

Research Article / Araştırma Makalesi

Endoscopic Ear Surgery : 7 Years of Single Center Experience
Endoskopik Kulak Cerrahisi: 7 yıllık Tek Merkez Deneyimi

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Abstract: This study aims to share our clinic's endoscopic ear surgery experiences and create a guide for future, more detailed studies. The data of patients who were operated on endoscopically or in combination with a microscope were collected between 2015 and 2022 years retrospectively. The data of 70 patients who had ear surgery with an endoscopic or combined approach with a microscope in our clinic were included in this study. The patients were divided into four groups. The type-1 tympanoplasty group (26 cases) was followed for an average of 16.3 months. The mean follow-up period of 9 cases in the middle ear exploration and ossiculoplasty group was 13.4 months. The case group of 18 people who were operated on for cholesteatoma was followed up for an average of 17.7 months. The stapedectomy case group (17 patients) was followed up for a mean of 14.9 months. Significant improvement was observed in the air-bone gap. Considering the increasing use of endoscopy in otology, we believe that its advantages over the traditional microscopic approach in pathologies limited to the middle ear should be supported by further studies.
Keywords: Endoscopy, Otology, Neurotology, Middle Ear

Özet: Bu çalışmanın amacı, kliniğimizin endoskopik kulak cerrahisi deneyimlerini paylaşmak ve sonrasında daha detaylı çalışmalar için kılavuz oluşturmaktır. Araştırmada retrospektif olarak kliniğimizde 2015-2022 yılları arasında; endoskopik veya mikroskopla kombine olarak opere olan bireylerin verileri, hastane veri tabanından toplanmıştır. Araştırmaya kliniğimizde endoskopik veya mikroskopla kombine yaklaşımla kulak operasyonu olmuş 70 hastanın verileri dahil edilmiştir. Temelde yapılan cerrahinin niteliğine göre hastalar dört gruba ayrılmıştır. Tip-1 timpanoplasti olan gruptaki 26 vaka ortalama 16,3 ay takip edilmiştir. Eksplozasyon ve işitme rekonstrüksiyonu yapılan gruptaki 9 vakanın takip ortalama süresi 13,4 aydır. Kolesteatom nedeniyle opere edilen 18 kişilik vaka grubu ise ortalama 17,7 ay takip edilmiştir. Stapedetomi yapılan 17 kişilik vaka grubu ise ortalama 14,9 ay takip edilmiş olup hava ve kemik yolu arasındaki gapte ortalama 16,7 desibellik kazanç sağlanmıştır. Endoskopinin KBB pratiğinde giderek yaygınlaşması ve otoloji alanındaki kullanımı düşünüldüğünde, orta kulağa sınırlı patolojilerde geleneksel mikroskopik yaklaşıma göre avantajlarının ileri çalışmalarla desteklemesi gerektiği kanaatindeyiz.
Anahtar Kelimeler: Endoskopi, Otoloji, Nörotoloji, Orta Kulak

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1. Introduction

Although endoscopy in otolaryngology practice dates back to the 1960s, its use in treatment and follow-up became widespread in the 90s. High-quality endoscopes and new technologies have triggered endoscope usage, especially in ear surgery [1].

Although the endoscope has a disadvantage, such as one-handed use, absence of binocular vision, and potential thermal damage to surrounding tissues due to the endoscope's heat effect; it provides better control over areas such as sinus tympani and hypotympani, where sufficient surgical vision cannot be achieved microscopically. In addition, because of the minimally invasive approach to the middle ear, the decrease in postoperative morbidity and contribution to better wound healing cannot be ignored[1,2].

Although the microscope is still considered the main instrument for ear surgery today, endoscopic middle ear approaches are gaining importance, especially in isolated and limited pathologies[1,2].

This study shares the experiences of our clinic regarding endoscopic ear surgery. We aim to create a database for further studies to compare the advantages and disadvantages of endoscope use in ear surgery.

2. Materials and methods

The data of patients who were operated on only with the transcanal endoscopic approach or the combined approach with the microscope were collected retrospectively between 2015 and 2022 years. The patients were selected from those who were operated on through the external auditory canal with a standard 0°, 3.0 mm rigid endoscope by a single experienced surgeon. Age, previous ear surgery history, preoperative and postoperative physical examination findings, changes in preoperative and postoperative complaints, preoperative and postoperative audiological data, postoperative follow-up period, discharge time, and preoperative radiological findings were evaluated parameters.

