Aesth Plast Surg (2019) 43:1028–1033
https://doi.org/10.1007/s00266-019-01356-y

Objective Assessment of Nose Tip Light Reflections in Rhinoplasty

Arın Öztürk[1] · Tevfik Sözen[2] · Halil Bülent Karcı[1] · Sercan Göde[1]

Received: 21 November 2018 / Accepted: 10 March 2019 / Published online: 22 March 2019

Abstract
Purpose To assess the objective and subjective analysis of facet and infratip lobule in postoperative digital pictures of rhinoplasty patients and compare them with the people with good-looking noses. With the help of simple software that measures the brightness of the pixels, we investigated the relation between light reflections and patient satisfaction.
Methods egardless of the technique, forty patients who underwent external open approach rhinoplasty were selected randomly. Twenty participants with a good-looking nose without operation history were selected as the control group. Digital Color Meter® in MacOS X® was used for measuring the brightness of the facets and infratip lobule. As a subjective outcome measure, the visual analog scale (VAS) was used and compared with brightness ratios.
Results The mean brightness ratios and VAS of operated noses were statistically low from the control group. There was a significant positive correlation between brightness ratios and VAS in all groups.
Conclusion Our study presents the results of a simple method of measuring the light reflections of the nose tip. Noses with a good aesthetic outcome have more symmetric and subtle facets and infratip lobule. This method was feasible, and its results were correlated with patients' aesthetic perceptions.

✉ Arın Öztürk
arinozturk@yahoo.com

[1] Otolaryngology Department, Ege University School of Medicine, 35100 Bornova, Izmir, Turkey

[2] Otolaryngology Department, Hacettepe University School of Medicine, Ankara, Turkey

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Keywords Facets · Light reflections · Nasal tip · Rhinoplasty · Soft triangle

Introduction

Creating an attractive nose is the primary aesthetic goal of rhinoplasty. The common point to achieve aesthetically pleasing and natural looking noses is creating smooth transitions, harmony, and symmetry between lights and shadows. Many authors used nasal surface analysis through the light reflections for defining the attractive nose in their studies [1–4]. They described subunits of the nasal surface as geometric shapes, and there were also aesthetic lines and breakpoints. The nose tip unit, the most complex anatomic one, has many subunits. It includes the dome triangles, lateral crura, interdomal triangle, facets, infralobular polygon, columella, and the footplate [1]. With three-dimensional analysis, Toriumi described the favorable nose tip as properly located shadows [2].

Facets (or soft tissue triangles) are adjoining subunits of the nose tip, polygon shape between the inferior tip, medial rim, lateral rim, and columella break point [2, 3]. Underlying soft tissue and intermediate crura of alar cartilages are the main supports of facets. Also, the domal angle directly defines the shape of facets. They are located between the nose tip lobule and the alar lobule. Disharmony between these two anatomic subunits may end up with notching.

An objective facial analysis is usually based on measurements of such as angles between subunits and length of structures. Recently, three-dimensional surface imaging systems brought a new perspective to facial analysis [4]. Their limitation in clinical use is a handicap for their broader applicability. Subjective ratings on patients' photographs are usually used for postoperative analysis of rhinoplasty. This condition creates a handicap about defining the specific pathology of the framework that lies under the nasal surface. Numeric definition of colors that allows statistical analysis for researchers is used as an objective method in many scientific fields. Objective evaluation through the color measurement and definition of shadow characteristics of many subunits may give a chance to perform a statistical analysis. Thus, various pathologies of the operated noses can be presented with an objective comparison with good-looking noses. Our hypothesis is that one can objectively and quickly assess the light reflections on the nasal surface that may have a role in the prediction of the cartilage framework. There is no previous study that evaluated the light reflections on the nasal surface to predict the facet, rim, and infratip lobule support.

The new cartilage framework of the nose tip can create different light reflections on the nasal surface. The shadows on the nose tip skin may reflect the underlying cartilage framework. Our aim was to assess the objective and subjective analysis of facets and infratip lobules in postoperative digital photographs of rhinoplasty patients and to compare them with people with good-looking noses. With the help of a simple software program that measures the brightness of the pixels, we investigated the relation between light reflections and patient satisfaction.

