



## Effects of Extraction vs. Non-Extraction Treatment on Soft Tissue Changes in Class I Borderline Malocclusion Cases

Authors

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### Abstract

#### Aim and Objectives

- To determine the soft tissue changes between the two treatment groups, extraction and non-extraction, equally susceptible to both treatment options.
- To compare the changes taking place in the soft tissue variables from one group to another using cephalometric analysis

#### Materials and Methods

- The pretreatment and posttreatment cephalograms of the class I borderline sample (50 patients, 25 of the patients were treated with premolar extraction and 25 were treated without extraction)
- The pretreatment and posttreatment cephalograms of all subjects were recorded and subjected to cephalometric analysis

**Results:** Both groups, showed retraction of upper lip in posttreatment cephalograms, whereas non extraction group showed protrusion of lower lip in posttreatment cephalograms.

- With regard to upper lip thickness, the difference in increase between both the groups was significant
- Significant differences ( $p < 0.01$ ) regarding upper and lower lip protrusion, upper lip thickness ( $p < 0.05$ ) and the nasolabial angle ( $p < 0.01$ ) occurred after treatment.

#### Conclusion

- Class I borderline malocclusions cases treated with premolar extraction resulted significant soft tissue changes in relation to the upper and lower lip position, thickness and nasolabial angle
- Class I borderline malocclusion cases treated with non-extraction led to significant upper lip retraction and lower lip protrusion.

**Keywords:** Borderline Class I, Soft tissue changes, Extraction vs non-extraction.

## Introduction

One of the major reasons patients seek orthodontic treatment is to improve their facial appearance<sup>1</sup>. In today's world, people are more concerned about their facial appearance. To improve the facial profile, employment of either one of the two important treatment approaches has been used that is extraction and non-extraction treatment protocols. Evaluating facial profiles and facial balance is a continuous learning process for orthodontists. The debate concerning the extraction of teeth and its effect on the facial profile began more than 100 years ago.<sup>2</sup> 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 improvements in the profile and frequently justify the extraction of teeth in patients without other indications<sup>3</sup>.

The objectives of orthodontic treatment are to attain optimal functional occlusion and harmonious facial esthetics and to maintain those results. Clinical observations have shown that to obtain stability of the attained orthodontic results, balance between dental and perioral muscles must be achieved.<sup>4-5</sup> Orthodontic treatment with fixed appliances includes two exclusive treatment modalities; extraction; and nonextraction. Extraction treatment is mostly used to relieve moderate to severe crowding and sometimes also to correct dental or dentoalveolar protrusion. On other hand, Nonextraction treatment is selected or preferred for the cases with minor skeletal and moderate dental discrepancies.

The choice between extraction and nonextraction treatment is usually based on orthodontic training, treatment philosophy, or temporal trends<sup>6-7</sup>. In the orthodontic literature, the perception of ideal facial esthetics, mainly identified with the patient's profile, and the employment of either one of the two main treatment approaches (extraction or nonextraction) have been highly controversial issues. The controversy becomes even greater when dealing with borderline cases.<sup>1</sup>

In extraction therapy, orthodontists<sup>1</sup> 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<sup>8-9</sup>. 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<sup>10-11</sup>.

Therefore the purpose of the study is to determine the soft tissue changes between the two treatment groups, extraction and non-extraction, equally susceptible to both treatment options and To compare the changes taking place in the soft tissue variables from one group to another using cephalometric analysis.

## Materials and Method

The present study was conducted on 50 orthodontically treated patients, that were divided into two groups, extraction group (25 patients) and nonextraction (25 patients). The pretreatment and post-treatment lateral cephalograms were obtained from the Department of Orthodontics, Pandit Deendayal Upadhyay Dental college, Solapur.

### Criteria for Patient Selection

All patients were with a full complement of teeth

- Exclusion criteria-** 1) congenitally missing teeth  
2) congenital anomalies  
3) facial asymmetries

**Inclusion criteria-** Patients with Class I dental and malocclusion cases, treated with or without extraction of premolars.

**Table 1.** Cephalometric Measurements Used:**1) Profile**

- G9-Sn-Pg' -Glabella-subnasale-S.t. pogonion

**2) Lip protrusion**

- Ls-E-plane-- Labrale superiorous - E-plane
- Li-E-plane -abrale inferiorous - E-plane
- Ls-Sn-Pg' L-abrale superiorous - subnasale-S.t. pogonion
- Li-Sn-Pg' La-brale inferiorous - subnasale-S.t. pogonion

**3)Upper incisor exposure**

- Is-Stm -Incision superiorous-stomion (FH)

