The Impact of Extraction vs Nonextraction Treatment on Soft Tissue Profile in Borderline Class I Malocclusion: A Cephalometric Study

1Sneh Lata Verma, 2Vijay P Sharma, 3Pradeep Tandon, 4Gyan P Singh

ABSTRACT

Introduction: The continuous controversy concerning extraction of premolar teeth and its supposed effects on the facial profile led to the origin of this study, which compares the pretreatment and post-treatment facial profiles of patients who underwent premolar extraction with those of patients who did not undergo extraction.

Objective: To analyze the soft tissue changes between the two different treatment groups, equally susceptible to both treatment options (extraction and nonextraction) and to compare the changes taking place in the soft tissue variables from one group to another using the cephalometric analysis.

Materials and methods: The diagnostic extraction and treatment decisions were based on a total space analysis with differential extraction protocols. The pretreatment and post-treatment cephalograms of the borderline sample (100 female patients, 50 of the patients were treated with premolar extraction and 50 were treated without premolar extraction) were then subjected to a thorough soft tissue cephalometric analysis.

Results: The results indicated that the three variables that played the most important role in the clinician’s treatment decision were indicators of lower crowding, soft tissue convexity, and lower incisor protrusion. Significant differences (p < 0.05) regarding upper and lower lip protrusion, upper lip thickness (p < 0.05) and the nasolabial angle (p < 0.05) occurred after treatment.

Conclusion: Extraction treatment of Class I borderline malocclusions led to significant soft tissue changes in relation to the upper and lower lip position and thickness as well as the nasolabial angle, whereas the nonextraction treatment resulted in significant upper lip retraction and lower lip protrusion.

Keywords: Soft tissue profile, Borderline extraction-nonextraction (NE) subjects, Standard edgewise mechanics.


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INTRODUCTION

The success of orthodontic treatment is influenced by the clinician’s ability to develop an optimal treatment plan, because facial harmony in orthodontics is determined by the morphologic relationships and proportions of the nose, lips, and chin as well as his or her mastery of the techniques used for treating different types of malocclusions.

In extraction therapy, orthodontists have long recognized that the extraction of premolars often is accompanied by changes in the soft tissue profile. At times, these changes result in substantial improvement in the profile and frequently justify the extraction of teeth in patients without other indications. At other times, however, premolars extraction can lead to a flatter profile. For this reason, a carefully studied extraction policy, accounting for all possible changes, would be very valuable.

A positive correlation between incisor movement and soft tissue changes has been reported. On the other hand, the studies of Angelle and Hersey showed that the changes in tooth position are not systematically followed by proportional soft tissue profile changes. Variables, such as lip morphology, type of treatment, extraction vs nonextraction therapy, choice of extraction, patient gender, and age have been held responsible for individual differences in soft tissue response.

The purpose of this study was to compare orthodontic treatment outcomes in Indian female patients with borderline problems treated with and without premolar extractions.

MATERIALS AND METHODS

The present study was conducted on 100 orthodontically treated female patients, that were divided into two groups, extraction group (50 patients) and nonextraction group...
(50 patients). The pretreatment and post-treatment lateral cephalograms were obtained from the Department of Orthodontics, Faculty of Dental Sciences, CSMMU, Lucknow.

Subjects: Two groups of 100 patients were investigated and were grouped as follows:

<table>
<thead>
<tr>
<th>Groups</th>
<th>No. of patients</th>
<th>Mean age</th>
<th>Average duration of treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (E4):</td>
<td>50</td>
<td>14 years</td>
<td>24 to 30 months</td>
</tr>
<tr>
<td></td>
<td>Four first</td>
<td>1 month</td>
<td></td>
</tr>
<tr>
<td>premolars</td>
<td>were</td>
<td></td>
<td></td>
</tr>
<tr>
<td>extracted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2 (NE):</td>
<td>50</td>
<td>13 years</td>
<td>18 to 24 months</td>
</tr>
<tr>
<td></td>
<td>No teeth were</td>
<td>5 months</td>
<td></td>
</tr>
<tr>
<td>extracted</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Criteria for Patient Selection

All patients were females with a full complement of teeth (no congenitally missing teeth, congenital anomalies or facial asymmetries) exhibiting Class I dental and skeletal malocclusion, treated with standard edgewise appliance with or without extraction of premolars. The treatment they received did not include the use of a functional appliance or any orthognathic surgical procedure.

