CLINICAL STUDY

COMPARING THE ENDOSCOPIC TECHNIQUE WITH THE MICROSCOPIC BUTTERFLY CARTILAGE TYMPANOPLASTY

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SUMMARY

Objectives: To investigate the differences between endoscopic and microscopic butterfly cartilage tympanoplasty.

Material and Methods: Eighty-seven patients under endoscopic and microscopic butterfly cartilage tympanoplasty was done. Mean audiometric results were evaluated among the groups before surgery and six months after surgery at 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz at air and bone conduction thresholds. Air conduction pure tone audiometry (PTA), air-bone gap reduction, air-bone gap (ABG) and hearing gain before and after surgery were calculated after surgery.

Results: No statistically significant difference was found between the groups respectively in terms of the mean ABG before and after surgery (24.9±7.5 dB vs. 23.7±6.5 dB; 16.7 dB ± 5.2 vs. 15.9 dB ±5.8dB). Both groups showed significantly lower ABG after surgery than that before surgery ($p<0.05$). No statistically significant difference was found between the microscopic tympanoplasty group and the endoscopic tympanoplasty group (8.2±5.9 dB vs. 7.8±5.3 dB, ($p=0.896$) in terms of the mean improvement of the ABG.

Conclusion: There is a similarity between the microscopic and endoscopic groups in terms of the successful graft rate and the hearing outcomes.

Keywords: Microscopy, endoscopy, butterfly, cartilage, tympanoplasty

KELEBEK KIKIRDAK TİMPANOPLASTİDE ENDOSKOPİK VE MİKROSKOBİK TEKNİKLERİN KARŞILAŞTIRILMASI

ÖZET

Amaç: Kelebek kıkırdak timpanoplasti uygulanan hastalarda endoskopik ve mikroskobik tekniklerin arasındaki farkları araştırmak.

Gereç ve yöntem: Endoskopik ve mikroskobik kelebek kıkırdak timpanoplasti uygulanan 87 hasta çalışmaya alındı. Gruplar arasında, ortalama odyometrik sonuçlar ameliyat öncesi ve ameliyattan altı ay sonra 500 Hz, 1000 Hz, 2000 Hz ve 4000 Hz"de hava ve kemik iletim eşiklerinde değerlendirildi. Ameliyat öncesi ve sonrası saf ses odyometrisi (SSO), hava kemik boşluğunda azalma, hava kemiği boşluğu (HKB) ve işitme kazancı hesaplandı.

Bulgular: Ameliyat öncesi ve sonrası ölçülen ortalama HKB değerinde, iki grup arasında istatistiksel olarak anlamlı fark bulunmadı (24.9 ± 7.5 dB ve 23.7 ± 6.5 dB; 16.7 dB ± 5.2 ve 15.9 dB ± 5.8dB). Her iki grupta da ameliyat sonrası HKB değeri, ameliyat öncesi HKB değerinden daha düşük bulundu ($p <0.05$). HKB değerinin ortalama iyileşmesi değerlendirildiğinde; mikroskobik timpanoplasti grubu ile endoskopik timpanoplasti grubu (8.2 ± 5.9 dB ve 7.8 ± 5.3 dB ($p = 0.896$) arasında istatistiksel olarak anlamlı bir fark bulunmadı.

Sonuç: Mikroskobik ve endoskopik gruplar arasında greft başarı oranı ve işitme sonuçları açısından benzerlik bulunmaktadır.

Anahtar Sözcükler: Mikroskobik; endoskopik; kelebek; kartilaj; timpanoplasti

INTRODUCTION

To cure the disease in the middle ear, an important surgical procedure i.e. tympanoplasty is applied. This procedure repairs the perforated tympanic membranes and ossicles. The graft materials which are used in this procedure include fat temporal muscle fascia, cartilage, and perichondrium[1,2]. The cartilage which is used in many graft laying techniques as the graft material has been elaborated[3].

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Eavey described the butterfly cartilage myringoplasty technique as one of the well-known techniques[4]. The technique has been newly used for the total and near-total perforations while it was first used for the small and medium-sized perforations[2].

This technique doesn"t necessarily require elevation of the tympanomeatal flap. This technique can be used in case of local anesthesia which requires shorter operating time and has no bleeding. For this reason, the difference between this technique and other tympanoplasty techniques is that there is no need for any canal incision or packing after surgery.

A microscope was used to perform middle ear surgery traditionally. In the 1990s, the endoscope was first used to perform ear surgery[5] and was commonly performed by the surgeons since then.

