Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology 27 (2015) 465–469

Contents lists available at ScienceDirect

Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology

journal homepage: www.elsevier.com/locate/jomsmp

Original Research

Changes in maximum lip closing force following orthognathic surgery in patients with jaw deformities

Gentaro Takeuchi [a], Tadaharu Kobayashi [a,*], Daichi Hasebe [a], Akinori Funayama [a], Toshihiko Mikami [a], Chikara Saito [b]

[a] Division of Reconstructive Surgery for Oral and Maxillofacial Region, Department of Tissue Regeneration and Reconstruction, Niigata University Graduate School of Medical and Dental Sciences, Japan
[b] Department of Oral and Maxillofacial Surgery, Tokyo Dental College, Japan

ARTICLE INFO

Article history:
Received 25 February 2014
Received in revised form 9 April 2014
Accepted 21 April 2014
Available online 4 June 2014

Keywords:
Maximum lip closing force
Dentofacial deformities
Orthognathic surgery

ABSTRACT

Objective: This study was conducted to investigate the changes in maximum lip closing force and craniofacial morphology following orthognathic surgery.
Methods: The subjects were 36 female patients with skeletal Class III malocclusions and 12 female patients with skeletal Class II malocclusions in whom dentofacial deformities had been surgically corrected. The control group consisted of 25 females with normal occlusion. Maximum lip closing force was measured with a strain-measuring device before surgery and 2 weeks, 6 months and 1 year after surgery. Skeletal morphologies were evaluated using lateral cephalograms taken before and immediately after surgery.
Results: Mean maximum lip closing force in the Class II group was significantly lower than that in the Class III group but not significantly different from that in the control group, and correlation analysis between maximum lip closing force and cephalometric analysis items suggested that patients with protrusive maxilla and long face pattern have lower lip closing force. Maximum lip closing forces in Class II and III groups at 1 year after surgery were significantly larger than that before surgery and not significantly different from that in the control group. There was no significant difference between maximum lip closing forces in one-jaw and two-jaw surgery groups.
Conclusion: Patients with protrusive maxilla and long face pattern have lower lip closing force, and orthognathic surgery improves maximum lip closing force regardless of the surgical procedure.

1. Introduction

Recovery of masticatory functions is one of the important objectives of orthognathic surgery. Numerous studies have documented masticatory functions such as masticatory efficiency [1–5], muscle activity [6–8], bite force [3,9–13], mandibular movement [8,14,15], and occlusal contacts [1–4,12,13] in patients with jaw deformity before and after orthognathic treatment, but there is little information on lip function in patients with jaw deformities. In the lip area, many muscles converge or are intermingled. Their functional harmony and balance are important for masticatory function. In eating behavior, lips hold food and pass the food into the mouth. In addition, lips serve to close the mouth airtight shut, to hold food and drink inside, and to keep out unwanted objects. Lip incompetency and muscle imbalance have been observed in some patients with jaw deformities [16–21], and these imbalances are thought to be causative factors of malocclusion. Moreover, there have been few reports on lip function in patients treated with orthognathic surgery.

We have been interested in lip function in patients treated for jaw deformities with orthognathic surgery. In this study, therefore, we investigated the changes in maximum lip closing force and craniofacial morphology following orthognathic surgery to reveal the effect of orthognathic surgery on lip function.

☆ Asian AOMS: Asian Association of Oral and Maxillofacial Surgeons; ASOMP: Asian Society of Oral and Maxillofacial Pathology; JSOP: Japanese Society of Oral Pathology; JSOMS: Japanese Society of Oral and Maxillofacial Surgeons; JSOM: Japanese Society of Oral Medicine; JAMI: Japanese Academy of Maxillofacial Implants.

* Corresponding author at: Division of Reconstructive Surgery for Oral and Maxillofacial Region, Department of Tissue Regeneration and Reconstruction, Niigata University Graduate School of Medical and Dental Sciences, 2-5274 Gakkocho-Dori, Cyuo-ku, Niigata 951-8514, Japan. Tel.: +81 25 227 2880; fax: +81 25 223 6516.
E-mail address: tadaharu@dent.niigata-u.ac.jp (T. Kobayashi).

http://dx.doi.org/10.1016/j.ajoms.2014.04.010
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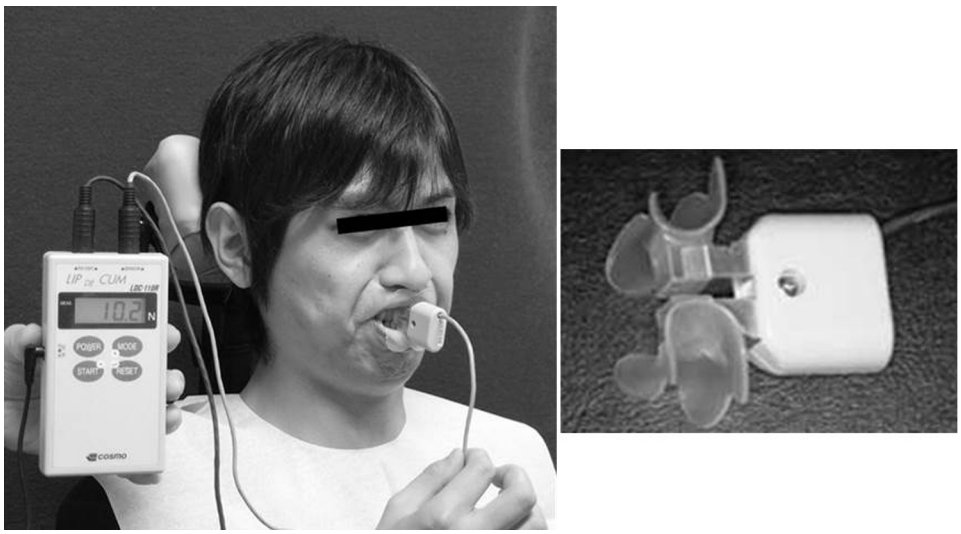

