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ORIGINAL ARTICLE

Correlation between change of tongue area and skeletal stability after correction of mandibular prognathism

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Abstract The purpose of this study was to investigate the correlation between postoperative stability and a change in tongue area after treatment of mandibular prognathism. Twenty-six patients, who were treated for mandibular prognathism using intraoral vertical ramus osteotomy, were evaluated cephalometrically. A set of three standardized lateral cephalograms were obtained from each participant preoperatively (T1), immediately postoperatively (T2), and after 2 years postoperatively (T3). Student *t* test and Pearson correlation coefficient were used for statistical analysis. Immediately after the surgery (T12), the setback of the menton (Me) was 12.9 mm ($p < 0.001$) and the tongue area had significantly increased to 105.8 mm^2 ($p = 0.047$). At a 2-year follow-up to examine postsurgical stability (T23), the Me exhibited a forward movement of 0.6 mm ($p = 0.363$) and the tongue area had significantly decreased to 124.3 mm^2 ($p = 0.004$). Pearson correlation coefficient test revealed no statistical significance between postoperative stability and change in tongue area. The tongue area significantly increased during the T12 period and decreased during the T23 period. There is no significant correlation between postoperative skeletal relapse and a change in tongue area.

Conflicts of interest: All authors declare no conflicts of interest.

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Introduction

The tongue is a muscular structure that occupies the mouth floor and is probably the most active, functional part of the oropharyngeal system. The tongue is divided into anterior and posterior parts and is directly influenced by modifications in the dentoskeletal environment, especially in the mandible [1]. The anterior portion of the tongue is approximately two-thirds of the total length of the tongue and is attached to the lingual surface of the mandible. The root of the posterior portion of the tongue is attached to the hyoid bone by the hyoglossi and genioglossi muscles. It also forms a part of the anterior wall of the oropharynx and connects with the soft palate, epiglottis, and pharynx by the glossopalatine arches, glossoepiglottic mucous membrane, and superior pharyngeal constrictor muscle [2—4]. A study by Yamaoka et al [5] observed that the tongue roots of patients with distocclusion (Angle class II occlusion) were positioned further back than those of patients with Angle class III malocclusion.

In mandibular prognathism, the tongue must compensate for altered physiological functions caused by severe dental and skeletal deformities [6]. Studies [7—10] have indicated that the position of the tongue and hyoid bone shift backward after mandibular setback surgery for the treatment of mandibular prognathism. Therefore, the positional changes that occur in the tongue after mandibular setback surgery might cause postural adaptation of the tongue to preserve the airway, which can influence surgical stability [11].

No studies have addressed whether changes in the tongue are associated with postoperative mandibular stability. In the present study, we investigated whether changes in the tongue area affect the stability of the mandible position following intraoral vertical ramus osteotomy (IVRO).

Methods

Twenty-six patients (18 women, 8 men; aged from 17 years to 34 years) were diagnosed with mandibular prognathism. The inclusion criteria of the present study included the following: (1) an Angle class III malocclusion with mandibular protrusion; (2) no history of trauma or other congenital craniofacial abnormality; (3) no growth of the mandible; and (4) underwent bilateral IVRO only. Patients who had tongue thrust habits were not excluded from the study and were treated with physical therapy during the orthodontic procedure. All patients received consultations from orthodontists and oral maxillofacial surgeons prior to the surgery. After careful data analysis and assessment, detailed treatment plans and steps were formulated. We used the cervical vertebral maturation method discussed in a study by Baccetti et al [12] to determine the surgical timing for the treatment of mandibular prognathism. All patients were determined to be in the sixth maturational stage (final stage), which was at least 2 years after the peak of growth. Patients were examined by cephalograms preoperatively (T1), immediately postoperatively (T2), and 2 years postoperatively (T3) to evaluate the postoperative changes in tongue areas and related mandibular positions. Reference points and tongue areas are shown in Figure 1. The reference points and definitions used in this study were as follows: S, sella; N, nasion; Me (menton), the most inferior point on the mandibular symphysis; H, the most superior and anterior point of hyoid bone; G, the most prominent point of the mandibular symphyseal posterior border; V, vallecula epiglottica; TT, tongue tip.

The two reference lines were as follows: (1) *X* axis, constructed by drawing a line through the nasion 7° above the sella - nasion (SN) line; (2) *Y* axis, constructed by drawing a line through the sella (S) perpendicular to the *X* axis. The magnitude of setback and tongue area was measured. The surgical changes were defined as follows: postsurgical immediate change (T12), 2-year postsurgical stability (T23), and final 2-year postsurgical change (T13). Postoperative changes at the reference points during each period (T12, T23, and T13) were quantified to estimate statistical parameters, including the mean value and standard deviation. In the present study, there were only eight men, which was too small of a sample size to investigate the relationship between men and women and to provide entirely corrective postoperative results for both sexes. Therefore, we evaluated the 26 patients as a group for preoperative and postoperative comparisons.

A statistical analysis was performed using a paired *t* test at a confidence level of 95%. Additionally, a Pearson's

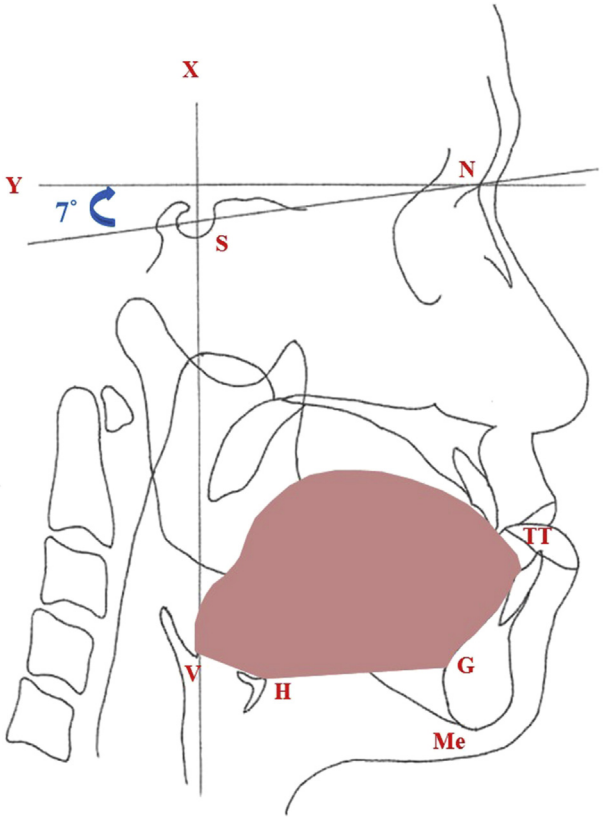

Figure 1. Reference points and tongue area (pink color). G = the most prominent point of the mandibular symphyseal posterior border; H = the most superior and anterior point of hyoid bone; Me = menton; N = nasion; S = sella; TT = tongue tip. V = vallecula epiglottica.