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Original research

Advancement of thyroid surgery video recording: A comparison between two full HD head mounted video cameras

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HIGHLIGHTS

- Head mounted video recording have been used in the most varied fields of surgery.
- Head mounted video camera - new prototype - attempts to record the real point of view of the magnified vision of surgeon.
- Head mounted video camera - new prototype - shows the difference between magnified vision and the naked-eye vision.
- Head mounted video camera - new prototype - is better than conventional video cameras in surgical education and training.

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ABSTRACT

Background: The aim of this study was to test two different video cameras and recording systems used in thyroid surgery in our Department. This is meant to be an attempt to record the real point of view of the magnified vision of surgeon, so as to make the viewer aware of the difference with the naked eye vision.
Materials and methods: In this retrospective study, we recorded and compared twenty thyroidectomies performed using loupes magnification and microsurgical technique: ten were recorded with GoPro® 4 Session action cam (commercially available) and ten with our new prototype of head mounted video camera.
Results: Settings were selected before surgery for both cameras. The recording time is about from 1 to 2 h for GoPro® and from 3 to 5 h for our prototype. The average time of preparation to fit the camera on the surgeon's head and set the functionality is about 5 min for GoPro® and 7–8 min for the prototype, mostly due to HDMI wiring cable. Videos recorded with the prototype require no further editing, which is mandatory for videos recorded with GoPro® to highlight the surgical details.
Conclusion: the present study showed that our prototype of video camera, compared with GoPro® 4 Session, guarantees best results in terms of surgical video recording quality, provides to the viewer the exact perspective of the microsurgeon and shows accurately his magnified view through the loupes in thyroid surgery. These recordings are surgical aids for teaching and education and might be a method of self-analysis of surgical technique.

INTRODUCTION

The history of thyroid surgery in recent decades has been characterized by the introduction of significant technical and technological innovations, improving the accuracy of diagnosis and surgical operations, patient outcomes and reducing operative time and complications [1–5].

While the surgical technique is currently almost the same as that described by Lahey in 1938 [6], the technological progress of

Abbreviations: NIM, intraoperative neuromonitoring; HD, high definition; ISO, international standard organization; LUX, unit of illuminance; FPS, frames per second; EV, exposure value; MP, megapixel; DPI, dot per inch; SD, secure digital; CM, centimeter; GR, gram; $, dollar.

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the past 25 years has introduced innovations and tools which entered into daily surgical practice, from the sealing devices, based on radiofrequency and ultrasound, to intraoperative neuromonitoring (NIM) to routine use of loupes magnification [7–9].

It is now common belief that use of optical and digital magnification in any field of surgery (minimally invasive video-assisted surgery, laparoscopy, endoscopy, loupes-assisted surgery, robotic surgery) [9–11] improves the performance of the surgeon and the results.

The rationale is that the magnification improves the visibility and perception of depth of the operative field and facilitates the identification and preservation of anatomical structures.

Just as technology is working to improve the surgeon's vision, so the surgeon is trying to find the best possible system to allow other people to see exactly what he sees and does [12].

In effect, in order to paraphrase a famous quote “a picture is worth a thousand words”, so we can say that “a video is worth a thousand pictures”. It means that certainly the best way to teach people what you're doing is to show it directly, to let them see your work.

Here comes the wide spread of video recording systems of surgical procedures worldwide. The resulting footage is mainly used as a teaching tool [13] for the training and assessment of surgeons, as well as a source of material for courses and conferences or even teleconferences on live surgery [14]. It also provides a method of self-analysis of the surgical technique in order to improve it, reducing intra and postoperative complications.

The literature shows many examples of the application of video recording in the most varied fields of surgery, from neurosurgery and orthopedics, to hand surgery, to get even the trauma surgery [13–17].

Several studies examined some of the most widespread commercial action cameras and their use in the operating rooms, analyzing the technical features and highlighting their major strengths and weaknesses.

The most popular and used camcorders at the time are GoPro (several models) [16,18,19], Contour High Definition (HD) Helmet Camera [15], Panasonic HX-A100 and Google Glass [17,20–22]. Each of these showed its pros and cons in the operating room application.

The ideal camcorder should have these features: it has to be small, lightweight, comfortable and user friendly; to be able to capture the exact surgeon's view; to provide high definition images and videos; to have a long battery life; to be as cheap as possible. To date, this camera does not exist.

The aim of this study was to introduce a novel prototype of head mounted video camera which we built and patented with the exact target of being used by surgeons in the operating theater. This is meant to be an attempt to record the real point of view of the magnified vision of surgeon, so as to make the viewer (as a trainee surgeon) aware of the difference with the naked eye vision.

For this purpose, we decided also to test two different cameras and recording systems, our prototype and the commercial action cam GoPro® 4 Session, used in thyroid surgery performed with loupes magnification and microsurgical technique.

1. Materials and methods

From January to July 2016, in the Department of General Microsurgery and Hand Surgery, “Fabia Mater” Hospital, Rome, Italy (reference center for thyroid surgery by the Italian Club of the Endocrine Surgery Unit) we video recorded twenty thyroidectomies performed using loupes magnification (4,5× with focal range al 17 inches) and microsurgical technique [9]. Of these, ten were recorded with GoPro® 4 Session action cam (commercially available) (Fig. 1) and ten with our new prototype (Fig. 2) of head mounted video camera (built in 2013 and patented on October 2016; Italian Patent number 102013902204193). Informed consent for picture and video recordings was submitted to all patients.

Technical features of both cameras are showed in Table 1.

The GoPro® was head mounted with elastic bands and oriented to the surgeon's perspective using the application of video preview function to be installed in smartphone, tablet or computer system.

The prototype was head mounted with adjustable bands and oriented to the surgeon's perspective by checking the image on a HDMI-TV screen wired connected and correctly positioned by turning the tilt system of an innovative internal mirror, like a “periscope”. We use a proper and autonomous lighting provided by a double optical led (optional), assembled in an all-in-one system with the camera.

2. Results

Settings were selected before surgery for both cameras.

GoPro® 4 Session was set for surgical recording use with 1080p, medium field of view (the narrower selectable for this model), 30 fps (the only selectable for 1080p and medium field of view), low light was turned off, spot meter was turned on, white balance was on auto, color set on “GoPro® standard color”, International Standard Organization (ISO) limit to 400, sharpness at high and exposure value (EV) at 0.

The prototype camera was set for surgical recording use with 1080p, 60 fps, and white balance was made preoperatively on a white gauze. Through a wire controller, zoom could be set manually also during surgical time, not only previously as required by the GoPro®.

Using these settings, the recording time is about from 1 to 2 h for GoPro® and from 3 to 5 h for our prototype.

The average time of preparation to fit the camera on the surgeon's head and set the functionality is about 5 min for GoPro® and 7–8 min for the prototype, mostly due to HDMI wiring cable.

Videos recorded with the prototype require no further editing, which is mandatory for videos recorded with GoPro® to highlight the surgical details.

3. Discussion

Video recording of surgical procedures has always been a subject of interest since wearable devices were introduced. Apart from

Fig. 1. GoPro® 4 Session action cam.