Methods

The cephalograms obtained from the department had been taken by properly positioning the patients on a universal counterbalancing type of cephalostat with the Frankfort horizontal plane parallel to the floor and the teeth in centric occlusion. All cephalograms had been taken with patients in a standing position with relaxed lips (Burstone, 1967).

Kodak X-ray films (8 × 10 inch) had been exposed at 70 kVp: 30 mA for 1.8 seconds from a fixed distance of 60 inches by following the standard technique employed in the Department of Orthodontics.

Each selected cephalogram met the following essential requirements:

i. Good definition of the hard and soft tissue structures and profiles.
ii. Teeth in centric occlusion.
iii. Soft tissue subjectively judged to be in relaxed habitual repose.

After placing registration points on the cephalogram, the pre- and post-treatment radiographs were traced on acetate tracing sheets 0.5 microns in thickness using a sharp 4H pencil on a view box using transilluminated light in a dark room. Any stray light radiations were eliminated by covering the margins of the view box with a black paper leaving only that much part required for radiograph visibility.

Where there was a lack of superimposition of the right and left structural outline, the average between the two was drawn by inspection and the cephalometric points were located in reference to the arbitrary line so obtained. The linear and angular measurements were made to the nearest 0.5 mm and 0.5° respectively, with the help of scale and protractor.

Methods of Analysis

Cephalometric points used in the present study are shown in Figure 1.

SOFT TISSUE MEASUREMENTS

Angular (Fig. 2)

1. Nasolabial angle: Angle formed between tangent to columella and tangent to upper lip.
2. Mentolabial angle: Angle formed between tangent to soft tissue chin and tangent to lower lip at ILS.
3. ’Z’ angle: Angle formed between FH plane and most protrusive lip to pog line.

Linear (Fig. 3)

1. Sulcus superius-E-line
2. Sulcus inferius-E-line
3. Max.1 to labrale superius
4. Md. 1 to labrale inferius
5. Sn-Stms: Upper lip length
6. Stmi-ILS: Lower lip length

All linear and angular measurements were made to the nearest 0.5 mm and 0.5° respectively. The readings which showed an increase in the post-treatment value as compared to pretreatment values were recorded as positive while those which decreased after treatment were recorded as negative.

STATISTICAL METHODS USED FOR ANALYSIS OF DATA

Means and standard deviations of the 11 variables previously described were calculated for both groups before and after treatment. The means and standard deviations for the differences that each treatment group experienced from pretreatment to post-treatment were also calculated. Independent sample t-tests were performed to test the significance of the differences between the change values of the two different treatment groups. Paired t-tests were
performed to test the null hypothesis that no differences exist within the same treatment group between the onset and the end of treatment in the cephalometric measurements. The levels of significance tested were $p < 0.05$ and $p < 0.01$.

The data were subjected to statistical analysis using the following methods:

1. **Mean used to calculate the average value:**

   $$\bar{X} = \frac{\sum x}{n}$$

   $\bar{X} =$ Mean

   $\sum x =$ Summation of $X$ values

   $n =$ Total number of samples

2. **Standard deviation:** Most frequently used, measure of dispersion denoted by SD:

   $$SD = \sqrt{\frac{\sum (X - \bar{X})^2}{n-1}}$$

   $SD =$ Standard deviation, $X =$ Individual value for the parameter, $\bar{X} =$ Arithmetic mean, $n =$ Number of observations.

