Photography's role in documenting changes after aesthetic surgical procedures is well established. Facial resurfacing procedures usually cause subtle changes in skin topography. Capturing these objective photographic differences necessitates an understanding of basic photographic principles pertinent to accurately documenting photographic changes. Variables examined include lighting, exposure, aperture, camera type, white balance, lens focal length, and patient positioning. A set of suggested guidelines for accomplishing these goals is given for the facial plastic surgeon.

**KEYWORDS:** Photography, facial resurfacing, standardized

Photography serves an important role in facial resurfacing procedures in that it allows objective comparison of the pre- and postprocedure state. When properly performed, standardized photography can accurately illustrate these subtle differences. However, photography of the resurfacing patient involves many variables that are interrelated. Minor changes in any of these variables may cause major inaccuracies in the photographic depiction of the patient. This is particularly important in determining the efficacy of facial rejuvenation and resurfacing procedure studies, during which skin texture, fine wrinkles, pigment irregularities, and pore size may be analyzed.

To draw any meaningful conclusion from the effect of facial resurfacing treatment, the photographs must have been captured in a standardized fashion.\(^1\)\(^2\) Standardization of photography has been established in aesthetic analysis for various procedures including rhinoplasty, rhytidectomy, and blepharoplasty.\(^3\)\(^-\)\(^10\)

Criteria do not exist for standardized photography in facial resurfacing procedures. Dermatologic photography can be misleading: a change in photographic technique can demonstrate a clinical difference when none exists. The challenge of dermatologic photography is to capture subtle three-dimensional changes in a two-dimensional medium. In addition, dermatologic photography must capture accurate and consistent color.

The purpose of this article is to examine major photographic variables pertinent to facial resurfacing procedures. Variables examined include lighting, exposure, aperture, camera type, white balance, lens focal length, and patient positioning. Many of these components are interdependent and these relationships are discussed. It is hoped that discussion of these variables and their resultant effects will allow the facial plastic surgeon to recognize their impact on resurfacing photography.
LIGHTING

Lighting plays a critical role in accurate depiction of skin coloration and contour.20 Fashion photography takes advantages of several properties of lighting with the use of diffuse, soft lighting techniques to hide facial blemishes and contour irregularities. In contrast, the facial plastic surgeon should be less interested in flattering lighting because it may hide objective change. There are many different light sources available, each with particular advantages and disadvantages—consistency is critical. Direct light, coming mainly from one direction, produces relatively high contrast between bright highlights and dark shadows. Although this type of illumination may emphasize contour changes, it may make proper exposure more difficult. Diffused light bounces onto the subject from several directions, lowering contrast. Contrast affects the perception of color saturation and the amount of visible texture and detail.

Regardless of the lighting technique employed, an understanding of the importance of color temperature and white balance is necessary. The reason skin will sometimes have an orange or red cast is due to color temperature. Different light sources emit light of different color. A fluorescent light source tends to be blue, whereas a sunset tends to be red. White balance is a function on a digital camera that defines for the camera what is white. There are various modes on a digital camera, including preset white balances and custom white balance. Fig. 1 demonstrates proper custom white balance versus preprogrammed white balance mode. As the pictures demonstrate, proper white balance will allow more accurately for critical judgment of resurfacing photographs. It is important to review the parameters of your digital camera to see how to white balance it effectively for the lighting environment.

One method of lighting is the sole use of ambient lighting. Some examples of ambient lighting include overhead fluorescent lighting and tungsten floodlights. Both light sources can create uneven shadows and tend to slowly fade with time, subtly decreasing the amount of light emitted. Less light will alter the exposure and may diminish the appearance of wrinkles. Tungsten lamps tend to become warmer with age, potentially producing inaccuracies in skin tones. Tungsten lamps create a large dissipation of heat, which makes it difficult for patients to avoid squinting because of the continuous nature of the light. The outdoor environment must be accounted for if there is a window in the room. The light from the midday sun is much bluer than that from the light at dawn and the proper white balance must be used. Closing the shades can create less sunlight and again cause differences in capturing subtle changes and texture. The many variables of ambient lighting make it difficult to achieve consistent and reproducible photographs.

