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ENDOSCOPIC EAR SURGERY IN CROATIA – INITIAL RESULTS OF TOTAL ENDOSCOPIC TRANSCANAL MYRINGOPLASTY

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SUMMARY – The aim of this study was to show clinical outcome in 56 patients with tympanic membrane perforation operated on by total endoscopic transcanal myringoplasty. Out of the total of 74 patients operated on exclusively endoscopically, we identified 56 patients in whom tympanoplasty type I (myringoplasty) was performed. In 43 patients (45 ears), myringoplasty was performed in a standard transcanal fashion with lifting of the tympanomeatal flap, and in 13 patient butterfly myringoplasty was performed. The size and position of perforation, surgery duration, hearing status and closure of the perforation were evaluated. Perforation closure was obtained in 50 of 58 ears (86.21%). The mean surgery duration was 62.69±22.56 minutes in both groups. Hearing improved significantly, with the preoperative mean air-bone gap of 20.41±9.29 dB improving to the postoperative mean air-bone gap of 9.05±7.77 dB. No major complications were recorded. Our results of graft success rate and hearing outcomes are comparable with those of microscopic myringoplasties but without the need for external incisions and with reduced surgical morbidity. Hence, we recommend total endoscopic transcanal myringoplasty as the method of choice for tympanic membrane perforation regardless of its size and location.

Key words: *Type 1 tympanoplasty; Endoscopic ear surgery; Endoscopic myringoplasty; Tympanic membrane perforation; Chronic otitis media*

Introduction

Since Wullstein introduced microscope into otosurgery in the 1950s, conventional microscopic techniques have been the standard in middle ear surgery. Although endoscope has been used for decades in other fields of otorhinolaryngology, it has only recently begun to be used more intensively in otosurgery. In microscopic tympanoplasty, we are often limited by the curvature and protrusions of the auditory canal, which prevents transmeatal access through the ear speculum, and we are forced to perform retroauricular or endaural incisions often with canalplasty to adequately visualize the eardrum in its entire circumference[1].

When using a rigid endoscope 3 or 4 millimeters wide, we successfully bypass the unfavorable anatomy of the external auditory canal by passing the endoscope through its narrowest segment, which gives us a wide panoramic view of the eardrum and tympanic cavity, even in narrow children's auditory canals[1-3]. The visibility and width of the operative field obtained by the endoscope is better than the microscopic one, and traditionally difficult to reach areas of the middle ear, such as the retrotympanum or anterior epitym-

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panum, are fully visible immediately after lifting the tympanomeatal (TM) flap[4-6]. It is a minimally invasive approach without external incisions, which leads to the elimination of scars, less postoperative pain, most often with a shorter duration of surgery[7]. The advantages of using an endoscope in ear surgery have led to a wider prevalence of its use and today there are numerous indications, from the external ear all the way to the lateral skull base (Table 1)[8]. Recently published articles which compared the results of endoscopic and microscopic approaches in tympanoplasty and otosclerosis surgery have shown that audiological and functional results are equal, while the duration of surgery in endoscopic group is shorter, recovery faster and less painful[7,9-11].

The authors of this paper were the first in Croatia to perform endoscopic middle ear surgery and thus introduced endoscopes into otosurgical practice[12]. Since then, we have successfully performed fully endoscopic transcanal operations of chronic otitis media, cholesteatomas, ossicular chain reconstructions, and stapedotomies[13,14]. The aim of this paper is to present our results of tympanoplasty type I (myringoplasty) in 56 patients operated on by transcanal total endoscopic approach.

Materials and Methods

This study represents a retrospective analysis of the database of patients operated on endoscopically by the first author from 2018, since when we regularly perform endoscopic ear surgery, till February 2021. Out of a total of 74 operated patients, the study included 56 patients (31 men and 25 women) having undergone tympanoplasty type I (myringoplasty) with a minimum follow-up of 3 months after surgery. In 43 patients, the operation was performed with standard lifting of the TM flap, while in 13 patients the operation was performed without TM elevation in the so-called butterfly fashion[15]. We analyzed the size and position of the perforation preoperatively, the duration of surgery, hearing improvement and success of closing the perforation. Small perforation was the size of the eardrum defect up to 1/3 of the total surface area, medium perforation up to 2/3 of the total area, and large perforation larger than 2/3 of the eardrum surface area. The average hearing threshold and difference in the air-bone gap were determined at frequencies of 500, 1000, 2000 and 4000 Hz before and 3 months after surgery.

