Early Changes in Facial Profile Following Structured Filler Rhinoplasty: An Anthropometric Analysis Using a 3-Dimensional Imaging System

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BACKGROUND Quantitative measurements are important for objective evaluation of postprocedural outcomes. Three-dimensional (3D) imaging is known as an objective, accurate, and reliable system for quantifying the soft tissue dimensions of the face.

OBJECTIVE To compare the preprocedural and acute postprocedural nasofrontal, nasofacial, nasolabial, and nasomental angles, early changes in the height and length of the nose, and nasal volume using a 3D surface imaging with a light-emitting diode.

METHODS The 3D imaging analysis of 40 Korean women who underwent structured nonsurgical rhinoplasty was conducted. The 3D assessment was performed before, immediately after, 1 day, and 2 weeks after filler rhinoplasty with a Morpheus 3D scanner (Morpheus Co., Seoul, Korea).

RESULTS There were significant early changes in facial profile following nonsurgical rhinoplasty with a hyaluronic acid filler. An average increase of $6.03^\circ$ in the nasofrontal angle, an increase of $3.79^\circ$ in the nasolabial angle, increase of $0.88^\circ$ in the nasomental angle, and a reduction of $0.83^\circ$ in the nasofacial angle was observed at 2 weeks of follow-up. Increment in nasal volume and nose height was also found after 2 weeks. Side effects, such as hematoma, nodules, and skin necrosis, were not observed.

CONCLUSION The 3D surface imaging quantitatively demonstrated the early changes in facial profile after structured filler rhinoplasty. The study results describe significant acute spatial changes in nose shape following treatment.

Supported by a grant of the Korean Healthcare Technology R&D Project, Ministry of Health & Welfare, Republic of Korea (Grant No.: NH15C0105). The authors have indicated no significant interest with commercial supporters.

The nose is the central and most prominent feature of the face such that slight change can greatly improve one’s appearance. Asians typically have a flatter and less distinct nose and thus cosmetic nose enhancement procedures are popular.¹ For decades, surgical rhinoplasty has been the therapeutic gold standard. However, in recent years, nonsurgical rhinoplasty with injectable fillers has gained popularity.²⁻⁶ The biggest strength of filler rhinoplasty is that it is minimally invasive, has a relatively good safety profile, provides immediate visible results, and can be done conveniently in an office setting without the downtime of surgery.

One issue in cosmetic practice is the paucity of objective assessment tools. Facial measurements were originally performed with craniofacial anthropometry, which directly measures the patient using calipers and a measuring tape. Because of the time commitment and the need of perquisite training, direct measurements were replaced by photographs. Two-dimensional (2D) photographs have been widely used...
in clinical practice for evaluation, but there are certain limitations. The face and the nose are 3-dimensional (3D) structures, and subtleties can be lost when they are portrayed in 2 dimensions. Particularly in the frontal view, it can be difficult to appreciate small irregularities of the nose. The 3D imaging has been developed to enable more precise evaluation of the nose after rhinoplasty. It allows calculation of volume and topographic distances as well as the facial angles.

Several forms of 3D imaging modalities have been developed and tested. Computed tomography, 3D ultrasonography, and 3D photogrammetry are just a few of these techniques. The 3D photogrammetry has gained popularity with its ability to capture surface data in high-resolution color at relatively fast speeds and has advantage over computed tomography as it does not expose patients to radiation.

Our aim was to use 3D imaging to objectively quantify the early changes in facial profile after nonsurgical rhinoplasty. The 3D imaging system used in this study was the Morpheus 3D Aesthetic Solution (Morpheus Co., Seoul, Korea), which is an example of a 3D photogrammetry imaging device that uses a structured light scanning system. Studies have demonstrated the accuracy and reproducibility of the results obtained using this system.

Methods

Patients

Forty female patients meeting the inclusion criteria were enrolled. The inclusion criteria for the study were patients aged 20 years or older, with no previous surgical or nonsurgical (i.e., dermal fillers) treatment to the nose. The authors excluded lactating or pregnant women, patients with known allergy to lidocaine, those with a risk of poor protocol compliance, and patients on immunosuppressive treatment or with a history of autoimmune disease.

