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## RESEARCH ARTICLE

# RETRACTION OF THE MAXILLARY INCISORS AND CHANGE IN THE INFRANASAL SOFT TISSUE PART OF THE FACE

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### ABSTRACT

**Introduction:** The potential effect of maxillary incisor retraction on infranasal soft tissue part is debatable. **Aim:** This study aims to evaluate the soft tissue changes of the infranasal part of the face after retraction of the maxillary incisors following Begg mechanotherapy. **Materials and Methods:** The parent sample consisted of one hundred patients. Of them, 40 female and 20 male patients had class II division 1 malocclusion whereas 24 male and 16 female patients had class I malocclusion with anterior protrusion. All the patients were treated with fixed appliances (Begg's technique following extraction of either all first premolars or only upper first premolars) for an average period of one year and six months. Each patient had lateral skull radiographs taken before commencement of treatment, at the end of the first stage of treatment; that is as soon as the incisors reached an edge-to-edge relationship; and at the end of treatment 2 months after appliances were removed. Chi-square test was applied as the measures of associations, T-test was used to compare the means. The soft tissue parameters compared between pre-treatment and post-treatment were as follows: Labrale superior(Ls) to E line, Labrale inferior(Li) to E line, Sulcus superior(Ss) to E line, Sulcus inferior(Si) to E line, lower lip to H line, upper lip to profile line, lower lip to profile line, Z angle, Nasolabial angle, Labiomental angle and H angle. **Results:** Soft tissue analysis revealed that significant changes were noted in case of labrale superior to E line, labrale inferior to E line, Z angle, H angle, nasolabial angle and labiomental angle whereas non-significant changes were noted in case of sulcus superior to E line, sulcus inferior to E line, H line and profile line relative to both upper and lower lips. **Conclusions:** The findings of the present study indicates that retraction of maxillary incisors is a viable option for a desirable decrease of lip procumbency although the amount of this reduction varies from person to person.

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## INTRODUCTION

It is well said that a person's internal emotions, be it happiness or sadness is duly reflected on his/her face. Social acceptance, psychological well-being and the self-esteem of an individual are related to physical appearance.

Facial attractiveness is very important in interhuman communication (1). Attractiveness is also suggested to influence personality development and social interaction (2). Facial proportions are important in that to be harmonious, the upper, middle and the lower facial thirds need to be approximately equal in size. In 1999, Arnett et al (3)

introduced soft tissue cephalometric analysis (STCA) which includes soft tissue measurements of the midface area aimed at objectively evaluating facial harmony and balance. Movement of teeth which are in direct contact with facial soft tissue can influence it greatly. So soft tissue changes are variably influenced by the amount, direction and location of forces acting on the underlying hard tissues. The prediction of lip change in response to tooth movement has commonly been expressed as the ratio of maxillary and mandibular incisor retraction to lip change. However, reports of this ratio vary considerably according to gender(4,5), dentofacial morphology(6) and ethnicity(7,8). Some researchers have found a high degree of correlation between incisors and upper lip retraction, suggesting a close relationship between soft tissue and underlying hard tissue.(9,10). Others have found that a definite proportional change in the soft tissue does not necessarily follow changes in the dentition (11). Various other studies on the relationship between the retraction of anterior teeth and profile changes have been reported (12, 13).

The aims of this study were to measure the changes that occurred in the soft tissues of the infranasal part of the face after retraction of the maxillary incisors. Specific objectives of this study was to determine the position of the upper lip, lower lip, the relation between tip of the nose, both the lips and the chin and also to evaluate any change in facial profile angle like nasolabial and labiomental angle.

