PHOTOGRAPHIC DOCUMENTATION OF HAIR GROWTH IN ANDROGENETIC ALOPECIA

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The ability to photographically document patient progress is especially useful in recording the subtle changes that a hair loss patient may have between office visits. Serial photography (sequential photographs) can be used by both the physician and the patient to assess these changes. Figures 1*A* and 1*B* show the therapeutic benefit a patient has achieved in the vertex area of the scalp from an initial to a 6-month follow-up visit. The physician's challenge as the photographer is significant: to take photographs that allow for the assessment of change, and not a critique of photographic technique. Variability in technique, including patient preparation, lighting, camera settings, camera to patient registration, film, and processing can all undermine the best intentions of photographic documentation.

High-quality clinical photography can be accomplished in the examination room. With the 35-mm camera equipment you may already have in your office, you can structure a methodic approach for taking reproducible serial photographs. Controlled reproducible serial photographs should read like a time-lapse movie, allowing for only the change in a patient's condition over time. Clinical researchers studying androgenetic alopecia worldwide use controlled photography for primary and secondary endpoints of protocols to determine the efficacy of therapies.

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GLOBAL PHOTOGRAPHY

A global photograph of a patient with hair loss should record the patient's cosmetic state. This effort requires a cooperative patient with clean, dry hair and a detail-oriented technician who is able to take the time to comb and prepare the hair precisely the same way at each office visit. If possible, the patient should be advised to maintain the same hair style and color.

PATIENT PREPARATION

The variables in patient preparation for global photography can be daunting. Oily or

From Canfield Scientific, Inc., Cedar Grove, New Jersey

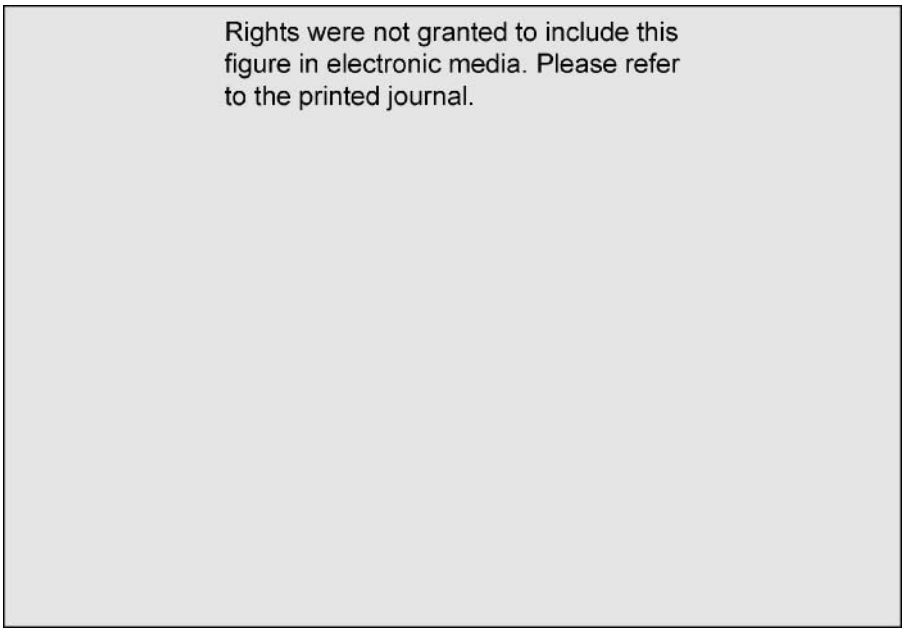

Figure 1. *A*, Week 0 vertex view of a patient with androgenetic alopecia. *B*, Week 24 vertex view showing efficacy of therapy. (Courtesy of Ronald C. Savin, MD, New Haven, CT.)

wet conditions increase reflection and also cause the hair to clump, revealing more scalp and portraying the patient as having less hair. If the hair is not combed precisely the same way in follow-up visits, photographs will record different areas of the scalp and will obviously make assessment difficult or even impossible. Extraneous information, such as shirt collars and distracting backgrounds, should be eliminated or masked. The background should be a medium color density. Blue is the most popular owing to its pleasing contrast to skin tones. Background paper is readily available and can be hung on an open wall in the examination room (sometimes easiest found behind a door). Blue felt, which can also be used, is advantageous because it won't crease and wrinkle as easily as paper. Black drape cloth is recommended when masking shirt collars because shadows created in the drape cloth's folds will not be seen.

