 0030-6665/87 $0.00 + .20

Facial Analysis for Rhinoplasty

*Wayne F. Larrabee, Jr., MD**

Editors' Commentary: Analysis for rhinoplasty is of primary importance. The surgeon must develop a working knowledge of facial proportion and aesthetics. He must be able to apply these rigid parameters throughout the variety of cultural and ethnic variations that he will see daily among his patients.

Dr. Larrabee's article gives an excellent foundation for facial analysis. He traces through history a formulation of aesthetically pleasing proportions. He continues with a more detailed commentary on work that has dealt with cephalometric analysis of the face and facial features.

His comments on photography are particularly valuable. Accurate photographic records are an essential part of the patient's chart. Not only can they be used in a medicolegal situation, but also they can be used for patient education and physician self-evaluation. We prefer color photographs, which are kept with the patient's chart. These can be reviewed each time the patient comes in for interview and postoperative follow-up.

The article concludes with comments about the use of a computer. The computer is an interesting tool that can be used for facial analysis. Its usefulness is just beginning to be developed.

Excellent results in rhinoplasty require careful patient evaluation, an understanding of facial aesthetics, and the ability to set appropriate surgical goals for a specific patient. In this discussion we present some basics of facial analysis and discuss our methods of using photography, computers, and cephalometrics to study patients pre- and postoperatively.

FACIAL PROPORTIONS

Our current concepts of an aesthetic profile probably began with the Egyptians. Profiles such as that of Queen Nofretete (1365 BC) have influenced artists up to modern times (Fig. 1). Egyptian concepts of beauty

*Head, Sections of Reconstructive and Aesthetic Plastic Surgery and of Otolaryngology, The Mason Clinic, Seattle, Washington

Figure 1. Queen Nofretete.

included a relatively broad face, sloped forehead, prominent eyes, full lips, and a relatively prominent chin. It is the Greeks, however, who set many of our standards for facial proportions. Statues such as those of Apollo Belvedere and Aphrodite (Figs. 2 and 3) have influenced our concepts of male and female beauty up to modern times. In his book on malocclusion in 1900, Angle described the sculpture of Apollo, "Every feature is in balance with every other feature, and all the lines are wholly incompatible with mutilation or malocclusion."[15] Typical Greek faces were oval, including a slight taper to the chin, a prominent anterior forehead, and a nose beginning almost at the glabella with a very flat nasofrontal angle. The Romans changed our view of facial aesthetics very little, but were immensely helpful in preserving the work of the Greeks. During the Middle Ages, with emphasis on mind and spirit versus body, very little new appeared in facial proportions.

The period of modern facial analysis began in the Renaissance with the work of Leonardo Da Vinci. As an artist and scientist he was uniquely qualified to develop a science of facial proportions. This artist said, "Let no man who is not a mathematician read the elements of my work."[17] Leonardo was influenced by the Roman architect Marcus Vitruvius Pollio (31 BC to 14 AD), who described the division of the face into three parts (*De Architectura Libri Decem*, Book III, Chapter I). He describes these basic proportions as follows: ". . . from the tip of the chin to the nose, from the

Figure 2. Apollo Belvedere.

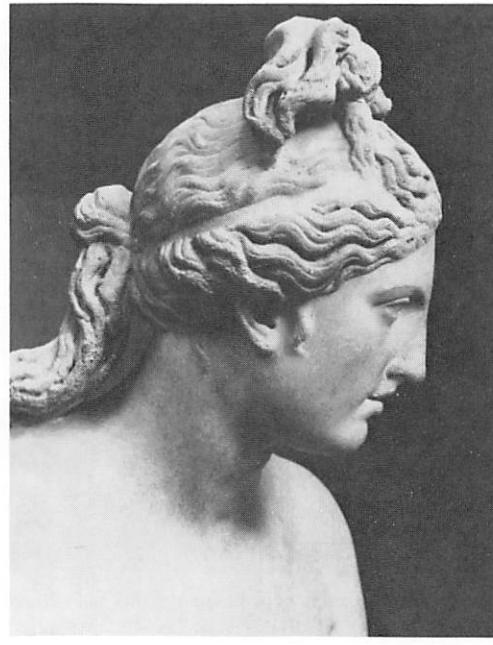


Figure 3. Aphrodite.

tip of the nose to the midpoint of the eyebrows, and then to the root of the hair, each one-third."[22] Leonardo's drawings showing similar proportions are seen in Figure 4. The German artist Albrecht Dürer was 20 years younger than Leonardo but spent the year 1506 in Italy and was probably influenced by him. In his book *The Human Figure* there are many meticulous facial analyses such as those seen in Figure 5.[22] Both Leonardo and Dürer were more interested in realistic depiction of faces than in defining an aesthetic ideal.

The Greek ideal has persisted in many ways to the present. In the last century it has been varied somewhat by extensive objective measurements of facial proportions in specific populations. The majority of this work has been done by orthodontists in their development of both hard- and soft-tissue cephalometric measurements.

FACIAL ANALYSIS

The aesthetic judgment of the surgeon must ultimately determine the surgical goals. No single measurement or set of measurements can be considered without understanding the relationship of the nose to the remainder of the face and body. However, certain simple proportions and rules have proven useful in analyzing the nose. Their use can help point out problems and direct our attention to specific areas.

