DOI: 10.1111/tct.13272

ORIGINAL ARTICLE

THE CLINICAL TEACHER

Point-of-view technology to teach surgery

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Abstract

Background: Varied and limited opportunities to assist during operations, hamper surgical procedural training. Furthermore, the trainee's view of the procedure differs from that of the operating surgeon. New solutions could emerge when instruction under direct supervision can be combined with technological advances in surgical practice. This study assesses the feasibility of using the GoPro HERO™ to record operations for educational purposes, from the perspective of the surgical and technical team.

Method: A "point-of-view" wearable GoPro camera was used to record standard operations at Tygerberg Academic Hospital, affiliated with Stellenbosch University, in Cape Town. Semi-structured interviews evaluated the practical acceptability of the GoPro in theatre by clinical personnel. The technical team reflected on picture quality, video editing and formatting. Techsmith Camtasia Studio 9® programme was employed for post-recording editing.

Results: Eight operations were performed by three surgeons. No interference with operative sterility, procedural length, nor functioning in the operating room was encountered by clinical personnel. Technically, the quality and picture field were adequate. All surgeons found the camera head band tight and the camera heavy. The limited battery life during recording was problematic throughout the study.

Conclusion: Wearable cameras allow recordings of surgical procedures from the surgeon's view, for adjunctive educational purposes. This study confirms the feasibility and utility of GoPro to record real time operations without compromising patient care. The videos have cross-discipline potential for teaching within medicine. Creation of a video library as a resource to evaluate the educational value for trainees is envisioned.

1 | INTRODUCTION

Resources for training of surgical operative technique are limited. These include lack of training time, variable exposure to procedures during the clinical rotation and inadequate opportunities to review procedures outside of the operating room. The pedagogical transfer of learning during a procedure is further impeded by the differing physical and visual vantage points of the assistant and the surgeon.

Amidst these constraints, surgical training has to be reviewed and innovative educational alternatives sought.[1] Evolution of technology influences health professions education,[2] creating opportunities to increase efficacy of surgical training and decrease demand on face-to-face teaching.[3] Combining traditional teaching methods with technology can generate new learning opportunities in surgical education, with recommendations for reporting of educational surgery videos to be utilised on the training platform, already established.[4,5]

Audiovisual technology is the standard in endoscopic and laparoscopic surgery. Such procedures can easily be recorded and used to augment surgical teaching. This does not apply to open, minimally invasive or rare procedures. Wearable cameras provide a view from the surgeon's perspective and may extract more value from surgical procedures. The high-quality footage is cost-effective and available

with GoPro HERO™[6,7] cameras. The devices are small, lightweight, robust, and are wearable or mountable on objects. It captures high-definition videos through a wide angle lens that enables surgeons to record procedures with ease in any operating and minor room.[7]

Wearable cameras provide a view from the surgeon's perspective and may extract more value from surgical procedures

The GoPro system does exhibit restrictions. The reflection of the operating room lights can overexpose the video and the limited battery life is challenging. Surgeon discomfort in prolonged cases is also problematic.[8] However, it remains an excellent way to record rare procedures, educate and build video libraries for presentations, research and assessments.[8,9] The videos can be used as supplemental material towards self-learning and revision by students, but should not replace active participation in operations.[10]

The study employs "point-of-view" wearable technology to create teaching videos to be utilized by surgical trainees as a training tool. The objective was to assess the feasibility and acceptability of using a GoPro camera to record operative procedures, from the perspective of the surgical and technical team.

2 | METHODS

The study was approved by the institutional Ethics committee (project number N17/03/030). During the study period of 1–31 May 2017, electively admitted patients at Tygerberg hospital, Cape Town, South Africa were asked to partake. All participating patients, clinical personnel and technicians provided signed written informed consent. The recordings took place during operative procedures on the standard theatre list, not to impede workflow, compromise theatre time, nor the patients' condition.

