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Original Research

Digital Analysis of Soft Tissue Nasal Anatomy for Individual Treatment Planning

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ABSTRACT

Objective: Changing contour lines of the external nose following traumatic, aesthetic and tumour surgeries have become very trendy. The goal of this research is to study the several soft tissue landmarks, measurements (linear distances, ratios, angles) of the external nose and its nasal indicis using a computer program.

Methods: Face region were taken a photographs of the two hundred adults. Analyses of linear (the lengths of nares, nasal bridge, and columella and nose height, nares width) and angular analyses (angles of nasofrontal, nasolabial and nasal tip) were computed and averaged for gender with age.

As for the shape of the nose, it was categorized as subunits: nasal tip (sharp, normal, wide, protrusive and asymmetric), nasal base (normal, wide, asymmetric) nasal alae (normal, thick, thin, asymmetric), nares (normal, horizontal and asymmetric) and columella (normal, wide, short and bifid) nasal base, nares, nasal alae, columella and classified subunit as normal, protrusive, sharp, asymmetric, and wide.

Results: The nose height have to 49.05 ± 3.48 mm in young male adults, 50.37 ± 2.33 mm in young female adults. Distance lengthwise the nasal bridge have to 48.60 ± 3.24 in males, 37.09 ± 5.49 females. The two mean measured nasal lengths were significantly greater in men. At the same time, angular measurements for nasolabial and interalar were higher in males. Nasal tip angle was 127.47 ± 82.9° in males, 75.8° in females. On average, young male adults had larger nasal linear distances such as nasal bridge length, nares lengths and nares widths relation of height than young female adults ($p<0.01$); No gender differences were observed for columella widths and to nose height ratio ($p<0.01$). The nasofrontal, nasal tip, nasolabial and interalar angles showed statistically significant differences among young male adults and young female adults ($p<0.05$). The nasolabial angle exhibited considerable variability. The shape details of nares was showed large variability. Nasal base, nasal tip and nasal alae shapes were similar, nares asymmetry was more frequently compared with other features.

Conclusions: The Anatolian people's nose exhibits wide nasal tip, has a wider nasal base, and is more thicker at the alae, with wider definition of the columella. The significant gender differences of nasal shapes were found. The wide and sharp features of nasal tip were related to an important features in men, whereas asymmetric nares were dominant in young female adults. Using digitized reference details, this study helped define the best cosmetic surgery recreate the nose and increase the success of customized therapy. Also, our findings facial alteratios, facial reconstruction, personal identification, Trauma assessments may also have data banks based on age and gender.

Keywords: aesthetic surgery, columella, facial aesthetics, facial analysis, nose, nasal tip, nares, nasal alae.

INTRODUCTION

The nose is the most characteristic feature of the face and it can create a beauty of the face and attractive appearance to the face.[1,2] Since interest in cosmetic surgical procedures has increased in recent decades, a great deal of research has been done to examine and refine the cannons through which beauty can be measured.[2,3] The appearance of nose such as the size, protrusive shape, and asymmetry are important features of facial beauty (Fig. 1).[3,4-5] Definition of ideal nose changes as age, gender, ethnic, culture, and current fashions. The ideal definition is complete with a well-defined nasal end and with the right balance between the two nares.[6,7-8] The upper face anatomy has various relationships among of the cartilaginous and the osseous overlying skin.[9,10-11] Nasal reconstruction including congenital defects and secondary defects such as tumor resection or traumatic injury require redesigning with aesthetic and reconstructive approach.[12,13-14] Knowledge of nasal dimensions and form is essential for repairing and reconstructing an aesthetic nose. Various authors have included soft tissue parameters in photogrammetric analyses and various soft tissue facial analyses based on a standard photogrammetric approach. [15,16-17]

Quantitative practice as computerized photogrammetry and di-

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Figure 1. Views of frontal and basal soft tissue of nose.