**4)Lip thickness**

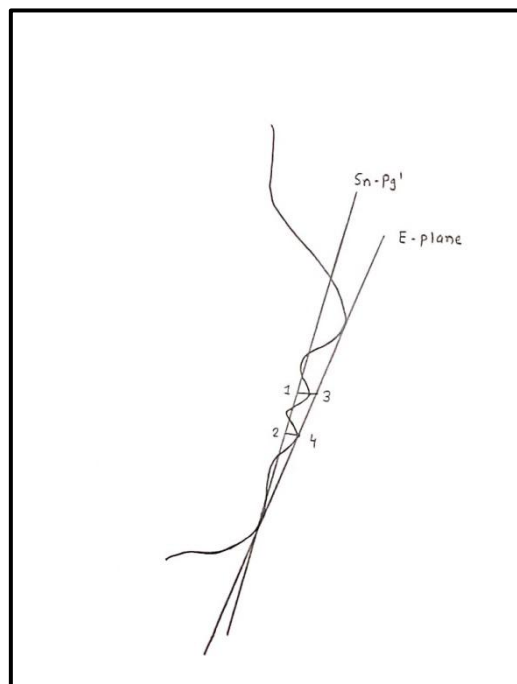
- Is-Ls- Incision superiorous-labrale superiorous (FH)
- Ii-Li -Incision inferiorous-labrale inferiorous (FH)
- Max. Sulcus - Sn-Ls Sup.labial sulcus - subnasale-labrale sup.
- Mand. Sulcus - Li-Pg' Labiomental fold - labrale inf.-S.t. pogonion

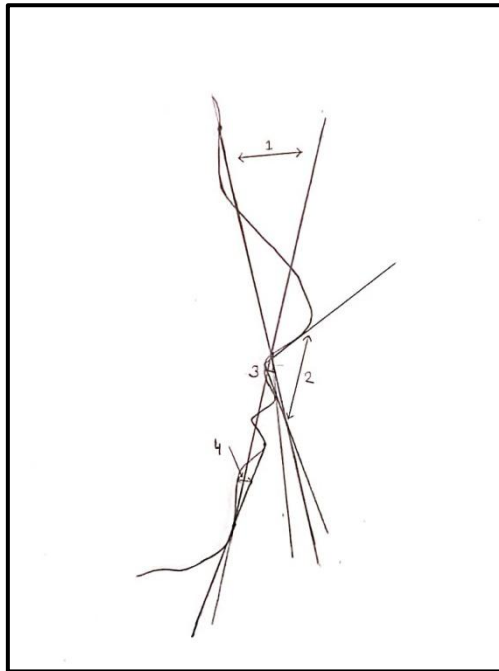
**5)Nose and upper lip**

- **Nasolabial angle-** Subnasale-columella-labrale superiorous

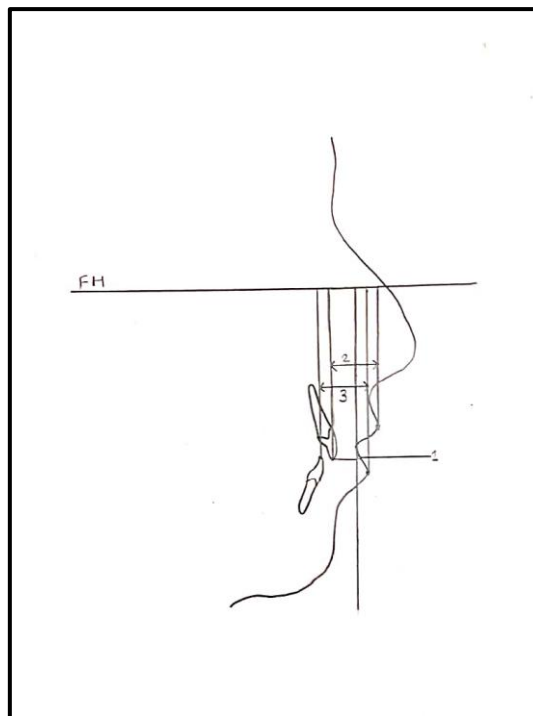
**Method –**

- Tracing on the the pre and post treatment lateral cephalograms was done on the acetate sheets of 0.5 microns in thickness by using sharp pencil of 0.3mm diameter
- To assess the soft tissue changes, the measurements shown in table no.1 and figures 1,2,3 are used.

**Figure 1.-** (1) Upper lip to Sn-Pg' line. (2) Lower lip to Sn-Pg' line. (3) Upper lip to E-plane. (4) Lower lip to E-plane.



**Figure 2.-** (1) Angle of facial convexity (G-Sn-Pg'). (2) Nasiolabial angle. (3) Maxillary sulcus depth (Max. Sulcus - Sn-Ls). (4) Mandibular sulcus depth (Mand. Sulcus - Li-Pg').



**Figure 3. -(1)** Upper incisor exposure (Is-Stm). (2) Upper lip thickness (Is-Ls). (3) Lower lip thickness (Ii-Li).

### Statistical analysis

Statistical analysis was done by descriptive statistics as mean, SD, percentage etc.

