Facial beauty results from symmetry and harmonious proportions. The nose and nasal proportions can greatly affect facial balance and attractiveness. Rhinoplasty is one of the most popular procedures in the Asian population. In the past, Asian rhinoplasty focused mainly on dorsal augmentation. At present, augmentation of the nasal tip is a very popular and important aspect of achieving a natural and balanced nose. In the Asian population, the nasal tip is often underprojected, blunt, and round. As such, tip augmentation should include not only changes in projection but also nasal length (derotation). Correction of the nasal tip position can contribute to a more pleasing nasal appearance.

Preoperative analysis is a very important aspect of planning and execution of successful tip augmentation. Perceived adequate nasal tip position depends on its relationship with other facial features. The position of the nasal tip is affected by the subnasal contour, proportion of facial height, and relative facial size and shape. The ideal procedure for tip positioning should incorporate all of these factors. This type of analysis is based on easily identifiable soft-tissue structures and can be rapidly performed. The nasolabial angle is used most frequently as a focal point. Nasal length is one-third of the vertical height of the midfacial area, tip projection is two-thirds of the nasal vertical height, and tip projection...
Effect of Facial Measurements on the Nasal Tip

Methods

In this retrospective clinical trial, we analyzed photographs of 100 men and 100 women aged 20 to 40 years who presented to the Department of Otorhinolaryngology for rhinoplasty from January 1, 2007, through December 31, 2010. Our exclusion criteria consisted of a history of facial surgery or injury and an exaggerated facial expression in the preoperative photograph, such as a large smile.

Photographs were obtained according to techniques of standardized clinical photography. Before taking the photographs, hair covering the face, hair bands, hairpins, eyeglasses, and earrings were removed. For standard clinical photography, a constant brightness and exposure were used. For reproducibility, the patient, simple lighting devices, and a camera were placed at predetermined positions to ensure that the photographs were consistently obtained under identical conditions. The patient was placed 50 cm in front of a blue fabric background. The camera was installed on a camera tripod fixed firmly to the floor. The distance between the patient and the camera was fixed at 50 cm, and the camera was focused by moving it forward and backward. The photographs were taken at a shutter speed of 1/60 seconds, and the aperture was F stop 8. The subject was also instructed to keep his or her jaw in a relaxed position and eyes level with the horizontal line. Lateral photographs with the Frankfort horizontal plane parallel to the ground were taken.

We used a commercially available computer program (Adobe Photoshop; Adobe Systems Incorporated) for photograph measurements. Measurements were performed by 2 different experienced examiners, and the mean was calculated. The objectively measured structures were the glabella, nasion, subnasale, and pogonion. The nasofrontal, nasolabial, nasomental, and Legan angles were also measured. In addition, the ratios of the height to tip projection, radix height to tip projection, glabella to subnasale, subnasale to mentum, nasion to subnasale, and subnasale to mentum were obtained. Subsequently, we analyzed all measurements (Figure 1).

Two experienced rhinoplasty specialists (J.Y.C. and J.H.P.) analyzed the tip location. Each nasal tip was scored according to its level of rotation as derotated, ideal, or overrotated. Consensus between the 2 expert observers was reached via discussion. No attempt was made to analyze features objectively; ranking was purely subjective. This subjective rating was chosen as our criterion standard because it approximates the perception of facial attractiveness made by the public in daily interactions with others (Figure 2). All the objective measurement variables described above were compared with the subjective criterion standard. We calculated and compared the mean (standard deviation) of each variable for men and women. We used an analysis of variance test and regression analysis to compare differences among the 3 groups. To analyze the correlation of each variable, we used a commercially available statistical program (SPSS, version 17.0; SPSS, Inc).

Results

The mean age of the men was 31.5 years; of the women, 28.2 years. The landmarks are defined in Table 1. The mean measurements of the nasofrontal, nasolabial, nasomental, and Legan angles and the ratios of the dorsal height to tip projection, the radix height to tip projection, the glabella to subnasale, the subnasale to mentum, the nasion to subnasale, and the subnasale to mentum for men and women can be found in Table 2. For all measurements, we found no statistically significant difference between men and women.

We examined the correlation of each measurement to tip location (derotated, ideal, or overrotated) (Table 3). For cases with derotation, the mean measurement of the nasolabial angle was 80.4° (8.5°); for ideal cases, 87.1° (12.3°); and for cases with...
overrotation, 88.6° (8.9°). This difference was statistically significant. The mean nasomental angle for cases with derotation was 106.6° (9.4°); for ideal location, 110.8° (9.2°); and for overrotation, 115.5° (8.9°). These differences were also statistically significant.

The nasolabial and nasomental angles were further studied by regression analysis. The nonstandardized and standardized coefficients of the nasolabial and nasomental angles can be found in Table 4.

