Prevalence of Occult Nostril Asymmetry in the Oversized Nasal Tip

A Quantitative Photographic Analysis

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Objective: To objectively determine the prevalence of occult nasal base asymmetry in adults with wide nasal tips using a standard photographic editing program.

Methods: We performed a retrospective observational study in a private practice, ambulatory care setting. The photographs of 100 randomly selected patients undergoing rhinoplasty who presented with excessive nasal tip width and no apparent nasal base asymmetry were evaluated for occult nostril asymmetry. Patients varied by ethnicity and sex and ranged in age from 16 to 40 years. We excluded patients with discrete nasal base asymmetry, crooked or twisted noses, caudal septal deviation, columellar tilt, a history of craniofacial trauma, or a history of nasal surgery. Measurements were obtained using a standard photographic analysis program.

Results: On the basal view, the median percentage of asymmetry (95% confidence interval) was 4.91% (4.17%-5.66%); on the frontal view, 4.66% (3.68%-5.62%). On the basal view, 73% of noses were at least 2.5% asymmetric; on the frontal view, 67% (McNemar P = .53). On the basal view, 48% of noses were at least 5% asymmetric; on the frontal view, 50% (McNemar P = .74). On the basal view, 11% of noses were at least 10% asymmetric; on the frontal view, 20% (McNemar P = .11).

Conclusions: A large percentage of individuals presenting with excessive nasal tip width and no obvious alar size discrepancies have nasal base asymmetry. Moreover, nostril asymmetry is demonstrated from the frontal and basal views with reasonable consistency. In a small subset of study patients, occult nostril asymmetry exceeded 10% of the total nasal base width. We postulate that clinically significant nostril size discrepancies are hidden by excessive tip width, and we speculate that these nostril size discrepancies become more apparent after surgical refinement of the oversized nasal tip, thereby potentially leading to unexpected postoperative cosmetic imperfections and patient dissatisfaction. The apparent frequency of (occult) nostril asymmetry in patients with excessive nasal tip width underscores the importance of nostril size assessment in the preoperative aesthetic analysis. We offer a reliable and convenient method for objective analysis of nasal base symmetry.

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ONE OF THE MOST IMPORTANT FEATURES WHEN EVALUATING THE NOSE IS SYMMETRY. ASYMMETRY SHOULD BE RECOGNIZED PROOPERATIVELY IN ALL APPLICABLE VIEWS OF THE NOSE, AND CORRECTION OF NASAL ASYMMETRY SHOULD BE A GOAL OF ANY SURGICAL PROCEDURE THAT SEeks TO ALTER NASAL CONTOUR. HOWEVER, IN THE EXPERIENCE OF ONE OF US (R.E.D.), ALAR BASE ASYMMETRY IS OFTEN DIFFICULT TO DISCERN IN PATIENTS WITH EXCESSIVE NASAL TIP WIDTH AND THEREFORE MAY LEAD TO UNEXPECTED COSMETIC IMPERFECTIONS DESPITE AN OTHERWISE SUCCESSFUL SURGERY. THEREFORE, A SIMPLE AND EFFECTIVE METHOD FOR DEMONSTRATING NOSTRIL SIZE DISPARITIES IS NEEDED FOR PREOPERATIVE NASAL ANALYSIS AND PATIENT COUNSELING.

The human nose is generally asymmetric; however, studies providing useful objective measurements are lacking. Furthermore, the methods used in past morphometric studies are difficult to replicate for daily use in a busy clinical practice. This is especially problematic when comparing photographs taken at varying distances, when using different cameras, or with changes in magnification. It is also challenging to perform with increased time constraints placed on physicians.

The purpose of this retrospective study was to objectively evaluate nostril asymmetry in individuals with obvious excessive nasal tip width but no apparent nostril size discrepancies. All patients were adolescents or adults of varying ethnicities without any history of nasal surgery,
Photographic consent was obtained from all participants. Four measurements (2 of the nasal base, and 2 of the nose on frontal view) were recorded retrospectively for 100 randomly selected healthy patients of varying ethnic backgrounds, aged 16 to 40 years, who presented with a wide or bulbous nasal tip and no apparent nasal base asymmetry. Patients presenting with crooked or twisted noses, caudal septal displacement, a history of craniofacial trauma, a history of rhinoplasty, or columellar tilt were excluded from the study.

Measurements were taken from high-resolution photographs of frontal (whole-face) and basal (close-up) views. Horizontal alignment of the face was standardized before measurement by rotating the photograph until both pupillary light reflexes were aligned with the horizontal plane. Although precise vertical alignment of the face requires a bite-block for absolute standardization, in this study vertical alignment was standardized by positioning the head in the Frankfort horizontal plane on the frontal view. In addition, only photographs that visually lacked axial rotation were used for analysis. All photographs were taken under the same lighting conditions using a digital camera (Nikon D70; Nikon Corporation, Tokyo, Japan) with a 60-mm macro lens and a single light source.

