

Guidelines

General Aspects and Guidelines in Medical/Clinical Photography

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Characteristics of medical photography

Clinical photography is an essential part of medical research, diagnostics and documentation. Clear and consistent pre- and postoperative photos document a patient's progress, demonstrate what results may look like to prospective patients who are having the same procedure, and create a visual record of your work. High quality clinical photos are also important for use at scientific meetings, in medical journals and for other educational purposes.

Photographs can tell us a great deal about a patient's condition at an instant in time, and serial photographs taken over a period of time can tell us much more about the progress of disease or response to treatment. So why is it that the clinical photographs we see are so often a disappointment? They are too dark, too light, have dark shadows, are out of focus, show color variations, important details are obscured, they are untidy, the scale is indeterminate, etc.

Undoubtedly, fully trained clinical photographers take the best medical photographs in professional studios with the full range of lighting and equipment available. But such a facility is not always available, and certainly not at all hours of the day and night or in every location at which they see patients.

The clinical photographers are not concerned with photographic tricks, such as are seen in advertisements for anything from hair tonics to plastic surgery. Playing with visual angles, make-up and clothing, perspective tricks, soft focus and lighting can exaggerate the benefits of treatments on offer. Images can be manipulated at the processing stage, which is easier to do with digital images, as well as harder to detect. There is no place in clinical recording or publication for using such photographic manipulation to misrepresent outcomes, and in some cases it would be illegal. Original films and written records should be retained, and for digital images track files should be maintained.

All institutions that deal with patients should require photographers that have been specially trained.

This should ensure the best way to take the type of pictures that the doctors need. In general the photographic output depends on what the doctor has asked for – the photographer will tell the patient what is necessary in order to obtain the required pictures.

It is important that the photographs demonstrate the condition as clearly as possible. In order to do this, it may be necessary to tie back hair or to remove jewelry. In some cases, make-up should be removed. Sometimes the condition being recorded will require any clothing that would appear in the picture to be removed. Occasionally special instruments (such as nasal retractors) are needed to help to get a clear picture. If this is necessary in a specific case, the photographer will explain the instruments to the patient before the photographs are taken.

The photographer should be informed of any concerns or reservations the patient may have about the photography, and be sure that he/she is given all the information that is needed.



Getting consent

The patients should sign a Photo Consent Form. Ideally, this should be done even if publication (paper or online) is not planned. Taking this precaution may make it easier, should you change your mind later on. If the patient is easily recognized, the Patient Consent Forms are required if the clinical photos are to be published in a journal, for educational purposes or on a website. The form is regarded as legally binding and very important and must thus be as specific as possible.

Perspective

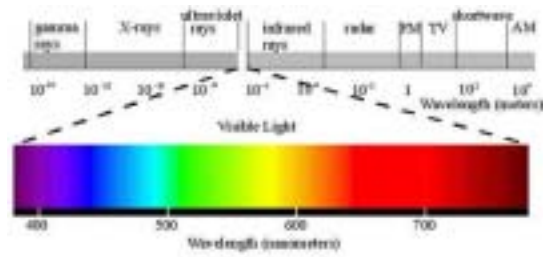
The perception of depth that perspective gives to a clinical photograph is an important attribute. The concept of image size diminishing with distance is familiar, but perspective also affects the appearance of objects and people as viewpoint changes: come too close and features can appear distorted, but take the photograph from too great a distance and the perception of depth is lost. That is why not only the image size, but also the distance from which a photograph is taken, should be standardized. For 35 mm film, a lens of around 100 mm focal length allows distortion-free images in most clinical situations, but a shorter focal length of around 50-60 mm will be needed for full length photographs, or when working in a confined space.

Depth of field

Depth of field is the amount of a subject that appears sharp in front of, and behind, the principal plane of focus. The smaller the lens aperture, the greater the depth of field, and this is particularly critical in close-up work where there is considerable depth, such as when photographing the teeth. Relative aperture size is denoted on a lens by f-numbers - the higher the number, the greater the depth of field, but the smaller the amount of light passed through the lens. Generally in clinical photography needs the maximum depth of field so the flash should be bright enough to allow it to use the smallest possible aperture. 35 mm cameras should aim for at least f/16 and up to f/32 for close-up work where depth is important. Using a faster film will improve depth of field, but at the expense of some image quality.

Lighting

The human eyes and brain have an extraordinary ability to adjust to different lighting conditions - we work quite happily in daylight, or under tungsten and fluorescent lights. Color temperature is measured in Kelvin (K) and its definition is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water, which also, in



fact, is the absolute temperature scale. (Conversion Celsius to Kelvin: $K = ^\circ C + 273$). Normal daylight will be measured to approximately 5500 Kelvin, blue skies and shadow will be more. Tungsten light is approx. 3400 Kelvin. Halogen bulbs are stable in color temperature, but conventional light bulbs will be more red/yellowish down to 2900 Kelvin in daily/monthly use. An electronic flash will produce color temperatures similar to daylight.