## MATERIALS AND METHODS

For this prospective study, hundred young adolescent patients(12-18 years) with class-II division 1 malocclusion(forty female, twenty male patients) and class I malocclusion with protrusion(twenty four male, sixteen female) were conveniently selected from department of orthodontics of Dr. R. Ahmed Dental college and Hospital, Kolkata(India). Ethical clearance for this study was approved by the Ethics committee, Calcutta University. The mean age (mean± s.d.) of males was 14.00± 2.05 years with range 12-16 years and the median age was 14.0 years. The mean age (mean± s.d.) of females was 15.70± 4.31 years with range 12-18 years and the median age was 14.5 years. The duration of study was 18±3.14 months. Begg's retraction mechanics were applied for all patients. Only those patients were chosen for this study who were ready to visit for post-treatment follow up and who had inclusion criteria as follows:

All the subjects chosen had full complement of teeth except third molars, no congenital deformity of the facial structures, no periodontally weak(two degree and three degree mobility) teeth, incompetent(they are morphologically short lips which do not form lip seal in a relaxed state) or potentially competent lips(they are normal lips that fail to form a lip seal due to proclined upper incisors), presence of over jet of more than 4 mm and presence of complete deep bite. Consent was taken from all these patients/parents. Lateral cephalometric radiographs were taken for soft tissues before and after treatment. Tracings of these radiographs were made on 0.003 inch matte acetate tracing paper (de'smat<sup>TM</sup>) with a 3H hard lead pencil. All the patients were treated by three orthodontists but cephalometric tracings and measurements were done by only one orthodontist to avoid inter-examiner discrepancy in cephalometric tracing.

There was no drop-out of patients during the study. To trace the soft tissue change the following planes were traced:

### Soft tissue parameters (14) (Fig.1)

1. **Subnasale(Sn):-** The point at which the columella (nasal septum) merges with the upper lip in the midsagittal plane
2. **Labrale superior(Ls):-** The most anterior point of the upper lip
3. **Labrale inferior(Li):-** The median point in the lower margin of the lower membranous lip.
4. **Sulcus superior(Ss):-** The point of greatest concavity in the midline between labrale superior and subnasale
5. **Sulcus inferior(Si):-** The point of greatest concavity in the midline of the lower lip between labrale inferior and soft tissue pogonion(Pog')
6. **E-line:-** The esthetic line or plane proposed by Ricketts extending from the tip of the nose to the soft tissue pogonion
7. **H-line:-** Harmony line proposed by Holdaway, tangential to chin point and upper lip
8. **Profile line:-** Line tangent to soft tissue chin(pog') and to the most anterior point of either the lower or upper lip whichever is most protrusive
9. **Z angle:-** Inner inferior angle formed by intersection of FH plane and profile line
10. **Nasolabial angle:-** Angle formed by the intersection of the upper lip and the nasal columella at subnasale
11. **Labiomental angle:-** Angle formed by the intersection of the lower lip and chin measured at soft tissue B point
12. **H angle:-** Formed by intersection of soft tissue nasion(N') pogonion(pog') line and H line

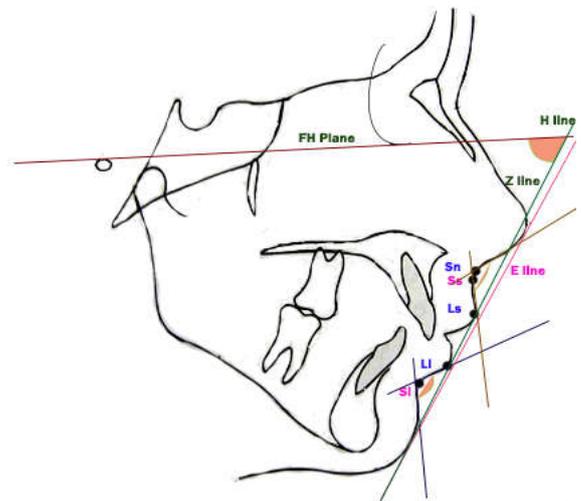


Fig. 1. Soft tissue cephalometric landmarks

1. Subnasale (Sn)
2. Labrale superior (Ls)
3. Labrale inferior (Li)
4. Sulcus superior (Ss)
5. Sulcus inferior (Si)
6. E-line
7. H-line
8. Profile line
9. Z-angle
10. Nasolabial angle
11. Labiomental angle
12. H-angle

The purpose of measuring E line, H line and profile line was to evaluate cephalometrically (in mm) how much change occurs (if any) in these parameters before and after orthodontic treatment. The change in both E line and profile line were measured with respect to upper lip and lower lip whereas the change in H line was measured with respect to lower lip only.

