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Double-handed endoscopic myringoplasty with a holding system in children: Preliminary observations

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ABSTRACT

Objectives: Endoscopic transcanal myringoplasty is a newly-introduced technique for reconstruction of tympanic membrane perforation that offers the advantage to obviate postauricular incision. The objective of this study was to evaluate the feasibility of a double-handed endoscope holder transcanal myringoplasty in children. This technique permits bimanual execution of the procedure and allows the surgeon to overcome the two significant issues of single-handed endoscope surgery, i.e. easy domination of a bloody field and smooth introduction of the graft.

Methods: A prospective non-randomized study of 10 consecutive primary endoscope holder-aided myringoplasties was performed; 3 mm or 4 mm 0° rigid endoscopes were used. A xenograft, biologic soft tissue, was applied in all cases.

Results: All procedures were performed successfully. Duration of surgery was faster than with a single-handed procedure and varied between 20 and 60 min. The tympanic membrane healed successfully in all patients.

Conclusions: In this preliminary experience in children, a bimanual endoscopic holder-aided myringoplasty technique offers the possibility to overcome the obstacles encountered in a single-handed technique, since it can replicate the same concept of a bimanual microscopic approach and allow for easy management of a bloody field and introduction of the graft in the middle ear.

1. Introduction

Tympanic membrane reconstruction is a common procedure in the pediatric age and frequently requires a postauricular approach [1,2]. The introduction of endoscopy allows mini-invasive procedures such as transcanal myringoplasty in all patients [3,4]. Different reports have been published describing the advantages of an endoscopic approach in ear surgery [5,6], and Khan and Parab [7] have recently published a study on cartilage tympanoplasty using an endoscope holder. Since 2010, myringoplasty is always performed using a transcanal endoscopic approach in our Department. The most limiting factor of endoscopic surgery is that one hand is always dedicated to holding the endoscope, making surgery more tedious in bloody fields. The aim of this study is to report our preliminary experience on the feasibility and advantages of a double-handed transcanal myringoplasty with the use of an endoscope holder and biologic xenograft in children.

2. Materials and methods

The design and informed consent form for the study were approved by the Institutional Review Board of the Province of Brescia.

The endoscopic procedure consisted of: 1) application of the endoscope holder on the operating table in front of or laterally to the surgeon (Fig. 1); 2) positioning of the endoscope on the posterior wall of the cartilage part of the external auditory canal; 3) refreshing the margins of the perforation using a sickle knife and grasping forceps; 4) elevating the medial tympano-meatal flap with a semilunar incision at 12 and 6 o'clock; 5) inserting the graft in an underlay fashion; 6) applying gelatin sponges in the middle ear and, after repositioning the flap, in the ear canal (Fig. 2).

For these procedures, 3 and 4 mm rigid 0° endoscopes (Hopkins KARL STORZ GmbH & Co. Tuttlingen Germany) with lengths 14 and 18 cm, respectively, were used. A HD 3 CCD camera and Xenon

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Fig. 1. Holder set-up ready for surgery.

175 W cold light source (Hopkins KARL STORZ GmbH & Co. Tuttlingen Germany) were used. The endoscope holder used was a mechanical articulating holding system (28272 H C; 28272 UGK; 28172 H R: KARL STORZ GmbH & Co. Tuttlingen Germany) (Fig. 3). All procedures were performed under general anesthesia by either the first or the third author (Table 1). A xenograft, biologic soft tissue repair graft (ENT-SRG BIODESIGN COOK MEDICAL, Bloomington, Indiana, USA) was always used.

3. Results

Transcanal endoscopic myringoplasty with holder was performed in 10 patients, 7 males and 3 females, with an age ranging from 6 years to 14 years (mean age 10 years). Duration of surgery varied between 20 and 60 min (median 35 min). All procedures were performed with no complications. Bleeding was easily managed throughout surgery thanks to the bimanual procedure. Six-month follow-up showed a healed tympanic membrane in each child with air-bone gap closure and no bone threshold impairment. A detailed description of the patient characteristics is shown in Table 1.

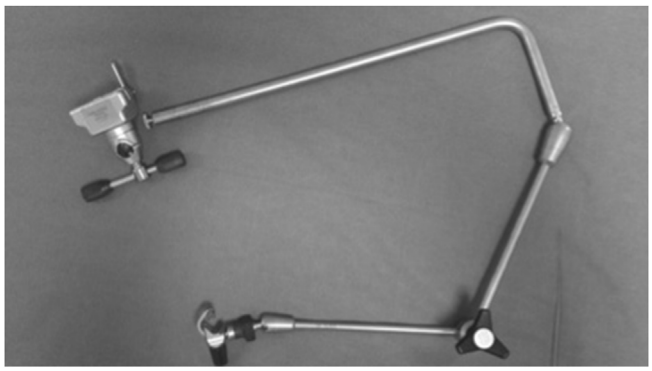

Fig. 3. Mechanical articulated holder.