The Comparison of mean and SD values of all parameters from Pre treatment to Post treatment under study in Extraction Group and Non

Extraction Group was done by applying Student's Paired 't' test at 5% ( $p < 0.05$ ) and 1% ( $p < 0.01$ ) level of significance.

The Comparison of mean and SD values of all parameters from Post to Post treatment under study in Extraction Group and Non Extraction

Group was done by applying Student's Unpaired 't' test at 5% ( $p < 0.05$ ) and 1% ( $p < 0.01$ ) level of significance.

Also, One way ANOVA (Tuckey Kramer multiple comparison test) at 5% ( $p < 0.05$ ) and 1% ( $p < 0.01$ ) level of significance was used to test the difference between mean values of all parameters from Pre to Post treatment together in Extraction and Non-extraction groups.

## Results

### Intergroup Posttreatment Differences

The mean change values for the upper lip to E-plane were 5.60 mm for the extraction and -2.80 mm for the nonextraction group. The lower lip was retracted -4.00mm relative to the E-plane in the extraction group and brought forward -0.40mm in the nonextraction group. In relation to

Burstone's Sn-Pg' line, the upper lip was retracted -4.00 mm in the extraction and -0.70 mm in the nonextraction group, whereas the lower lip was retracted -3.50mm and brought forward 2.80 mm, respectively. From the measurements estimating lip thickness and sulcus depth, only the mean value change for upper lip thickness proved to be statistically significant ( $P < 0.05$ ), exhibiting an increase of 3.00 mm in the extraction vs 0.80 mm in the nonextraction group. The nasiolabial angle had a statistically significant ( $P < 0.01$ ) increase of 13.9degree within the extraction group and a decrease of -0.70 degree within the nonextraction group. Table no 2 shows the results of the two sample t-tests that were run to evaluate differences in the mean value changes between the two different treatment groups.

**Table No.2:** Extraction vs Non extraction: Descriptive and Inferential Statistics of Mean Value Differences:

	Extraction group (n=25)	Non-Extraction group (n=25)	Difference	't' test value
G-Sn-Pg' (Degree)	1.00	1.00	0	0.000
Ls-E plane (mm)	5.60	-2.80	-8.40	-4.026**
Li-Eplane(mm)	-4.00	-0.40	3.60	3.942**
Ls- Sn-Pg'(mm)	-4.00	-0.70	3.30	3.723**
Li- Sn-Pg;(mm)	-3.50	2.80	6.30	5.611**
Ls-St(mm)	-0.90	-0.20	-0.70	-0.5897
Is-Ls(mm)	3.00	0.80	-2.20	-2.9947*
Ii-Li(mm)	0.80	-0.30	-1.10	-0.9953
Sn-Ls(mm)	2.90	1.10	-1.80	-1.2471
Li-Pg'(mm)	0.90	0.60	0.30	0.9713
Nasolabial angle(Degree)	13.90	-0.70	-14.6	-7.4258**

\* $p < 0.05$ , \*\*  $p < 0.01$

### Intragroup Differences for the Extraction Sample

All parameters estimating upper and lower lip protrusion relative to the E-plane and the Sn-Pg' line indicate a retraction of both lips, which was statistically significant ( $P < 0.0001$ ).

At the beginning of the treatment, the upper and lower lips were 2.30mm and 2 mm in front of the E-plane, respectively. At the end, both lips were found to be -3mm and -2mm behind the E-plane.

The upper and lower lip protrusion relative to the Sn-Pg' line decreased from 7.0 and 5.2 to 3.0 and 1.70 mm, respectively.

The upper lip thickness increased significantly from 12.8 to 15mm at the end of treatment ( $P < 0.0001$ ).

The maxillary sulcus depth increased also significantly from 12.8 to 15.7mm ( $P < 0.0001$ ). The nasiolabial angle became more obtuse, thus exhibiting a statistically significant increase from 92 to 106degree ( $P < 0.0001$ ). The paired t-test results for the extraction sample can be found in Table no 3

