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Endoscopic Ear Surgery in an Under-Equipped Context: The Case of Mali

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Abstract

Objective: The aim of this work is to expose the advantages of the endoscope in otologic and neurotological surgery in an under-equipped context and its realization using an unusual tool. **Methods:** This is a prospective study extended over 2 years on the medical observations of twenty (20) patients operated endoscopically using a type tool (1080P HD Otoscope with LED light and Built-in Camera). The tool is connected to a mobile androïd phone (Samsung galaxy S24 ultra et S21 ultra) with a wifi diffuser placed in front of the surgeon. The standards relating to ethics have been well respected since the writing of medical files, in particular respect for anonymity, private life, the information of patients and their informed consent in relation to the use of their file in the scientific research framework. Respect for the principles of integrity; independence of work, absence of conflict of interest and assessment of risks to patient health. **Results:** During our study period, we collected 20 patients operated on by our tool. The average age of our patients was 36.65 years with extremes ranging from 12 to 70 years. The female sex was the most represented with a sex ratio of 0.81. The preoperative assessment included tone audiometry in all cases. A CT scan of the rock was performed in eight (8) patients (40%). The indications were mainly represented by type I tympanoplasties in 16 cases (80%), cholesteatoma treatments in four cases (20%). The approaches were: the duct in four patients (20%), the endaural route in ten patients (50%) and the retroauricular route in six patients (30%). The results of the audiological control tests showed a closure of the rinne to less than 20db in 18 patients (or 90%). The first follow-up CT scan at 12 months was normal. A clinical check-up is carried out every 6 months. A questionnaire on post-surgical quality of life noted significant hearing comfort in all patients.

Keywords

Unusual Endoscope, Middle Ear, Cholesteatoma, Tympanoplasty, Facial Nerve

1. Introduction

Endoscopic ear surgery is evolving perfectly in the modern era. However, this technological innovation is not always available, especially in underdeveloped or developing countries. The endoscope has become an essential tool in otological surgery, especially since the microscope has limitations in terms of exploring certain regions of the ear. In Mali, otological surgery remains a challenge, particularly the management of middle ear cholesteatoma. In a prospective study carried out between 2020 and 2023, cholesteatoma surgery represented approximately 9% of all otological surgeries. However, the indications were limited by the extension to certain regions of the retrotympanum [1].

A surgical endoscope is a rigid optic with a lens and a light source to visualize cavities [2]. Endoscopic ear surgery has a prominent place in otological surgery as a complement or, in some cases, as a replacement for traditional microscopy [2]. It was first introduced in otology in the late 1960s [2]. Initially, the endoscope was used as a diagnostic tool for ear pathologies to examine the tympanic membrane, as an aid to microscopes to determine diagnoses, and later to observe the structures and anatomy of the middle ear transmeatally [1]. Later, in the 1990s, it was used as an aid to cholesteatoma surgery for the detection of residual or recurrent disease [1]. In the following years, with the pioneers Thomassin and Tarabichi, it evolved from an observational tool to a surgical tool to perform surgical dissection during otologic ear surgery [3] [4]. Endoscopic ear surgery has several advantages over the traditional microscopic approach, the main advantages being better visualization of the middle ear [2] [4]-[7]. It offers a high-resolution, wider, and more magnified view of the middle ear and the ability to look "into the corners" with minimally invasive access. The microscope allows a forced direct view through the ear canal of the middle ear. The view of the tympanic cavity with the microscope during transcanal surgery is defined and limited by the narrowest segment of the ear canal. In contrast, the view with the endoscope during transcanal surgery is not limited since the endoscope bypasses the narrow segment and the light source is located at the distal end of the endoscope, which gives a wider view and the possibility of "looking around corners" (even with a 0˚ endoscope) [2]-[6]. The realization of the surgical dissection of the middle ear in our context using a simple observation tool connected to a mobile phone without cable makes all the importance of this article.