Some of the major points used to define the facial profile are seen in Figure 6. The soft-tissue *Frankfurt horizontal* (FH) is defined as a horizontal

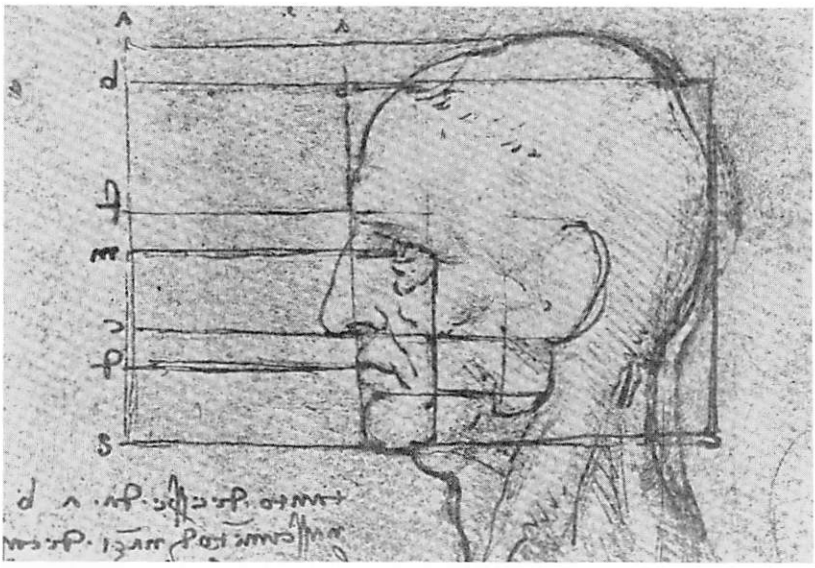


Figure 4. Sketch from Leonardo DaVinci's *Notebooks* demonstrating the facial thirds of Vitruvius.

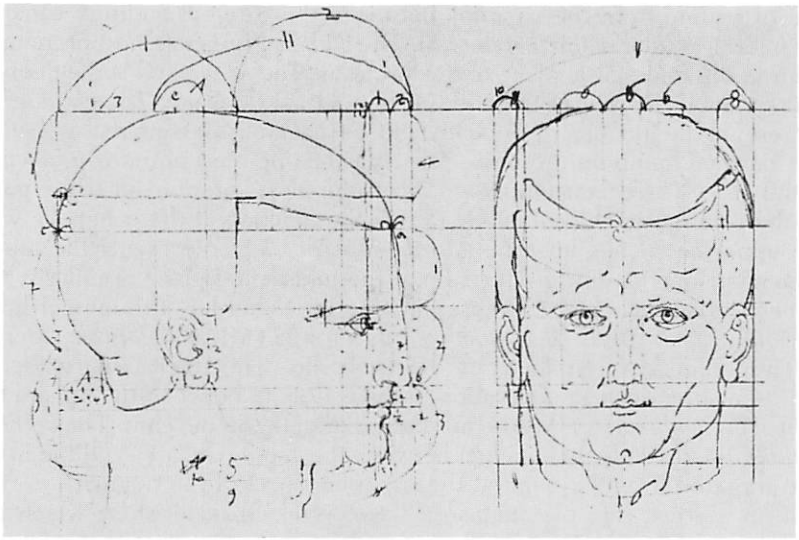


Figure 5. Facial analysis of Albrecht Dürer from *The Human Figure.*[22]

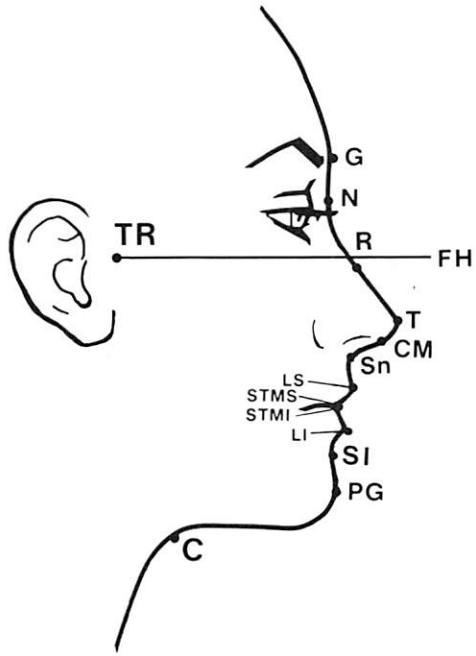


Figure 6. Commonly used soft-tissue cephalometric points.

line extending from the superior border of the external auditory canal to the inferior border of infraorbital rim. The *glabella* (G) is the most prominent point in the midsagittal plane of the forehead. The *nasion* (N) is the deepest depression at the root of the nose in the midsagittal plane. The *rhinion* (R) represents the junction of the bony and cartilaginous dorsum and is usually the maximal hump on the nose. The *tip* (T) is the most anterior projection of the nose. The *columella point* (CM) is the most anterior soft-tissue point on the columella. The *subnasale* (Sn) is the junction of the columella with the upper cutaneous lip. The *labrale superius* (LS) represents the mucocutaneous junction of the upper lip at the midsagittal plane. Similarly, the *stomion superiorus* (STMS) represents the lower border of the upper lip at the midsagittal plane. The *stomion inferioris* (STMI) and *labrale inferius* (LI) are similarly described for the lower lip. The *sulcus inferioris* (SI) represents the deepest depression in the concavity between the lip and the chin. The *pogonion* (PG) is the most anterior point on the chin. The *cervical point* (C) represents the junction between the submental area and the neck. The *tragion* (Tr) is the point at the superior aspect of the tragus.

An aesthetically pleasing nose has certain characteristics, which are depicted in Figures 7 and 8. The proportions between ala and the lobules should be approximately 1:1 in the lateral view. From the basal view, the columella should be approximately twice the length of the lobule. The nasolabial angle usually measures 90 to 115 degrees with a double break. There is usually a subtle superlobular dip in the dorsal profile, and 2 to 4 mm of columella show from the lateral view. From the frontal view, there should be a gentle curve from the superorbital rim to the tip area as described by Sheen[19] (see Fig. 7); this line is nicely seen in the Greek sculpture "Apollo of Piombino" from the fifth century BC (Fig. 9). It is difficult to define tip projection in a simple manner; the perceived size of the nose depends on its relationship to many other facial characteristics

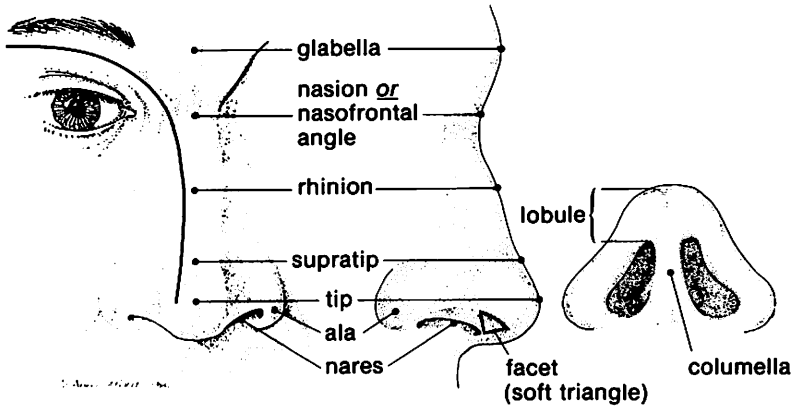


Figure 7. Characteristics of an aesthetically pleasing nose.

