

# Dimensional changes in height of labial alveolar bone of proclined lower incisor after lingual positioning by orthodontic treatment: A cephalometric study on adult Bengali population

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## Abstract

**Aim:** The study aims to know whether modern orthodontic treatment procedure do actually cause permanent bone loss at the alveolar bone crest or improve alveolar bone morphology on labial aspect of permanent incisors which are to be moved lingually. **Settings and Design:** manual tracings of pre and post treatment lateral cephalometric radiographs were used. **Material and Method:** The cephalometric radiographs of 34 adult bengali subjects whose orthodontic treatment involved lingual positioning of procumbent mandibular central incisors were examined to determine the morphologic changes (bone height) in the labial alveolar bone that resulted from orthodontic treatment. **Result:** Comparison of tracings of radiographs taken before and after treatment indicated that 57.6% shows an increase in labial alveolar bone height, 30.3% shows decreased value and 12.1% shows no change with the decrease in the angulation between long axis of lower incisor and mandibular plane (GoGn). In the increase group there is a significant increase in the distance 'incisal edge to D point' whereas this dimension decreased significantly in the rest of the cases. In addition, a significant positive correlation ( $r = 0.56$ ) was found between the changes in the distance from the incisal edge to the 'D' point and the alveolar bone height. But no significant relation was found between alveolar bone height and decrease in angulation of lower incisor either in the 'increase group' ( $r = 0.13, p > 0.05$ ) or in the 'decrease group' ( $r = 0.37, p > 0.05$ ). **Conclusion:** These findings indicate that during orthodontic treatment that involves lingual positioning of procumbent teeth but no intrusion, an increase in the amount of buccal alveolar bone may take place.

**Keywords:** Incisor retraction, labial alveolar bone height, Lateral cephalometric radiograph

## Introduction

A basic axiom in orthodontics is "bone traces tooth movement." In a healthy periodontium regardless of the direction in which a tooth is moved, the bone around the tooth remodels without damage to the supporting tissues.

When the mandibular incisors are protrusive labial alveolar bone will be thin. Sometimes there may be a dehiscence or fenestration. These areas of alveolar bone establish an environment that is less resistant to tissue trauma (such as vigorous tooth brushing, plaque-induced inflammatory

lesion or sometimes orthodontic treatment) and conducive to gingival recession.<sup>[3]</sup>

An upright position of incisors in the basal bone improves the support around the root of each incisor and also leads to better periodontal condition which may require excessive lingual retraction of the incisors.<sup>[16]</sup> Biology of orthodontic tooth movement dictates lingual movement of incisors causes remodeling of labial alveolar process. This may result in a change in height of alveolar bone. Previous studies often indicate that a considerable amount of destruction at the height of alveolar bone proper results after completion of orthodontic treatment.<sup>[1,9,15]</sup> A different finding could be found in several studies which indicate orthodontic correction of malaligned teeth that involves lingual positioning of procumbent permanent incisors may induce a spontaneous improvement in gingival morphology and an increase in the amount of buccal alveolar bone.<sup>[2,4,5,13,18]</sup>

This study will determine whether the height of the alveolar process increases, decreases or remains the same following completion of orthodontic treatment which involves lingual movement of procumbent mandibular permanent incisors. It would be of value to know whether modern orthodontic treatment procedure do actually cause permanent bone loss at alveolar bone crest or improve alveolar bone morphology on the labial aspect of permanent incisors which are to be moved lingually.

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## Materials and Methods

### Study area

Material of this study is obtained from Department of Orthodontics, Dr. R. Ahmed Dental College and Hospital, Kolkata.

### Study population

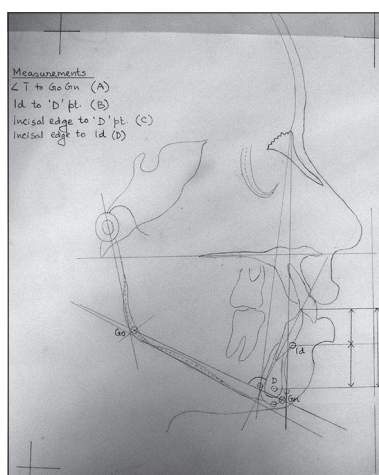
Adult Bengali in the age group 19–25 years, having no history of previous orthodontic treatment and pretreatment lateral cephalogram showing procumbency of mandibular incisors.

After completion of treatment pre and posttreatment values of following parameters are compared.