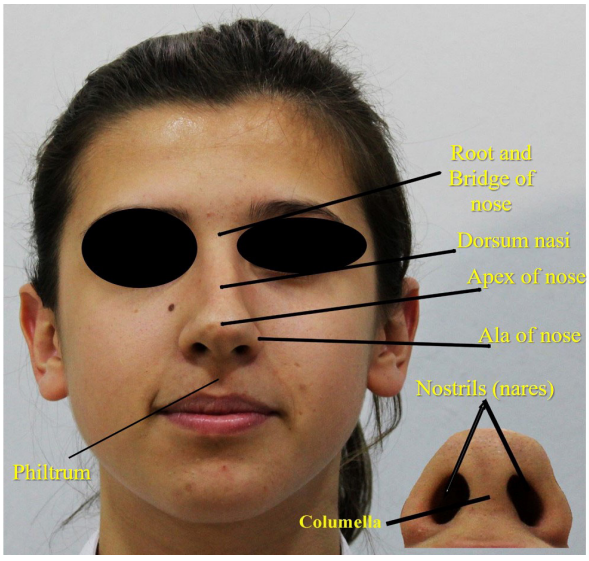


Figure 2. Frontal (**A**), lateral (**B**) views of some linear and angular measurements with soft tissue landmarks. glabella (**g**), nasion (**n**), pronasale (**prn**), subnasale (**sn**), ala (**al**).

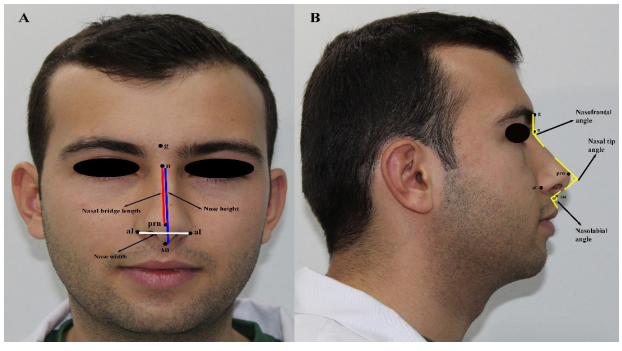
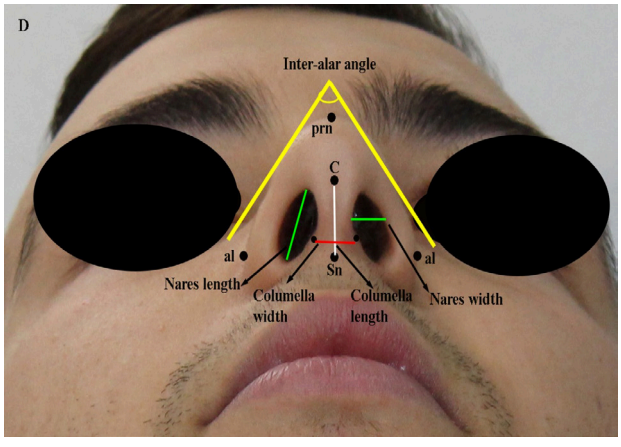


Figure 3. The nasal tip and columella in relation to the selected reference points: Linear and angular measurements. Columella ©, subnasale **(Sn)**, pronasale (**prn**), ala (**al**).



mensional imaging are utilized for analysis soft tissue of the nose with guide landmarks as the linear and angular measurements defining the patterns of nose.[18,19] It is important to save detailed nose measurements in order to plan an individual treatment protocol for each patient. The goal of this research (1) to apply digitalized reference norms from standardized photographs, (2) to find gender differences, and (3) to check against features of Anatolian patterns with that of other researchers studying nasal beauty.

METHODS

2.1 Subjects

100 young male adults and 100 young female adults (19 - 21 years old) no nose surgery, no traumatic effects and congenital syndromes to the nose were selected. The resulting demographics included age, birth rate and parental inheritance. This study was endorsed by duly incorporated individuals Ethical Committee at Research (Date: May 16, 2014, Decision no: 659/311). Each individual who participated in the study voluntarily declared to participate in the study by filling out the informed consent form.
2.2. Collection of nasal landmarks

Personal photographs were taken from the standard distance by same researcher. Photographs of each individual's face (frontal, left side, right side and basal side) were taken (Figs. 2 and 3). The pictures were used to calculate the distances and angles using Image J 1.48v software (Fig. 4). All measurements were obtained by the same investigators. All nasal points used for measurements have been described in detail as indicated in Figures 2, 3 and Table 1. The linear parameters (nose height, nasal bridge length, nose width, columella width, columella length, nares length and nares width) were extracted. Angles of nasofrontal, nasolabial, nasal tip, inter alar were calculated (Figs. 2,3 and 4) , (Table 1).

2.3. Statistical Analysis

The statistical analysis was carried out using SPSS 22.0 for Windows (IBM Corporation, New York, USA). The results were analyzed using the mean value, the standard deviation, the estimate of the population average with a 95% confidence interval, and the Student test t with meaning was established at P;< 0.05).