3. **Standard error:**

   $$SE = \frac{SD}{\sqrt{n}}$$

   $SE =$ Standard error, $SD =$ Standard deviation, $n =$ Total number of samples.

4. **Student ‘t’ test:** To test equality of two means:

   $$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S^2}{n_1} + \frac{S^2}{n_2}}}$$

   Where $S^2 = \frac{1}{n_1 + n_2 - 2} \times \left[ S_1^2 (n_1 - 1) + S_2^2 (n_2 - 1) \right]$

   $\bar{X}_1 =$ Mean 1, $\bar{X}_2 =$ Mean 2, $SD_1 =$ Standard deviation 1, $SD_2 =$ Standard deviation 2, $n_1 =$ Number of values in group 1, $n_2 =$ Number of values in group 2.

5. **Paired ‘t’ test:** It is used to compare the change in variables in subjects of the two groups:

   $$t = \frac{\bar{d}}{Sd/\sqrt{N}}$$

   where $\bar{d} =$ Mean of difference; $SD =$ Standard deviation of difference; $N =$ Number of subjects.

6. **Measurement of reliability:** Reliability of measurement was tested by doing double determination of 10 cephalograms randomly selected at 15 days interval from the collected sample, by the same operator and comparison was drawn from the first and second determinants (Table 1).

**OBSERVATIONS**

The pretreatment and post-treatment lateral head cephalogram of 100 orthodontically treated patients were traced and
analyzed for soft tissue variables (4 angular and 7 linear). The data was sequentially evaluated in following manner:

**Aim**

1. To find out the changes in soft tissue variables with treatment in each group.
2. To compare the changes taking place in soft tissue variable from one group to another.

Intragroup difference for the extraction sample depicts parameters defining upper lip protrusion related to E-line, Sn-Stms, nasolabial angle changes significantly showing upper lip retraction. Lower lip was also found retracted up to a highly significant level. Improvement in facial profile was found as ‘Z’ angle was increased (Table 2 and Fig. 4). Intragroup difference for the nonextraction sample. Only parameter that showed just significant change was related to lower lip protrusion as the mean decrease of 0.56 ± 1.46 in distance between sulcus inferior E-line was observed (Table 2 and Fig. 5).

**INTERGROUP COMPARISON OF CHANGES IN GROUPS 1 AND 2**

**Intergroup Post-treatment Differences**

Upper lip was retracted in both the groups as related to the nasolabial angle, sulcus superior-E line, but the change was more in extraction group. With regard to upper lip thickness, the difference in increase between the two groups was also significant. Lower lip was retracted relative to the E-line in extraction group but was brought forward in nonextraction group. Improvement in profile was more pronounced in extraction group relative to Z angle (Table 3 and Fig. 6).

**DISCUSSION**

The study of beauty and harmony of the facial profile has been central to the practice of orthodontics. From its earliest days, orthodontic treatment by removing teeth had been widely accepted for many type of patients for better long-term stability. But, nonextraction treatment have again gained widespread popularity in recent years.

Recent studies of extraction vs nonextraction treatment have focused on the profile effects of these treatments. But, the choice of treatment should depend not only on the profile but may be also on some other skeletal and dental parameters.

Pretreatment values of extraction and nonextraction groups of Class I malocclusion presented similar soft tissue facial characteristics with no significant differences between the measurements. The treatment objective for these patients regarding lower incisor position was to place these teeth in a stable position on their bony bases. After treatment, both the groups were still almost similar with only significant difference in few soft tissue variables.