2. Materials and Methods

This is a prospective study extended over 2 years on the medical observations of

twenty (20) patients operated on endoscopically using a tool of the type (1080P HD Otoscope with LED light and built-in camera) (Figure 1). It is a 0 degree optic offering an improved surgical view with highly resolved images. The tool is connected to a mobile phone using a wifi diffuser. The endoscopic images are directly displayed on the screen. The phone is held by a port placed in front of the surgeon. There is currently no specialized ethics committee in our establishment. However, the standards relating to ethics have been well respected since the writing of medical files, in particular respect for anonymity, private life, the information of patients and their informed consent in relation to the use of their file in the scientific research framework. Respect for the principles of integrity; independence of work, absence of conflict of interest and assessment of risks to patient health.

Figure 1. 1080P HD Otoscope with 6 LED Lights.

3. Results

During our study period, we collected 20 patients operated on by our tool. The average age of our patients was 36.65 years with extremes ranging from 12 to 70 years. The female sex was the most represented with a sex ratio of 0.81. The preoperative assessment included a pure-tone audiometry in all cases. A CT scan of the petrous bone was performed in eight (8) patients or (40%) (Figure 2). The indications were mainly represented by type I tympanoplasties in 16 cases or (60%) (Figure 3), cholesteatoma cures in four cases or (20%) (Figure 4). The approaches were: the canal route in four patients or (20%), the endaural route in ten patients or (50%) and the retroauricular route in six patients or (30%). The conchal cartilage graft was used in all our patients (Figure 5). The cholesteatoma was located in the attic, hypotympanum and sinus tympani. The cholesteatoma was dissected at the level of the Prussak space of the head of the malleus and the body of the incus, both preserved in one case. Reconstruction of the lateral wall of the attic was performed at the same time (Figure 3). Two cases of infectious complications, such as otorrhea were noted. There was no iatrogenic lesion of the facial nerve. The monitoring protocol was based on clinical and scan items. Short- and medium-term monitoring was based on the following elements: the local condition of the operating wound, the existence of signs (nausea, vomiting; dizziness, tinnitus, hypoacusia, facial paralysis, taste disturbance) and audiometric tests.

Long-term monitoring was based on CT scan of the rock. The results of the follow-up audiological tests showed a closure of the rinna to less than 20 dB in 18 patients (90%). The first follow-up CT scan at 12 months in patients with cholesteatomas was normal. A clinical follow-up is performed every 6 months. A questionnaire on post-surgical quality of life noted significant hearing comfort in all patients.

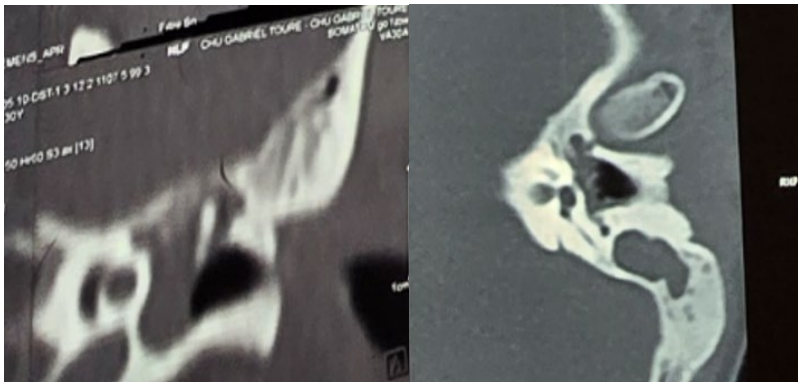


Figure 2. CT scan of the middle ear: tissue hypodensity filling the epitympanic and mesotympanic cavities.

