Exoscope and Personal Protective Equipment Use for Otologic Surgery

in the Era of COVID-19

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INTRODUCTION

The SARS-CoV-2 virus (COVID-19) and subsequent pandemic, has rapidly changed how physicians, and specifically, otolaryngologists think about personal protective equipment (PPE) and personal safety in the operating room. Since the Wuhan outbreak, high rates of nosocomial spread were seen among otolaryngologists due to the high viral load in the upper respiratory tract\(^1\text{-}\text{3}\). The true infectious risk of various procedures is still unknown. Consequently, the definition of “proper PPE” for each procedure is debated. Many otolaryngology procedures are aerosol-generating and require an N95 mask and face protection, at a minimum. Some procedures warrant powered air-purifying respirators (PAPR).\(^4\)

Transmastoid and lateral skull base surgical procedures are particularly high risk for several reasons. First, the lining of the middle ear is continuous with the nasopharynx, the site of highest COVID-19 viral concentration.\(^3\) Prior studies have detected a wide variety of respiratory viruses in the middle ear in the setting of upper respiratory infections.\(^5\text{-}\text{6}\) It is therefore reasonable to assume COVID-19 is present in the middle ear and mastoid. Second, otologic surgery often demands the use of high-powered drills and irrigation, which may readily aerosolize the virus. Third, using the microscope with the appropriate PPE is challenging. In particular, it is difficult to look through the eyepiece of a microscope while wearing goggles, a face shield, or a PAPR hood.

Recently, the use of exoscopes has gain traction in otologic/neurotologic surgeries.\(^7\text{-}\text{8}\) In the current article, we describe our use of the exoscope as well as a novel draping method to safely perform a high-risk, aerosol-generating otologic procedure after obtaining exempt status from the NYU Langone Health IRB. The technique with the exoscope accommodated full use of PPE without compromising on surgical visualization, patient outcomes, or surgical time.
Therefore, it may serve as a potential solution for performing otologic surgery in the era of COVID-19.

CASE

A 69 year-old male with a widely infiltrative T4aN3bM0 parotid carcinoma with invasion of the facial nerve underwent wide local excision, mastoidectomy with decompression of the facial nerve and reconstruction with anterolateral thigh free flap and nerve grafting. The patient had a negative preoperative COVID-19 test. All members of the operating team utilized N95 masks and 3D eye shields with routine patient draping. A plastic sterile drape (3M Steri-Drape 1015) with adhesive end was applied circumferentially around the normally draped 4K 3D exoscope (Olympus ORBEYE) and enclosed around the sterile field to create a small tent (Figure 1). The surgeon’s hands were placed as usual in the field beneath the tent, with the drapes acting as a physical barrier to spray, aerosolized particles, and bone dust from the drilling. Instrument exchanges were easily performed both under and around the tented drape. Of note, the surgical team initially utilized the 3D glasses beneath a faceshield, however the curved shape of the faceshield resulted in subtle refraction of the image reaching the polarized glasses, obscuring the 3D visualization. As the 3D glasses themselves provided wide eye protection very similar to disposable goggles, they were used as the sole eye protection.

DISCUSSION

While the true risk of transmission of COVID-19 during otologic surgery is currently unknown, transmastoid procedures are considered high-risk. Therefore, proper PPE and overall safety of all team members in the operating room remains paramount. An exoscope system
allows the surgeon the option of wearing many forms of PPE with a comfortable view of the operative field utilizing a custom draping “tent technique” as a barrier. The barrier method has been discussed as a possible solution for intubations as well as nasal endoscopy. We found a similar anecdotal reduction in macroscopic dispersal of fluid and dust using this method. Additionally, we identified similar advantages described by others implementing the exoscope for otologic surgery such as: the learning curve was minimal; the surgeon subjectively felt ergonomically better positioned; and surgical time was roughly equivalent to use of a traditional microscope.

While this report focuses on exoscope use, we feel a draping barrier can certainly be applied to traditional microscopes and customized based upon available equipment, and may serve to protect all operating room staff. When debriefing with the surgical team, we felt there are other potential areas for improvement. For example, a metal support (Leyla holding rod, or a “Christmas tree”) could be placed on the opposite end of the table and the clear drapes secured from the exoscope (or microscope) head to the raised bar. The drape should be pulled taut and positioned to avoid interference with the lens of the scope. The depth perception created by this exoscope relies on the use of polarized 3D glasses. Attempts to use these beneath faceshields reduced the 3D depth perception, likely by obscuring the image reaching the polarized filters. Further experimentation with the system found that the easily deconstructed glasses placed on the outside of the faceshield produced an excellent view (Figure 2). This practical arrangement is likely also suitable for goggles or PAPR shields, similar to the existing clip-on style of 3D glasses for prescription glasses.

As healthcare teams and otolaryngologists around the world navigate methods to safely resume care of patients, the high incidence of asymptomatic SARS-CoV-2 patients combined...
with currently imperfect available testing methods emphasizes the importance of taking available precautions. Transmastoid exoscope visualization may be combined with endoscopic ear transcanal approaches to allow surgeons broader use of PPE. The use of the exoscope and alternative draping techniques may serve to improve safety while providing comparable views and surgical outcomes in otologic surgery, as well as other otolaryngologic procedures.
A. After standard draping of the exoscope, a sterile drape with adhesive was circumferentially attached to the camera head and draped on to the operative field to create a barrier tent without obscuring the camera views. A member of the surgical team is wearing full PPE – N95 respirator beneath a standard surgical mask, with the 3D glasses as eye protection.

B. The surgeon’s arms can rest in typical position, beneath the barrier tent and instrumentation such as a high-powered drill and suction are carefully passed by the surgical tech beneath the tent from the opposite side of the table. The large 3D monitor is visible to the surgical team and all operating room staff.

Figure 2 3D Glasses and Personal Protective Equipment
A. Initial attempts at using the polarized 3D glasses beneath a curved clear plastic faceshield reduced the integrity of the visualized 4K 3D images on the screen.

B. Further trials found the glasses are easily disassembled and the polarized filter element placed on the outside surface of the faceshield to produce excellent visualization.


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Figure 2B

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