Cleaning Your Lens ***(continued)***

to clean your lens well: Be patient and resist the urge to "scrub" the glass. Complete the process by breathing gently on the lens before the final wipe with a dry tissue.

Use common sense when cleaning your camera's lens. Clean regularly (but not after each patient) and gently (not vigorously).

After cleaning, the best way to keep your front element clean is to actively use the lens cap. Place the lens cap over the lens between each patient and whenever you leave the room—even when changing film!

It is wise to have your optics checked regularly by the manufacturer's service technician. Refer the cleaning of internal optics to a trained professional.

You may experience some residue that does not yield to these instructions. More extreme measures are described below. Caution: Because each different manufacturer uses different optical glass and lens coatings, check with your technical representative before using any of the following cleaning solutions. In addition, because these chemicals may pose a health hazard, use them with caution. Observe proper Occupational Safety and Health Administration (OSHA) regulations concerning both use and material safety data sheets (MSDS) documentation.

If your lens has a particularly nasty spot, these solutions, listed in order of least to most potent, may prove useful:

- Denatured alcohol
- Equal parts denatured alcohol and acetone
- Acetone
- Lacquer thinner followed by acetone

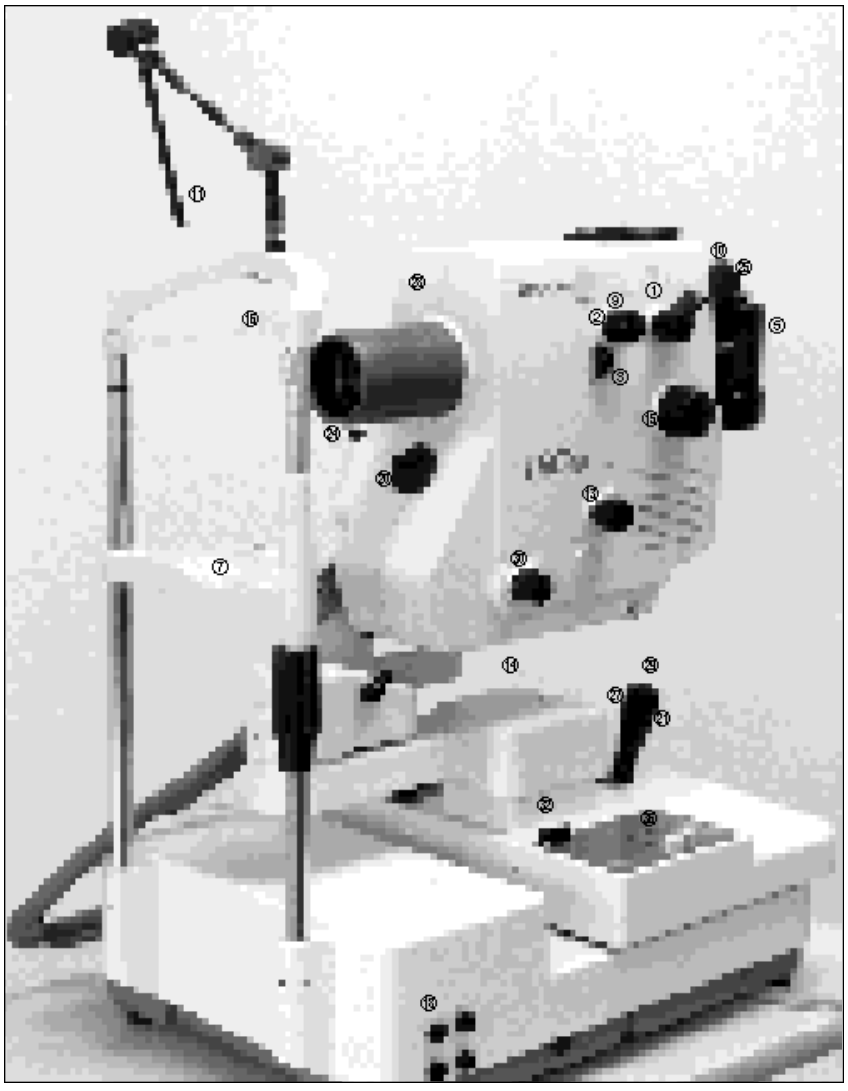
Of course, your front element is not the only place your fundus camera needs to be cleaned. External surfaces that come into contact with your patients should be disinfected both between each patient and at the end of the day.