**Table No.3:** Comparison of mean and SD values of all parameters from Pre to post treatment in Extraction group (n=25)

Parameters	Pre Treatment (n=25)	Post Treatment (n=25)	Difference	Student's Paired 't' test value	'p' value and significance
	Mean $\pm$ SD	Mean $\pm$ SD			
G-Sn-Pg' (Degree)	157.8 $\pm$ 2.3	158.8 $\pm$ 2.20	1.00	0.9934	p=0.3337, not significant
Ls-E plane (mm)	2.30 $\pm$ 0.67	-3.30 $\pm$ 0.82	5.60	16.634	P<0.0001, significant
Li-Eplane(mm)	2.0 $\pm$ 1.15	-2.0 $\pm$ 0.66	-4.00	9.487	P<0.0001, significant
Ls- Sn-Pg'(mm)	7.0 $\pm$ 0.81	3.0 $\pm$ 0.81	-4.00	10.954	P<0.0001, significant
Li- Sn-Pg'(mm)	5.20 $\pm$ 0.78	1.70 $\pm$ 0.67	-3.50	10.661	P<0.0001, significant
Ls-St(mm)	5.20 $\pm$ 1.03	4.30 $\pm$ 1.25	-0.90	1.754	p=0.0965, not significant
Is-Ls(mm)	12.80 $\pm$ 0.92	15.80 $\pm$ 0.92	3.00	7.300	P<0.0001, significant
Ii-Li(mm)	12.70 $\pm$ 1.25	13.50 $\pm$ 1.08	0.80	1.530	p=0.1434, not significant
Sn-Ls(mm)	12.80 $\pm$ 1.32	15.70 $\pm$ 1.08	2.90	5.048	P<0.0001, significant
Li-Pg'(mm)	20.0 $\pm$ 2.21	20.90 $\pm$ 2.99	0.90	0.7640	p=0.4548, not significant
Nasolabial angle(Degree)	92.70 $\pm$ 2.98	106.6 $\pm$ 5.23	13.90	7.298	P<0.0001, significant

By applying Student's Paired 't' test there is a Pre treatment to Post treatment significant difference between mean values of parameters Ls-E plane (mm), Li-Eplane(mm), Ls- Sn-Pg'(mm), Li- Sn-Pg'(mm), Is-Ls(mm), Sn-Ls(mm) and Nasolabial

angle(Degree). While no significant difference found for the parameters G-Sn-Pg' (Degree), Ls-St(mm), Ii-Li(mm) and Li-Pg'(mm) in Extraction group.

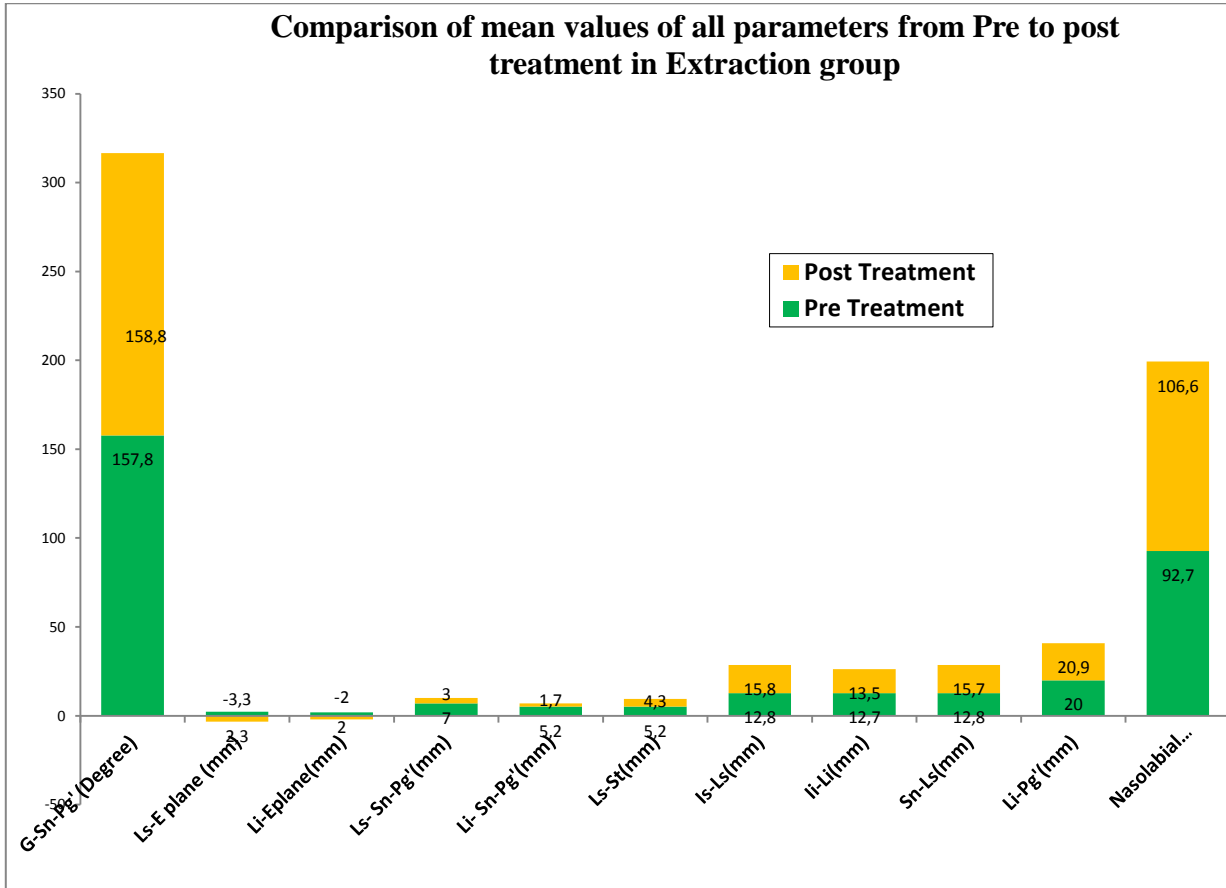
**Table No.4:** ANOVA TEST: For Pre to Post treatment values for all parameters compared together Extraction group