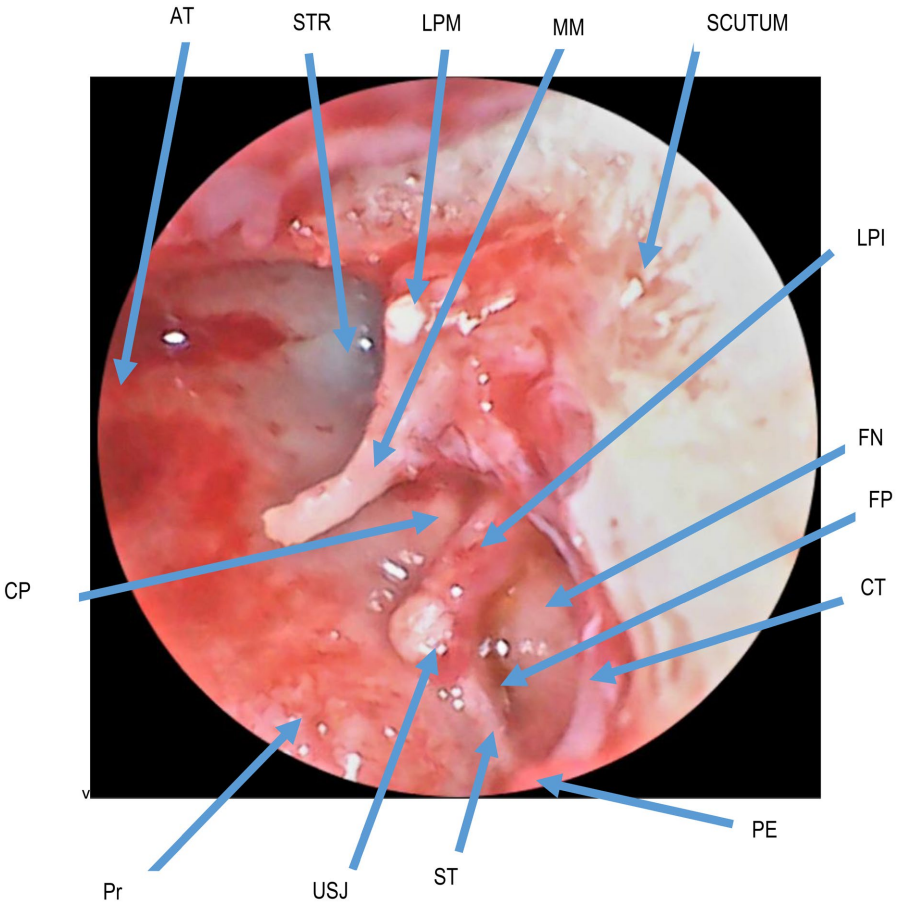


Figure 3. Endoscopic view during myringoplasty. Left ear.

