LOWER FACIAL HEIGHT TREATMENT CHANGES IN BI-MAXILLARY PROTRUSION ORTHODONTIC CASES

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ABSTRACT

Aim of the study was to investigate the change in lower anterior facial height (LAFH) following 1st premolar extraction and incisor retraction in bimaxillary proclination orthodontic cases. 35 patients (M:F ratio 18:17) with bimaxillary protrusion with age ranging from 14-17 years (mean calculated age 15.6 years) were treated with 1st premolar extractions followed by retraction of the upper and lower labial segments with fixed orthodontic appliances.

Pre and post cephalometric values were recorded for each patient. The skeletal parameters measured were SNA, SNB, ANB, MMA, SN-MP and the facial height ratio. The angular soft tissue parameters measured were the naso-labial and the labio-mental angle to investigate the soft tissue changes compared with lower facial height. Pre and post cephalometric values were calculated separately for each patient and the mean value was calculated.

The lower anterior facial height decreased by 3 percent following 1st premolar extraction space closure and retraction of the upper and lower labial segments. The naso-labial angle showed 4 degrees mean value change following upper incisor retraction, while the labio-mental angle demonstrated a mean value change of 2 degrees post-treatment.

Lower facial height can be altered following 1st premolar extractions and incisor retraction in bimaxillary proclination patients with increased anterior vertical discrepancies. Skeletal effects were more pronounced as compared to the overall soft tissue profile changes.

Key Words: Bi-maxillary proclination, Orthodontic treatment, Lower Facial Height, Premolar extraction, soft tissue profile.

INTRODUCTION

In orthodontics, bi-maxillary proclination is defined as the concomitant proclination of the upper and lower dental arches. It is most common in afro-caribbeans and oriental populations. Skeletal bi-maxillary protrusion or prognathic jaws is usually associated with increased skeletal lower facial height, accentuated ANB angle, short posterior cranial base, anterior positioned glenoid fossa and divergent facial planes. Lower facial height change following premolar extractions is a debatable topic in orthodontics. Most orthodontists agree that lower facial height can be influenced following 1st premolar extraction, while others report mild to insignificant changes. Maxillary and mandibular 1st premolars are frequently extracted in orthodontics for bimaxillary retraction of the incisors. Upper and lower lip prominence can be reduced following premolar extraction and incisor retraction. Most bimaxillary protrusion adult cases complain of increased facial height and lip protrusion rather than the dental protrusion. This is due to the increased esthetic awareness in recent years amongst the adult population.

Some authors have a strong negative view of extraction treatment, which they believe produces a
dished-in profile, flattens the face and reduces the lower facial height giving the patient an older aged appearance. Other orthodontists reject this flattening of the face theory and have reported vertical and anterior-posterior improvement in facial profile after four 1st premolar extractions.

Previous studies have investigated changes in soft tissue profile with four 1st premolar extractions, few have investigated the vertical dimensions especially the lower facial height changes in bi-maxillary cases. Therefore, present study was done to address the pre- and post treatment skeletal vertical height changes in bi-maxillary proclination cases after 1st premolar extractions concentrating particularly on the lower anterior region, which is prone to the greatest changes by treatment.

**METHODOLOGY**

In the study, 35 patients (male: female ratio 18:17) with class 2 skeletal malocclusions and bi-maxillary dental proclination were selected and treated with fixed orthodontic appliances. All the patients were between 14 and 17 years age at the beginning of treatment (mean calculated age 15.6 years). The mean values of crowding were 7.2 mm in upper arch and 6.4 mm in the lower arch.

All the patients were treated with Roth 0.022” prescription straight-wire fixed appliances. The total treatment was between 14 to 24 months. The treatment objectives were to ideally align the incisors, correct the incisor inclinations, close the pre-molar extraction spaces and provide an esthetically pleasing profile.

**Exclusion Criteria**

- No functional appliance or orthognathic surgical procedure between pre- and post- treatment lateral cephalometric radiographs.
- No congenitally missing teeth (excluding 3rd molars).

The skeletal and soft tissue measurements were investigated using pre- and post treatment lateral cephalometric tracings exposed at the beginning and end of treatment. All radiographs were taken in standing position, with the frankfort horizontal plane parallel to the floor, the dentition in centric occlusion and the lips relaxed.

Standardized cephalometric radiographs measuring 8” X 10” were taken using a Siemens Orthophos-C cephalostat with settings of 14mA, and between 73 and 77 kV. Exposure time varied between 0.5 and 0.63 seconds. The film used was either Kodak TMG-RA1 or DuPont Ultravision G, with a developing time of 90 seconds using a Kodak N35 developer.

