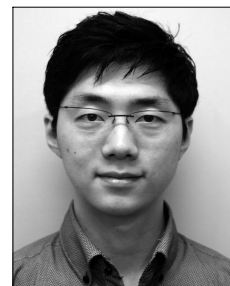


# 코높임술과 코끝성형술 후 안면부 옆모습 변화에 대한 계측학적 분석

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## Anthropometric Analysis on Facial Profile Alterations Following Augmentation Rhinoplasty with Nasal Tip Plasty

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There are various nasal measurement parameters for rhinoplasty, so it is difficult for surgeons to decide which measurements to place more emphasis on. Among many, we searched for measurements that are significantly altered after the augmentation rhinoplasty with nasal tip plasty to figure out which measurements are most required in preoperative preparation. From January, 2006 to July, 2008, a total of 85 patients underwent augmentation rhinoplasty with nasal tip plasty and 40 were selected for comparative analysis of preoperative and postoperative photographs. Among many measurement factors reflecting changes of a face and a nose, we measured and compared following parameters, 1) nasofrontal angle, 2) nasofacial angle, 3) nasolabial angle, 4) nasal tip angle, 5) columella-lobular angle, 6) nasal length to tip projection, 7) alar slope angle, 8) nostril axis angle, 9) lobule-to-nostril ratio before and after operations. The result was analyzed using paired t-test. The measurement parameters most significantly altered after augmentation rhinoplasty with nasal tip plasty were the increase in nasolabial angle, the decrease in nasofacial angle, and the decrease in nostril axis angle. Therefore, surgeons should place more emphasis on these parameters in preoperative planning and postoperative evaluation.

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**Key Words:** Anthropometry, Rhinoplasty

### I. INTRODUCTION

Undoubtedly, the nose is the most important feature affecting the appearance of a face as it is the most protruding and occupies the central part of a face. The nose is also a 3-dimensional

structure, so it has different appearances and profiles when viewed at different angles. Therefore, the nose is very important in deciding the attractiveness and aesthetics of a face.<sup>1</sup>

In order to surgically produce the optimal nasal shape and profile, it is extremely important to consider the aesthetic factors, which are; the position of the nasion, the optimal nasolabial angle, the natural exposure of infra-tip lobule with and columella, the position of the tip defining point in harmony with the dorsal profile, and the smooth and natural silhouette of the lateral nasal profile as it descends into the inferior portion of the nose.<sup>2,3</sup> Successful rhinoplasty begins with careful preoperative preparation and planning, and nasal analysis provides a reliable guideline in operative planning. However, there are various nasal measurement parameters for rhinoplasty, so it is

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difficult for surgeons to catch the direction for placing more emphasis on which measurements. In our study, we measured nasal profile factors on digital photographs of our patients who underwent augmentation rhinoplasty with nasal tip plasty for correction of a depressed nose, a deviated nose, or a hump nose, from January 2006 to July 2008.

## II. PATIENTS AND METHOD

### A. Subjects

Of the 85 patients who had augmentation rhinoplasty with nasal tip plasty for correction of depressed, deviated, or hump noses from January, 2006 to July, 2008, 40 were selected for comparative analysis of preoperative and postoperative photographs. The patients were between 16 to 65 years old with the average age of 30. 35 were females and 5 were males. The chief complaints were depressed nose for thirty patients, deviated nose for eights, and hump nose for two patients. Three cases were revision surgery, for reasons of artificial nasal shape or unfavorable nasal tip. Anteroposterior views, both lateral views, and basal views of preoperative and postoperative photos were compared.

Postoperative photographs were taken 3 or 4 weeks after the operation. To reduce errors, only NIKON (Nikon Corporation, Tokyo, Japan) 35 mm single lens digital camera with 60 mm focal length lens was used to take photos.

We adjusted the distance between the camera and the subject consistently. To assess augmentation objectively, numerical measurements and analysis were done.

Measurements on both lateral view printouts are belows (Fig. 1).