Main Points:

- Nares asymmetry was more frequentin young male adults compared with other features. However, the same group of young female adults reported lower values for nasal bridge length, nose width, and nares measurements.
- On average, young male adults had larger nasal linear distances such as nasal bridge length, nares lengths and nares widths and height ratio than young female adults.
- With assistance from digitized reference details, in our study has helped determine the best aesthetic design remedy for the nose in addition to Improve successful reconstruction treatment.

Tablo 1. Linear and angular distances measured between two different points are shown below: (n:200, mm: millimeters).

Linear Analysis	AVE	STD	MAX	MIN	p value
Nose height	M= 49.08 F= 50.37	M= 3.48 F= 2.34	M= 53.65 F= 53	M= 34.77 F= 38.27	0.025
Nasal bridge length	M= 48.6 F= 37.09	M= 3.24 F= 5.49	M= 53.22 F= 49	M= 36.12 F= 27.55	0.014
Nose width	M= 33.23 F= 32.57	M= 2.8 F= 2.18	M= 41.22 F= 39.22	M= 23.44 F= 23.66	0.026
Columella width	M= 7.94 F= 7.82	M= 1.59 F= 1.62	M= 11.4 F= 11.3	M= 4.1 F= 4.8	0.033
Columella length	M= 9.15 F= 8.64	M= 1.62 F= 1.43	M= 14 F= 11.3	M= 5.4 F= 4.8	0.038
Nasofrontal angle	M= 133.73 F= 130.94	M= 6.24 F= 5.71	M= 145 F= 141.43	M= 112 F= 118.53	0.049
Nasal tip angle	M= 82.91 F= 75.81	M= 12.08 F= 8.49	M= 109 F= 97.32	M= 60 F= 62.99	0.028
Nasolabial angle	M= 83.53 F= 91.91	M= 12.65 F= 5.76	M= 113 F= 105.77	M= 57 F= 77.44	0.016
Inter-alar-angle	M= 89.15 F= 91.97	M= 8.73 F= 5.77	M= 108.5 F= 105.77	M= 71 F= 77.44	0.029
Nares length ®	M= 9.33 F= 8.09	M= 1.68 F= 1.32	M= 14.5 F= 12	M= 6.4 F= 6	0.045
Nares width ®	M= 6.06 F= 5.80	M= 1.12 F= 1.35	M= 8.7 F= 8.7	M= 3.9 F= 3.3	0.019
Nares length (L)	M= 9.27 F= 7.98	M= 1.55 F= 1.19	M= 13.7 F= 11.4	M= 6.4 F= 5.4	0.015
Nares width (L)	M= 6.1 F= 5.89	M= 1.07 F= 1.02	M= 8.6 F= 8.3	M= 4.3 F= 4.1	0.032

Significant P level of < 0.05.

Tablo 2. Nose shape analysis and values (n: 200, mm: millimeters).

Shape nose	Nasal tip	Nasal base	Nasal alae	Nares	Columella
Normal	M= 43 F= 54	M= 70 F= 70	M= 53 F= 60	M= 62 F= 61	M= 29 F= 39
Wide	M= 31 F= 26	M= 28 F= 29	M= 0 F= 0	M= 0 F= 0	M= 40 F= 32
Sharp	M= 17 F= 11	M= 0 F= 0	M= 0 F= 0	M= 0 F= 0	M= 0 F= 0
Protrusive	M= 7 F= 6	M= 0 F= 0	M= 0 F= 0	M= 0 F= 0	M= 0 F= 0
Asymmetric	M= 7 F= 3	M= 2 F= 1	M= 1 F= 7	M= 22 F= 25	M= 9 F= 0
Thick	M= 0 F= 0	M= 0 F= 0	M= 37 F= 23	M= 0 F= 0	M= 0 F= 0
Thin	M= 0 F= 0	M= 0 F= 0	M= 9 F= 10	M= 0 F= 0	M= 0 F= 0
Horizontal	M= 0 F= 0	M= 0 F= 0	M= 0 F= 0	M= 16 F= 14	M= 0 F= 0
Short	M= 0 F= 0	M= 0 F= 0	M= 0 F= 0	M= 0 F= 0	M= 22 F= 14
Bifid	M= 0 F= 0	M= 0 F= 0	M= 0 F= 0	M= 0 F= 0	M= 9 F= 15

Figure 4. Measurement of the nasofrontal angle using Image J 1.47 version.

