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Evaluating the effects of first premolar extraction on Point A, Point B and Nasolabial angle in patients with bimaxillary protrusion

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Abstract

Objective: *The aim was to determine the effects of first premolar extraction on point A, point B and nasolabial angle in patients with bimaxillary protrusion.*

Materials and Methods: *The following study included pre- and post-orthodontic treatment cephalograms of fifty bimaxillary protrusion patients. First premolars were extracted and all the cases were treated with maximum anchorage. Cephalometric radiographs were used to measure the changes in point A, point B and nasolabial angle. Pre- and post-treatment variables comparison was done using paired t-test and study of relationship between soft- and hard-tissue variables was carried out using Pearson correlation coefficient and linear regression equation.*

Results: *Mean point A and soft tissue point A (sA) were retracted 2.8 mm ($P < .001$) and 1.8 mm ($P < .001$), and mean point B and soft tissue point B (sB) were retracted 2.2 mm ($P < .001$) and 2.2 mm ($P < .001$), respectively. Mean increase in nasolabial angle was 14.96 degree.*

Mean ratio of retraction of point A with sA and point B with sB was 1.5:1 and 1:1, respectively. Mean ratio of retraction of point A with NLA was 1:5.

A significant degree of correlation existed between retraction of point A and soft tissue point A ($r = 0.917$, $P < .001$), point B and soft tissue point B ($r = 0.929$, $P < .001$), point A and NLA ($r= 0.420$, $P< .05$).

Linear regression analysis used to predict the changes in sA and sB showed significant relationship between point A and sA ($R^2 = 0.842$, $P < .001$) and point B and sB ($R^2 = 0.863$, $P < .001$). Decreases in hard and soft tissue convexity were due to the retraction of the skeletal and soft tissue points A and B in addition to the lips retraction and increase in nasolabial angle.

Conclusions: *Retraction of skeletal point A and B lead to retraction of sA,sB and increase in nasolabial angle under controlled root positions. Nearly proportionate changes existed in the skeletal points and overlying corresponding soft tissue points.*

Keywords: *Point A, Point B, Premolar extractions, Soft tissue point A, Soft tissue point B, Nasolabial angle, Bimaxillary protrusion.*

Introduction

Bimaxillary protrusion is stated as a condition in which the upper and lower incisors are proclined and protrusive, which results in increased lip procumbency. Dentoalveolar flaring of the anterior teeth, protrusive lips and a convex facial

profile usually result in poor facial esthetics because of the forwardly placed dentoalveolar segments. Many patients with bimaxillary protrusion seek orthodontic treatment to reduce the procumbency because of the negative perception of protrusive dentition and lips.[1]

The underlying cause of bimaxillary protrusion is multifactorial and includes genetic component along with environmental factors such as mouth breathing, tongue thrust, lip sucking habits, and tongue volume.[2]

Treatment of these cases involves backward movement of anterior teeth with a certain amount of uprighting of the incisors to correct excessive proclination so that a straighter profile is achieved. Since the objective of treating bimaxillary protrusion cases is to achieve an esthetically superior profile and harmonious lip relationship, it is important to study the changes in relationship of soft tissues to skeletal and dental structures that actually define the treatment outcome with orthodontic tooth movement.[3]

The main aim behind the orthodontic treatment of bimaxillary protrusion is to retract the maxillary and mandibular incisors with the resultant reduction in soft tissue procumbency and convexity which is brought about by extracting the four first premolars followed by the retraction of anterior teeth using maximum anchorage mechanics.[4]

However, in Class I bimaxillary protrusion cases treated with first premolar extraction, limited literature exists regarding the relationship of skeletal point A and B with soft tissue point A (sA), B (sB) and nasolabial angle following orthodontic treatment.

Thus, this study was undertaken to relate the skeletal point A and B changes with the soft tissue points A, B and nasolabial angle of Class I bimaxillary protrusion patients treated with extraction and fixed mechanotherapy so that a clinician's attention is drawn more towards the apical bases and the tooth apices than the clinical condition.

The aim of this study was to test the correlation in the interrelationships of skeletal and soft tissue points A, B and nasolabial angle with anterior tooth retraction in bimaxillary protrusion patients, following all four premolars extraction.

Materials and Methods

Pre-treatment and post-treatment lateral cephalograms of 50 adults having Class I bimaxillary protrusion, treated at the Department of Orthodontics and Dentofacial Orthopaedics, Pandit Deendayal Upadhyay Dental College, Solapur were selected for this study. A written consent was obtained before treatment after patients agreed to the treatment planning.

Sample selection criteria included

(1) Minimum age 16 years

(2) Class I first molar, canine and premolar relationship

(3) Well aligned arches with no or minimal crowding

(4) Protrusive upper and lower lips

(5) Acute nasolabial angle

(6) Pre- and post-treatment radiographs with good hard and soft tissue outlines and teeth in full occlusion, lips resting in natural position.

(7) All pre-treatment and post-treatment cephalograms were taken from the same machine in the standard position by the same operator.

(8) Treatment includes fixed orthodontic appliance using maximum anchorage and maximal retraction of anterior teeth.

All cephalometric measurements were performed manually using a ruler to the nearest 0.1 mm so that the linear distance between the two points can be measured, making the measurements and protractor to the nearest 0.5° to measure the angular measurements.

A constructed Frankfort horizontal (FH) plane, drawn at an inferior angle of 7 degrees to SN plane through point ''S'', was referred to as a modified plane and denoted by ''FH''. Frankfort horizontal perpendicular was constructed perpendicular to the FH plane through point ''S''

and denoted by ‘‘FHp.’’ The linear measurements were done from FHp plane to skeletal and soft tissue points A and B (Figure 1, Table 1).