Materials and Methods

This retrospective study was carried out on sixty participants' digital pictures. Forty of them were in the rhinoplasty group that underwent an external open approach rhinoplasty in a rhinology clinic of a tertiary medical clinic between May 2013 and April 2017. Regardless of the technique, patients were selected randomly from the archives of three different senior rhinoplasty surgeons. Twenty participants, each with a good-looking nose and without a history of nasal surgery, were selected as the control group. All procedures performed in the study were in concordance with the ethical standards of the institutional and/or national research committee and the Declaration of Helsinki in 1964 and its subsequent amendments or comparable ethical standards. We obtained informed consents from all of the participants in the study.

Patient Selection

Regardless of the surgical technique, forty patients who underwent open approach primary rhinoplasty were selected as the rhinoplasty group.

Twenty participants with non-operated good-looking noses were selected as the control group. We performed the 10-Item standardized cosmesis and health nasal outcomes survey (SCHNOS) [5] to the group of people that were chosen subjectively as having good-looking noses with favorable nose tips by Toriumi's ideal nose tip contour description [2]. Twenty of them were selected who had a SCHNOS score lower than ten.

Revision cases, severe septum deviations, and crooked noses were excluded from the study to overcome the adverse effect of other causes on the facet, rim, and infratip lobule problems. Age, gender, comorbidities, trauma, previous functional complaints were neither inclusion nor exclusion criteria.

As an inclusion criterion, no structural graft was used for facet or rim reconstruction in any patients in the rhinoplasty group according to operative reports. The minimum follow-up period was 1 year for each group. All patients were primary cases and had standard preoperative and postoperative facial photography for rhinoplasty. There was an informed consent related to photography, including the permission for publication of all patients and the control group who were included in the study.

Procedure and Instrumentation

Measuring the highlights and shadows of digital photos requires computer software. Digital Color Meter is free software in MacOS X® that provides the color of pixels of digital images. All colored digital images were converted to black and white. In black and white form, Digital Color Meter shows one value as the mean of red, green, and blue (RGB) that we noted as the luminance intensity of the pixel (0–255) (Fig. 1). An otolaryngologist who did not participate in the operations made the color measurements.

We performed a standardized rhinoplasty photography procedure for each patient. The same medical photographer took frontal, lateral, three-quarter, basal, and sky views in a standard photography room setup. Each patient stood 2 m away from the camera, and the visual axis was parallel to the floor of the room for the frontal, three-quarter, and lateral views. The camera head was horizontal to the lens of the camera (Nikon f2.8 105-mm macro-lens, Nikon, Japan). A single camera-mounted flash was used with two synchronized studio flashes that were positioned at 45 ° from the subject-camera axis behind the photographer. We did not use any other light source. Patients were seated in a fixed position and asked to gaze directly at the fixed points