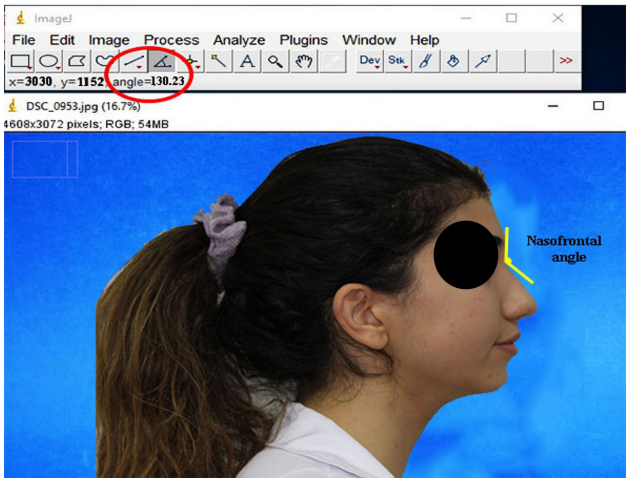


Figure 5. Specimens of nasal tip as normal, sharp, asymmetric, protrusive and wide cases.

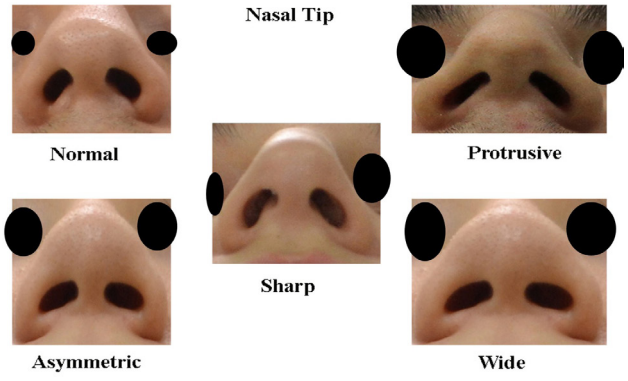
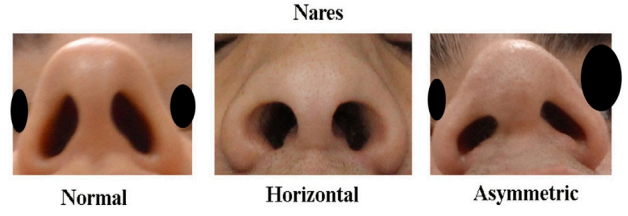


Figure 6. Specimens of nasal base as normal, asymmetric and wide cases.



2.4. Shape analysis

Nasal shape analyses were controlled by another researcher. Shapes of nasal tip (sharp, normal, wide, protrusive and asymmetric) (Fig. 5), nasal base (normal, wide, asymmetric) (Fig. 6), nasal alae (normal, thick, thin, asymmetric) (Fig. 7), nares (normal, horizontal and asymmetric) (Fig. 8) and columella (normal, wide, short and bifid) were determined (Fig. 9), (Table 2).

RESULT

Demographic Data

All subjects were of purely Anatolian descent.

Nasal Soft Tissue Distances

The distances of the external nose in connected to the marked reference landmarks were presented in Table 1. The nose height was 49.05 ± 3.48 mm in males, 50.37 ± 2.33 in young female adults. Length of nose bridge 48.60 ± 3.24 in males, 37.09 ± 5.49 in females. The two measured mean nasal reference lengths computed a much greater value in young male adults. The angle of the nasal tip was much more pronounced for females than for males. (males = 82.91° ± 12.08, female = 75.80° ± 8.49, p;<0.001). On average, young male adults had larger nasal linear distances such as nasal bridge length, nares lengths and nares widths and height ratio than young female adults (p;<0.01); no gender differences were found in the columella widths and nose height ratio (p;<0.01). The nasofrontal, nasal, nasolabial and interalar angles exhibited statistically significant gender differences (p;<0.05). The nasolabial angle exhibited great variability of 57 to 113 degrees. It was much more common among females than males (young male adults = 83.53 12.65, young female adults = 91.91 5.76, p;<0.05). The details of nostril shape also showed large variability. Nasal base, nasal tip and nasal alae shapes were similar. Nares asymmetry was more frequent in young male adults compared with other features. However, the same group of young female adults reported lower values for nasal bridge length, nose width, and nares measurements.