Changes in the extraction Class I group showed, that among the soft tissue angular variables nasolabial and mentolabial angles were observed to be significantly increased by 5.22° and 4° respectively. Increase in these angles can be related to upper and lower lip retraction respectively. Increase in nasolabial angle can be substantiated by Finnoy et al (1987)6 and Drobocky and Smith (1989)7 also observed an increase of 7° in this angle in their studies. An increase in mentolabial angle was also previously reported in studies carried out by Park et al (1989).8

Merrifield’s study (1966)9 of facial profile in a sample of 120 treated and untreated patients with pleasing facial esthetics led to the development of ‘Z’ angles to quantify balance or lack of the lower facial profile. In present study in this group, ‘Z’ angle was found to be increased by 2.11°, thus improving facial profile. Kocadereli (2002)10 made the same conclusion as pretreatment Z angle was 67.5° and became 69° post-treatment with an increase of 1.5°. Study made by James (1998)11 concluded that ‘Z’ angle increased by about 6° after treatment.

<table>
<thead>
<tr>
<th>Name of variables</th>
<th>First determination</th>
<th>Second determination</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft tissue angular variables (°)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Nasolabial angle</td>
<td>105.42 ± 9.01</td>
<td>105.60 ± 9.10</td>
<td>0.04</td>
<td>NS</td>
</tr>
<tr>
<td>2. Mentolabial angle</td>
<td>105.80 ± 15.10</td>
<td>105.40 ± 15.20</td>
<td>0.05</td>
<td>NS</td>
</tr>
<tr>
<td>3. Z-angle</td>
<td>57.90 ± 6.60</td>
<td>57.80 ± 6.65</td>
<td>0.03</td>
<td>NS</td>
</tr>
<tr>
<td>4. N-Sn-Pog</td>
<td>155.92 ± 6.28</td>
<td>156.0 ± 6.15</td>
<td>0.03</td>
<td>NS</td>
</tr>
<tr>
<td>Soft tissue linear variables (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Sul-sup-E-line</td>
<td>7.16 ± 1.22</td>
<td>7.25 ± 1.22</td>
<td>0.16</td>
<td>NS</td>
</tr>
<tr>
<td>6. Sul-inf.-E-line</td>
<td>4.56 ± 1.93</td>
<td>4.50 ± 1.90</td>
<td>0.07</td>
<td>NS</td>
</tr>
<tr>
<td>7. Ɪ to LS</td>
<td>10.50 ± 2.92</td>
<td>10.56 ± 2.90</td>
<td>0.04</td>
<td>NS</td>
</tr>
<tr>
<td>8. Ɪ to Li</td>
<td>12.80 ± 2.32</td>
<td>12.85 ± 2.58</td>
<td>0.05</td>
<td>NS</td>
</tr>
<tr>
<td>9. Sn-Stms</td>
<td>19.80 ± 2.66</td>
<td>19.60 ± 2.60</td>
<td>0.17</td>
<td>NS</td>
</tr>
<tr>
<td>10. Stml-ILS</td>
<td>14.74 ± 2.70</td>
<td>14.70 ± 2.20</td>
<td>0.01</td>
<td>NS</td>
</tr>
<tr>
<td>11. Stms-Stmi</td>
<td>4.60 ± 3.50</td>
<td>4.66 ± 2.60</td>
<td>0.04</td>
<td>NS</td>
</tr>
</tbody>
</table>

***p < 0.001: Highly significant; **p < 0.01: Significant; *p < 0.05: Just significant; NS > 0.05: Not significant
The Impact of Extraction vs Nonextraction Treatment on Soft Tissue Profile in Borderline Class I Malocclusion

Table 2: Borderline extraction sample (Group 1: N = 50) and nonextraction sample (Group 2: N = 50): descriptive and inferential statistics of the soft tissue analysis