Electronic flash is another modality for illuminating the subject matter. The simplest method is to use a single direct flash. A single flash will cause a shadow and tend to wash out the subject. Dual-flash units attached to a camera may be used to eliminate some shadow seen with a single-flash unit. They are difficult to use and cumbersome, however, but can provide improved lighting versus single-light cameras. A ring flash will impart a flat, shadowless appearance to a subject, and often fails to capture the true color. In a patient with rosacea, the impact of taking a photograph with various flashes will affect analysis of treatment.21 Although a ring flash can provide for fairly consistent and reproducible lighting, it may wash out the color and skin tones. This may hide subtle changes seen in postprocedure patients. If color is an important variable, alternative lighting techniques should be employed.

Studio lighting can be produced by a variety of light sources available, including reflective umbrellas.

Figure 1 With variation in color balance, flesh tones exhibit different characteristics even when all other variables are held constant. (A) Demonstration of auto color balance on Nikon D1 camera. (B) Demonstration of a custom color balance.
and translucent softboxes. Translucent softboxes have the advantage of more natural-appearing light, which is better for a larger studio. Conversely, reflective lights may provide improved utility in tighter spaces. Studio lighting generates a flash of light at 1/50,000 of a second. It is important to place studio lights in the same position and level relative to the patient and particular area of change. An important additional advantage of studio lighting is the effect of high-intensity lighting on decreasing aperture size. Decreased aperture size will allow for increased depth of field, which allows for improved three dimensionality of photographs and the ability to capture accurately several different areas within the depth of focus.

The farther the light source is from the patient, the more magnification is needed for greater detail. This is primarily due to the inverse square law, which dictates that the intensity decreases exponentially the farther light is from a source. This law explains why larger, more powerful lights are needed. Overall, studio lighting provides a harmonious balance between aperture size and over saturation of light, while capturing flesh tones consistently and accurately.

Soft lighting techniques and the use of light reflectors are techniques typically used by professional photographers to decrease texture and pore size. Ménéghini[2] uses a light reflector and soft light box for facial photography for physicians with limited office space to eliminate shadows from a single light source for surgical procedures.

A white balance should be performed prior to using a camera in a study. As long as the lighting remains constant, future color balance does not need to be performed.

Obtaining consistent lighting depends on reproducibility of technique. The ideal setting is studio lighting with ample space to compensate for shadow effects. However, a photographic studio may be a limitation to many physicians. Consistent alternatives include using flash with frequent white balance and eliminating environmental variables.

**LENS APERTURE AND SHUTTER SPEED**

The aperture and shutter speed directly effect one another and the final results of the photograph. The aperture of the camera affects many variables, one of which is the depth of field. A narrow aperture will provide increased depth of field compared with a larger aperture. Adjustment of aperture will result in changes seen in skin texture, pore size, and overall volume effects of the patient. Although it is inherently obvious that the same aperture should be used on a pre- and postresurfacing patient, the use of the proper aperture is essential to capture change. Too wide of an aperture will allow for a shallow depth of field. This will make it difficult to capture accurately the simultaneous change in the crow’s feet area and the submentum in a frontal photograph (Fig. 2). An f-stop of 16 or greater should be used. Subjects with darker pigmentation may require

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**Figure 2**  (A) Photograph taken with settings of f/16 at 1/250-second exposure time. (B) Photograph taken at f/22 with 1/125-second exposure. Notice obvious differences in light/dark tones in the subject as well as textural detail.
0.5 to 1 size larger in f-stop, and this should be documented.

There is a delicate balance between aperture, lighting, and shutter speed. Shutter speed controls the amount of time that light is exposed to the image sensor. Increased shutter speed lets less light in, whereas decreased shutter speed will allow for too much subject movement. The combination of aperture and shutter speed need to be balanced for accurate exposure.