A point-of-view wearable GoPro Hero Inc., camera was used with a head strap by the operating surgeon. The GoPro was head-mounted (see Figure 1) and oriented to the surgeon's perspective, prior to scrubbing and switched on by a non-scrubbed colleague in the operating room, once the patient was completely draped. No additional lighting was used while recording with the camera. The camera costs approximately 8000ZAR, at current exchange rate this is around £370.

The GoPro camera was made available by the Unit for Learning Technologies, in the Centre for Health Professions Education at the Faculty of Medicine and Health Sciences at Stellenbosch University

FIGURE 1 GoPro camera mounted on the head of the operating surgeon during the procedure

and included post-production editing support. The technical team members are learning and instructional designers.

Recording only commenced once the patient was completely draped and no identifiable features of the patient nor staff were included. Sound was recorded by the device, but immediately removed during editing. All recordings were made with the same camera and recorded at 720p resolution without affecting picture quality. The recorded video was subsequently edited, with the addition of a voice over by the researcher, using Camtasia Studio by TechSmith

TABLE 1 Semi-structured interview questions

Surgeon
1. How comfortable did you feel when you used the GoPro during the operation? Please explain?
2. Did you find GoPro distracting to your activities? Please elaborate on why you say so?
3. Was the device easy to use? Please tell me why you find it easy/not easy?
4. Do you think the use of the camera influences the operative procedure? Why do you think so?
5. Did the battery life of the device influence the procedure? Please elaborate?
Scrub sister
6. Did you find the GoPro distracting to your activities? Please explain your answer?
7. Did the use of the GoPro influence the length of the operation? What is your opinion about it?
8. Did the use of the GoPro influence the sterility of the operation? Please explain?
9. Did the GoPro influence interaction in the team? Please elaborate?
Anesthetist
10. Did you find the GoPro distracting to your activities? Please explain your answer?
11. Did the use of the GoPro influence the length of the operation? What is your opinion about it?
12. Did the GoPro influence interaction in the team? Please elaborate?

Corporation®. Any remaining possible identifiable features were removed or made hidden during the editing process.

Upon using the GoPro, the researcher (a surgeon), used a reflective diary to capture her experiences during the operation. The reflective diary did not only provide the personal perspective of the surgeon, but was also used to formulate the interview questions (see Table 1). The reflection and interview questions focused on the practicality and feasibility of using the device during an operative procedure. A semi-structured interview was held with each clinical participant (the surgeons, the anaesthetist as well as the scrubbed nurse). The operating surgeons reflected on aspects of the impact on the surgeon's ability to perform the operation, procedural length and influence on the theatre environment. Further probing was related to the comfort of using the GoPro, as well as the influence of the battery life of the camera on the process.

The video technicians remarked on picture quality, post-procedure video editing, time required for editing and voice over recording.

We used a contextualised interpretive content analysis to analyse the data.[11] The researcher read through the verbatim transcripts and became immersed in the data to become familiar with the contents. The researcher coded the data transcripts and notes, and identified themes or topics from the initially recorded transcripts.

3 | RESULTS

Eight breast and endocrine surgical procedures were recorded over the study period (see Figure 2). The average duration of the unedited surgical videos were 65 min, with a range of 28–117 min. No adverse patient events related to the use of the GoPro camera during operative procedures were experienced (Figure 1).

The semi-structured interviews revealed that all three surgeons experienced heaviness of the camera and tightness of the head band. One surgeon stated that towards the end of the prolonged operation, it started to feel heavy and tight around her head.

The camera battery life was a recurrent problem, and some recordings could not be completed due to battery drainage. The camera was not a distraction to the procedure, nor the sterility of the operative field. During the last operation in the series, the GoPro app was used during recording and the un-scrubbed students could watch the operation on the tablet screen, live during the procedure.

Responses from the anaesthesiologists and scrub nurses revealed no interference in the theatre environment, functioning of the team nor the length of the procedure. Interest was expressed about the potential use of the camera for teaching of anaesthesiology procedures. One nurse commented that similar videos could be valuable in the training of a scrub nurse, giving a bird's eye view of how the tray layout should be, the handling and passing of instruments to the surgeon etc.