| Name of variables | Extraction sample (N = 50) | | | | | Nonextraction sample (N = 50) | | | | |
|--------------------|----------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
|                    | Pre-treatment (mean ± SD) | Post-treatment (mean ± SD) | Change (mean ± SD) | t-value | p-value | Pre-treatment (mean ± SD) | Post-treatment (mean ± SD) | Change (mean ± SD) | t-value | p-value |
| **Angular variables (°)** | | | | | | | | | | | | | |
| 1. Nasolabial angle | 109.38 ± 8.16 | 114.61 ± 6.64 | 5.22 ± 3.80 | 5.83 | <0.001*** | 103.31 ± 11.19 | 104.06 ± 13.93 | 1.25 ± 7.78 | 0.13 | NS |
| 2. Mentolabial angle | 111.28 ± 15.16 | 115.28 ± 12.56 | 4.00 ± 10.73 | 1.50 | NS | 110.38 ± 13.43 | 105.18 ± 15.20 | –5.19 ± 16.61 | 1.25 | NS |
| 3. Z-angle | 62.66 ± 7.07 | 64.56 ± 6.97 | 2.11 ± 3.23 | 2.11 | <0.05* | 68.25 ± 7.12 | 70.25 ± 6.29 | 2.00 ± 2.28 | 2.76 | <0.05* |
| 4. N-Sn-Pog | 155.50 ± 7.63 | 156.56 ± 6.07 | 1.06 ± 3.65 | 1.23 | NS | 160.06 ± 5.76 | 161.38 ± 5.54 | 1.31 ± 2.75 | 1.91 | NS |
| **Linear variables (mm)** | | | | | | | | | | | | | |
| 5. Sul-sup-E-line | 3.94 ± 1.47 | 5.28 ± 1.32 | 1.33 ± 1.57 | 3.60 | <0.01** | 8.69 ± 2.18 | 9.06 ± 2.74 | 0.38 ± 1.66 | 0.92 | NS |
| 6. Sul-Inf-E-line | 4.28 ± 1.84 | 4.50 ± 1.94 | 0.22 ± 1.94 | 0.49 | NS | 6.87 ± 2.21 | 6.31 ± 1.66 | –0.56 ± 1.46 | 1.54 | < 0.05* |
| 7. I to LS | 11.61 ± 2.66 | 12.83 ± 1.94 | 1.22 ± 2.05 | 2.54 | <0.05* | 14.13 ± 2.09 | 13.94 ± 1.34 | –0.19 ± 1.94 | 0.39 | NS |
| 8. I to Li | 13.28 ± 2.09 | 12.89 ± 2.89 | 0.39 ± 2.85 | 0.58 | NS | 14.94 ± 2.08 | 15.38 ± 1.75 | 0.44 ± 1.96 | 0.89 | NS |
| 9. Sn-Stms | 20.20 ± 2.79 | 20.77 ± 2.73 | 0.57 ± 1.22 | 2.73 | <0.05* | 18.69 ± 1.85 | 19.16 ± 2.39 | 0.48 ± 1.12 | 1.71 | NS |
| 10. Stml-ILS | 15.56 ± 1.98 | 16.83 ± 1.95 | 1.28 ± 1.23 | 4.42 | <0.001*** | 14.88 ± 1.36 | 15.38 ± 1.78 | 0.19 ± 1.22 | 0.39 | NS |
| 11. Stms-Stmi | 3.11 ± 2.05 | 1.22 ± 1.17 | –1.89 ± 1.49 | 5.37 | <0.001*** | 1.81 ± 1.87 | 1.63 ± 1.02 | –0.18 ± 1.22 | 0.59 | NS |

*p < 0.05: Just significant; **p < 0.01: Significant; ***p < 0.001: Highly significant; NS > 0.05: Not significant

Table 3: Extraction vs nonextraction: descriptive and inferential statistics of mean value differences—soft tissue analysis post-treatment result