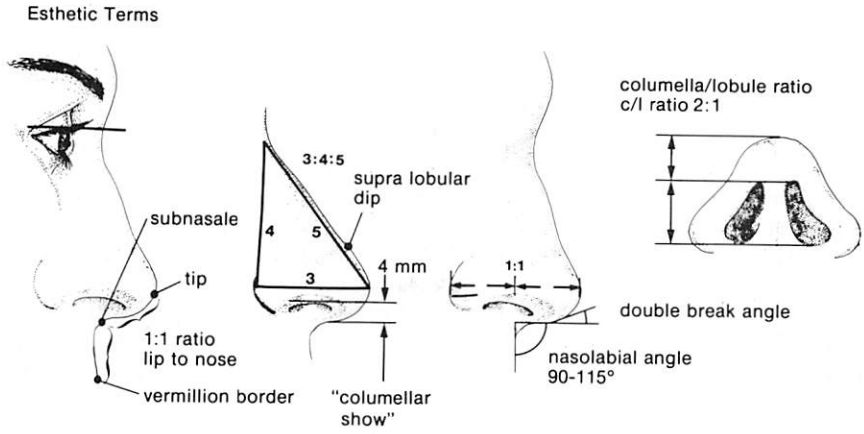


Figure 8. Nasal tip projection and proportions.

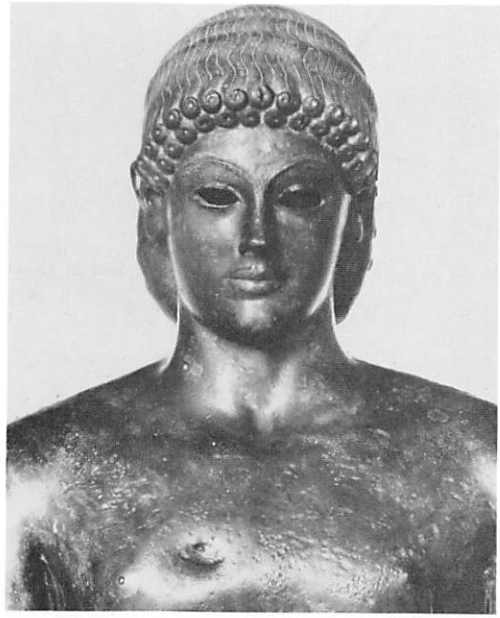


Figure 9. Apollo of Piombino.

and the patient's height and weight. Two simple technics for measurement of tip projection, however, are seen in Figure 8. As described by Simons,[21] the ratio of the distance from the upper lip to the subnasale should be approximately the same as the distance from the subnasale to the tip. Although clinically useful, this method is limited by the high variability in the length of the upper lip. A simple and elegant approach to the description of tip projection is that of Crumley.[6] He describes a right angle triangle with vertices at the nasion, nasal tip, and alar crease whose sides have 3:4:5 proportions as seen in Figure 8. This 3:4:5 triangle actually relates very well to another measurement of tip projection: the nasofacial angle as described by Brown and McDowell[5] (Fig. 10). They believed an ideal nasofacial angle was about 36 degrees, with desirable limits between 30 and 40 degrees. The 3:4:5 triangle generates a similar angle of between 36 and 37 degrees.

In addition to analyzing the fine anatomy of the nose and surrounding structures, it is important to obtain a view of the overall facial proportions. In the vertical direction, the facial thirds of Leonardo are very helpful and can be measured directly from photographs (Fig. 11). As seen in this view, the width of the nose at its base should be approximately the distance between the eyes. The length of the upper lip is about twice that of the lower lip and chin.

In analyzing the front view one should also consider the overall shape of the face. A 6:8 ratio between the width and height of the head is fairly

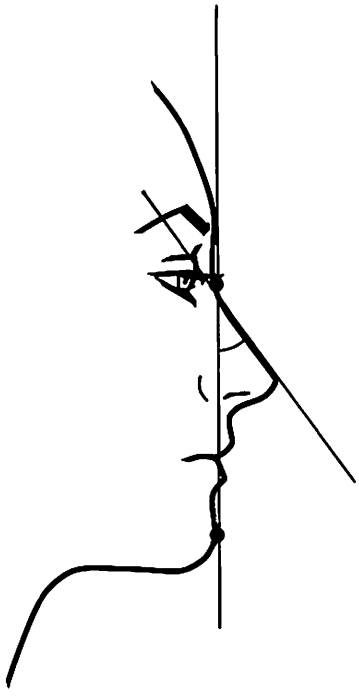


Figure 10. The nasofacial angle of Brown and McDowell.

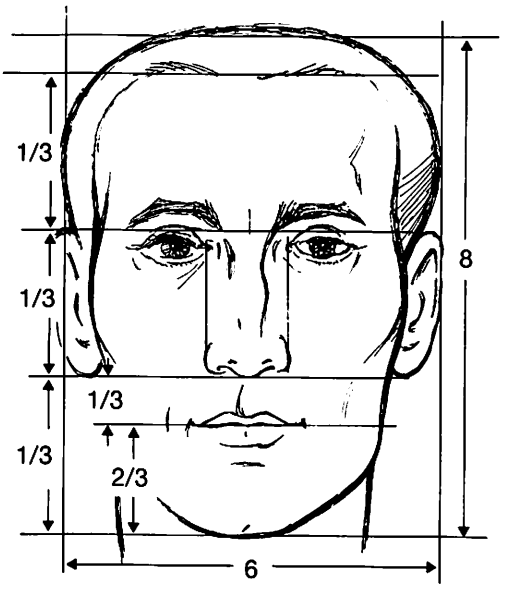


Figure 11. Basic facial proportions from a frontal view.

