

Video Capture of Plastic Surgery Procedures Using the GoPro HERO 3+

Steven Nicholas Graves, MA* Deana Saleh Shenaq, MD† Alexander J. Langerman, MD† David H. Song, MD, MBA†

Background: Significant improvements can be made in recoding surgical procedures, particularly in capturing high-quality video recordings from the surgeons' point of view. This study examined the utility of the GoPro HERO 3+ Black Edition camera for high-definition, point-of-view recordings of plastic and reconstructive surgery.

Methods: The GoPro HERO 3+ Black Edition camera was head-mounted on the surgeon and oriented to the surgeon's perspective using the GoPro App. The camera was used to record 4 cases: 2 fat graft procedures and 2 breast reconstructions. During cases 1-3, an assistant remotely controlled the GoPro via the GoPro App. For case 4 the GoPro was linked to a WiFi remote, and controlled by the surgeon.

Results: Camera settings for case 1 were as follows: 1080p video resolution; 48 fps; Protune mode on; wide field of view; 16:9 aspect ratio. The lighting contrast due to the overhead lights resulted in limited washout of the video image. Camera settings were adjusted for cases 2-4 to a narrow field of view, which enabled the camera's automatic white balance to better compensate for bright lights focused on the surgical field. Cases 2-4 captured video sufficient for teaching or presentation purposes.

Conclusions: The GoPro HERO 3+ Black Edition camera enables highquality, cost-effective video recording of plastic and reconstructive surgery procedures. When set to a narrow field of view and automatic white balance, the camera is able to sufficiently compensate for the contrasting light environment of the operating room and capture highresolution, detailed video. (*Plast Reconstr Surg Glob Open 2015;3:e312; doi: 10.1097/GOX.00000000000242; Published online 25 February 2015*)

ideo recordings of surgical procedures provide a method for analyzing operative performance, augmenting surgical education, and presenting cases to a wider audience of plastic and reconstructive surgeons. Although many hospitals provide video recording services, significant improvements can still be made in this arena, particularly in capturing high-quality video recordings from the surgeon's point of view. One potential and cost-effective solution is the use of commercially available amateur video systems. Previous studies have detailed the development of do-it-yourself vid-

From the *The University of Chicago Pritzker School of Medicine, Chicago, Ill.; and †The University of Chicago Medical Center, Chicago, Ill. Received for publication August 28, 2014; accepted

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eo systems for use in the operating room,¹ whereas more recent studies have explored the utility of using popular "action" cameras such as the Contour helmet camera (Contour LLC, Provo, Utah)^{2,3} and the GoPro HERO 3 Silver Edition camera (GoPro, Inc., San Mateo, Calif.).⁴ Recently, a more advanced GoPro HERO 3+ Black Edition camera (GoPro, Inc.) became available, and the purpose of this

Copyright © 2015 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of The American Society of Plastic Surgeons. All rights reserved. This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives 3.0 License, where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially. DOI: 10.1097/GOX.0000000000242 study was to examine the utility of this device for high-definition, point-of-view recordings of plastic and reconstructive surgery.

METHODS

Device Specifications

The GoPro HERO 3+ Black Edition camera is a commercially available "action" camera popular with athletes and extreme sports enthusiasts available for purchase online and in retail stores for approximately \$400. The camera is capable of recording smooth, high-definition video at various resolutions ranging from 720p to 4000p at a rate of 15-120 frames per second. Although the GoPro is not equipped with a zoom capability, there are 3 field of view settings (wide, medium, and narrow), which allow the user to focus the camera shot on a smaller area. Continuous recording time ranges from 1 to 2 hours depending on camera settings, with a battery life of approximately 1.3 hours when configured to record in the operating room. The camera unit alone weighs 74g and 88g as tested using the GoPro Frame camera housing. The GoPro HERO 3+ Black is WiFi capable and can be operated using a WiFi remote or with the free GoPro App on a smartphone or tablet. The camera's WiFi capability also enables real-time video streaming of surgical procedures and is password protected using industry standard encryption.

