Title
Using Google Glass to solve communication and surgical education challenges in the operating room.

Journal
The Laryngoscope, 125(10)

ISSN
0023-852X

Authors
Moshtaghi, Omid
Kelley, Kanwar S
Armstrong, William B
et al.

Publication Date
2015-10-01

DOI
10.1002/lary.25249

The Laryngoscope

How I Do It

Using Google Glass to Solve Communication and Surgical Education Challenges in the Operating Room

Omid Moshtaghi, BS; Kanwar S. Kelley, MD, JD; William B. Armstrong, MD; Yaser Ghavami, MD; Jeffery Gu, BS; Hamid R. Djalilian, MD

Key Words: Google glass, otolaryngology, surgery, wearable technology, camera.
***Laryngoscope*, 125:2295–2297, 2015**

INTRODUCTION

Although the use of video recording became popularized in otolaryngology beginning in 1959, a new generation of wearable technology has evolved.[1] One of these technologies includes a device called Google Glass (Google, Inc., Mountain View, CA), hereafter referred to simply as Glass. This device allows the capture of video from the perspective of the wearer. In addition, it provides an interface to access the Internet, communicate with others, and use applications hands free—relying mostly on voice commands. Google is not the only company developing wearable technology; other products such as Vuzix Smart Glasses M100 (Rochester, NY) have similar features to Glass.[2] Despite the many existing products, none is as popular and as widely implemented for use in medicine as Glass, which has been used experimentally in specialties including primary care, dermatology, and pediatric surgery.[3–5] With this in mind, we set out to demonstrate the utility of this technology specifically within the context of otolaryngologic surgery. Furthermore, we utilized Glass to assess the potential to augment surgical education and enhance communication with the surgical team.

Additional Supporting Information may be found in the online version of this article.

From the Division of Neurotology and Skull base Surgery, Department of Otolaryngology–Head and Neck Surgery (O.M., K.S.K., W.B.A., Y.G., J.G., H.R.D.); and the Department of Biomedical Engineering (H.R.D.), University of California, Irvine, Irvine, California, U.S.A.

Editor's Note: This Manuscript was accepted for publication February 12, 2015.

The authors have no funding, financial relationships, or conflicts of interest to disclose.

Send correspondence to Hamid R. Djalilian, MD, Director of Otology, Neurotology, and Skull Base Surgery, University of California Irvine, 101 City Drive South, Bldg 56, Ste 500, Orange, CA 92868. E-mail: hdjalili@uci.edu

DOI: 10.1002/lary.25249

MATERIALS AND METHODS

Patient Population

Three different physicians were tracked as they performed a wide range of otolaryngologic procedures to demonstrate the efficacy of Glass in various operative settings. A neurotologist, head and neck surgeon, and a general otolaryngologist were followed. Written consent was obtained from every patient before Glass was used. Procedures involving only endoscopes and microscopes were not included in this study.

Device

Glass connects to a computer or smartphone via Bluetooth or a wireless network, providing users with the ability to access the Internet in a hands-free manner. By means of a 720p high-definition camera and microphone, Glass records video and audio while giving the user control via various voice commands.[6] Additionally, a bone-conduction speaker conveys sound to the user (Fig. 1). The device requires a wireless network in the hospital for fast streaming of video; however, an additional battery pack was used for this study to allow for longer usage during surgery. In addition, the device in our study was stripped of the integrated social media software to prevent accidental upload of surgical video on social media sites. Currently, Glass is sold only in the Explorer edition, a beta version of the product, which is being sold for $1,500 on the Google Play store.[7]

RESULTS

Benefits of Glass: Real-Time Intraoperative Uses

Communication. During head-and-neck cancer surgery, Glass proved to be useful to the surgeon. As an example, during one procedure involving a laryngeal cancer, the surgeon utilized Glass to speak to another physician at a remote location for an intraoperative consultation. Despite proving its use for communication, in this instance the physician at the remote location was not able to visualize the epiglottis through the video feed. Further follow-up studies are necessary to explore how much anatomy the viewer can distinguish.