- 1) Nasofrontal angle: the angle defined by glabella (the most prominent point of the forehead in the midline between the eyebrow)-to-nasion (the midline point of the junction of the frontonasal suture and the superior nasal bones) line intersecting with nasion-to-tip line

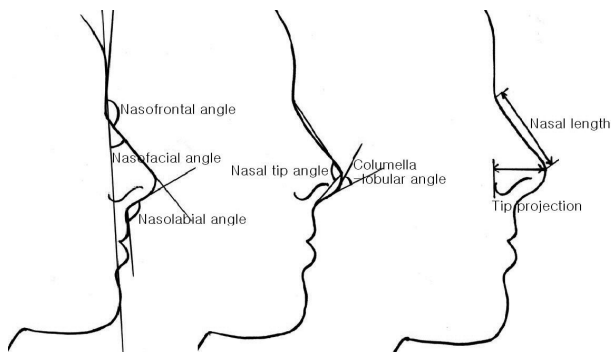


Fig. 1. Measurements on both lateral view.

- 2) Nasofacial angle: the angle defined by glabella-to-pogonion (the most prominent point of the chin in the midline) line intersecting with nasion-to-tip line
- 3) Nasolabial angle: the angle between the columella and the upper lip
- 4) Nasal tip angle: the angle of nasion-pronasale (the most prominent point of the nasal tip)-subnasale (the deepest point at the junction of the base of the columella and the upper lip in the midline)
- 5) Columella-lobular angle: the angle formed by the junction of the infra-tip lobule with the columella
- 6) Nasal length to tip projections: the length of a horizontal line drawn from the nasal tip to the alar line (a line drawn through the alar crease, perpendicular to the Frankfort plane), alar point-to-nasal tip line, divided by the length of the nasion-to-nasal tip line Measurements on basal view printouts are belows (Fig. 2).
- 7) Alar slope angle: the angle of right alare (the lateral point on the flare of the nose) -pronasale-left alare
- 8) Nostril axis angle: the angle between both long axes of nostril
- 9) Lobule-to-nostril ratio: the ratio of the nasal lobule to the nostril length

The preoperative measurements and proportions were compared with those of postoperative photos. The analysis of results was conducted using paired t-test and significant level  $p < 0.05$  were employed for statistical analysis. And these data values were estimated with known optimal profile values (Table I).

### B. Surgical Technique

The operation was performed under local or general anesthesia. Surgical approach was an open rhinoplasty with a transcolumella incision followed by an alar rim incision. For a hump nose, rasping was processed for natural, soft, S-shaped, nasal profile. Alar cartilages were fully exposed and separated from upper lateral cartilages. To shape the tip cartilages, to increase the tip projection, and to increase the definition of the nasal tip, some tip suture techniques were accomplished: transdomal suture, interdomal suture, lateral crural spanning

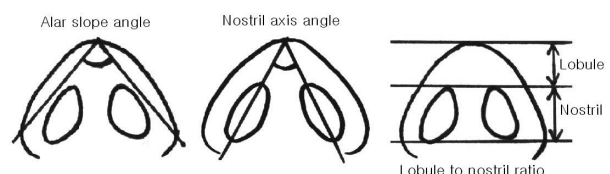


Fig. 2. Measurements on basal view.

**Table I.** Preoperative and Postoperative Measurements

Measurement factor	Mean		Difference	Optimal profile	Standard deviation	<i>p</i> value (*: <0.05)
	Preop.	Postop.				
Nasofrontal angle	139.65°	140.28°	0.625°	135~140°	17.9	0.826
Nasofacial angle	29.88°	28.53°	1.35°	30~35°	2.923	0.006*
Nasolabial angle	86.4°	91.5°	5.575°	95~100°	12.399	0.007*
Nasal tip angle	121.23°	121.9°	0.675°	•	5.399	0.434
Columella lobular angle	50.68°	51.23°	0.55°	30~45°	13.259	0.794
Nasal length: tip projection	1:0.574	1:0.6	0.026	1:0.67	0.165	0.320
Alar slope angle	91.39°	91.71°	0.316°	•	22.866	0.933
Nostril axis angle	80.61°	69.45°	11.158°	•	12.75	0.000*
Lobule: nostril ratio	1:1.43	1:1.47	0.004	1:2	0.252	0.924

