Section: Research Paper

LIP MORPHOLOGY CHANGES AFTER FIRST PREMOLAR EXTRACTIONS IN PATIENTS WITH BIMAXILLARY PROTRUSION IN CHHATTISGARH POPULATION – A PILOT STUDY

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Abstract

Background: As in the present decade, we consider the soft-tissue paradigm the prime focus. Treating the face becomes as important as treating the hard tissues. Therefore, it becomes a key factor to quantify the soft-tissue response to hard tissue changes following orthodontic treatment to aid in prediction of treatment outcomes.

Purpose of the Study: To determine lip morphology changes after four first premolar extractions in patients with bimaxillary protrusion as ratios of hard and soft-tissue changes.

Materials and Methods: The sample consisted of pretreatment and post-treatment lateral cephalograms of 20 subjects with Class I bimaxillary protrusion who had undergone orthodontic treatment with four first premolars extraction and retraction of upper and lower incisors. Pre- and post-treatment lateral cephalograms were traced and superimposed by using SN-7˚ plane.

Fourteen linear measurements were made. Statistical analysis was performed to analyze the correlation between the hard and soft tissue change by Pearson's correlation.

Results: Significant changes after treatment was found both in dental and lip analysis. The co-relation of hard tissue to soft tissue was calculated as ratio.

Conclusion: Statistical analysis revealed that a 1 mm retraction of the incisor cervical point would produce a 0.5 mm retraction of lip. The predictability of this study may be helpful for the clinician in predicting the prognosis of treatment, amount of change in profile of the patient post treatment, and will help in producing a perfect treatment planning.

Keywords: Bimaxillary Protrusion, Lip Morphology, Cephalometric Analysis

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Introduction: For non-professionals, facial aesthetics place more emphasis on the aesthetic of facial soft issue. Patients who seek orthodontic treatment show concern to improve their appearance. Bimaxillary protrusion refers to a protrusive dentoalveolar relation of maxillary and mandibular dental arches that produce a convex facial profile and an increased procumbency of lips and sometimes popping out of teeth at rest (lip trap) making facial esthetics, a primary concern for patients[1]. According to Lewis (1948) the term "bimaxillary protrusion" was first used as early as 1897 by Calvin C. Case to define bimaxillary protrusion or bimaxillary dentoalveolar protrusion as it is sometimes referred to as a condition characterized by protrusive and proclined upper and lower incisors and an increased procumbency of the lips [2]. Tarisai and Nanda (2003) used the term bialveolar protrusion, when referring to bimaxillary protrusion and noted that it is a common occurrence in some ethnic groups because of the forward positioning of the teeth and its effect on the facial profile[3]. Chae (2007) used the term bi-alveolar protrusion to describe the condition of bimaxillary protrusion in the Asian population. He also stressed the increased procumbency of the lips and emphasised that patients sought treatment for the unaesthetic appearance of the lips[4].

The etiology of bimaxillary protrusion is considered to be multifactorial and consists of a genetic component as well as environmental factors, such as mouth breathing, tongue and lip habits, and tongue volume[5]. Savage (1963) concluded that the maxillary prognathism observed is a genetic feature and that functional activity has little or no effect on it. Dental protrusion of the upper and lower anterior teeth and spacing of these teeth, according to him, was the result of the true bimaxillary protrusion, assisted by the powerful tongue, the growth of the obtuse angle

mandible; and the texture of the lips which appears to be sufficient to hold the teeth in balance without retarding forward spacing and growth[6]. Posen found that a significant relationship exists between maximum strength and force of the lips and the final position and the angulation which the mandibular and maxillary incisor teeth assume after eruption[7]. The high occurrence of bimaxillary protrusion among black people has led to the idea that tooth size may play a part in the etiology of bimaxillary protrusion[8]. McCann and Burden (1996) concluded that although the adjacent soft tissues are likely to play a dominant role in the etiology of bimaxillary dental protrusion, it is possible that the larger teeth found in patients with bimaxillary protrusion may contribute to the proclination of the incisors[9].This type of malocclusion is a result of arch length and tooth material discrepancy.