- Angulation between mandibular plane and long axis of mandibular central incisor
- Distance from infradentale to “D” point [bone height]
- Distance from incisal edge of mandibular central incisor to “D” point [Figure 1].

Reliability of radiographic measurement is maximized by:

- Use of standardized cephalometric radiograph (1:1 ratio)
- All the tracings will be done by the same person familiar with the anatomy of cephalometric radiograph.



**Figure 1:** Measurements taken from tracing of lateral cephalometric radiograph. (a) Angulation between the long axis of lower central incisor (#41) and mandibular plane (Go-Gn). (b) Distance between infradentale and “D” point (c) Distance between incisal edge of lower central incisor (#41) and “D” point

To eliminate the effect of growth and development on dimensional changes in alveolar bone due to incisor retraction:

- Adult patients are chosen in whom pubertal growth spurt has been completed,
- “D” point is used as a main anatomic reference point since it has been demonstrated to be the most stable landmark in the mandible.

The student paired “*t*”-test is used to determine the significance of the difference between the pretreatment and posttreatment measurements. The extent of the relationship between pairs of differences will be obtained by calculating correlation coefficient (*r*).

## Result

Comparison of the measurements from the baseline and second radiographs showed an increase in labial alveolar bone height in 57.6% of total population, 30.3% show decreased value and 12.1% shows no change with the decrease in the angulation between long axis of lower incisor and mandibular plane (GoGn).

The angle lower incisor long axis to the mandibular plane (1 to GoGn) showed a significant decrease in the total population (mean =  $-10.24^\circ$ ,  $P < 0.001$ ) indicates significant retraction of mandibular incisors. Height of labial alveolar bone (distance between infradentale (Id) to “D” point) in the total population shows a mild increase from the pretreatment value which is statistically insignificant. (mean = 0.62 mm,  $t = 1.36$ ,  $P > 0.05$ ) [Table 1].

However analyzing separately the group of patients, with an increase in alveolar bone height, shows this increase is statistically significant (mean = 2.40 mm,  $t = 7.86$ ,  $P < 0.001$ ) [Table 2]. But no significant positive correlation was found ( $r = 0.13$ ) between the amount of lingual retraction and increase in bone height [Table 3]. Therefore, an increase in alveolar bone height cannot be regarded solely as an effect of lingual positioning of teeth.

Analyzing separately the group of patients who experienced same or decreased value of alveolar bone height following incisor retraction showed that this decrease is statistically

**Table 1: Mean measurement for the total population (n=33)**

	Pretreatment		Posttreatment		Difference		Significance	
	Mean	SD	Mean	SD	Mean	SD	<i>t</i>	<i>P</i>
A (#41 to GoGn)	106.32	7.84	96.08	8.03	-10.2	5.81	10.12	<0.001
B (Id to D point)	20.11	3.68	20.73	3.44	0.62	2.62	1.36	NS
C (incisal edge to D point)	31.25	3.66	31.68	3.62	0.33	2.92	0.66	NS

SD: Standard deviation; NS: Not significant

**Table 2: Mean measurement for patients who showed an increase in the value of “B” (n=19)**

	Pretreatment		Posttreatment		Difference		Significance	
	Mean	SD	Mean	SD	Mean	SD	t	P
A (#41 to GoGn)	103.71	7.82	94.39	8.05	-9.32	-5.97	5.83	<0.001
B (Id to D point)	18.71	3.88	21.11	3.60	2.40	1.33	7.86	<0.001
C (incisal edge to D point)	30.0	3.68	31.87	3.80	1.87	2.40	3.40	<0.01

SD: Standard deviation

**Table 3: Correlation analysis of change in value of “B” with change in value of “A”, “C” (increase group)**

	r	Significance		Remarks
		t	P	
B versus A	0.13	0.54	>0.05	Positively correlated but not significant
B versus C	0.56	2.77	<0.02	Positively correlated and significant

significant (mean = -1.79 mm,  $t = 3.53$ ,  $P < 0.01$ ) [Table 4]. Again, there is no significant positive correlation between incisor retraction and decrease in bone height [ $r = 0.37$ , Table 5].

Interestingly both the “increase group” and “same or decrease group” shows a positive correlation of change in bone height (B) with the distance from incisal edge to “D” point (C) [ $r = 0.56$  and  $r = 0.70$ , respectively, Tables 3 and 5].

Presents the mean values for the total population [Table 1]. Presents the mean values for a segment of the population who showed an increase in the distance from Id to “D” point (increase group) [Table 2].