Four global views are demonstrated in Figure 2 to assess cosmetic change: the vertex, mid-pattern, frontal, and temporal views. For the vertex photo the hair is combed out from the vertex (like the spokes of a wheel); hair is parted in the center for the mid-pattern photo and pulled back to reveal the hairline for the frontal and temporal views. Additional views, including sides, can also be useful, but we have found the vertex and mid-pattern views to be the most meaningful when assessing drug therapy. Figures 3*A* and 3*B* demonstrate therapeutic efficacy at a 6-month follow-up using the mid-pattern views.

Depending on the coarseness, length, and style of the hair, combing can prove to be most challenging, and the amount of time required to adequately comb and position the hair can be extensive.

LIGHTING AND EXPOSURE CONTROL

Variability in lighting is one of the most criticized aspects of serial photography. Angle and distance of the light source to the patient must be optimized and fixed. A ring flash (a circular tube mounted around the perimeter of the lens) is not an appropriate light source for photographing most dermatologic conditions, especially alopecia. A ring flash is a shadowless light used primarily for intraoral photography and reflects light directly back

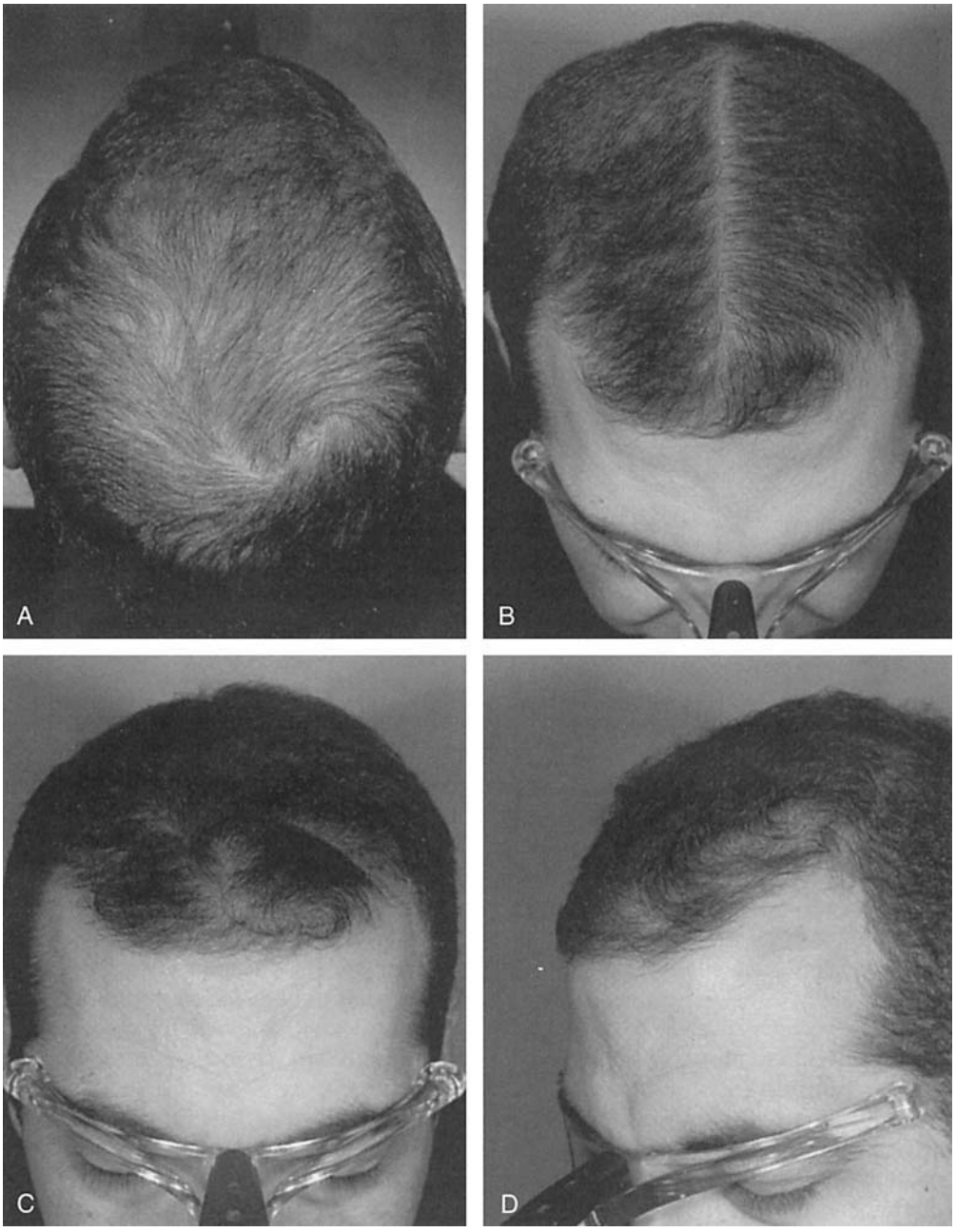

Figure 2. *A,* Vertex view, hair combed away like spokes of a wheel. *B,* Mid-pattern view, hair carefully center parted. *C,* Frontal view, hair combed back to reveal hairline. Headbands should be used with patients with longer hair. *D,* Temporal view, 45-degree angle, hair should be combed away. (*From* Canfield D: Photographic documentation of hair growth in androgenetic alopecia. Dermatol Clin 14:716, 1996; with permission.)