Source of variation	d.f.	Sum of squares	Mean square
Treatment (Between columns)	21	521056	24812
Residuals (Within columns)	198	683.70	3.453
Total	219	521739	

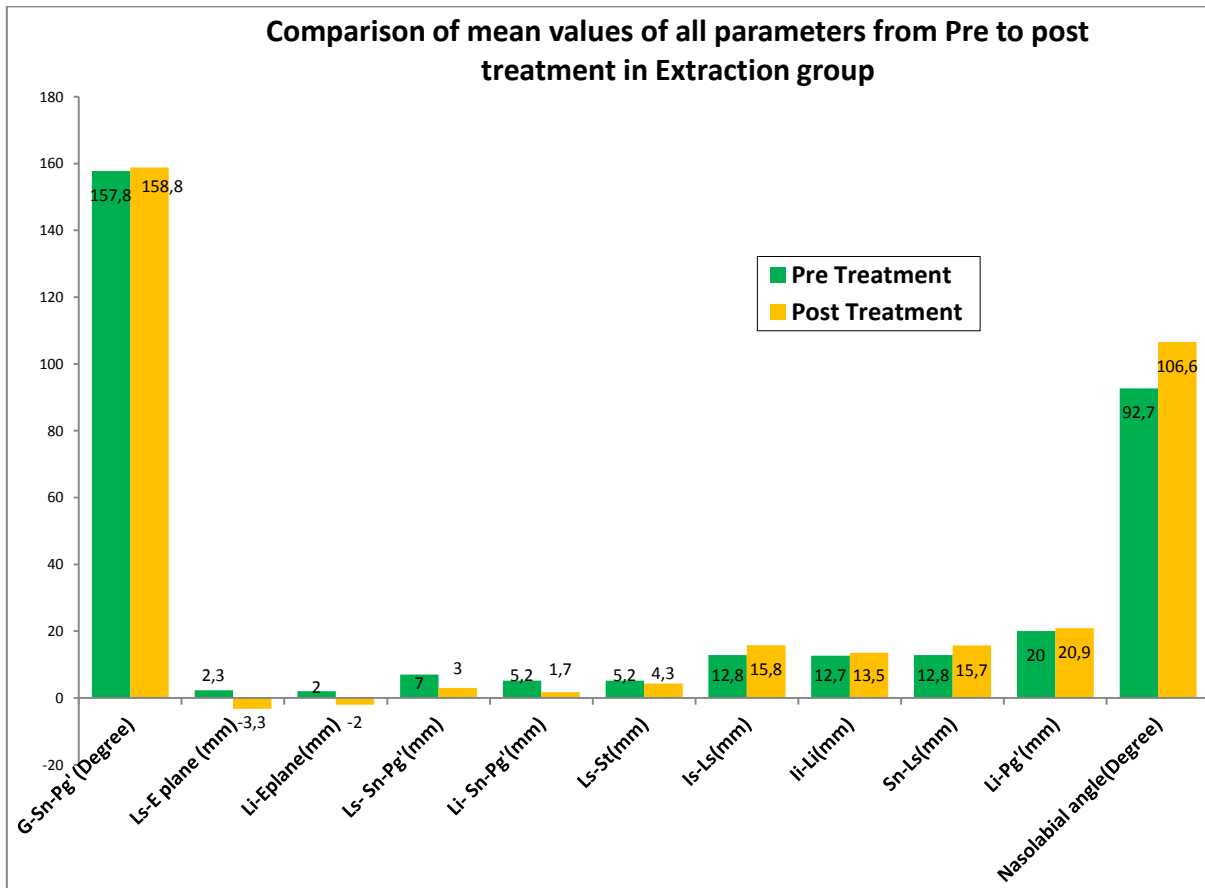
Value of F = 7185.60, p<0.0001, highly significant

By applying Tuckey Kramer Multiple comparison test (ANOVA Test) there is a significant difference between mean values of all parameters

from Pre to Post treatment in Extraction Group compared together. (p<0.0001)



Graph 1- Comparison of all parameters from pre and post treatment in extraction group



Graph 2 - Comparison of all parameters from pre and post treatment in extraction group

**Intra group Differences for the Non-extraction Sample**

In the nonextraction group, the upper lip to E-plane measurement indicated a significant retraction ( $P < 0.0001$ ) from 0.50 mm at the onset to -2.3 mm at the end of treatment. Lower lip to

Sn-pg' plane indicates protrusion from 3.5mm at onset 6.3mm at end of the treatment. Regarding the rest of the parameters, there were minimal, nonsignificant changes. The results of the paired t-tests for the nonextraction group are shown in Table 5.