The treatment approach usually consists of extracting the four first premolars and retracting the anterior teeth with maximum anchorage mechanics. Maximum anchorage of the posterior teeth allows the anterior teeth to be retracted to the greatest extent. Excessive lingual retraction of the incisors may be needed to reach the objectives of treatment, and the extent of alveolar bone remodeling that occurs in response to this type of movement may vary with each patient. This retraction and retroclination of maxillary and mandibular incisors will hopefully result in a decrease in the soft tissue procumbency and convexity [10,11,12,13,14,4]. Orthodontic treatment of these cases not only produces changes in dental component but also indirectly alters the soft-tissue profile of the patient by reducing lip procumbancy. As soft tissue follows the hard tissue, lip morphology and position plays a vital role in planning the treatment and predicting treatment outcome. Predicting the amount of lip retrusion in patients with bimaxillary protrusion can be used as a tool for the clinician to predict the amount of changes in the profile of the patient and estimate post treatment changes. Lew (1989) looked at profile changes after the extraction of four first premolars and orthodontic treatment of bimaxillary protrusion in 32 Asian adults. He reported significant improvement in upper and lower incisor protrusion, nasolabial angle, upper and lower lip length, and upper and lower lip protrusion[15].

Materials and Methods: The study is designed as a retrospective cross-sectional study. Records of bimaxillary protrusion cases in the Department of Orthodontics and Dentofacial Orthopaedics, Maitri college of dentistry and research centre, anjora, durg were included in the study.

Inclusion criteria

1. Adults (minimum 18 years of age at the start of the treatment)
2. Pretreatment Class I molar relationship, upper and lower incisor protrusion (U1 to NA >4 mm, L1 to NB >4 mm)
3. Orthodontic treatment consisting of the extraction of four premolars with subsequent retraction of anterior teeth
4. Pre- and post-treatment cephalometric radiographs of adequate diagnostic quality.

The present study was conducted as a pilot study for a larger sample study. Twenty cases were identified from the record room. The study was performed on the pre and post treatment cephalograms. All the cephalograms were traced with fine 3H pencil, and each parameter was measured with the same ruler and protractor. Before tracing, all cephalograms were checked to ensure that the radiographs were taken when subjects were relaxed, in maximum intercuspation and lip in relaxed state. All the cephalograms were taken from the same cephalostat (Orthphos XG 3D, Dentsply), under same exposure parameters (77 kV, 15 mA, 9.4 s).

The reference lines for cephalometric analysis were S-true horizontal and S-true vertical. S-true horizontal was constructed 7º tangent with SN plane and S-true vertical was the line perpendicular with S true horizontal [Figure 1]. The variables mentioned in Table 1 were traced to indicate the position of hard and soft tissue landmarks related to the horizontal [Figure 2a] and the vertical reference lines [Figure 2b].

Table 1: Parameters used for hard tissue and soft tissue changes

Parameters	Definitions
H-tU1 (mm)	Distance from upper incisor edge perpendicular to S-true vertical line
H-cU1 (mm)	Distance from cervical of upper incisor perpendicular to S-true vertical line
H-tL1 (mm)	Distance from lower incisor edge perpendicular to S-true vertical line
H-cL1 (mm)	Distance from cervical of lower incisor perpendicular to S-true vertical line
V-tU1 (mm)	Distance from upper incisor edge perpendicular to S-true horizontal line
V-cU1 (mm)	Distance from cervical of upper incisor perpendicular to S-true horizontal line
V-tL1 (mm)	Distance from lower incisor edge perpendicular to S-true horizontal line
V-cL1 (mm)	Distance from cervical of lower incisor perpendicular to S-true horizontal line
H-U-lip (mm)	Distance from most anterior of upper lip perpendicular to S-true vertical line

H-L-lip (mm)	Distance from most anterior of lower lip perpendicular to S-true vertical line
V-U-lip (mm)	Distance from most inferior of upper lip perpendicular to S-true horizontal line
V-L-lip (mm)	Distance from most superior of lower lip perpendicular to S-true horizontal line
H-subnasale (mm)	Distance from subnasale perpendicular to S-true vertical line
H-sulcus superioris (mm)	Distance from sulcus superioris perpendicular to S-true vertical line

