial inclination of the maxillary and mandibular incisors with respect to their supporting bones and the facial profile. (1)

Patients with bi-maxillary protrusion demonstrated increased incisor proclination and protrusion, a vertical facial pattern, increased procumbency of the lips, a decreased nasolabial angle, and thin and elongated upper and lower anterior alveoli. (2-4)

Bi-maxillary protrusion is seen commonly in African-American and Asian population, but it can be seen in almost every ethnic group. Because of the negative perception of protrusive dentition and lips in most cultures, many patients with bi-maxillary protrusion seek orthodontic care to decrease this procumbency. (5-8) The etiology of bi-maxillary protrusion is complex involving environmental factors, genetic component, soft-tissue function, volume and habit. (9)

The goals of orthodontic treatment of bi-maxillary protrusion include the retraction of both maxillary and mandibular incisors to decrease soft tissue procumbency and facial convexity. The extraction treatment has gained the popularity due to its greater long-term stability and greater esthetic changes after treatment especially in those cases where there is dentoalveolar protrusion. The common treatment approach would involve extraction of first four premolars with maximum anchorage mechanics. (8)

In Iraq, Ismael (10) identify the cephalometric features of bi-maxillary protrusion in ninety four Mosuli adolescents with class I normal occlusion. The lack of facial improvement after treatment of bi-maxillary protrusion cases behind the conduction of this study.

MATERIALS AND METHODS
Sample
Ten female patients with an age ranged between 17-22 years old and had Class I bi-maxillary protrusion were selected in this study.
All of them were white Iraqi Arab in origin and had full permanent dentition regardless the wisdom teeth with minimal crowding (1-2mm.).

Methods
Standardized profile photographs with Frankfort plane horizontal using Canon Power shot SD750 digital Elph (7.1 Megapixel, Japan) camera with a 100 cm distance from the patient were taken prior to the orthodontic treatment. After dental extraction of the maxillary and mandibular first permanent premolars, Roth stainless steel brackets (Bionic, Orthotechnology Co., USA) with 0.022" slot were bonded on the maxillary and mandibular teeth using no-mix orthodontic composite (Orthotechnology Co., USA). Orthodontic bands with Roth prescription were cemented on the first permanent maxillary and mandibular teeth using glass ionomer cement. Trans-palatal and lingual bars were constructed to get good anchorage during anterior teeth retraction.

Firstly, leveling and alignment phase was completed using NiTi archwires with cinch back posteriorly, then canines were retracted on 0.018" stainless steel archwires and finally the anterior teeth were retracted on 0.016 × 0.022" stainless steel archwires. Finishing and settling the occlusion were completed and the orthodontic appliances were removed in about two years treatment duration.

Second profile photographs were taken after the orthodontic treatment and the effect of treatment was compared.

Photographic points, lines and angular measurements

Points
1. Point Na’ (Nasion soft tissue): The point of deepest concavity of the soft tissue contour of the root of the nose.
2. Point NT (Nasal tip): The most protruded point of the apex nasi.
3. Point Cm (Columella): The most anterior point on the columella of the nose.
4. Point Sn (Subnasale): The point where the lower border of the nose meets the outer contour of the upper lip.
5. Point Ls (Labrale superious): The median point in the upper margin of the upper membranous lip.
6. Point Li (Labrale inferius): The median point in the lower margin of the lower membranous lip.
7. Point B’ (soft tissue B): The point of greatest concavity in the midline of the lower lip between labrale inferius and menton.
8. Point Pog’ (soft tissue pogonion): The most prominent point on the soft tissue contour of the chin.
9. Point CT (Chin tangent): The most antero-superior point on the soft tissue chin where the concavity of the soft tissue changes to convexity.
10. Point or (Soft tissue orbitale): The lowest point on the lower margin of each orbit. It is identified by palpation and is identical to the bony orbitale.
11. Point po (Soft tissue porion): The highest point of the upper margin of the cutaneous auditory meatus.

Lines
1. Frankfort horizontal plane: It extends between soft tissue porion and orbitale.
2. Na’-Pog’ line: It extends between soft tissue nasion and pogonion.
3. Na’- NT line: It extends between soft tissue nasion and the tip of the nose.
4. Sn-Cm line: It extends between subnasale and columella.
5. Sn-Ls line: It extends between subnasale and labrale superious.
6. Na’-Ls line: It extends between soft tissue nasion and labrale superious.
7. Na’-Li line: It extends between soft tissue nasion and labrale inferius.
8. Li-B’ line: It extends between labrale inferius and soft tissue B.
9. CT-B’ line: It extends between chin tangent and soft tissue B.
10. Na’-Sn line: It extends between soft tissue nasion and subnasale.
11. Sn-Pog’ line: It extends between soft tissue subnasale and pogonion.
12. Pog’- NT line: It extends between soft tissue pogonion and the tip of the nose.

