Lip Response to Incisor Movement in Operated Cleft Lip and Palate Patients

Abstract
Background: Although the literature has shown that the lip response to maxillary incisor retraction varies, these studies have been done on a non-cleft lip/palate sample. Aim: The aim of this study was to evaluate response of operated cleft lip to orthodontic tooth movement and to determine if there are any differences in the response between the operated cleft lip and the non-cleft lip. Settings and Design: This was a hospital-based retrospective study using radiographs. Materials and Methods: Lip changes were evaluated using pre- and post-operative lateral cephalometric radiographs. The experimental group consisted of 12 patients with operated cleft lip while the control group consisted of 12 non-cleft patients with dental and skeletal Class I malocclusion. Statistical Analysis: ANOVA was used for statistical analysis. Results: The operated lip responded less to incisor movement than the non-cleft group ($P < 0.05$). While the cleft group demonstrated an increase in upper lip thickness measurements at Point A and vermilion following incisor retraction, the control group showed a decrease in thickness of the upper lip at Point A and an increase at vermilion. Conclusion: The cleft team should be aware that the operated lip responds differently to incisor movement. This will enable them to better plan comprehensive treatment for the cleft lip and palate patient.

Keywords: Cleft lip, incisor, response

Introduction
Orthodontic treatment has the potential to alter the position and contour of lips.[1] It is important to accurately determine changes in lip position which occur following tooth movement. Furthermore, public focus is more on lip changes than nose/chin changes.[2]

Ratios of maxillary incisor retraction to movements of labrale superius vary from 1.2:1 to 3.2:1.[3–10] However, lip response to tooth movement has not been conducted extensively on operated cleft lip and palate (CLP) patients. The operated lip might have a variant response to changes in incisor position.

Hence, the aim of this retrospective study is to assess lip response to incisor movement in operated CLP patients.

Materials and Methods
Ethical approval for the study was obtained from the Institutional Ethics Committee. The experimental group consisted of 12 patients with operated CLP while the control group consisted of 12 non-CLP patients who were matched for age and gender, had Class I molar relationship, and were treated with premolar extractions.

The inclusion criteria for the experimental group were:
• Operated CLP (lip operated before 1 year of age)
• Radiographs showing good hard and soft tissue resolution
• Availability of both pre- (T1) and post-treatment/presurgical (T2) radiographs
• Adolescents between 11 and 18 years of age at T1
• No syndromes and craniofacial anomalies
• No previous surgery (other than lip/palate repair).

The mean age of the patients at T1 was 14 years 8 months for the control group (range of 12 years 4 months–17 years 2 months) while it was 13 years 6 months (range of 12 years 2 months–16 years 6 months). Both the groups consisted of 6 males and 6 females.

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Cephalometric procedures and measurements

All pre- (T1) and post-treatment/presurgical (T2) cephalograms which were taken at rest and at natural head position were traced [Figure 1]. From these, nine linear and four angular measurements were computed [Table 1]. The difference in values between T1 and T2 were calculated and subjected to statistical analyses.

Results

The cleft sample demonstrated an increase in upper lip thickness measurements at Point A and vermilion following incisor retraction while the control group showed a decrease in thickness of the upper lip at Point A and an increase at vermilion. Only the changes for the cleft sample in vermilion were statistically significant. In both the cleft and the noncleft sample, the upper and lower lips showed an increase in length. There was also greater retraction of the upper and lower teeth in the noncleft sample. Correlation between the tooth movement and the response of the lips ranged from weak to moderate.

Discussion

Cheiloplasty for cleft lip defects often results in severe scar formation, which, in turn, markedly affects facial esthetics.[11] Therefore, assessment of scar tissue distribution in the repaired lip is of great importance for orthodontic diagnosis, treatment planning, and prognosis since scar tissue makes it difficult to ideally align the anterior teeth.[11] Furthermore, the repaired cleft lip is thinner and more flexible.[12] Bardach[13] has reported that lip pressure in the rabbits with repaired clefts remained significantly higher than in the control group.

The objective of this study was to evaluate if the response of the operated cleft lip differed to orthodontic tooth movement. The upper lip was assessed at two regions, namely, Point A and vermilion. Both the groups demonstrated an increase in upper lip thickness at vermilion while differing in response at Point A. However, only the changes in vermilion were statistically significant. Mathematically, the change in upper lip thickness was 0.43 mm for the cleft group and 0.48 mm in the control group for every mm of incisor movement. This leads to the inference that changes in lip thickness were lesser in the cleft group than in the control group for every mm of tooth movement. However, the dental changes were also less. The changes in the control group were similar to those reported by Mamandras, Subtelny, and others.[9,14–20]