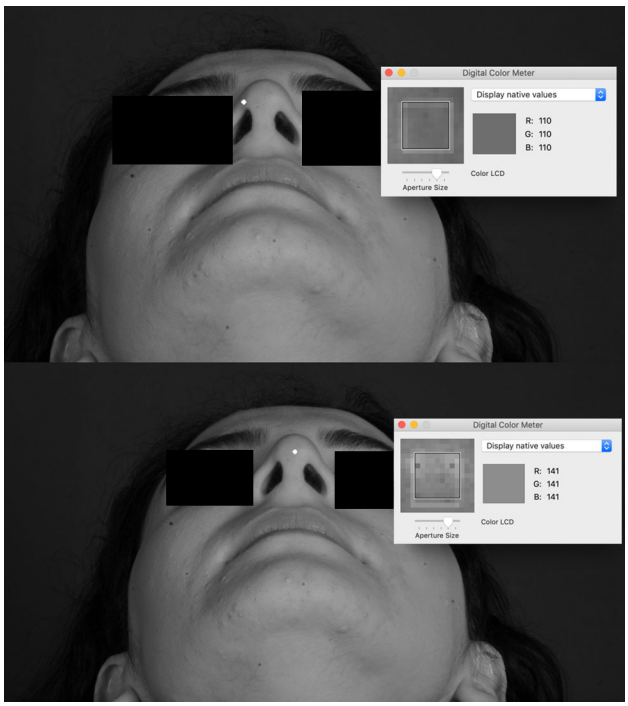

Fig. 1 Digital Color Meter® for measuring the light highlights and shadows of facets and infratip lobule

for different views. Standard pictures were obtained as follows: The eyes were fully open with a direct gaze, and the lips were closed with no smile. For the basal view, the head of the patient was tilted back to the level of the nasal tip to be aligned with the level above the medial canthus and below the eyebrows.

Outcome Measures

We used at least 1-year postoperative photographs of operated patients. The basal views of these photographs were used as an objective outcome measure to assess the brightest point of the infratip lobule and darkest point of the facets. The brightness ratio of the facet/infratip lobule was used to overcome external factors. Many factors like position of the patient's head and camera and the level of the flashlight can easily affect the brightness level of the digital photos. The brightness ratios of facets to infratip lobule were used to have a more reliable statistical analysis. We compared this ratio to subjective outcome measures.

We used the visual analog scale (VAS) as a subjective outcome measure. We showed patients their own postoperative basal pictures and asked them how happy they were with that view of the new nose tip particularly. We compared VAS with brightness ratio results.

Statistical Analysis

Statistical analysis was done using computer software (SPSS® version 22.0, SPSS Inc. Chicago, IL, USA). Independent and paired sample t tests were used for the analysis of parametric variables. The Shapiro–Wilk test was used for determining the distribution pattern of the data. The distribution patterns of the VAS and ratios between the darkest pixel point of facets and the brightest pixel point of the infratip lobule of all groups were parametric. All data were expressed as ''mean ± SD.''

Results

The mean ages of the rhinoplasty and control groups were 25.9 years (range 18–39 years) and 27.5 years (range 18–37 years), respectively. There were twenty-three males and seventeen females in the rhinoplasty group. There were eleven females and nine males in the control group. There was no significant difference in brightness ratios between male and female patients in either the study or control groups.

The mean ratios of the facet to infratip lobule brightness of groups were 0.81 ± 0.07 in rhinoplasty group and 0.87 ± 0.03 in the control group. The mean brightness ratio of operated noses was statistically lower from the control group. The mean aesthetic VAS scores of the groups were 7.17 ± 0.95 in rhinoplasty group and 7.75 ± 0.88 in the control group. There was a significant difference between the two groups. There was a positive correlation between brightness ratio and VAS in both groups ($p < 0.01$) (Table 1) (Figs. 2, 3, 4). Regarding the two sides' facets symmetry, the difference between two side's mean facet/infratip lobule brightness was 0.05 ± 0.04 in the rhinoplasty group. In the control group, the difference between the two side's ratios was 0.02 ± 0.01. This difference was significantly higher in the rhinoplasty group (p 0.002). The difference between the two side's ratios correlated with all participants' VAS. There was a negative correlation between difference and VAS ($p < 0,05$).

Discussion

The surface of the nasal base has three subunits: infratip lobule, alar lobule, and columella. Disharmony between these units can cause notching. Toriumi defined the base view of the ideal nose as a triangular shape with no notching between the tip lobule and the alar lobule [2]. The underlying anatomic structures affect the nasal surface, and

Table 1 Mean luminance values and ratios of facets and infratip lobules and Visual Analog Scale scores

	Mean facet luminance	Mean infratip lobule luminance	Ratio	Mean ratio of two side's difference	Mean aesthetic VAS
Rhinoplasty group (*N*:40)	145.48 (± 19.87)	177.46 (± 16.3)	0.81 (± 0.07)	0.05 (± 0.04)	7.17 (± 0.95)
Control group (*N*:20)	135.35 (± 15.79)	153.65 (± 14.7)	0.87 (± 0.03)	0.02 (± 0.02)	7.75 (± 0.88)