Fundus cameras that are used daily should have yearly inspections by factory-trained technicians. Consider returning your camera to the factory for complete optical realignment and refurbishment every 5–10 years. Mobile cameras may need service more often.

Fundus Photography Technique: Step By Step

The time involved in obtaining a good fundus photograph is significantly longer than the tiny fraction of a second it takes to expose the film. Like the athlete who is judged on split-second decisions, you should recognize that proper preparation, standardized technique, and careful follow-through are vital to successful fundus photography.

Fundus photography is actually a multistep procedure (Table 2-1). We will explore each of the following four major steps in detail:



A

FIGURE 2-10
Controls on three different fundus cameras are labeled to correspond with the numbered descriptions below (A, B, C). Your controls may vary according to the specific make and year of your fundus camera. You should be completely familiar with the function of all of your fundus camera's dials, knobs, and switches; consult the manual or the manufacturer if you are not. (Courtesy of Canon USA, Nikon, Inc., and Topcon USA.)

1. **Angle selection lever.** Inserts lenses into the optical pathway, which either increases or decreases the angle of view (or magnification). You should be familiar with the retinal area circumscribed by each setting, as well as the relative sharpness of each.
2. **Anterior segment lens.** Inserts a positive lens into the optical pathway, allowing for a more accurate imaging of the external eye or name tag. The diopter compensation lens performs this function on some cameras.
3. **Astigmatism compensation control.** Inserts an adjustable cylindrical lens into the optical pathway. It is especially useful when patients have a large amount of astigmatism or when photographing the periphery of the retina.

FIGURE 2.10 ***(continued)***

Which Eye Should Be Photographed First?

When both eyes are to be photographed, one convention dictates that the macula of the right eye (OD) be photographed first. This establishes a routine introduction to the patient both at the camera and at the editing table. This approach is often favored for novice fundus photographers because of its simplicity.

Another approach is to photograph the affected eye first. This is the eye the physician is most interested in; it may have been chosen for the transit phase of a fluorescein angiogram. In this system, if the session ends early (e.g., if the camera breaks or if a very young patient declines further photography), the most important images have been captured. Additionally, the second eye photographed often exhibits increased light sensitivity.

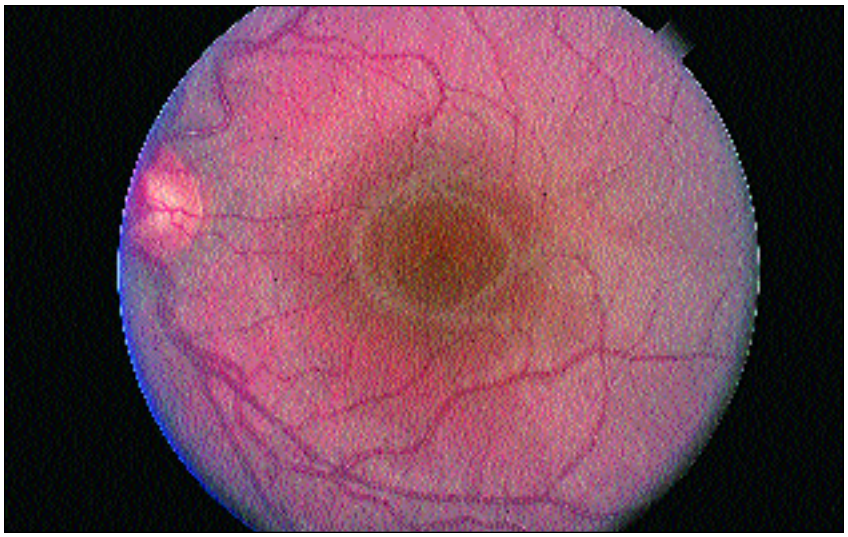
It matters little which specific system you choose as long as you establish a logical and systematic approach to your patients.