into the lens, creating glare and flatness in the photographs. A dual point light source creates balanced illumination and enhances both depth and texture, which maximizes the visualization of hair. Setting up a dual point light source can be accomplished in a number of ways. The first is by mounting standard flashes on brackets that attach to the camera's tripod socket at the bottom of the camera. The flashes are then connected via synch cords to

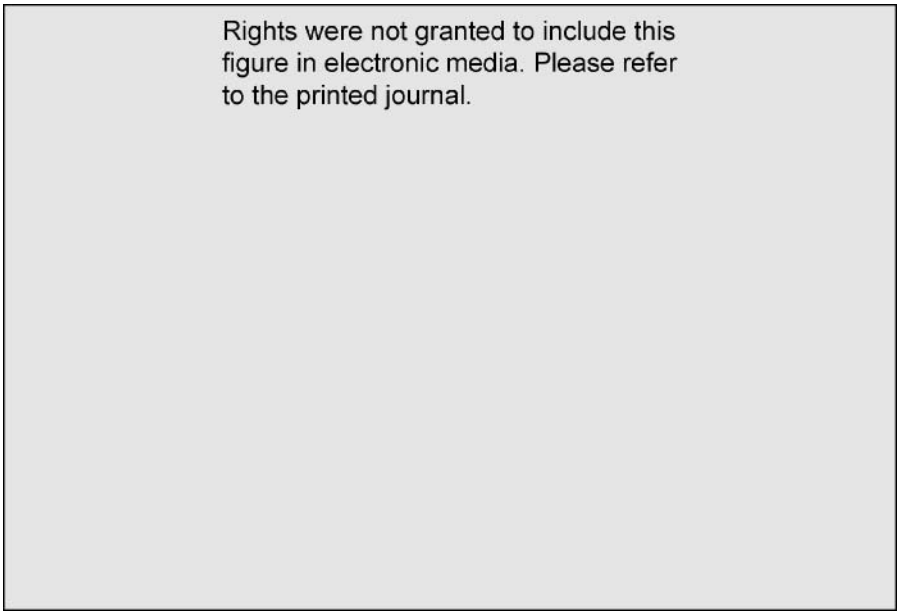

Figure 3. *A*, Week 0 mid-pattern view. *B*, Week 24 mid-pattern view showing efficacy of therapy. Assessment is possible due to consistent hair parting. (Courtesy of Ronald C. Savin, MD, New Haven, CT.)

the camera's hot shoe. The photos shown in this article have been taken using a CCS-70 Twin Flash (Canfield Clinical Systems, Cedar Grove, NJ), which has two heads that independently extend and pivot. Each arm is extended and locked at 14 cm from the center of the lens, and the flash heads angled and locked at 20 degrees (two click stops in from center). Figure 4 illustrates the camera system set for global hair photography.

Exposure control is critical when taking dermatologic photographs. Even slightly overexposed photos will capture less detail, and finer hairs will not be recorded. Slightly underexposed photos can make the patient appear to have a smaller hair pattern, and thus, more hair. Another complication in achieving the correct exposure is that lighter hair and skin require less light and darker hair and skin require more light. Changes in scalp color and hair color (usually due to sun exposure) and hair density will require a change in the amount of light needed for the same patient at different visits.