typical (see Fig. 11) but there is wide variation. Faces can be classified as square, round, oval, or triangular. A square or round face may suggest a somewhat wider and shorter nose than might an oval or triangular one.[2]

From the lateral view, the general shape of the facial profile is important in rhinoplasty surgery. The basic concept of facial convexity was described by Woolnoth in 1865 when he wrote, "The general form and outline of all faces, especially as they are seen in profile, are of three orders—the straight, the convex, and the concave. The straight face is considered the handsomest. . . ."[15] Gonzalez-Ulloa[7] defined a straight face with his profileplasty; in his technique a line is dropped from the nasion perpendicular to the Frankfort horizontal and should touch the forehead, lips, and chin (Fig. 12). The anterior-posterior relationship between the chin and remainder of the profile is of practical significance. No simple measurement can define chin position exactly. Studies of aesthetic ideals and classical art have shown a preference for a relationship such as that seen in Figure 13; the lower lip is slightly posterior to the upper lip, and the chin lies on a straight line connecting the two (the male chin may be somewhat more anterior). In addition to the technique of Gonzalez-Ulloa, that of Rish[20] is useful. With his system a perpendicular line is dropped from the lower lip, and chin augmentation is considered if the chin does not reach this line. Obviously, the patient's occlusion and the functional mandibular-maxillary relationship should be considered before simple cosmetic chin augmentation.

The relatively simple study of facial proportions presented thus far is adequate for the vast majority of rhinoplasty cases. When a more detailed analysis of the facial profile is required, the surgeon can proceed to hard-tissue cephalometrics, soft-tissue cephalometrics, or more complex photo-

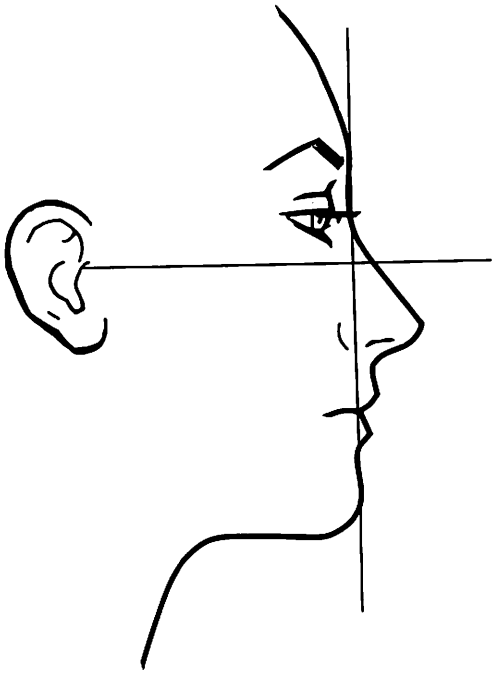


Figure 12. The profileplasty of Gonzales-Ulloa.

metric analysis. Excellent reviews of the various bone-to-bone and soft tissue–to–bone cephalometric analysis systems are available;[9, 10, 12, 14, 18, 23–25] however, they are beyond the scope of this article. Two fairly straightforward and helpful systems are those of Powell and Humphries[16] and Peck and Peck.[15] Powell and Humphries describe their "aesthetic triangle" (Fig. 14) and believe that the following ranges are ideal: nasofrontal angle (NaFr)—120 degrees, nasofacial angle (NaFa)—36 degrees, nasomental angle (NM)—130 degrees, and mentocervical angle (MeC)—85 degrees. Peck and Peck describe a nasal angle (Na) that measures the nasal height from nasion to tip; a maxillary angle (Mx), which measures the maxillary height from the tip to the labrale superius; and a mandibular angle (Mn), which records the mandibular height from the labrale superius to the pogonion (Fig. 15). In their study, mean values for these angles in healthy adults were 23.3, 14.1, and 17.1 degrees, respectively. Peck and Peck then describe a unique orientation plane (Fig. 16). A single line is dropped from the nasion to the pogonion. A line drawn from the tragion to the midpoint of this line forms a new orientation plane. The point where these lines cross describes a facial angle (F) whose mean value in aesthetically pleasing individuals is 102.5 degrees. The maxillofacial angle (MF) is determined by extending another line from the nasion to the labrale superius. This angle relates the upper lip to the chin, and a mean value in aesthetically pleasing adults was 5.9 degrees. A final line is drawn from the labrale superius to the nasal tip. The angle between this line and the orientation plane is termed the "nasal maxillary angle" (NM) and relates the upper lip to the nasal tip. Its mean value was 106.1 degrees.

Figure 13. The classical relationship between the lips and chin projection.

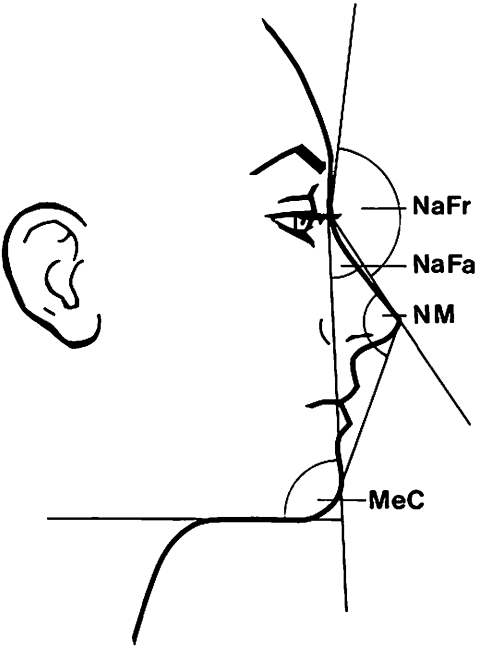


Figure 14. The aesthetic triangle of Powell and Humphries.[16]

