Clinical observations of correction of square jaw in East Asian individuals
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Objective. A square face along with a variety of facial features is considered to be unappealing in the East Asian population. Thus, the objective of this study was to assess the facial features and the various operative techniques available for surgical correction of a square jaw via the intraoral approach.

Study design. All surgical procedures were performed via the intraoral approach. Surgical approaches such as curved mandibular ostectomy, outer cortex splitting ostectomy, “V-Line” ostectomy, and modified genioplasty were performed according to the different types of facial characteristics. All the patients had standard frontal and lateral cephalometric radiographs and panoramic radiographs, and were photographed preoperatively and postoperatively to assess their facial contour.

Results. The width of the lower face caused by prominence of the mandibular angle was effectively corrected, resulting in improved facial contours. Limitation of mouth opening was seen immediately postsurgically but returned to normal following a period of mouth-opening exercises. Serious complications, such as facial nerve injury or fracture, were not witnessed in our study.

Conclusion. Mandibuloplasty is an effective and a safe method for the treatment of a prominent mandibular angle. The selection of surgery should be based on the type of square jaw. (Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011;111:428-434)

Among the East Asian population, a square mandible with prominent mandibular angles is commonly seen. Even though this cannot be considered a disease per se, it nonetheless affects one’s profile considerably. Until now, square mandibles have no specific and uniform diagnostic criteria; many times it depends on a patient’s aesthetic demands. Doctors usually look for these factors, as well as the patient’s cultural background, when deciding on a treatment plan. With increasing influence of fashion and media, more and more women are opting for a slender oval face, traditionally known as “melon seed face” or “goose egg face.” Thus, in the Asian population, cosmetic surgery for correction of these unaesthetic facial profiles using various modalities has been on the rise.1-3

When correcting a square mandible, one should look for a naturally contoured mandible that harmonizes well with the face. Not only should the frontal and lateral facial contour be in accordance with the currently advocated aesthetic standards, but the patient’s demand should also be considered. Unlike in the past, where simple removal of mandibular angle or removal of outer (lateral) cortex at the mandible angle would suffice, in modern times these procedures are deemed inadequate.4 Thus, to fulfill various and complex demands, various modes of treatment have been suggested, such as curved mandibular angle ostectomy,5 “V-line” ostectomy,4 mandibular outer cortex splitting ostectomy,6-8 and narrowing and sliding genioplasty,9,10 as well as resection of masseter muscle11 and removal of buccal pad of fat. The objective of this study was to assess the facial features and the various operative techniques available for surgical correction of square jaw via the intraoral approach.

PATIENTS AND METHODS
A total of 184 cases, approximately 20 to 39 years old, presenting with square mandible with and without bilateral symmetry, were included in the study. These patients were further divided into small groups as per their facial characteristics: A, increased lower facial width on frontal view; B, gonial angle more than 120° on lateral view; C, gonial angle less than 120° or approximately 90°, or posterior protrusion of mandibular angle; D, asymmetric mandibular angle; E, retruded chin; and F, square chin. The division of the patients is shown in Table I. Some of the patients also had masseter muscle and buccal fat pad hypertrophy. The aim was to modify and recontour the mandible and satisfy the aesthetic requirements of the
patients. Preoperative frontal and lateral cephalometric radiographs and panoramic radiographs were taken; patients were also photographed to rule out any pathological bony changes or tumors, and also to analyze mandibular symmetry, the degree of the gonial angle, and the shape of mandible. Comprehensive communication was done with the patients so as to fully understand their demands and requirements. Likewise, a treatment plan was formulated keeping in mind the patients’ facial characteristics and their demands, with special attention paid to vital structures present in that vicinity.

All procedures were performed under general anesthesia using naso-tracheal intubation. All surgical procedures were performed intraorally. Four different operative methods were performed depending on patients’ needs and facial contours as follows:

A. Mandibular outer cortex splitting ostectomy: The resection line is at the ramus region, at least 10 mm below the tangent drawn at the sigmoid notch. Likewise, at the body of mandible, the resection line is just posterior to the mental foramen, ending approximately 10 mm behind. The entire outer cortex within these resection lines is removed along with outer cortex at the inferior border, posterior ramus border, and the mandibular angle region (Fig. 1).

B. Curved mandibular angle ostectomy: Using a narrow-blade oscillating saw or fissure bur, a cut is made from the posterior border of the ramus, at one-third the distance from the lower border of the mandible. The resection is carried out in a curvilinear fashion proceeding anteriorly ending just behind and below the mental foramen (Fig. 2).