Discussion

Anthropometric measurements are an important method used to show facial characteristics and symmetry that can be changed by comparing preoperative and postoperative photographs. Since the introduction of standard photographic techniques such as craniofacial measurement analysis, photographic measurement methods have become relatively simple, rapid, and accurate. As such, they have been used widely for surgical planning and postsurgical evaluation, including comparative analysis. Analysis of the nose and its ratios is arguably the most important part of presurgical planning and patient and technique selection in rhinoplasty procedures.

Augmentation of the nasal tip has recently become one of the most widely performed rhinoplasty procedures in Asian patients. Tip rhinoplasty is usually the last step of the rhinoplasty and is an important aspect of achieving a natural and balanced nasal profile and appearance. The factors associated with determination of the tip location include overall facial shape, length, and size and nasal shape, length, and height. Other important factors include the location of the lips, mentum, and forehead. However, no criterion-standard method exists for determination of the ideal nasal tip position with regard to all of these factors. The ideal nasal length has been described as one-third of the vertical height of the midfacial area and the ideal tip projection as two-thirds of the nasal vertical height. The ideal tip projection should appear to be natural and 2 to 3 mm higher than the bridge of the nose. When viewed from the front, the tip-defining point and tip lobule should be seen and located approximately 2 to 3 mm lower than the nasal alae (columella shows).

The measurements and techniques used for determination of ideal tip location vary in the literature. Powell reported that a 90° to 120° nasolabial angle is ideal, whereas Maran and Lund reported an ideal angle of 90° to 105°. McKinney...
and Sweis\(^9\) reported an ideal 2:1 ratio of nasal bridge length to tip height, and Wang et al\(^{10}\) reported a similar ideal ratio of nasal length to projection of 2:0.97. In the present study, the mean nasolabial angle of men was 78.5° and of women was 82.7°.

The Legan angle of facial convexity is measured through the glabella and subnasale and through the pogonion and subnasale. This angle has been reported to be useful for planning and preoperative evaluation for surgery of the nose and mentum.\(^{11}\) Ricketts\(^{12}\) reported that, when assessing the location of the lips compared with the aesthetic plane connecting the tip of nose and the chin prominence (E-plane), the upper lip should be located 4 mm behind the E-plane and the lower lip 2 mm behind the E-plane for an aesthetically pleasing appearance.

The Legan angle of facial convexity is measured through the glabella and subnasale and through the pogonion and subnasale. This angle has been reported to be useful for planning and preoperative evaluation for surgery of the nose and mentum.\(^{11}\) Ricketts\(^{12}\) reported that, when assessing the location of the lips compared with the aesthetic plane connecting the tip of nose and the chin prominence (E-plane), the upper lip should be located 4 mm behind the E-plane and the lower lip 2 mm behind the E-plane for an aesthetically pleasing appearance.

The various measurements obtained in our study are consistent with those of previous studies of Asian subjects.\(^{13,14}\) For example, in our study, the mean (SD) nasolabial angle of men was 85.33° (10.53°) and for women it was 87.86° (11.02°). Similarly, Leong and White\(^{15}\) reported a mean nasolabial angle of 86.2° in men and 87.6° in women. Nothing the differences between Asian and white subjects, Leong and White found nasolabial angles of 96.8° in men and 101.8° in women of white ethnicity.

Current techniques of nasal tip position analysis have drawbacks and at times can be confusing, thus impairing their usefulness. Some of these problems include the lack of incorporation of relationships of the subnasal contour, proportion of facial height, and relative facial size and shape.

Because the shape of the face and nose in each individual is different, the ideal shape and location of the nasal tip is different. Therefore, no precise standards can be applied to every face and nose.

Because the lower one-third of the face is considered to have an important effect on overall facial appearance, its individual factors have often been examined in studies. Aufricht\(^{16}\) was one of the first researchers to discuss the aesthetic significance of the nose-chin relationship in the analysis of the facial profile. He stated, “The nose and the chin are conspicuous components of the profile line, and there is a marked aesthetic interrelation between the two. The prominence of one will influence the relative prominence of the other;”\(^{16}(p233)\) He reported that 25% of all his rhinoplasty patients received simultaneous procedures to augment the chin. In 1965, Millard\(^{17}\) described a 15% incidence of simultaneous rhinoplasty and chin implants in a series of 1000 patients undergoing rhinoplasty. Since physicians have become aware of this, it has been generally considered acceptable and appropriate to inform patients of the nose-chin relationship and to combine these aesthetic procedures.\(^{18}\)

In this study, we found statistically significant differences in the nasolabial angle of subjects considered to have an ideal tip position vs those considered to have a derotated or