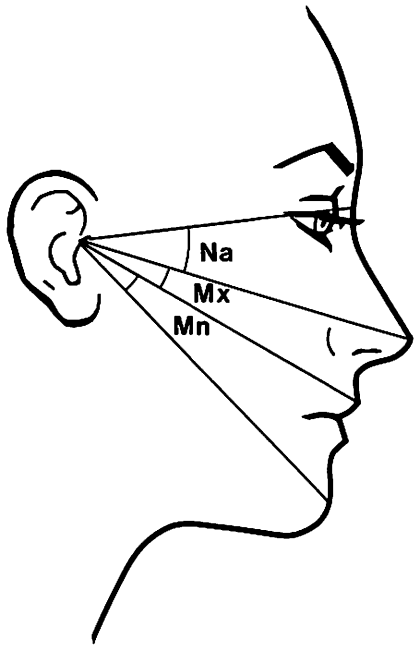


Figure 15. The nasal angle, maxillary angle, and mandibular angle of Peck and Peck.[15]

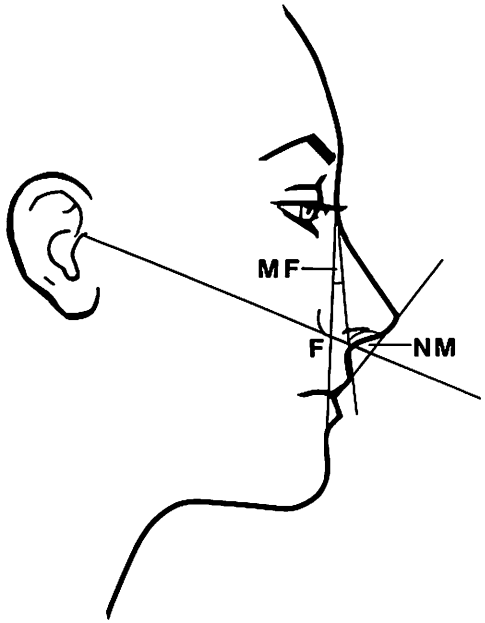


Figure 16. The facial angle, maxillofacial angle, and nasal maxillary angle of Peck and Peck.[15]

A unique analytic technique is the lateral photometric system of Bütow,[3] based on Leonardo's facial thirds. It is a complex, but useful, way to analyze facial proportions. Details are contained in the references.

In this report, we have considered isolated facial measurement, but other variables such as sex, race, and age must be studied to determine appropriate nasal proportions. An excellent study on desirable male and female profiles was conducted by Lions et al.[13] The profiles that participants in their study found most aesthetic for women and men are seen in Figure 17. The male profile had more prominent nasal projection, a more acute nasolabial angle, and a more prominent chin.

PHOTOGRAPHY

Consistent, quality photographs are important not only to document pre- and postoperative results, teaching, communication with patients, and medicolegal purposes, but also are essential in preoperative planning and accurate evaluation of postoperative results. Five areas need to be standardized: equipment, background, magnification, views, and lighting.

Equipment

In equipment choices, there is the long-term investment in the camera, lens, flash system, and the ongoing expense of film. The brand of camera and lens can be determined by personal preference as long as one stays with well-known, quality brands. Flash and lighting equipment will be discussed subsequently.

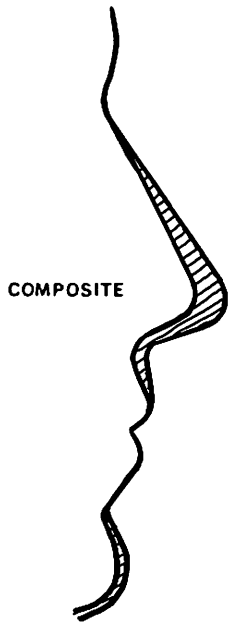


Figure 17. A composite of aesthetically pleasing female and male profiles drawn from Lions et al.[13]

The essential camera equipment is a good 35-mm SLR camera and a lens with a fixed focal length of between 90 and 110 mm. The standard 50-mm lens is not appropriate for faces, because close-ups make the face appear distorted. Some cameras have through the lens (TTL) flash metering, which automatically gives the correct exposure when used with TTL flash units.

Color slide film should be shot if the images are needed for presentations, and prints are only occasionally required. A black-and-white negative and print can be made from a color slide, although it costs more and the quality is not as good as if it had been shot initially on black-and-white film.

Color slide film that can be developed by the "E-6" process, such as Ektachrome and Fujichrome, can be processed locally and quickly. Kodachrome must be processed by Kodak, but some photographers prefer it because of the fine grain and color quality. Kodachrome slides are more fade-resistant over time than the E-6 processed films.

Film "speed" signifies the amount of light needed for exposure and is indicated by the ISO (previously ASA) number. Slow-speed films (an ISO below 64) have the finest grain and highest quality, but require brighter lighting and/or a larger lens aperture, which can decrease depth of field. High-speed films (an ISO of 200 or more) allow less powerful lighting and/or smaller aperture opening, but are more grainy. A good compromise is medium-speed films (ISO 125 for black and white and 64 or 100 for color slide film). Always use the finest grain film that can be used with your lighting situation.

Background

Backgrounds vary with black-and-white versus color film. Light blue is commonly used for color because it is pleasant and nondistracting. It would, however, photograph as gray with black-and-white films. A white background works best for black-and-white prints because it provides good separation from skin tones and works well in publications. However, without a separate light just for the background, the white would come out light gray.

For background material, a blank wall is suitable, provided it is not painted with a glossy paint. A piece of heavy fabric can be used for a colored background. It should be stored rolled around a tube to prevent folds. A white movie screen also works well for a white background. For a permanent studio area, professional photography dealers sell large rolls of colored paper. They can be mounted on the wall, and the desired color pulled down for a background.

If the patient is always the same distance from the background, the background intensity will not vary. Put a mark on the floor as to exactly where the stool should be placed.

Magnification

The accepted magnification for medical photography of the adult head is 1:9. In other types of patient photography, the anatomic boundaries of each patient are the best guidelines for consistent views. However, in

photographing the head, that would be more difficult because there is a margin of blank space left around the head, and it would be difficult a month later (or for a different photographer) to photograph the same patient and know that the same amount of margin is being left. Any slight change in magnification could change the size of the nose more than surgery. Because there are only slight variations of head size, any aesthetic value gained by "custom magnification" is not compensated for by loss of the scientific value of consistency.

