Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.JournalofSurgicalResearch.com

Best practices to optimize intraoperative photography

Sébastien Gaujoux, MD, PhD,[a,b,c,*] *Cecilia Ceribelli, MD, PhD,*[a] *Geoffrey Goudard, MD,*[a] *Antoine Khayat, MD,*[a] *Mahaut Leconte, MD, PhD,*[a] *Pierre-Philippe Massault, MD,*[a] *Julie Balagué,*[a] *and Bertrand Dousset, MD*[a,b,c]

[a] *Department of Digestive and Endocrine Surgery, Cochin Hospital, APHP, Paris, France*
[b] *Faculté de Médecine Paris Descartes, Université Paris Descartes, Sorbonne Paris Cité, Paris, France*
[c] *INSERM Unit 1016, Centre National de la Recherche Scientifique Unit Mixte de Recherche 8104, Institut Cochin, Paris, France*

ARTICLE INFO

Article history:
Received 27 September 2015
Received in revised form
19 November 2015
Accepted 24 November 2015
Available online 30 November 2015

Keywords:
Intraoperative photography
Camera
Ethics
Technique
Single-lens reflex
Smartphone

ABSTRACT

Background: Intraoperative photography is used extensively for communication, research, or teaching. The objective of the present work was to define, using a standardized methodology and literature review, the best technical conditions for intraoperative photography.
Materials and methods: Using either a smartphone camera, a bridge camera, or a single-lens reflex (SLR) camera, photographs were taken under various standard conditions by a professional photographer. All images were independently assessed blinded to technical conditions to define the best shooting conditions and methods.
Results: For better photographs, an SLR camera with manual settings should be used. Photographs should be centered and taken vertically and orthogonal to the surgical field with a linear scale to avoid error in perspective. The shooting distance should be about 75 cm using an 80–100-mm focal lens. Flash should be avoided and scialytic low-powered light should be used without focus. The operative field should be clean, wet surfaces should be avoided, and metal instruments should be hidden to avoid reflections. For SLR camera, International Organization for Standardization speed should be as low as possible, autofocus area selection mode should be on single point AF, shutter speed should be above 1/100 second, and aperture should be as narrow as possible, above f/8. For smartphone, use high dynamic range setting if available, use of flash, digital filter, effect apps, and digital zoom is not recommended.
Conclusions: If a few basic technical rules are known and applied, high-quality photographs can be taken by amateur photographers and fit the standards accepted in clinical practice, academic communication, and publications.

1. Introduction

Academic oral presentations or written publications are frequently supported by illustrations. Graphical representations such as drawings, sketches, figures, or photographs support the text, strengthen the messages, and highlight the key points. In medical and surgical literature, photography has been used extensively to illustrate case

* *Corresponding author*. Department of Digestive and Endocrine Surgery, Cochin Hospital, APHP, Université Paris Descartes, Paris, France, 27, rue du Faubourg Saint Jacques, 75014, Paris, France. Tel.: +00 33 1 58 41 17 15; fax: +00 33 1 58 41 29 62.
E-mail address: sebastien.gaujoux@cch.aphp.fr (S. Gaujoux).
0022-4804/$ – see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jss.2015.11.048

series or, more frequently, to illustrate surgical procedures and specific technical points. Nevertheless, in a clinical setting and mainly in operating rooms, the technical constraints of photography are particularly important. As a result, the quality of photographs taken either by smartphones, compact cameras, or single-lens reflex (SLR) cameras is often poor, making them frequently unsuitable for clinical or academic purposes. The quality of photographs could be improved through the enforcement of a few basic rules. The aim of this work was to define, using a standardized methodology and through literature review, the best technical conditions for intraoperative photography using the most commonly available cameras.

2. Material and methods

2.1. Camera used

Three cameras, representing most of the cameras commercially available, were used, that is, a smartphone camera (iPhone 4S, Apple Inc, California), a bridge camera (Lumix DMC-FZ200, Panasonic, Japan), and a professional SLR camera (EOS 5D mark II, Canon, Japan, with EF USM 85 mm *f*/1.8 lens, Canon, Japan). Their main technical characteristics are summarized in Table 1.

2.2. Lighting

The operative field was lit with either fluorescent ceiling light from the operating room, main and satellite scialytic lights focused on the operative field with a color temperature of 3800K (marLED V16 and V10, KLS Martin, Mühlheim, Germany) and/or LED, pop-up, or cobra flash (Speedlight 580 EX II, Canon, Japan).

2.3. Photography condition, presetting, and study protocol

All photographs, centered on the surgical field, were taken by a professional photographer. On surgical drapes, a photography test pattern was disposed (Color Control Patches, Kodak, Rochester, NY) with various fresh, moistened animal organs and a surgical blade held in a gloved hand with a surgical gown, mimicking a real operative field (Figure). As in surgical conditions, the shooting distance was about 70 to 80 cm with a focal length of about 80 mm for the bridge and SLR camera. When the camera allowed for it, we preset the focal lens (at about 80 mm), autofocus area selection mode (singlepoint AF), International Organization for Standardization (ISO) speed (as low as possible), shutter speed (above 1/100 second), aperture (above f/8), and activated the image stabilizer to avoid motion blur. Images were recorded in RAW and/or JPEG formats. Three to five pictures were taken for each condition.

2.4. Image analysis and definition of best shooting condition

No postprocessing treatments with image-editing software were used. All images with available shooting information were analyzed using an RGB (red, green, and blue) histogram by two professional photographers assessing lighting conditions, exposure, contrast, depth-of-field, noise, and color accuracy, blinded to camera and lighting conditions. Sharpness, geometric distortion, and chromatic aberration, mainly dependent on the lens or the camera, were not studied. According to these criteria, pictures and images quality were subjectively rated from 0 to 5 and best shooting conditions defined. These optimal conditions were then tested intraoperatively by surgeons themselves on planned surgical procedures.

2.5. Systematic review

We conducted a systematic literature review of articles published over the last 10 y in MEDLINE via PubMed using the following search strategy for the MeSH and non-MeSH heading: (picture OR photography) AND (clinical OR surgery OR intraoperative) AND (guide OR guideline). After identifying relevant title, abstracts were read and eligible articles retrieve, selecting only the ones dealing with surgical or intraoperative photography. A manual cross-reference search of the bibliography of all publications retrieved was performed for relevant references, and the « related article » function in PubMed also used to identify studies that may have been missed in the database search. English language relevant original clinical studies or reviews on human of any level of evidence were included.

3. Results

3.1. Lighting

Regarding the three lighting sources used, ceiling fluorescent light provided an intensity of 164 lux, whereas the scialytic lights were >100 times as luminous with a light intensity of 21,920 lux, resulting in more contrasted pictures. Flash intensity varied in accordance with the exposure condition but was associated with important reflection, especially on wet or metallic surfaces such as retractors and surgical instruments.

3.2. Exposure and focus area selection mode

Exposure should be done in the center of the scene that is the point of interest. On smartphones, exposure and focus area selection modes are commonly nonadjustable. When using a bridge camera, automatic mode could be selected to avoid incorrect settings. For more advanced use, it is possible to work in semiautomatic mode with ISO and white balance adjustment. With an SLR camera, central single point mode can be chosen to adjust the exposure and autofocus to the center of the scene.

3.3. Focal length

Focal length and field of view are inversely proportional. On the smartphone, the focal length is equivalent to a 33 mm and cannot be adjusted. Consequently, the photographer must adjust the distance between the camera and the operative field to get an appropriate field of view, often as close as 30 to 40 cm, which questions the need for intraoperative asepsis.