**STATISTICAL METHOD**

SPSS program 10.0 (Statistical Package for Social Sciences) was used for statistical evaluation. Mean and standard deviation was calculated. As noted in our study, dental cephalometric values were not included in the results. Only the skeletal and soft tissue parameters were investigated.

**Skeletal Parameters Measured**

The Skeletal angular parameters measured with pre- and post- treatment lateral cephalogram tracings were done to verify the skeletal contribution to the bi-maxillary protrusion cases (Fig 1).

**SNA:** Sella-Nasion line with maxillary apical base point A. (Normal value 82° ± 2°)

**SNB:** Sella-Nasion line with the mandibular apical base point B. (Normal value 80° ± 2°)

**ANB:** Difference between SNA & SNB. (Normal value 2° ± 2°)

**MMA:** Maxillary plane to mandibular plane angle. (Normal value 26° ± 5°)
Lower Facial Height Changes in Bi-Maxillary Protrusion

SN-MP: Sella-Nasion to mandibular plane angle. (Normal value 32° ± 5°)

Facial Height Ratio: Mention to anterior nasal spine (ANS) to Nasion-Mention distance measured in millimeters (Normal value range 50-55%).

Soft Tissue Angular Parameters Measured

Naso-labial Angle: It is defined as the angle between the line tangent from the sub-nasale (Sn) to the lower border of the nose, and from Sn to the vermilion border of upper lip (Fig 2).

Labio-mental Angle: It is formed by the intersection of the line drawn between the sulcus inferior an soft tissue chin and a line originating at sulcus inferior tangent to lower lip. Most investigations have determined that at mean 18 years age, the normal value is 125° ± 12° in males and 127° ± 12° in females. In our present study we have taken the mean of 130° ± 5° as normal (Fig 2).

RESULTS

The mean pre-and post-treatment values of the patients in our study are shown in Table 1.

Pre- & Post-Treatment Skeletal Measurements

The skeletal cephalometric parameters measured before and after treatment showed significant vertical and anterior posterior changes. The pre-treatment SNA, SNB mean values showed that the patients selected for the study had an underlying skeletal class 2 base with an increased mean ANB value of 7°. The major contribution to the skeletal class two malocclusion was due to a prognathic maxilla as evident from the pre-treatment mean SNA value of 87°. The pretreatment SNB value of 82° also confirms the presence of a slight associated prognathic mandible amongst our patient sample. As noted, the mean pre-treatment maxillary-mandibular plane angle value was 33°, showing a tendency towards an associated high angle or increased anterior lower facial height. This was further confirmed by the pre-treatment facial height ratio of 56 percent, which decreased to 53 percent post-treatment. The SN to mandibular plane angle also decreased 4° post-treatment from 37° to 33° respectively.

Pre- & Post-Treatment Angular Soft Tissue Measurements

The naso-labial angle increased from a mean pre-treatment value of 86° to 90°, showing a mean difference of 4° change post-treatment. However, The labio-mental angle showed a slight 2° increase from 124° to 126° during treatment.

DISCUSSION

The investigations in our study mostly depended on pre- and post treatment hard tissue and soft tissue lateral cephalometric analysis. Normal Caucasian cephalometric values were taken to measure bi-maxillary proclination and facial aesthetic parameters.18

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameter measured</th>
<th>Normal value</th>
<th>SD ±</th>
<th>Pre-treatment Mean</th>
<th>Post-treatment Mean</th>
<th>Mean difference</th>
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<tbody>
<tr>
<td>a. Skeletal AP and vertical measurements</td>
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<tr>
<td>1</td>
<td>SNA&lt;</td>
<td>82°</td>
<td>2°</td>
<td>87°</td>
<td>85°</td>
<td>2°</td>
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<td>2</td>
<td>SNB&lt;</td>
<td>80°</td>
<td>2°</td>
<td>82°</td>
<td>81°</td>
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<td>3</td>
<td>ANB&lt;</td>
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<td>2°</td>
<td>7°</td>
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<tr>
<td>4</td>
<td>Max-Man. plane&lt;</td>
<td>26°</td>
<td>5°</td>
<td>33°</td>
<td>30°</td>
<td>3°</td>
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<tr>
<td>5</td>
<td>SN/ Man. plane &lt;</td>
<td>32°</td>
<td>5°</td>
<td>37°</td>
<td>33°</td>
<td>4***</td>
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<tr>
<td>6</td>
<td>Facial Height Ratio</td>
<td>50-55%</td>
<td>56%</td>
<td>53%</td>
<td>3%**</td>
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<td>b. Angular Soft tissue measurements</td>
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<tr>
<td>8</td>
<td>Naso-labial &lt;</td>
<td>100°</td>
<td>5°</td>
<td>86.2°</td>
<td>90.4°</td>
<td>4***</td>
</tr>
<tr>
<td>9</td>
<td>Labio-mental &lt;</td>
<td>130°</td>
<td>5°</td>
<td>124.3°</td>
<td>126.2°</td>
<td>2°</td>
</tr>
</tbody>
</table>