Through-the-lens (TTL) metering, which is found on most modern single lens reflex camera systems, controls the duration of the flash by using the camera's internal meter to adjust the exposure. TTL metering is recommended for most dermatologic photography owing to its accuracy, reproducibility in exposure control, and ease of use.

LENS TYPE AND SETTING

There are several manufacturers producing appropriate lenses for dermatologic photography. A lens that allows for close-up photography without distortion is recommended. For example, the 60-mm f-2.8 and the 105-mm f-2.8 micro-Nikkor lens (Nikon Inc., Melville, NY) are the two appropriate Nikon lenses for most dermatologic photography. Both Nikon lenses shoot at a reproduction ratio of 1:1 (image is recorded life size on the film). The primary difference between the 60-mm and the 105-mm lenses is the focal length or how far away the lens is from the subject at a given reproduction ratio or magnification. For example, if a 60-mm lens is set at 1:1, the image will be in focus at approximately 21.5 cm from the film plane to the subject. Likewise the 105-mm lens will be in focus at 31 cm.

Reproduction ratios on the 60-mm and the 105-mm micro-Nikkor lenses can be adjusted from 1:1 to infinity simply by rotating the

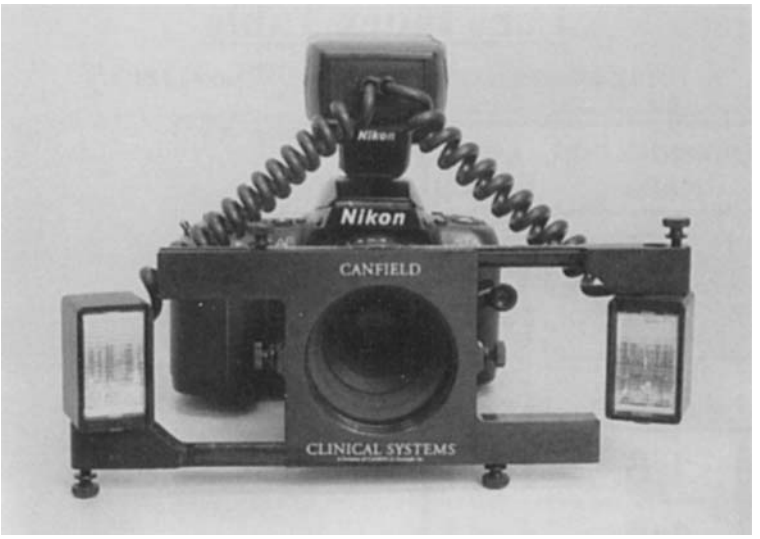

Figure 4. CCS-70 Twin Flash (Canfield Clinical Systems, Cedar Grove, NJ) with Nikkor 60-mm f-2.8 lens (Nikon Inc., Melville, NY) and Nikon N6006 camera. Each arm is extended and locked at 14 cm and angled at 20 degrees. (*From* Canfield D: Photographic documentation of hair growth in androgenetic alopecia. Dermatol Clin 14:717, 1996; with permission.)

focusing ring on the lens. Serial photography requires standardization of magnification that can be accomplished by selecting the reproduction ratio and/or distance setting shown on most macro lenses. Medical photographer Bill Slue at New York University has written about the "Three Views Method," an approach in which the photographer preselects standardized reproduction ratios to photodocument any patient in the clinic. After a reproduction ratio is selected, focusing is accomplished, not by the traditional method of rotating the focus ring (which would change the reproduction ratio or magnification) but rather by adjusting the distance between the subject and the camera. This method of focusing by distance is called body focusing. Although both of the Nikon lenses recommended have auto focus capability, this feature is not appropriate for clinical photography and should not be used. Auto focus changes the reproduction ratio as it focuses, which makes standardized magnifications over time unobtainable.

The other adjustment on most lenses is the f-stop setting. The f-stop is the size of the aperture or opening in the lens. The lower the f-stop number, the larger the aperture. The maximum depth of field (range of sharpness from front to rear) is achieved when the smallest aperture is selected. The selection of an f-stop that maximizes depth of field is dependent on the reproduction ratio, power of the flash, and speed of the film (the amount of light sensitivity). Figure 5 indexes the f-stops to the reproduction ratios based on using ISO 64 film and the CCS-70 Twin Flash. This table may need to be adjusted depending on the flash and film speed used.