The visible light is - in wavelength - measured in nanometers (nm). Cameras and films are less adaptable, particularly in mixed light, so photographs taken with a daylight film in fluorescent lighting will have a green cast, while those taken in tungsten lighting will have a strong orange/ yellow cast. Indoor lighting is not bright enough and the quality of the light is never appropriate for clinical photography. An electronic flash is ideal for providing a bright light source that is of such short duration that it is capable of 'freezing' any movement. It is powerful enough to negate the effects of normal room lighting, although if you work in a room with strong sunlight coming in through the

windows, you should close your blinds or curtains. Similarly, powerful examination lights or operating lights should be dimmed while taking photographs with flash. The existing light - e.g. strong light in the examining room - can be counteracted by a higher shutter speed.

If an existing - tungsten - light is used in analog photography, a film for tungsten light should be used, alternatively a filter (blue) for compensation. Again, this will affect the speed of the film. In digital photography this is not a problem, but the white balance has to be set. This is a normal procedure in professional digital photography.

The above issues make it clear, that the most secure method to produce acceptable photos, is to use flash-light.

Modern compact cameras have a flash built into them, usually with automatic exposure control, making it difficult to produce a badly exposed photograph. This is fine for a quick record, but the lighting is too close to the lens axis to provide sufficient modeling effect to demonstrate shape and texture. It will also produce 'red eye' - the red reflexes you see in people's eyes in photographs taken with compact cameras (red-eye reduction modes use a pre-flash, which causes a delay in the shutter firing, and thus are not ideal for moving subjects such as lively children).

A still photograph does not have the advantage one has in a live examination; that of moving oneself or the patient to look at a subject from any angle. Shape and texture can be revealed by off-axis lighting from a portable flashgun held in the hand that is not holding the camera, or attached to a bracket. Ensure that it is pointing directly at the subject, to avoid the light falling off toward the edges.

Lighting should as nearly as possible replicate what we are used to seeing: light from the sun, or indoor lighting from the ceiling, throwing shadows downward. Lighting should therefore come from above, and not below, in relation to the 'anatomical position' in which we pose the patient. Getting this wrong can have strange effects.

For the sake of consistency, always use the same camera, flash, lens, film, lighting and patient position. It is axiomatic that the only variable among photographs taken to show change over time should be in the patient. Everything else should stay the same - view-point, positioning, lighting, color, magnification, perspective, contrast, and background. The relative importance of these properties of a photograph might vary: color might not always be important to an orthopedic surgeon, although to a dermatologist it might be the most salient feature of a condition. However, the principles of standardization should apply to any set of two or more photographs

taken at different times. In practice it is extremely difficult to standardize absolutely so many variables - the photographs might be taken by different people, in different rooms, using different cameras, lenses or films, under different lighting, and from a different distance or angle to the patient. Slight variations in the film processing or digital treatment are highly likely. Different manufacturing batches of film - or in digital photography, the manufacture of the CCD chip - will have variations in sensitivity and response to color. Clearly, standardization requires a certain amount of planning, a systematic approach, and adherence to protocol and attention to detail.

Room space

Set aside a place solely for clinical photography to maximize privacy and patient comfort. Try to have the space situated near to the exam room for convenience.

Background

Try to use a seamless background, of a rich blue or green. Too much color in backgrounds can reflect, or throw a cast of the complementary color onto the subject, so the background should be a muted blue/green or a neutral white/grey. If you routinely photograph patients in a clinic or study it is worth setting up a plain, neutral background sheet or use the - more or less - sterile cloth or tissue, normally in 'hospital' color. Professional medical photographers often prefer to use a black back-

ground, which requires several carefully placed lights to ensure that the edges and hair of the patient are not lost in the photograph. When photographing patients in a ward it is best to place them against a plain white, grey or dimmed blue/green color sheet.

Patient positions

The patients should use the same positions, angles and poses for both pre- and post-operative photos. Keep image size consistent in your pre- and postoperative shots.

Occasionally, it might be useful to include contextual information in a photograph, such as showing the patient sitting up in bed, or attached to equipment. Similarly, if the photograph is to show dermatitis caused by an elastic bra strap, it might be useful to include the item of clothing responsible in the photograph. In most cases, however, only the clinical appearance of the patient is interesting, so all other distractions and possible influences on judgment should be excluded from the image.