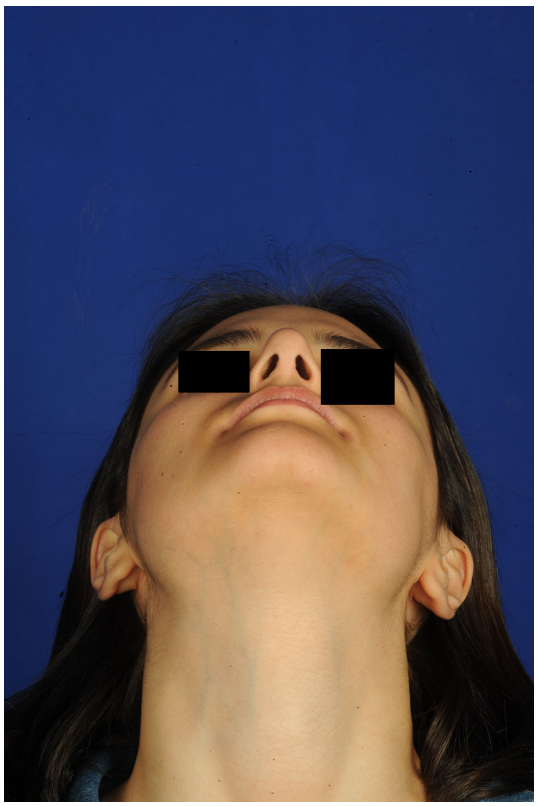

Fig. 2 Basal view of the patient with a good postoperative aesthetic outcome (VAS: 9). Mean of two sides' facet/infratip lobule ratio is 0.87

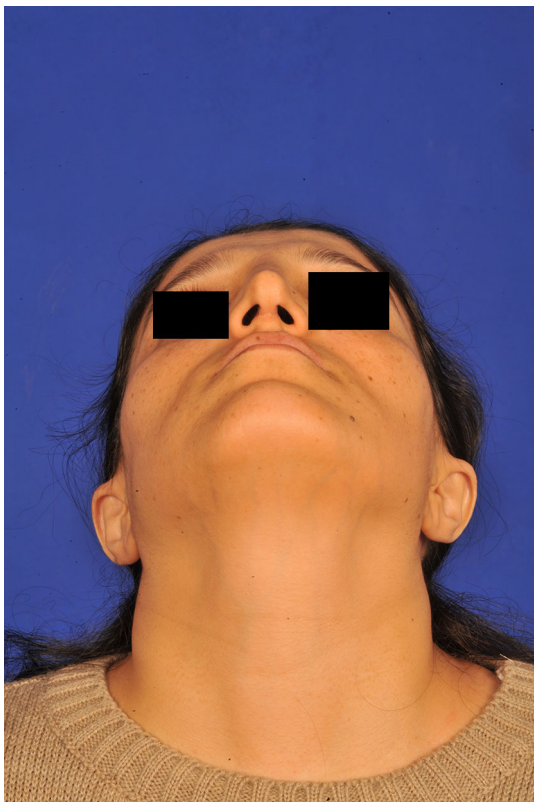

Fig. 3 Basal view of the patient with poor postoperative Visual Analog Score (5), the mean of two sides' facet/infratip lobule ratio is 0.75

lack of internal support directly causes notching on facets area.

We measured the brightness level of the subunits of the nasal base with simple software in the routine digital photographs of operated patients in our study. The software analyzes the RGB intensity components of the pixels in any rectangular area of relatively uniform color. A colored area in a digital image can be depicted objectively as R, G, and B. The mean of R, G, B of decolorized black and white pixels gives us shadow or brightness levels of the pixel. In our control group of good-looking noses, the brightness levels of the facets and infratip lobule were relatively close, and the mean ratio was 0.87. As Toriumi described in the ideal nose that the soft triangle contour should be subtle [2], the contrast between facets and infratip lobule was lower in the control group. There was a significantly higher difference between the brightness level of subunits in the rhinoplasty group. This difference can create an unnatural and unwanted shadowing in the basal view of the nose.

