Effects of Tongue Plate on the Nasomaxillary Complex of Patients with Unilateral Cleft Lip and Cleft Palate

Eslami S, Showkatbakhsh R, Narimani MA, Kamali Z, Jamilian A

1 Post Graduate Student, Orthodontics Dept, Dental Branch of Tehran, Islamic Azad University, Tehran, Iran.
2 Professor, Orthodontics Dept, Dentistry Faculty, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
3 Associate Professor, Orthodontics Dept, Member of Craniofacial Research Center, Dental Branch of Tehran, Islamic Azad University, Tehran, Iran.
4 MSc National Nutrition and Food Technology Research Institute, Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
5 Professor, Fellow of Orthognathic Surgery, Orthodontics Dept, Member of Craniofacial Research Center, Dental Branch of Tehran, Islamic Azad University, Tehran, Iran.

ABSTRACT

Background and Aim: Cleft lip and cleft palate are among the most common orofacial abnormalities. Patients with these deformities commonly present with midface deficiency and need challenging treatment modalities that focus on improving the position of the maxilla. Tongue plate appliance is an intraoral device that has shown promising results in the treatment of growing patients with maxillary deficiency. Nonetheless, the effects of tongue plate on patients with cleft lip and cleft palate have not been evaluated yet. This study aimed to assess the effects of tongue plate on growing patients with cleft lip and palate.

Materials and Methods: Twenty-four growing patients (12 girls and 12 boys) with non-syndromic unilateral cleft lip and cleft palate between the ages of 6-12 years volunteered to participate in this quasi-experiment. All the patients had undergone the preliminary stages of lip and palate closure during infancy, but none of them had received bone grafts. They were treated with tongue plate appliance for 18±3 months. Lateral cephalograms were obtained and were analyzed at the beginning and at the end of the treatment. Paired t-test was used for statistical analysis of normally-distributed data; otherwise, Wilcoxon test was used.

Results: Paired t-test showed that the Sella-Nasion-Point A (SNA) angle was increased from 76.3±0.2 to 77.3±0.14 degrees, and the Point A-Nasion-Point B (ANB) angle was enhanced from -2.26±0.17 to 0.93±0.82 degrees (P<0.001).

Conclusion: Tongue plate appliance has shown favorable results in the treatment of class 3 malocclusion and maxillary deficiency in growing patients with cleft lip and cleft palate.

Keywords:
Cleft lip,
Cleft palate,
Orthodontic Appliance Design

*Corresponding author:
Jamilian A
Email: Info@jamilian
Introduction:

Cleft lip and cleft palate are among the most common types of congenital dentofacial deformities. The prevalence of these deformities is about one in every 500 to 550 births.\(^1\)

These deformities are usually presented in a non-syndromic form, while many factors are involved in their development and therefore, the etiology is multifactorial.\(^2-5\) Since the patients undergo surgical procedures for closure of the cleft lip and cleft palate early in life, the resultant scar tissue constricts the growth of their nasomaxillary complex in all dimensions.\(^6\) These patients also have a characteristic retrognathic maxilla.\(^7\) Therefore, the major focus of orthopedic treatments is to increase the dimensions of the nasomaxillary complex and protract the maxilla in order to improve the existing skeletal class 3 condition. Many modalities serve to correct the maxillary deficiency such as orthopedic treatments and orthognathic surgery and a combination of both. While orthognathic surgeries have the ability to correct the skeletal discrepancy, they are deferred until after the puberty and could potentially harm the velopharyngeal efficiency of the patients.\(^8\) On the other hand, orthopedic treatments can enhance the skeletal relationship without compromising the patients’ velopharyngeal capacity. However, they can only be applied during the growth period.\(^9\)

Different modalities such as face mask, reverse chin cap and combination of rapid maxillary expansion protocols in conjunction with maxillary protraction have been used for correction of the maxillary deficiency in growing patients.\(^10-11\) However, most of these devices are extraoral and bulky and impose the risk of a low patient compliance. Tongue plate is an intraoral maxillary protractor device, which has been proven useful in advancing the maxilla in growing class 3 patients with maxillary deficiency.\(^4,10\)

The resting tongue pressure and also the pressure produced during swallowing are transmitted to the nasomaxillary complex via this device and exert a forward push force on the maxilla without directly affecting the mandible.\(^12-17\) To date, no study has evaluated the effects of tongue plate on patients with cleft lip and cleft palate. Therefore, the aim of the present study was to evaluate the effects of tongue plate on the nasomaxillary complex of patients with unilateral cleft lip and cleft palate.