Establishing Fixation

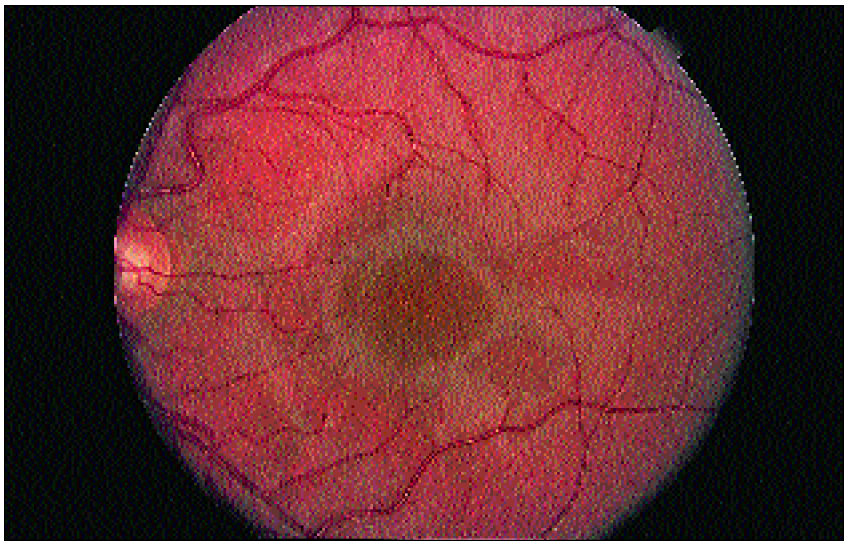
There are a number of reasons why your patient may not be able to fixate on the external fixation light, the most obvious of which is that your patient probably has vision problems! If you are having trouble establishing fixation using the external fixation device, try one of the following practical suggestions:

1. ***Clarify your instructions.*** Patients may look to the side and see the fixation light with the eye you are photographing (as opposed to the fixating eye). They will ask you which of the two lights you want them to look at—the one to the side or the one straight ahead. Instruct them to look at the little light in the middle of the big light, or at the small light straight ahead, not at the light to the side.
2. ***Alter the visual stimulus.*** Amoving or blinking stimulus commands attention better than a stationary stimulus. Try moving the fixation light from side to side using short, quick movements. If your camera doesn't have a blinking fixation light, then simulate blinking by rapidly moving your finger back and forth in front of the fixation light.
3. ***Change the fixation light location.*** Younger patients may attempt to fixate with both of their eyes. These patients will cross their eyes, making it difficult for you to obtain the proper field of view. If your instructions to look straight ahead fail, try adjusting the distance between the fixation light and the patient's eye. Some patients will straighten their eyes if you move the fixation light further away, effectively hiding it from the eye being photographed. Alternately, rotate the fixation light in slightly and move it closer toward the inner canthus. The fixating eye will remain crossed, but the eye being photographed will be looking straight ahead.
4. ***Use the internal fixation device.*** Insert your internal fixation device into the optical pathway where it will cast a shadow onto the patient's fundus. This stick-like shadow will look in focus to the patient when it looks in focus to you. In most cases you will want to remove the internal fixation device

(continued)



C



D

FIGURE 2-20 ***(continued)***

side of the fundus image, the camera is off-center to the right side of the pupil. In this case, use the joystick to shift the camera slightly to the left, centering the doughnut in the pupil. These crescent artifacts can occur above, below, and to each side. Using the joystick, move in the opposite direction of the crescent to recenter the camera in the pupil (and eliminate the artifact). (See Chapter 3 on stereo fundus photography to learn the importance of finding and using these artifacts.) Once your view is free from crescent-shaped artifacts, seek proper color saturation. Moving the joystick toward and away from the patient, check for the most even, most fully saturated view. Remember that the reticle should still be sharp.