Measurements were recorded in pixels for each high-resolution photograph using the measure function of a commercially available photographic analysis program (MarketWise, version 8.0; United Imaging Inc, Winston-Salem, North Carolina). Measurements were acquired in the default calibration mode, in which pixel size is governed by image resolution. Because all measurements were obtained from high-resolution photographs, each measurement yielded a precise pixel count between the 2 designated measurement points. The same midline measurement point (along a single midline reference line) was used for the right and left nostrils, and the number of pixels was determined for each side. Values were expressed as a ratio of pixels between the right and left nostrils for the basal and frontal views.

To maximize identification of occult nasal asymmetry, measurements were taken from the basal and frontal views. On the basal view, positioning of the midline reference line was determined by measuring the narrowest point of the columella and then bisecting this line to determine the midpoint (Figure 1). The widest point of the nostril was used for each measurement. On the frontal view, a vertical line was drawn along what was perceived to be the sagittal midline of the nose because the columella was often hidden. As with basal measurements, nostril width was measured from this reference line to the widest part of the ala and then tabulated as a ratio of total base width (right to left ratio – 1). One investigator (S.D.R.) took all measurements. We compared the right and left sides of each patient.

For each patient, the ratio of the right-sided to left-sided unit measurements was calculated, and a value of 1.0 represented perfect symmetry. The percentage of asymmetry was defined as (right to left ratio – 1) × 100. To determine whether one view was consistently more likely to demonstrate asymmetry, the difference between views in asymmetry was calculated for each patient by subtracting the percentage of asymmetry on the frontal view from the percentage of asymmetry on the basal view. By this calculation, a positive value would reflect greater asymmetry on the basal view; a negative value, greater asymmetry on the frontal view. An a priori sample size calculation estimated that 98 patients would be required to identify a 1%-dif-
We analyzed the photographs of 100 consecutive patients (86 female and 14 male) aged 16 to 40 years. The median basal view unit measurement was 168 (range, 92-253). The median frontal view unit measurement was 60 (range, 42-95).

On the basal view, the median percentage of asymmetry was 4.91% (95% confidence interval, 4.17%-5.66%). On the frontal view, the median percentage of asymmetry was 4.66% (95% confidence interval, 3.68%-5.62%) (Figure 3). When we compared each patient’s percentage of asymmetry on the basal view to the percentage of asymmetry on the frontal view, there was no difference between views (Wilcoxon P = .47). The mean basal-frontal asymmetry difference was −0.07% (95% confidence interval, −1.15% to 1.00%), indicating that there was no tendency toward greater asymmetry on the basal or the frontal view. In 48 patients, the basal view was more asymmetric; in 51 patients, the frontal view was more asymmetric; and in 1 patient, there was perfect symmetry on both views. A scatterplot of basal-frontal asymmetry differences is shown in Figure 4.

Patients were then categorized according to the following 3 dichotomous thresholds of asymmetry: 2.5%, 5%, and 10%. On the basal view, 73% of noses were at least 2.5% asymmetric; on the frontal view, 67% (McNemar P = .53). On the basal view, 48% of noses were at least 5% asymmetric; on the frontal view, 50% (McNemar P = .74). On the basal view, 11% of noses were at least 10% asymmetric; on the frontal view, 20% (McNemar P = .11). For all 3 threshold levels, there were no differences in the rate of asymmetry between the matched basal and frontal views for each patient (Figure 5).

We then analyzed the correlations between the basal and frontal views of asymmetry. Using 5% asymmetry as a threshold, there was a statistically significant but weak correlation between the basal and frontal views (Spearman r = 0.22; P = .03). Similarly, when we compared the percentage of asymmetry between the basal and frontal views for each patient, there was a statistically significant but weak correlation between the 2 views (Spearman r = 0.24; P = .02) (Figure 6). The latter 2 significant correlations correspond to $r^2$ values of 0.06, indicating that asymmetry on one view is only able to explain 5% of the variability in asymmetry on the other view.

According to our findings, a large percentage of patients presenting with excessive nasal tip width and no obvious alar size discrepancies have nasal base asymmetry. Moreover, nostril asymmetry was demonstrated from the frontal and basal views with reasonable consistency. On the...
basal and frontal views, the average percentage difference in width of one side compared with the other was approximately 5%. Most patients (67%-73%) had a small (>2.5%) degree of asymmetry, but as many as 20% had occult asymmetry greater than 10%. Despite designing this study with adequate statistical power to identify small differences in the prevalence of asymmetry between views, we did not identify a higher degree of asymmetry on the basal or the frontal view. However, because the correlation between measurements on either view was weak, we recommend using both measurements.