Angular measurements
1. Na’-Ls/FH: The inferior, inner facial angle formed by the intersection of a line drawn from nasion (Na’) to labrale superious (Ls) and Frankfort plane (FH).
2. Na’-Li/FH: The inferior, inner facial angle formed by the intersection of a line drawn from nasion (Na’) to Labrale inferius (Li) and Frankfort plane (FH).
3. Naso-labial angle: It is the angle formed between columella-Sn line and Sn–Ls line.
4. Na'-Pog’/FH (facial divergence): The inferior, inner facial angle formed by the intersection of a line drawn from nasion (Na') soft tissue pogonion (Pog’) and Frankfort plane (FH).
5. Na'-Sn-Pog’ (profile angle): The inner angle between Na'-Sn and Sn-Pog’ lines.
6. Na' NT- Pog’: The inner angle between Na'-NT and NT- Pog’.
7. Labio-mental angle (Li-B'-CT): The intersection angle at point (B’) of the lines extending from the laberale inferius (Li) and the tangent to the chin.

Statistical Analyses
All the data of the sample were subjected to computerized statistical analysis using SPSS version 20 computer program. The statistical analysis included:

2. Inferential Statistics: Paired-samples t-test to test the treatment effect.

In the statistical evaluation, the following levels of significance are used:
- Non-significant NS P > 0.05
- Significant S 0.05 ≥ P > 0.01
- Highly significant HS P ≤ 0.01

RESULTS
Table 1 showed the descriptive statistics and treatment effect of the bi-maxillary protrusion by extraction of four premolars.

The results showed highly significant decrease in the upper and lower lips protrusion and increase in the naso-labial and mento-labial angles.

The facial divergence and profile angle showed non-significant difference.

DISCUSSION
When a decrease of lip procumbency is desirable, extracting premolars and retracting incisors is a practicable option to complete these objectives. On the basis of the patient’s chief complaint and the diagnosis of the malocclusion, extracting the maxillary and mandibular first premolars was indicated (12).

When extracting premolars is desired to correct the malocclusion, the treatment plan must address space closure of the extraction sites. Closure of the extraction sites can occur by retraction of the anterior segments, protraction of the posterior segments, or a combination of the two (13). When it is indicated to prevent mesial movement of the posterior segments in the anteroposterior dimension, this is termed maximum anchorage. Maximum anchorage in this case was necessary and predicated on the need to restrict mesial movement of the maxillary and mandibular first molars until the crowding and bi-maxillary protrusion were resolved.

To augment anchorage, adjunctive appliances, such as a trans-palatal bar, a Nance holding arch, palatal implants, or extra-oral traction, are usually necessary. Intraoral sources of anchorage include alveolar bone, teeth, dental arches, palatal and mandibular basal bone, differential moment mechanics, and lip musculature (13).

Renfroe (14) stated that, to be stable, the anchorage unit must be overwhelmingly more resistant than the teeth being moved. In this case, anchorage in the maxilla was achieved with a trans-palatal bar, bonding of the second molar, and Class II elastics. Mandibular anchorage was achieved by bonding the second molars. Nowadays, mini-implants provide excellent anchorage control and considered to be effective that the trans-palatal bar. In this study, trans-palatal and lingual bar were used to increase the anchorage.

Generally the prominence of the upper and lower lips was reduced significantly about 12.9 degrees for the upper lip and about 4.9 for the lower lip; this is due to the retraction of the maxillary and mandibular incisors.

Confirming the results in this study, the naso-labial and labio-mental angles were increased significantly also due to the retraction of the maxillary and mandibular anterior teeth; this comes in agreement with Bravo (15). Sukhia et al. (16) found significant increase for the naso-labial angle and non-significant for labio-mental angle.

Lo and Hunter (17) reported that the greater the maxillary incisor retraction the greater the increase in the naso-labial angle. In the present study, the naso-labial angle was increased about 17 degrees.

Relating the soft tissue nasion and the tip of the nose to the soft tissue pogonion revealed non-significant difference after treatment. This indicated that the retraction of the anterior teeth may not affect the underlying basal bone and
hence the soft tissue pogonion followed the bony one so the soft tissue profile here is not affected. The small change in Na’-Sn-Pog’ angle (0.9 degrees) was attributed to the backward position of the subnasale after treatment.

CONCLUSIONS

Treatment of bi-maxillary protrusion with fixed orthodontic appliances and extraction of four premolars improve the facial esthetics of the patients by decreasing the lip projection and increasing the naso-labial and mento- labial angles.

Careful evaluation of patients with bi-maxillary protrusion is needed to gain more information on the possible consequences of incisor retraction, so one should bear in mind that individual variation in response is great. Therefore, it would be prudent to inform the patient of average changes to expect, while also informing the patient that in his or her particular instance, this could be different.

REFERENCES


Table 1. Descriptive statistics and treatment effect on the angular measurements used in this study

<table>
<thead>
<tr>
<th>Angular measurements (degree)</th>
<th>Descriptive statistics</th>
<th>Difference (d.f. = 9)</th>
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<tr>
<td></td>
<td>Before treatment</td>
<td>After treatment</td>
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<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
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<tr>
<td>Na’-Ls/FH</td>
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<td>3.89</td>
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<td>Na’-Li/FH</td>
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<td>Naso-labial angle</td>
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<tr>
<td>Na’-Pog’/FH</td>
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<td>Na’- NT- Pog’</td>
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<td>Labio - mental angle</td>
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