**Greater changes reported

TABLE 1: MEAN VALUES OF PRE- AND POST TREATMENT CEPHALOMETRICS
Lower Facial Height Changes in Bi-Maxillary Protrusion

In our study, all patients selected suffered had bi-maxillary protrusion and associated increased vertical dimensions. However, Facial attractiveness is due to individual perception. It has no standard perception, and an attractive face perceived by the public may not match the average person’s face. The patients in our study complained of soft tissue protrusion, increased vertical proportions and lip prominence. As mentioned earlier, that since we are only investigating the vertical dimension changes, the dental cephalometric measurements have not been mentioned. As noted in table 1, the cephalometric tracings confirmed the presence of skeletal maxillary protrusion, and to some degree, mandibular protrusion combined with underlying increased vertical dimensions beyond normal Caucasian standards.

As investigated by Looi LK and Mills JRE\textsuperscript{19}, hard tissue skeletal values show little change with tooth movement. Young T & Smith R\textsuperscript{20} also concluded that 1\textsuperscript{st} premolar extractions caused insignificant to no skeletal changes with orthodontic treatment. Our study agrees with these findings as the anterior-posterior skeletal hard tissue measurements showed mild to insignificant differences post-treatment. SNA decreased from 87° to 85° post-treatment in our patient sample, showing a mean 2° difference. ANB angle showed a 3° difference post-treatment from 7° to 4° respectively.

As compared to the anterior-posterior changes, the vertical measurements showed greater changes post-treatment. The maxillary mandibular plane decreased 3° from 33° to 30° post-treatment. This was confirmed by post-treatment reduction in both SN to MP angle and facial height ratio. Our results agree with the findings of Chhibber et al\textsuperscript{21} and Bravo LA\textsuperscript{22} who also confirmed reduced vertical dimensions following treatment with first premolar extractions. These effects could be attributed to the class 2 elastics mechanism causing forward mandibular dento-alveolar movement during treatment decreasing the maxillary-mandibular plane angle or due to leveling of the curve of spee during treatment leading to better inter-cuspation of the buccal teeth in centric occlusion.\textsuperscript{23} Most authors quote the wedging-hypothesis\textsuperscript{24-25} to justify the decrease in anterior facial height following treatment with 1\textsuperscript{st} premolar extractions. Orce-Romero et al\textsuperscript{26} also states that premolar extractions causes forward movement of the upper and lower buccal segments leading to decrease in anterior vertical dimensions. Furthermore, Bills DA & Handelman CS\textsuperscript{27} has stated that premolar extractions leads to better anterior-poste-
rior and vertical facial esthetics in bi-maxillary pro-
trusion patients post-treatment.

Numerous authors\textsuperscript{26-28} have reported greater an-
gular soft tissue changes in bi-maxillary protrusion
treatment. In our study, theangular soft tissue mea-
surements showed significant post-treatment changes.
The labio-mental angle increased from a pre-treat-
ment mean value of 124.3° to 126.2° showing a mean
difference of 2° respectively. The increased labio-
mental angle post-treatment could be due to retraction
of the lower incisors. Fitzgerald et al\textsuperscript{30} calculated the
mean naso-labial angle value of 114° ± 10° in Cauc-
sian adults with well-balanced faces. In our study, we
have taken the mean value of 100° ± 5° as several
studies\textsuperscript{31-32} of pleasing profiles indicate a range of 90° to
120° for the ideal naso-labial angle. The naso-labial
angle showed greater differences from a pre-treat-
ment mean value of 86.2° to 90.4° with a mean differ-
ence of 4°. Our findings agree with the results of Lo and
Hunter\textsuperscript{33} who reported that the greater the maxillary
incisor retraction the greater the increase in the naso-
labial angle.

Lastly, Facial esthetics is difficult to measure and
record. In some cases, angular measurements may be
within normal cephalometric values yet there may be
presence of protrusion of the incisors and lips. In our
study, we investigated the skeletal vertical changes in
bi-maxillary protrusion cases. However, other mea-
surements such Jarabak analysis and Frankfort to
mandibular plane (FMA) angle\textsuperscript{34} can be used in the
future to study lower facial height changes following
1st premolar extraction.

CONCLUSION

On the basis of the results obtained from this
study, the Lower facial height can be altered following
1st premolar extractions and incisor retraction in bi-
maxillary proclination patients. The soft tissues asso-
ciated with the lower facial height also showed changes
which contributed to the improvement in the patients
facial profile post-treatment. Thereby the main com-
plaints of increased facial height and especially lip
protrusion can be addressed following extraction treat-
ment.

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