**Table No.5:** Comparison of mean and SD values of all parameters from Pre to post treatment in Non-Extraction group (n=25):

Parameters	Pre Treatment (n=25)	Post Treatment (n=25)	Difference	Student's Paired 't' test value	'p' value and significance
	Mean ± SD	Mean ± SD			
G-Sn-Pg' (Degree)	170.0±1.88	171.0±1.76	1.00	1.146	p=0.5672, not significant
Ls-E plane (mm)	0.50±1.27	-2.30±0.94	-2.80	4.392	P<0.0001, significant
Li-Eplane(mm)	0.60±1.07	0.20±0.91	-0.40	1.441	p=0.1996, not significant
Ls- Sn-Pg'(mm)	4.0±0.81	3.30±0.94	-0.70	1.441	p=0.1996, not significant
Li- Sn-Pg'(mm)	3.50±0.84	6.30±0.94	2.80	6.584	P<0.0001, significant
Ls-St(mm)	2.70±0.82	2.50±0.53	-0.20	1.672	p=0.9874, not significant
Is-Ls(mm)	13.60±0.97	14.40±0.96	0.80	0.544	p=0.6036, not significant
Ii-Li(mm)	12.80±1.87	13.10±2.02	-.30	1.947	p=0.9967, not significant
Sn-Ls(mm)	16.30±1.16	17.40±1.26	1.10	1.382	p=0.2163, not significant
Li-Pg'(mm)	21.60±1.07	22.20±1.23	0.60	1.133	p=0.2148, not significant
Nasolabial angle(Degree)	105.70±4.94	105.0±4.24	-0.70	0.1589	p=0.8790, not significant

By applying Student's Paired 't' test there is a Pre treatment to Post treatment significant difference between mean values of parameters Ls-E plane (mm) and Li- Sn-Pg'(mm). While no significant difference found for the parameters Ls-St (mm),

Ii-Li(mm), Li-Pg'(mm), G-Sn-Pg' (Degree), Li-Eplane (mm), Is-Ls(mm), Sn-Ls(mm) and Nasolabial angle (Degree) in Non-Extraction group.

**Table No.6:** ANOVA TEST: For Pre to Post treatment values for all parameters compared together Non- Extraction group

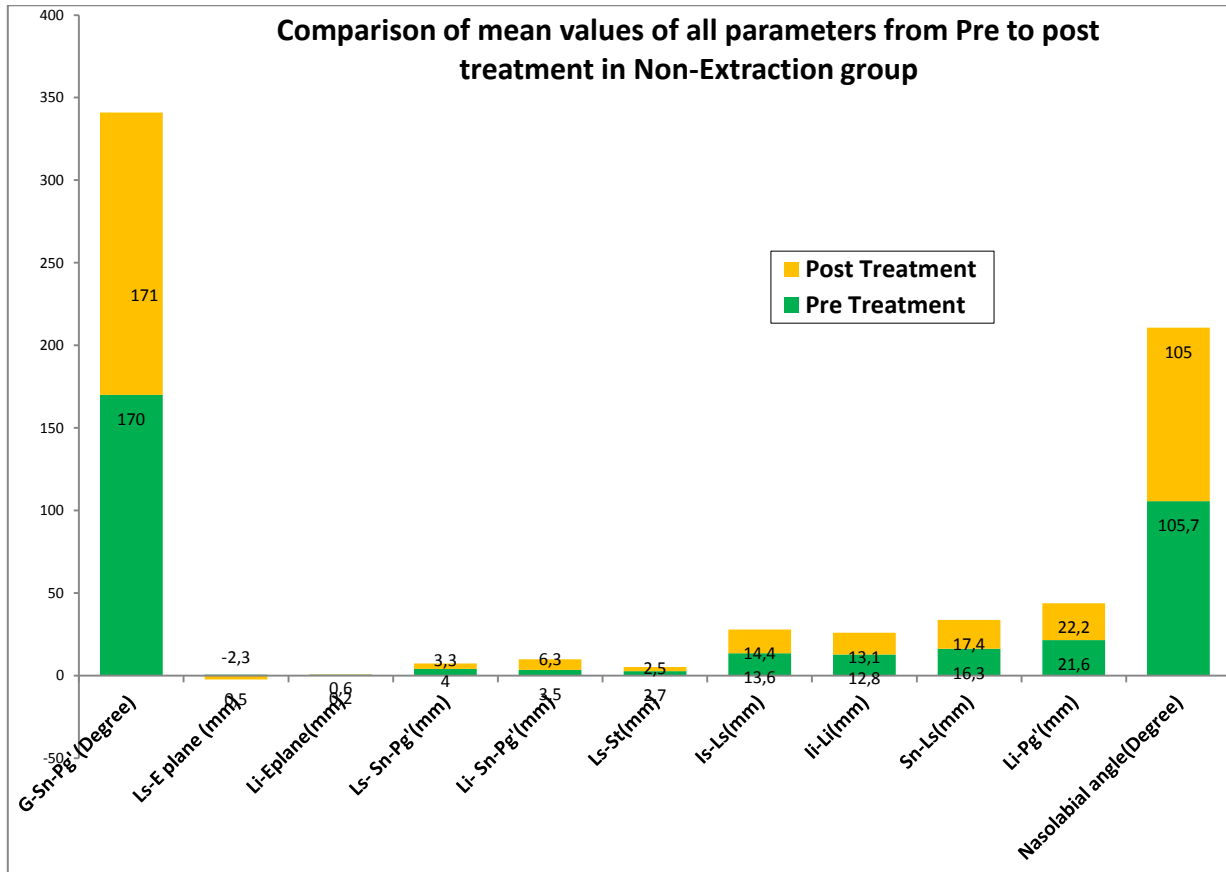
Source of variation	d.f.	Sum of squares	Mean square
Treatment (Between columns)	21	594748	27459
Residuals (Within columns)	198	649.30	3.0214
Total	219	595397.3	