### Table 2. Measurements of Profile Analysis

<table>
<thead>
<tr>
<th>Measurement, Mean (SD)</th>
<th>Men (n = 100)</th>
<th>Women (n = 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>31.5</td>
<td>28.2</td>
</tr>
<tr>
<td>Nasofrontal angle, degrees</td>
<td>137.9 (11.6)</td>
<td>145.2 (6.3)</td>
</tr>
<tr>
<td>Ratio of height to tip projection</td>
<td>Dorsal 0.55 (0.10)</td>
<td>0.63 (0.15)</td>
</tr>
<tr>
<td></td>
<td>Radix 0.21 (0.12)</td>
<td>0.34 (0.14)</td>
</tr>
<tr>
<td>Angle, degrees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasolabial</td>
<td>85.3 (10.5)</td>
<td>87.86 (11.0)</td>
</tr>
<tr>
<td>Nasomental</td>
<td>110.2 (8.7)</td>
<td>113.93 (10.4)</td>
</tr>
<tr>
<td>Legan</td>
<td>8.6 (5.3)</td>
<td>7.6 (5.5)</td>
</tr>
<tr>
<td>Ratio of G-Sn to Sn-Me</td>
<td>1.06 (0.09)</td>
<td>1.08 (0.10)</td>
</tr>
<tr>
<td>Ratio of N-Sn to Sn-Me</td>
<td>0.71 (0.13)</td>
<td>0.74 (0.07)</td>
</tr>
</tbody>
</table>

### Table 3. Correlation of Objective Measurements With Tip Position

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Derotation (n = 37)</th>
<th>Ideal (n = 85)</th>
<th>Overrotation (n = 78)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasofrontal angle, degrees</td>
<td>139.2 (8.7)</td>
<td>141.9 (9.7)</td>
<td>141.2 (11.5)</td>
<td>.66</td>
</tr>
<tr>
<td>Ratio of height to tip projection</td>
<td>Dorsal 0.63 (0.13)</td>
<td>0.58 (0.13)</td>
<td>0.57 (0.12)</td>
<td>.32</td>
</tr>
<tr>
<td></td>
<td>Radix 0.27 (0.12)</td>
<td>0.26 (0.14)</td>
<td>0.27 (0.17)</td>
<td>.91</td>
</tr>
<tr>
<td>Angle, degrees</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasolabial</td>
<td>80.4 (8.5)</td>
<td>87.1 (12.3)</td>
<td>88.6 (8.9)</td>
<td>.03*</td>
</tr>
<tr>
<td>Nasomental</td>
<td>106.6 (9.4)</td>
<td>110.8 (9.2)</td>
<td>115.45 (8.9)</td>
<td>.004*</td>
</tr>
<tr>
<td>Legan</td>
<td>8.6 (6.1)</td>
<td>7.7 (5.4)</td>
<td>8.55 (5.1)</td>
<td>.74</td>
</tr>
<tr>
<td>Ratio of G-Sn to Sn-Me</td>
<td>1.08 (0.13)</td>
<td>1.08 (0.10)</td>
<td>1.05 (0.08)</td>
<td>.30</td>
</tr>
<tr>
<td>Ratio of N-Sn to Sn-Me</td>
<td>0.72 (0.11)</td>
<td>0.75 (0.07)</td>
<td>0.70 (0.13)</td>
<td>.06</td>
</tr>
</tbody>
</table>

### Table 4. Linear Regression Correlation of Objective Measurements With Tip Position

<table>
<thead>
<tr>
<th>Angle</th>
<th>Nonstandardized Coefficient, B</th>
<th>Standardized Coefficient, β</th>
<th>Adjusted R²</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasolabial</td>
<td>-0.01</td>
<td>-0.08</td>
<td>0.12</td>
<td>.004*</td>
</tr>
<tr>
<td>Nasomental</td>
<td>0.03</td>
<td>0.41</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Indicates a significant difference among the groups.

Abbreviations: G, glabella; Me, mentum; N, nasion; Sn, subnasale.
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REFERENCES


Conclusions

In this study, we found that the Legan angle and the ratios of the midface to lower face and nasal length to lower face did not exert significant effects on the ideal location of the nasal tip. The nasolabial and nasomental angles, however, showed significant effects on nasal tip appearance. With regard to the location of the nasal tip, the results of linear regression analysis of the nasolabial and nasomental angles showed significantly greater effects of the nasomental angle compared with the nasolabial angle on ideal nasal tip location.

Although the nasolabial angle is typically the primary measure to determine the ideal location of the nasal tip before rhinoplasty, the results of this study show that the nasolabial and nasomental angles have important effects. The nasomental angle should be considered with the nasolabial angle in the preoperative determination of the ideal nasal tip location. In addition, the results of this study provide further support for concurrent genioplasty to optimize rhinoplasty outcomes in appropriately selected patients.