Thus eg for the upper or lower lip placed behind E-line, the distance between the lip and E line would have a negative value and vice versa. The same held true for the profile line and H line. The measurement of Z angle, nasolabial angle, labiomental angle and H angle were done for assessment of maxillary incisor retraction effect on these parameters. The change in these angles (if any) were measured by subtracting post-treatment values from corresponding pre-treatment values and was expressed in degrees.

**Statistical analysis:** Statistical analysis was performed with help of Epi Info (TM) 3.5.3. EPI INFO is a trademark of the Centre for Disease Control and Prevention (CDC). Descriptive statistical analysis was performed to prepare different frequency tables and to calculate the means with corresponding standard errors. Test of proportion was used and corresponding Standard Normal Deviate (Z) was calculated to compare the proportions. Chi-square test was applied as the measures of associations. t-test was used to compare the means.  $p < 0.05$  was taken to be statistically significant.

## RESULTS

**Soft tissue changes:** Soft tissue analysis revealed that labrale superior to E line had a mean decrease of 2.13 mm. The labrale inferior to E line had a mean decrease of 1.49 mm. Sulcus superior to E line and sulcus inferior to E line had a mean increase of 0.12 mm and 0.41 mm respectively. The lower lip with respect to H line receded by a mean value of 0.29 mm. The upper lip to profile line and lower lip to profile line had a mean increase of 0.46 mm and 0.24 mm respectively. The nasolabial angle had a mean increase of 11.6 degrees. The labiomental angle had a mean increase of 5.57 degrees. The mean increase of Z angle was 3 degrees and the mean decrease of H angle was 2.23 degrees (Table 1).

Similar findings have been reported in other studies (15). One of the main concerns of class II division 1 patients is proclined upper incisors with a resultant increase in overjet. In this study, the nasolabial angle before treatment had a mean value of 97.73 degrees. Orthodontic treatment made this angle more obtuse with a mean increase of 11.6 degrees after treatment. Lew (15) reported a change of 10 degrees and Finnoy et al (16) found in a study (Edgewise mechanics was used for both extraction and non-extraction groups) involving white subjects, a smaller reduction in nasolabial angle of 6.5 degrees. Hayashida H *et al* (13) showed a change of 9.42 degrees in nasolabial angle (edgewise mechanics was used for extraction cases). Kachiwala V A, Kalha A S and Machado G (17) using edgewise technique after four premolar extractions noted a significant increase of 15.2 degrees in nasolabial angle. Significant mean increase was also observed for nasolabial angle in various studies done by Verma S L, Sachan K, Sharma V P, Tandon P and Singh G P (18), Kojo M, Nishiura A, Yamagata S and Matsumoto N (19), Trisnawaty N, Loi H, Kitahara T, Suzuki A and Takahashi I (20), Janson G, Mendes L M, Junqueira C H and Garib DG (21). Bourzgui F *et al* (22) and Pedrin R A, Henrique S J, Almeida R R, Almeida M R and McNamara J A Jr (23) in their respective studies found non-significant increase in nasolabial angle. Chang N Y, Cho J H, Lee Y M and Kang KH (24) noted that in both adolescents and adults after extraction treatment, nasolabial angle significantly increased and in both subjects after non-extraction treatment, nasolabial angle significantly decreased. These studies showed that the final inclinations were directed toward the attainment of a result closer to the accepted norms for respective racial groups. Thus excessive retraction of the maxillary incisors was avoided to prevent dishing in of the profile in different populations. The mean increase of labiomental angle was 5.57 degrees. Looi and Mill (25) evaluated 30 class II division 1 cases treated with four premolar extractions by the Begg's technique.