<table>
<thead>
<tr>
<th>Name of variables</th>
<th>Extraction</th>
<th>Nonextraction</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Angular variables (°)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Nasolabial angle</td>
<td>5.22 ± 3.80</td>
<td>1.25 ± 7.78</td>
<td>2.65</td>
<td>&lt;0.05*</td>
</tr>
<tr>
<td>2. Mentolabial angle</td>
<td>4.00 ± 10.73</td>
<td>–5.19 ± 16.61</td>
<td>1.94</td>
<td>NS</td>
</tr>
<tr>
<td>3. Z-angle</td>
<td>5.11 ± 3.23</td>
<td>1.00 ± 2.28</td>
<td>4.23</td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>4. N-Sn-Pog</td>
<td>1.06 ± 3.65</td>
<td>1.31 ± 2.75</td>
<td>0.22</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Linear variables (mm)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Sul-sup-E-line</td>
<td>1.35 ± 1.57</td>
<td>0.38 ± 1.66</td>
<td>1.83</td>
<td>NS</td>
</tr>
<tr>
<td>6. Sul-Inf-E-line</td>
<td>0.22 ± 2.05</td>
<td>–0.56 ± 1.46</td>
<td>0.55</td>
<td>NS</td>
</tr>
<tr>
<td>7. I to LS</td>
<td>1.22 ± 2.05</td>
<td>–0.19 ± 1.54</td>
<td>2.15</td>
<td>&lt;0.05*</td>
</tr>
<tr>
<td>8. I to Li</td>
<td>0.39 ± 2.85</td>
<td>0.44 ± 1.96</td>
<td>0.05</td>
<td>NS</td>
</tr>
<tr>
<td>9. Sn-Stms</td>
<td>0.78 ± 1.22</td>
<td>0.48 ± 1.12</td>
<td>0.28</td>
<td>NS</td>
</tr>
<tr>
<td>10. Stml-ILS</td>
<td>1.28 ± 1.23</td>
<td>0.19 ± 1.22</td>
<td>0.21</td>
<td>NS</td>
</tr>
<tr>
<td>11. Stms-Stmi</td>
<td>–1.89 ± 1.49</td>
<td>–0.18 ± 1.22</td>
<td>1.49</td>
<td>NS</td>
</tr>
</tbody>
</table>

*p < 0.05: Just significant; **p < 0.01: Highly significant; NS > 0.05: Not significant

Fig. 4: Significant soft tissue changes in Group 1 (borderline Class I malocclusion extraction group)

Fig. 5: Significant soft tissue changes in Group 1 (borderline Class I malocclusion nonextraction group)
In soft tissue linear variable distance between sulcus superior to E-line shows increase in values, about 1.33 mm depicting retraction of upper lip. Holdaway (1983)\textsuperscript{12} gave the acceptable range of 1 to 4 mm for superior sulcus depth. The change in value is due to change in positioning of maxillary denture base, which is followed by soft tissue. This was supported by studies done by Kocadereli (2002),\textsuperscript{10} who also observed mean increase of 1.2 mm in superior sulcus E-line in extraction Class I group.

Authors like Rudee (1964)\textsuperscript{13} Anderson et al (1973)\textsuperscript{14} Garner (1974)\textsuperscript{15} Ross (1977)\textsuperscript{2} and Caplan Shivpuja (1997)\textsuperscript{16} have taken out ratios between lip retraction and incisor retraction. Lip structure also seems to have an influence on lip response to incisor retraction. Oliver (1982)\textsuperscript{17} found that patients with thin lips or high lip strain displayed a significant correlation between incisor retraction and lip retraction. Whereas patients with thick lip or low lip strain displayed no such correlation. Wisth (1987)\textsuperscript{6} found that lip response as a proportion of incisor retraction decreased as the amount of incisor retraction increased. This seems to indicate that the lips have some inherent support. Perkins (1993)\textsuperscript{18} found that decrease in upper vermilion height were positively correlated with upper lip retraction.

Lip thickness at Mx1 (upper lip thickness) increased about 1.22 mm giving post-treatment mean value 12.83 mm. Anderson et al (1973)\textsuperscript{14} reported a similar finding. They even gave a ratio of 1.0 mm increase in lip thickness for every 1.5 mm of incisor retraction. Holdaway (1983)\textsuperscript{12} substantiated these findings. He said that retraction of upper incisors leads to an increase in lip thickness at Mx1, which further leads to decrease in lip strain.

