

Principles and practice of external digital photography in ophthalmology

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It is mandatory to incorporate clinical photography in an ophthalmic practice. Patient photographs are routinely used in teaching, presentations, documenting surgical outcomes and marketing. Standardized clinical photographs are part of an armamentarium for any ophthalmologist interested in enhancing his or her practice. Unfortunately, many clinicians still avoid taking patient photographs for want of basic knowledge or inclination. The ubiquitous presence of the digital camera and digital technology has made it extremely easy and affordable to take high-quality images. It is not compulsory to employ a professional photographer or invest in expensive equipment any longer for this purpose. Any ophthalmologist should be able to take clinical photographs in his/her office settings with minimal technical skill. The purpose of this article is to provide an ophthalmic surgeon with guidelines to achieve standardized photographic views for specific procedures, to achieve consistency, to help in pre-operative planning and to produce accurate pre-operative and post-operative comparisons, which will aid in self-improvement, patient education, medicolegal documentation and publications. This review also discusses editing, storage, patient consent, medicolegal issues and importance of maintenance of patient confidentiality.

Key words: Digital camera, external photograph, photography

A picture is worth a thousand words. A clinical photograph is an invaluable tool in the learning process of any medical practitioner by documenting the progression of a disease or response to treatment over time. Ophthalmic photography is a highly specialized form of medical imaging dedicated to the study and treatment of the disorders of the eye. Surgeons and healthcare providers rely extensively on photographic communication for patient conditions, surgical outcomes, teaching, education, research, and marketing.^[1]

Digital Photography

Over the past two decades, digital photography has taken over film photography and has now become the standard. Digital photography offers significant advantages over conventional photography. Storing and retrieving digital images is particularly convenient in terms of time and space. Digital format offers an undisputed economic advantage as immediate visualization of pictures allows deletion of the undesired images and recapturing the same, avoiding the cost of useless prints, as with traditional photography.

Digital images can also be useful in providing care in tele-ophthalmology systems deployed in remote or underserved areas and in sharing images via electronic communication with peers.^[2] Digital photography offers the ability to correct almost all aspects of an image once it has been imported into a computer and the proper software has been installed.^[3] Digital photographs are indispensable in today's world

for publications, presentations, patient information and communication, and medicolegal documentation. This article deals with the principles and practice of external ophthalmic digital photography.

Basic Setup

Camera

i. Choosing the right camera: A multitude of digital cameras at affordable prices offering a wide array of features are available in the market. Cameras essentially are either single lens reflex (SLR) or 'point-and-shoot' (compact digital). The main difference between the two is how the photographer sees the object through the lens. In a point-and-shoot camera, the viewfinder is a simple window through the body of the camera. One does not see the real image formed by the camera lens. An SLR camera uses a mechanical mirror system and pentaprism (a five-sided prism) to direct light from the lens to an optical viewfinder on the back of the camera, thereby enabling the photographer to see the exact frame about to be captured. Furthermore, point-and-shoot cameras have a shutter lag, which is the time delay between pressing down the 'click' (shutter) button and the image actually being captured. In point-and-shoot cameras it is important to initially press the shutter button halfway down to enable the camera to focus on the subject properly before pressing all the way down. Different lenses can be used with an SLR camera, which also allow the photographer to modify parameters such as shutter speed and aperture, and enable him to take photographs under all conditions. An SLR camera is bulky, heavy and expensive, whereas a point-and-shoot camera is light, portable and relatively inexpensive.

The choice between an SLR and a point-and-shoot must be made keeping in mind the budget, ease of use, photographic requirements, ability of the photographer and features required. Of late, a few cameras have been built with the purpose of bridging the gap between the professional SLR

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cameras and the more consumer-friendly point-and-shoot cameras. These cameras are called the 'prosumer' (professional + consumer) cameras.

Here are some of the frequently used terms to be kept in mind before buying a camera intended for clinical photography.

Mega Pixel: Digital images are made up of thousands of small tile-like picture elements called pixels. One mega pixel equals one million pixels. More the number of pixels, higher the image resolution. Before deciding on the mega pixels of a camera, one must decide the maximum size of the print that might be needed. A picture taken at 6 mega pixels can be optimally printed up to 11 inches x 14 inches size without 'pixilation', or individual pixels being visible. However, even a 3.2-mega pixel camera is sufficient for clinical photography.

