In Western countries, a somewhat square mandible is considered a symbol of a glamorous and youthful face. In contrast, in East Asian countries, a prominent, long, and squared contour of the lower third of the face is considered unattractive, strong, and masculine. Moreover, because of the influence of the entertainment and the fashion industry, the desire to have a small face that is described as an “egg-like oval face” or “V-line face” is increasing.1–5

To satisfy these considerations with mandibular surgery, various surgical methods have been introduced and developed, including curved mandibular angle ostectomy, “V-line” ostectomy, mandibular outer cortex splitting ostectomy, and narrowing and sliding genioplasty.1–6 Among these options, some

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authors focus on the importance of the chin area. Park and Noh\(^2\) described that the main reason why resection of the mandible alone does not make the face appear slender may be due to a wide, flat chin, and a U-shaped lower facial morphology, and they performed horizontal osteotomy and rectangular central bony segment resection to reduce the width of the chin. In another study, Park et al.\(^3\) reported that mandibular tubercle resection maximizes the benefits of reduction mandibuloplasty. The methods that they introduced for treatment of the chin area are useful and widely used in Asian countries.\(^1,6\)

Among these, horizontal osteotomy and the central segment resection method, as described by Park et al.\(^3\) are the most widely used procedures. However, this method has little effect on the reduction of the chin width considering the amount of central bony segment resection. Wider central segment resection is needed to solve this problem, but it may cause many problems including a palpable mass due to the contraction of the detached genial musculature (e.g., anterior digastrics and geniohyoid) of the lingual side or an unnatural look of the submental area. Furthermore, this method does not reduce the vertical length of the chin; therefore, additional horizontal bony segment resection is required, which also separates the genial musculature of the lingual side to a large degree and causes additional bone bleeding leading to the aggravation of final contour of the lower mandible. Thus, we introduce a simple but very effective method to reduce the chin width and length simultaneously with an inverted V-shaped osteotomy and central segment resection instead of a horizontal osteotomy and central segment resection.

**PATIENTS AND METHODS**

From March 2010 to May 2013, 432 women and 117 men underwent mandibular contouring surgery, including curved mandibular angle ostectomies and V-line ostectomies. Of these patients, 321 needed a correction of the chin shape with simultaneous mandibular contouring surgery. Narrowing and vertical reduction genioplasty was performed in these patients using inverted V-shape osteotomy with central bony segment resection.

The age of the patients ranged from 20 to 36 years, with an average age of 26.7 years. The average follow-up period was 1.6±0.5 years. The patients wanted to have more a slender chin shape for various reasons, including the presence of wide chins, square chins, long chins, or broad chins with overall roundness, which results in a broad lower third of the face. There were no patients with malocclusion, severe facial asymmetry, facial syndrome, or any other facial deformities.

Before surgery, photographs were taken from 5 directions (frontal, both oblique, and both lateral view), and radiographs, including frontal, lateral cephalometric, and panoramic radiographs, were obtained. For a more comprehensive evaluation of the patients’ mandibular contours, facial 3-dimensional computed tomography was done. After evaluating these radiographs and photographs, each patient’s concerns and wishes were determined, the surgical plan was discussed with the patient, and a comprehensive surgical plan was established.

**Surgical Procedure**

Under general anesthesia using nasotracheal intubation, the approach to the mid-symphyseal area was accomplished with a conventional intraoral vestibular incision and subperiosteal dissection. The soft-tissue attachment of the chin was maximally preserved to prevent an unnatural looking chin after narrowing of the bony segments and to maintain the blood flow to the bony segments.