**FOCAL LENGTH AND LENS**

Different lenses will influence the amount of distortion seen by the camera and the size of the aperture used. Macro lenses are designed for near focusing and for capturing facial details. When examined with all other variables constant, the difference in lens will influence mid-face distortion. When taking close-up dermatologic photographs, a 90- to 120-mm macro lens is ideal. A 50-mm focal length lens will distort the image of the patient because of the wider angle of view. It will also require the light source to be too close to the patient. A 200-mm lens is a fine portrait lens but will require a larger studio because the photographer must be farther from the patient. Fig. 3 demonstrates the effects of lenses of differing focal length.

**SUBJECT POSITIONING**

Subject positioning and facial expression play an important role in accurate depiction of skin topography. Facial muscle movement can accentuate wrinkles and create rhytides where none exist, altering the photograph completely. Movement in one area of the face can influence significantly distant areas due to interconnections between fascia and skin layers (Fig. 4).

Facial expression during a photograph will significantly change the amount of perceived rhytides seen. Having a patient smile will increase peri orbital wrinkles and accentuate nasolabial folds. Neutral facial expression is necessary for examining the topography of the skin.

Due to the fascial interconnections, even position of the head and neck must be similar to prevent perceived distortion. Raising the chin superiorly will create the impression of less neck fullness and improve overall skin contour. Subject positioning has been proven to alter the appearance of the submental area, jawline, and melolabial grooves by certain maneuvers. Sommer and Mendelsohn demonstrated this by having subjects alter their neck by flexion or extension, and move their head by either protrusion or retraction while maintaining the head in the Frankfort horizontal line.

Perhaps not as recognized is the direction of gaze of the patient. Neutral gaze is crucial to obtain accurate and reproducible photographs (Fig. 2). Having the patient look up will decrease the amount of periorbital wrinkles.

Stephan et al. demonstrated that highly reproducible photographs could be taken using a craniofacial rig with exact positioning and lighting for every photograph. It remains to be seen if head positioning devices will become the standard in photography after all facial plastic procedures.

**CAMERA VARIABILITY**

With the increased use of digital cameras, numerous differences are seen between individual digital cameras. Cameras have a variable number of photo sensors, camera sensors vary, and lens size varies. The appearance of a subject will be remarkably different with two cameras with all other variables held constant. Multiple studies have shown differences in photographic results with different digital cameras.

A single-lens reflex (SLR) camera holds several advantages over cameras with a standard viewfinder. An SLR camera gives the photographer the ability to compose and focus the image through the same lens with which the picture will be taken. The viewfinder of a standard digital camera often does not capture the image borders accurately and can result in a parallax error. Having a viewfinder that accurately represents the subject allows for more consistent photographs. Specialized focusing screens can be purchased for many SLR cameras and can be used as a guide for subject placement.

Reproduction ratios have been calculated for 35-mm cameras and are followed in the Cardiff scales of reproduction. Digital cameras have variabe-sized imaging sensors that are often smaller than a 35-mm frame of film. This is important because the resultant cropped image will simulate an image from a longer focal length lens. To describe this, manufacturers have used the terms crop factor or focal length multiplier. As an example, an imaging sensor that is two thirds the size of a 35-mm frame would have a crop factor of 1.5. Therefore, a 100-mm focal length lens will produce an image comparable to that of a 150-mm lens on a 35-mm film camera. These conversions must be considered when calculating the reproduction ratio. Young demonstrates how to calculate the reproduction ratio for an individual digital camera.

**TIME AFTER PROCEDURE**

It is not only important to standardize how a picture is taken, but also to standardize when it is taken. Post-procedure erythema can often mask wrinkles and improve flesh tones. An example of this is seen in Fig. 2 (rubbing the skin of the patient demonstrates fewer wrinkles and improved skin flesh tones). There are
several solutions to this dilemma. For a rejuvenation procedure that requires weekly interventions (i.e., microdermabrasion, light chemical peels), the photograph should be taken prior to the next intervention. The last photograph should be taken either 1 week after the intervention or when the underlying erythema has resolved. Long-term follow-up is necessary for documenting subsequent changes.