Macro mode: Macro photography is essentially close-up photography of small objects. Cameras can be switched into macro mode by pressing the button with an icon of a 'flower'. This is of particular use while photographing small skin lesions.

Flash: The use of a flash is to illuminate a dark scene or the object to be photographed. Most cameras have built-in flashes that can be turned off. SLR cameras can have additional flash fixtures, which can be used to create diffuse illumination. Flashes can wash out subtle skin conditions. Hence flash should be used with caution in those particular case scenarios. It is imperative to stabilize the camera when not using the flash to prevent a blurred photograph. 'Image Stabilization' (IS), 'Vibration Reduction' (VR) or 'Optical Image Stabilization' (OIS) are names given by different manufacturers to technology which is available in newer digital cameras to minimize the effects of camera shake.

The camera is held horizontal in taking frontal views, even of vertical subjects so as to standardize illumination, with the light always coming from above. On the contrary, it may be necessary to turn the camera vertical for lateral and oblique views, such that the flash comes from the side to avoid shadows.^[4] Keeping the subject set off from the background (50 - 90 cm) helps to avoid shadows as well.^[5]

Video Mode: This is a feature regularly available in point-and-shoot cameras, and only recently included in digital SLR cameras. This is particularly of use while capturing surgical procedures, ocular motility and dynamic clinical conditions such as nystagmus and blepharospasm.^[6]

Accessories: Other accessories such as tripods and additional lights and/or reflectors may be helpful. Nowadays, to power the newer high-performance cameras, manufacturers have shifted to 'AA' batteries or more efficient Lithium-ion battery packs, which last longer. The charging kit for the battery packs comes as a standard accessory and usually takes 4-6 hours to charge when fully drained. Hence, it is always advisable to have charged batteries and spare camera cards available so as not to miss important clinical photographs.

Standardization of External Clinical Photography

Standardization requires planning, adherence to the set protocols and common sense.

Patient position: Most external photographs are taken in the patient in anatomical position, unless the object of interest is hidden in that position.

Patient Preparation: Whenever the face is photographed, hair should be pulled off the face and placed behind the ears.^[7] Jewelry, glasses, and hearing aids should be removed as far as possible. Makeup is not allowed, especially in cases of skin resurfacing procedures (e.g., laser resurfacing, dermabrasion, chemical peelings). All garments that interfere with the visibility of the area must be removed.^[8]

Background: The background should be an even, neutral, nonreflecting, monochromatic surface. Preferred background colors are white, gray, and blue.^[9] White or light blue panels on walls or the backs of doors can be adapted in places where photographs are taken (e.g. in the clinic). An assistant can hold a light-colored drape behind the patient in the ward or in the operation theater.

For serial photographs to show progression/regression/post-operative results in a patient it is important that the only variable should be in the patient and everything else should stay the same—viewpoint, positioning, lighting, color, magnification, and background^[10] [Fig. 1].

Commonly Required Views in Ophthalmology:

Face views

Frontal view: From the upper limit of the head to the "jugular incisure," with the patient looking at the camera [Fig. 2]. The reference plane that runs from upper edge of the tragus to the lowest point on the lower edge of the orbit (Frankfurt plane) should be horizontal.^[7]

Oblique view (right and left): From the frontal view, with the patient's face rotated 45 degrees so as to align the tip of the nose with the cheek outline. Care must be taken to leave a narrow strip of cheek to set off the nasal tip from the background. The Frankfurt plane is held horizontal. The patient looks ahead.

Lateral view (right and left): From the frontal view, with the patient's whole body rotated 90 degrees so as to align the nasal tip and chin. The head must be in its anatomic position with no lateral inclination, flexion or extension. The Frankfurt plane is held horizontal, and the contralateral eyebrow is not visible. The patient looks ahead. Images are taken asking the patient to assume a neutral face expression, holding a relaxed and natural head position, unless it is to assess muscular contractions.

The series of photographs with patient's frontal, oblique and lateral views (right and left) together is called a 'standard five-view head series', and is indicated in oculo-facial plastic surgery practices [Fig. 3].

Eye views

Frontal view: The upper margin is the eyebrows, and the lower margin is the malar arches. The lateral canthi are included [Fig. 4].