Case Recording

For the purposes of this study, the GoPro was head-mounted on the surgeon with a head strap and correctly oriented to the surgeon's perspective using the video preview function on the GoPro App, which had been previously downloaded to an iPad. The camera was used to record 4 cases: 2 fat graft procedures and 2 breast reconstructions. Patients gave advance written permission for recording, and no personally identifiable images were collected.

RESULTS

Case 1: Fat Grafting for Breast Contour Deformities following Implant-based Reconstruction

The GoPro was head-mounted and oriented to the surgeon's perspective using the GoPro App,

Disclosure: The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors. and then remotely controlled by an assistant via the App. Camera settings for the procedure were as follows: 1080p video resolution, 48 frames per second, Protune mode on, wide field of view, and 16:9 aspect ratio. The lighting contrast due to the overhead lights resulted in limited washout of the video image (Fig. 1). Camera battery life was sufficient to enable recording of the entire procedure, approximately 36 minutes. The head strap fit too tightly and did cause some discomfort to the surgeon by the end of the procedure.

Case 2: Breast Reconstruction with Abdominal-based Free Flap

For the second case, we changed the GoPro field of view to "narrow" and adjusted the head strap for an appropriate fit, but did not change any of the other camera settings. The narrow field of view enabled the camera's automatic white balance to better compensate for bright lights focused on the surgical field. The camera was head-mounted on the attending surgeon and oriented using the preview feature on the GoPro app and remotely controlled using the app. After headstrap adjustment, the surgeon did not note any discomfort and stated that he forgot he was wearing the camera. Video resolution and level of detail were excellent (Fig. 2). The camera enabled approximately 74 minutes of continuous video recording time.

Case 3: Breast Reconstruction with Abdominal-based Free Flap

During the third case, we retested the camera settings from case 2. The camera was head-mounted and oriented and controlled using the GoPro app. The GoPro captured high-resolution video and sufficient detail for teaching and presentation purposes



Fig. 1. Screenshot of GoPro video; case 1, wide field of view.

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Fig. 2. Screenshot of GoPro video; case 2, narrow field of view.



Fig. 3. Screenshot of GoPro video; case 3, narrow field of view (note the detail of central picture and activity in upper left periphery).



Fig. 4. GoPro configured with WiFi remote.

(Fig. 3). Battery life was approximately 70 minutes of continuous recording time.

Case 4: Fat Grafting Procedure for Poland's Syndrome

For the fourth case, camera settings were unchanged and the camera was head-mounted and oriented using the GoPro app. After achieving the correct camera orientation, the camera was linked to the WiFi remote to operate the camera over the course of the procedure. The WiFi remote was placed in a Steri-Drape plastic covering (3M, St. Paul, Minn), which enabled the surgeon to operate the camera from the surgical field without compromising sterility (Fig. 4). The camera battery life was sufficient for the entire procedure and approximately 9 minutes of video were recorded.

SUMMARY

The GoPro HERO 3+ Black Edition camera enables high-quality, cost-effective video recording of plastic and reconstructive surgery procedures. When set to a narrow field of view and automatic white balance, the camera is able to sufficiently compensate for the contrasting light environment of the operating room and capture high-resolution, detailed video. The camera is light, and once correctly adjusted, it does not impede the surgeon. Battery life is a significant limitation, especially for longer procedures, but this can be mitigated by using the WiFi remote, which enables the surgeon to selectively record segments of the procedure. The GoPro performed well in each of the 4 cases, and more rigorous testing over a greater number of cases will further validate its utility as a video recording platform in the operating room.

David H. Song, MD, MBA

The University of Chicago Medical Center 5841 South Maryland Avenue MC 6035, Chicago IL 60637 E-mail: songd@uchicago.edu

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