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Comparison of the Efficacy of Endoscopic and Microscopic Type 1 Tympanoplasty

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Abstract

Objective: To compare the graft success rates and hearing gains of patients who underwent endoscopic and microscopic tympanoplasty.

Methods: A total of 90 patients, 45 patients who underwent endoscopic tympanoplasty and 45 patients who underwent microscopic tympanoplasty between 2014 and 2019, were included in the study. Patients' age, gender, operation side, perforation location, graft material type, graft placement type, preoperative, and postoperative audiological findings and graft success were compared in the two groups.

Results: There was no significant difference between the two groups in terms of age, gender, operation side, perforation location and the way the graft was placed ($p>0.05$). There was a difference between the two groups in terms of the graft material used. The mean hearing gain was found statistically significant in the audiological evaluations performed before and after the operation in both groups ($p<0.001$), but there was no difference between the groups ($p=0.222$). When the graft success rates were compared between the two groups, no statistically significant difference was found ($p=0.748$).

Conclusion: There is no difference between endoscopic tympanoplasty and microscopic tympanoplasty operations in terms of graft success rates and hearing gain. Both methods are effective and safe methods to use in chronic otitis media surgery.

Keywords: Endoscopic tympanoplasty, microscopic tympanoplasty, tympanoplasty, chronic otitis media

INTRODUCTION

Chronic otitis media (COM) is one of the most common otological problems with permanent changes in the tympanic membrane and/or middle ear structures. It is generally divided into two subgroups as with and without cholesteatoma. Tympanoplasty is the surgical reconstruction of the tympano-ossicular system, which includes canaloplasty, meatoplasty, myringoplasty, and ossiculoplasty (1). The tympanoplasty procedure has been performed microscopically for many years. However, with the development of endoscopic instruments, especially since the 90's, the endoscopic tympanoplasty procedure has been used with increasing acceleration and its popularity has increased recently (2,3).

During microscopic surgery, the surgical field view is limited to the narrowest part of the external ear canal, while in endoscopic surgery, this narrow area is bypassed and a wide view of the surgical field is provided even with 0° endoscopes. In microscopic tympanoplasty, retroauricular or endaural incisions are usually made to expand the view of the surgical field and canaloplasty may be required when necessary. However, one of the most important advantages of endoscopic tympanoplasty is that it can be performed transcanally without the need for any incision or canaloplasty, deep and corner areas that are difficult to see with a microscope can be easily seen, and it is a less invasive procedure (3-5). The greatest advantage of microscopic tympanoplasty is that it allows the use of 2 hands together at the same time (6).

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Although the rate of successful closure of the tympanic membrane perforation in microscopic tympanoplasty varies between 83%-100% in the literature, these rates are between 80%-100% in endoscopic tympanoplasty (7). In this study, we aimed to compare the results of endoscopic and microscopic type 1 tympanoplasty and examine the graft success rate and the changes in the hearing of the patients.

METHODS

Forty five patients [5 females, 20 males; endoscopic tympanoplasty (ET) group] who underwent endoscopic type 1 tympanoplasty and 45 patients [22 females, 23 males; microscopic tympanoplasty (MT) group] who underwent microscopic type 1 tympanoplasty in the ENT Clinic of Haseki Training and Research Hospital between January 2014 and December 2019, in 90 patients were analyzed retrospectively. Ethics committee approval of the study was obtained from the University of Health Sciences Turkey, Istanbul Haseki Training and Research Hospital Local Ethics Committee (date: 14.05.2020, decision no: 2020-57). Patients with cholesteatoma and otosclerosis who underwent ossiculoplasty in the same session and revision operations were excluded from the study. Age, gender, side of the perforation, location of the perforation, average air-bone conduction gap in the preoperative and postoperative 3rd month, mean hearing gain, the graft material used in the operation and the success rates of the graft in the postoperative follow-ups were evaluated. Hearing thresholds were calculated by taking the averages of 500 Hz, 1000 Hz and 2000 Hz in the audiogram. All patients underwent type 1 tympanoplasty under general anesthesia. A retroauricular or endaural approach was used in patients who underwent microscopic tympanoplasty. During endoscopic tympanoplasties standard endoscope assisted transcanal tympanoplasty was performed. Perforations were grouped according to their anatomical location as central-marginal and anterior-posterior-inferior. The temporal fascia, perichondrium, tragal cartilage, or conchal cartilage were used as graft materials in all operations. The grafts were placed as underlay or over-underlay. Postoperative routine control of the patients was carried out in the 1st week, 3rd week, 3rd month and 6th month. Complete closure of the perforation in these controls was defined as graft success.