On a 105-mm lens, 1:9 would correspond to 3.8 feet (or 1.2 meters). To make focusing quick and accurate, mark the focus point on the lens with a drop of paint or white typewriter correction fluid. When photographing a patient, first set the magnification of the lens. Do not change the focus, but focus by moving the camera closer and farther from the patient, watching the eye, until it is in sharp focus.

Views

The views may be varied according to preference or needs, but there are certain accepted views for rhinoplasty: frontal, right lateral, left lateral, oblique, and basal (Fig. 18).

For the first picture, have the patient hold a card bearing his or her name and identification number, in order to put the face and name together correctly when the film is returned. Large earrings should be removed, and hair should not be covering the ears. Preferably, the patient should not wear any make-up. All views should be photographed at eye level. The camera should be held in a vertical position to best fill the frame.

For frontal views the patient should look directly at the lens. Correct any head tilting. For the lateral views, the patient should turn his or her whole body to the side. On lateral view the Frankfurt horizontal should be parallel to the true horizontal. If you are more interested in comparing the same patient before and after surgery, rather than comparing one patient to another, it can be easier to allow them to use their natural head position (on the frontal as well), because studies have shown that people will be very consistent about repeating slight tilts of their head.[1, 4]

An oblique angle is often helpful in the evaluation of the shape of the nose. Have the patient turn to a 45-degree angle (look at a standard mark). For the basal nose position, have the patient face forward and tilt his or her head back. Focus on the patient's nose; in all other views it is easiest to focus on the eyelid. A smiling view can help evaluate tip depression.

Lighting

Lighting is the most crucial aspect for any type of photography. Other things can go wrong without the result being disastrous, but without the proper lighting the pictures may be wasted. The lighting system is the major difference between a studio and a simple in-office set-up.

For office use, a strong flash unit that mounts on the hot shoe of the camera is effective and inexpensive. It is not necessary to get one that changes angles for bounce flash; although bounce flash produces attractive lighting, the larger apertures required produce decreased depth of field (less sharpness in face).

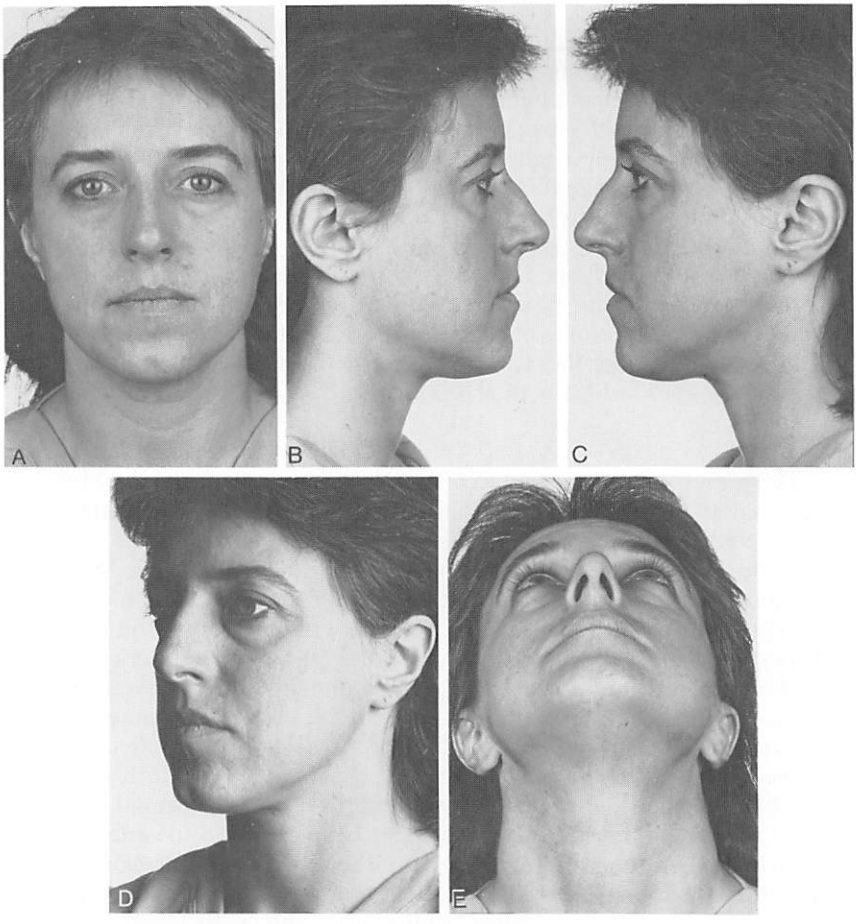


Figure 18. Standard photographic views for rhinoplasty surgery. A smiling lateral view is also helpful.

The ideal location for a single light is about a foot above the camera lens. Use an appropriate bracket or keep the flash on the hot shoe. It is important to have the flash on the same side of the camera as the patient's nose when the lateral views are taken. When the patient is turned to the right, rotate the camera 90 degrees from horizontal, putting the flash to the right of the lens. When the patient faces left, rotate the camera left 90 degrees from horizontal. This will prevent shadows. A slightly more complex system uses a pair of studio flash heads. If space is available, the heads can be attached to floor or ceiling; otherwise, they can be attached to light stands. One flash could be triggered by a PC cord attached to the camera. A slave unit can be attached to the other flash; this unit would automatically fire it when the first flash goes off. Alternatively, both flash heads could have slave units attached and be triggered by a small flash unit on the camera. Figure 19 shows a studio set-up.