Fig. 1. Strain measuring device (LIP DE CUM LDC-110R, Cosmos Instruments Co. Ltd., Japan). The subjects inserted the lip holder into the oral vestibule with centric occlusion and were instructed to close the upper and lower lips with their utmost strength for 30 s.

2. Materials and methods

2.1. Subjects

The subjects consisted of 48 female patients in whom dentofacial deformities had been surgically corrected in the clinic of Oral and Maxillofacial Surgery, Niigata University Medical and Dental Hospital. The subjects were divided into two groups: 36 patients with skeletal Class III malocclusions (Class III group) and 12 patients with skeletal Class II malocclusions (Class II group). The mean ages at surgery were 23 years (range: 16–46 years) in the Class III group and 23 years (range: 17–30 years) in the Class II group. A combination of Le Fort I osteotomy and bilateral sagittal split osteotomies was used in 29 patients, and bilateral sagittal split osteotomies were performed in 19 patients. No cases of cleft palate or craniofacial syndrome were included. All of the subjects received pre- and postoperative orthodontic treatment, and osteosynthesis was achieved using titanium miniplate and/or resorbable fixation devices. Maxillomandibular fixation was performed 1 day after surgery and maintained for 14 days. The control group consisted of 25 females with normal occlusion. Their mean age was 24 years (range: 21–35 years). The study protocol was approved by the Ethics Committee of Niigata University and informed consent was obtained from the subjects.

2.2. Measurement of maximum lip closing force

Maximum lip closing force was measured with a strain-measuring device (LIP DE CUM LDC-110R, Cosmos instruments Co. Ltd., Japan) before surgery and 2 weeks, 6 months and 1 year after surgery. This device consists of a sensor with a lip holder and digital display, and the sensor is held between the upper and lower lips with a lip holder to assess the maximum perpendicular force produced to close the lips. The subjects sat upright with the Frankfort horizontal plane (FH plane) parallel to the floor and inserted the lip holder into the oral vestibule with centric occlusion and were instructed to close the upper and lower lips with their utmost strength for 30 s (Fig. 1). Measured load value (N) was displayed on a personal computer connected to the Lip De Cum and the largest value was defined as the maximum lip closing force. The measurements were performed three times at 60-s intervals for each subject and the maximum value was taken as the representative value of the subject.

2.3. Cephalometric analyses

Skeletal morphologies were evaluated on lateral cephalograms that were taken with the FH plane parallel to the floor and with the patient in a centric occlusion before and immediately after surgery. The cephalograms were traced to identify landmarks of hard tissues (Fig. 2), and serial cephalograms were superimposed using the sella

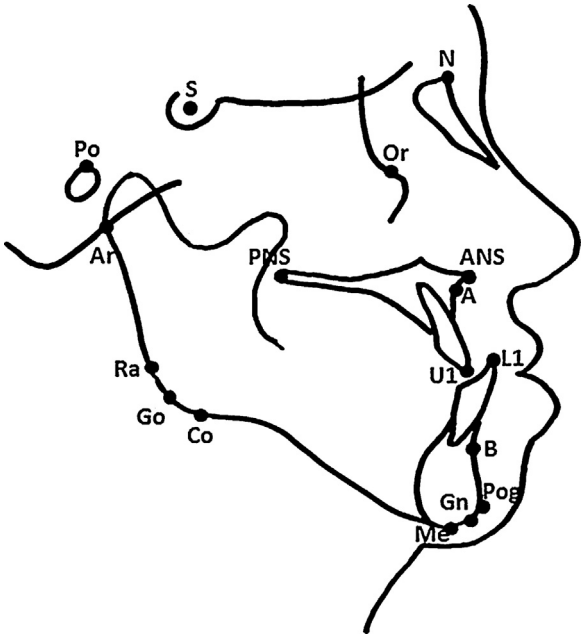

Fig. 2. Cephalometric landmarks. S: center of the sella torcica; N: most anterior point of the frontonasal suture; Or: lowest point on the average left and right inferior borders of the bony orbit; Po: uppermost point on the bony external auditory meatus; ANS: most anterior point of the nasal spine; PNS: most posterior point of the nasal spine; A: innermost point on concavity of the maxilla between the incisor tooth and ANS; B: innermost point on concavity of the mandible between the incisor tooth and bony chin; Pog: most anterior point on the osseous contour of the chin, Gn: most anteroinferior point of the chin; Me: most inferior point of the mandibular symphysis; Co: the point of a tangent of the inferior border of the corpus; Go: most posterior inferior point on the angle of the mandible; Ra: lower point of a tangent of the posterior border of the ramus; Ar: a mid-plane point at the intersection of the posterior ramus with the inferior cranial base; U1: tip of the crown of the upper incisor; L1: tip of the crown of the lower incisor.