Changes in electric activity of masseter and anterior temporalis muscles before and after orthognathic surgery in skeletal class III patients

Gianluigi Frongia, DDS, DOS, PhD,[a] Guglielmo Ramieri, MD, DDS,[b] Corrado De Biase, DDS, DOS,[a] Pietro Bracco, MD, DDS, DOS,[a] and Maria Grazia Piancino, MD, DDS, PhD[a]
University of Turin, Italy

Objective. The purpose of this study was to evaluate, through clinical and electromyographic (EMG) assessments, the electric activity of masseter muscle and anterior temporalis muscles during clenching, before and after orthodontic treatment and mandibular setback, with or without LeFort I osteotomy, for correction of mandibular excess.
Study design. Seventeen adult patients (10 males, 7 females, mean age: 22.5 ± 2.4 years) were recruited for this study. All patients received orthodontic treatment and surgical corrections. EMG recordings were obtained from 4 channels of the 8-channel electromyograph FREELY (DeGoetzen spa, Olgiate Olona, VA, Italy).
Results. A significant difference was found in the value of activity index at T0-T1 (33% T0, 1% T1) ($P < .05$), of asymmetry index at T0-T1 (21% T0, 4% T1) ($P < .05$), and of torque index at T0-T1 (24% T0, 5% T1) ($P < .05$).
Conclusions. The evaluation of EMG activity after surgery may be considered a sign of good adaptation of the neuromuscular system to the new occlusal condition and a good method for detecting nonresponding patients who might require further treatment. (Oral Surg Oral Med Oral Pathol Oral Radiol 2013;116:398-401)

Orthognathic surgery is commonly used to correct severe dentofacial deformities, including congenital and acquired jaw discrepancies, with predictable outcomes.[1] In some cases, this discrepancy can be corrected by early treatment to change the growth pattern, but in other cases, when it is not possible to modify the growth pattern, late treatment using orthognathic surgery is the best approach to correct severe skeletal and dental malocclusion.[2] Skeletal, occlusal, and esthetic outcomes are predictable, but the short- and long-term functional effects of the surgical–orthodontic treatment on the masticatory muscles are, however, still unclear. The relative position of the upper and lower molar and premolar determines occlusal stability, which is related to muscular performance. In fact modifications of the craniofacial morphology using orthognathic surgery reflect not only on esthetics, but also on the masticatory muscles, specifically the masseter muscle (MM) and anterior temporalis (TA) muscles.[3]

Previous studies have investigated changes in the masticatory muscles after orthognathic surgery using electromyography.[4-6] Surface electromyography is a noninvasive technique, which provides information about the muscle properties through electrodes located over the skin.[7] It is well established[8] that the electromyographic (EMG) activity of MM and TA muscles, in normal young people during rest position, contact in centric occlusion and clench.

Preorthognathic surgery patients with a variety of dentofacial deformities showed lower masticatory performances,[9,10] reduced maximum EMG activity,[10] and also reduced EMG activity during mastication.[10,11]

Surgery did not increase EMG activity during maximum clenching in retrognathic patients,[12,13] 3 years after surgery in muscle activity per unit in bite force,[14] and 5 years after orthognathic surgery.[15]

Raustia and Oikarinen noted an increase in EMG activity during maximal bite in intercuspal position and chewing 12 months after surgery in the MM and TA muscles.[3]

Other studies reported an improvement in muscular activity after 6-8 months because of better occlusal stability,[16] and an improvement in index of the symmetric distribution of the muscular activity (percentage overlapping coefficient [POC]) and torque index (TI) after surgery.[16]

In a recent study Trawitzki et al.[17] have demonstrated an improvement in the EMG activity during chewing and

Statement of Clinical Relevance

The evaluation of electromyographic activity after surgery may be considered a sign of good adaptation of the neuromuscular system to the new occlusal condition and a good method for detecting nonresponding patients who might require further treatment.

[a]Department of Orthodontics and Gnathology-Masticatory Function, University of Turin.
[b]Department of Maxillofacial Surgery, University of Turin.
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bite force in MM only, after 3 years of the orthognathic surgery to correct skeletal class III. A greater instability has been observed in the temporalis muscle.

The purpose of this study was to evaluate, through clinical and EMG assessment, the electric activity of MM and TA muscles during clenching, before and after orthodontic treatment, and mandibular setback, with or without LeFort I osteotomy, for correction of mandibular excess.

