Evaluation of Masseter Muscle Volume after Contouring of Prominent Mandible Angle by Measurement of CT Scan Image

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Purpose The prominent mandible angle, otherwise known as “square face”, has been recognized as an aesthetic problem that needs correction by many in the Asian community. Many surgeons considered that mandible angle ostectomy alone, brings about hypotrophy of the masseter muscle. However, it was only proven indirectly (by clinical experience and histological animal experiments) and not objectively. In this study, we evaluated the volume of masseter muscle to prove the effect, objectively.

Materials and method Computed tomography (CT) images were used to measure the masseter muscle volume of normal female group (n=6), and of female patient group n=8, preoperative and early & late postoperative volumes) presenting the symptom of prominent mandible angle. The data was analyzed statistically by two-sample t-test and paired t-test using SAS (version 8.2).

Results In normal female group, volume average was 16,142±2,829.8 mm³. In patient group, preoperative volume averaged 24,447±4,544.5 mm³ (p<0.0001), early postoperative volume measured average of 31,966±50,421mm³ which is a 30% increase from the preoperative volume (p<0.0001). Late postoperative measurement was 20,202±4,092.3 mm³, which is a 20% decrease from the preoperative volume (p<0.0006).

Conclusion The bone reduction of prominent mandible angle induce the hypotrophic effect of masseter muscle after long term follow up (5 more months). This result mean that the result of mandible angle contouring surgery can be considered as combined effect of bony angle reduction and subsequent masseter muscle hypotrophy.

Key Words Prominent mandible angle · Masseter muscle · Computed tomography.
was not proven objectively by enumeration. In this study, we measured and analyzed the change of volume of masseter muscle before and after mandible angle ostectomy based on computed tomography image information, and thus the method and results are reported here.

### Materials and Methods

The volume of masseter muscle of 6 normal individuals (aged from 13 to 37 years) and 8 patients (aged from 18 to 46 years, 6 bilateral and 2 unilateral cases) who visited our hospital from January 2002 to June 2004 was measured (Table 1). The patient group data includes presurgical volumes, early postsurgical volumes (within 5 months after surgery) and of late postsurgical volumes (5 up to 9 months after surgery) (Table 2). The surgery was performed under general anesthesia and only mandible angle ostectomy by the intraoral approach was performed. To measure the volume, tomographic images were taken by 2 mm thickness with 1 mm interpolation, 12 bit, and 512 × 512 pixels and transmitted subsequently from the hard disk of computed tomography scanner to an IBM personal computer by the interface π-Viewer (Mediface, Seoul, Korea). All axial image information was stored as DICOM format. Then by using Analyze AVW 5.0 (Analyze AVW, Inc. 11425 Strang Line Road Lenexa, KS, 66215 USA) program, division of the area to be analyzed, 3 dimensional reconstruction of the divided image data, and measurement of the volume were performed (Fig. 1 and 2). The obtained data was analyzed by two sample t-test and paired t-test using SAS (version 8.2) program.

### Results

In normal female group, volume average was 16,142 ± 2,829.8 mm³. In patient group, preoperative volume averaged 24,447 ± 4,544.5 mm³ (p < 0.0001), early postoperative volume measured average of 31,966 ± 50,421 mm³ which is a 30% increase from the preoperative volume (p < 0.0001). Late postoperative measurement was 20,202 ± 4,092.3 mm³, which is a 20% decrease from the preoperative volume (p < 0.0006) (Table 2).

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<th>Pre Op</th>
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<th>Late Post Op</th>
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<td></td>
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<td>Lt. (mm³)</td>
<td>Rt. (mm³)</td>
<td>Lt. (mm³)</td>
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Mean±SD 24477±4544.5 31966±5042.1 20202±4092.3

*p-value* 0.0001 (30% increase)

*p-value†* 0.0006 (20% decrease)

*statistical analysis between pre op and early post op, †statistical analysis between pre op and late post op
Discussion

The external appearance of prominent mandible angle is considered as an appearance with the combined effect of masseter muscle and mandible angle. Therefore, the contouring of prominent mandible angle was treated by bony contouring and/or resection of masseter muscle. However, masseter muscle resection has the risk of injuring the major blood vessel and nerves, and sometimes it may cause trismus. In addition, the hypotrophy of masseter muscle was reported only after mandible angle ostectomy, so, the necessity of masseter muscle resection has been under discussion (4-9). The result of our study shows that patient group displays statistically significant larger volume than in normal group. This result is considered as same as generally known concept in prominent mandible angle. In other word, the final appearance of prominent mandible angle is the result of not only bony prominence of the mandible angle, but also normal masseter hypertrophy.

In comparison between the preoperative measurement and early postoperative measurement, a statistically significant increase in masseter muscle volume was seen (p<0.0001). This is believed to be because of the edema after all the dissection and traction during operation, the loss of muscle tension, and accumulation of connective tissues and adipocytes within the masseter muscle (11, 12). However, additional researches are required. Significant decrease was noted in comparison between preoperative and late postoperative volumes (p<0.0006). Masseter muscle volume decreased despite the regular oral food uptake, and thus it is considered to be a continuous result rather than a temporary one, because the follow up duration of late post-op. is from 5months to 9months.

In 1994, Hong et al. (11) reported an experiment performed on rabbits. After curved angle ostectomy, gradual histological volume decrease of masseter muscle was observed. The causality was reported to be the loss of normal function by disinsertion of the muscle attachment area, reduction of muscle tension or the change of contraction direction of the masticatory muscle. In addition, in 2004, Gerber (12) reported that after tenotomy of the rotator cuff in sheeps, muscle atrophy was brought about and confirmed by CT. Also, in this study, accumulation of adipocytes was detected in histologic and electron microscopic examination. Such muscle atrophy has been reported to be irreversible. Elevation of periosteum surrounding the mandible seems to decrease the tension of the masseter muscle, similar to tenotomy. Also, ostectomy of the mandible angle decreases the masseter’s attachment area to the mandible, decreasing the tension even more, inhibiting quantitative recovery of muscle volume.

In our study, mandible angle ostectomy was done by resection of mandible angle only. However, numerous studies report that resection of mandible body including the mandible angle induces even more decrease in masseter muscle volume after surgery (4-9). Therefore, difference of muscle atrophy amount seems to depend on surgical technique, but conclusion requires additional comparative studies.

Even though, this study can confirm the hypotrophic effect of masseter muscle after bony angle resection, objectively, we have to study more to clarify how much bony resection result how much reduction of masseter muscle volume.

Conclusion

The bone reduction of prominent mandible angle induce the hypotrophic effect of masseter muscle after long term follow up (5 more months). This result mean that the result of mandible angle contouring surgery can be considered as combined effect of bony angle reduction and subsequent masseter muscle hypotrophy.
**Acknowledgements**

This work was supported by the Technology Innovation Program (10045651, Development of continuous automatic cranio-maxillofacial distraction osteogenesis device for minimal invasive surgery and acceleration bone healing), funded by the Ministry of Trade, industry & Energy (MI, Korea).

**REFERENCES**