Statistical Analysis

SPSS 15.0 for Windows program was used for statistical analysis. Descriptive statistical methods were given the number and percentage for categorical variables; mean, standard deviation, minimum, maximum, and median for numerical variables. The rates in the groups were compared using the chi-squared test. Since the numerical variables did not provide normal distribution condition, the comparisons of the two groups were made using the Mann-Whitney U test. Dependent group analyzes were performed using the paired t-test when the differences in numerical variables provided the normal distribution condition and the Wilcoxon test when the normal distribution condition was not met. The statistical significance level was set as $p<0.05$.

RESULTS

A comparison of the demographic and clinical characteristics of the patients in the ET group and in the MT group is shown in Table 1. The mean age of the ET group was 31.4±12.6 (range 18-63 years) while the mean age of the MT group was 32.5±11.2 (range 18-60 years). There was no statistical difference between the two groups in terms of age ($p=0.387$). There were 20 males (44.4%), 25 females (55.6%) in the ET group; 23 males (51.1%), 22 females (48.9%) in the MT group and there was no significant difference in terms of gender ($p=0.527$). While 17 left ears (37.8%) and 28 right ears (62.2%) were operated in the ET group; 20 left ears (44.4%) and 25 right ears (55.6%) were operated in the MT group and there was no significant difference between the groups in terms of the operated side ($p=0.520$).

Perichondrium was used in 19 patients (42.2%), tragal cartilage in 17 patients (37.8%), the fascia in 7 patients (15.6%) and conchal cartilage in 2 patients (4.4%) who underwent endoscopic tympanoplasty. However, perichondrium was used in 3 patients (6.7%), tragal cartilage in 6 patients (13.3%), the fascia in 14 patients (31.1%) and conchal cartilage in 22 patients (48.9%) who underwent microscopic tympanoplasty. A statistically significant difference was found between the two groups in terms of the graft materials used ($p<0.001$).

In the ET group, the grafts of 20 patients (44.4%) were placed as underlay, while 25 patients' grafts (55.6%) were placed as over-underlay. In the MT group, the grafts of 14 patients (31.1%) were placed as underlay, while 31 patients' grafts (68.9%) were placed as over-underlay. There was no significant difference between the two groups in terms of graft placement position ($p=0.192$).

The perforations of the patients who underwent endoscopic tympanoplasty were posteriorly located in 19 patients (42.2%), anteriorly located in 15 patients (33.3%) and inferiorly located in 11 patients (24.4%). Simultaneously, 40 of the perforations (88.9%) were central perforation while 5 of them (11.1%) were marginal. The perforations of the patients who underwent microscopic tympanoplasty were posteriorly located in 24 patients (53.3%), anteriorly located in 7 patients (15.6%) and inferiorly located in

14 patients (31.1%). While 39 of the perforations (86.7%) were central perforation, 6 of them (13.3%) were marginal. There was no significant difference between the two groups in terms of the location of the perforations (p=0.146 and p=0.748).

In the controls performed in the postoperative 6th month, the graft success rate in the ET group was found 86.7% (39 of 45 patients). The graft success rate in the MT group was found 88.9% (40 of 45 patients). No statistically significant difference was found between the two groups in terms of graft success rate (p=0.748) (Table 2).