Methods and Materials:

This study received ethical approval from the Local Research Ethics Committee of Shahid Beheshti University of Medical Sciences, and all participants or their legal guardians signed informed consent forms.

The inclusion criteria consisted of non-syndromic patients with unilateral cleft lip and cleft palate who showed growth potential based on the cervical vertebrae stage on lateral cephalograms,\(^18\) whereas the patients with bilateral clefts, syndromic patients and those who had received alveolar grafts were excluded from the study. All the patients had class 3 malocclusion due to maxillary deficiency. The patients also had anterior and bilateral posterior crossbite prior to appliance therapy. No abnormal mandibular asymmetry was observed clinically. None of these subjects had a history of orthodontic treatment, and all of them were non-syndromic.

The sample size consisted of 24 growing patients with non-syndromic unilateral cleft lip and cleft palate (12 girls and 12 boys) between the ages of 6-12 years who had volunteered to participate in this study. All patients had undergone the preliminary stages of lip and palate closure during infancy, but none of them had received bone grafts.

Tongue plate was constructed consisting of Adams clasps for first upper molars and C clasps for anterior teeth in order to increase the retention. A screw was mounted in the midpalatal area to correct the bilateral posterior crossbite. The screw was activated at weekly intervals by the patient. The tongue plate was incorporated in the palate, in the canine-to-canine area. The plate was long enough to cage the tongue and was adjusted in the clinic to avoid traumatizing the floor of the mouth. This appliance was used for 20 hours a day, and each patient was evaluated at monthly intervals. The duration of the treatment...
with tongue plate appliance was 18±3 months. Panoramic and lateral cephalometric radiographs, dental casts and photographs of the face were obtained from all subjects. Pre- and post-treatment lateral cephalograms were analyzed. These cephalograms had been taken with the teeth in occlusion. The magnification factor was recorded for each radiograph. All radiographs were traced on acetate paper by the same investigator. Figures 1 to 4 show pre-treatment intraoral and extraoral images of a patient with class 3 malocclusion.

Figure1: Pre-treatment extraoral image

Figure2: Pre-treatment intraoral image (lateral view)

Figure3: Pre-treatment intraoral image (frontal view)

Figure4: Pre-treatment intraoral image (lateral view)

Figure5 :Tongue plate in situ

The tongue plate in situ can be seen in figure 5. Data were analyzed by an orthodontist at the beginning and at the end of the treatment. The
No statistically significant differences were found with regard to the MPA and inclination angle before and after the treatment. The U1 increased significantly (P<0.001). No significant changes were observed in the inclination of lower incisors (L1). Figures 6 to 8 show extraoral and intraoral images of the same patient after the treatment. Figures 9 and 10 show the pre- and post-treatment lateral cephalograms, respectively.

Table 1. Mean and standard deviation (SD) of pre- and post-treatment measurements (statistical significance was set at P<0.05)

<table>
<thead>
<tr>
<th>Cephalometric variable</th>
<th>Pre-treatment Mean±SD</th>
<th>Post-treatment Mean±SD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td>76.3±0.2</td>
<td>77.3±0.14</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SNB</td>
<td>78.66±0.59</td>
<td>78.68±0.94</td>
<td>0.5</td>
</tr>
<tr>
<td>ANB</td>
<td>-2.26±0.17</td>
<td>0.93±0.82</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Inclination angle</td>
<td>76.53±7.79</td>
<td>74.88±5.72</td>
<td>0.26</td>
</tr>
<tr>
<td>MPA</td>
<td>42.21±5.07</td>
<td>44.55±4.35</td>
<td>0.83</td>
</tr>
<tr>
<td>ANS-PNS</td>
<td>44.12±2.3</td>
<td>46.71±2.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Go-Gn</td>
<td>63.33±5.3</td>
<td>66.24±7.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>U1-SN</td>
<td>79.33±8.2</td>
<td>85.15±9.82</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>IMPA</td>
<td>88.73±1.73</td>
<td>88.69±2.99</td>
<td>0.018</td>
</tr>
</tbody>
</table>
Discussion:

This study evaluated the effects of 18±3 months of treatment with tongue plate on 24 growing patients with non-syndromic unilateral cleft lip and cleft palate. This study showed that the SNA and ANB angles were increased significantly, which indicate the forward movement of the maxilla. In the current study, the U1 has also increased significantly, but no forward movements of the mandible or mandibular incisors were detected.