Use a chair with an adjustable back to pose the seated patient and exclude any parts of the furniture from the frame. Remove jewellery and make up as far as possible. Allow patients time to replace them in private afterwards, and provide a mirror for that purpose. Ideally, all clothing should be removed from the field of view. This clearly requires some sensitivity and tact, as few people are used to exposing them-

selves to a camera. The patient can remove only the parts of clothing appropriate for each picture, rather than leaving them exposed any longer than is necessary. Photographs of patients hitching up their clothing can appear less dignified, less clinical and probably cause the patient no less discomfort than if they removed those items completely. Modesty garments can be worn if it is not necessary to show the genitalia; disposable white underwear should be available, or use small sheets held up with tape or bulldog clips. Any extraneous items of clothing appearing at the edge of the frame should be cropped out afterwards.

Try and provide photographic garments (underwear and paper gowns) for patients so that they can feel comfortable before taking photos and move from the examining room to the clinical photography area.

Discuss the pre- and postoperative photos. Avoid having the clinical photography feature be a surprise to patients! Let them know in advance (this should be part of your initial consultation) that photos are an essential part of medical treatment, confidential and provide a good visual record of before and after treatment and surgery.

If the patient is assisted, for example a child held by a parent, care should be taken to avoid including that person in the photograph. While photographing a child on a mother's

lap, ask her to sit sideways, so that she is not seen behind. Keep helping hands out of frame, or be as discreet as possible. In close-up photographs, where a hand is seen retracting eyelids, lips, etc., ask the person who is doing the retraction to wear an examination glove. The distraction of a patient or parent's dirty fingernail in the field of view can ruin an otherwise excellent close-up view. Hair should be swept back from the face, using a hair band and/or hairclips. Hairclips can also be used to expose lesions on the scalp to their best advantage. While photographing the lateral aspect of the head, long hair should be swept over the opposite shoulder, or held up in a bun.

Much confusion can arise from photographs - particularly close ups - in which the patient's position, or the orientation of a body part, is ambiguous. If we are going to produce a serial record of a patient the positioning should be consistent. The convention used by most medical photographers is, wherever possible, to photograph the patient in the anatomical position. All clinical photographs should be viewed with reference to this position - the top of the photograph should always be nearest the top of the head. This works for most views but some parts of the anatomy are best viewed from other angles, or in different positions. The arms are best photographed in extension, and are normally photographed in a horizontal position. However, the palms should still face forward, so

the back of the forearm should be photographed with the patient facing away from the photographer. Close-up views can easily be disorienting, so should normally be accompanied by an 'establishing' view, to show their precise anatomical position.

A full-length photograph of a patient is one of the most difficult to achieve satisfactorily. Fortunately, it is not often necessary or particularly useful, except to show abnormal stature, posture or body shape. The distribution of skin lesions is better shown with separate photographs from waist up, waist down, both front and back with the arms photographed separately. For some conditions it is preferable to show the patient weight bearing. If the patient can stand unaided, they should do so in the anatomical position, as described above. While photographing the standing patient, remember that from the position of your head the patient's feet are a long way away compared to their head. This can cause both perspective distortion, with the patient appearing to have tiny feet and legs, and a dramatic decrease in exposure between the head and feet. You should position



the camera level with the patient's mid-point – about waist level. For pictures taken of the lower extremities from the knees to the feet's, a platform covered with cloth in the same color as the background is useful in order to get the right mid-point angle.

It is difficult to produce satisfactory photographs of patients, other than infants and small children, in the prone or supine position. Such photographs require a greater working distance than can be achieved with the patient lying in bed – even if you stand on a chair or stepladder. A short working distance means using an extreme wide-angle lens, which will result in unacceptable distortion

Babies, before they can sit or stand, can be photographed on a physiotherapy mat, or several layers of blanket, covered in a white sheet on the floor. Not only is this safer (they have nowhere to fall), but from a standing position you can achieve a full-length view without distortion. You will need the assistance of a parent or helper to position the child for lateral views, and to gently extend the legs to be showed in full length.

Movement

If the photo requires movement, the photographer should be the one to move with the camera and not the patient. Have the patient stand on a mark (you can have an X marked with black tape) and stand still.

Ring flash

There is a common misconception that all medical photographs should be taken with a ring flash. The ring flash is an important tool for photographing cavities, where the shadow of a directional flash would obscure important detail. Thus, it is useful for dental photography or for deep wounds in surgical photography. A ring flash provides virtually shadowless lighting, with the flash tube wrapped around the camera lens. This type of lighting is very flat and reduces modeling. It also causes large circular reflections, which are particularly noticeable on wet surfaces such as the eye. For this type of work, a hand-held flash is preferable: a powerful light source providing modeling and a single, small reflex.

Optimal exposure

Photographs that are too dark or too light are a bitter disappointment, and clinical photography presents greater challenges than almost any other type of photography. Clinical detail is easily lost in washed out



pale skin or underexposed dark skin. The extremes of light and dark in specialties such as dental or operative photography can disrupt the most sophisticated light metering systems. It is really worthwhile to tests for your camera/flash/film combination on different subject matter. Predetermined exposures that can be manually set for any magnification ratios are more reliable than automatic exposure meters, because automatic metering can be influenced by the background to cause the area of interest to be incorrectly exposed.