Statistical Analysis

The data were entered in Microsoft Excel and a master file was created in the spreadsheet. Descriptive statistics for mean, median, mode, standard deviation, range, and frequencies were calculated using the SPSS program version 11.5. The cephalometric values of pre-treatment and post-treatment cephalograms were evaluated using paired t-test. Mean and the standard deviation are calculated [Table 2]. $P < .05$ was considered significant in the study. Pearson correlation coefficient was used to find out the correlation between required variables. A linear regression analysis was used to predict changes in the soft tissue point A and point B.

Results

Themean point A and soft tissue point A (sA) were retracted 2.8 mm ($P < .001$) and 1.8 mm ($P < .001$), and mean point B and soft tissue point B (sB) were retracted 2.2 mm ($P < .001$) and 2.2 mm ($P < .001$), respectively. Mean increase in nasolabial angle was 14.96 degree.

According to Pearson’s correlation coefficient, a significant degree of correlation existed between retraction of point A and soft tissue point A ($r = 0.917$, $P < .001$), point B and soft tissue point B ($r = 0.929$, $P < .001$), point A and NLA ($r= 0.420$, $P< .05$).

Linear regression analysis used to predict the changes in sA and sB showed significant relationship between point A and sA ($R^2 = 0.842$, $P < .001$) and point B and sB ($R^2 = 0.863$, $P < .001$).

Angle SNA retracted by 4.2 degrees and angle SNB retracted by 2.4 degrees. The mean ANB angle changed by 1.8 degrees. The mandibular plane angle (SN-Go-Gn) did not show any significant changes. The mean interincisal angle was increased from 95.2 degrees to 119.4 degrees. The mean IMPA was decreased from 107 degrees to 98.2 degrees. The tip of the upper incisor and the tip of the lower incisor were retracted 3.8 mm and 2.76 mm respectively. The upper and lower lips were retracted 2.5 mm and 3.1mm respectively. The changes in the above parameters were statistically significant.

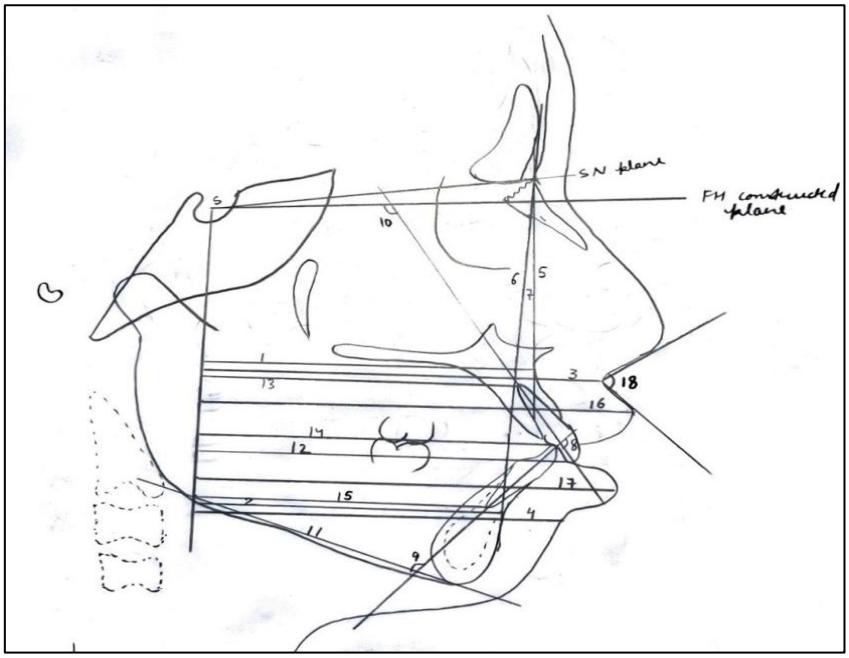

Figure 1: Cephalometric landmarks, measurements, and reference planes. (1) AFHp, (2) BFHp, (3) ssFHp, (4) siFHp, (5) SNA, (6) SNB, (7) ANB, (8) IIA, (9) IMPA, (10) U1SN, (11) sellanasion and gonion gnathion, (12) TU1FHp, (13) AU1FHp, (14) TL1FHp, (15) AL1FHp, (16) IsFHp, (17) IiFHp, (18) NLA

Table 1. Cephalometric Measurements Used:

Variable	Description
AFHp	Horizontal distance in mm from point A to constructed FH plane vertical.
BFHp	Horizontal distance in mm from point B to constructed FH plane vertical.
ssFHp	Horizontal distance in mm from soft tissue point A to constructed FH plane vertical.
siFHp	Horizontal distance in mm from soft tissue point B to constructed FH plane vertical.
SNA	Angle between SN plane and point A.
SNB	Angle between SN plane and point B.
ANB	Angle between point A and B at nasion.
IIA	Angle between the long axis of upper and lower incisors.
IMPA	Angle between the mandibular plane and long axis of lower incisors.
U1SN	Angle between long axis of upper incisor and SN plane.
SN-Go-Gn	Angle between mandibular plane and SN plane.
TUIFHp	Horizontal distance in mm from the tip of the upper incisor crown to constructed FH plane vertical.
AUIFHP	Horizontal distance in mm from the apex of the upper incisor to constructed FH plane vertical.
TLIFHp	Horizontal distance in mm from the tip of the lower incisor crown to constructed FH plane vertical.
ALIFHp	Horizontal distance in mm from the apex of the lower incisor root to constructed FH plane vertical.
lsFHp	Horizontal distance in mm from the upper lip point to constructed FH plane vertical.
LiFHp	Horizontal distance in mm from the lower lip point to constructed FH plane vertical.
NLA	Nasolabial Angle.