Management of the basal view of the nose tip depends on many factors. Mainly, the nose tip reconstruction and projection level of the nose directly affect the basal view. In the last two decades, many surgeons defined different tip suture techniques [6, 7]. Usually, the primary goal of these sutures is creating a proper cartilage frame to support the nose tip. It can be called the tenting effect. The columellar double break supported by the intermediate crura is a significant part of the nose tip contour. Improper tip suturing can cause breaking down of the ideal shape of the intermediate crura, and this insufficient tenting effect can cause

Fig. 4 Participant with high SCHNOS and VAS (9), and the mean of two sides' facet/infratip lobule ratio is 0.88

notching. In a cadaveric study that focused on notching and aesthetic deformities in the facet area, Campbell et al. emphasized the preservation of facets during dissection and also the augmentation of this weak subunit after tip reconstruction [8]. Also, some studies suggest lateral strut grafting and facet grafting for preventing notching and modified incisions for preserving the anatomy of this subunit [9–11]. In these studies, the authors used subjective methods for postoperative results.

We observed a significant difference in shadowing between facets and the infratip lobule in operated patients with poor aesthetic outcomes. Based on medical records, no facet grafts were used in any patients of our rhinoplasty group. Support of a strong strut graft to the columella and nose tip usually creates an excellent tenting effect. However, notching in the facet area can occur in some patients in the postoperative period. We presumed soft triangle weakness had been due to the lack of structural support rather than the shape and length of the soft triangle. Despite the increased awareness about facet and alar rim problems, grafts are still generally overlooked for structural support. Possible soft triangle support outcomes between different surgical techniques are not the subjects of this study. We believe that structural facet and rim grafts may be sufficient for eliminating notching on the soft triangle; however, further comparative studies are necessary. Studies that focus on different units and reconstruction techniques are needed with the same objective analysis.

Symmetry between subunits of the nose is a crucial goal to achieve in rhinoplasty. The description of an ideal and natural nose contains symmetry and harmony between two sides of the nose [2, 3]. We analyzed symmetry of both good-looking and operated noses and whether it was related to our outcomes or affects patient aesthetic satisfaction. We observed there was a significant brightness difference between the two sides' facets in the rhinoplasty group. Also, this difference was significantly higher in patients with poor aesthetic outcome. Asymmetry in the basal view of the nose was related to the low aesthetic outcome in the rhinoplasty group. This negative correlation between patient pleasure and asymmetry supports the consistency of our results. In the basal view of the nose tip, symmetric soft triangles with subtle transitions and shadows can affect patient's pleasure.

One of the good things about our method is its feasibility. This measurement can be made quickly on standard patient pictures. Our study is the first that successfully used an objective and applicable assessment method for nasal tip surface aesthetics. It was correlated with patients' aesthetic perception of the base view of the nose tip. Further studies must be conducted for different aspects of rhinoplasty, especially for elucidating the effect of the facet and rim grafting on postoperative unwanted shadowing of the soft triangle.

Conclusion

Our study presents the results of a simple method of measuring the light reflections of the nose tip. We focused on the facets and infratip lobule and defined the basal view of the nose tip with light reflection levels. We observed that noses with a good aesthetic outcome have more symmetric and subtle facets and infratip lobule. Our method was feasible, and its outcome was correlated with patients' aesthetic perception. Further investigations have to be performed for its consistency. The effect of different reconstruction and augmentation techniques must be compared with similar methods for achieving the best possible postoperative outcome.

Compliance with Ethical Standards

Conflict of interest None of the authors has declared any conflict of interest (financial or non-financial) from being named as an author on the manuscript.

Ethical Approval All procedures performed in the study were in concordance with the ethical standards of the institutional and/or national research committee and the Declaration of Helsinki in 1964 and its subsequent amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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