suture, intercrural suture, and columellar-septal suture. Not all these types of sutures were required in each patient. Carved silicone implant was inserted for augmentation. When surgeons judged the necessity of additional projection of the nasal tip despite suture techniques, the shield-shaped conchal cartilage graft was placed in the lobule to augment the dome and middle crura region. For the patient with short columella, columellar struts were placed on the anterior nasal spine to increase the tip projection.

### III. RESULTS

Forty patients were followed up after surgeries for 6 months to 24 months with the mean 18.5 months. The following changes were measured. The average increase in nasofrontal angles was from 139.65° to 140.28°. The average decrease in nasofacial angles from 29.88° to 28.53° was noted. The average change in nasolabial angles on the lateral views was from 86.4° to 91.98°. The nasal tip angle increased from 121.23° to 121.9°, while the columella-lobular angle increased from 50.68° to 51.23°. The average ratio from nasal length to tip projection changed from 1 : 0.574 to 1 : 0.6. On basal views, the alar slang angle was increased from 91.39° to 91.71°. The angle between nostril axis was decreased from 80.61° to 69.45°. The change of the lobule-to-nostril ratio was from 1:1.143 to 1:1.147. Among these measurement factors, the nasolabial angle, the nasofacial angle, and the nostril axis angle showed statistically significant differences ( $p < 0.05$ ).

#### Case 1

A 50-year-old female had a short, depressed nose with a nasal

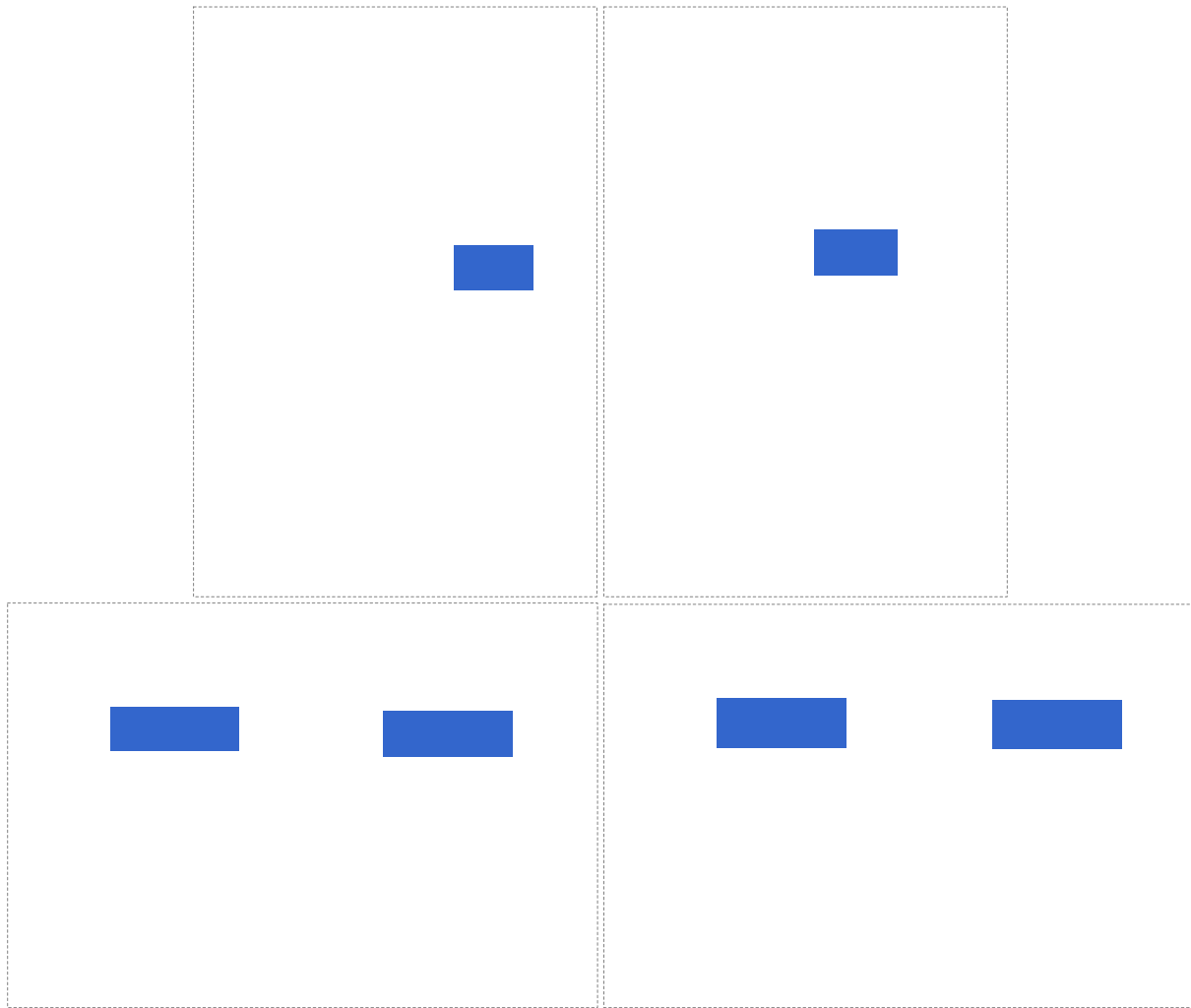
tip dropping downward. On preoperative photographs, the nasolabial angle was only 81.4°, making her mouth look protruded and the overall face appear flat. Three weeks after rhinoplasty, the nasal to facial ratio was optimized, the nasolabial angle was increased to 97.5° as the tip projects out more, and the nasofacial angle was 31° producing more natural-looking lateral profile (Fig. 3).