Table 2: Comparison of mean and standard deviation values of skeletal and soft tissue point A and point B changes following orthodontic treatment from pre-treatment to post-treatment (n=50)

Parameters	Groups	Mean	Standard Deviation	Mean difference	95% Confidence Interval		t	p
					Lower	Upper		
AFHp	Pre	59.9200	3.78506	2.88000	2.53629	3.22371	17.294	**.000(HS)**
	Post	57.0400	3.89957					
BFHp	Pre	54.4000	4.98331	2.20000	1.72336	2.67664	9.526	**.000(HS)**
	Post	52.2000	5.72276					
SsFHp	Pre	70.6000	3.26599	1.88000	1.60516	2.15484	14.118	**.000(HS)**
	Post	68.7200	2.87981					
SiFHp	Pre	64.4000	5.95119	2.20000	1.73850	2.66150	9.839	**.000(HS)**
	Post	62.2000	5.64948					
SNA	Pre	85.6800	3.50856	4.24000	3.42937	5.05063	10.795	**.000(HS)**
	Post	81.4400	2.85890					
SNB	Pre	81.3600	4.21189	2.44000	1.63995	3.24005	6.294	**.000(HS)**
	Post	78.9200	3.31562					
ANB	Pre	4.3200	1.37598	1.80000	1.38722	2.21278	9.000	**.000(HS)**
	Post	2.5200	.82260					
IIA	Pre	95.2000	11.06044	-24.28000	-30.41701	-18.14299	-8.165	**.000(HS)**
	Post	119.4800	7.41125					
IMPA	Pre	107.0800	7.80449	8.84000	5.27580	12.40420	5.119	**.000(HS)**
	Post	98.2400	5.61456					
UI-SN	Pre	121.9600	13.30251	16.84000	12.68361	20.99639	8.362	**.000(HS)**
	Post	105.1200	5.08527					
Sn-Go-Gn	Pre	29.2800	5.17623	-.28000	-1.50404	.94404	-.472	.641(NS)
	Post	29.5600	5.30000					
TUIFHp	Pre	70.5600	5.35475	3.80000	2.76119	4.83881	7.550	**.000(HS)**
	Post	66.7600	6.02965					
AUIFHp	Pre	60.4400	12.17607	-.12000	-1.52143	1.28143	-.177	.861(NS)
	Post	60.5600	11.09084					
TLIFHp	Pre	61.8400	5.61753	2.76000	1.93204	3.58796	6.880	**.000(HS)**
	Post	59.0800	5.90141					
ALIFHp	Pre	49.7600	5.33292	-.40000	-1.67227	.87227	-.649	.523(NS)
	Post	50.1600	5.77119					
IsFHp	Pre	74.4400	3.61801	2.52000	2.12264	2.91736	13.089	**.000(HS)**
	Post	71.9200	3.85054					
IiFHp	Pre	71.0000	6.75154	3.12000	2.38237	3.85763	8.730	**.000(HS)**
	Post	67.8800	6.17333					
NLA	Pre	85.0800	7.95257	-14.96000	-17.21296	-12.70704	-13.705	**.000(HS)**
	Post	100.0400	4.44860					

NS = Not significant, HS = Highly significant ($p<0.001$)