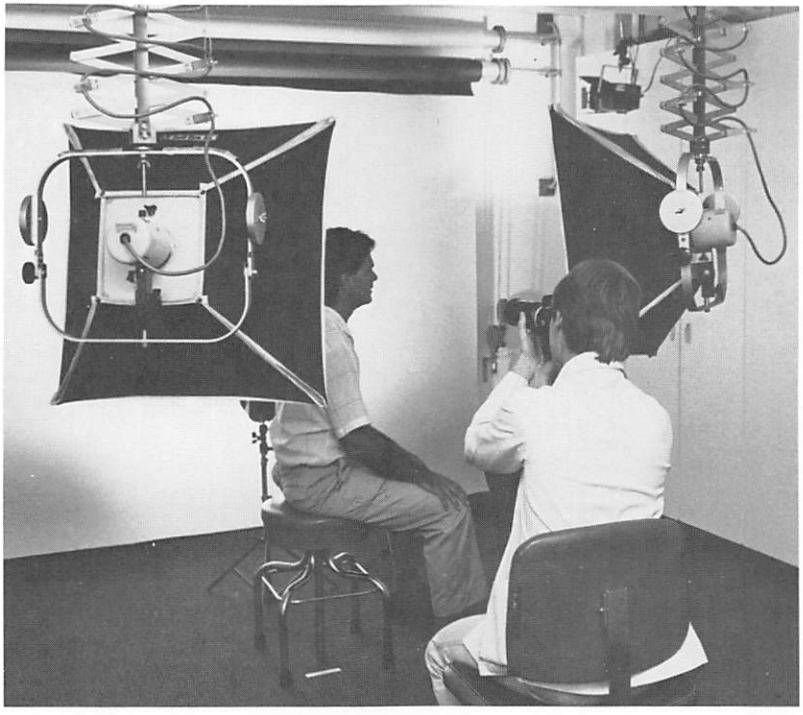


Figure 19. A professional studio photographic set-up.

By positioning the patient at least 3 to 4 feet away from the background and using two lights at 45 degrees, shadows on the background will be eliminated. When using this arrangement, for the oblique angle, turn off one light and have the patient face it. This gives better lighting for the side of the nose. A third light can be added to light up a white background for black-and-white film.

When equipment and background are ready, shoot a test role of film. Whenever using flash, always be certain the shutter speed is set on "x," or whatever the correct flash synchronization is for your camera. Use color slide film for the test because it has very little margin for error of exposures, so you can easily see if it is correct. Try all of the views that you will be using and vary the exposures. Keep track of how each exposure was made so you will know exactly how the best one was made.

You may set up your own standards depending on your needs, but it is most important to be able to duplicate them. Pre- and postoperative photographs need to be taken at the same magnification, with the same lighting, and with the patient in the same position. The only visible difference between photographs taken pre- and postoperatively should be the change that you want to show.

Slides and prints should be stored so they are protected and can be easily retrieved. We prefer to use hanging slide holders made of polypro-

Figure 20. An effective photographic filing system using hanging folders made of polypropylene.

pylene (polyvinyl chloride can damage colors) (Fig. 20). These sheets are then suspended in a standard file cabinet labeled and ordered by name. Slides can be retrieved either directly by name or with a computer filing system (see subsequent discussion).

COMPUTERS IN RHINOPLASTY

The most straightforward use of computers in rhinoplasty is record-keeping; keeping accurate records not only of patient data but also of surgical techniques and results is essential for realistic self-evaluations, as well as for teaching and research. We use a very simple record-keeping system that can be easily adapted to the data bases on any microcomputer. Our standard rhinoplasty form (Fig. 21) is completed by the surgeon after each procedure. It can then be stored in the chart or used as a basis for generation of operative notes on a word processor. Office personnel daily enter the patient data. Using a numeric system makes it very easy for the surgeon to circle the correct procedures and for the office personnel to enter them. Additionally, this system saves computer memory. Once the data are entered, the surgeon can later use the data base to generate patient letters (for example, those who need follow-up photographs), or to search for patients who have undergone certain techniques or who fall into specific

Rhinoplasty

File Name Rhino 01

Name: _____

Street: _____

City: _____ State _____ Zip _____

Last Name: _____ Pt # _____ DOB (yr/m/d) _____

Mailing List 0 No 1 Yes

Referring Physician _____

Race: 1 White 2 Black 3 Oriental

Sex: 0 Male 1 Female

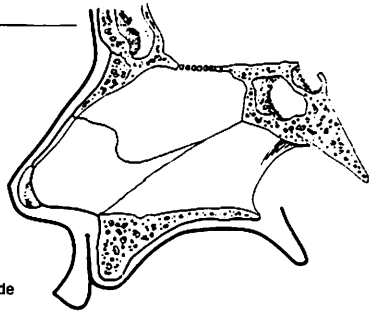
Photos: 0 None 1 Preop only 2 Early postop (less than 1 yr) 3 Late postop (greater than 1 yr)

Date of Procedure 1 (Yr/mo/d): _____

1 Septoplasty
2 Rhinoplasty
3 Rhinoplasty, tip
4 Septorhinoplasty
5 Closed Reduction Fracture
6 Open Reduction Fracture

Date of Procedure 2 (yr/mo/d): _____

1 Septoplasty
2 Rhinoplasty
3 Rhinoplasty, tip
4 Septorhinoplasty



Septal Incision:
1 Hemitransfixion
2 Complete Transfixion
3 High Transtision

Septum Shortened 1 yes

Tip Approach:
1 Delivery
2 Cartilage Splitting
3 Intercartilaginous/Retrograde
4 Open Rhinoplasty
5 Marginal

Lateral Crura Excised (along):
1 Cephalic margin anterior only
2 Cephalic margin complete

Lateral Crura Excised (across):
1 Lateral segment
2 Medial segment

Lateral Crural Incised:
1 Divided laterally
2 lateral crural flap

Dome Technique:
1 Dome split - simple
2 Dome split - projection lowered
3 Dome weakened
4 Other

Dome Suture: 1 Intact dome sutured
2 Medial crura sutured (dome split)

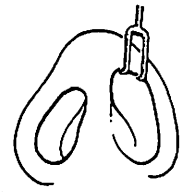
Figure 21. A simple form used to create a computer data base for rhinoplasty surgery.