Surgical technique

All surgeries were performed under general anesthesia by fully endoscopic transcanal route using a 14 cm long and 3 mm wide rigid 0-degree endoscope (Karl Storz, Tuttlingen, Germany). The ear canal was infiltrated with a local anesthetic (2% lidocaine with 1:100,000 adrenaline). In all patients, the cartilage graft was harvested from the tragus using standard technique.

In butterfly myringoplasty, which we use for small defects, the edges of the perforation would first be refreshed by removing the inflamed scar tissue 1-2 mm around the edge of the perforation using a Wullstein needle. The middle ear would then be filled with Gelfoam. The lateral perichondrium from the cartilage graft is removed and a composite graft approximately 1 mm larger than the perforation itself is shaped. We

Table 1. Indications for endoscopic ear surgery[8]

External ear	Canalplasty, repair of exostosis, debridement and biopsy
Middle ear	Myringotomy, grommet insertion, myringoplasty, medial graft tympanoplasty, lateral graft tympanoplasty, retraction of the tympanic membrane, acquired cholesteatoma, congenital cholesteatoma, neoplasms of the middle ear (e.g., glomus tympanicum), ossiculoplasty, stapes surgery, facial nerve decompression
Inner ear & skull base	Intracochlear schwannoma, intracanalicular vestibular schwannoma, facial nerve schwannoma, petrous apex cyst, repair of perilymph fistulas (congenital or traumatic)

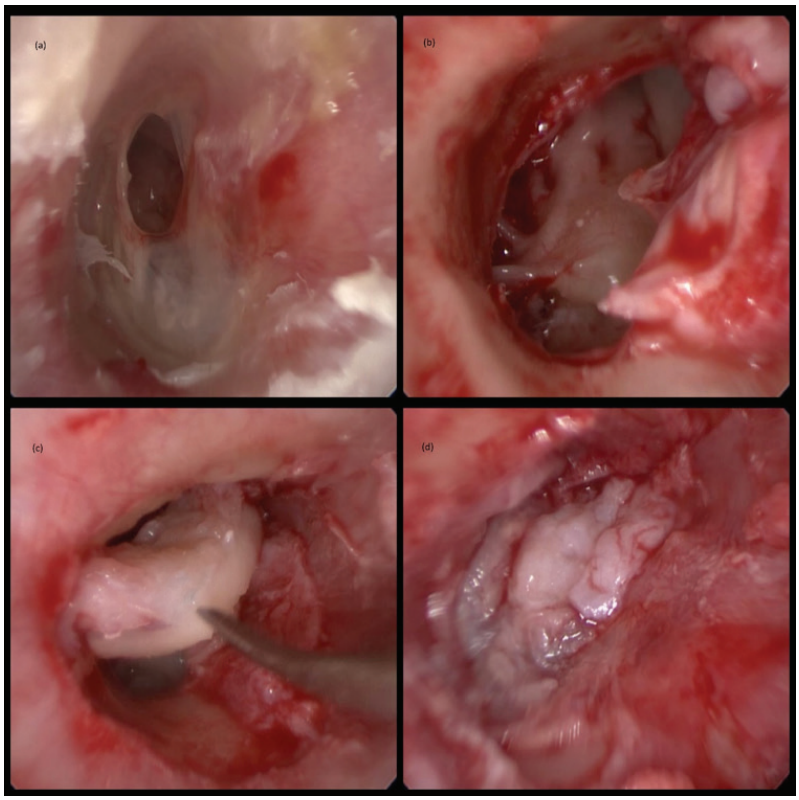

Fig. 1. Perforation of the ear drum in the inferior quadrants (a), superiorly elevated TM flap (b), composite cartilage island graft placement (c), and final result after repositioning of the TM flap (d).

make a groove in full circumference of the graft with a no. 11 scalpel. We place the graft inlay in such a way that the drum falls into the groove made on the graft. The eardrum and auditory canal are then filled with Gelfoam soaked in ciprofloxacin.