Physical examinations of all patients were performed with an otoscope or microscope in the preoperative and postoperative first month under polyclinic conditions. Preoperative and postoperative first-month audiological evaluations of all patients were performed. The mean of the hearing levels at 0.5, 1, 2, and 4 kHz were used as the pure tone average [3].

The Ethics Committee of Eskişehir Non-Interventional Clinical Research Ethics approved this study on 16.06.2020(04).

Analysis of all data was performed by using SPSS 23. Statistical program (SPSS Inc, Chicago, Illinois). Descriptive analyses were performed. Audiologic results were compared by using the Wilcoxon signed rank test for dependent groups. The probability value of $p < 0,05$ was accepted as the level of significance.

The authors declared that it was not considered necessary to get consent from the patients because the study was a retrospective data analysis.

3. Results

These results include the data of 70 patients who underwent otological surgery with an endoscopic approach or the combined approach with a microscope in our clinic between 2015 and 2022. Patients whose external auditory canal skin was elevated as a tympanomeatal flap and operated under general anesthesia were included in the study group. Patients who were operated on under local anesthesia or whose external auditory canal skin was not elevated as a flap were excluded from this study. The patients were divided into four groups, namely, type 1 tympanoplasty, middle ear exploration and ossiculoplasty, chronic otitis media with cholesteatoma, and stapedetomy (Table 1).

There were 26 cases in the type-1 tympanoplasty group; the mean age was 37(range 14-65 years), and the mean follow-up was 16.3(range 7-26) months. Among the perforated tympanic membranes, 3 were posterior marginal, 2 were anterior marginal,

4 were central, 7 were subtotal, and 10 were total perforated (Table 2). During the follow-up, the success rate of the graft membrane was 84.6%. In half of the cases, tragal cartilage; in the other half, temporalis muscle fascia was used as a graft. The mean preoperative air-bone gap (ABG) significantly decreased from 25.1 ± 7.45 to 17.08 ± 7.09 dB postoperatively ($p < 0.05$ -Wilcoxon signed rank test) (Table 3). During the follow-up period, in the pure tone audiometry performed in the postoperative first month, 7.3 decibels (dB) ABG closure was detected compared to the preoperative period. Only one patient described a short-term tinnitus and fullness sensation, which later regressed spontaneously in the follow-ups. No postoperative complications were reported in the remaining patients. All patients were discharged within one day. There was no additional pathology except tympanic membrane perforation in the preoperative computed tomography (CT) scan.

There were 9 cases in the middle ear exploration and ossiculoplasty group; the mean age was 28.3 (range 14-49 years), and the mean follow-up was 13.7 (range 8-20) months. The primary ossicular defect was detected in 6 cases, and after ossiculoplasty with bone cement, 29 dB mean ABG closure was achieved in pure tone audiometry ($p < 0.05$ -Wilcoxon signed rank test) (Table 3). One case was operated on suspicion of perilymph fistula after trauma, and no fistula was observed during the case. Two cases were revision tympanosclerosis cases and a second look together with ossiculoplasty was performed. No complications occurred except for one patient who had a temporary taste disorder. The mean discharge time of cases was 1.3 days. There was no additional pathology in the preoperative CT scan.

There were 18 cases in the chronic otitis media with cholesteatoma group; the mean age was 32.8 (range 7-62 years), and the mean follow-up was 17.7 (range 6-36) months. Five cases were combined with a microscope, and 13 cases were performed with the endoscope only. Two cases were congenital cholesteatoma, and 16 cases were acquired cholesteatoma. Two congenital cholesteatomas were Potsic stage 4[4]. In the

group of acquired cholesteatoma; 4 of them were Stage 3, 6 of them were Stage 2, and 6 of them were Stage 1 according to EANO / JOS cholesteatoma classification[5] (Figure 1). Half of the cases were revision cases and there was a history of previous cholesteatoma surgery. 94% (17/18) of the cases showed no recurrence suspicion with a physical examination during the postoperative follow-up period. In only one of the cases, revision was needed with the suspicion of recurrence. In one of the cases, facial paralysis developed in the preoperative period, and because of that surgery was planned as an emergency. The patient's facial paralysis completely resolved with medical treatment in the postoperative period. In one of the cases, vertigo developed in the preoperative period, because of that surgery was planned as an emergency with suspicion of labyrinthine fistula. The labyrinthine fistula was also repaired in this case with a combined approach, and no vertigo was reported in the postoperative period. One case was operated bilaterally at 6-month intervals with a preliminary diagnosis of bilateral congenital cholesteatoma. The petrous apex cholesteatoma was excised with a combined approach in two cases. Two patients with petrous apex cholesteatoma had House-Brackmann grade 6 facial paralysis preoperatively, and their facial paralysis continued in the postoperative period. No additional complications were reported during the follow-up of the cases. The mean discharge time of the patients was 2.3 days. All patients had preoperative CT and diffusion magnetic resonance imaging (MRI) scans to map cholesteatoma.