During another case involving an auricular squamous cell carcinoma and an application called Pristine,

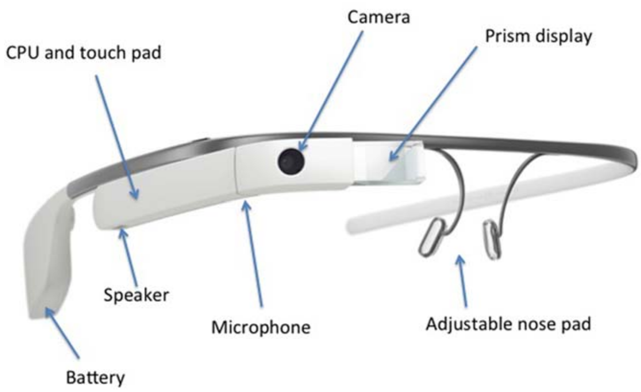

Fig. 1. Translucent prism over right eye along with 720p high-definition camera located adjacent to display. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

the surgeon was able to broadcast a video feed of the surgery to a pathologist performing frozen section analysis on a margin. The pathologist was able to obtain a better understanding of the specimen in question. Without real-time video stream, these scenarios would have required a significant amount of time for a visit to the operating room and a delay in the surgery.

Surgical Education. Another useful application of Glass during surgery applies to medical students, residents, and other providers not directly in the surgical field. The small operative field in many forms of head and neck surgery prevents medical students and sometimes even residents from visualizing the procedure.

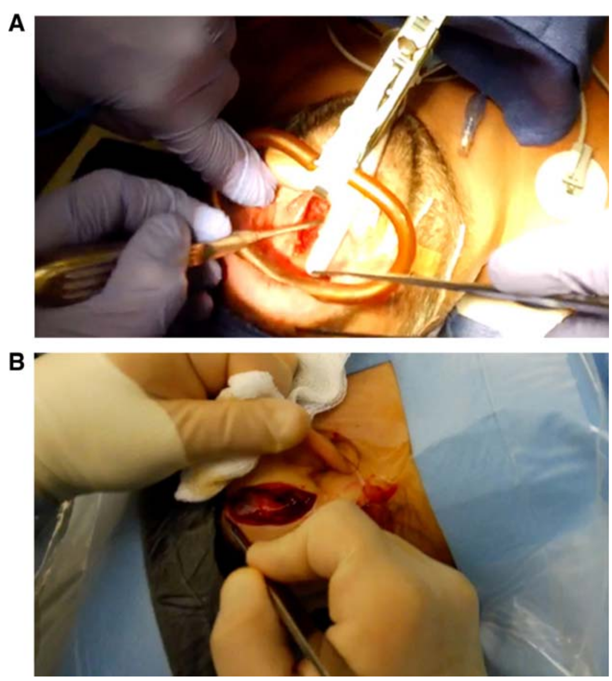

Fig. 2. a) Surgeon removing palatine tonsils during tonsillectomy. b) Surgeon making incision over mastoid, as imaged by the Google Glass (Google, Inc., Mountain View, CA). [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

Fig. 3. Surgeon wearing Google Glass (Google, Inc., Mountain View, CA), attached to auxiliary battery pack for longer battery life. Worn with magnification loupes and headlight. CPU = central processing unit. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

Using Glass, the surgeon can stream the video to any computer in real time by using the Pristine application (Austin, TX). This allowed students a more meaningful and immersive learning experience when the Glass was used for streaming.

Most significantly, resident physicians used Glass as an educational tool for self-monitoring and instant technical feedback. By recording the surgical procedure (as in Supporting Video S1), the recording was then viewed postoperatively with an attending at double speed. The attending used the video as a second teaching opportunity to improve technique and more effectively teach residents outside of the operating room.

Limitations of Google Glass

Although it has many functional features and capabilities, Google Glass does have limitations in otolaryngology. Due to the small anatomical structures of the head and neck, it is difficult to always visualize the full depth of anatomy on film when high-intensity light is in use, despite the high-definition camera. In addition, the bright lights of the operating room caused overexposure of the images. For example, the recording of a tonsillectomy did show the structures of the oral cavity, but distinguishing tonsillar tissue from the rest of the mucosa was somewhat difficult (Fig. 2a). Alternatively, in a tympanoplasty, the surgeon's initial incision to expose the mastoid was clearly visualized on video (Fig. 2b). This may be due to the high-intensity light of the headlight combined with the longer distance to the target area.

Many procedures in otolaryngology require magnification loupes with an associated headlight. Currently, wearing Glass in addition to this equipment proved to be difficult (Fig. 3a). Although aftermarket safety glasses retrofitted with Glass exist, there are scattered reports of Glass being adapted for use with loupes and surgical headlights in customized pieces.

DISCUSSION

We have shown the feasibility and uses of the Google Glass device in otolaryngology surgery. The device appears to have a beneficial educational effect and allows for remote intraoperative consultation. Further hardware and software developments will make Glass more effective for wider use in an otolaryngologic setting. The development of zooming capabilities with increased resolution would make this device better suited for capturing the detailed anatomy of the head and neck.