Two simple guidelines affect positioning artifacts during fundus photography: (a) moving the joystick from side to side and moving the optical head up and down controls the centration of the illuminating ring in the pupil and therefore controls the presence or absence of crescent shaped artifacts, and (b) moving the joystick in and out controls the color saturation of the image.

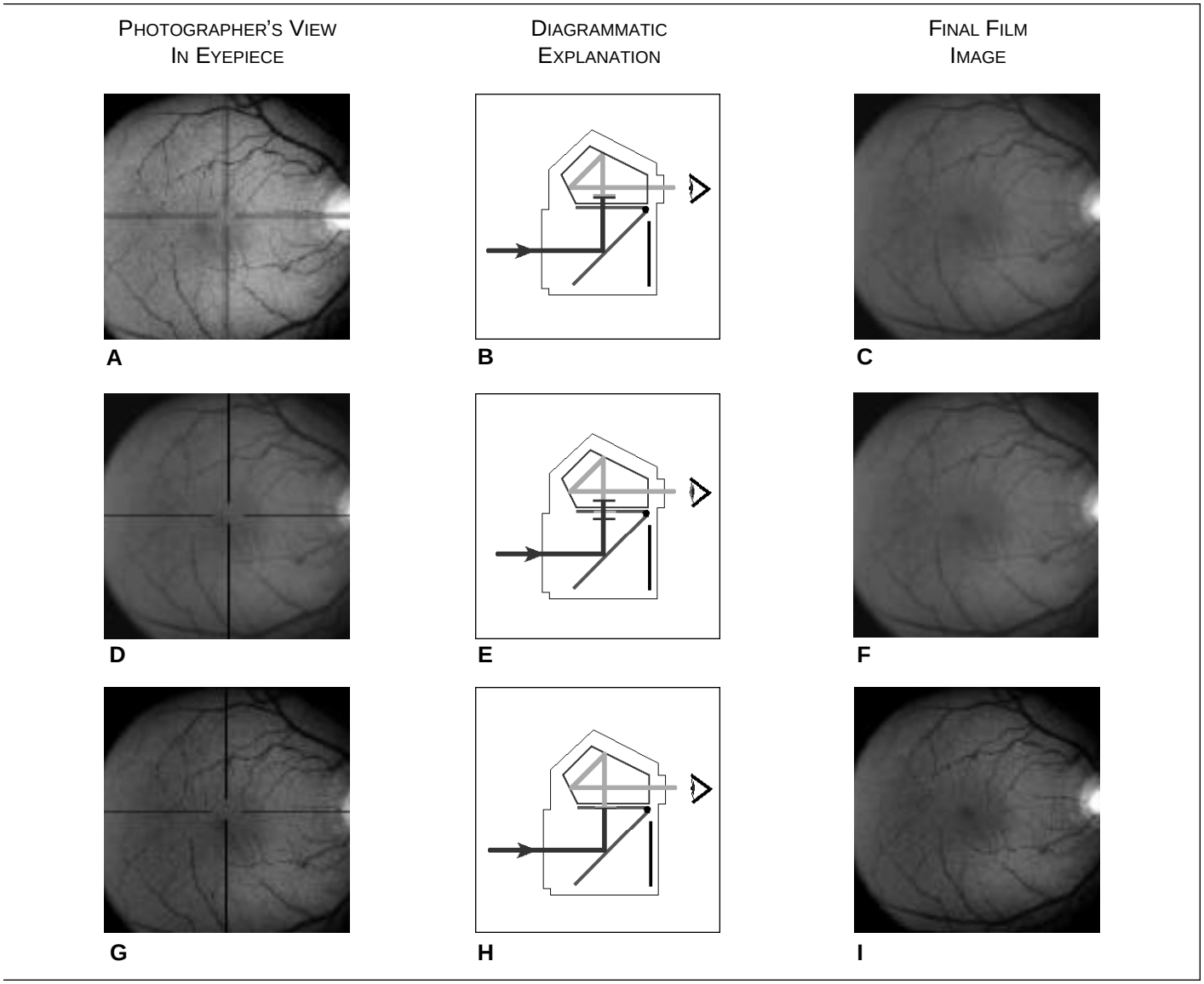


FIGURE 2-32
Using the reticle to focus. This figure illustrates the relationship between sharpness in the reticle, your fundus view, and the sharpness in the final fundus photograph. When you focus the image without regard to the sharpness of the focusing reticle, you will perceive the fundus image as sharp while the reticle image appears blurry (A). The image you see is focused by your eyes above the focusing screen, closer than infinity (B). Even though you see a sharp image in the viewfinder, the exposed photograph will be blurry (C). When you view through a correctly adjusted eyepiece before the fundus has been focused on, the fundus appears blurry while the reticle is distinctly sharp (D). You have correctly focused on the reticle, but the camera's image has not yet been adjusted to coincide with the receiving plane (E). If a picture is taken, the resulting image will be as unsharp as you see it in the