MATERIALS AND METHODS

Seventeen patients (10 males, 7 females, mean age: 22.5 ± 2.4 years) requiring correction for mandibular excess were recruited, from June 2001 through December 2003, to participate in this longitudinal study, and informed consent was obtained from all subjects.

Inclusion criteria of the patient group (PG) were as follows:

(1) skeletal and dental class III;[18]
(2) anterior and posterior bilateral cross bite;
(3) absence of fixed or removable dental prosthesis;
(4) absence of periodontal disease; and
(5) presence of all teeth (with the exception of the third molars, which were routinely extracted at the beginning of treatment, if present).

Subjects with craniofacial syndromes or clefts were excluded from this study.

Each patient received preoperative and postoperative orthodontic treatment (mean duration 36 ± 12 months) with fixed appliances. All the patients underwent surgery by the same 2 surgeons, who had over 10 years of experience in orthognathic surgery. Nine patients received bilateral sagittal split osteotomy (BSSO) to reduce mandibular excess and 8 patients received combined BSSO and LeFort I osteotomy for maxillary advancement. In all cases, fixation of the mandibular segments was performed with 1 titanium individually bent miniplate and 4 monocortical screws per side, whereas the maxilla was fixed with 4 miniplates. Intra-operative manual seating of the condyle in the passive dorsocranial position in the glenoid fossa was performed in all cases, whereas the distal fragment was held in planned occlusion with temporary intermaxillary fixation. No postoperative intermaxillary fixation was used, light guidance elastics were placed to maintain the ideal occlusion for 2 weeks and a soft diet was suggested for 4 weeks.

EMG recordings were obtained from 4 channels of the 8-channel electromyograph FREELY (DeGoetzen spa, Olgiate Olona, VA, Italy). The analogic EMG signal was amplified, digitized, and digitally filtered. The instrument was interfaced with a computer for data storage and subsequent analysis (EMA software, DeGoetzen spa). The signal was assessed as the root mean square of the amplitude. Four electrodes (Duotrode silver/silver chloride EMG electrodes; Myotronics Inc., Tukwila, WA, USA) were located on the MM and TA muscles of both sides with an interelectrode distance of 20 mm. Before electrode placement, the skin was cleaned with ethanol. The location of the electrodes was based on anatomical landmarks.[19]

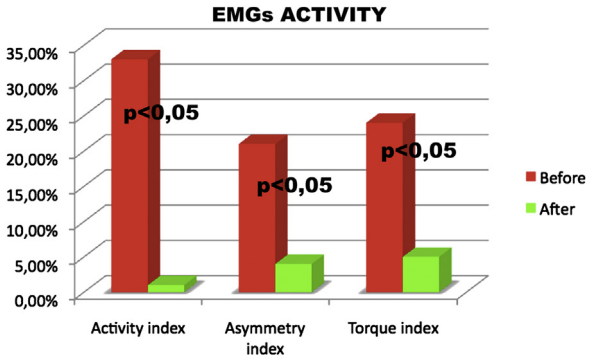

Fig. 1. Comparison of activity index, asymmetry index, and torque index before (T0) and after (T1) orthodontic treatment—surgical correction of severe skeletal class III patients.

The EMG data of the right and left MM and TA muscles were evaluated during clenching in the PG at baseline (T0), and 6-8 months (T1) after completing the surgical—orthodontic treatment.

Following were the EMG parameters considered[8]:

- Activity index (range between −100% and +100%): positive values indicate an MM dominance and negative values indicate TA muscle dominance. The normal value during clenching of the activity index is 15% ± 9%.
- Asymmetry index (range between −100% and +100%): positive values indicate a stronger right side muscular activity and negative values indicate a stronger left side muscular activity. The normal value during clenching of the activity index is 9.37% ± 7.43%.
- Torque index (range between −100% and +100%): positive values indicate a stronger right side resultant force and negative values indicate a stronger left side resultant force. The normal value during clenching of the activity index is 9.47% ± 7.19%.

Reference values used were suggested by Ferrario et al.[8] The statistical analysis was performed with the Student *t* test to compare data before (T0) and after (T1) therapy.

RESULTS

The results showed (Figure 1):

- a significant difference in the value of activity index at T0-T1 (33% T0, 1% T1) ($P < .05$);