The inverted V-shaped osteotomy line, which has an apex at the middle point of the central incisors, and 2 vertical osteotomies were designed (Fig. 1). The upper osteotomy lines (inverted V-shape) in the submental region were 5 mm below the root apices of the lower anterior teeth and were 6 mm apart from the mental foramen laterally.\(^1,7\) Depending on the amount of central segment resection, the width and height of the chin was determined preoperatively, taking into account the patient’s desire and referring the contour of the mandible. The width of the central strip ranged from 6 to 12 mm, and the angle of the apex of the central strip varied from 50 to 65 degrees. According to the width and the apex angle of the central strip, the surgeon can easily...
adjust the amount of horizontal and vertical reduction of the chin area. If the more vertical reduction is required, a narrower apex angle and a broader width of the central strip are needed. In addition to the height of the triangular portion of the central strip, excesses in the vertical part of the caudal border of the symphysis are removed simultaneously (Fig. 2 and Table 1). After osteotomy, the muscular attachment was stripped off and the central segment was removed. Two lateral segments were approximated centrally and superiorly. Both segments were fixed with miniplates and screws (Mini-I shape plate, Miniscrew [2.0 Φ, 8-mm length], Le Forte System; JEIL Medical Corporation, Seoul, Korea (Fig. 3). During the fixation, advancement or sliding of the 2 segments was performed if a correction of the profile was needed. The mandibular asymmetry and the deviation of the symphysis were corrected by adjusting the location and apical angle of the central strip.

To obtain a smooth contour and resect the wide mandibular body of the lower mandibular border, an oscillating saw and burs were used to trim the bony edges on the cutting boundary.

After saline irrigation and meticulous bleeding control, the intraoral incision line closure was achieved with an absorbable suture. Negative pressure drainage was applied. Antibiotics were used for 3–4 days, and a bulky compressive dressing was applied for 5 days postoperatively in all cases.

**Soft- and Hard-tissue Changes**

The authors estimated the preoperative and postoperative distance of the subnasale to gnathion in the frontal view. Of the 321 patients, 82 women and 15 men were verified, and the average time of follow-up for the estimation was 1.1 ± 0.3 year (minimum follow-up time, 9 months). The patients were divided into the following 5 groups according the amount of vertical reduction: 4-mm group (n = 7), 5-mm group (n = 19), 6-mm group (n = 38), 7-mm group (n = 22), and 8-mm group (n = 11). In each group, the postoperative distance of the subnasale to gnathion was compared with the preoperative distance. Using the collected data, the mean value and the difference were calculated. Finally, the ratio of soft-tissue change to hard-tissue change was determined in each group, and the total reduction ratio was computed (Table 2).

**RESULTS**

Narrowing and vertical reduction genioplasty was successfully performed in all cases. No severe complications were observed. Postoperative recovery was uneventful. Transient sensory changes of the skin around the mental nerve area were observed in 87 patients, but all recovered within 3 months. In addition, a minor bony step-off at the chin-mandible junction occurred in 8 cases, bunching of the chin in 6 cases, wound dehiscence in 2 cases, and wound infection in 2 cases (Table 3). There were no other postoperative functional problems, such as temporomandibular joint dysfunction, malocclusion, mastication problems, or tooth root injury. The preoperative and postoperative photographs of each patient were used to compare the changes in their face. The photographs ranged from 5 to 29 months after surgery. Furthermore, radiographs, including frontal and lateral cephalometric radiographs, panoramic radiographs, and facial 3-dimensional computed tomographies, were taken 3–6 months after surgery. In all cases, the square and long face was reshaped into a slender ovular contour, and the chin was changed from square to slender (ovular on anterior view). All of the patients were satisfied with the results of the treatment. During the evaluation of soft- and hard-tissue changes, the ratio of soft-tissue reduction to hard-tissue reduction was estimated at 0.48 (Table 2).

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**Table 1. The Amount of Vertical Reduction (h)’ at the Apex of the Central Strip According to the Apex Angle (a) and the Width of the Strip (w)**

| Angle (°, Degree) | Width (w, mm) | 6   | 8   | 10  | 12  |
|------------------|--------------|-----|-----|-----|-----|
| 50               |              | 2.5 | 3.4 | 4.2 | 5.0 |
| 55               |              | 2.1 | 2.8 | 3.5 | 4.2 |
| 60               |              | 1.7 | 2.3 | 2.9 | 3.5 |
| 65               |              | 1.4 | 1.9 | 2.3 | 2.8 |

Values are rounded up to the first decimal place. h, a, and w have the same meaning as in Figure 2.

h is calculated by the following formula: $h = \frac{w}{2} \times \tan (90° - a)$. 