Maxillary protraction by means of face mask is one of the most common treatment methods for growing patients with cleft palate. This protocol has multiple variations and can be simultaneously used with different types of maxillary expansion devices. (9,19-21)

Face mask therapy has become a common technique for correction of the maxillary deficiency. However, this appliance is bulky, which makes it a discouraging choice for children. Patients who wear glasses experience more discomfort. This discomfort and the embarrassment caused by the large size of the device, especially at school, reduce the patient’s compliance.

Due to the above-mentioned disadvantages, we decided to use the tongue plate intraoral appliance for treatment of this malocclusion. Placing the tongue plate in the mouth transmits considerable pressure to the deficient maxilla. This pressure is constant during rest position and intermittent during swallowing and functional activity.

Tongue plate is an intraoral device, which can be tolerated rather easily and therefore, can be used for longer durations. In terms of the point of force application, face mask directly exerts the force on both maxilla and mandible. In the mandible, the force vector leads to counterclockwise rotation, which can contribute to the improvement of the class 3 discrepancy, and
also it increases the vertical dimensions of
the patient’s lower facial height. This effect, in
time, can be avoided by the use of tongue
plate appliance since this device has no direct
effect on the mandible. However, since the
rotation of the palatal plane can occur with
tongue plate, this can, in turn, lead to clockwise
rotation of the mandible. However, this
effect has been minimal and insignificant in
the present study.

No significant changes were observed in
the L1, which can be explained by the mech-
anism of tongue plate appliance, which only
exerts direct force to the maxilla and max-
illary dentition, and not on the mandible.
The current study showed that tongue plate
is successful in the treatment of growing pa-
tients with class 3 malocclusion and maxil-
lar deficiency due to unilateral cleft lip and
cleft palate. Similarly, in another study, it has
been shown that tongue plate is effective in
the treatment of class 3 malocclusion with maxillary deficiency. The difference be-
 tween the latter article and current study is
that the present study has been performed on
patients with cleft palate. In both studies, for-
ward movement of the maxilla and maxillary
dentition was observed.

Forward movement of lower incisors was
not detected in the present study. Tongue plate
removes the tongue pressure on lower inci-
sors, therefore the IMPA will be decreased.

The reason behind the exclusion of pa-
tients with the bilateral cleft is that the pre-
maxilla in these patients tends to be rather
protruded. This can, in turn, distort the results
of the study. We suggest recalling the patients
after the retention period to determine which
effects of the device have been stable. Also,
designing a clinical trial to compare the re-
sults achieved by the use of tongue plate to
the results obtained by another appliance
such as face mask is the next step.

Conclusions:
Tongue plate appliance has shown promising
results related to maxillary protraction in pa-
tients with cleft lip and cleft palate. Due to
the simple intraoral design of the appliance,
we recommend tongue plate for maxillary
protraction in patients presenting with cleft
lip and cleft palate.

References:
1. Molina-Solana R, Yanez-Vico RM, Ig-
lesias-Linares A, Mendoza-Mendoza A,
Solano-Reina E. Current concepts on the
effect of environmental factors on cleft
2013;42(2):177-84.
2. Farronato G, Cannalire P, Martinelli G, Tu-
lip and/or palate: review. Minerva Stomatol
3. Jamilian A, Jamilian M, Darnahal A, Ha-
medi R, Mollaei M, Toopchi S. Hypodontia
and supernumerary and impacted teeth in
children with various types of clefts. Am J
Orthod Dentofacial Orthop 2015;147(2):221-
5.
4. Jamilian A, Lucchese A, Darnahal A, Ka-
mali Z, Perillo L. Cleft sidedness and congen-
tally missing teeth in patients with cleft lip
5. Singh GD. Morphologic determinants in
the etiology of class III malocclusions: a re-
6. Arosarena OA. Cleft lip and palate. Otolar-
7. Liao YF, Mars M. Long-term effects of
clefts on craniofacial morphology in patients
with unilateral cleft lip and palate. Cleft Pal-
ate Craniofac J 2005;42(6):601-09.
8. Rachmiel A. Treatment of maxillary
cleft palate: distraction osteogenesis ver-
sus orthognathic surgery—part one: Max-
9. Liou EJ, Tsai WC. A new protocol for max-
illary protraction in cleft patients: repetitive
weekly protocol of alternate rapid maxillary
expansions and constrictions. Cleft Palate