Although only tested in surgery, a resident physician or midlevel provider could use Glass in emergency department consultations, which would enable remote supervision of simple procedures. The junior residents could receive real-time feedback from a senior resident or an attending able to remotely monitor the procedure from home. Research has shown that 50% to 75% of adverse events that take place in the hospital occur when the patient is under surgical care.[8,9] Problems in communication are among the most common causes of errors in surgery.[10] Improvement in communication using a device such as Glass would allow improved flow of information between members of the surgical team inside and outside of the operating room. Better communication with the pathologist with live streaming video would improve the interpretation, especially in three-dimensional specimens. Also, the bone conduction speaker of the device allows the surgeon to continue to operate while speaking to the pathologist when obtaining the report. Our team found this two-way communication more effective than the use of a telephone.

Glass also proved its use in teaching residents. Many studies show that simulation and virtual reality are considered an important component in improving surgical education.[11,12] We believe that by using Glass, surgical education could also be enhanced by allowing the surgeons to review their own surgical video postoperatively. Just as our physicians did in this study, an expert can point out mistakes and discuss methods of improving technique. This would allow the surgeon to gain more knowledge from each experience, which could potentially decrease the number of patient encounters necessary to obtain the knowledge required to achieve proficiency of the surgical procedure.

The potential use of Glass in telemedicine is another unique application of this technology. Establishing real-time communication with video requires extensive electronic equipment.[13] In a rural or third-world county, this may not be feasible. By using Glass, a clinician can broadcast a patient interaction to a specialist across the globe using only an Internet connection. In this setting, Glass proves its real advantages through its portability and use in many environments.

While the prevalence of this technology expands, more surgeries will be recorded from the surgeon's perspective using Glass. And while the database for this expands, resident physicians will have an opportunity to view previous surgeries recorded before they complete the same procedure. This type of educational tool could be very useful to resident education. In addition, new techniques could be documented and rapidly spread worldwide.

Ethical Issues

Use of Glass will make it more difficult to protect patient privacy. Before recording, patients consent must be obtained. The proliferation of wearable recording technology such as Glass increases the potential for breaches in privacy-protected health information that did not exist before. Care must be taken to protect the identification of patient's face during surgery.

CONCLUSION

Using Google Glass, otolaryngologists can record and communicate on a very versatile platform, improving surgical workflow and providing an opportunity for remote supervision and enhanced surgical education. With the variety of applications that this technology presents, the full use of this device is yet to be seen.

BIBLIOGRAPHY

1. Linder TE, Simmen D, Stool SE. Revolutionary inventions in the 20th century. *The history of endoscopy. Arch Otolaryngol Head Neck Surg* 1997; 123:1161–1163.
2. Vuxix. Product features. October 2014. http://www.vuzix.com/consumer/products_m100/. Accessed January, 2015.
3. Muensterer OJ, Lacher M, Zoeller C, Bronstein M, Kübler J. Google Glass in pediatric surgery: an exploratory study. *Int J Surg* 2014;12:281–289. doi: 10.1016/j.ijsu.2014.02.003.
4. Kantor J. First look: Google Glass in dermatology, Mohs surgery, and surgical reconstruction. *JAMA Dermatol* 2014;150:1191. doi: 10.1001/jamadermatol.2014.1558.
5. Monroy GL, Shemonski ND, Shelton RL, Nolan RM, Boppart SA. Implementation and evaluation of Google Glass for visualizing real-time image and patient data in the primary care office. *SPIE* 2014;8935. doi: 10.1117/12.2040221.
6. Google Staff. Tech specs. April 2013. https://support.google.com/glass/answer/3064128?hl=en. Accessed August 7, 2014.
7. Google Play. Devices. Glass Explorer Edition (Cotton). https://play.google.com/store/devices/details?id=glass_cotton. Accessed January 2015.
8. Leape LL, Brennan TA, Laird N, et al. The nature of adverse events in hospitalized patients. *Results of the Harvard Medical Practice Study II. N Engl J Med* 1991;324:377–384.
9. Gawande AA, Thomas EJ, Zinner MJ, Brennan TA. The incidence and nature of surgical adverse events in Colorado and Utah in 1992. *Surgery* 1999;126:66–75.
10. Gawande AA, Zinner MJ, Studdert DM, Brennan TA. Analysis of errors reported by surgeons at three teaching hospitals. *Surgery* 2003;133:614–621.
11. Ota D, Loftin B, Saito T, Lea R, Keller J. Virtual reality in surgical education. *Comput Biol Med* 1995;25:127–137.
12. Barsness K. Simulation-based education and performance assessments for pediatric surgeons. *Eur J Pediatr Surg* 2014;24:303–307.
13. Lin JC. Applying telecommunication technology to health-care delivery. *IEEE Eng Med Biol Mag* 1999;18:28–31.