#### Case 2

A 24-year-old male had a depressed nose with a hump. The nose appeared short and projected downward. On the lateral view taken before the surgery, the mouth appears to be protruding as the nasal projection ratio is 1 : 0.6 and the nasolabial angle is only 60°. On the basal view, alar slope angle and the angle between nostril axis were 103° and 125°, respectively. One month after the operation, the ratio between the nasal length and the facial length was close to the ideal measurement. With the more protruding nose, the nasolabial angle increased to 85.5° and nasal projection changed to 1:0.66, giving a more natural looking lateral profile. On the basal view, alar slope angle and the angle between nostril axis decreased to 94° and 90°, respectively, also resulting in more natural looking nose (Fig. 4).

#### Case 3

A 18-year-old female had a rhinoplasty with a nasal tip plasty 6 months ago to correct a short, depressed nose. She was not satisfied with the lateral profile and the shape of the nasal tip, so she underwent a re-operation. Before the first operation, the nasolabial angle was 82° and the nasal tip projection was 1 : 0.52. Six months after the surgery, the nasolabial angle was 85° and the



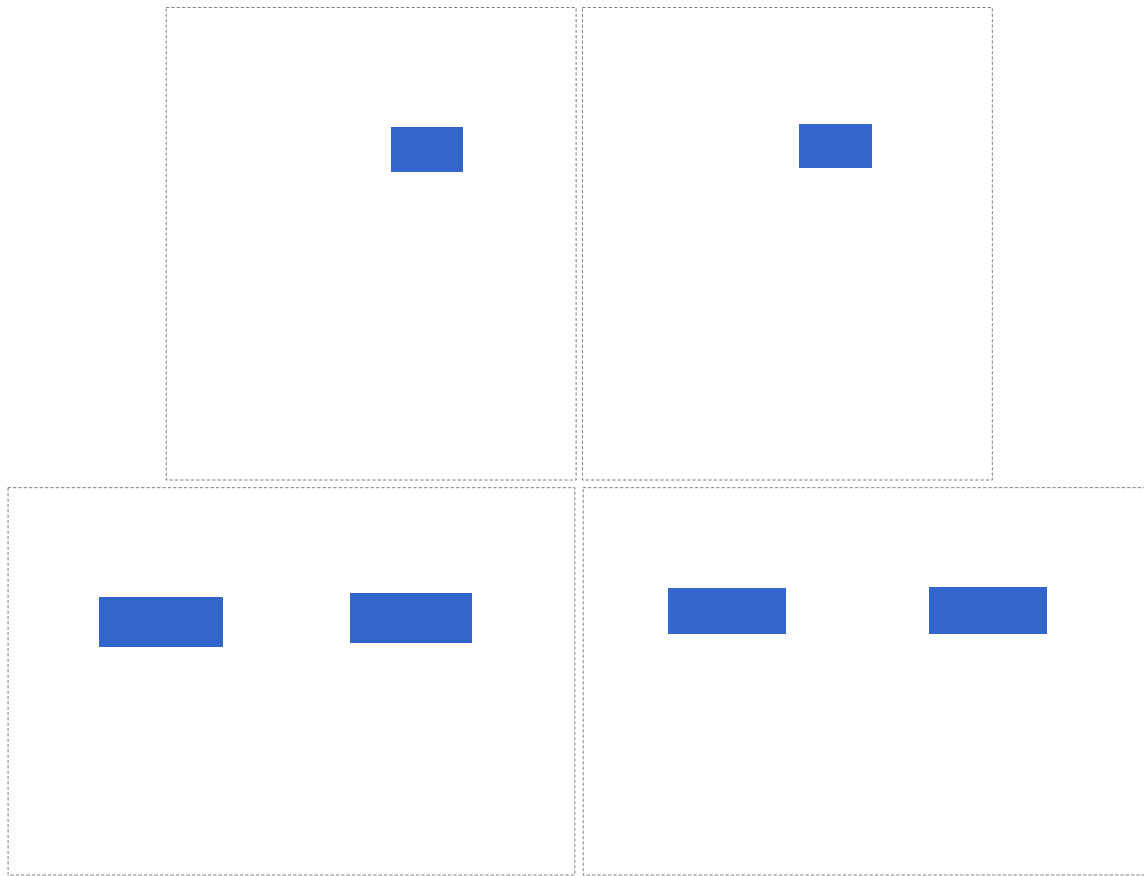
**Fig. 3.** Case 1. (Above, left) Preoperative lateral view of a 50-year-old female with unfavorable nasal profile. The nasolabial angle was only  $81.4^\circ$ , making her mouth look protruded and the overall face appear flat. (Below, left) Preoperative basal view. A short, depressed nose with a nasal tip dropping downward is noted. The alar slope angle was  $101^\circ$  and the nostril axis angle was  $100^\circ$ . (Above, right) Postoperative lateral view of the patient 3 weeks after augmentation rhinoplasty and nasal tip plasty. The nasal to facial ratio was optimized, the nasolabial angle was increased to  $97.5^\circ$  as the tip projects out more, and the nasofacial angle was  $31^\circ$  producing more natural-looking lateral profile. (Below, right) Postoperative basal view shows decreased alar slope angle ( $93^\circ$ ) and nostril axis angle ( $80^\circ$ ).

nasal tip projection was 1: 0.57. However, the patient felt the nose was still too depressed. Three weeks after the revision surgery, the nasolabial angle was  $91.5^\circ$ , nasal tip projection was 1: 0.64, and the lateral profile improved. The patient was satisfied with the final result (Fig. 5).