There were 17 cases in the stapedectomy group; the mean age was 38.7 (range 23-60 years), and the mean follow-up was 14.9 (range 6-24) months. The mean preoperative air-bone gap (ABG) significantly decreased from 29.6 ± 7.83 to 9.35 ± 3.23 dB postoperatively ($p < 0.05$ -Wilcoxon signed rank test) (Table 3). Mean 20.2 dB ABG closure was achieved compared to the preoperative period in the pure tone audiometry performed in the postoperative 1st month. In 13 of the 17 cases, 10 dB or below ABG was achieved in the postoperative period. In all cases, the ABG was below 20 dB in the postoperative period. There was a complaint of persistent

tinnitus during the follow-ups in one case. Five cases described post-operative short-term mild to moderate vertigo. The patient with the complaint of persistent tinnitus had a history of tympanoplasty. Tympanosclerosis which was detected intraoperatively was thought to be the main reason for the tinnitus in this patient. Revision surgery was planned in the second month postoperatively, considering **Table 1.** Number of the patients

piston dislocation in one patient. No complications were observed in the remaining patients in the postoperative period. The mean discharge time of the patients was 2.7 days. Otosclerosis findings of varying severity were found in all patients except the patients with tympanosclerosis in the preoperative CT scan (Table 4).

<i>Surgery type</i>	<i>Number of patients</i>
Type 1 tympanoplasty	26
Exploration	9
Cholesteatoma	18
Stapedetomy	17

Table 2. Perforation sizes and sites

<i>Perforation site</i>	<i>Number of the patients</i>
Posterior marginal	3(2 small*, 1 medium)
Anterior marginal	2(2 small)
Central	4(1 small, 2 medium, 1 large)
Subtotal	7
Total	10

*small: <25% of the tympanic membrane size, medium 25%-50% of the tympanic membrane size, large 50%-75% of the tympanic membrane size, >75% classified as total or subtotal perforation

Table 3. Preoperative and postoperative ABG thresholds

Group	Preoperative ABG	Postoperative ABG	Test statistics	p
Type 1 tympanoplasty (n=26)	25.1±7.45 db	17.08±7.09 db	Wilcoxon	<0.001
Exploration (n=9)	44,3±11.96 db	15,29±10.23 db	Wilcoxon	<0.001
Otosclerosis (n=17)	29.6±7.83 db	9.35±3.23 db	Wilcoxon	<0.001

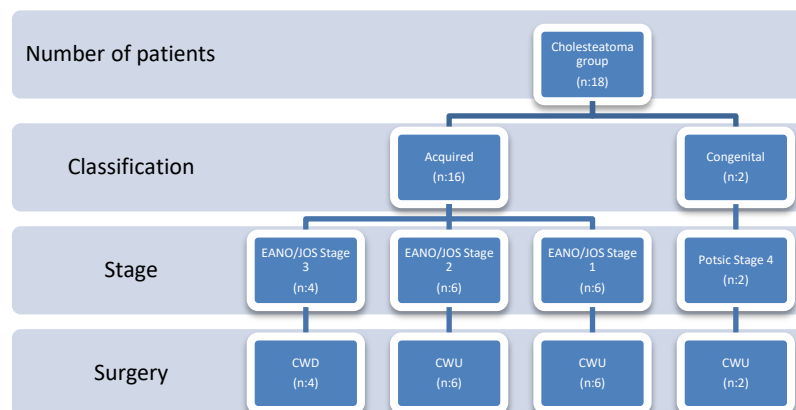


Figure 1. Cholesteatoma group

*CWU: Canal Wall Up mastoidectomy

*CWD: Canal Wall Down mastoidectomy

4. Discussion

In the group who had endoscopic type 1 tympanoplasty performed, a graft success rate(84.6%)was achieved parallel to the literature during follow-ups. A low complication rate and 7.3 dB mean ABG closure in the pure tone audiometry performed in the postoperative first month is in line with the current endoscopic type 1 tympanoplasty literature[6]. There is no significant difference between the two methods in graft success rate, complication rate, and hearing gain in studies comparing the traditional microscope with the endoscope; therefore, endoscopic type-1 tympanoplasty can be considered a reliable method[6-8].

