



Self-monitoring of the tympanic membrane: An opportunity for telemedicine during times of COVID-19 and beyond

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ABSTRACT

The interest for telemedicine has increased since the COVID-19 pandemic because of the risk of infection. Recently, commercial companies started selling digital USB-otoscopes (DUO) that can be connected to a mobile phone. These DUOs are inexpensive (costing approximately \$6–35 each) and make it possible to visualize the whole tympanic membrane. Here, we illustrate the case of a patient who had operative correction of a tympanic membrane retraction, and who self-monitored the tympanic membrane in the course of time. Additionally, we discuss the use of DUOs in otolaryngology telemedicine practice. The use of simple digital USB otoscopes provides a promising method to assess and monitor the tympanic membrane remotely. However, more research is needed to establish the role of DUOs in telemedicine.

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Level of evidence

Case report.

Introduction

Telemedicine is the practice of medicine by means of telecommunications technology. The interest in telemedicine has increased since the COVID-19 pandemic (Huang et al., 2020) because of the risk of infection (Mann et al., 2020). Otolaryngologists are especially at risk for COVID-19 contamination, as they are close to the patient during examinations and perform interventions in high-risk areas such as the mouth, nose and throat, with greater exposure to viral aerosols (Piccirillo, 2020). Otolaryngologists also tend to see a high volume of patients every day in the clinic. To reduce the number of patients visiting the clinic, telemedicine might provide a solution (Khariwala et al., 2020). However, whereas

telemedicine can be implemented rather easily into some other medical specialties, in otolaryngology this can be difficult due to lack of specialized medical equipment needed for ear, nose and throat examination in the home setting.

Recently, commercial companies started selling digital USB-otoscopes (DUO) that can be connected to the mobile phone. These DUOs are inexpensive (costing between \$6–35 each) and make it possible to visualize the entire tympanic membrane. The DUO come with software which allows users to take pictures and make videos of the tympanic membrane (Bhavana et al., 2018). These pictures can then be uploaded and sent to a physician for review. Common conditions in otolaryngology for which this provides a good solution are ear infections and tympanic membrane retractions. For mild retractions, otolaryngologists often use a ‘watchful waiting’ policy, where patients attend the clinic regularly for follow-up. This watchful waiting policy is associated with good clinical outcomes (e.g. hearing outcomes) in patients with mild retractions (Bayoumy et al., 2021). Another strategy, especially for more severe retractions and adhesive otitis media, is to excise the tympanic membrane retraction, leaving behind a perforation which heals spontaneously in more than 90% of cases (Borgstein et al., 2008a). These patients need a regular follow-up of the tympanic membrane either to observe the mild retractions for progression or to observe healing and watch for possible recurrence

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after excision. This follow-up can be made easier for the specialist, by using the DUO and telemedicine. The images can be compared by the physician to earlier otoscopic images, to assess whether the tympanic membrane retraction has progressed and/or healing of the tympanic membrane has occurred, while monitoring for possible recurrence after excision. Here, we illustrate a case of a 65 year-old male patient who had surgery for a tympanic membrane retraction, with excision of a retraction pocket encompassing approximately 1/3 of the pars tensa, who self-monitored the tympanic membrane in the course of time (see Fig. 1). The device that was used was a visual earpick D13L22. Since we do not routinely use ear packing (Borgstein et al., 2008b) or ear drops after ear surgery, it was possible to see how the tympanic membrane gradually healed within 3 weeks and that the retraction has been recovered on longer follow up, with a normal tympanic membrane at 3 months and no signs of recurrence. Thus, there was no need to plan a physical follow-up appointment to assess the tympanic membrane in the case of this patient in the first 3 months. After 3 months a regular follow-up visit was planned and the tympanic membrane was assessed/reviewed at the ENT outpatient clinic.

Discussion

A major advantage of self-monitoring is that patients are encouraged to assess their own tympanic membrane status, which leads to increased insight in their own disease.

It could take less time for an otolaryngologist to assess the status

of the tympanic membrane for a selected subgroup of follow-up patients. A possible disadvantage is that some patients are not proficient enough to assess their own tympanic membrane, or too young to permit the parents to collect suitable images, but this would soon become clear from the images and the patient can be scheduled for a regular clinic visit. Previously, positive results for DUO-assisted telemedicine consultancies have been published by various authors (Mandavia et al., 2018; Meng et al., 2020; Erkkola-Anttinen et al., 2019).

Mandavia et al. (2018) performed a study on screening of 52 participants for ear pathology by a digital otoscope. These digital images were then assessed remotely by an otolaryngologist. After this screening, the participants received an examination by conventional otoscopy. The concordance for primary diagnosis and decision to refer to an otolaryngologist was then compared. They found that the same diagnosis was reached in 95% and decision to refer was 100% accurate.