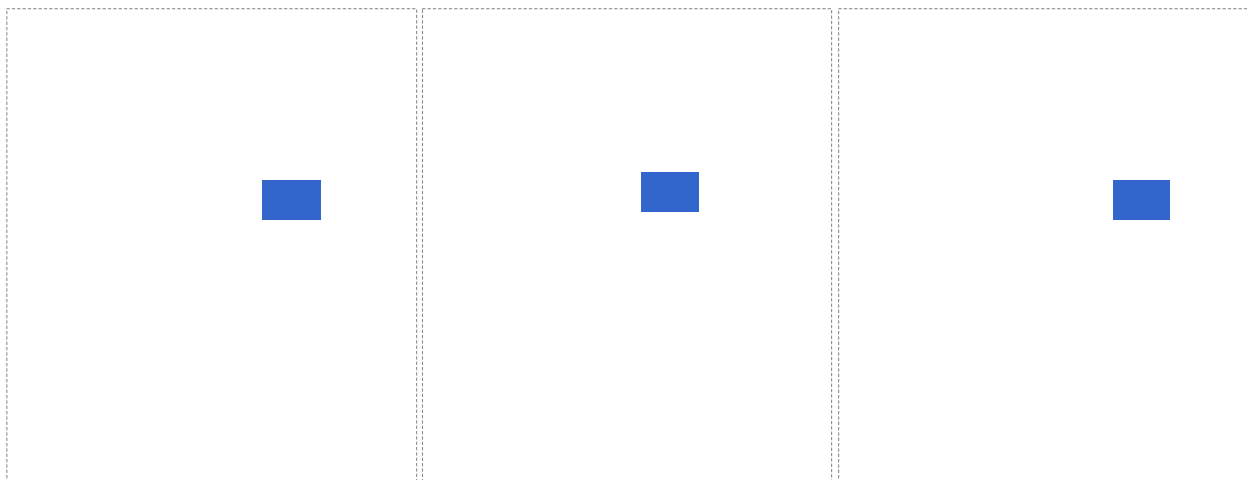
#### IV. DISCUSSION

The nose occupies the central portion, exerting a great effect on facial features and overall facial aesthetics. Considering the fine movement of its surrounding cartilage and muscles, the nose is an important organ with a delicate anatomical shape and physiological functions. At the same time, the nose projects out

as a three-dimensional structure. This makes the nose one of the major aesthetic organs that determines a person's appearance expressing dynamic beauty.<sup>4</sup> There are several characteristics of the nose in Koreans; the nasal length is short, the dorsum of nose is flat and low, the skin is thick with high tension, the skin has thick subcutaneous tissue with highly developed sebaceous glands, the nasal tip is bulbous, the nostril is wide, and the projection of the nose is limited due to a poorly developed alar cartilage with a short columella.<sup>5,6</sup> Because of these elements, augmentation of the dorsum and the tip should be performed together in order to create an aesthetically attractive nose that is harmonious. The basic element of an ideal nose is that it is in a proper proportion with the rest of the face. The nose should



**Fig. 4.** Case 2. (Above, left) Preoperative lateral view of a 24-year-old male with a nasal hump and unfavorable profile. The mouth appears to be protruded as the nasal projection ratio is 1 : 0.6 and the nasolabial angle is only 60°. (Below, left) Preoperative basal view. The alar slope angle and the angle between nostril axis were 103° and 125°, respectively. (Above, right) Postoperative lateral view of the patient 1 month after augmentation rhinoplasty with humpectomy and nasal tip plasty. With the more protruding nose, the nasolabial angle increased to 85.5° and nasal projection changed to 1:0.66, giving a more natural looking lateral profile. (Below, right) The alar slope angle and the angle between nostril axis decreased to 94° and 90°, respectively, resulting in more natural looking nose.



**Fig. 5.** Case 3. (Left) Preoperative view of 18-year-old female with unfavorable nasal profile. The nasolabial angle was 82° and the nasal tip projection was 1 : 0.52. (Center) Postoperative view of the patient 6 months after primary augmentation rhinoplasty and nasal tip plasty. The nasolabial angle was 85° and the nasal tip projection was 1 : 0.57. (Right) Postoperative view of the patient 3 weeks after revisional rhinoplasty. The nasolabial angle was 91.5°, nasal tip projection was 1 : 0.64. Increased nasolabial angle and tip projection and improved natural nasal profile are noted.