The exploration and hearing reconstruction group results align with the existing literature with a 29 dB mean ABG closure. In five of our cases, there was a history of head trauma, and in four cases, we detected a separation in the ossicular chain (between incus and stapes). In one of the children, there was no history of trauma; therefore, congenital incudostapedial joint separation was the diagnosis for this patient. The perilymphatic fistula was not detected intraoperatively in the patient with suspected perilymphatic fistula secondary to trauma. Considering that the endoscope provides better surgical vision over the oval and round windows, we can assume that the endoscope is superior to the microscope in terms of perilymphatic fistula repair[9]. In two cases, hearing reconstruction was not performed to avoid additional complications due to extensive tympanosclerosis affecting the oval window floor. Although the advantages of the endoscopic approach over the microscopic approach should be supported by more research, especially in isolated ossicular pathologies; we believe that the endoscopic method will be preferred in the future in terms of surgical view and approach [10,11].

Although the follow-up period of our clinic is limited in the case series of endoscopic cholesteatoma surgery, the recurrence rate of 6% in an average follow-up of 17.7 months is in line with the existing endoscopic cholesteatoma surgery literature. Recurrence rates vary between 2% and 25% in different

studies, depending on the follow-up period and surgical technique [12]. It has been reported in different studies that recurrence rates are higher in Canal Wall Up (CWU) techniques compared to Canal Wall Down (CWD) mastoidectomy after a single surgery in the microscopic approach[12]. Different studies state that endoscopic approaches are more successful in recurrence than microscopic CWU mastoidectomy techniques in cholesteatomas confined to the middle ear [12]. It has been shown that the endoscope provides better surgical vision than the microscope, especially in the sinus tympani and epitympanic areas, and therefore the endoscope prevents residual cholesteatoma in such areas [13]. The advantage of the minimally invasive approach provided by the endoscope in congenital cholesteatoma cases cannot be ignored, especially in the pediatric age group [14]. In terms of complication rates, the case series of our clinic is approximately the same as the literature data. Although the limited follow-up period in our clinic is disadvantageous in this study, it is clear that more reliable data can be obtained in future studies. Recurrence rates in cholesteatoma surgery may differ depending on the follow-up period, surgical method, and technique. We believe that the combined use of an endoscope and microscope is more successful than the microscopic approach alone in terms of long-term recurrence rates, and this will be further supported by future studies [15,16].

An acceptable 20.2 dB mean ABG closure was achieved in the endoscopic stapedotomy group. In 70% (12/17) of the patients, an air-bone gap of 10 dB or less in the postoperative period can be considered successful in terms of stapes surgery. In different studies; postoperative ABG of 10 dB or less, varies between 72.1% and 94.2% in the microscopic stapedotomy techniques[17]. Our clinic's postoperative complication rates align with the literature [17,18]. We believe that the advantages of the endoscope over the microscope in protecting the corda tympani and scutum during stapedotomy can be studied with future work. Especially the complication rates in long-term follow-ups and the differences between the microscopic

approach and the endoscopic approach should be supported by further studies[18,19]. The two major limitations of this study are that relatively small sample size and being retrospective. The main disadvantage of this retrospective study is the lack of control of the data. Duration of surgery could be significant data for endoscope versus microscope comparison. Evaluation of the potential chorda tympani injury and disturbances of the taste also could be significant data for the success of endoscopic surgery. Duration of surgery and injury of the chorda tympani have been evaluated since 2021 as our clinical approach. In this context, this study can not give any data for the potential damage of the chorda tympani and the duration of surgery because of its retrospective nature.