**Table 1. Soft tissue changes following retraction of maxillary incisors**

Measurement	Pre-treatment (Mean 1±s.d)	Post-treatment (Mean 2±s.d)	Difference (mean 1-mean 2)	t-test	p-value
<b>Linear measurements(mm)</b>					
Labrale Superior(Ls) to E-Line	1.05±2.25	-1.08±2.06	2.13	$t_{28}=3.82$	<0.01
Labrale Inferior(Li) to E-Line	2.67±2.34	1.18±1.87	1.49	$t_{28}=2.72$	<0.05
Sulcus Superior(Ss) to E-line	8.71±2.03	8.83±1.96	-0.12	$t_{28}=0.23$	>0.05
Sulcus Inferior to E-line	4.64±2.29	5.05±2.76	-0.41	$t_{28}=0.62$	>0.05
Lower lip to H-Line	1.97±1.84	1.68±1.34	0.29	$t_{28}=0.69$	>0.05
Upper lip to profile line	-4.33±3.15	-3.87±1.96	-0.46	$t_{28}=0.67$	>0.05
Lower lip to profile line	-0.37±0.79	-0.13±0.52	-0.24	$t_{28}=1.38$	>0.05
<b>Angular measurements(°)</b>					
Z-angle	61.53±5.04	64.53±4.11	-3	$t_{28}=2.52$	<0.05
Nasolabial angle	97.73±14.60	109.33±10.62	-11.6	$t_{28}=3.51$	<0.01
Labiomental angle	100.20±14.25	105.77±15.49	-5.57	$t_{28}=2.44$	<0.05
H-angle	22.20±4.31	19.97±3.30	2.23	$t_{28}=2.25$	<0.05

Minus(-) sign in pre-treatment and post-treatment column indicates values of the parameter which are placed behind reference line  
Minus (-) sign in difference column (mean 1-mean 2) indicates values which have increased after treatment.

## DISCUSSION

Orthodontics is the oldest speciality in dentistry. The study of beauty and harmony of the facial profile has been central to the practice of orthodontics from its earliest days<sup>4</sup>. The purpose of this study was to evaluate the soft tissue change in the infranasal part of the face following retraction of the maxillary incisors which in its turn effects favourable change in facial aesthetic. Following retraction of the maxillary incisors, there was an improvement of the soft tissue profile along with improved posture of the lips.

They reported a mean increase of 5.3 degrees in the labiomental angle which is almost equal to the value of this study. Hayashida *et al* (13) reported a mean increase of 3.74 degrees in labiomental angle. Kachiwala V A, Kalha A S and Machado G (17) also showed a significant increase of 12.2 degrees in labiomental angle. In a study concerning soft tissue profile preference De Smit and Dermaut (26) reported that a flattening of the mental fold led to a more drastic loss of esthetic preference than a deepening. A significant increase of 3 degrees was noted in Z-angle after treatment.

Merrifield (27) found the normal Z- angle range in his sample of 120 patients to be 72degrees to 83 degrees. In his study the pre-treatment Z-angle of the extraction group was 67.5 degrees and the post-treatment Z angle became 69 degrees , an increase of 1.5 degrees. Verma S L, Sachan K, Sharma V P, Tandon P and Singh G P (18) also noted a significant mean increase of 4 degrees in Z angle in extraction group and 0.92 degree in non-extraction group. H angle measures the prominence of the upper lip in relation to the overall soft tissue profile. A significant decrease of 2.23 degrees ( $p<0.05$ ) was found in H angle after the treatment. The measurement in a study done by Bascifti and Usumez (28) also shows a significant decrease ( $p<0.01$ ) during the orthodontic treatment . Measurements of the lips relative to Ricketts' E-line focuses attention on the relationship of nose, lips and chin. In this study the labrale superior(Ls) to E line and labrale inferior(Li) to E line were retracted by 2.13mm(mean) and 1.49mm(mean) respectively after treatment . Lew K(15) noted 2.60 mm reduction of upper lip to E line and 3.80mm reduction of the lower lip to E line following incisal retraction . Hayashida et al(13) noted a mean reduction of 2.84 mm and 2.80 mm in case of upper lip to E line and lower lip to E line respectively. Kojo M, Nishiura A, Yamagata S and Matsumoto N(19) found a mean reduction of 3.06 mm and 4.27 mm in case of upper lip to E line and lower lip to E line respectively. Janson G, Mendes L M, Junqueira C H and Garib D G (21) found that the changes in two premolar extraction groups varied from -0.75 mm for both lips to -5.03 mm for the upper lip.