For certain small, and all medium and large perforations we prefer the classic technique with elevation of the TM flap (Fig. 1). After the edges of the perforation are refreshed in the previously described manner, an incision is made in the skin of the ear canal 5-7 mm lateral to the annulus. We do not routinely make the incision in the standard 6 to 12 o'clock position. Instead we position incision in accordance with the position of the perforation. The skin of the auditory canal is being raised to the level of the fibrous annulus, and by lifting the annulus out from its bony sulcus, we enter the middle ear. The composite cartilage island graft is placed in the underlay fashion in such a way that the perichondrium covers the bony annulus and the manubrium of the malleus. The TM flap is then repositioned, and the ear canal is filled with Gelfoam as previously described.

Results

The study included a total of 58 operated ears (28 right and 30 left) in 56 patients. The mean age of patients on the day of surgery was 42.72 (12 to 76) years. There were 31 (55%) male and 25 (45%) female patients. Table 2 shows data on the perforation size distribution. The mean duration of surgery was 62.69±22.56 minutes. If we divide and analyze the duration of surgery according to butterfly myringoplasty and regular TM flap elevation myringoplasties, the mean duration of surgery was 30.54±5.61 min and 71.47±16.34 min, respectively. There were no major complications or the need for canalplasty or conversion to microscopic technique regardless of the size or position of the perforation. One patient developed postoperative fungal infection that was successfully treated with local antifungals, and another patient developed granulation tissue around the graft, which led to reoperation. The overall perforation closure success rate was 86.21% (50 of 58 ears). Postoperatively, significant improvement in the difference in the air-bone gap compared to pre-

Table 2. Perforation size distribution

Size of perforation	All patients		Myringoplasty with tympanomeatal flap elevation		Butterfly myringoplasty	
	n	%	n	%	n	%
Small	32	55.17	19	32.76	13	100
Medium	20	34.48	20	34.48	0	0
Large	6	10.34	6	10.34	0	0

Table 3. Comparison of results

	All patients	Myringoplasty with tympanomeatal flap elevation	Butterfly myringoplasty
Number of patients	58	45	13
Patient age (yrs)	42.72±18.27	50.00±14.94	40.62±18.74
Preoperative air-bone gap	20.41±9.29 dB	21.08±9.51 dB	18.08±8.41 dB
Postoperative air-bone gap	9.05±7.77 dB	8.83±7.99 dB	9.81±7.21 dB
Closure success rate	86.21% (50/58)	86.67% (39/45)	84.62% (11/13)
Surgery duration	62.69±22.56 min	71.47±16.34 min	30.54±5.61 min

operative values was achieved. Audiometric results are shown in more detail in Table 3.

Discussion

Until the last decade, all middle ear surgeries were performed under control of a microscope. Although it is certainly possible to operate different sizes of eardrum perforations transmeatally microscopically through the ear speculum, narrow parts of the auditory canal often make it impossible to adequately visualize the whole area of the perforation, especially anterior edge. Then we usually opt for a retroauricular or endaural approach, often with canalplasty, which improves visibility, but at the expense of additional tissue trauma and subsequent scarring. The possibilities of endoscopes and first results of completely endoscopic myringoplasties were published in 1999 by Tarabichi[16]. He achieved a perforation closure success rate of 94% in 64 patients with a minimum follow-up of one year, without significant complications. Encouraged by his pioneering work, other otorhinolaryngologists began to use endoscope in ear surgery, guided by the idea that it was possible to achieve results identical to microscopic while completely avoiding external skin incisions[17-21]. Today, after numerous published papers including meta-analyses with direct comparison of results and complications rates between microscopic and endoscopic operations, endoscopic myringoplasty is becoming the technique of choice owing to better visibility, simplicity and minimal invasiveness[7-10,22,23].

Despite many advantages, opponents of endoscopic surgery still question the success and safety of this technique[24-26]. As the main disadvantages they quote the lack of third dimension (depth) and doing the surgery with one hand, where in the other we have to hold an endoscope. The reason for suspicion is primarily in the habit of holding suction in one hand in order to clean the operative field from bleeding. However, as this is a minimally invasive approach where we treat the surrounding tissue as sparingly as possible, bleeding during endoscopic surgery is rarely a problem and usually less than during microscopic surgery[27].