4. Discussion

In recent years, some studies have been published that emphasize the advantages and feasibility of an endoscopic technique for myringoplasty [3,4,8,9]. Otosurgeons are often skeptic and hesitant in using this technique for several reasons. First, single

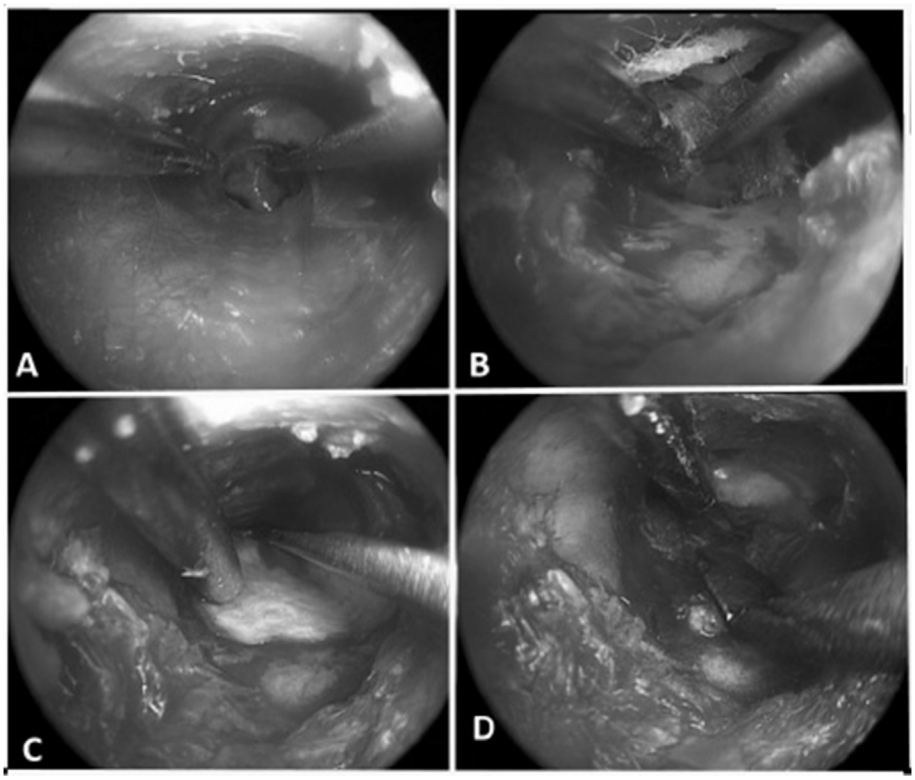

Fig. 2. Endoscopic bimanual refreshing margins of the perforation (A), elevation of the fibrous annulus (B), insertion the graft in an underlay fashion (C), repositioning of the flap (D).

Table 1
Detailed description of patient cohort.

Patient	Age	Gender	Side	Perforation quadrants	Middle ear	Contralateral ear	Surgical time (m)	Pre-ABG	Post-ABG	Surgeon
1	14	M	L	Post-sup, post inf	Dry	Normal	60	20	7.5	RDZ
2	6	F	R	Post-sup	Dry	Normal	60	6.25	5	N
3	6	M	L	Post-sup, post inf	Dry	Normal	50	7.5	5	N
4	9	M	L	Post-sup, post inf	Dry	Normal	30	15	7.5	RDZ
5	10	M	R	Ant-inf	Dry	Normal	35	15	5	N
6	13	F	L	Post-inf, ant-inf	Dry	Previous cholesteatoma	30	15	10	RDZ
7	11	M	R	Post-sup, post inf	Dry	Normal	40	20	10	N
8	10	M	L	Post-inf	Dry	Normal	35	10	6.25	N
9	11	F	L	Post-inf	Dry	Normal	20	7.5	7.5	RDZ
10	8	M	R	Post-inf	Dry	Normal	35	15	7.5	RDZ

Ant: anterior, Post: posterior, Sup: superior, Inf: inferior, RDZ: Redaelli de Zinis.
N: Nassif.

handedness in endoscopy is a limitation, especially in bleeding fields. When it occurs, bleeding is often a disturbing occurrence and frequent suction is needed, so that the surgeon is prone to interrupt the procedure and convert it to traditional bimanual microscope technique [9,10]. Second, otosurgeons are experienced with double-handed stereoscopic vision. Their experience, and therefore their maneuvers, are based on two hands, whereas with endoscopy otosurgeons must manage maneuvers with one hand and thus lose depth of vision. Differently, surgeons who practice nose and paranasal sinus surgery are familiar with a one-hand procedure, and for them approaching middle ear surgery is much preferred to an operative microscope. For this reason, endoscopy seems to be better accepted by non-dedicated otosurgeons than by dedicated ones.

5. Experience in bimanual procedure

In our pediatric department, since 2010, myringoplasty is carried out using an endoscope. Our experience has been very interesting, and all procedures were easily performed independently of the size and localization of the perforation. Up to December 2015, 69 procedures have been carried out. It was not necessary to abandon the endoscopic technique and revert to a standard technique in any case. One of the drawbacks of the technique is that it is a single handed one. In case of a bloody field, especially in hyperplastic mucosa of the middle ear, surgery becomes demanding and time consuming. In trying to overcome this limitation, starting in January 2016 we initiated a prospective non-randomized study of consecutive primary endoscope holder aided myringoplasties using the STORZ endoscope holding system. To date, 10 children have undergone this bimanual endoscopic procedure. A similar experience was recently published where an endoscope holder was developed by modifying an operative microscope, removing the optical system and mounting an endoscope holder [7].