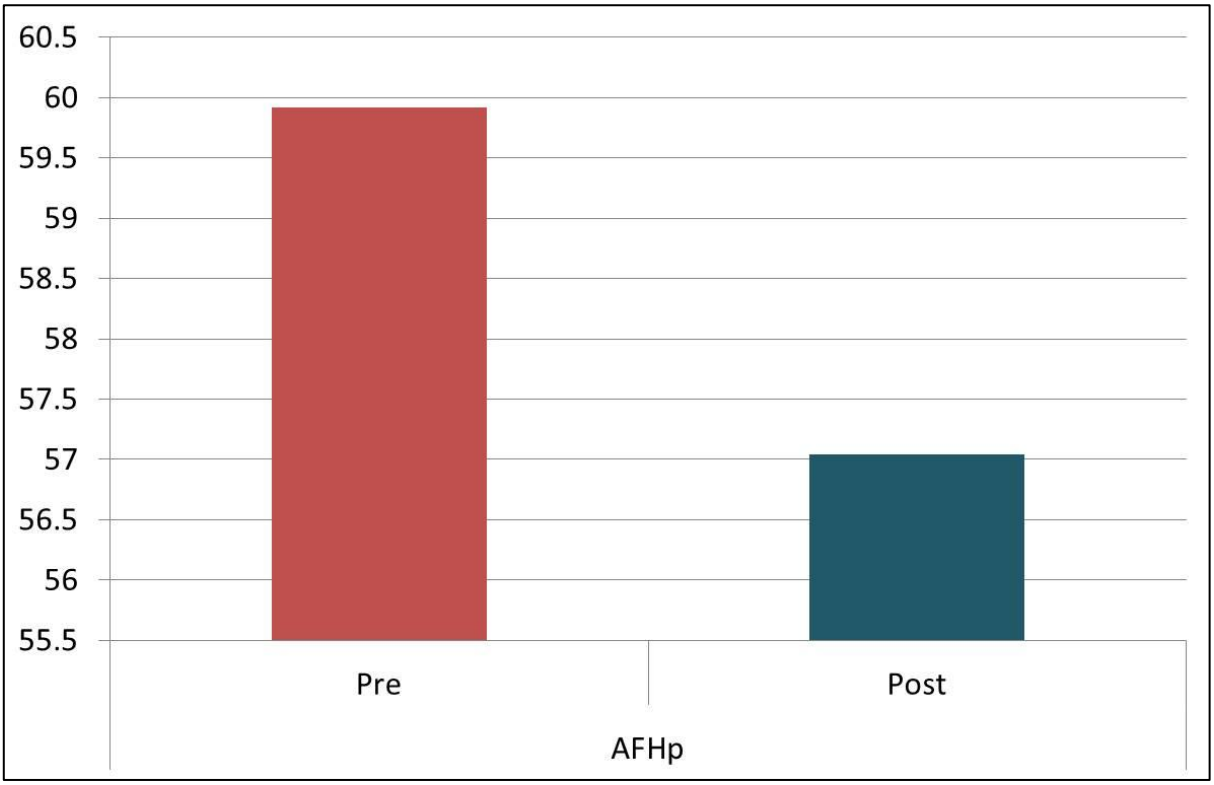

Figure 2: Mean changes in point A

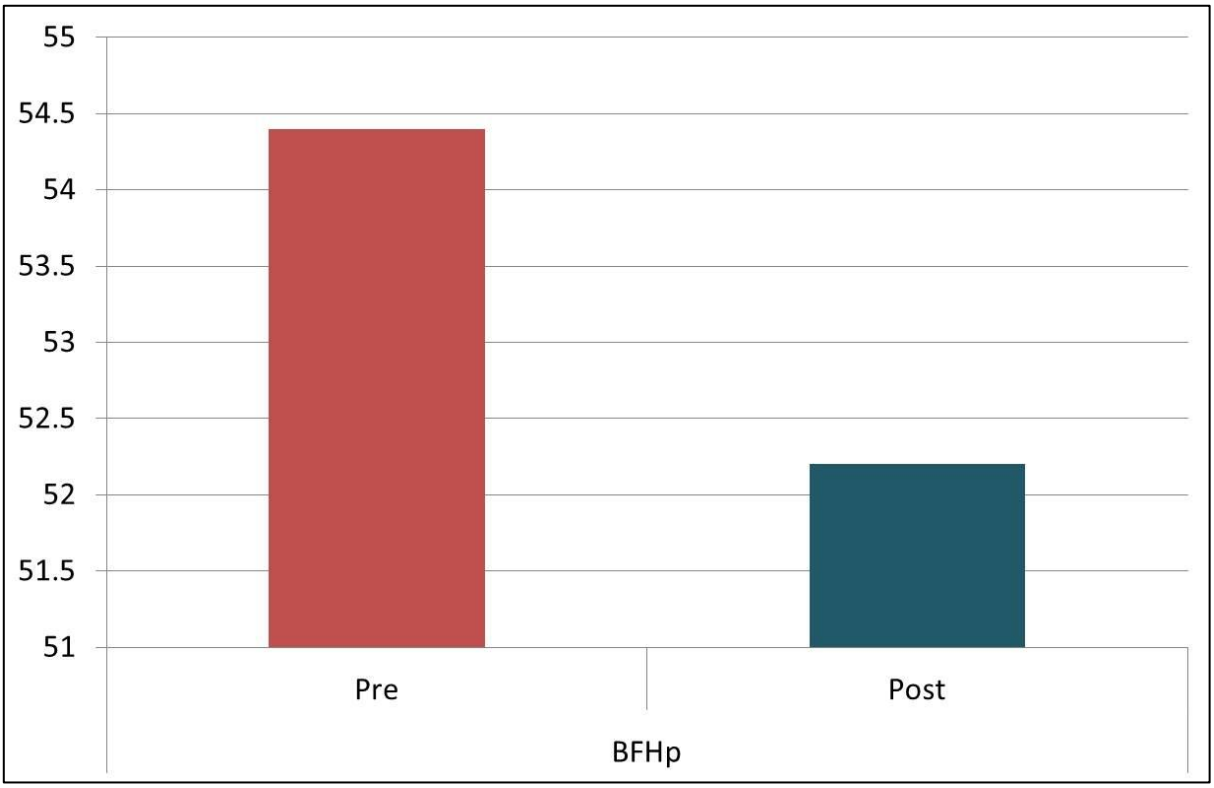

Figure 3: Mean changes in point B

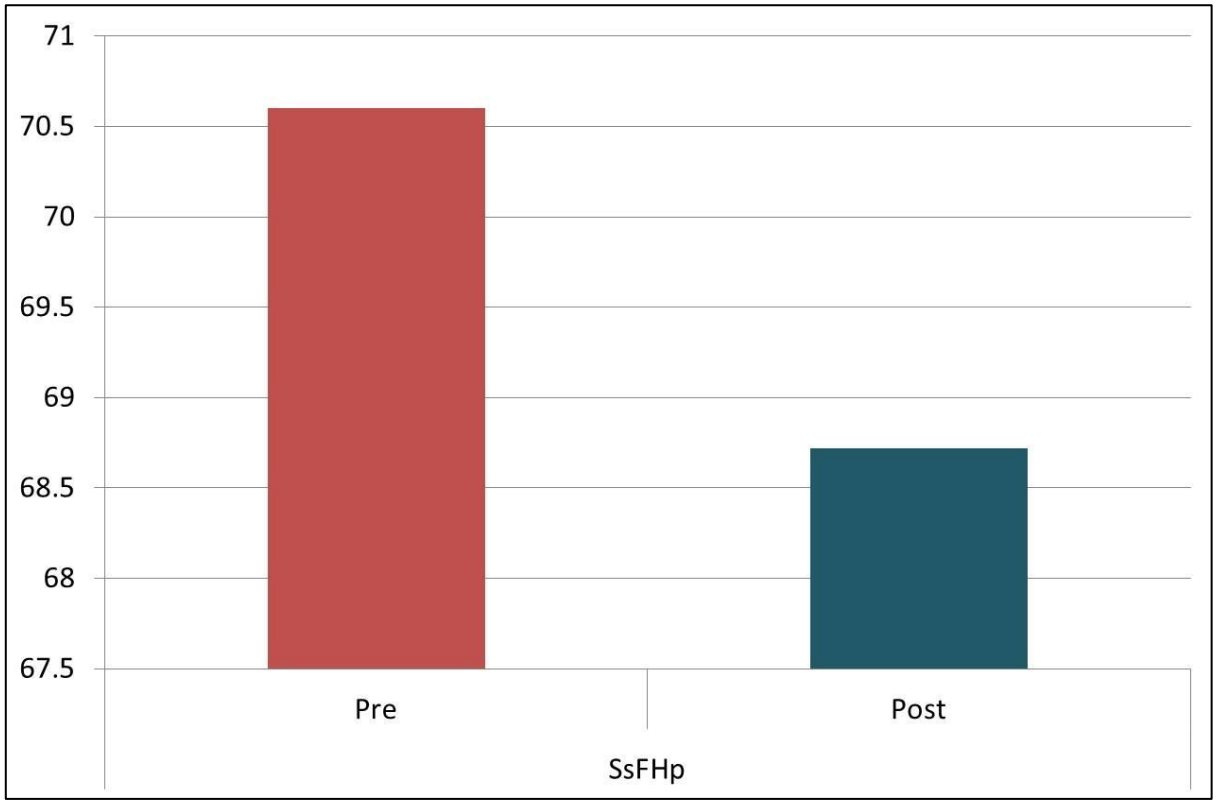

Figure 4: Mean changes in soft tissue point A

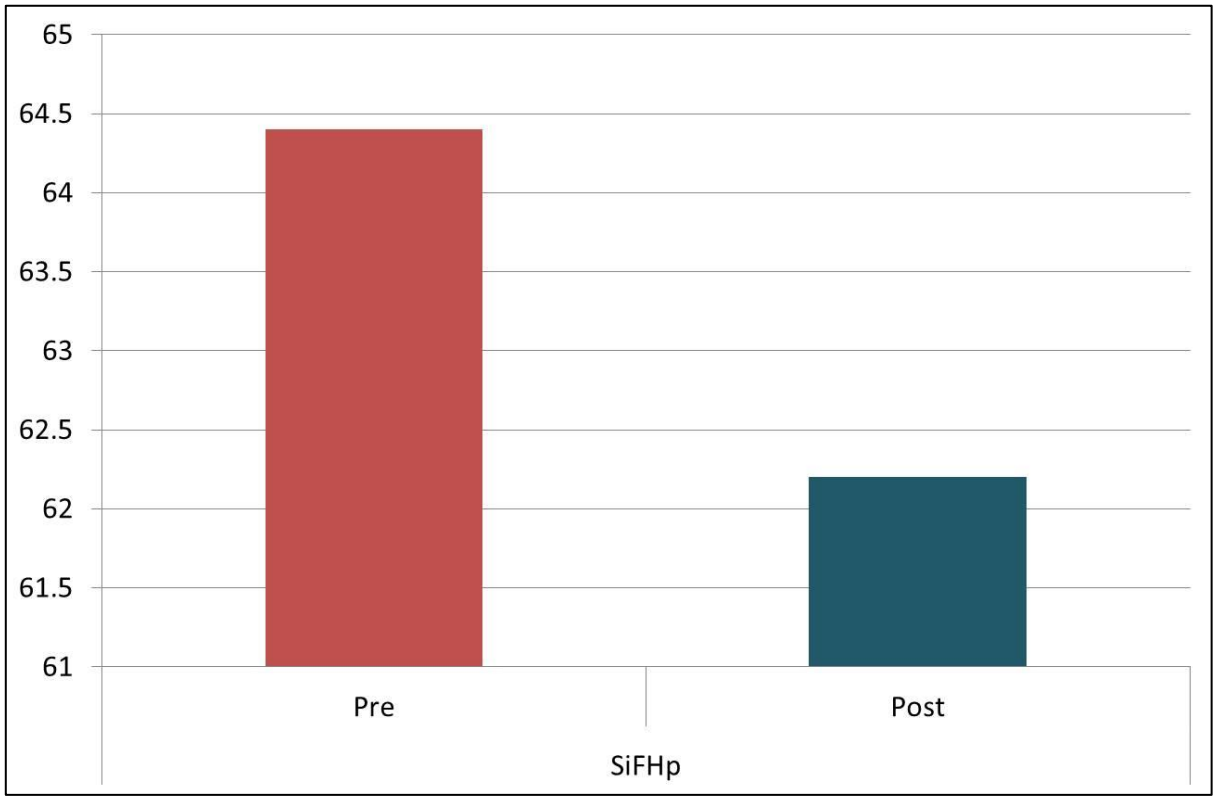

Figure 5: Mean changes in soft tissue point B

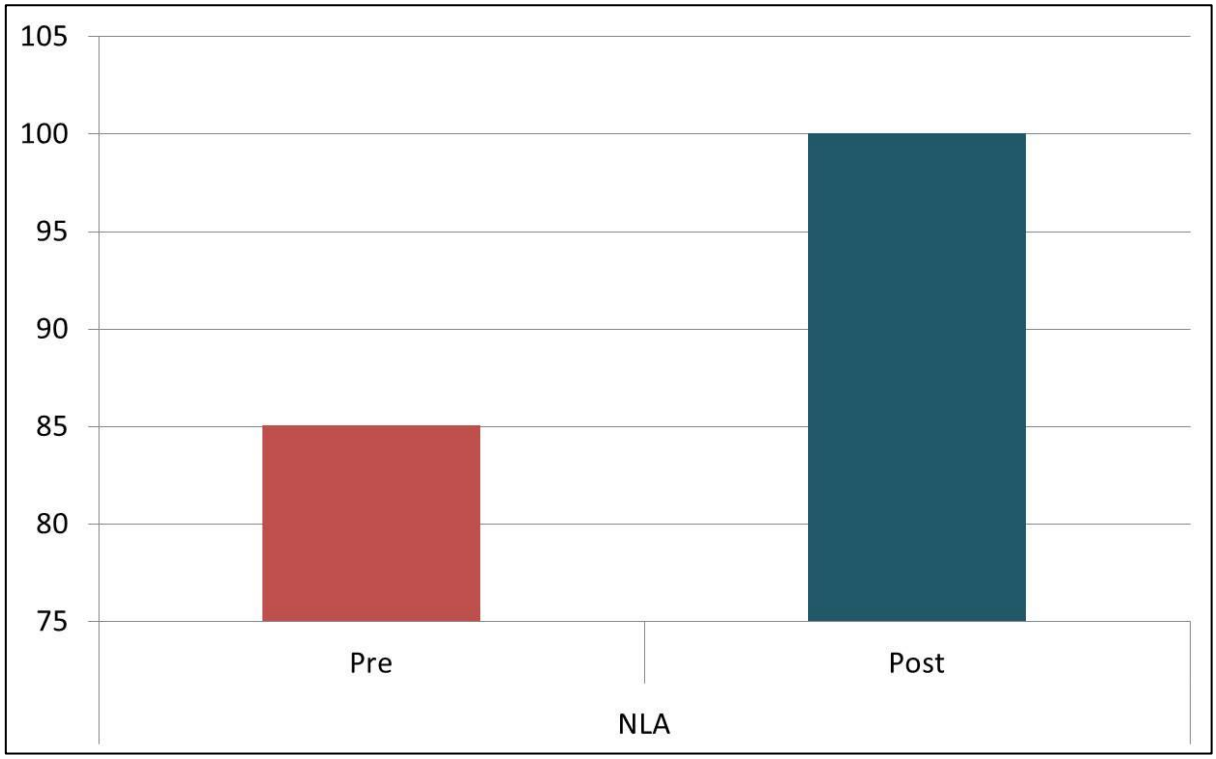

Figure 6: Mean changes in Nasolabial angle

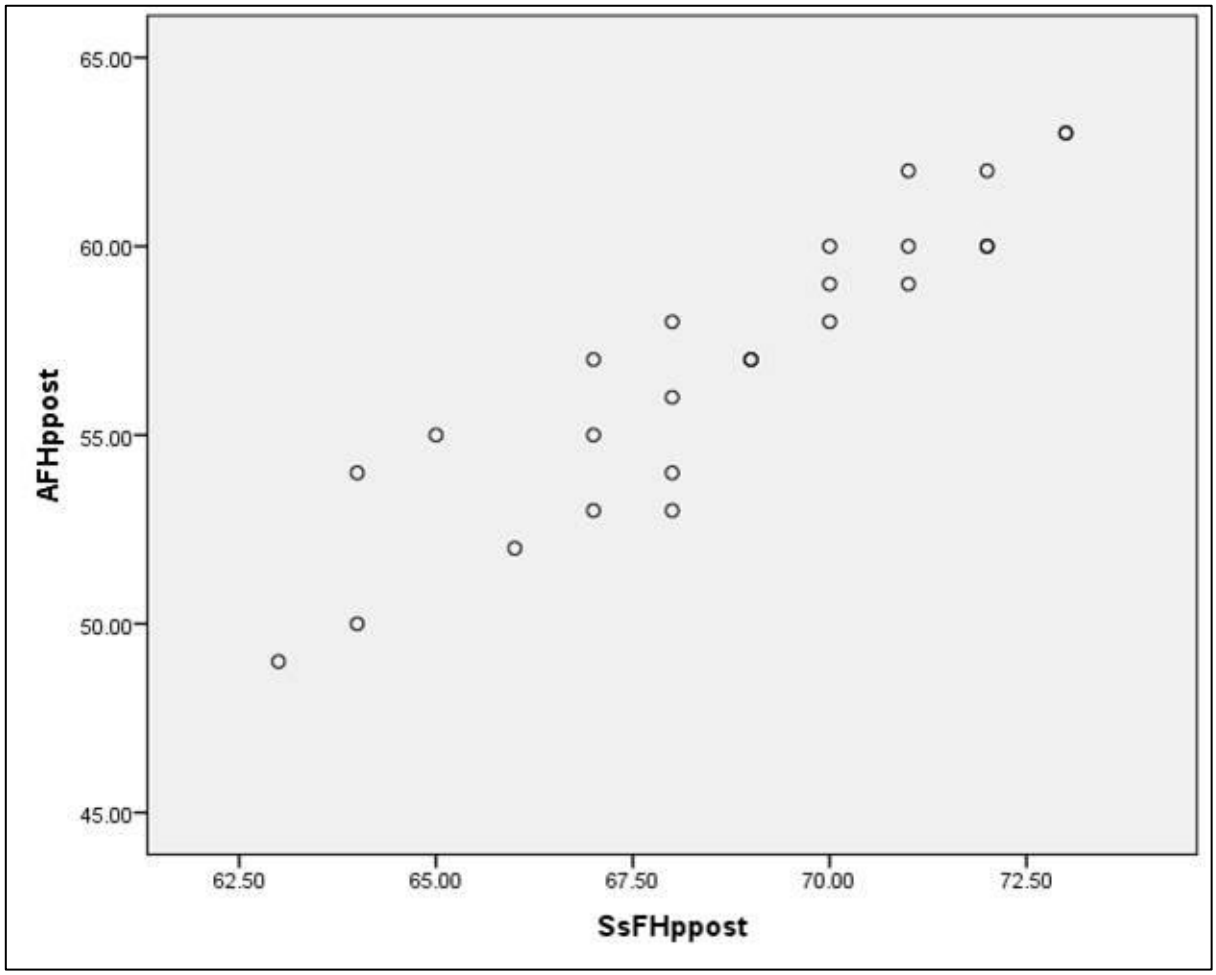

Figure 7: Correlation between Point A and soft tissue point A

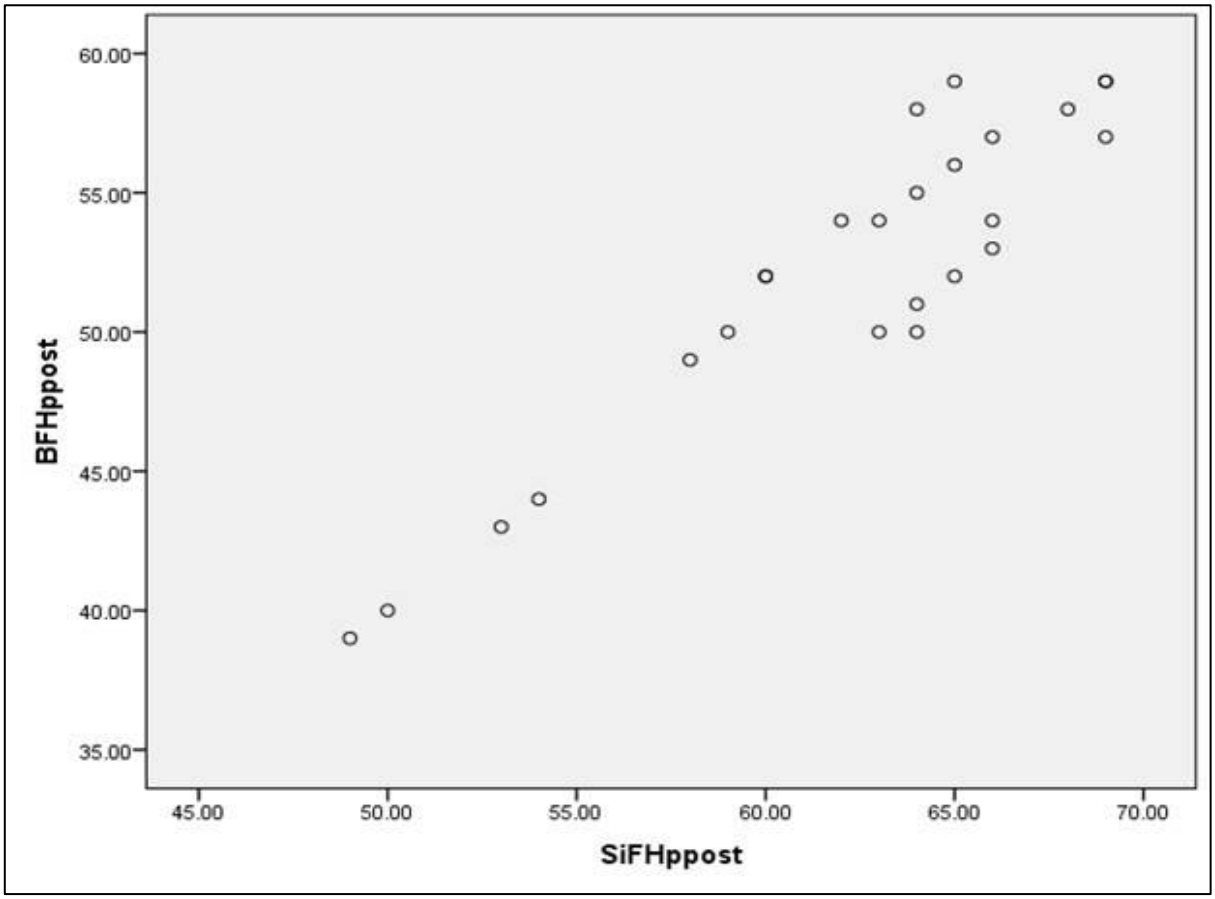

Figure 8: Correlation between Point B and soft tissue point B

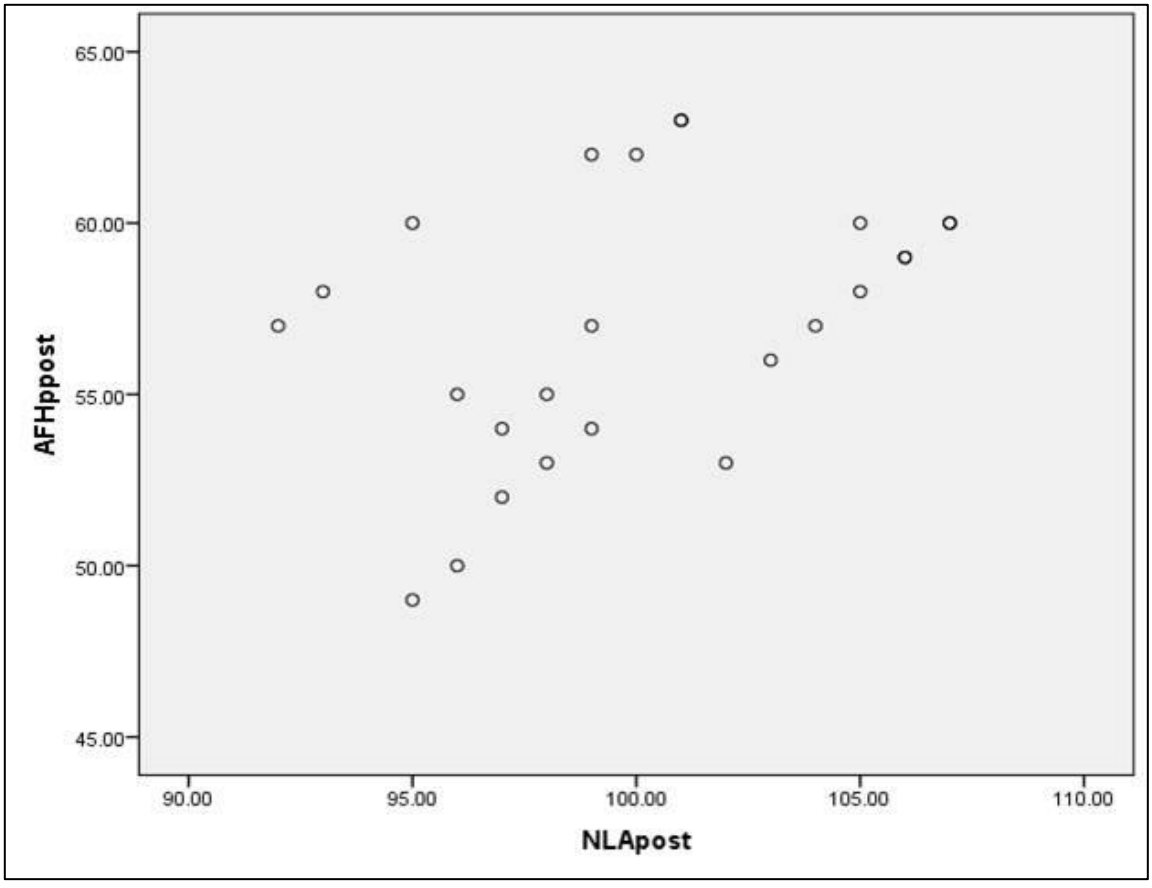

Figure 9: Correlation between Point A and Nasolabial angle

Discussion

