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Surgeon and Assistant Point of View Simultaneous Video Recording

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Abstract. Video recording has become a very common practice in surgery and is one of the paramount methods to teach proper surgical techniques. Traditionally it has been limited by a variety of factors including cost, the need for constant camera reposition, and the use of external photographers, which is both costly and labor-intensive. We describe the use of dual modified point of view (POV) GoPro head mounted cameras to record synchronized POV surgery for the purpose of training surgical assistants. POV cameras are inexpensive, easy to use and manipulate. The GoPro camera was mounted using a head strap on both the surgeon's and surgical assistant's head, providing different optimal views. We used the GoPro Hero4 Silver for the surgeon and the GoPro Hero3+ Black Edition for the assistant. The lens used was optimized for our purposes. With the modified camera for the primary surgeon, the magnification was satisfactory in recording of fine details, and provided a usable depth of field and field of view. We found that using two synchronized POV GoPro head mounted cameras was an innovative way to record otolaryngology surgery and provided excellent video footage which can be used for the education of both surgeons and surgical assistants.

Keywords. video recording, surgical education, surgery

1. Introduction

The challenge of training a surgical assistant (fellow, resident, scrub nurse) is that often the assistant does not see the primary surgeon's perspective, and therefore may be assisting in a suboptimal matter. As there is very little data relevant to training surgical assistants, video recording surgery may be a useful tool to enhance the experience of trainees working from the surgical assistant position. Video recording has proven to be helpful for training medical residents and fellows in the details of surgical technique, as well as emphasizing instrument ergonomics [1,2]. Innovative training programs need to ensure the surgical competence of its trainees, which can be assisted with video capture and reflective review of surgeries [3]. It is also crucial for physicians to be constantly evaluating and improving their surgical techniques to ensure better surgical outcomes. One method of attaining this is by using point of view (POV) cameras that offer high definition video recording from the "surgeon's perspective".

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In this study we describe a novel technique of surgical video recording, using two synchronized, modified head mounted POV cameras: one on the surgeon's head and one on the surgical assistant's head. We demonstrated this technique to be used for training surgical assistants in otolaryngology surgery.

2. Methods

The study adhered to the principles of the Declaration of Helsinki. All patients involved in the study consented to surgery and the intra-operative recording of video and still images.

Subjects included patients above age 18 years undergoing head and neck surgery who consented to video recording. The setting occurred in a quaternary head and neck oncology surgical service. Materials included the recording system, which comprised of two head mounted POV GoPro cameras (GoPro, San Mateo, CA). The recording procedure was as follows. For the primary surgeon, we used a GoPro Hero4 Silver (GoPro, San Mateo, CA) set to 1080P on narrow recording at 48fps, with spot metering and the low light functions turned on. This model was modified to yield higher magnification through a 5.4mm f/2.5 aftermarket lens with a 60° field of view (Peau Productions Inc, San Diego, CA). This lens was pre-focused to a working distance of 17 inches, which is the same as the working distance for our surgical loupes. For the assistant, a GoPro Hero3+ Black Edition (GoPro, San Mateo) with the stock lens was utilized with similar settings. The stock lens was focus-free. Synchronization of the video feeds was accomplished by having both cameras record the digital output from a stopwatch to establish a frame of reference for subsequent video editing.

3. Results

Surgery was successfully recorded from both the primary surgeon's and assistant's POV. Using the stock lens for the assistant provided a wider field of view that enabled viewing of surgical ergonomics. Synchronizing the assistant's video feed with that of the primary surgeon allowed the assistant to understand how their instrument placement and use affects the primary surgeon's work (Figure 1).

At the same time, the modified camera for the primary surgeon provided sufficient magnification to show delicate surgical details as a learning reference for the trainee. The modified lens also afforded a usable depth of field for the primary surgeon. This setup worked best without the waterproof housing, as the protective lens would push on the aftermarket lens and change the focus of the camera. Overall, the impression was that the primary surgeon's POV at high magnification was most conducive to learning the details and intricacies of the surgery. Thus, surgical fellows and residents would likely benefit most from reviewing a recording from the surgeon's POV. The assistant's perspective was likely more beneficial to full-time surgical assistants, medical students, and scrub nurses, where optimal placement of retractors, suction, and other instruments minimalizes obstruction of the surgical field. Both primary surgeon and assistant did not find the recording gear to be hindersome in performing their tasks, nor straining.

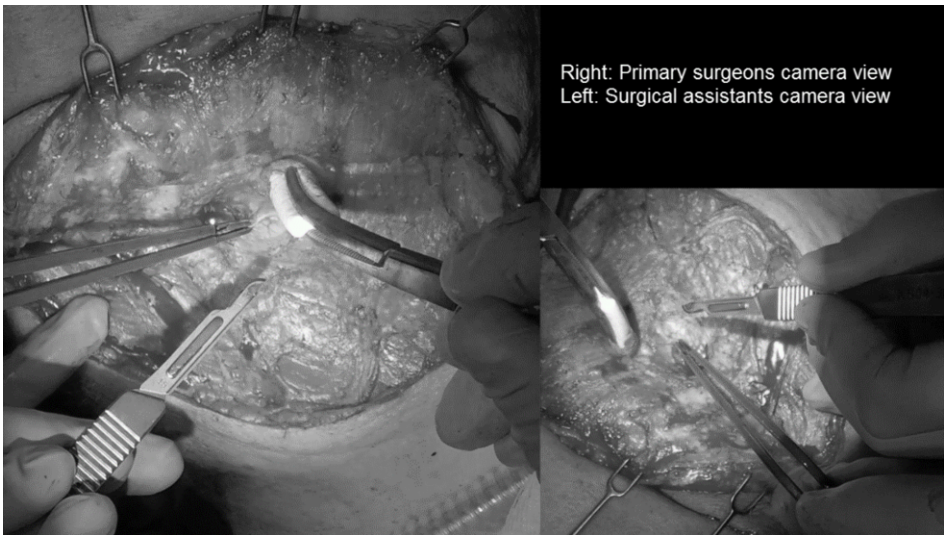

Figure 1. Synchronized video feed point of view stills of the surgical assistant (left) and primary surgeon (right) during otolaryngology surgery. Head mounted GoPro Hero4 Silver (GoPro, San Mateo, CA) was used for the surgeon with a 5.4mm f/2.5 aftermarket lens with a 60° field of view (Peau Productions Inc, San Diego, CA), and a head mounted GoPro Hero3+ Black Edition was use for the surgical assistant.