CAMERA SETTINGS

When presetting the lens reproduction ratio and f-stop it is important to select the "aperture priority" mode on your camera (most manufacturers and models designate this mode with an "A"). The aperture priority mode allows the camera to recognize the f-stop you have selected and uses the TTL metering system. If the camera has an autofocus mode it should be turned off. The camera illustrated is a Nikon N6006 (Nikon Inc., Melville, NY), which accepts an external flash, has an aperture priority mode, and has an automatic film advance and rewind. Extra features are not necessary for good clinical photography and actually increase the potential for error in the clinical setting. The flash

Lens Index Table

Using 60-mm lens and CCS-70 TwinFlash ™

Reproduction Ratio	Lens F-Stop
1:1	f-22
1:2	f-16
1:4	f-16
1:6	f-11
1:8	f-11
1:12	f-8

Figure 5. By preselecting the reproduction ratio and indexing to the appropriate f-stop, correct exposures are assured when using the flash in the TTL position and the camera in the aperture priority mode. (*From* Canfield D: Photographic documentation of hair growth in androgenetic alopecia. Dermatol Clin 14:718, 1996; with permission.)

and lens are by far the most important components of your camera system.

FILM AND PROCESSING

There are several appropriate films between ISO 50 and 100. The right film is largely dependent on your needs and personal tastes. Film brands and types have different color balances; therefore, once you determine which film works best for you, it is important that you stay with it. Because color accuracy, resolution, and long-term archival qualities are important factors, especially in clinical trials, Kodachrome ISO 64 slide film (Kodak Inc., Rochester, NY) is still the recommended first choice. Ektachrome slide film is also a good choice and has the benefit of local processing (Kodachrome is only processed at regional Kodalux Laboratories).

CAMERA TO PATIENT REGISTRATION

The medical photographer should always maximize the amount of clinical information recorded on the film. The global photographs shown were taken by framing the head vertically and using the highest magnification possible while still obtaining a global view.

When framing the head for serial photography you need to develop a consistent method for patient positioning. A stereotactic camera device precisely positions the patient in a head support. The camera is mounted on a rotating arm that has preset positions and is registered to the head support. Figure 6 illustrates a stereotactic device in the four different positions. Stereotactic equipment is specifically designed for the exacting needs of clinical research.

Good results can also be achieved by mounting the camera onto a tripod or by hand holding the camera as shown in Figure 7. One way to accomplish consistent results is to always keep the camera lens parallel to the floor and position the patient to the camera. For global photography of androgenetic alopecia the camera should be held in the vertical format to maximize the clinical information recorded. An adjustable stool on casters can be of help in adjusting the patient.