viewfinder (F). After correctly adjusting the eyepiece and the fundus camera's focusing mechanism, both the fundus image and the reticle appear sharp and clear (G). Your eyes are focused on the reticle, and the image from the fundus camera corresponds with the film plane (H). Only this final combination will yield a sharply focused fundus photograph (I).

possibility of accommodation and the unsharp photographs that may result.

2. If you think you are accommodating during a procedure, look away from the eyepiece. Merely blinking or closing your eyes may help reset their focus. Upon looking again into the viewfinder, concentrate on the thin black lines of the focusing reticle. Intentionally blurring the fundus image (move the plane of focus into the vitreous by rotating the focusing knob) may help you concentrate on the reticle image.
3. Try to keep both eyes open throughout the procedure, preferably with the non-eyepiece eye focused across the room. A well-placed

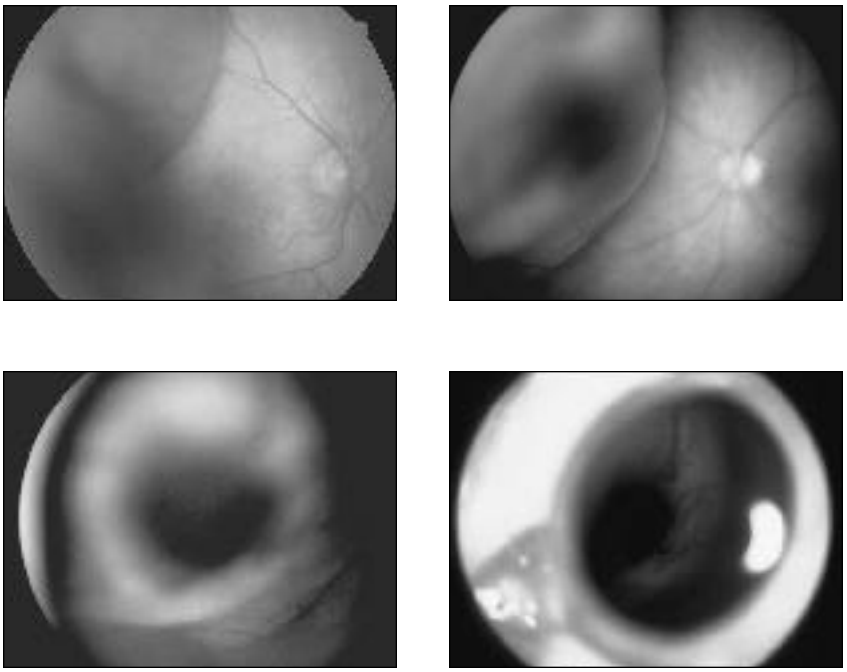


FIGURE 2-41
Be prepared to alter your focus or alignment to capture items of interest extending into the vitreous. Documenting the extent of this tumor required both changing the focus and pulling the camera away from the patient's eye.

reticle and precisely targeting the focus to a specific retinal level are keys to success.

