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Viability of a modified GoPro for Professional Surgical Videography

Timothy Zoltie BA (Hons) PgC MIMI LBIPP [1]
Mr Michael Ho FRCS, (OMFS) FEBOMFS [2]

[1] University of Leeds
[2] Leeds Teaching Hospitals NHS Trust

Contact:
Timothy Zoltie
Head of Medical & Dental Illustration
University of Leeds
Level 5 Worsley Building
Clarendon Way
Leeds LS2 9LU
t.zoltie@leeds.ac.uk

Tel: +44 (0)113 3436258
Email: t.zoltie@leeds.ac.uk

Abstract

Surgical videography can be a valuable tool in education and teaching but can also be very challenging. We evaluated common complications of current and previously tested systems to develop a method of high quality surgical videography using a modified GoPro HERO5 video camera from Back-Bone Gear Inc [1]. The high resolution of the camera, coupled with the ease in maneuverability meant that this system costing less than £1200.00 at the time of publishing provides a cost effective, high fidelity imaging service for surgical procedures.

Introduction

There are multiple aspects to consider when deciding upon the best method of filming a surgical procedure. A jib with a precision, remote controlled pan and tilt head is commonly preferred, however these systems are not only expensive, but require the presence of a video operator and the inherent difficulty in maneuverability during surgery. Ease of use, simplicity, and usability of footage are therefore the main factors evaluated in previous papers [2-4]. We aimed to not only address these factors but also establish the best method of placement and camera settings using our adapted system.

Method

The GoPro HERO5 is a compact and lightweight camera capable of shooting up to 4k footage at 30fps (frames per second). This offers the ability to crop to ¼ of the original resolution whilst retaining full 1080p resolution. With its additional Wi-Fi capabilities and voice control, it is an ideal option for a surgical video camera but requires some adaptations most notably to the focal range. To convert it from a wide-angle action camera to a surgical videography tool, the GoPro was adapted with a Back-Bone Inc. 'ribcage' modification kit to allow C-mount lens attachments. A 9-90mm Kowa varifocal lens was then attached to provide an efficient focal range and minimise distortion [Fig 1].

The next consideration was placement. Arguably the best view would be directly above the operating table. Previous papers have discussed wearable technology, utilizing a point of view (POV) camera such as a head mounted GoPro or Google Glass [5, 6], however it has been found that wearable technology may not reach the optimal resolution needed for useful surgical technique videos [7]. This is mainly down to too much movement and too wide a field of view.

Our adapted GoPro was affixed to the operative theatre light using the GoPro handlebar mount [Fig. 2]. The theatre light was then controlled by the camera operator or theatre staff. A Sandisk 128gb Extreme PRO microSDXC card provided up to 270 minutes recording time at the maximum 4k resolution, meeting the GoPro's recommended Class 10 or UHS-I rating for optimal write speed. To overcome the internal batteries limited power, a power pack was placed in a custom-built mount and

fixed to the posterior of the theatre light which provided an additional 12,000mAh of power allowing up to 10 hours continuous use. The GoPro was set to Protune, which enables advanced control over shutter speed, white balance, ISO, sharpness, frame rates and colour. This was to overcome over sharpness in the footage, auto white balance shifts, and lower the contrast and saturation for post-production and viewing of finer vessels.

The modified GoPro HERO5 camera kit was used to film the following procedures;

- Neck dissection
- Ablation of orofacial pathology
- Anterior oral and maxillofacial surgical procedures (e.g. placement of dental implants)
- Subscapular system free flap harvest
- Premolar transplantation

Results

The 9-90mm Kowa lens provided an extensive focal range, with the 90mm range being utilized for microscopic filming of the vessel preparation and microvascular anastomosis and/or coupling procedures on vessels as small as 4mm in diameter [Fig 3]. Whilst sometimes troublesome, the voice control function enabled the operative team to to start and stop recording, take a photograph, or activate other features whilst remaining sterile.

The initial concern of this system was its maneuverability; could it be maneuvered discreetly and easily whilst attached to the theater light? The authors found the use of the operating light as a vessel for the camera suited the requirements of both the surgeon and the video operator; The surgeon had adequate illumination of the operative field whilst the video operator achieved a good angle of capture. The light could also be maneuvered in multiple positions where a jib or conventional camera may struggle.

The difficulty in manual focusing on the inbuilt GoPro screen was alleviated by the use of a high-resolution monitor connected by HDMI, and the wide depth of field meant the camera could be regularly adjusted without the need to re-focus.