Following global trends, the authors of this paper started endoscopic ear surgery a few years ago in Croatia[12]. The results of this study are the first results of otologic surgical techniques performed exclusively by endoscope published from Croatia. The primary goal of any chronic otitis media surgery is to make the ear safe and dry, and success is measured by the perforation closing rate. Our results show that endoscopically we can achieve a closure rate of 86.21%, which is comparable to the literature. We also achieved significant improvement in the mean difference in the airbone conductivity from preoperative 20.41±9.29 dB to postoperative 9.05±7.77 dB.

In this paper, we have reported two different endoscopic techniques of transcanal myringoplasty. While for medium and large perforations or if we are not sure about the continuity of the ossicular chain, we still prefer classic underlay myringoplasty, the standard for small central perforations is becoming butterfly myringoplasty, where we completely avoid any incision within the ear canal. Initially described more than 20 years ago[15], with the development of endoscopic surgery it has become much more common. Owing to the possibility to see the edges of the perforation from different angles, it is possible to correctly place the graft in the whole circumference of the edges of the perforation[28-30]. The short duration of surgery and the simplicity of technique without compromising usual closure rates, are the main arguments for butterfly myringoplasty. Although the results of closing medium and large perforations with this technique have also been published[31], we are currently using it exclusively for small perforations. The mean duration of surgery in 13 patients was 30.54 min with a closure rate of 84.62%. We believe that in the near future, endoscopic myringoplasty could become the method of choice for closing all sizes of tympanic membrane perforations, owing to an excellent field of view, minimal invasiveness, and results which are at least comparable to the conventional techniques.

Conclusion

With endoscopic ear surgery we can achieve the results which are at least comparable to classic microscopic techniques, while significantly reducing surgical morbidity. The results of this study show that it is possible to achieve a closure success rate of 86.21%, exclusively endoscopically through the transcanal route. Hence, we recommend transcanal endoscopic myringoplasty as the method of choice for closing all perforations of the eardrum, regardless of its size and position.

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Sažetak

ENDOSKOPSKA KIRURGIJA UHA U HRVATSKOJ – PRVI REZULTATI POTPUNO ENDOSKOPSKIH TRANSMEATALNIH MIRINGOPLASTIKA

M. Malić i *M. Gjurić*

Cilj ovoga rada je prikazati naše dosadašnje rezultate potpuno endoskopskih transmeatalnih miringoplastika. Provedena je retrospektivna analiza baze podataka bolesnika operiranih endoskopskim putem. Od ukupno 74 operiranih bolesnika u studiju je uključeno 56 bolesnika (58 ušiju) kod kojih je rađena timpanoplastika tip I. (miringoplastika) s minimalnim trajanjem praćenja od 3 mjeseca nakon operacije. Kod 43 bolesnika (45 ušiju) operacija je izvedena standardnim odizanjem timpanomeatalnog režnja, dok je kod 13 bolesnika operacija učinjena bez odizanja režnja, tzv. tehnikom *butterfly*. Pratili smo veličinu i poziciju perforacije prijeoperacijski, trajanje same operacije, poboljšanje sluha te uspješnost zatvaranja perforacije. Ukupno je uspješnost zatvaranja perforacije bila 86,21% (50 od 58 uha). Prosječno je operacija trajala 62,69±22,56 minuta. Značajno poboljšanje postignuto je u kvaliteti sluha koja se poboljšala s 20,41±9,29 dB razlike u zračno-koštanoj vodljivosti prijeoperacijski na 9,05±7,77 dB razlike poslijeoperacijski. Endoskopska kirurgija uha omogućava rezultate koji su u najmanju ruku usporedivi s klasičnim mikroskopskim tehnikama, a pritom značajno smanjuje kirurški pobol. Preporučamo transkanalnu endoskopsku miringoplastiku kao metodu izbora za zatvaranje svih perforacija bubnjića, neovisno o veličini i poziciji perforacije.

Ključne riječi: *Timpanoplastika; Endoskopska miringoplastika; Endoskopska kirurgija uha; Kronična upala srednjeg uha; Perforacija bubnjića*