The frequency of occult alar base asymmetry observed in this study leads us to postulate that clinically significant nostril size discrepancies are more difficult to appreciate in the bulbous or wide-tipped nose. More important, we also speculate that surgical reduction of the nasal tip width in this patient population may unmask formerly hidden nostril asymmetry and thereby taint the cosmetic outcome. If true, this underscores the importance of careful preoperative analysis to identify occult nostril asymmetry and the importance of counseling patients seeking surgical refinement of the overly wide or bulbous nasal tip. Accordingly, this study offers a reliable and convenient method for objective analysis of nasal base symmetry using a commercially available photographic imaging program. Once practiced, this method can be incorporated into any preoperative discussion concerning rhinoplasty.

In a study by Nouraei et al,7 objective preoperative and postoperative nasal measurements of patients undergoing rhinoplasty (performed with methods similar to those of the present study) indicated improved symmetry of the noses postoperatively. This also corresponded to the perceptual analysis by observers that the entire face became more symmetric. Thus, the nose centered on the face plays a large role in the perception of facial symmetry.

Refinement of the tip in rhinoplasty is challenging because of the complex 3-dimensional shape of the framework involved, the "memory" of the cartilages, the need to obtain symmetry in likely asymmetric lower lateral cartilages, the thickness of the skin overlying, and the unpredictable impact of postoperative scarring. These factors make the final outcome of the tip difficult to predict, especially if the nose is asymmetric at the start. Discussion with the patient must include this possibility of continued asymmetry, which may alter postsurgical expectations. The determination of which threshold (2.5%, 5%, or 10%) is clinically and cosmetically significant may vary among patients and should be individualized after a discussion between the patient and surgeon.

A potential limitation of our study may include an issue regarding observer subjectivity because the senior investigator (R.E.D.) selected patients on the basis of having what appeared to be a straight and symmetric nose on the frontal view. This method of patient selection invariably introduces subjectivity into the cohort of analyzed patients. We attempted to minimize this subjectivity with a large sample of patients of diverse ages and ethnicities. However, it is possible that others might be slightly more or less inclusive in defining clinically apparent asymmetry. Nevertheless, cosmetic rhinoplasty is a visual art form in which visual impressions supersede objective measurements. In essence, if the nose appears symmetric, it is symmetric, and vice versa. Moreover, although this study did not investigate the effect of tip reduction on the perception of asymmetry, we suspect that a narrower lobule amplifies the visual impression of asymmetry, making widespread occult asymmetry an important clinical finding. Indeed, the importance of unmasking visually inapparent nostril asymmetry as it relates to patient satisfaction cannot be overstated.

Although other studies have attempted to perform objective analysis of the nose, most methods have lacked applicability to clinical use.7-6 Past studies have analyzed ethnic differences in the size and orientation of the nostrils,4-6 as well as nostril asymmetries and asymmetry of the soft tissues surrounding the nose. In 1983, Farkas et al performed a morphometric study on standard nostril types. That study used a protractor on 243 individuals of varying ethnicities. The authors made observations of the soft-tissue nasal dimensions based on the patient's nostril type. Their work continued in 1984, when they examined asymmetries in nostrils and the surrounding soft tissues of the nose in 156 white patients. They measured deviations of the columella and nasal bridge, the length of the columellar rims, the inclination of the longitudinal axis of the noses, and the difference in the level between the alar bases and the side of the lower base. They concluded that columellar deviations, columellar length asymmetry, and alar base dislocations occurred more frequently to the left, whereas nasal base dissections and septal dislocations occurred more often to the right. The studies by Farkas and coworkers5-7 provided numerous observations and objective measurements regarding the morphometrics of a random cross-section of white noses, providing normative data for further studies.

In 2003, a study from South Korea examined the morphometry of the nasal base and nostrils specifically in Koreans. That study was performed using digital photographs and "drawing" computer software. Although the method in that study could be useful in the clinical setting, this particular software was not used in normal preoperative planning, and measurements required a separate analysis. Furthermore, the study was limited to 1
ethnicity. A study in 2009 by Rosati and coworkers used silicone-based impressions of the noses cast in dental stone. Subsequently the plaster models were digitized. Although this offered a 3-dimensional evaluation of the nose, the procedure required much effort and labor on the part of the examiners. To our knowledge, our study is the first to use a simple and novel method to make morphometric observations in a specific subset of noses. The Nouraei group has developed software for Microsoft that automates many of the measurements taken manually in their study. However, the program demonstrates many of the standardization issues that limit the present study. It also involves porting the photographs to an additional program, whereas measurements in our study were easily performed within the existing archiving and imaging software program.

In conclusion, a large percentage of patients presenting with excessive nasal tip width and no obvious alar size discrepancies had occult nasal base asymmetry. We postulate that clinically significant nostril size discrepancies are visually concealed and deemphasized by excessive tip width. More important, we speculate that nostril size discrepancies may become more easily apparent after surgical refinement of the oversized nasal tip, thereby potentially leading to unexpected postoperative cosmetic imperfections. We offer a reliable and convenient method for objective analysis of nasal base symmetry, and we recommend careful preoperative evaluation and counseling in all patients undergoing surgical reductions in nasal tip width.

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REFERENCES