Analysis Results of Nose Shape

The shape of the nose in 200 adults was analysed with respect to the nasal tip, nasal base, nasal alae, nares and columella (Figs. 3,4). The Anatolian people's nose exhibits wide nasal tip. It has a wider nasal base, and is thicker at the alae, with wider definition of the columella. Significant gender differences were observed in the beauty classifications of nasal forms. Wide and sharp features of nasal tip were related to a substantial fraction in young male adults, whereas asymmetric nares were predominant in young female adults (Table 2).

DISCUSSION

Asymmetries, deformities and irregularities of the nasal region have a basis symbol on the sensation of face beauty (Figs. 5-8). The majority of women reported to change a disliked nasal feature mostly thought of as unattractive (54%).[20,21] Probability of irregularities has been detected to play a critical role in its reconstruction in personalized procedure for facial beauty (Figs. 5-8). It is possible to shorten and reshape nose with operative efforts or with non-surgical techniques We know that nose surgery is the most common procedure.[17,22]

Nasal morphology and morphometry are valuable in establishing treatment expectations and identifying a primary for monitoring evaluation of algorithm effectiveness.[23] In addition, the achievement of cosmetic goals with minimal damage to adverse events requires knowledge of the morphology of the nose, clinical experience in the use of various surgical and non-surgical injection techniques. Various materials as cartilage, expanded

Figure 7. Specimens of nasal alae as normal, thick, thin and asymmetric cases.

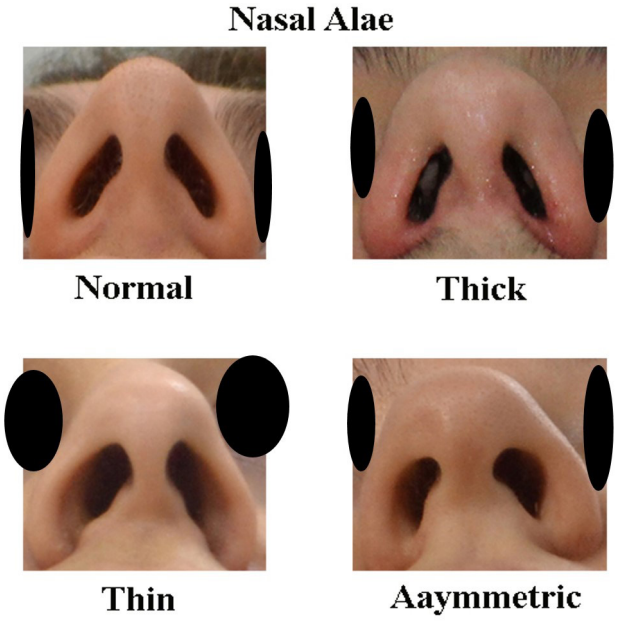


Figure 8. Specimens of nares as normal, horizontal and asymmetric cases.

Figure 9. Specimens of columella as normal, short, wide and bifid cases.

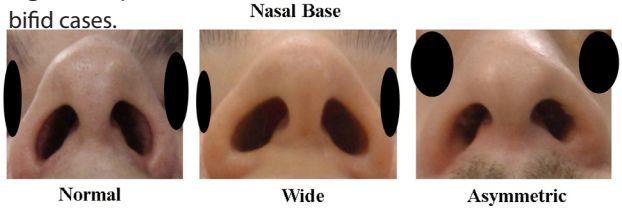
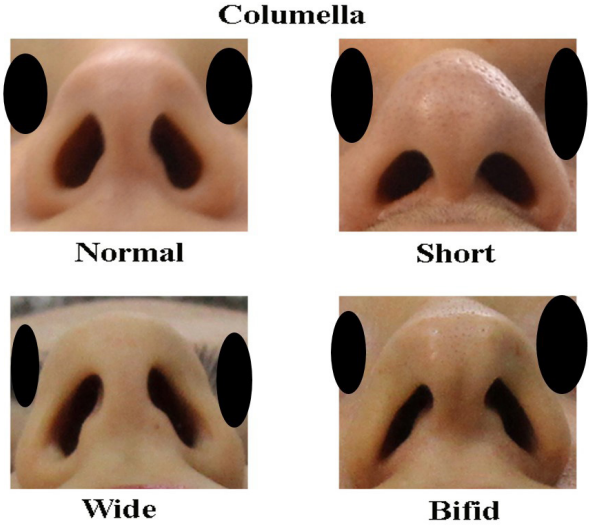