REFERENCES

1. Yiannakis CP, Sproat R, Iyer, A (2018) Preliminary outcomes of endoscopic middle-ear surgery in 103 cases: a UK experience. *J Laryngol Otol* 132(6):493-496.
2. Kanona H, Virk JS, Owa A (2015) Endoscopic ear surgery: A case series and first United Kingdom experience. *World J Clin Cases* 3(3):310-317.
3. Committee on Hearing and Equilibrium guidelines for the evaluation of results of treatment of conductive hearing loss. American Academy of Otolaryngology-Head and Neck Surgery Foundation, Inc. *Otolaryngol Head Neck Surg.* 1995;113(3):186-187.
4. Potsic, W. P., Samadi, D. S., Marsh, R. R., & Wetmore, R. F. (2002). A staging system for congenital cholesteatoma. *Archives of Otolaryngology-Head & Neck Surgery*, 128(9), 1009-1012.
5. Yung, M., Tono, T., Olszewska, E., Yamamoto, Y., Sudhoff, H., Sakagami, M., ... & Özgürin, N. (2017). EAONO/JOS joint consensus statements on the definitions, classification, and staging of middle ear cholesteatoma. *J Int Adv Otol*, 13(1), 1-8.
6. Choi N, Noh Y, Park W, Lee JJ et al (2017) Comparison of Endoscopic Tympanoplasty to Microscopic Tympanoplasty. *Clin Exp Otorhinolaryngol* 10(1):44-49.
7. Dündar R, Kulduk E, Soy FK, Aslan M, Hanci D, Muluk NB, Cingi C (2014) Endoscopic versus microscopic approach to type I tympanoplasty in children. *Int J Pediatr Otorhinolaryngol* 78(7):1084-1089.
8. Marchioni D, Alicandri-Ciufelli M, Molteni G, Genovese E, Presutti L (2010) Endoscopic tympanoplasty in patients with attic retraction pockets. *Laryngoscope*. 120(9):1847-1855.
9. Kim MS, Chung J, Kang JY, Choi JW (2020) Transcanal endoscopic ear surgery for traumatic ossicular injury. *Acta Otolaryngol.* 140(1):22-26.
10. annella G, De Vincentiis M, Greco A et al. (2019) Endoscopic approach in second stage ossicular chain reconstruction *Am J Otolaryngol* 40(5):735-742.
11. Isaacson B Wick CC, Hunter JB (2017). Endoscopic ossiculoplasty. *Oper Tech Otolaryngol Head Neck Surg* 28(1):39-43.
12. Li B, Zhou L, Wang M, Wang Y, Zou J (2021) Endoscopic versus microscopic surgery for treatment of middle ear cholesteatoma: A systematic review and meta-analysis. *Am J Otolaryngol.* 42(2):102451
13. Hu Y, Teh BM, Hurtado G, Yao X, Huang J, Shen Y. (2020) Can endoscopic ear surgery replace microscopic surgery in the treatment of acquired cholesteatoma? A contemporary review. *Int J Pediatr Otorhinolaryngol.* 131:109872
14. Park JH, Ahn J, Moon IJ (2018) Transcanal Endoscopic Ear Surgery for Congenital Cholesteatoma. *Clin Exp Otorhinolaryngol* 11(4):233-241.
15. Kozin ED, Gulati S, Kaplan AB et al (2015) Systematic review of outcomes following observational and operative endoscopic middle ear surgery. *Laryngoscope* 125(5):1205-1214.
16. Presutti L, Gioacchini FM, Alicandri-Ciufelli M, Villari D, Marchioni D (2014) Results of endoscopic middle ear surgery for cholesteatoma treatment: a systematic review. *Acta Otorhinolaryngol Ital* 34(3):153-157.
17. Nassiri AM, Yawn RJ, Dedmon MM, Tolisano AM, Hunter JB, Isaacson B, Rivas A (2018) Primary Endoscopic Stapes Surgery: Audiologic and Surgical Outcomes. *Otol Neurotol* 39(9):1095-1101.

5. Conclusion

Although the use of endoscopy in otological surgery is still at an early stage compared to microscopy; the endoscope has been accepted as a safe and successful surgical procedure with the proper indication in the field of otology. Although endoscope has disadvantages such as single-hand use and the heat effect, its use will gradually increase parallel to the developing technology. We believe that the advantages of endoscopes in pathologies limited to the middle ear should be supported by further studies, especially in terms of postoperative discharge time, complication rate, and surgical success.

18. Bianconi L, Gazzini L, Laura E, De Rossi S, Conti A, Marchioni D (2020) Endoscopic stapedotomy: safety and audiological results in 150 patients. Eur Arch Otorhinolaryngol 277(1):85-92.
19. Sproat R, Yiannakis C, Iyer A (2017) Endoscopic Stapes Surgery: A Comparison With Microscopic Surgery. Otol Neurotol 38(5):662-666.

Ethics

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