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**Fig. 2.** According to the width (w) and the apex angle (a) of the central strip, surgeon can easily adjust the amount of horizontal and vertical reduction of the chin area. In addition to the height (h) of the triangular portion of the central strip, the vertical excess ($h'$) at the caudal border of the symphysis is removed simultaneously. Finally, the total amount of vertical reduction is $h + h'$. 

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*Values are rounded up to the first decimal place. h, a, and w have the same meaning as in Figure 2.*
the amount of bony resection increased, the amount of soft-tissue vertical reduction also increased.

**CASES**

**Case 1: Trapezoid and Long Chin**

A 29-year-old woman who had a constant complaint about her long, angular chin and masculine features visited our clinic. Inverted V-shaped genioplasty and mandibular angle reduction were performed, and a 10-mm central strip was resected. The patient was satisfied with her more feminine contour. The appearance of the lower face was shortened and was more slender and ovular. Additionally, the facial proportion was more balanced and harmonious than before (Fig. 4 and Table 4).

**Case 2: Broad Chin**

A 32-year-old woman complained about her broad, heavy lower face, especially around the lateral side of the mouth. Inverted V-shaped genioplasty and mandibular angle reduction were performed, and a 12-mm central strip was resected. The main goal of this case was not shortening but narrowing of chin at the lateral side of the mouth. Postoperatively, her lower face appeared slender and had a tapering oval shape (Fig. 5 and Table 4).

**Case 3: Trapezoid and Long Chin with Asymmetry**

A 27-year-old patient presented with a heavy, long, and asymmetric chin. Inverted V-shaped genioplasty and mandibular angle reduction with zygoma resection were performed, and a 10-mm central strip was resected.
Inverted V Genioplasty with a Central Strip

resected. For correction of asymmetry, 6 mm of the 10-mm central strip was resected on the left side and 4 mm on the right side. With zygoma reduction and genioplasty, her face appears shortened and more symmetric and harmonious than before (Fig. 6 and Table 4).

**DISCUSSION**

To achieve oval and slender facial features, which are especially preferred in East Asian countries, several methods have been introduced and developed. These methods used to fix a square contour generally require resection of the mandibular angle or reduction of the mandible itself; however, several authors emphasize the aesthetic significance of the harmonious and smooth overall curve from the chin and the anterior part of mandible to the inferior margin of the mandible. Some authors reported that the main reason why a resection of the mandible alone does not make the face appear slender is due to a wide, flat chin and a U-shaped lower facial morphology, and they performed a surgical approach to the center of the chin to excise the rectangular central bony segment and reduce the width of the chin. Therefore, if patients have a wide chin and symphysis, the correction of the chin area with the treatment of the posterior part of the mandible is essential to accomplish the overall smooth curve during the mandibuloplasty.

Park and Noh performed narrowing genioplasty, which is a surgical approach to the center of the chin to excise the rectangular segment of bone and reduce the width of the chin. In another study, Park et al described mandibular tubercle resection to maximize the benefits of reduction mandibuloplasty. The horizontal osteotomy and central segment resection method introduced by Park et al suggested a new concept of narrowing genioplasty, and it has been widely used to create slender and oval chin shapes. This method continues to be the most popular method. The basic principle of this method is to reduce the width of the chin through a horizontal osteotomy and central segment resection. However, this method has little effect on the reduction of the chin width considering the amount of central segment resection. To create a lower face that is more slender and oval, the central segment should be resected excessively by up to 15–20 mm. Therefore, the genial musculature of the lingual side is more detached and retracted, which results in many problems including palpable mass and bulging of the submental area. Furthermore, this method does not reduce the vertical length of the chin. Many patients who want a narrowing genioplasty have a long chin and need additional horizontal bony segment resection to shorten the length of the chin (Fig. 7). Because of additional horizontal bony segment resection, the genial musculature of the lingual side is detached too excessively, thereby affecting the aesthetically natural line of the chin. Bone bleeding and swelling increase, and the recovery period is lengthened.