The endoscope used was 4 mm diameter in 7 patients and 3 mm in 3 patients. The surgical maneuvers were more easily managed using the 3 mm endoscope, and according to our experience we would recommend it as it offers more space. The reason for using the 18 and 14 cm endoscopes, and not 6 or 11 cm, is the possibility to maneuver both the hand around the endoscope without encountering any obstacle by the camera and handle of the holder. The surgical instruments used for the microscope technique fit well with this technique.

The holder is attached at the head of the operating table, opposite to the surgeon, as illustrated in Fig. 1, or lateral to the surgeon towards the feet of the patient. The endoscope is introduced into the canal up to the mid-level of the cartilaginous part and leaned on the posterior canal wall and kept fixed. This permitted maneuvering the instruments with no particular hindrance. In the first 2 cases, time was needed to better understand how to position the holder arms in order not to create obstacles for the surgeon and nurse, and in the following cases the procedure ran more smoothly. The advantages of using a mechanical holder compared to the technique described by Khan and Parab [7] are that there is no need to modify the microscope and purchase an endoscope holding plate, the space that the microscope occupies is much more that the holder, and such a holder may already be available in the operating room, as in our case.

Concerning heat issue transmitted to the ear canal and middle ear, low energy is generated at the tip of the endoscope for several reasons. First, a cold light source with a 175 W Xenon lamp is used at low intensity (40% of output) thanks to the 3 CCD camera with an electronic diaphragm opening that allows good illumination of the ear at low intensity transmitted through a fiber-optic light guide. Furthermore, cooling of the tip of the endoscope is also achieved by frequent irrigation of the ear canal for cleansing and to avoid fogging. Finally, we have not experienced any problems in middle ear structures, probably because the endoscope is always distant from them.

6. Advantages

Different from other endoscopic procedures where a dynamic field is required, i.e. cholesteatoma removal [11], during myringoplasty, the endoscope seldom needs to be moved to adjust the field of vision, so that the application of an endoscope holder is particularly favorable. Moreover, small movements of the endoscope are easily performed by acting on the fastening screw. The immediate advantage noticed is the rapidity of the procedure in elevating the tympanomeatal flap and fibrous annulus without frequently stopping to aspirate blood. Washing and suctioning simultaneously always guarantees optimal vision, and cleaning of the endoscope and blurred vision due to a blood clot, liquid, or debris left behind in the EAC during the frequent introduction and extraction of the endoscope is avoided. Another advantage is that during introduction of the flap in case of liquid in the middle ear suction by the second hand is easily performed. Positioning the graft underneath the anterior anulus with two hands is much easier by avoiding its wrinkling, and the application of gelatin sponges under the graft itself is simpler. Fig. 2 shows the different steps of the endoscopic surgery and how it is handled bimanually, offering a clear advantage over a single-handed procedure.

In our experience with single-handed endoscopic myringoplasty, the duration of the procedure varied between 63 and 125 min (median 80 min) [3]. In the present study, the duration of surgery with the holder was shorter (median 30 min), thanks not only to the use of a bimanual procedure but also to the use of a xenograft biologic soft tissue repair graft (in our hands median time

of tragal pericondrium harvesting is 10 min). The graft, per se, offers two advantages; the first is that there is no need to harvest the tragus and peel off the perichondrium, and the second is that neither a scar nor an anatomical defect remains. Therefore, this approach offers three fundamental advantages:

1. no external incision is needed with less invasiveness of the procedure;
2. surgery is no longer hampered by profuse bleeding;
3. duration of surgery is less than with single-handed endoscope surgery.

6.1. Limitations of the technique

The endoscope is fixed in the canal allowing a reduced range of zooming and focusing, limiting surgical maneuvers when a dynamic view is needed as in cholesteatoma surgery. At the beginning of the procedure, the best view is to completely observe the ear canal, and then gradually magnify the middle ear throughout the surgery. Another limitation is during the introduction of the graft in the EAC, since in some cases the endoscope should be slightly pushed outward by the surgeon to allow visualization of the graft that completely lies on the posterior wall and therefore gliding it all the way through to the middle ear. The evolution of this technique could be helped by a camera with a remote control foot pedal to dynamically change magnification and focus during the procedure. An expensive electronic holder allowing fine movements is available (KARL STORZ GmbH & Co. Tuttlingen Germany) and could overcome the limits of the technique in cholesteatoma surgery.

7. Conclusions

Endoscopy in otosurgery is a useful tool as it is less invasive than a traditional microscope technique and is becoming widely utilized. In our hands, the use of an endoscope holder during myringoplasty demonstrates a tangible advantage in overcoming the limiting issue of bleeding. Along with the use of xenograft tissue, it considerably decreases the duration and invasiveness of surgery.

Conflict of interest

No actual or potential conflict of interest is involved in this study.

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