Lateral view: This view shows the position of the eyeball relative to the zygomatic bone.

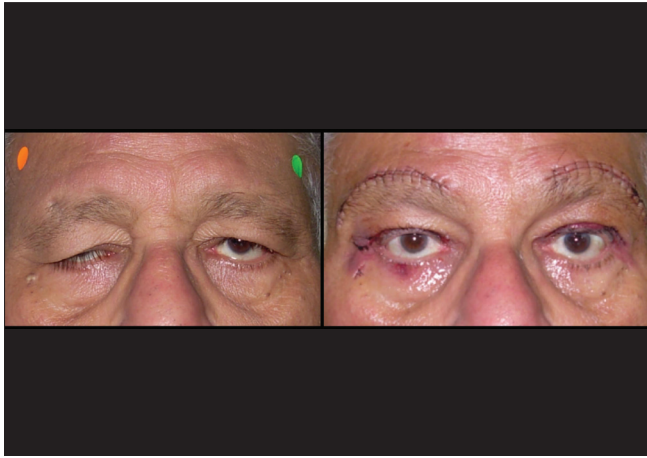


Figure 1: Standardization in images: Note the same position and lighting which allows for easy pre-operative and post-operative comparisons



Figure 2: Face: Frontal view. The horizontal line indicates the Frankfurt plane. Masking has been done to protect the identity of the patient



Figure 3: Standard 5-view head series: From left to right: Left profile; left oblique; frontal view; right oblique and right profile

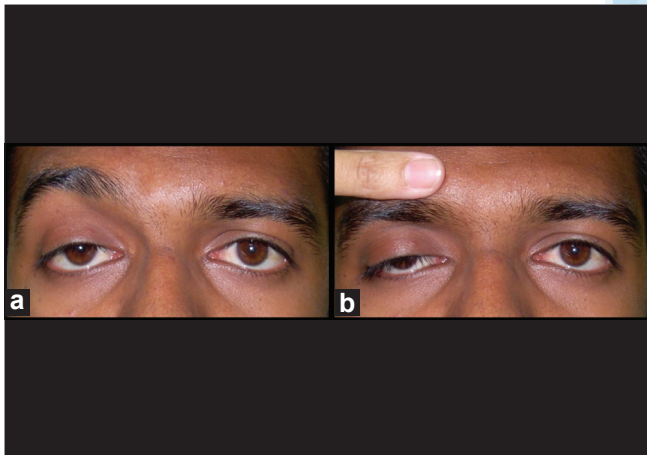


Figure 4: Right upper eyelid ptosis with frontalis acting (a) and relaxed (b). In eye view, the upper margin is at the eyebrows and the lower margin the malar arches



Figure 5: Head posture in Ptosis

Photography in Specific Situations

In oculoplasty/aesthetic surgery practice

Ptosis

It is important to document any face turn/head tilt before taking photographs of the face in anatomical position [Fig. 5].

Primary gaze: Two separate photographs are shot with both eyes looking straight: first with frontalis overaction followed by one without the frontalis overaction [Fig. 4]. These are followed by one where the subject is looking down to document any pre-operative lid lag. Finally a photograph with the eyes closed and the brow relaxed [Fig. 6].

Motility pictures must also be captured if patient has a squint (see below).

Proptosis/ Enophthalmos

Basal view (Worm's eye view): The head is bent backward so as to align the nasal tip with brows on a horizontal plane [Fig. 7a].

Cephalic view (Bird's eye view): Taken from above, with eyebrows aligned horizontally. The patient should be looking straight up [Fig. 7b]. The focus should be on the corneas, not the brow or chin.

Strabismology

Motility Photographs: External photographs of both eyes together, which are taken with the patient looking at all directions of gaze. Usually a collage is made from the photographs and combined into a single one in order to show the abnormality [Fig. 8].

Tip: It is advisable to crop the photos to show only the eyes.

Skin Lesions: Images in macro-mode or optimal cropping of a high-resolution image yield good results [Fig. 9]. Placing the camera too close to the subject should be avoided, as it would distort the normal features.