To improve these points, we designed an inverted V-shaped osteotomy line instead of the horizontal osteotomy line and performed simultaneous central bony segment resections. With this method, the width of chin can be reduced more than with the conventional horizontal osteotomy technique described by Park et al. In addition, it is a simple and effective method to shorten the vertical length simultaneously without additional horizontal bony segment resection.

Our method has several advantages compared with the conventional horizontal osteotomy technique. First, with the conventional technique, the remaining 2 lateral segments are centralized medially and horizontally after central segment resection. However, with our method, the 2 lateral segments

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**Table 2. The Comparison of Preoperative and Postoperative Distances of the Subnasale to the Gnathion in the Frontal View According to 5 Groups Related to Amount of the Vertical Reduction**

| Total Amount of Vertical Reduction (h + h’) | Preoperative Distance (mm) | Postoperative Distance (mm) | Difference (mm) | Ratio of Soft-to Hard-tissue Reduction |
|------------------------------------------|---------------------------|-----------------------------|----------------|-------------------------------------|
|                                         | Mean (±SD)                | Mean (±SD)                  | Mean (±SD)     | Mean (±SD)                          |
| 4 mm (n = 7)                             | 66.1 (±2.4)               | 64.2 (±2.1)                 | 1.9 (±1.4)     | 0.48                                |
| 5 mm (n = 19)                            | 66.8 (±1.9)               | 64.5 (±1.5)                 | 2.3 (±1.2)     | 0.46                                |
| 6 mm (n = 38)                            | 68.1 (±2.8)               | 65.3 (±1.9)                 | 2.8 (±1.6)     | 0.47                                |
| 7 mm (n = 22)                            | 69.3 (±3.2)               | 65.8 (±2.7)                 | 3.5 (±2.2)     | 0.50                                |
| 8 mm (n = 11)                            | 70.2 (±2.2)               | 66.3 (±2.0)                 | 3.9 (±1.9)     | 0.49                                |
| Total                                    |                           |                             |                | 0.48                                |

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**Table 3. Postoperative Complications**

| Complication                 | n (%)     |
|-----------------------------|-----------|
| Transient sensory change    | 87 (27.1) |
| Minor bony step-off         | 8 (2.5)   |
| Bunching of chin            | 6 (1.9)   |
| Wound dehiscence            | 2 (0.6)   |
| Wound infection             | 2 (0.6)   |
| Total cases                 | 105 (32.7)|
removing after central resection are centralized medially and superiorly due to inverted V-shaped osteotomy line. Therefore, the more lateral and proximal bony edges that remained after centralization can be excised, which reduce the width of the chin more than the conventional technique with the same amount of central segment resection (Fig. 7). Second, the inverted V-shaped osteotomy can preserve more of the genial musculature of the lingual side compared with the conventional technique, and it can decrease the rate of complications, such as a palpable mass due to the contraction of the detached genial musculature or an unnatural contour of the submental area. Third, it can shorten the vertical length without additional horizontal bony segment resection due to cephalic movement of 2 lateral segments. It can shorten 4–8 mm of length, and it may adjust the amount according to the width and apex angle of the central strip. Finally, it can easily correct the asymmetry of the mandible and symphyseal deviation by adjusting the location and apical angle of the central strip.

For the surgical plan, the factor that was considered most important was the amount of the vertical reduction. According to the amount of vertical reduction, the apical angle and the width of the central strip were taken into consideration. The amount of vertical reduction was approximately 4–8 mm in

Table 4. Case Summary of Inverted V-shaped Osteotomies

| Case No. | Apex Angle ($a$, Degree) | Width ($w$, mm) | Total Amount of Vertical Reduction ($h + h'$, mm) |
|----------|--------------------------|----------------|---------------------------------|
| Case 1   | 60                       | 10             | 5                               |
| Case 2   | 65                       | 12             | 5                               |
| Case 3   | 55                       | 10             | 6                               |