Figure 3  Differences in focal length of the lens creates remarkable distortion in subject matter as seen in photographs taken with a Nikon D1 camera at a shutter speed of 1/250 second, an aperture of f/16, and strobe lighting. (A) Photograph taken with an 80-mm Prime lens at 80 cm. (B) Photograph taken with a 160-mm lens at 160 cm. (C) Photograph taken with a 38-mm zoom lens at 38-cm distance from subject. Notice the fish-eye effect in (C) compared with images (A) and (B).
GUIDELINES FOR STANDARDIZING PHOTOGRAPHS OF FACIAL REJUVENATION

The goal is to standardize photographs to document the true amount of benefit obtained from a particular procedure. A series of guidelines have been formulated that will help the facial plastic surgeon achieve consistent and reproducible results in making standardized facial resurfacing photographs.

1. The same photographer should take the pictures before and after the procedure.
2. The same camera, studio, and lighting should be used with the same settings.

Figure 4 Photographs demonstrating the impact of periorbital rhytides with expression. Demonstration of (A) a neutral gaze, (B) with patient smiling, and (C) with patient looking up. Notice the increase in wrinkles with expression in (B), and the decrease in wrinkles with upward gaze in (C).
Obtaining a standardized lighting system is crucial to achieving color and tonal consistency. An ideal lighting system would consist of studio lighting without ambient light sources and frequent custom white balances to calibrate the system.

Exposure should be standardized and a record kept of the aperture and shutter speed. Tardy and Thomas recommend taking a series of photographs at various exposures to allow a studio to be calibrated. Digital photography simplifies this process by providing a histogram immediately after the photograph has been taken. The histogram can easily permit identification of under- or overexposure (Fig. 5). Once this has been determined, the aperture and shutter speed must be the same for the subjects photographed.

Camera positioning should be consistent. A tripod will allow for accurate reproduction of camera height but is difficult to use when changing the distance between the camera and patient. Manually walking back forth to achieve accurate reproduction ratios is commonly performed but allows for too much variability in camera positioning. Marking the floor with predetermined distances and placing the tripod on a dolly will allow for fewer camera position errors.

The same lens should be used. Resolutions for dermatologic photography at least 3.0 megapixels allow for improved visualization of skin structures. A compression setting of medium to high quality should be used to minimize loss of information and compression artifacts.

3. Patient positioning and facial expression should be standardized. Consistent patient positioning is perhaps the most difficult to achieve. Placing the head in a neutral position and gaze must be done precisely and accurately. Standardized views include a frontal photograph, right and left laterals, a close-up of eyes, 45° oblique photographs, and close-up oblique of the face and another of the eyes.

4. The postoperative photographs must be taken when the edema has subsided. If a series of treatments are being documented, the photograph should be taken immediately before the next treatment to minimize erythema and edema.

**CONCLUSION**

The results of many resurfacing procedures are analyzed with photographic analysis. This attempts to provide objective pre and posttreatment analysis of an intervention. However, if the variables in photographing subjects are not accounted for, interpretation of the results is difficult.

Meticulous attention to the principles of standardized photography is currently the best way to minimize misrepresentation of the skin. Alternative methods of analysis may play a larger role in the future in analyzing postprocedure dermatologic changes. Pore size readers (skin depth) and Wood’s lamp readers can closely examine the skin quantitatively but are not in common use at present.

With skin resurfacing techniques, often the change sought is subtle and found at the pore level. Pigment changes, skin scaling, and fine wrinkles are difficult to capture photographically, and differences in photographic technique will either emphasize or de-emphasize the differences.

Patients seeking facial resurfacing procedures do so because of anticipated improvement in skin texture, fine wrinkles, and pore size. Capturing these subtle changes is often difficult and is dependent on consistent, standardized photography.
REFERENCES