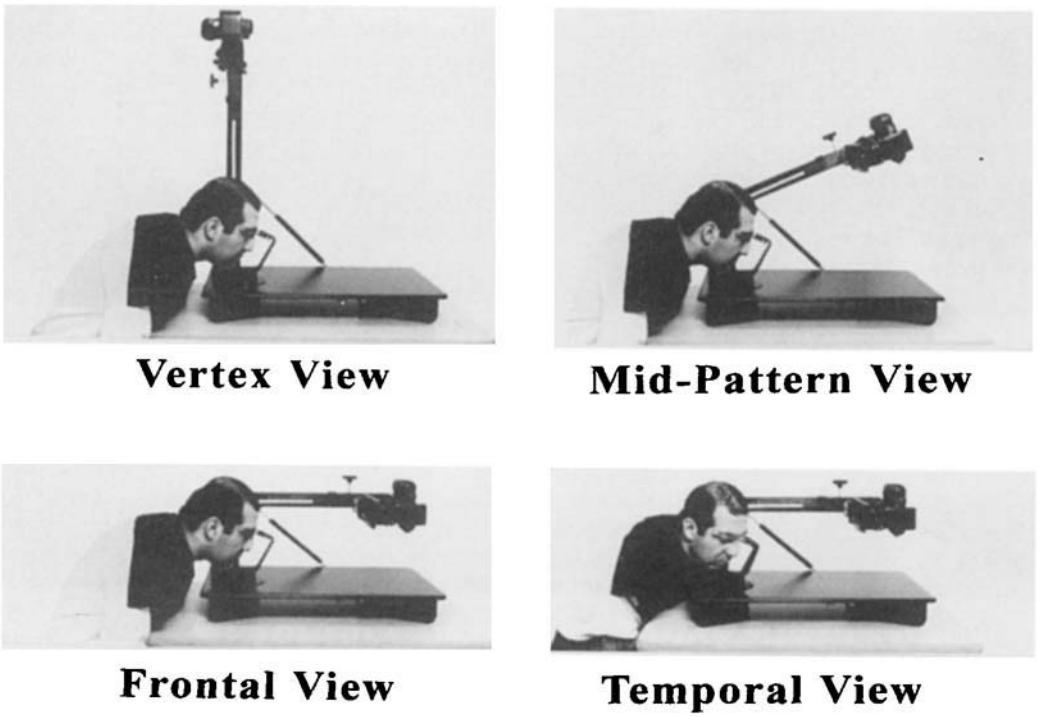

Figure 6. Serial photographs were taken on a stereotactic camera device that precisely aligns the patient's head to a camera mounted on a rotating arm. The chin support rotates into a 45-degree position *(lower right)* for temporal hairline view. (*From* Canfield D: Photographic documentation of hair growth in androgenetic alopecia. Dermatol Clin 14:719, 1996; with permission.)

The vertex photo is taken by having the patient turn away from the camera. The patient is then instructed to look at the ceiling, which, in effect, tips the head back. By instructing the patient where to look on the ceiling you can adjust the angle to maximize the thinning crown in the photograph. While keeping the lens parallel to the floor, move toward or away from the patient until the vertex is in focus and take the picture. Next, have the patient turn and face you. Instruct the patient to interlock his or her fingers and position his or her hands flat on a table, and then place the face on his or her hands. A piece of black drape cloth placed across the hands can remove this distraction in the photograph. After taking the mid-pattern photos, have the patient place the chin between the thumbs and index fingers. This will angle the head up to capture the frontal hairline. Again, keeping the lens parallel to the floor, adjust the height of the camera. Move toward or away from the patient until focus is achieved and take the picture. The last picture to take is of the temporal area. Angle the patient approximately 45 degrees to the camera. Instruct the patient to place his or her chin between the thumbs and index finger and, using the same body focusing method, take the picture.

Baseline photographs are a critical tool for taking reproducible serial photographs. Baseline photographs should be available for reference at all follow-up photo sessions. This allows the patient's hair to be prepared exactly the same way and the patient positioning to be matched.

HOUSEKEEPING AND ARCHIVING

One area that should be addressed after you have decided whether you will be using slides or prints is how you will organize and archive your photographic documentation. For clinical research studies a photographic identification card that contains the study information, patient data, date, and other study-specific notations is photographed onto