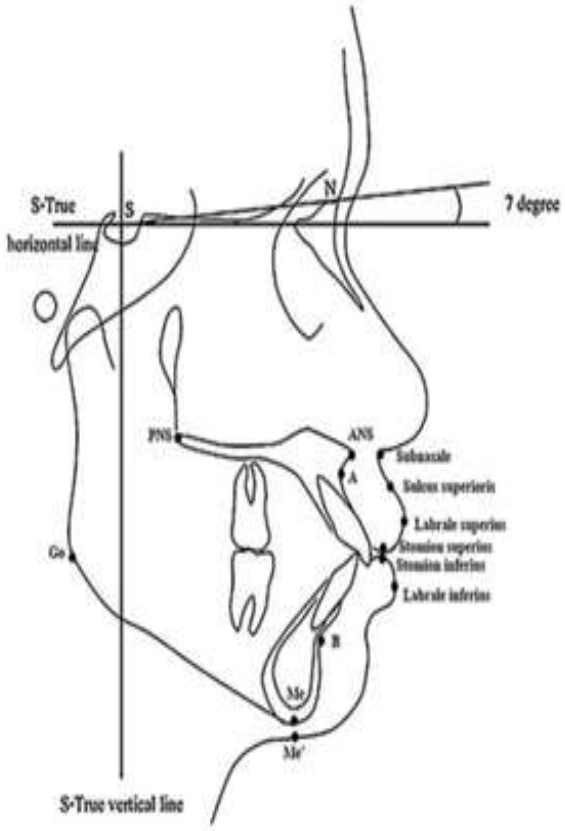

Fig1: Reference point of study

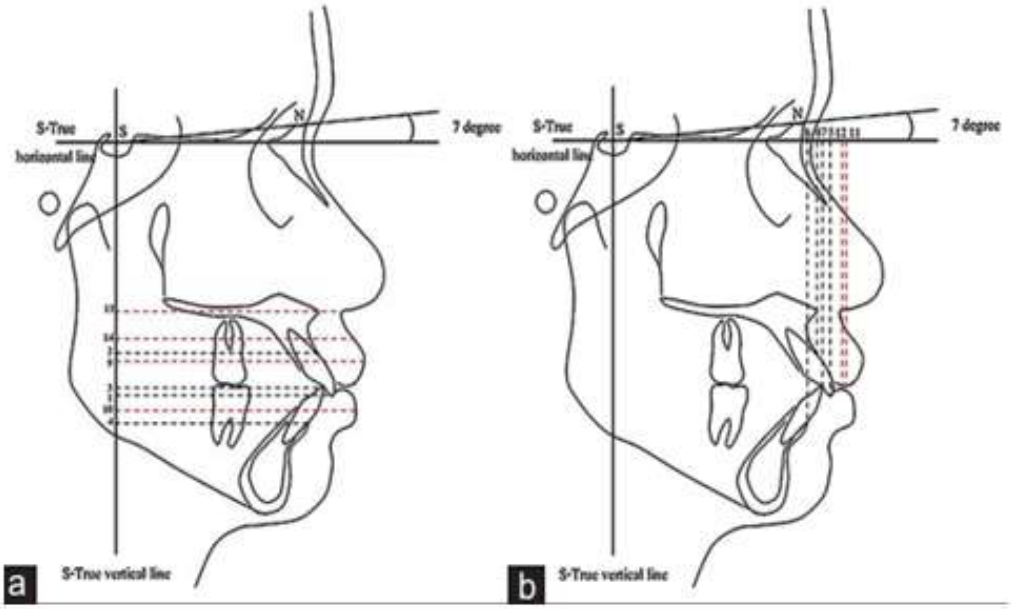

Figure 2: (a) Horizontal measurements of dental and lip changes in Table 1.[20] (b) Vertical measurements of dental and lip changes in Table 1