Figure 6: Ptosis of the left upper eyelid: Primary gaze (a), down gaze (b) and eyes closed (c)

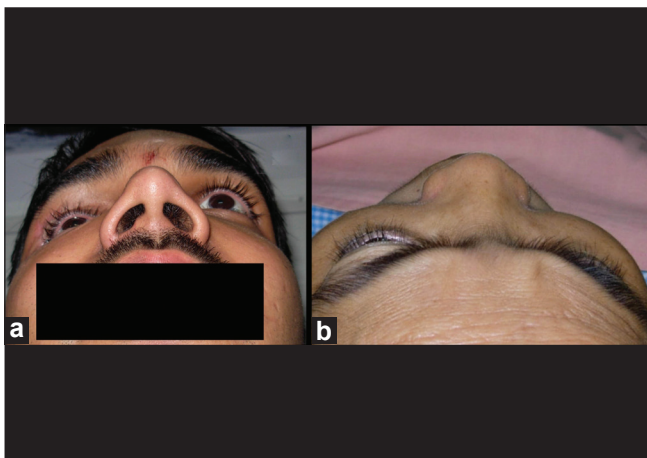


Figure 7: Enophthalmos and proptosis: Worm's eye view (a) and Bird's eye view (b)

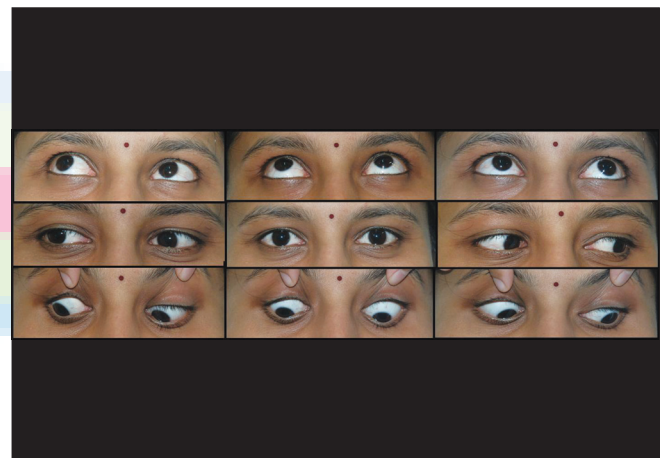


Figure 8: Ocular Motility: 9 positions of gaze



Figure 9: Ideal cropping of a high-resolution image to demonstrate a right lower lid lesion



Figure 10: Per-operative photography: The image clicked with both flash and the overhead lights on. The hand with the bloody gauze in the left upper corner should be cropped

Per-operative photography: One should try different combinations of overhead lamps with and without flash to obtain the correct exposure in an operation theater [Figs. 10 and 11].

Tip: It is preferable to remove gauzes, Q-tips or hands of the surgeon/assistant from the field. A scale can be placed against an object to document the size (foreign bodies, tumours etc.) [Fig.12].

Radiographic images: High-quality images of computed tomography (CT) scans and magnetic resonance imaging (MRI) can be procured from the radiologist and viewed on a computer using a DICOM (Digital Imaging and Communications in Medicine) viewer. One can photograph the image sheets placed against a film viewer with the flash in the 'off' mode to avoid reflection. The camera should be held steady to avoid blur [Fig. 13].

Ethical and Legal Issues with Clinical Photography

Consent: Patient consent for photo-documentation must be

obtained prior to any photography. The consent includes a statement of understanding that the photographs are part of the patient's medical record for purposes of medico-legal documentation and may be used for educational purposes, lectures, exhibits and publications.^[11]

Informed consent for publication of patient information is necessary because the physician-patient relationship is confidential.^[12] Patients can be at times identified in photographs or descriptions of their sex, age and other details.^[13] Furthermore, patients do have the right to refuse photography.

Electronic publishing: About a third of the 70 million MEDLINE searches each year at the website of the National Library of Medicine are performed by members of the general public.^[12] Scientific material is widely available on the internet and there is no control over viewership of the images once they are published. Hence, it is recommended by some that specific consent should be obtained if an image will be used in electronic publishing, explicitly mentioning all possible forms of publication now in existence^[13] [Table 1].