Injection

Four dermatologic surgeons (N.K.R., J.Y.P., C.S.Y., S.-K.L.) who are recognized filler experts in Korea, and at the same time, the executive board members of the Korean Academy of Anti-aging Dermatology, performed the injection procedure. Ten patients were allotted to each dermatologist. Filler rhinoplasty was performed either by a 27-gauge sharp needle or a 23-gauge blunt cannula according to the practitioners’ preference. Topical anesthetic cream (EMLA, eutectic mixture of 2.5% lidocaine and 2.5% prilocaine; Astra USA Inc., Westborough, MA) was applied under occlusion for approximately 45 minutes followed by the injection of a small bolus of local anesthesia to the nasal tip (the entry point). A cross-linked hyaluronic acid gel product containing 0.3% lidocaine (YVOIRE volume plus; LG Life Sciences, Seoul, Korea) was used in all cases. A structured filler rhinoplasty was performed with slight variation depending on the shape of the individual’s nose and preference of the patient and the practitioner. The sequence of the structured filler rhinoplasty is as follows: (1) First stage—The entire length of the dorsum (from the radix to the nasal tip) is augmented at the level of supra-periosteal or supraperichondrial plane using a linear threading technique in a retrograde manner. The radix and the forehead dorsum angle are further augmented, creating a new radix at the approximate level of the supratarsal fold. (2) Second stage—With an entry point at the tip of the nose, the needle (or cannula) is advanced along the subcutaneous plane, all the way down to the nasal spine. The filler material is injected slowly, filling the columella–labial angle. The needle is then slowly withdrawn while injecting the filler to the columella (Figure 1).

Study Protocol

After obtaining approval from the institutional review board of Incheon St. Mary’s Hospital, The Catholic University of Korea, as well as written informed consent, patients were enrolled and followed in a prospective manner. Each participant received a single session of structured filler rhinoplasty. The 3D surface data were acquired before, immediately after, 1 day, and 2 weeks after the procedure. Three-dimensional facial images were taken with the Morpheus 3D scanner (Morpheus Co.). A light-emitting diode white light was used as the light source in the imaging unit, providing a manufacturer’s accuracy of less than
0.1 mm. The entire scanning procedure took approximately 0.8 seconds. Patients were asked to sit with natural head positions and reposed lips. For each subject, 3 images were taken from 3 different horizontal angles (the front, right, and left sides at an angle of 45°) and then merged into a single 3D facial image.

As landmarks to evaluate the nasal shape, the authors chose the glabella (g), the radix (r), pronasale (prn), columella point (c) (the highest point of the columella), subnasale (sn), and the pogonion (pg) (Figure 2). To evaluate the effects of treatment, nose height (linear distance between the radix and subnasale), nose length (linear distance between the radix and pronasale), and the nasofrontal, nasolabial, nasomental, and nasofacial angles were measured and compared (Figure 3). Quantitative volume measurements were also made using the 3D imaging software that compared the volume between the pretreatment image and the posttreatment images of the nose. Superimposable 3D volumetric assessments allowed changes in volume to be reflected as color changes on the nose (Figure 4). A paired $t$-test was used to evaluate the significance of the changes measured at each time point compared with baseline. $p < .05$ was considered significant.

**Results**

Forty patients completed the study. All were female with a mean age of 28.5 years (range, 20–44 years). In terms of the baseline values, the average and standard deviations (SDs) measured were 41.51 mm (SD = 2.77) for the nose length, 51.00 mm (SD = 3.48) for nose height, 145.81° (SD = 6.03) for the nasofrontal angle, 95.97° (SD = 8.54) for the nasolabial angle, 132.42° (SD = 4.66) for the nasomental angle, and 30.62° (SD = 3.17) for the nasofacial angle (Table 1). Filler rhinoplasty was performed by a 27-gauge sharp needle in 20 patients and with a 23-gauge blunt cannula in the
remaining 20 patients. The average amount of filler injected for filler rhinoplasty was 0.69 mL (range, 0.20–1.25 mL), and the following changes were observed at 2 weeks of follow-up: an increase of 2.15 ± 1.49 mL in nasal volume (Figure 5), increment of 0.3 ± 0.51 mm in nose height, increase of 6.03 ± 3.30° in the nasofrontal angle, 3.79 ± 8.71° in the nasolabial angle, 0.88 ± 1.97° in the nasomental angle, a decrease of 0.38 ± 0.48 mm in nose length, and a reduction of 0.8 ± 0.94° in the nasofacial angle (Figure 6). All measures presented a statistically significant difference ($p < .05$). Nose edema measured by subtracting the nasal volume immediately after filler rhinoplasty from the nasal volume the day after filler rhinoplasty was 0.85 ± 2.25 mL and was also statistically significant. Treatment was well tolerated and caused minimal discomfort. Significant adverse events, such as hematoma, nodules, and skin necrosis, were not observed during the study.

**Discussion**

Filler rhinoplasty is a popular procedure in the Asian population.\(^2\)\(^–\)\(^6\) In the past, nonsurgical Asian rhinoplasty has been used successfully and reliably to raise the nasal dorsum, but unlike surgical rhinoplasty, was limited in its ability to produce a significant change in the caudal aspect of the nose.\(^5\) “Structured” filler rhinoplasty allows a combined approach, correcting various components of the nose (i.e., nose dorsum, columella) leading to a more holistic aesthetic enhancement.\(^5\) Despite the general understanding that filler injection provides immediate visible results, few studies have assessed the acute changes of the nose. To
our knowledge, this is the first study to provide objective data regarding the early spatial changes of the nose following structured filler rhinoplasty.