C. “V-line” ostectomy: Using a reciprocating saw, the lower border of the mandible is resected from the posterior border of the ramus until the sub-mental region. The ostectomy line is made below the mandibular canal in a straight manner as shown in Fig. 3. As per the preoperative decision made regarding the necessary adjustments and the degree of inclination of the cut, the lower border of the mandible is ostectomized (Fig. 3).

D. Narrowing and sliding genioplasty: The cut is made horizontally in the sub-mental region 5 mm below the root apices of the lower anterior teeth and is extended posteriorly, sometimes even to the man-

<table>
<thead>
<tr>
<th>Clinical characteristics</th>
<th>No. of patients</th>
<th>Operative method</th>
<th>Degree of satisfaction</th>
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<tbody>
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<td>C</td>
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<td>I+III</td>
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<td>A+C+F</td>
<td>21</td>
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A, increased lower facial width on frontal view; B, gonial angle more than 120° on lateral view; C, gonial angle less than 120° or approximately 90° or posterior protrusion of mandibular angle (low gonial angle); D, asymmetric mandibular angle; E, retruded chin; F, square chin; I, mandibular outer cortex splitting ostectomy; II, curved mandibular angle ostectomy; III, “V-line” ostectomy; IV, Narrowing and sliding genioplasty.
dible angle region. After down-fracturing the resected segment, the central part of the resected fragment is cut and removed as shown in Fig. 4 so as to allow the lateral segments to slide medially. The amount of bone to be resected is mainly determined by the total thickness of the outer cortex at the mandible angle and body region on either side, which usually adds up to 8 to 10 mm. The resected segments can then be adjusted in a horizontal and/or vertical direction and rigidly fixed with the upper segment using mini/micro plates and screws. A watertight closure was done with absorbable chromic gut suture. Negative pressure drainage was applied. Antibiotics were used for 3 to 4 days and bulky compressive dressing was applied for 5 days postoperatively in all cases.

RESULTS
All patients showed satisfactory healing with no signs of infection, and were discharged after a week of hospital stay. Follow-up at 3 to 24 months showed no numbness in the lower lip, no limitation of mouth opening or any other serious complications such as facial paralysis or severe bleeding. The aesthetic results of all the operations were successful except for 3 patients. A total of 181 patients were satisfied with the results, as the square face had been transformed into one more slender and ovoid with smooth contours. Of the 3 unsatisfied patients, 2 patients complained of postoperative asymmetry in the lower face; and in the other patient, a vertical green stick condylar fracture was seen. The mandibular asymmetry improved as the postoperative swelling subsided and did not require a secondary operation for additional correction; the condylar fracture was taken care of by intermaxillary fixation for 2 weeks. The results are shown in the Table I.

Clinical case 1
A 21-year-old woman with a wide and angular lower face, gonial angle about 120°, lower mandibular plane angle about 30°, and masseter hypertrophy sought treatment for the same. In March 2007, the mandibular outer cortex ostectomy, buccal fat pad resection, and partial masseter myectomy were performed. In subsequent visit 12 months after the operation, the lower face had become slender oval with appropriate facial proportion and natural contour (Fig. 5).

Clinical case 2
A 24-year-old female with a wide but symmetrical lower face reported to our department for correction. The gonial angle and lower mandibular plane angle were 90° and 0° respectively, the chin was squarish, but not too weak and there was buccal fat pad hypertrophy. In March 2006, a curved mandibular angle ostectomy combined with mandibular outer cortex ostectomy were performed. In a subsequent visit 12 months after the operation, the contour of the lower mandible margin had become smooth and steep from mental region to mandibular angle region, and the mandibular plane angle and mandibular angle had improved to 35° and 125° respectively (Fig. 6).

Clinical case 3
A 22-year-old woman visited our department complaining of a prominent mandibular angle and a short chin. She exhibited a square angle with laterally projected angle plus retrogenia and short chin. Roentgenograms revealed obvious lateral flaring of the mandibular angle and a short chin. In May 2008, a mandibular “V-Line” ostectomy, combined with outer cortex ostectomy, was performed. Concomitantly, 6-mm narrowing, 8-mm advancement, and 5-mm elongation genioplasty were performed along with removal of buccal pad of fat. The postoperative clinical course was uneventful, and a satisfactory result was obtained (Fig. 7).

Clinical case 4
A 23-year-old woman visited our department complaining of the prominent right mandibular angle and a deviated chin. She exhibited a wide and angular right lower face, a complicated retrogenia, and the chin deviated toward the left. In September 2007, mandibular contouring was performed with left mandibular outer cortex splitting ostectomy, combined with 6-mm advancement and 4-mm rightward sliding genioplasty. Swelling persisted for a month but her postoperative clinical course was uneventful, and the patient was
Fig. 4. Illustration of narrowing and sliding genioplasty.