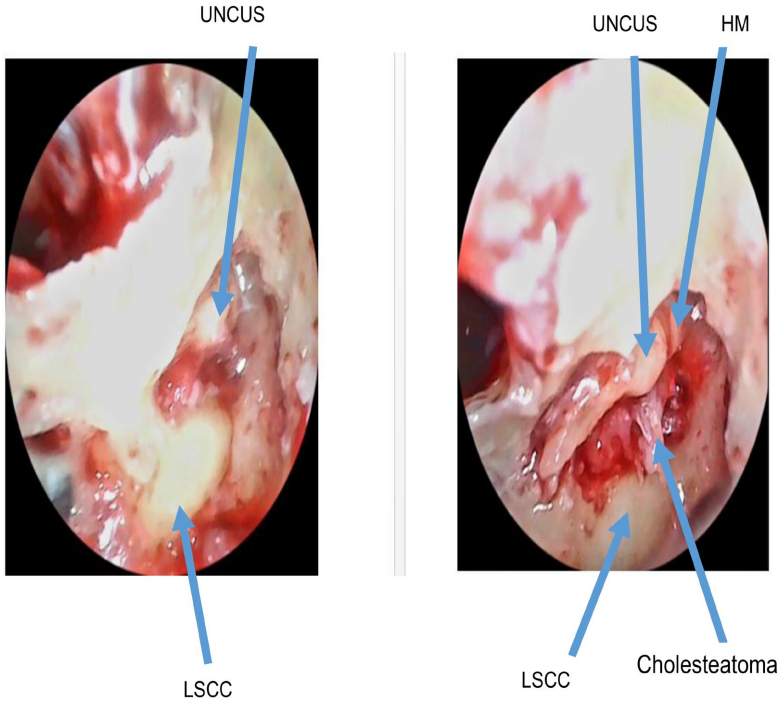
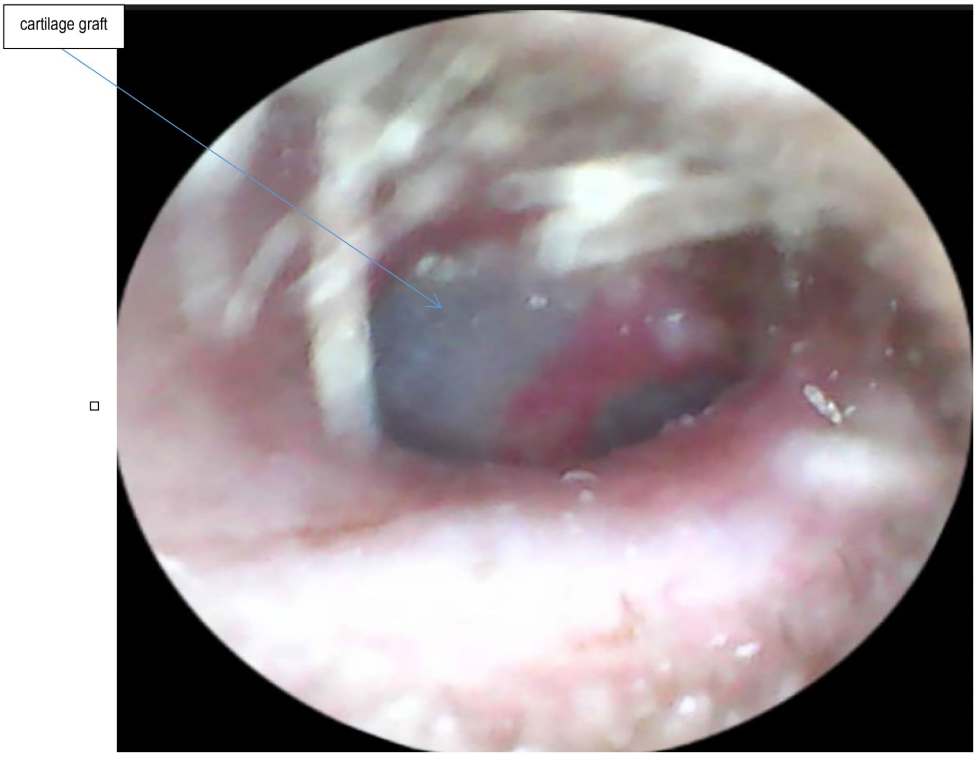


Figure 4. Antroatticotomy. Left ear.



Abbreviations: AT: Auditory Tube, STR: Supratubal Recess, LPM: Lateral process of the Malleus, NM: Neck of the Malleus, MM: Manubrium of the Malleus, LPI: Long Process of the Incus, USJ: Uncudostapedial Joint, FN: Facial Nerve, CT: Chorda Tympani, ST: Stapedial tendon, PE: Pyramidal Eminence, CP: Cochleariform Process, RWN: Round window Niche, Pr: promontory, CH: Cholesteatoma, FP: Footplate, Latéral semicircular canal: LSCC, Short process of incus: SPI.

Figure 5. Healed graft.

4. Discussion

In our case, this is a prospective study which presented a certain number of limitations:

- These are microbleeds requiring tamponade with cotton soaked in adrenaline, leading to an extension of the operating time.

- One-handed surgery with suction difficulties (the endoscope was held by one hand and the instruments by the other). Which often required a pause to achieve an aspiration.

- Elsewhere the need for the simultaneous use of two endoscopes in the event of battery discharge.