blend naturally with the three-dimensional appearance of the face. The nasal length should be equal to two thirds of the vertical length of the midface, and the width of alar base should be equal to the width of one palpebral fissure.<sup>1</sup>

Nasal measurements vary widely according to each individual's ethnicity. The measurements accepted to be aesthetically pleasing also vary according to the ethnic background. Han<sup>5</sup> reported that the nasal measurement of adult Korean males and females of age 20 years old to be as the following: the nasal length was 53.5 mm and 45.6 mm, nasal height was 17.5 mm and 15.8 mm, nasal width was 39.9 mm and 35.8 mm, nasofacial angle was 31.5° and 30.4°, nasolabial angle was 87.9° and 93.6°

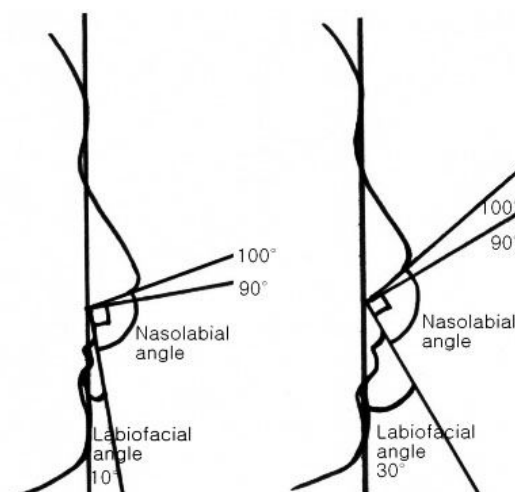
The aesthetically preferred nasal shape of Koreans is a nose with high dorsum and a prominent tip, with nasal measurements as the following: nasal root width was 13 mm in males and 10 mm in females, the ratio of interpalpebral width to nasal width was 95% and 114% (in males and females, respectively), nasofrontal angle was 135° and 140°, nasolabial angle was 100° in both males and females, nasofacial angle was 35° and 30~35°.<sup>7</sup> Ideally, the tip of the nose should be placed at the foremost position on lateral view, should be well distinguished from the dorsum, and the contour of the nasal tip should change its angle at the lowest point where the columella and alae meet. The nasolabial angle should be larger than 90°, the subnasale angle should not be too obtuse or too acute, the columella should be more than 2 mm lower and parallel to the alar rim.<sup>2</sup> The basal view of the columella and the outline of the nasal base should form an equilateral triangle. The ideal lobule-to-nostril ratio is 1 : 2. The nostrils should have a slight teardrop shape with the long axis from the base to the apex in a slight medial direction.<sup>8</sup> The columella-lobular angle is formed by the junction of the infratip lobule and is approximately 30~45°.<sup>9</sup> According to Byrd<sup>10</sup>'s analysis, ideal nasal length is assessed as a ratio of nasal length (RT) to tip projection (AT), 1.0 : 0.67.

In our study, the nasofrontal angle increased, while the nasofacial angle decreased. There seems to be a correlation between the increase in nasofrontal angle, the decrease in nasofacial angle, following augmentation rhinoplasty. The nasal root reveals a more remarkable alteration than the tip. It is because the support base of nasal root part lies on hard nasal bones, while the support base of nasal tip area lies on soft cartilages.<sup>11</sup> The skin tends to be thinner and looser in upper half of the nose. It is thicker and more adherent distally. Because of thick subcutaneous fibrofatty tissue under the skin of nasal lobule, soft tissue response to surgical alterations is not 1 : 1.12 The nasal root is more augmented than the tip, and the nasal inclination becomes more steep. And then, the nasofrontal angle increases and the nasofacial angle from the vertical facial line

decreases. Reduction of a bony hump with osteotomy and rasping can cause a decreased nasofacial angle.