Results: The means and standard deviations of the pre- and post-treatment hard tissue measurements and the changes between them are shown in Table 2-9. The means and standard deviations of the pre- and post-treatment soft tissue measurements and the changes between them are shown in Table 10-15. Table16 shows the correlations between the changes in the soft tissue with the hard tissue and with the pretreatment soft-tissue variables in the horizontal and vertical planes. Horizontal lip changes Pearson's correlation showed significant positive correlations between the horizontal changes in upper lip position and the horizontal changes of maxillary incisor cervical position, horizontal changes of mandibular incisor cervical position (R = 0.5). There were significant positive correlations between the horizontal changes of lower lip position and those of maxillary incisor tip position, maxillary incisor cervical position (R = 0.89), mandibular incisor tip position (R = 0.5). The changes of upper and lower lips correlated with the changes of upper and lower incisors mainly occurred in the sagittal direction.

The data were evaluated for statistical significance and P < 0.05 was considered as the level of significance. Mean comparison of each parameters were calculated (table2-15). Pearson's correlation coefficients were calculated to assess the association between the hard and soft tissue measurements (table16).

Table 2: Mean comparison of HtU1 pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	72.40	7.13	11.23	0.001 (h.s)
Post-data	20	68.50	6.41		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

H.S.- Highly Significant

Table 3: Mean comparison of HcU1 pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	69.30	5.41	15.21	0.001 (h.s)
Post-data	20	66.40	5.75		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

H.S.- Highly Significant

Table 4: Mean comparison of HtL1 pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	67.20	5.57	39.23	0.001 (h.s)
Post-data	20	62.70	5.48		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

H.S.- Highly Significant

Table 5: Mean comparison of HcL1 pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	62.90	5.39	22.13	0.001 (h.s)
Post-data	20	59.10	5.24		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

H.S.- Highly Significant

Table 6: Mean comparison of VtU1 pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	69.90	5.62	23.14	0.001 (h.s)
Post-data	20	67.30	5.85		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

H.S.- Highly Significant

Table 7: Mean comparison of VcU1 pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	58.60	4.90	0.96	0.372 (n.s)
Post-data	20	57.40	6.26		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

N.S.- Not Significant

Table 8: Mean comparison of VtL1 pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	67.80	5.54	21.74	0.001 (h.s)
Post-data	20	65.30	5.62		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

H.S.- Highly Significant

Table 9: Mean comparison of VcL1 pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	77.70	5.73	21.79	0.001 (h.s)
Post-data	20	75.20	5.69		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

N.S.- Not Significant

Table 10: Mean comparison of HUlip pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	81.1000	5.99034	27.5	0.001 (h.s)
Post-data	20	77.1000	5.91964		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

H.S.- Highly Significant

Table 11: Mean comparison of HLlip pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	78.60	6.02	13.39	0.001 (h.s)
Post-data	20	75.70	5.98		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

H.S.- Highly Significant

Table 12: Mean comparison of VUlip pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	65.30	6.63	13.77	0.001 (h.s)
Post-data	20	63.80	6.70		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

H.S.- Highly Significant

Table 13: Mean comparison of VLlip pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	70.0000	6.45633	11.83	0.001 (h.s)
Post-data	20	68.1000	6.75044		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects

H.S.- Highly Significant

Table 14: Mean comparison of HsubNasale pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	77.60	4.45	45.76	0.001 (h.s)
Post-data	20	73.40	4.42		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects H.S.- Highly Significant

Table 15: Mean comparison of Hsulcussuperior pre-data & post-data:

Data type	N	Mean	SD	t-value	p-value
Pre-data	20	78.40	4.70	32.03	0.001 (h.s)
Post-data	20	74.80	4.87		

Statistical test: Paired t-test; (p<0.05- significant, CI=95%), N= number of study subjects H.S.- Highly Significant

Table 16: correlation matrix of hard and soft tissue:

Group	r-value	Inference	p-value
Hard tissue values	0.5	moderate correlation	0.001 (h.s)
Soft tissue value			

Statistical test: Pearson's Correlation; (p<0.05- significant, CI=95%), N= number of study subjects H.S.- Highly Significant

Discussion: Since this study focused on the effects of the dental changes of the anterior teeth, the initial soft tissue profile variables on lip changes were included as criteria. The ratio of the amount of retraction of the anterior teeth to lip movement is a key factor for the prediction of the soft tissue profile after orthodontic treatment. This ratio has been evaluated in subjects with different morphological, gender, and racial backgrounds using various reference points of the maxillary and mandibular incisors.