Meng et al. (2020) reported results of 12 patients with various otological problems that were assessed by DUOs and subsequently received a telemedicine consultancy. Two patients (17%) and ten patients (83%) were somewhat and very satisfied with the telemedicine consultancy assisted by DUOs, respectively. However, the study of Shah et al. (2018) reported different results. In their study, parents filmed their children’s tympanic membrane for diagnosis, after which a physician did the same. Recordings occurred prior to standard pediatric otolaryngology office evaluation. Later, a remote

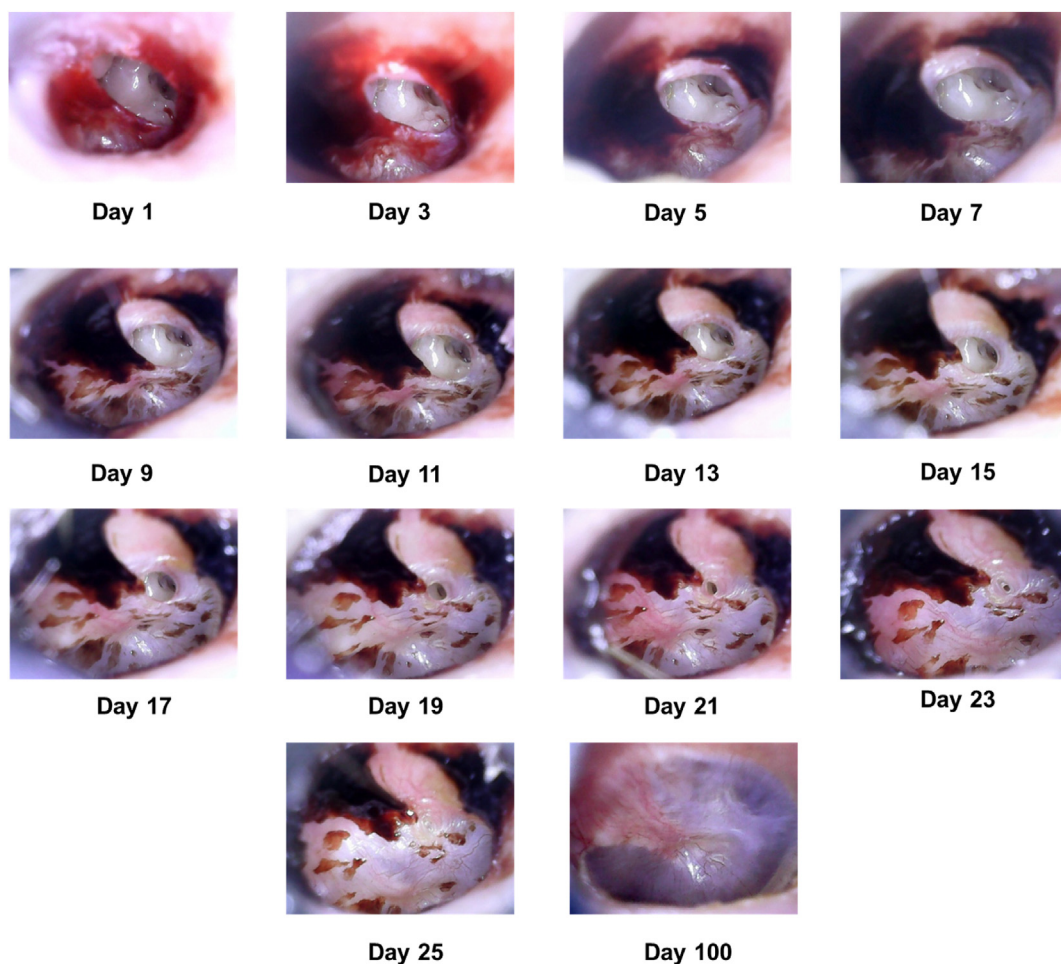


Fig. 1. Self-monitoring of the tympanic membrane by a patient by using a simple digital USB-otoscope. This figure shows that a created perforation, which was formed after excision of a posterosuperior tympanic membrane retraction, healed completely 25 days after the operation. It shows that patients can self-monitor the healing process of the tympanic membrane, and provide longer follow-up without need to visit the clinic. [images supplied by J Borgstein, MD].

pediatric otolaryngologist attempted diagnosis solely based on the videos, blinded to whether the examination was filmed by a parent or physician. They found that patients' self-reported digital otoscopy videos had lower interrater agreement rates ($k = 0.42$) with a pediatric otolaryngologist, compared to digital videos taken by a physician ($k = 0.71$). Furthermore, Demant et al. (2019) found that the usefulness of video-otoscopy was 18% when these were made by local health care workers (physicians and non-physicians) in pediatric patients in rural Greenland. The usefulness was judged by three independent otolaryngologists, who had an inter-rater agreement of 67% [CI-95%, 57–76]. A substantial amount of patients had wax impaction (38%) and the training of personnel was only through written instructions. It seems that patients' self-reported images do not provide satisfactory outcomes for diagnosis, and that for diagnostic purposes the digital otoscopy should be performed by a trained physician. However, data is lacking for patients who are already diagnosed or treated, and are willing to use digital otoscopy for follow-up. Therefore, more research is needed.

We suggest that digital otoscopy can be a valuable addition to regular follow-up visits, during and beyond the COVID-19 pandemic. It may lead to better compliance for the long term follow-up and less visits to the outpatient clinic. Patients can be issued with a suitable video-camera (or given instructions for purchase), instructed how to use the DUO, and take the responsibility for their own health. However, digital proficiency and access to internet and smartphones are a prerequisite for successful practice. An additional constraint is the varying image qualities among DUOs (Tötterman et al., 2020).

Conclusion

The COVID-19 pandemic has resulted in a considerable increase in telemedicine practices and applications. Otolaryngologists are in particular at risk for COVID-19 infections, and the use of simple digital USB otoscopes provides a promising method to assess and monitor the tympanic membrane remotely. However, more research is needed to establish the role of DUOs in telemedicine.

Consent for publication

All authors agreed with the final version of the manuscript.

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Declaration of competing interest

All authors declare that they have no conflict of interests.

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