Value of F = 8426.89,  $p < 0.0001$ , highly significant

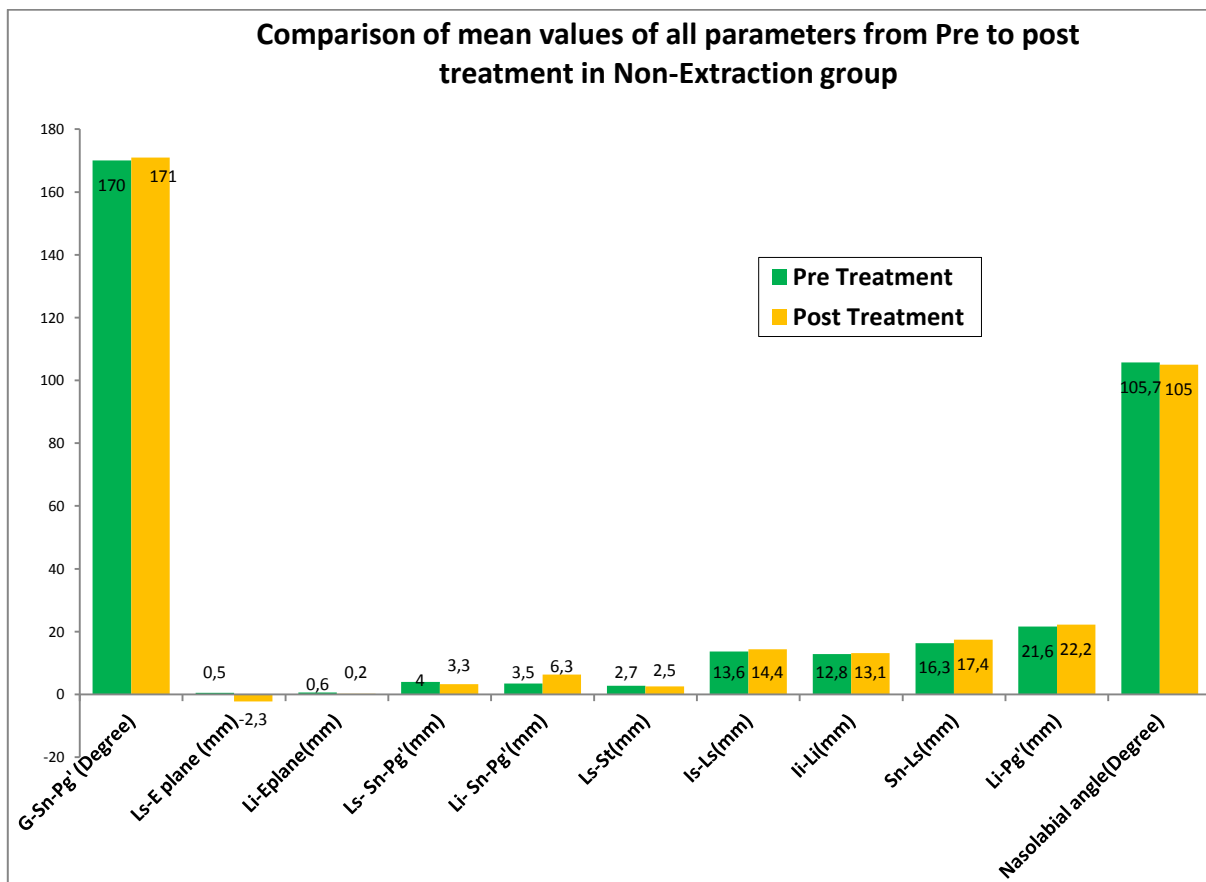
By applying Tuckey Kramer Multiple comparison test (ANOVA Test) there is a significant difference between mean values of all parameters

from Pre to Post treatment in Non-Extraction Group compared together. ( $0 < .0001$ )