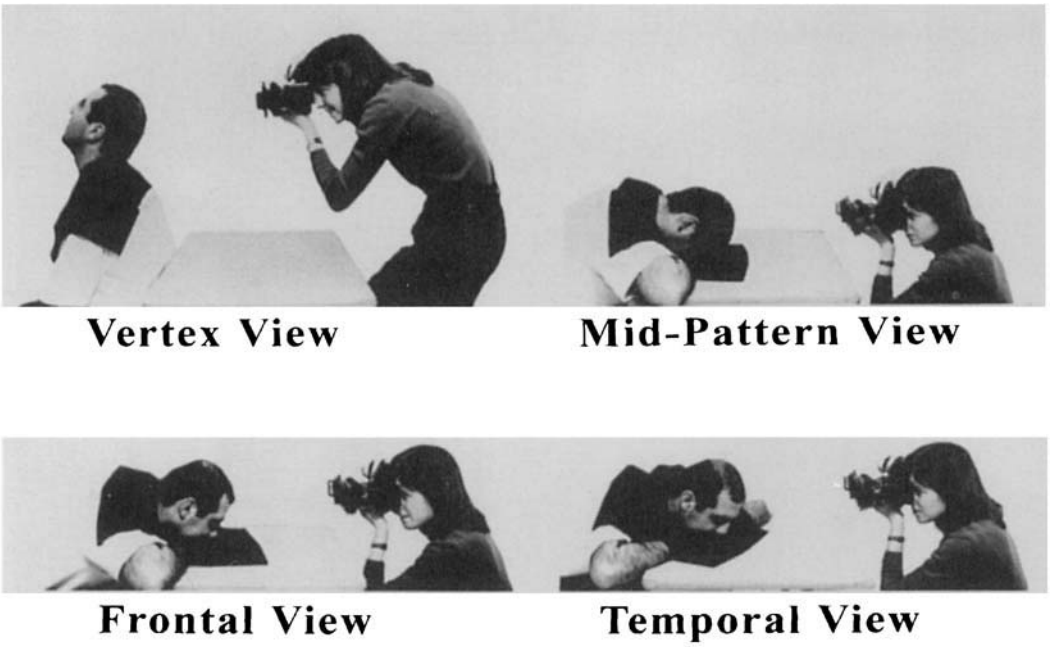

Figure 7. Keeping the lens parallel to the floor and moving the patient into position is one way of increasing the reproducibility of serial photography. It is critical that baseline reference photos be used during follow-up photographic sessions to match hair preparation and patient positioning. (*From* Canfield D: Photographic documentation of hair growth in androgenetic alopecia. Dermatol Clin 14:719, 1996; with permission.)

the roll of film before each patient series. When using slide film it is easiest to photograph the patient's chart before each series because most photofinishers number the slide mounts chronologically. When using print film this identification method does not work as well. The prints are not numbered and the negatives can be cumbersome and difficult to read. One way to identify your patients on print film is to hold, or have the patient hold, an identification card in the frame with the first photo. The photo should ideally be taken again without the identification to avoid distraction. Any simple system that allows for slides or prints to be properly identified and marked when returned from the photofinisher is effective. A convenient way to handle photos is to store them in archival quality plastic pages that are widely available in camera stores or through direct mail order.

COMPUTER-ASSISTED HAIR COUNTS

Hair counts allow for a quantitative measurement of hair within a specific target area over time. Manual counting can be done during the office visit using a magnifying loupe and an examination lamp. This is a cumbersome, undesirable method because of the length of time that it takes, the precision (multiple counts of the same area should be done and compared before the patient leaves), and the inability to re-examine the hair count area once the patient leaves. Photography, however, allows for a much more efficient patient visit and a more controlled hair count process. Patient photographs can be "counted" at a centralized facility that uses highly trained and validated technicians and maintains thorough records, including the original photographs.

When hair count photography is used, a target area on the scalp is chosen, clipped and prepared, and permanently landmarked with a single tattoo for future site location. Controlled photographs are then taken, centrally processed, monitored for technical adequacy, and counted using specially designed validated computer-assisted methods. Figure 8 is a sample of a controlled hair count photograph.

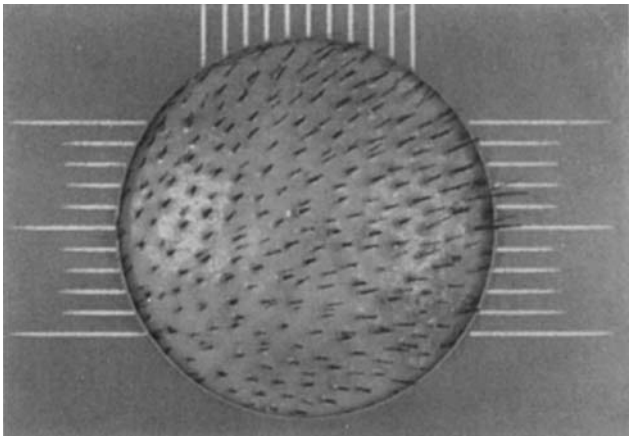

Figure 8. A sample hair count photograph. Stray hair clippings and hairs originating outside of the target area create artifacts that may make photographs unusable. (*From* Canfield D: Photographic documentation of hair growth in androgenetic alopecia. Dermatol Clin 14:720, 1996; with permission.)

Standardized photography for hair counting requires a dedicated, preset camera system with a fixed dual point flash system and a macro lens set at a fixed reproduction ratio for consistent magnification, and a fixed f-stop for consistent depth of field. The camera system should be mounted to a positioning device that precisely registers the camera to the target area.

Although precise hair counts are important in quantifying the number of visualized hairs in a specific area of the scalp, the technical procedures of permanently landmarking a designated counting site, clipping and preparing the target site, and the necessary specialized camera equipment make this method practical only for dedicated researchers with trained technicians and cooperative patients.

SUMMARY

The challenge of useful serial photographic documentation of hair loss can be met by using a regimented approach at each photographic session. Patient outcomes that are better documented allow for more informed decisions to be made about the course of therapy by both the physician and the patient.

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