Illustration continued on following page

Right Osteotomy:
1 Medial
2 Lateral
3 Medial and lateral
4 Intermediate
5 Medial and intermediate
6 Medial and intermediate and lateral

Left Osteotomy:
1 Medial
2 Lateral
3 Medial and lateral
4 Intermediate
5 Medial and intermediate
6 Medial and lateral and intermediate

Dorsum
1 Reduction, bone
2 Reduction, cartilage
3 Reduction, bone and cartilage
4 Augmentation with cartilage
5 Augmentation with bone
6 Augmentation with Alloplastic implant
7 Augmentation demineralized bone
8 Other



ULC
1 Separated from septum and lowered
2 Separated from septum and shortened
4 Separated from septum alone
5 Separated from septum · shortened and lowered

ULC Technique: 0 Mucosa intact
1 Mucosa incised

Alar Excisions: 1 Nostril narrowing
2 Other

Tip graft 1 Yes Columellar Strut: 1 Yes Batten: 1 Yes

Mentoplasty:
1 Osteotomy
2 Alloplasty implant
3 Reduction genioplasty
4 Implant, other

Comments: _____

_____

_____

B

Figure 21 *Continued*

age or racial groups. This same data base can also be used as a file retrieval system for photographs. Photographs filed as described previously by name can be easily retrieved. This particular form is designed for our use; individual surgeons can easily vary the information included to meet their own needs.

Another very useful role for microcomputers is in cephalometric and photometric analysis. Several surgeons have developed systems that allow use of a digitizing pad to input the various points from the photograph or x-ray film, and then have the computer automatically compute the cephalometric values and analyze the results.[8, 11] These stored points can then also become part of the permanent data base for that patient in addition to the technical information and photographs.

Another important use of computers is in the planning of operations and communication with patients. Systems that allow manipulation of both two- and three-dimensional images are currently available and will certainly become more widely utilized in the future. By allowing both the surgeon and the patient to see the intended surgical results preoperatively, more sophisticated planning and better communication with the patient can be achieved.

One hesitates to predict the eventual role of computers in nasal surgery. It seems likely that facial plastic surgeons will continue to use a variety of techniques such as photography, video, and cephalometric analysis to document and study their patients. In the future, a computerized patient data base will probably include not only the normal information from history and physical examination, but also operative techniques and graphic materials. Such a graphics data base will allow the surgeon to better integrate these various techniques.

CONCLUSION

Rhinoplasty is the most subtle and artistic of the operations performed by facial plastic surgeons. The aesthetic judgment of the surgeon will always be essential in determining the surgical goals. Consistent, quality photographs are important for patient evaluation and teaching. A study of facial proportions and measurements will increase the surgeon's awareness of facial interrelationships and assist him or her in preoperative planning. The addition of computers to the armamentarium of the facial plastic surgeon will allow more complex pre- and postoperative analysis, better visualization of intended surgical results, and better communication with the patients.

REFERENCES

1. Bean LR, Kramer JR, Khouw FE: A simplified method of taking radiographs for cephalometric analysis. J Oral Surg 28:675–678, 1970
2. Bernstein L: Esthetic anatomy of the nose. Laryngoscope 82:1323–1330, 1971
3. Bütow KW: A lateral photometric analysis for aesthetic-orthognathic treatment. J Maxillofac Surg 12:201–207, 1984
4. Broca M, Cited by Moorrees CF, Kean MR: Natural head position: a basic consideration in the interpretation of cephalometric radiographs. Am J Physiol Anthropol 16:213–234, 1958
5. Brown JB, McDowell F: Plastic Surgery of the Nose. St. Louis, C.V. Mosby Co., 1951, pp 30–34
6. Crumley RL, Lancer R: Quantitative analysis of nasal tip projection. Arch Otolaryngol Head Neck Surg, in press
7. Gonzalez-Ulloa M: Quantitative principles in cosmetic surgery of the face (profileplasty). Plast Reconstr Surg 29:186–198, 1961
8. Hilger P, Webster R, Hilger J, et al: A computerized nasal analysis system. Arch Otolaryngol 109:653–661; 1983
9 Holdaway R: A soft-tissue cephalometric analysis and its use in orthodontic treatment planning. Am J Orthod 84:1–28; 1983
10. Holdaway R: A soft-tissue cephalometric analysis and its use in orthodontic treatment planning, Part II. Am J Orthod 85:279–293, 1984
11. Larrabee WF, Jr., Maupin G, Sutton D: Profile analysis in facial plastic surgery. Arch Otolaryngol 111:682–687, 1985
12. Legan H, Burstone C: Soft-tissue cephalometric analysis for orthognathic surgery. J Oral Surg 38:744–751, 1980
13. Lions PA, Lions RR, Lions CA: Profilemetrics and facial esthetics. Am J Orthod 73:648–657, 1978
14. Merrifield LL: The profile line as an aid in critically evaluating facial esthetics. Am J Orthod 52:804–812, 1966
15. Peck H, Peck S: Concept of facial esthetics. Angle Orthod 40:284–317, 1970

16. Powell N, Humphries B: Proportions of the Aesthetic Face. New York, Thieme-Stratton, 1984, pp 51–55
17. Richter JP (ed): The Notebooks of Leonardo Da Vinci, Volumes 1 and 2. New York, Dover Publications, 1970, p 11
18. Riedel R: An analysis of dentofacial relationships. Am J Orthod 43:103–119, 1957
19. Sheen JH: Aesthetic Rhinoplasty. St. Louis, C.V. Mosby Co., 1978, p. 51
20. Simons RL: Adjunctive measures in rhinoplasty. Otolaryngol Clin North Am 8:717–742, 1975
21. Simons R: Nasal tip projection, ptosis, and supratip thickening. Ear Nose Throat J 61:452–455, 1982
22. Strauss WL (ed): Albrecht Dürer: The complete Dresden Sketchbook. New York, Dover Publications, 1972, p 10
23. Zide B, Grayson B, McCarthy J: Cephalometric analysis, Part 1. Plast Reconstr Surg 68:816–823, 1981
24. Zide B, Grayson B, McCarthy J: Cephalometric analysis for upper and lower midface surgery, Part 2. Plast Reconstr Surg 68:961–968, 1981
25. Zide B, Grayson B, McCarthy J: Cephalometric analysis for mandibular surgery, Part 3. Plast Reconstr Surg 69:155–164, 1982

ACKNOWLEDGMENT

The photography section in this article was contributed by Marilynn Payne, RBP, and the illustrations by Jo Ann Clifford.

Sections of Reconstructive and Aesthetic Plastic Surgery and of Otolaryngology
The Mason Clinic
P.O. Box 900
Seattle, Washington 98111