**Graph 4-** Comparison of all parameters from pre and post treatment in extraction group



**Graph 4-** Comparison of all parameters from pre and post treatment in Non-extraction group

## Discussion

The success of orthodontic treatment is always influenced by the ability of clinician to develop an optimal treatment plan, the morphologic relationships and proportions of the nose, lips and chin determine facial harmony in orthodontics.<sup>8</sup> The main purpose of the present study is was to compare the effects on the facial profile by the first premolar extraction between a sample of patients where premolar extractions were considered necessary and a similar sample where a conservative treatment was applied.

Lip structure seems to have an influence on lip response to incisor retraction. In an attempt to determine the effects of incisor retraction on the profile, several studies have been conducted to quantify and predict the relationship between incisor retraction and lip retraction.<sup>12-14</sup> In the extraction group, the upper and the lower lips moved back relative to the E-line and Sn-PG' line. In non-extraction group, upper lip was slightly retracted and lower was slightly protracted.

## Upper Lip

Considering Ricketts E-plane, the upper lip exhibited a 5.60mm retraction in the extraction group vs -2.80mm retraction in the nonextraction group. Relative to the Sn-Pg' line, the difference between the two groups was significant. Since this plane is considered a plane of minimal variation, all relative measurements are less influenced by any potential growth remainders.<sup>15</sup> The change value for the extraction group (-4.0 mm) is slightly smaller than that reported by Drobocky and Smith<sup>3</sup> and Bravo<sup>13</sup> -2.12 mm and -2.4 mm, respectively. The amount of upper lip retraction is smaller than that assessed to the E-plane. A possible explanation is that slight growth of the nose might have contributed to the whole retro positioning of the lip. The nonextraction patients exhibited a nonsignificant change of -0.70 mm,

With regard to upper lip thickness, the difference in increase between the two groups was also significant: 3.00 mm for the extraction and 0.80mm for the nonextraction group.

## Lower Lip

The mean value changes for the lower lip differed significantly between the two groups and were greater than those of the upper lip. In relation to the Ricketts E-plane, the -4 mm of retraction that the extraction patients exhibited is close to the -23.8 and -23.22 mm that Bravo<sup>16</sup> and Drobocky and Smith<sup>3</sup> reported. The measurements to Burstone's Sn-Pg' line confirmed that, the patients treated without extractions, the findings indicate that the lower lip was protracted 2.80 mm

## Nasolabial Angle

The nasolabial angle became 13.9degree more obtuse in the extraction group. The mean change value for the nonextraction group was -0.70degree. These findings agreed with the results of Finnoy et al, who found that their extraction group had a significantly greater increase of the nasolabial angle than the nonextraction group.<sup>17</sup>

The findings of the present study indicate that, when a decrease of lip procumbency is desirable, extracting premolars and retracting incisors is a viable option to achieve these objectives. However, individual variation in response is large. Incisor retraction in one patient might lead to a large amount of lip retraction, whereas, in another patient, a similar amount of retraction might lead to only minimal improvement in lip procumbency.<sup>2</sup> Its always better to inform patient about the expected average change, but also that it could be different in particular instance.

With sound diagnoses and good treatment, major differences in the soft-tissue profile should not necessarily be produced, irrespective of treatment with or without extraction of premolars. Therefore, the avoidance of extracting premolars for fear of significant detrimental effects on the face might not always be justified.<sup>4</sup> To treat patients nonextraction for the sake of not removing teeth, ease of treatment, or the dictates of an appliance is not sound reasoning and makes as much diagnostic sense as treating all patients with the extraction of all four first premolars. In other words, it is just as diagnostically wrong to

treat an extraction patient nonextraction as it is to treat a nonextraction<sup>19</sup> patient with extractions. The truth lies somewhere in between and is based on a sound quantified measurement analysis, differential evaluation of the problem, and clinical assessment.

### Conclusion

- Class I borderline malocclusions cases treated with premolar extraction resulted significant soft tissue changes in relation to the upper and lower lip position, thickness and nasolabial angle
- Class I borderline malocclusion cases treated with non-extraction led to significant upper lip retraction and lower lip protraction.

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