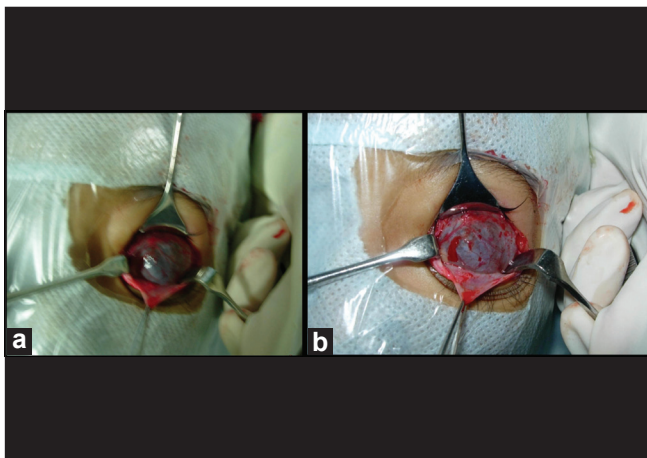


Figure 11: Per-operative photography: Flash off (a); flash on (b)



Figure 12: Macro mode: The image shows an intra-orbital foreign body, clicked in macro mode. The presence of a ruler indicates the size of the object

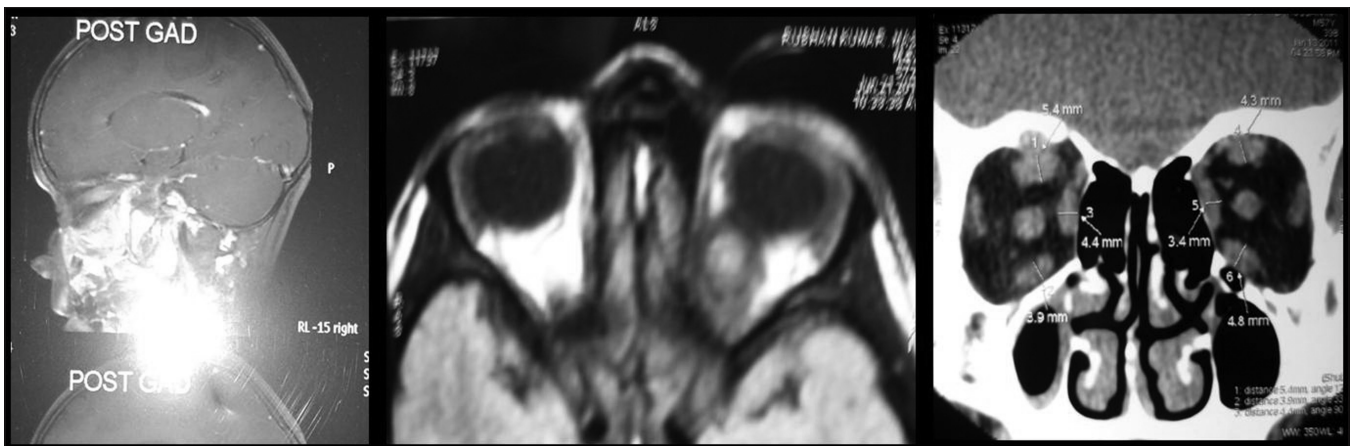


Figure 13: Capturing radiographic images: The left-sided image clicked with the flash turned on, resulting in the reflection of the flash being captured; the right-sided image clicked with the flash turned off, however, 'camera shake' results in a blurred image. The image on the right shows clear details with ideal illumination. CT and MRI scan images must be cropped to protect patient identity

Table 1: Consent form for medical photography

PATIENT CONSENT FORM FOR MEDICAL PHOTOGRAPHY

I, _____, hereby give my consent to Dr. _____ to include my/my ward's photograph/s in work to support medical teaching, research and science. This consent extends to all editions of the work, present, past and future, and in whatever form or medium (books, journals CD-ROMS, internet and online publication).

By signing, I confirm that this consent form has been explained to me in terms and language which I completely understand.

1. I understand that the photograph/s may be used in my medical record, for purposes of medical teaching, for publication in medical textbooks, journals and/or electronic publications.
2. It has been made clear to me that personal information such as my name, age, home or work place address and hospital identification number (MRD No.) will not be either displayed or used for any purpose.
3. I understand that I will not receive any payment from any party.
4. I understand that the image/ s may be seen by members of the general public, in addition to scientists and medical researchers who regularly use these publications in their professional education.
5. I understand that it is possible that someone may recognize me and that complete anonymity cannot be guaranteed.
6. Refusal to consent will in no way affect the medical care I will receive.