These changes in four premolar extraction groups varied from -2.29 mm for the lower lip to -4.9 mm for the lower lip. Pedrin R A, Henrique S J, Almeida R R, Almeida M R and McNamara J A Jr (23) noted in their study noted that relative to the esthetic plane (Eplane) the upper lip was significantly more retruded (-2.6mm)compared with the pendulum group (-1.0 mm) and the headgear group (-1.1 mm).Chang N Y, Cho J H, Lee Y M and Kang K H(24)found that in both adolescent and adult extraction group the values of upper lip to E line and lower lip to E line were statistically different between pre-treatment and post-treatment. In their study Drobocky OB and Smith RJ (29) found a mean retraction of 3.02mm and 3.06mm of upper lip to E line and lower lip to E line respectively. Konstantonis D (30) in his study showed the upper lip exhibited 2.75 mm retraction in extraction group and 0.68 mm retraction in non-extraction group whereas the lower lip exhibited 3.34mm retraction in extraction group but 0.67 mm forward movement in non-extraction group. The mean retraction of sulcus superior (Ss) to E line and sulcus inferior(Si) to E line were 0.12mm and 0.41mm respectively. Verma S L, Sachan K, Sharma V P, Tandon P and Singh G P (18) found a mean retraction of 1mm for Ss to E line and 0.92mm for Si to E line in 50 extraction cases whereas in 50 non-extraction cases they found a mean retraction of 0.15mm for Ss to E line but a mean advancement of 1.86 mm for Si to E line .Drobocky and Smith(29) evaluated profile change in 160 cases and they found a mean retraction of 2.60mm for the Ss to E Line and 2.10mm for the Si to E line.Finnoy , Wisth and Boe(16) also found in 30 class II division 1 cases a mean retraction of 2.4mm for the Ss to E line and 1.3mm for Si to E line. The mean pre-treatment and post-treatment value of lower lip to H line were 1.97mm and 1.68mm respectively. Bascifti FA, Uysal T, Buyukerkmen A and DemirA (31) showed that according to Holdaway the ideal position of the lower lip is zero to 0.5mm anterior to the H line but individual variations from 1mm behind to 2mm anterior to the H line are considered

to be in a good range. So the result of this study regarding H line nearly complies with the Holdaway proposal. The mean pre-treatment and post-treatment value of upper lip to profile line were -4.33mm and -3.87mm respectively. These findings are supported by retraction of mandibular incisors as well as labrale inferior (Li). Similarly the mean pre-treatment and post-treatment value of lower lip to profile line were -0.37mm and -0.13mm respectively. These two measurements are supported by retraction of maxillary incisors as well as labrale superior (Ls). The findings of the present study indicate that extraction of premolars and subsequent retraction of maxillary incisors is a viable option for a desirable decrease of lip procumbency. 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 (32). In an adolescent boy the nose and chin will continue to grow much more than a girl. This will have the effect of decreasing lip procumbency especially to a line drawn from the tip of nose to the tip of chin known as aesthetic line. As the duration of the study was short and sample size was small, so definitive conclusions regarding effect on soft tissue profile cannot be drawn properly. In future long duration study with more larger sample size will be undertaken to bring about more definitive results.

## CONCLUSION

The study can be summarized as -the Ls to E line was retracted more than Li to E line .Ss to E line was increased less than Si to E line .The lower incisor to H line was reduced to a very small amount .The retraction of profile line to upper lip was more than the retraction of profile line to lower lip .The Z angle was increased by a significant amount after treatment .The increase in the nasolabial angle was more than labiomental angle which corroborated with significant amount of retraction of upper incisors and lower incisors .The H angle also showed a significant increase after treatment. The findings of the present study indicate that retraction of maxillary incisors is a viable option for a desirable decrease of lip procumbence although the amount of this reduction varies from person to person.

**Conflict of interests:** None

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