*Fig. 4. Preoperative (A) and 6-month postoperative (B) frontal views with 3-dimensional computed tomography of a 29-year-old woman who had a constant complaint about her long angular chin and masculine features. Inverted V-shaped genioplasty and mandibular angle reduction were performed for a trapezoid and long chin, and a 10-mm central strip was resected.*
all cases. For the amount of vertical reduction, the proportion (ratio of lower face to midface) and occlusion of the patient, the request of the patient, the amount of angle resection, and operative history were considered using gross photographs and 3-dimensional computed tomography. The assessment in men was quite different from that in women because men already have a longer, wider, and more angled preoperative mandibular line, and most of them wish to have a more angled mandibular line than women. Therefore, they usually do not want a mental tubercle area that is too sharp or a mandibu-
lar angle that is too obtuse. Namely, the masculine beauty was focused on the operation to male patients in contrast with feminine beauty, just like V-line of mandible, in women. During the preoperative plan, a wider apex angle (more than 10 degrees) and more narrow width of the central strip (less than 2–4 mm) are usually needed in men than in women.

We estimated the preoperative and postoperative changes in soft tissue using the distance of the subnasale to the gnathion in the frontal view (Table 2). Eighty-two women and 15 men were verified and divided into 5 groups according the amount of vertical reduction. In evaluating soft- and hard-tissue changes, the ratio of soft-tissue reduction to hard-tissue reduction was estimated at 0.48. As the amount of bony resection was increased, the amount of soft-tissue vertical reduction was also increased; however, this result is not suggestive. Although this trial was due to obtain more objective and corrective results about soft-tissue changes, our results have several limitations. The distance from the subnasale to the gnathion was estimated only in the frontal view without the assessment of lateral cephalograms and statistics. Regarding soft- and hard-tissue changes, it is thought that additional evaluations are needed in the next follow-up series with a large data set.

Complications included a minor bony step-off at the chin-mandible junction, transient numbness of the lower lip, bunching of the chin, wound dehiscence, and wound infection (Table 3). To prevent bony step-offs at the chin-mandibular junction, meticulous trimming of the bony edges on the cutting boundary is essential with an oscillating saw and burs and the lateral end of the genial segment should be

Fig. 7. A, The inverted V-shaped osteotomy with central segment resection is more effective method for simultaneously reducing the width and height of the chin without additional procedures. B, The horizontal osteotomy and central segment resection method has little effect on the reduction of the chin width if it has the same amount of central resection as our method and it cannot shorten the vertical length. C, For comparable results with the inverted V-shaped osteotomy and central segment resection, the horizontal osteotomy and central segment resection method should excise excessively wide central strips and require additional horizontal bony segment resection to shorten the length.
located at approximately 5 mm from the mental foramen to avoid mental nerve injury.\textsuperscript{7,8} To avoid the bunching of the chin, soft tissue around the chin area should be minimally dissected. Numbness of the lower lip was a common complaint postoperatively. The numbness which is due to stretching of the mental nerves was transient. The wound dehiscence case was treated with wound revision under local anesthesia. The wound infection case presented as heat, erythema, and tenderness on postoperative day 5 and was treated with continuous intravenous antibiotics. On postoperative days 10–14, the infective symptom had diminished, and there were no signs of severe infection, such as purulent discharge.

**CONCLUSIONS**

Various surgical procedures have been suggested to solve a squared and long contour of the lower third of the face, but correction of the chin area with the treatment of the posterior part of the mandible is essential for successful treatment of overall mandibular reduction.

Horizontal osteotomy with central segment resection, the most widely used method for narrowing genioplasty, has little effect on the reduction of the chin width proportional to the amount of central segment resection, and it cannot shorten the vertical length. In case with a considerably wide and long chin, excessive central segment resection and additional horizontal bony segment resection are required, which eventually result in an unnatural curvature of the lower mandibular border.

To improve these points, we used an inverted V-shaped osteotomy line instead of a horizontal line and performed simultaneous central segment resection. In conclusion, inverted V-shaped osteotomy and central bony segment resection technique is a simple and more effective method for simultaneously reducing the chin width and height without additional procedures.

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**PATIENT CONSENT**

Patients provided written consent for the use of their images.

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