The average preoperative air-bone conduction gap was 20.4±9.7 in the ET group. In the postoperative 3rd month measurements, it was found 13.2±10.7 (Table 2). The mean hearing gain in the ET group was statistically significant (p<0.001) (Table 3). While the average preoperative air-bone conduction gap was 20.6±8.8 in the MT group, it was found 10.4±9.9 in the measurements at the postoperative 3rd month (Table 2). The mean hearing gain in the MT group was found to be statistically significant (p<0.001) (Table 3). However, when the mean hearing gains were compared between the ET and MT groups, no statistically significant difference was found (p=0.222) (Table 2).

DISCUSSION

Tympanoplasty is a term used to describe the surgical procedure performed not only for reconstructing the tympanic membrane,

Table 1. Comparison of the preoperative clinical characteristics of patients

		Endoscopic tympanoplasty	Microscopic tympanoplasty	p
Gender n (%)	Male	20 (44.4)	23 (51.1)	0.527
	Female	25 (55.6)	22 (48.9)	
Age mean ± SD (min-max)		31.4±12.6 (18-63)	32.5±11.2 (18-60)	0.387
Graft type n (%)	Tragal	17 (37.8)	6 (13.3)	**<0.001***
	Conchal	2 (4.4)	22 (48.9)	
	Fascia	7 (15.6)	14 (31.1)	
	Perichondrium	19 (42.2)	3 (6.7)	
Operation side n (%)	Left	17 (37.8)	20 (44.4)	0.520
	Right	28 (62.2)	25 (55.6)	
Graft position n (%)	Underlay	20 (44.4)	14 (31.1)	0.192
	Overlay	0 (0.0)	0 (0.0)	
	Over-underlay	25 (55.6)	31 (68.9)	
Perforation location n (%)	Posterior	19 (42.2)	24 (53.3)	0.146
	Anterior	15 (33.3)	7 (15.6)	
	Inferior	11 (24.4)	14 (31.1)	
Perforation type n (%)	Central	40 (88.9)	39 (86.7)	0.748
	Marginal	5 (11.1)	6 (13.3)	

*p<0.05, SD: Standard deviation, min: Minimum, max: Maximum

Table 2. Comparison of audiological results and graft success

		Endoscopic tympanoplasty	Microscopic tympanoplasty	p
Average preoperative air-bone conduction gap Mean ± SD (min-max/median)		20.4±9.7 (3-43/20)	20.6±8.8 (5-40/20)	0.689
Average postoperative air-bone conduction gap Mean ± SD (min-max/median)		13.2±10.7 (0-41/10)	10.4±9.9 (0-40/8)	0.095
Mean hearing gain Mean ± SD (min-max/median)		7.1±6.9 (-16-18/7)	9.9±11.7 (-19-36/10)	0.222
Graft success n (%)	Yes	39 (86.7)	40 (88.9)	0.748
	No	6 (13.3)	5 (11.1)	

SD: Standard deviation, min: Minimum, max: Maximum

Table 3. Comparison of hearing gain

	Average preoperative air-bone conduction gap	Average postoperative air-bone conduction gap	p
Endoscopic tympanoplasty mean ± SD	20.4±9.7	13.2±10.7	**<0.001***
Microscopic tympanoplasty mean ± SD	20.6±8.8	10.4±9.9	**<0.001***

*p<0.05, SD: Standard deviation, min: Minimum, max: Maximum

but also to remove middle ear pathologies such as COM, cholesteatoma and ossicular chain problems.