I declare that I have no claim on ground of breach of confidence against Dr. _____, in any legal case in context with the publication of the photograph/ s.

Signature of the patient

**Name of the patient
(CAPITAL LETTERS)**

In case of minor (patient age less than 18 years)/ intellectually disabled, consent can be given by the parent or guardian.

Signature of the Parent /Guardian

**Name of the Parent / Guardian
(CAPITAL LETTERS)**

Relationship with the patient

Signature of the Doctor

**Name of the Doctor
(CAPITAL LETTERS)**

Date

Time

Place

Copyright: Under the Indian copyright law, which protects the original works of authorship including photography, the creator of the original expression in a work is its author. The author is also the owner of copyright unless there is a written agreement by which the author assigns the copyright to another person or entity, such as a publisher. Many biomedical journals ask authors to transfer copyright to the journal (e.g., the *Indian*

Journal of Ophthalmology). However, an increasing number of "open-access" journals do not require transfer of copyright. Copyright infringement occurs when a copyrighted work is reproduced, distributed, publicly displayed, or made into a derivative work without the permission of the copyright owner. (For further information, see copyright.gov.in)

Table 2: Useful websites and software

Image viewing sites, also used for organizing, editing, and storing digital images:

1. <http://www.acdsee.com>
2. <http://www.digikam.org>
3. <http://www.picasaweb.com>
4. <http://www.snapfish.com>
5. <http://www.flickr.com>
6. <http://www.canto.com>

Software for editing and/or storing digital images:

Basic photo-editing software:

1. Windows Live Photo gallery/ Windows Photo Gallery (comes with Windows 7/Windows XP) – by Microsoft.
2. Microsoft Office Picture Manager / Microsoft Photo Editor (included with Microsoft suite starting with version 2003) – developed by Microsoft.
3. iPhoto (comes with iLife, Mac OS) – developed by Apple Inc.

Advanced photo-editing software:

1. Adobe® Photoshop® CS5/LightRoom - developed by Adobe Systems Inc.
2. IrfanView - freeware/shareware software developed by Irfan Skiljan.
3. PhotoImpression - developed by Arcsoft (For Mac OS based systems only)
4. Aperture - developed by Apple Inc.

Editing and storage: After the advent of digital photography, storage and editing of photographs has become easy. As practices move to electronic medical records, uploading photographs against patients' data will become even easier. There are many photo-editing programs which can help alter and manipulate photographs convincingly. The most common form of storing digital images are in high-quality JPEG (Joint Photographic Experts Group) files, but some publishers prefer TIFF (Tag Image File Format). It is advisable to save the photographs at a resolution of 200-300 dpi (dots per inch). Use of JPEG images saves memory space and makes images easier to store and manipulate. The standard for professionals involved in photo editing is Adobe Photoshop 7.0.

It is important to make backup copies of the photographs at regular intervals on CD-ROMs or external hard disks, which are inexpensive and freely available. The photographs can also be stored online on some websites [Table 2].

Most medical journals insist that submitted photographs adhere to guidelines suggested by them, in terms of quality, size, and color. This would mean a certain amount of manipulation of the photograph. Photographs may need manipulation to protect the identity of the patient such as masking [Fig. 2]. However, to maintain the integrity of the image, manipulation may only be carried out to the whole image, and must be limited to simple sharpening, adjustment of contrast and brightness, and correction of color balance.^[14] Photographic manipulation at the processing stage for misrepresentation of outcomes is unethical and illegal.

It is also advisable to watermark one's photographs and

videos to prevent unethical copying and usage. Digital watermarking is the process of incorporating the author's name or logo in the photograph, which helps to verify the identity of its owner. While watermarking is acceptable when images are incorporated into presentations and handouts, it is strictly forbidden while submitting to journals for publication. Watermarking can be done on any photo-editing program [Table 2].

Thus, procurement of a written consent from the patient, minimal modification, responsible and safe storage goes a long way in safeguarding the interests of the patient and the clinician. A simple and systematic approach to clinical photography ensures optimal photographic results by providing standardized views for specific procedures in ophthalmology.

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