This study is retrospective in nature and determined the effect of premolar extraction as a part of fixed orthodontic treatment on point A, point B and nasolabial angle in bimaxillary protrusion patients. In this study, it was noticed that following incisor retraction there was a relationship between retraction of skeletal point A (A) and soft tissue point A (sA), point B (B) and soft tissue point (sB) and soft tissue point A (sA) and nasolabial angle (NLA). The changes in the lip positions at the bases were found to be caused with the backward movement of the skeletal points A and B and the soft tissue overlying these osseous points that followed them.

The lower lip response was slightly higher when compared with the upper lip. This finding was in congruence with the findings of LaMastra[15], where skeletal point A moved back by 2.34 mm, soft tissue point A moved back by 1.75 mm, skeletal point B moved back by 1.89 mm, and soft tissue point B moved back by 1.73 mm.

Mean ratio of retraction of point A with sA was 1.5:1 and point B with sB was and 1:1. Mean ratio of retraction of point A with NLA was 1:5. The difference could be related to the difference in the amount of tooth movement in the maxilla and mandible in Class II division 1 cases unlike Class I bimaxillary protrusion cases in the present study where they all were high anchorage cases for both arches. Roos[17] in Class II malocclusion found the ratio of point A and point B retraction to corresponding soft tissue point A and B retraction to be 1:1.4 (r = 0.58) and 1.2:1 (r = 0.69), respectively.

Bimaxillary protrusion cases generally have perfectly good occlusion. Patients are undergoing orthodontic treatment solely for the correction of protrusive profile and to improve the facial esthetics.

The clinical importance of this study is that the clinician must position the incisors in the most esthetic position by initial up-righting and some bodily movement. The reciprocal movement of the roots of anterior teeth labially during treatment should be avoided. Thus, it is necessary to maintain the root positions and retract the incisors in this malocclusion group. The labial movement of the roots increases the skeletal convexity due to the forward movement of the skeletal points which could cause undesirable treatment results.[16]

The study also highlights the importance of immense changes in soft tissue profile in extraction patients, therefore careful consideration is recommended before taking the extraction decision and facial esthetics are of prime importance in any given case.

A further study with a larger sample size including the sexual variation and the differentiation of thick and thin lips and considering other possible variations is recommended.

Conclusions

1) Retraction of skeletal points A and B leads to retraction of sA and sB under controlled root positions and also showed a significant increase in nasolabial angle, thus affecting the overall facial esthetics.
2) Lip retraction and retraction of the skeletal and soft tissue points A and B improved the soft tissue profile and decreased the soft tissue convexity significantly.
3) Nearly proportionate changes in the skeletal and soft tissue points A and B existed with slightly better response in the lower lip than the upper lip.

Conflicts Of Interest

There are no conflicts of interest.

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