4. Discussion

This is the first study recording surgical video from an assistant's POV, with a synchronized video feed from the primary surgeon's POV. Again, this paper emphasizes that for surgical trainees, the most valuable perspective is the surgeon's POV. Thus, the majority, if not the entirety, of the case should be recorded using a head-mounted camera on the primary surgeon, using high magnification to appreciate delicate tissue dynamics. Surgical ergonomics may be appreciated by using a synchronized wide field camera [3].

The assistant's POV is less intuitive and less conducive to learning surgery or ergonomics. However, the surgeon's and assistant's simultaneous POV video feed is very useful in appreciating how the quality of an assistant's retraction can either facilitate, or sabotage, the primary surgeon's work. We feel that this approach would be particularly helpful for medical students to prepare them for their first surgical rotations. It would be also advantageous to use this type of video footage to train residents and other surgical assistants who are unfamiliar with a new technique or are seeking to improve their skills.

This work has implications in structuring video libraries. The ideal video library would have magnified, primary surgeon POV recordings of all procedures, variations, complications and subsequent management. For the most part, the primary surgeon POV recordings would include the entire surgery. Synchronized primary surgeon and surgical assistant video would be most useful in shorter segments that illustrate particular maneuvers rather than entire surgeries. For example, a synchronized video may first demonstrate proper technique with the assistant using retractors to provide the surgeon a clear, unobstructed view of the surgical field. Then, a short, synchronized segment shows poor assisting technique, where poor placement and tension on the retractors hinders the surgeon's work.

In an ideal surgical video library, the surgeon's POV videos would cover the breath of different disciplines, as well as have the depth of details to fully understand the procedure. The target audience would include primary surgeons, fellows, residents, and possibly medical students. It would comprise the vast majority of the content. In contrast, simultaneous surgeon and assistant POV recordings would likely be more broad, shorter, and focus on specific maneuvers that are generally applicable to multiple surgical specialties, such a retractor placement, use of suction, surgical sponges, and vessel ligation. The target audience for the simultaneous surgeon and assistant POV videos would likely include full time assistants, scrub nurses, and medical students.

Although we believe our method of recording is an improvement over existing methods, challenges still exist. Neck strain due to the head-mounted camera can be a concerning aspect for the surgeon, especially when there is additional head-mounted equipment, such as a headlight or loupes. With the GoPro camera itself, the battery life, storage capacity, and its ability to wirelessly transmit are issues that need to be optimized. Additionally, an assistant is still needed to periodically check the orientation of the camera on the surgeon's head. Finally, the need to synchronize the two camera feeds makes video editing more onerous.

When recording surgical video on a wide-scale, the cost, convenience and performance of the set-up need to be considered [4]. Standard approaches to recording macroscopic surgery are limited by a variety of factors. Overhead recording systems are expensive and require frequent repositioning during surgery to follow the surgeon's actions. Using an external videographer to record the surgery can be tedious and expensive, may interfere with the procedure, and can increase the risk of infection. Traditional video recording methods are further limited because they do not capture surgery from the surgeon's perspective, which would be ideal for teaching purposes and can enhance simulation training [3]. As video recording in the operating rooms becomes more common, further innovations for easier, cost-effective, and ergonomically savvy surgeon-directed methods will become increasingly important [5].

We feel that POV cameras are the future of high-definition surgical video recording. Studies using GoPro cameras have been used to record orthopedic and general surgeries, where operating room nurses controlled the camera remotely using an iPad app, thereby reducing surgeon distractions. The images and videos were found to be good quality, aside from the brightness due to the overhead lighting, and the surgeon did not report any head or neck strain due to the head strap [6]. GoPro cameras have also been used effectively in oculoplastics, intraocular surgery, plastic surgery procedures and spine surgery [7-10]. Google Glass is another common device that has been used to record surgery, with real-time transmission of the surgeon's perspective. Both the image and audio quality have shown to be adequate for the viewers, however, short battery life, neck strain and the operating room lights causing excessive picture and video brightness were limitations of the Google Glass platform for intraoperative recording [11]. A study using Google Glass in otolaryngology surgery found that it improved surgical workflow, surgical education, and allowed for remote supervision that may have use in teleophthalmology [12]. Comparing Google Glass to GoPro cameras for surgical video recording has shown that technical specifications, battery life, and ability to wear concurrent loupes while operating favored GoPro, but Google Glass provided more comfort, was easier to use [13]. Both of these devices provide POV video recording that can be used to produce synchronized surgeon and assistant POV recordings for teaching purposes.

5. Conclusion

This novel use of dual POV cameras provides a simultaneous and comparative POV between the surgeon and assistant, which may be valuable in preparing medical students for their surgical rotations, as well as teaching residents and other surgical assistants how to optimally perform new techniques. The compact design, simplicity, and ability to capture the surgeon's POV highlights the GoPro technology as a useful tool for the future of video-assisted surgical education.

6. Conflict of interest

No conflicts of interest exist in the publication of this paper.

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