Figure 9. Specimens of columella as normal, short, wide and bifid cases.



polytetrafluoroethylene and silicone are commonly used for dorsal nasal enhancement. Hussein et al. reports that sub-period nasal implants have been practiced on a large scale for dorsal nasal augmentation and nasofrontal angle shift.[18,23] As a result, non-surgical and surgical nasal redesign procedures should be based on recording patient-specific morphometric calculations and evaluating them on ethnic models.[24]

Along with many other racial or ethnic populations, plastic surgery will take into account racial or ethnic differences in planning and performing rhinoplasty.[19,22-25] An anthropometric nasal analysis is investigate among various populations as groups of Koreans, Chinese, Mexicans, Africans, Americans, Indians and Persians.[26,27] Korean women show a greater angle to measurements of the nasal, nasofacial and nasofrontal extremities.[27,28]

Women in Korea have higher values for nasal index, nasal root width and height index, and Simon ratio. Published standards for young North American white adult women show greater glabellonasal, nasolabial and nasomental angles.[29] The white group of North American also exhibits a more pronounced wing slope and inclination of the nostril axis.

This study examined many anthropometric measures of the nose of young adult Anatolians. The two average measured lengths of the nasal markers were much greater in young male adults. On average, men had more linear nasal distances such as the length of the nasal bridge, the length of the nares and the width of the nares in relation to the height, than young female adults (p;<0.01); no gender differences were found between the width of the columella and the height ratio of the nose (p;<0.01).

The nasolabial and interalar angular measurements were larger in young male adults (Table 1). The nasofrontal, nasal tip, nasolabial and interalar angles displayed statistically significant gender differences (p;<0.05). The nasal tip angle was narrower in females than in males. The shape details of nares showed large variability. Nasal base, nasal tip and nasal alae shapes were similar (Figs. 5-9). Nares asymmetry was more frequent compared with other features (Table 2).

The Anatolian people's nose exhibits wide nasal tip, has a wider nasal base, and is thicker at the alae, and the columella is wider (Table 1). Aesthetic classifications of nasal forms exhibited significant gender differences. The broad, acute features of the nasal end were associated with a substantial fraction in young male adults, while asymmetrical nares predominated in young female adults. The morphometric results of the nostril symmetry were as follows: The normal aspect of the nostrils is reflected across the hole. In light asymmetry, one side of the nose measured a difference of 1 mm in length or width of the standing nares. In moderate asymmetry, one side of the nose differed from the remaining nares by 1.1 to 2 mm in length or width. In severe asymmetry, one side of the columella displayed a >2mm difference in width or in length of the nares at repose.[30] Nares asymmetry with 24% of frequency was present in every one fourth, which is a high rate.

In present research, digitalized morphometrical and morphological patterns of the nose with standardized photographs determined from normal subjects. Our results also showed that facial alterations, facial reconstruction, personal identification and trauma assessment can also benefit from age- and gender-based databases.

In nasal surgery, it is important to check and standardise the modification of copies of previous measurements and after the operation.[19,28-31] This research shows that detailed measurements of the nose play a significant role in algorithmic planning concerning the aesthetic profile. In men, nose would occupy a much greater proportion. It might have a bigger aesthetic impact. Present research, not only focused on the nasal morphometrical findings to obtain the gender differences but also proposed an algorithm for morphological details. The Anatolian people's "ideal/attractiveness nose" manifests wide nasal tip, and nasal base, and is thicker at the alae with wider columella.

Using computerized methods is more useful in controlling nasal angles and nares.[32,33] One of them is to provide repeating nasal measurements anytime, and add new landmarks. Another advantage is desired in standard parameters.[34,35] The first point is to carry out a detailed knowledge of the geometric shapes and the mathematical value of the nasal zone for the reconstruction specific to the patient. Secondly, the identification of the surface analysis would provide an advantageous overview of how to reach the ideal nasal anatomy in terms of customized nasal measurements and the attractiveness of the patient's face. The use of computer technology also representing the nasal form of Anatolian men and women was investigated. The nasofrontal, nasal, vertical nasal, and nasal dorsum angles demonstrated statistically significant gender differences.

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Ethical Committee: The scan protocol was conducted in accordance with guidelines from The study was approved by the suitably constituted Ethical Committee at Research of Ege University (Date: May 16, 2014, Decision no: 659/311).

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