With the invention of binocular microscopes, ear surgery has undergone a great change and the foundations of modern otology have been laid. Then, with the introduction of rigid endoscopes, modern otology has passed to another stage. In 1978, Eichner (8) introduced the use of a 2.7 mm diameter and high resolution rigid endoscope for autological examination. Since el-Guindy's (9) first publication in 1992, endoscopes are now widely used in tympanoplasty. While the most important advantages of microscopic ear surgery are that both hands can be used simultaneously, it provides stereoscopic vision and requires a shorter training period, the most important disadvantage is that it cannot provide sufficient vision of the hidden areas in the middle ear without performing canaloplasty, particularly in patients with narrow and curved external auditory canal (10-12). These hidden areas, which cannot be seen easily with a microscope, have been easily accessible without canaloplasty with rigid endoscopes. However, working with one hand, difficulty in using endoscopes at the beginning of the training and not providing stereoscopic guidance are important disadvantages of endoscopic ear surgery (12,13).

In studies in the literature, many publications have shown that endoscopic tympanoplasty takes less time than microscopic tympanoplasty (11,14). As the most important reason for this, it has been advocated that there is no need for suturing in endoscopic tympanoplasty at the end of the operation.

Choi et al. (15) compared the results of endoscopic and microscopic tympanoplasty in their study published in 2017 and found no difference between the two groups in terms of graft success rate. Likewise, Shakya et al. (16) compared the graft success rate in endoscopic and microscopic tympanoplasty, achieved a success rate of 91.42% in both groups and found no significant difference in graft success rate between the groups. In our study, the graft success rate was 86.7% in the endoscopic tympanoplasty group, while it was 88.9% in the microscopic tympanoplasty group and no significant difference was found between the two groups (p=0.748).

Güler and Özcan (17) found a mean hearing gain of 12.8 dB and 12.4 dB, respectively, in their study comparing endoscopic and microscopic techniques and found no significant difference in gain between the two groups. Gulsen and Baltacı (14) found a mean hearing gain of 19.4 dB in endoscopic tympanoplasty and 18.7 dB in microscopic tympanoplasty and they found no significant difference in terms of hearing gain between the two techniques. In both studies, postoperative hearing gain was found to be significant in both techniques. In our study, the mean hearing gain was found to be 7.1 dB in the endoscopic tympanoplasty group and 9.9 dB in the microscopic tympanoplasty group. While the hearing gain in both groups was statistically significant ($p<0.001$), no significant difference was found when the mean hearing gain was compared between the two groups (p=0.222).

The biggest disadvantage of endoscopic tympanoplasty is the difficulty of working with one hand. Working with one hand, especially in the case of bleeding, makes the operation difficult and can prolong the duration of the surgery. However, with sufficient practice and experience, these disadvantages can be manageable.

We think that it is important to start tympanoplasty training with microscopic tympanoplasty first and to switch to endoscopic tympanoplasty after gaining the necessary experience because endoscopic surgeries require more experience.

Study Limitations

The main limitation of the study is that there was a statistically significant difference between the microscopic and endoscopic tympanoplasty groups in terms of the graft materials used. Further studies with a larger sample of patients and using the same graft materials are needed to confirm the data presented in this work.

CONCLUSION

When the results of our study and other studies in the literature are evaluated, there is no difference between the two techniques in terms of graft success rate and average hearing gain in both endoscopic and microscopic tympanoplasty. Although studies in the literature have shown that endoscopic tympanoplasty shortens the operation time, it requires more experience due to the difficulty of working with one hand. After gaining the necessary experience, we believe that endoscopic tympanoplasty may be preferred more frequently by surgeons as it provides a better surgical field view, is less invasive and short operation time.

Ethics

Ethics Committee Approval: Ethics committee approval of the study was obtained from the University of Health Sciences Turkey, Istanbul Haseki Training and Research Hospital Local Ethics Committee (date: 14.05.2020, decision no: 2020-57).

Informed Consent: Informed consent was obtained from all the patients included in the study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: S.U., O.Ü., G.G., Y.B., Concept: S.U., O.Ü., Design: O.Ü., G.G., Y.B., Data Collection or Processing: G.G., Y.B., Analysis or Interpretation: O.Ü., G.G., Y.B., Literature Search: O.Ü., G.G., Y.B., Writing: S.U., O.Ü.

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