The technical team deemed the field of picture and quality adequate. Specific comment was made about the overexposed appearance of lighter objects, which can be decreased by using the zoom function of the editing programme. The Techsmith Camtasia Studio 9® programme was utilised for post- recording editing and considered relatively easy by the team with a short learning curve. Techsmith Camtasia Studio 9® has sufficient editing capabilities for this type of video. The video is recorded in MP4 format and is playable on most devices and platforms.

4 | DISCUSSION

Surgery requires a high level of technical ability and continuous training of advanced surgical skill is vital. Technological

FIGURE 2 Still image of surgeon's view of the procedure with head-mounted GoPro camera

developments have escalated to the use of wearable devices in surgery, such as the GoPro head-mounted camera,[12] with integration into clinical practice and medical education. Data on high-quality evidence supporting the use of wearable recording equipment in surgical settings is slowly emerging.[12] Such technology should offer utility in a convenient and cost-effective bundle during operations.[13]

A shift has occurred toward skills training beyond the operating room, in line with the constant evolution of surgical technique, combined with fewer opportunities for trainees to perform procedures. With this study, clinicians evaluated the GoPro in real-time operating room circumstances to determine the practicality of the GoPro as an education adjunct for surgery and reported favourably thereupon. Head-mounted devices permit the user to assume regular and ergonomically acceptable positions throughout the procedure.[12] These recordings allow trainees a procedural view from the operator's perspective and do not interfere with sterility, duration of procedure, nor operating room environment.[13]

With this study, clinicians evaluated the GoPro in real-time operating room circumstances to determine the practicality of the GoPro as an education adjunct for surgery and reported favourably thereupon.

Certain limitations were encountered during the study. Not all operations were suitable for recording and not all patients provided consent for their procedures to be documented, leading to a small series of videos. The feasibility study was performed in a subdivision of Surgery, with only three consultant surgeons employed in the unit. The GoPro camera was heavy, especially towards the end of a long procedure and led to neck pain in one surgeon. The head strap felt tight towards the end of procedures for all the surgeons. Battery-powered devices allowed unlimited movement to the surgeon, but short battery life frequently restricted extended device utility. These cameras are mainly marketed for the sport arena and customization is needed for medical applications. Since the recording of the procedures, newer models of the camera are lighter and have prolonged battery life, which would alleviate the problems encountered during this study.

The technical team reported favourably on the feasibility of using the GoPro in a real-time theatre environment. The picture quality of the videos were adequate and the field of picture aligned with the surgeon's line of sight, akin to recent studies.[12] The Techsmith Camtasia Studio 9® programme was used for post-recording editing and considered reasonably easy to use. The recording is done in MP4 format and therefore usable on various platforms.

This study utilized "point-of-view" wearable equipment to produce videos as additional educational tools for training of operative technique. The feasibility, practicality and acceptability of the GoPro camera to record operative procedures from the perspective of both the surgical and the technical team were established. The next phase implementing the teaching videos in the surgical curriculum and evaluation of its effectiveness as learning tools, has been initiated.

5 | CONCLUSION

The recording of surgical procedures on the GoPro camera as an educational adjunct, is practical and user-friendly, without impairing clinical patient care. The next phase entails formation of a video library. The evaluation of the educational usefulness of the video as an additional tool of instruction has already begun.

The recording of surgical procedures on the GoPro camera as an educational adjunct, is practical and user-friendly, without impairing clinical patient care.

ACKNOWLEDGEMENTS

I wish to thank the patients for allowing their procedures to be recorded for the future use of teaching medical personnel. I would also like to acknowledge Ms. L. Keiller who introduced the project concept to me.

CONFLICT OF INTEREST

None declared.

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How to cite this article: Baatjes KJ, Keiller AV, Louw AJ, Van Rooyen M. Point-of-view technology to teach surgery. *The Clinical Teacher*. 2020;00:1–5. https://doi.org/10.1111/tct.13272