In filler rhinoplasty, the filler material is injected via a needle or a cannula which inevitably causes skin injury. This results in skin inflammation and subsequent edema, which from our clinical experience, is at its maximum on Day 1 (1 day after filler rhinoplasty), completely resolving within 2 weeks. Patients are very much surprised at the grotesque look they get during the first few days of filler rhinoplasty and often ask for a detailed explanation on the early outcome. Since the demand for a better explanation is high, the authors felt that it would be meaningful to objectively measure the degree of “nose edema” and the initial “true” effect of filler rhinoplasty (the increase in nasal volume without the confounding effect of the edema) and use them as reference. For this reason, the authors have measured the nasal volume immediately after filler rhinoplasty and on Day 1 to calculate “nose edema” (which is “nasal volume on Day 1” − “nasal volume immediately after filler rhinoplasty”) and also at 2 weeks of follow-up, which is the time point at which the authors believe the edema is all gone. In reality, edema usually resolves within a few days but to make things sure, the authors have performed the 3D measurements after 2 weeks.

Use of 3D imaging software technology has advanced our ability to analyze postprocedural outcomes over 2D photographic technology.9–11 It allows spatial analysis of rhinoplasty results without the problems associated with variability in 2D photography.6–8 The 3D scan image may be viewed in any desired position to carry out indirect anthropometric measurements, and the images can be stored and retrieved later for repeated assessments. The replica image permitted detailed measurements in the nasal region, relieving subjects from having to sit through long periods of clinical assessments.16

For the baseline values, the mean nasal height of our study patients was 51.00 mm which is similar to the values that have been measured from the general Korean (49.2, 51.8 mm),12,13 Chinese (46.93, 51.70 mm),16 and Caucasian (48.90 mm)16 women. The nasal length of our study patients was 41.51 mm, which is within the range reported from the general Korean and Chinese women (39.1–45.3 mm).12,13 The baseline nasofrontal angle was 145.81°, which is slightly larger than that reported from the general Korean (142.5°, 136.8°),12,13 Chinese (139.09°, 135.60°),16 and Caucasian (134.00°, 135.3°),16,17 women, but similar to the values measured from Korean women projected to rhinoplasty (145.2°, 142.4°, 143.6°).14,15 The nasolabial angle (95.97°) was within the range of values reported from Korean and Chinese women (84.6°–97.71°)12–16 but smaller than that of Caucasian women (99.10°, 101.8°).16,17 Few studies have measured the nasomental and nasofacial angles, allowing limited data to compare.
TABLE 1. Comparison of the Anthropometry Nasal Measurements in Various Populations in Women

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Our Study Mean (SD)</th>
<th>Korean Women Mean (SD)</th>
<th>Korean American Women Mean (SD)</th>
<th>Korean Women Projected to Rhinoplasty Mean (SD)</th>
<th>Korean Women Nose Without Saddle or Hump Mean (SD)</th>
<th>Korean Women With Saddle Nose Mean (SD)</th>
<th>Chinese Women Mean (SD)</th>
<th>Caucasian Women Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nose height (mm)</td>
<td>51.00 (3.48)</td>
<td>49.2 (3.0)</td>
<td>51.8 (4.3)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>46.93 (3.30)</td>
<td>51.70 (2.30)</td>
</tr>
<tr>
<td>Nose length (mm)</td>
<td>41.51 (2.77)</td>
<td>39.1 (3.4)</td>
<td>45.3 (3.9)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>40.04 (3.62)</td>
<td>44.30 (3.70)</td>
</tr>
<tr>
<td>Nasofrontal angle (°)</td>
<td>145.81 (6.03)</td>
<td>142.5 (5.0)</td>
<td>136.8 (6.4)</td>
<td>145.2 (6.3)</td>
<td>142.4 (4.9)</td>
<td>143.6 (6.6)</td>
<td>139.09 (7.65)</td>
<td>135.60 (4.40)</td>
</tr>
<tr>
<td>Nasolabial angle (°)</td>
<td>95.97 (8.54)</td>
<td>92.9 (9.1)</td>
<td>92.1 (9.2)</td>
<td>87.86 (11.0)</td>
<td>86.5 (7.8)</td>
<td>84.6 (11.0)</td>
<td>97.71 (9.69)</td>
<td>88.50 (11.20)</td>
</tr>
<tr>
<td>Nasomental angle (°)</td>
<td>132.42 (4.66)</td>
<td>—</td>
<td>128 (4.1)</td>
<td>113.93 (10.4)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>124 (4)</td>
</tr>
<tr>
<td>Nasofacial angle (°)</td>
<td>30.62 (3.17)</td>
<td>—</td>
<td>32.3 (5.1)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>36.6 (5.2)</td>
</tr>
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</table>
The nasomental angle of our study patients (132.42°) was larger than that reported from the general Korean women (128°), Korean women projected to rhinoplasty (113.93°), and Caucasian women (124°), whereas our nasofacial angle (30.62°) was smaller than those measured from the general Korean (32.3°) and Caucasian (36.6°) women (Table 1).