Errors in Fundus Photography: Artifacts

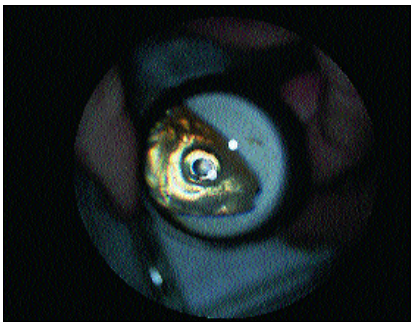
Successful fundus photographs are obtained through the mutual interaction and proper alignment of the patient, the camera, and the photographer. The patient contributes a cooperative attitude and clear media. The camera must faithfully translate the fundus image using integrated optical, mechanical, and electrical subsystems. The photographer must elicit a cooperative response from the patient, correctly align and set the camera controls, and make decisions concerning film choice and processing procedures. Each of these factors must be taken into consideration when evaluating a fundus photograph.

Causes of Artifacts

The ideal fundus photograph is an accurate visual representation of the retina. Of course, as with any complex process, many things may go wrong. If the error alters the ideal image (i.e., if the error can be seen in the final fundus photograph), it is called an *artifact*. Artifacts are portions of the image that arise from the process—not from the patient's retina. Typical artifacts include yellow or orange crescents, white or blue haze at the edge of the photograph, blinks, dust on the front element, and poor focus (Figure 2-42).

The fundus camera generates a flash that is projected into the patient's eye, reflects off the fundus, and then travels through the camera's optical system to the film. Each step in this process has the potential to compromise image quality. If we follow the pathway of image-forming energy from its point of origin (*the electrical wall socket*) to its final destination (*the finished fundus photograph*), we can identify specific problem areas where technical difficulties could occur.

A



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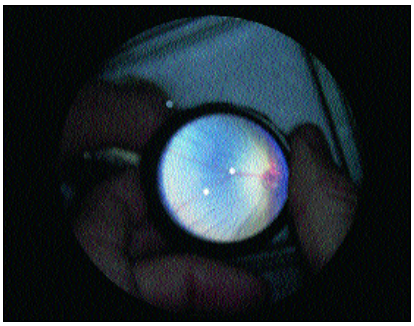

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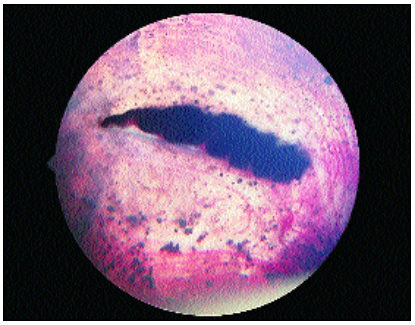

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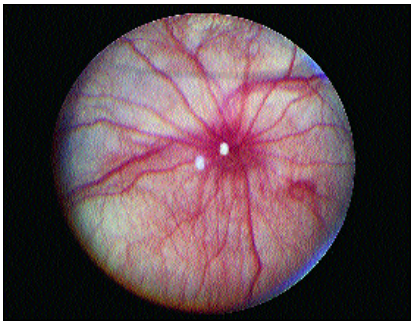

E

FIGURE 2-64
Fish fundus photography using a hand-held camera and a condensing lens (A). First obtain a red reflex (B), then optimize the distance for fundus imaging (C). An owl retina (D) and rat retina (E) complete this fundus menagerie. (Courtesy of M. Croswell.)

Hand-Held Fundus Cameras

Portable, hand-held fundus cameras are useful in a variety of situations—for babies and small children who are too small for the standard head rest and for supine patients (whether bedridden, undergoing surgery, or being examined under anesthesia) whose condition make standard patient positioning difficult. Animal fundus photography is also often performed using hand-held fundus cameras (Figure 2-64).

Positioning the hand-held fundus camera requires skill and practice. The patient should be stationary (papoose small babies and have one per-