Presents the mean values for a segment of the population who showed a decrease in the distance from Id to “D” point (decrease group) [Table 4]. Correlation studies are presented in Tables 3 and 5.

## Discussion

Axiom of orthodontics is “bone traces tooth movement.” According to this a 1:1 cortical bone remodeling/tooth movement ratio should occur during incisor retraction. Vardimon, Oren<sup>[17]</sup> investigated the validity of the postulate in maxillary incisor retraction and found 1:2 Bone/Tooth ratio. Therefore, bone remodeling may lag behind extent of tooth movement. This may be influenced by several factors – magnitude and direction of force applied, anatomic limit set by cortical plates of alveolus, oral hygiene status and health of the periodontium.

The objective of the present study was to find if there is any change in the height of the labial alveolar process, either decrease or increase, as a result of orthodontic uprighting of procumbent permanent mandibular incisors in adult

population. Despite the fact that in the total population the decrease in the angulation between the mandibular plane and the axis of the mandibular central incisors was highly significant (mean =  $-10.24^\circ$ ,  $P < 0.001$ ), an increase in alveolar height, expressed as the distance from the “D” point to the alveolar crest, was not evident in 42.4% of the cases. Furthermore, no significant correlation was found between the changes in the alveolar height and those in the angulation between the mandibular plane and the axis of the permanent mandibular incisors. This finding corroborates with results of Kloehn and Pfeifer,<sup>[7]</sup> Closs *et al.*,<sup>[8]</sup> Nelson and Artun,<sup>[11]</sup> Pearson,<sup>[12]</sup> Sadowski and Begole<sup>[14]</sup>, that no significant damage or benefit occurs to periodontal structures with vertical or horizontal tooth movement.

However, the findings of a significant increase in the distance from the incisal edge to the “D” point in the “increase” group and of a significant decrease in the “same/decrease” group suggests that the change in the alveolar bone height may be influenced not only by the change in angulation between the mandibular plane and the axis of the mandibular central incisors but also by other factors. This is further indicated by the highly significant correlations between the change in distance from the incisal edge to the “D” point and the change in the alveolar bone height ( $r = 0.56$  for the “increase” group, and  $r = 0.70$  for the “same/decrease” group).

A decrease in this distance (incisal edge to D point) may be due to orthodontic intrusion due to the presence of tip back bend during incisor retraction. Melsen<sup>[10]</sup> in his experiment on “tissue reaction following application of intrusive and extrusive forces” found that intrusion of teeth did not result in decrease in marginal bone level in periodontally healthy condition but presence of gingival inflammation may result in loss of alveolar bone height.

Bimstein *et al.*<sup>[2]</sup> suggested that the amount of anterior alveolar bone might increase during orthodontic treatment involving lingual positioning of protrusive teeth if there is no intrusion.

Data obtained from the present study indicates change in labial alveolar bone height may occur following alignment and retraction of proclined mandibular incisors, such a change is statistically insignificant and it may take place in either direction—increase or decrease, but is not correlated

**Table 4: Mean measurement for patients who showed same or decrease in the value of “B” (n=14)**

	Pretreatment		Posttreatment		Difference		Significance	
	Mean	SD	Mean	SD	Mean	SD	t	P
A (#41 to GoGn)	109.86	6.57	98.36	7.69	-11.5	5.53	7.78	<0.001
B (Id to D point)	22.0	3.30	20.21	3.26	-1.79	1.90	3.53	<0.01
C (incisal edge to D point)	33.18	2.85	31.43	3.50	-1.75	2.23	2.94	<0.02

SD: Standard deviation

**Table 5: Correlation analysis of change in value of “B” with change in value of “A”, “C” (same or decrease group)**

	r	Significance		Remarks
		t	P	
B versus A	0.37	1.38	>0.05	Positively correlated but not significant
B versus C	0.70	3.36	<0.01	Positively correlated and highly significant

with lingual retraction of incisors. Further, such a change is strongly influenced by post treatment vertical position of incisal edge with respect to “D” point.

The orthodontist must do a risk/benefit analysis for all patients, considering the age, malocclusion, periodontal health, and likely iatrogenic response to treatment since orthodontic treatment does not necessarily confer long-term increased periodontal health.<sup>[6]</sup>

## Conclusion

The results reveal no statistically significant change in labial alveolar bone following retraction of lower incisors. An increase or decrease in alveolar bone height is not correlated with change in inclination of lower incisors. However, if retraction is carried out without simultaneous intrusion of incisors and if periodontium is healthy during orthodontic treatment, an increase in height of labial alveolar bone can be expected following retraction.

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