In our study we found significant correlation between hard tissue and soft tissue changes. Horizontal lip changes Pearson's correlation showed significant positive correlations between the horizontal changes in upper lip position and the horizontal changes of maxillary incisor cervical position, horizontal changes of mandibular incisor cervical position (R = 0.5). There were

significant positive correlations between the horizontal changes of lower lip position and those of maxillary incisor tip position, maxillary incisor cervical position (R = 0.89), mandibular incisor tip position (R = 0.5).

The changes of upper and lower lips correlated with the changes of upper and lower incisors mainly occurred in the sagittal direction.On an average, with retraction of upper incisors upto 3.90mm, upper lip proclination is reduces by 4mm.On an average, with retraction of lower incisors upto 4.50mm, upper lip proclination is reduces by 3mm.

Data from previous studies shows different values for different ethnicities. Al-Abdwani et al. showed that each 10-degree retroclination of incisors resulted in a statistically significant change of 0.4 and 0.3 mm in the horizontal plane at points A and B, respectively[16]. Hassan et al. found that each 10-degree retroclination of incisors resulted in a 0.6-mm displacement at point A superiorly. However, there has been no evidence that changes in incisal inclination result in statistically significant positional displacement at point B[17].

A study evaluating the lip changes with the changes of the maxillary and the mandibular incisor positions in Japanese adults revealed a 1 mm retraction and a 1 mm intrusion of the maxillary incisor cervical point produced a 0.22 mm retraction of the upper lip and a 1 mm retraction of the mandibular incisor tip produced 0.76 mm retraction of the lower lip[18]. However, another study on African American females attained a ratio of 1.75:1 and 1.2:1 between mandibular incisor retraction and retraction of lower lip, and between maxillary incisor retraction and upper lip change respectively[19].

For Caucasians, the ratios of maxillary incisor retraction to upper lip retraction found to be from 2.24:1 to 2.93:1 and for mandibular incisor retraction to lower lip retraction from 1.11:1 to 1.23:1[20]. Sundareswaran and Vijayan performed another study on Dravidian ethnicity, attained a ratio of 1:2.01 for upper lip to upper incisor retraction and 1:1 for lower lip to lower incisor retraction[21].

The lip thickness of adult male patients was greater than that of adult female patients. The average ratio of maxillary incisor retraction to upper lip repositioning was 1.6:1,1.9:1 and 2.2:1 in the thin lips group, normal lips group and thick lips group, respectively. Gender differences exist in the thickness of upper lip. Horizontal changes of the maxillary incisor showed a significant correlation to horizontal changes of the upper lip ($p<0.001$)[22].

In another study all linear and angular measurements showed statistically significant ($p < 0.05$) changes except for changes in upper lip thickness, lower lip thickness, lower vermillion, B' point and lower lip. The Pearson's correlation test showed a significant positive correlation between upper incisor retraction and upper lip position statistically significant decrease in the interlabial gap by 3.4 ± 2.5 mm ($p < 0.001$)[23].

Conclusion: From our study we have concluded the followings:

1. It is relatively difficult to predict lip position after retraction of the incisors using a limited number of hard and soft tissue parameters, such as the maxillary incisor cervical point. However, the horizontal positions of upper and lower lips can be predicted by utilizing the multiple parameters identified in this study.
2. The vertical positions of the lips could be explained by three parameters with a higher than 62 per cent confidence.
3. The amount of change in lip position after retraction of the anterior teeth may differ among different ethnicities, genders, and/or types of malocclusions. The variables to predict both lip positions found in the present study may be beneficial for orthodontists for both making an accurate diagnosis and also for treatment planning.

There were significant changes of upper and lower lips as related to upper and lower incisor retractions.

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