Whilst it is relatively easy to control, the initial complexities of setting up the system meant a medical videographer was required. Whether this could be taught to surgical teams for future use would need further study, but there is no doubt from the authors point of view that this system provides a high-quality method of surgical videography without the complexities and costs of current alternative methods.

References

1. Back-Bone Ribcage H5PRO Manufactured By: Back-Bone Gear Inc 4-155 Terence Matthews Cres. Kanata, Ontario K2M 2A8 Canada
2. Chen, C., Lee, K. and Shen, Y. (2009). Simple method to record high-quality surgical videos. British Journal of Oral and Maxillofacial Surgery, 47(6), p.494.
3. Cosman, P., Shearer, C., Hugh, T., Biankin, A. and Merrett, N. (2007). A Novel Approach to High Definition, High-Contrast Video Capture in Abdominal Surgery. Annals of Surgery, 245(4), pp.533-535.
4. Nair, A., Kamal, S., Dave, T., Mishra, K., Reddy, H., Rocca, D., Della Rocca, R., Andron, A. and Jain, V. (2015). Surgeon point-of-view recording: Using a high-definition head-mounted video camera in the operating room. Indian Journal of Ophthalmology, 63(10), p.771.
5. Warrian, K., Ashenhurst, M., Gooi, A. and Gooi, P. (2015). A Novel Combination Point-of-View (POV) Action Camera Recording to Capture the Surgical Field and Instrument Ergonomics in Oculoplastic Surgery. Ophthalmic Plastic and Reconstructive Surgery, 31(4), pp.321-322.
6. Kapi, E. (2017). Surgeon-Manipulated Live Surgery Video Recording Apparatuses: Personal Experience and Review of Literature. Aesthetic Plastic Surgery, 41(3), pp.738-746.
7. Makhni, E., Jobin, C., Levine, W. and Ahmad, C. (2015). Using wearable technology to record surgical videos. American journal of orthopedics (Belle Mead, N.J.), (44), pp.163-166.

Fig 1. BackBone Ribcage H5PRO with attached 9-90mm Kowa lens

Fig 2. Photograph portraying fixation to theatre light handle using the GoPro handlebar mount

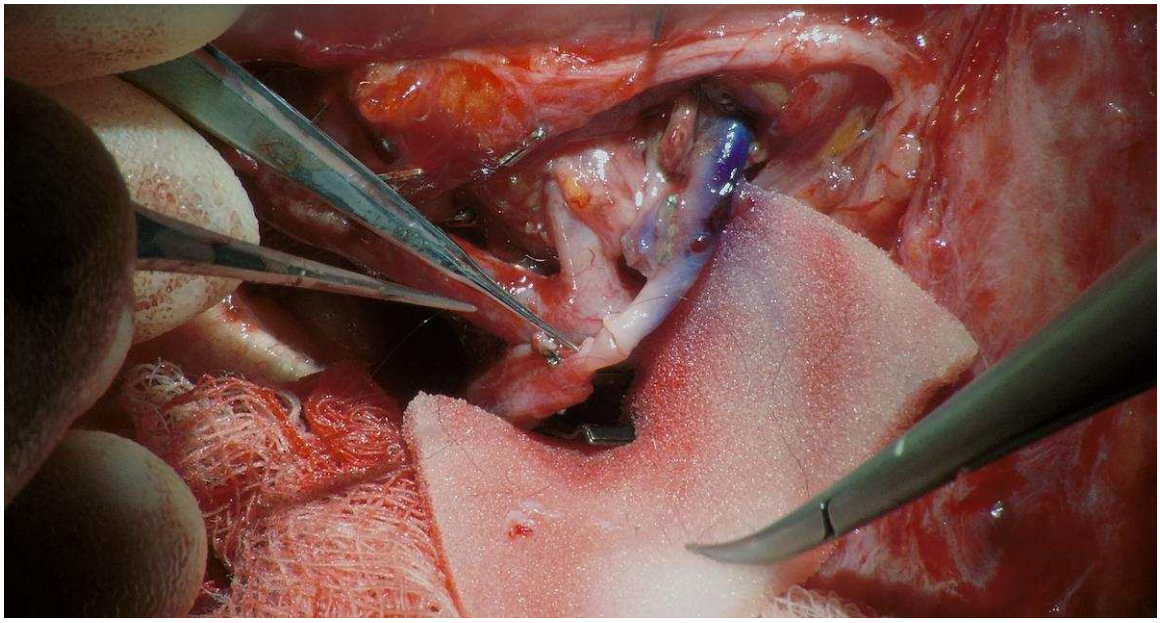

Fig 3. Still frame grab during microvascular anastomosis