The use of the endoscope in otological surgery has many indications. The initial idea of using the endoscope in ear surgery was in the management of cholesteatoma [1]. Acquired cholesteatoma usually begins with a retraction of the tympanic membrane, forming a sac that can invade the tympanic cavities: the attic, the tympanic sinus and sometimes the hypotympanum and protympanum [2] [3]. In advanced cases, the sac can extend more posteriorly into the mastoid. Therefore, the most logical approach is to clear the origin, which is the tympanic cavity by a transcanal approach and to follow the pathological process posteriorly by a transmastoid approach if necessary [3]. We can therefore understand that the endoscope is more suitable for middle ear surgery and the microscope is for the mastoid. In mastoid surgery, the microscope provides a useful 3D view to locate the depth of the surgical field, unlike the endoscope, which provides a 2D view. However, most cholesteatomas rarely extend beyond the mastoid antrum and the antrotomy can be performed safely without a microscope or endoscope [4]-[6]. It is after these steps that magnification becomes necessary. In our case, the use of the unusual endoscope alone allowed us to access the different regions of the mesotympanum, hypotympanum, retrotympanum and of course the attic after descent of the lateral wall and to perform the cholesteatoma excision there. It also allowed us, once the antrotomy was performed, to locate the incus and the lateral canal, which are essential landmarks for the facial canal via the mastoid route. Most surgical failures associated with the posterior approach appear to occur in the tympanic cavity and its adnexa, which are difficult to reach with the exclusive mastoid approach [2] [4]. The view during microscopic surgery is defined and limited by the narrowest segment of the ear canal [2] [3]. In contrast, the transcanal endoscopic approach bypasses the narrow segment of the ear canal and provides a wide view that allows surgeons to look "around the corner" [2] [5] [6] Even with a zero-degree endoscope, the surgeon can view the posterior and anterior spaces of the middle ear well and remove lesions [2] [3] [6] [7]. One of the main difficulties in cholesteatoma surgery is ensuring total excision, which is not easy with microscopic surgery [8]. The authors reported that the sinus tympani was the most common site of residual cholesteatoma, regardless of the type of procedure, whether with a transcanal approach or with mastoidectomy [2]. Our results are compara-

ble to those of a previous study carried out in the same department in 2024, however access to certain regions was limited in these studies. Tympanoplasty is a commonly used procedure for the treatment of chronic otitis media. It involves eradication of the disease in the middle ear, repair of the tympanic membrane perforation, and restoration of hearing [9] [10]. Most studies have noted similar results between tympanoplasty performed by microscope and endoscope [11]. In our series, it was simple myringoplasty. However, the use of the endoscope allowed us to perfectly control all angles of the tympanic frame even in cases of narrowness or exostosis of the external auditory canal. This allowed us to properly insert the cartilage graft into the tympanic frame in all our patients unlike previous studies where cases of medialization and residual perforation had been noted [1]. Endoscopic surgery has been reported to have difficulties, such as working with one hand, which can complicate bleeding control [7]-[9]. Some reports on possible thermal damage to middle ear structures when light is emitted from the tip of the endoscope are also controversial [2] [3]. The stepwise learning curve is another problem, as it takes some time to get used to holding the endoscope with one hand and working with the other hand [2] [3]. We did not encounter these problems, after a good infiltration with xylocaine adrenaline; fine cotton wool soaked in adrenaline allowed us to control microbleeding. The endoscope we use gives off very little heat and we also had the possibility to substitute it during the procedure. On the other hand, the endoscope has allowed a great progress in the detailed description of the anatomy of the middle ear with the different compartments as well as the understanding of the pathophysiology of the mechanisms of dysventillation of the attic [7] [11]. Thus it was possible to highlight the different ligaments and folds of the attic, the notion of isthmus and tympanic diaphragm, the protympanum and the size of the supratubal recess, the subdivision of the retrotympanum into its four retrotympanum compartments with different depths of the sinus tympani, the bony structures such as the ponticle and the subiculum with their variations [11], the detailed description of the region of the round window with the different conformations of the fustis and the finiculus, the hypotympanum with classification of the height of the jugular bulb in the middle ear [7] [11]. Knowledge of this anatomy and understanding of their physiology is a guarantee for the success of the surgery.

5. Conclusion

The endoscope is an essential tool for surgical exploration of the different compartments of the middle ear. Middle ear surgery can be performed in safe conditions regardless of the type of endoscope used. The disadvantages being surgery with only one hand, limiting the possibilities of concomitant aspiration with prolongation of the operating time. However, the realization of this approach using an unusual endoscope of extremely low cost and the mastery of its production will allow patients from underdeveloped countries to benefit from quality care.

Ethical Approval Statement

Informed Consent: It was a purely scientific work aimed at improving the grip of the in charge in the field of otology, the ethical standards have been strictly for each study participant with their informed consent, and respect for anonymity.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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