Cameras, films and processing

In choosing a camera for clinical photography, the two main choices are between digital and conventional film and between compact and single-lens reflex cameras. Your choice will depend largely upon the budget, and just how portable you need the camera to be. One of the biggest attractions of digital cameras is their immediacy. After taking a photograph you can check to see whether you have a useable image, and you can download photographs onto a computer within minutes. There are hundreds of digital cameras in the market, presenting a confusing range of choices. If you want a compact camera that fits neatly in your pocket or medical bag, you will have to make compromises in the control you have over lighting, image size and working distance. Greater control can be achieved with an single-lens reflex, which will allow

you to change lenses and attach different types of flash. However, digital cameras of this type are prohibitively expensive and are used mainly by professional photographers. The alternative is to use a conventional camera and have your slides or negatives scanned. Many processing laboratories will process and scan a film as a routine service, giving you a CD of all your images, sometimes in several different resolutions.

If not shooting with a digital camera, try to always use Kodak, Fuji or another recognized brand name in film. The film should be ISO 100-200. Remember to always use the flash.

Specialist photography

Specialist clinical photography requires more specialized equipment and techniques. For dental photography a range of mirrors and retractors is essential. Ophthalmic photography uses sophisticated slit lamp and retinal cameras, with which investigative photographs can be taken, such as fluorescent angiograms. Endoscopic photography uses cameras designed to attach to the instrument. Most in-strament manufacturers supply, and can advise on, proprietary recording systems. Orthopedic patients might present handling problems, requiring special chairs and other equipment. In dermatology, some conditions can be photographed in the invisible spectrum, using infrared, ultraviolet or fluorescence techniques.

Some conditions can be better illustrated using special photographic techniques, such as infrared and ultraviolet (direct/ fluorescence) photography, transillumination, dermaphotography or photomicrography. Please take extra care to preserve patient confidentiality when handling patient recordings of all types, and prevent patient images from being seen or used by anyone other than the appropriate professionals. Patients, wishes and written consent must be complied with at all times. Patients should have access to photographs. Clinical photographs, video and other images should all be considered to be a part of their clinical case notes.

Photographs should be stored and presented appropriately for their use and images for publication should be prepared according to the instructions to authors. Digital images for publication should be sized appropriately for the final reproduction size.

Output and viewing

Consideration should be given to the conditions for viewing images. Clinical photographs might be seen as prints in a patient's case-notes, as digital images on a computer screen or, more rarely these days, as projection slides. Prints should be viewed in good lighting - preferably daylight or 'white light' fluorescent illumination (5500 K). Ask your laboratory to print photographs on glossy, rather than matt or textured paper. Prolonged exposure to ultraviolet

rays will cause fading and color change, so keep prints stored out of direct light, preferably between sheets of acid-free paper.

Slides are better for group viewing and, with consistent processing in a good laboratory, can give quite consistent results. Store them in archival-quality polypropylene filing sheets to avoid chemical damage. Computer viewing and projection of digital files can present problems of both quality and consistency. Use a good quality monitor positioned away from brightly lit windows or colored surrounds.

The most important factor to control in viewing is consistency. Use a good professional laboratory for films and do not leave films in the camera for months before processing – both exposed and unexposed film deteriorates over time. Keep your films in a cool place. Store large batches of unexposed film in a refrigerator, but remove it at least an hour before use to allow it to return to room temperature.

Digital files for projection should be saved as high-quality JPEG (.jpg) files, but most publishers prefer TIFF (.tif) files. The file size will depend

upon the reproduction size and many publishers will state exactly which file size to submit. It is normally safe to save them at a resolution of 300 dpi (dots per inch) at the final reproduction size. Check recent issues of the journal to see what is the maximum size at which images are normally reproduced (usually defined by the column width).

Guidelines for publication

If possible, avoid cropping and cutting the image. This is because most of the photos will be altered according to the specifications of the particular organization you send them to. If you are dealing with analog images, the original negatives for yourself. Most organizations will ask for the actual photos; keep them for your own records.

Standardization

Standard representation is essential in clinical photography, to allow objective repeatability of views for comparison between different dates, or among different patients. Many clinical photographs are taken at fixed magnifications, and the views and magnification scales are recorded for each patient visit.

Lighting, background, viewpoint, perspective, film and processing should all be highly standardized and controlled.

Conclusion

Familiarity with equipment and adherence to simple protocols can make all the difference between success and failure in clinical photography. A systematic approach is essential. This should extend beyond the photography itself to the handling and storage of photographs. Considerable attention should also be paid to legal and ethical issues before undertaking any clinical photography.

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