Fig. 5. Preoperative views of a 21-year-old woman in Case 1 (left, top and bottom). Postoperative views after mandibular outer cortex ostectomy, buccal fat pad resection, and partial masseter myectomy (right, top and bottom).

Fig. 6. Preoperative views of a 24-year-old woman in Case 2 (left, top and bottom). Postoperative views after curved mandibular angle ostectomy combined with mandibular outer cortex ostectomy (right, top and bottom).
satisfied with the postoperative mandibular contour. Her Ricketts’s E-line improved with a satisfactory lateral contour for the normal Chinese population (Fig. 8).

DISCUSSION

The square face with prominent mandibular angles projects a strong and masculine impression. Many East Asians oppose such facial contours, and with the growing influence of fashion and films, more and more people would prefer their face to be slender and oval with smooth curves and outlines. Thus, nowadays, mandible contouring procedures are very popular in East Asian countries. Previously, western literature reported that the main cause for square face was benign masseter hypertrophy. However, in the Asian population the main cause for an angled square face is reported to be not from hypertrophy of masseter muscle, but from the outward prominence of mandibular angle.

Various surgical methods have been put forward to manage the square face: mandibular angle ostectomy and angle splitting ostectomy are the most common and popular methods. In 1947, Gurney was apparently the first to report the method of hypertrophic masseter muscle resection. In 1949, Adams resected hyperostotic bone and the medial portion of masseter muscle under direct vision through an external approach. In 1951, Converse used an intraoral approach to resect both the bone and muscle in a single patient. Later, Baek et al. and Yang and Park performed multistage mandible angle ostectomy for mandible contouring. For reduction of the lower facial width, different contouring methods have been reported. In 1997, Deguchi et al. proposed angle splitting ostectomy, which was done with the aim of removing excessive bone affecting the width of the lower face, especially for correction of asymmetry and easy predictability of postoperative contour. Han and Kim reported that the lateral cortex....
ostectomy was an effective technique for reducing the width of the lower face, producing a natural relief of the mandibular angle without the mandibular angle ostectomy.

One surgical method is not suitable for surgical improvement of the facial contour in all cases of prominent mandibular angle. We are of the view that a square face is not a unique problem of just the mandibular angle, but a complex problem resulting from disharmony of the midfacial bone, masseter muscle, and whole mandibular contour. Thus, conventional mandibular angle ostectomy or angle splitting ostectomy with contouring is inadequate as well as inappropriate for achieving a characteristic mandibular contour in every case. In our current concept of mandibular contouring, once correction of the square face is requested from the patient, the surgeon should consider the entire mandibular shape as a whole and perform mandibular contouring surgery from the ramus through the body to the symphysis to achieve perfection. Thus, mandibular angle–contouring operations should be conducted with a view of treating the entire disproportional mandible and not just focusing on the mandibular angle region. Moreover, simultaneous genioplasty such as vertical lengthening, narrowing, advancement, and sliding must be considered to solve the problem in harmony between the chin and angle that may ensue.

With the advent of better technologies, newer methods have been put forth and various classifications\(^1,16\) have been proposed. Treatments based on those classifications have been formulated and it is imperative that patients fulfill the standards presented in those classifications so as to corroborate with the specific type of treatment proposed. However, patients with square faces come with a multitude of facial features, which makes it difficult to categorize them as per the classifications and types stated. Here, we have stated the usual facial features seen in patients with square faces and subsequently stated the most appropriate treatment available to them.

The facial characteristics usually seen in these patients are as follows: A, increased lower facial width on frontal view; B, gonial angle more than 120° on lateral view; C, gonial angle less than 120° or approximately 90° or posterior protrusion of mandibular angle (low gonial angle); D, asymmetric mandibular angle; E, retruded chin; and F, square chin. The division of the patients as well as the preferred treatment is shown in Table I. Likewise treatments offered to them are as follows:

1. Mandibular outer cortex splitting ostectomy
   Wide lower face on frontal view, the gonial angle not less than 120° on lateral view, especially suit-
Mandibuloplasty is an effective and a safe method for the treatment of prominent mandibular angle and brings about great changes in patients’ facial contour with a great deal of satisfaction; nonetheless, it is not free of complications. Complications such as condylar neck fractures, mandibular angle fractures and bone defects, severe bleeding, and nerve palsy are seen. Thus, surgery requires adequate preoperative preparation and precise surgical design, and should be in strict accordance with the operation principles so as to achieve natural, harmonized mandibular contour both in frontal and lateral views while avoiding serious complications.

REFERENCES

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