In terms of the acute changes, structured filler rhinoplasty caused a statistically significant increase in nasal volume, height, and the nasofrontal, nasolabial and nasomental angles. The nasal volume at 2 weeks of follow-up was approximately 3 times the amount of the filler material injected. The volume was at its maximum on Day 1 (the day after filler rhinoplasty), probably due to injection-associated edema. Between the needle and the cannula group, needle injection produced a statistically higher degree of edema (1.68 vs 0.01 mL), suggesting that it is necessary to explain injection-associated edema to patients undergoing filler rhinoplasty with a needle. An increment in nose height at 2 weeks of follow-up was not surprising, considering that staged filler rhinoplasty augments both the radix and the nasal spine where nasal height is a straight line measure from the radix to the subnasale. A reduction in nose length (linear distance between the radix and pronasale) was a bit unexpected but may be explained by the greater elevation of the nasal tip compared to the radix. The authors have found few articles in the literature that demonstrated facial angle measurements in patients after surgical rhinoplasty. In agreement with our study, increase in the nasofrontal, nasolabial, and nasomental angles and decrease in the nasofacial angle were found, among which a statistically significant increase in the nasolabial angle was a universal finding. It has been stated that a key anatomical feature and end point in performing a successful and aesthetically pleasing result in rhinoplasty is attaining an ideal nasolabial angle. In a previous study, the most aesthetic female nasolabial angle was 104.9 ± 4.0°, where age, sex, ethnicity, education, and history of rhinoplasty did not change preference of the ideal female nasolabial angle. All patients in this study replied that they were either “satisfied” or “very satisfied” with filler rhinoplasty. Although many believe that augmentation rhinoplasty “westernizes” the nose, facial angle measures taken from our patients after filler rhinoplasty were still distinctly different from those of Caucasian women aside from the nasolabial angle. It has been reported that although the nasal index values differ between Asian and Caucasians, the facial index values are similar. This should be borne in mind when carrying out aesthetic rhinoplasty for Asian subjects as correction of individual parts of the nose may result in relative disproportion between the nose and the face.

Nonsurgical rhinoplasty is one of the most popular procedures among Asians. However, it is a challenging area to inject and requires extreme caution. The most feared complication associated with nonsurgical rhinoplasty is vascular compromise and resulting skin necrosis. External compression of an artery is particularly likely to occur in areas such as the nasal tip and alae, where the skin envelope is not so distensible. Therefore, such areas must be treated with conservative volumes and constant assessment of skin perfusion should be made to avoid a potentially disastrous sequelae. Injecting the nasal tip in a patient after rhinoplasty increases the risk of vascular obstruction as a result of scar tissue obliterating a potential plane of expansion in an uncorrected nose. After surgery, the inherent blood supply is also altered and typically diminished. For these reasons, fillers are not normally injected to patients who have had previous surgical treatments on the nose.
Additional tips the authors used to avoid serious complications are as follows: (1) perform slow, low-pressure injections—inject many times, depositing small amounts of filler along the way, (2) avoid injections near the angular artery (applying digital pressure over the artery while injecting the dorsum of the nose may help prevent migration of filler material into the vessels), (3) deep injection (the authors recommend filler injection into the supraperiosteal plane), and (4) syringe regurgitation to check possible puncture of the vessel.21 One of the limitations of this study is the difference in methodology of nasal index measurement between the study and the reference studies. This has made the direct comparison of the values less reliable. Furthermore, this study had a relatively small sample size. Future study with larger number of participants is needed to further validate the study findings.

To the authors’ knowledge, this study is the first to demonstrate the early spatial changes of the nose following structured filler rhinoplasty. Although

Figure 6. Two-dimensional (A) before and (B) after series of photographs from a patient.
a large patient population is needed for confirmation, a statistically significant increase in nasal volume, height, and the nasofrontal, nasolabial, and nasomental angles was found at 2 weeks of follow-up within the present study sample. Objective assessment with the use of 3D imaging was able to lend support for structured filler rhinoplasty, which yielded good patient satisfaction and minimal levels of discomfort and side effects. Long-term follow-up studies should be performed in future to identify the late changes in facial profile or the duration of cosmetic benefit following filler rhinoplasty.

References


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