The findings of the present study showed increase in lip length after treatment. Upper lip length was found to be increased about 0.57 mm and lower lip length about 1.28 mm. The question of change in lip height during treatment has been subject to controversy in the past. Kadar\textsuperscript{19} and Lew\textsuperscript{20} observed an increase in lip height subsequent to treatment. The findings of Kadar were statistically not significant. Perkins and Staley\textsuperscript{18} observed a decrease in lip height in their sample of Class I patients but also found no change in lip heights in patients whose upper lips were higher on the incisors pretreatment.

Decrease in interlabial gap by about 1.89 mm was observed after treatment in Class I extraction group. Retraction of maxillary incisors and mandibular rotation were found to correlate with vertical changes in lower lip. Same observation were found by Rains and Nanda\textsuperscript{21} who found in their study that stomion superius descended slightly by an average of 0.3 mm, with a range from 1.5 mm superior to 0.4 mm inferior movement. Stomion inferius experienced large movement from 3.0 mm inferiorly to 5.0 mm superiorly with a mean ascent of 0.6 mm.

**Changes in Nonextraction Class I Malocclusion**

In soft tissue variables, ‘Z’ angle was found to be increased to about 2°, which is in accordance to the study conducted by James\textsuperscript{11} who found a mean increase of 4° in ‘Z’ angle value and stated that nonextraction group complete treatment with a slightly more retrusive lip profile position than did the extraction group. Kocadereli\textsuperscript{10} observed that in the nonextraction group, the ‘Z’ angle remained the same.

Lower lip proclination depicted by decreased distance of sulcus inf. -- E-line (0.56 mm) was found to be statistically significant, which is due to forward tipping of lower incisors. Findings were supported by Bishara et al\textsuperscript{22} who found that protrusion of upper and lower lip increases in non-extraction group.

Part II of the study was conducted with the aim to compare the changes taking place in soft tissue variables between extraction and nonextraction group.

On comparing soft tissue variables, the variable that showed significant difference between two groups included ‘Z’ angle, nasolabial angle and basic upper lip thickness.

For the ‘Z’ angle, a significant mean increase of 4° was observed in extraction group but, in nonextraction group, it was not significant. In present study, mean increase of nasolabial angle was 5.22° in extraction group while in nonextraction group it is 1.25°. In a study by De Smit and Dermaut,\textsuperscript{23} the mean nasolabial angle for a mixed study group was found to be 11°. They observed mean values of nasolabial angle starting at a relatively high level, which increased within extraction group (3.2°); the less pronounced mean increase in nonextraction group was not significant. Finnoy et al\textsuperscript{6} found that their extraction group displayed a significantly greater increase of the nasolabial angle (6.5°) than nonextraction group (2.9°).
James\textsuperscript{11} stated in his study that both groups (extraction and nonextraction) completed treatment within the normal range of profile measurement but the extraction group began treatment with greater facial imbalance and had the greatest improvement in facial profile. After treatment upper lip thickness at Mx1 shows 1.22 mm increase in extraction group while nonextraction group showed mean decrease of 0.19 mm. Changes in the angle N’-Sn-Pog’ showed that the soft tissue profile, excluding the nose, led to a less convex form in the extraction group and became more convex in nonextraction group.

Although the study provides useful and reliable information regarding treatment changes and difference in changes between extraction and nonextraction treatment modalities, but the mean values in the study is only an average. Therefore, the extremes in the groups could cause variations in the values, thus falsely representing the mean for that group.

It is suggested that further study with an increased sample size with a longer follow-up period would greatly improve the authenticity of the results.

**CONCLUSION**

Mean finished profile for both extraction and nonextraction patients are within the normal and/or ideal esthetic ranges of the parameters investigated. A better understanding of factors that contribute to the observed profile changes would certainly assist the clinician in treatment planning by allowing anticipation of the soft tissue response to changes of the underlying skeletal structure and dentition with treatment.

**REFERENCES**