Generally, the ideal nasolabial angle for Asians is 95~100° for females, and 90~95° for males. An angle smaller than this makes the nose look dropped downwards, give an appearance of dorsum atrophy, and gives an appearance of a prominent mouth because the maxillary alveolar bone appears projected relatively to adjacent structures.<sup>13</sup> The nasolabial angle increased significantly in our study. Although it did not exactly match the ideal figure, most patients were satisfied. When manipulating the nasolabial angle, the operator must be guided by the upper lip projection. To assess the projection of the upper lip from the face, we measured the labiofacial angle defined by the glabella-to-pogonion line (facial line) intersecting with the subnasale-to-labrale superius line. In our study, the range of the labiofacial angle ranged from 10° to 30° (data not shown). The more the upper lip protrudes from the facial line, the larger the labiofacial angle. If the nasolabial angle is adjusted to 95~100°, the nose will rotate upward quite and nostrils will be shown much. With this result, the patient might complain of visible nostrils and demand a revision surgery.

On the contrary, in cases where upper lip is almost parallel to the facial line, labiofacial angle is close to 0°. Even if the nasolabial angle is adjusted to 95~100°, the nostrils would not be shown much (Fig. 6). Thus, the operator should consider the upper lip projection and the labiofacial angle when adjusting the nasal projection and the nasolabial angle. Unsatisfied cases leading to reoperation were cases in which changes in the nasolabial angle after primary operation were excessive or



**Fig. 6.** (Left) If the labiofacial angle is 10°, when the nasolabial angle is adjusted to 95~100°, the nostrils will not be visible much. (Right) If the labiofacial angle is 30°, when the nasolabial angle is adjusted to 95~100°, the nose will rotate upward and nostrils will be shown.

insufficient, failing to achieve a favorable lateral view. Patient satisfaction was improved when this problem was corrected.

If the patient also has a small and posteriorly retruded mandible, the maxillary alveolar bone looks even more prominent. In order to correct this, columella strut formation was performed in this study as well as nasolabial angle augmentation in order to make a nasal tip projection. Furthermore, the nasal tip was put up and eminence formation was done by suture techniques of alar cartilages in order to induce nasal tip projection. In addition, conchal cartilage was sculpted in a shield shape and implanted to make a natural projection that goes naturally down the nose when seen from the lateral side.<sup>14</sup>

To make oval, tear drop shaped nostrils, we lengthened the nostrils. However, the lobule-to-nostril ratio changed very little in our study. This seems to be because the infratip lobule was also lengthened by the silicone implant insertion and tip surgery.

Surgeons tend to place greater importance to the lateral view when they judge postoperative results. In a study by Kim<sup>1</sup>, the five following elements were considered in order to make a nose that approximates an aesthetically and metrologically ideal state: First, the sellion, which is the starting point of the nose, should begin naturally at the double eyelid level when the eyes are open. Second is the nasolabial angle. Third is a natural exposure of the lobule and the dorsum. Fourth is the harmony between the position of the tip defining point and the dorsum. Fifth is the smooth lateral silhouette in a toe of a padded sock shape.

Analysis of the nose give objective datas for judgment of the postoperative result, as well as datas with which one can check whether the operation was done as intended and evaluate the operator's abilities. In practice, not every operator uses a protractor to measure nasal profiles during the operation. The operation result is judged subjectively by whether the nose forms a toe of a padded sock shape, with a smooth and aesthetic S-shape silhouette or whether the nose takes an appropriate proportion ratio with a face. Therefore, the operator's subjective appreciative eyes and experiences are very important.

Although further long term follow up and more operation experience are required to find additional elements in order to attain a more aesthetically ideal nose and apply those elements to actual operations, keeping the findings of this study in mind during rhinoplasty will allow the operator to make a more aesthetically beautiful nose, especially a nose with a more

attractive lateral silhouette.

## V. CONCLUSION

The following can be concluded from preoperative and postoperative anthropometric analysis. The most significant alterations made by augmentation rhinoplasty with nasal tip plasty were the increase in nasolabial angle, the decrease in nasofacial angle, and the decrease in nostril axis angle. Therefore, operators should place more consideration on these factors in preoperative planning and postoperative evaluation to not only reconstruct a nose that appears beautiful and attractive but also to satisfy patients as well as operators.

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