The lower lip also increased in thickness for both the groups at vermilion while it marginally decreased at Point B for the cleft group. However, these findings were not statistically significant [Table 2]. The response of the lower lip should always be observed with caution since the upper lip is generally in contact only with the upper anterior teeth and would therefore be influenced mostly by the retraction of the upper teeth, while in bimaxillary proclination, the lower lip most often contacts both the upper and lower incisors and would therefore be influenced not only by the

| Table 1: Cephalometric variables |
|----------------------------------|
| Abbreviation | Scale | Definition |
|---------------|-------|------------|
| ULT-A | mm | Upper lip thickness measured from point A' to point A |
| ULT-V | mm | Upper lip thickness measured at vermilion |
| LLT-A | mm | Lower lip thickness measured from point B' to point B |
| LLT-V | mm | Lower lip thickness measured at vermilion |
| ULL | mm | Upper lip length measured from subnasale to stomion superioris |
| LLL | mm | Lower lip length measured from stomion inferioris to point B' |
| U1-NA | mm | Upper incisor tip to nasion point A line |
| L1-NB | mm | Lower incisor tip to nasion point B line |
| IMPA | ° | Lower incisor mandibular plane angle |
| MPA | ° | Mandibular plane angle |

| Table 2: Mean differences between the groups |
|-----------------------------------------------|
| Variable | Group I (control) | Group II (cleft) | P |
|----------|-------------------|-----------------|---|
| ULT-A | 0.50±2.50 | −0.81±2.40 | 0.10 |
| ULT-V | −1.92±1.93 | −0.42±2.00 | 0.04 |
| LLT-B | −0.42±1.54 | 0.07±3.32 | 0.46 |
| LLT-V | −0.67±1.83 | −1.03±1.94 | 0.31 |
| ULL | −1.75±2.73 | −1.28±3.13 | 0.35 |
| LLL | −2.25±3.11 | −2.01±2.70 | 0.41 |
| U1-NA (mm) | 4.00±3.62 | 0.98±3.00 | 0.02 |
| L1-NB | 11.33±5.50 | 4.93±9.54 | 0.03 |
| IMPA | 2.67±2.71 | −1.48±2.01 | 0.00 |
| MPA | 10.17±6.81 | 0.41±8.26 | 0.00 |
| MPA | 0.33±3.89 | −1.18±1.87 | 0.12 |
Table 3: Correlation coefficient

| Parameter                                           | Group I (control) | Group II (cleft) |
|-----------------------------------------------------|-------------------|------------------|
| Upper lip thickness at Apt (A–A’) (mm) and upper incisor linear | 0.78              | 0.42             |
| Upper lip thickness at Apt (A–A’) (mm) and upper incisor angular | 0.39              | 0.42             |
| Upper lip thickness at vermilion (mm) and upper incisor linear | -0.63             | -0.48            |
| Upper lip thickness at vermilion (mm) and upper incisor angular | -0.46             | -0.40            |
| Lower lip thickness at Bpt (B–B’) (mm) and lower incisor linear | 0.41              | -0.10            |
| Lower lip thickness at Bpt (B–B’) (mm) and lower incisor angular | -0.26             | -0.10            |
| Lower lip thickness at vermilion (mm) and lower incisor linear | -0.23             | 0.22             |
| Lower lip thickness at vermilion (mm) and lower incisor angular | -0.32             | 0.08             |
| Upper lip length (Sn-Stm perp TH) (mm) and upper incisor linear | -0.13             | 0.05             |
| Upper lip length (Sn-Stm perp TH) (mm) and upper incisor angular | 0.56              | -0.14            |
| Lower lip length (Stm-B’ perp TH) (mm) and lower incisor linear | 0.22              | -0.26            |

retraction of the lower incisors but retraction of the upper incisors as well.\[4\]

The upper and lower lip lengths increased in both the groups. The change in upper lip length was 1.31 mm for the cleft group and 0.44 mm in the noncleft group for every mm of incisor retraction. Thus, the cleft group showed a greater increase in length when compared with the noncleft group for every mm of retraction. The changes in maxillary and mandibular teeth in both the groups also showed significant differences. It should, however, be kept in mind that a cleft patient would generally have a Class III malocclusion and therefore would require retraction of upper incisors and protraction of lower incisors to decompensate. The control group, on the other hand, comprised skeletal Class I patients with premolar extractions, and hence, future studies comparing the operated lip with noncleft Class III patients undergoing decompensation would be required.

The results confirm that there is a wide range of variation in lip response, and also, the correlation coefficient [Table 3] ranged from weak to moderate. Moderate correlation was observed in the upper lip change at Point A with linear changes in upper incisor. Simplistic ratios of lip response to upper incisor movement would, therefore, seem to be of limited value for application to treatment planning in individual participants. It seems that the lips may be affected by anteroposterior tooth movements, but the degree to which this occurs is likely to be variable, depending on the treatment mechanics used, the various extraction or nonextraction decisions, the final angulations of the upper and lower incisors, and the pretreatment lip thickness, the underlying vertical and anteroposterior facial patterns.\[21\] To standardize many variables, the timing of lip surgery was kept as an inclusion criterion. Furthermore, only patients with unilateral CLP were studied. However, the closure technique and operator variations are some of the drawbacks of this study. The low sample size which is another drawback can be offset by the strict inclusion criteria and also by the fact that the response of the operated lip to orthodontic tooth movement has not been extensively studied. However, with regard to maxillary growth in CLP patients, only bony clefts retard maxillary growth, and the repaired lip is regarded to have no adverse effect on the basal maxilla, no matter its size or position.\[22,23\] Future studies with only cleft lip, bilateral cleft lip/palate, and including the above variables are required to assess the response of the operated lip to orthodontic tooth movement.

**Conclusion**

The cleft team should be aware that the operated lip responds differently to incisor movement. This will enable them to better plan comprehensive treatment for the cleft lip and palate patient.

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**Conflicts of interest**

There are no conflicts of interest.

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