The number of literature on the common use of endoscopic methods in otological operations increased[6]. The most important reason that the endoscopes have been accelerated in the otological surgery is that the difficult areas in the middle ear can be displayed with it easily. Endoscopes particularly give wider pictures and are used to see invisible places such as anterior marginal perforations, sinus tympania, and facial recesses.

This study aims to investigate the differences between the endoscopic and microscopic butterfly cartilage tympanoplasty.

MATERIAL and METHODS

Study design

The retrospective evaluation of the medical data obtained from 87 patients under endoscopic and microscopic butterfly cartilage tympanoplasty was done between September 2015 and January 2019 at the department of otorhinolaryngology and the minimum follow-up period was six months. All surgeries were performed by a single surgeon. The Institutional Review Board of School of Medicine approved the performance of this study (Ethics Committee Decision no: 25/07/2019-31733).

Exclusion criteria

The criteria such as signs of perforations total of the TM found in the patients, infection or inflammation during the microscopic examination of the middle-ear mucosa, extensive myringitis, possible mastoid cell pathology which requires the diagnosis of the middle ear including cholesteatoma, atrophied tympanic membrane, retraction pocket, possible ossicular chain problem, marginal perforations, discordant hearing loss based on the perforation size, and otorrhoea within the last month were excluded from the study.

Evaluation before the surgery

The retrospective evaluation of the patient's data about the localization, size, and demographics of the perforations was done. The graft success rates after surgery in the early and late periods and then the results of audiometric examinations before and after the surgery were analyzed. The small-sized tympanic membrane (TM) perforation was between 20% and 40% and the medium-sized perforation was between 40% and 60%.

The cases were audiologically evaluated based on bone conduction results and the average pure tone air at 500, 1000, 2000, and 4000 Hz. An endoscope and microscope were used to clinically evaluate the tympanic membrane. The high resolution computed tomography (HRCT) was used to evaluate the middle ear and mastoid bone.

The assessment of the mean audiometric results at 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz at air and bone conduction thresholds was done among the groups before surgery as well as six months after surgery.

Air conduction PTA, air-bone gap reduction, ABG and hearing gain before and after surgery were calculated after surgery.

Indications

In our practice, the butterfly cartilage tympanoplasty indications were as follows: lack of tympanosclerotic plaques in the perforation edge, central localization of the perforation, no signs of infection and inflammation for the otoscopic examination of the middle ear mucosa, no clinical or radiological signs of cholesteatoma, lack of otorrhea within three months and destruction of the ossicular chain.

Surgical technique

The microscope was used to perform surgery among five patients undergoing general anesthesia and the rest of patients underwent surgery with local anesthesia. The microscope was used to implement the transmeatal approach among all patients. The microscopic tympanoplasty group was studied with a microscope (Carl Zeiss, Oberkochen, Germany and Leica, Wetzlar, Germany).

An endoscope with 14mm length, 4mm width and A 0º angle which was connected to a camera screen was used for the endoscopic tympanoplasty group. The width of the cartilage graft was set to be 2 mm, which is wider than the perforation. To keep one butterfly wing lateral and another wing on the medial side of the perforation, the graft is placed on the edge of the perforation margin.

A dry sponge was used to do the packing. After one week, local ciprofloxacin drops were taken.

The dry sponge ceases to be visible 14 days after surgery. The routine examination of the patients was done in the first week and then, the patients were visited subsequently in the first, third and sixth months after surgery. The patients were examined with the microscope during each follow-up period. During the three-month follow-up period, PTA was also calculated.

Statistical analysis

The obtained data were analyzed with SPSS software, version 20.0 for Macintosh. The Fisher"s exact test and Mann-Whitney U test were used to evaluate the differences between the endoscopic tympanoplasty group and the conventional microscopic tympanoplasty group in terms of the hearing thresholds. Mean ± standard deviation (SD) was included in the data. There was a statistically significant difference at P<0.05.

RESULTS

Demographic data for all studied 87 patients is shown in Table 1. Inlay cartilage microscopic tympanoplasty was performed on 39 patients (22 males and 17 females) and endoscopic inlay cartilage tympanoplasty was performed on 48 patients (28 males and 20 females). There was no significant difference between the two groups in terms of size, age and anatomic location of the perforation.

No statistically significant difference was found between the endoscopic group (47.87±12.59 min) (p=0.573) and microscopic group (42.20±12.20 min) in terms of the actual operative time. The success rate in the endoscopic group was 93.7% (48/45) and the success rate in the microscopic group was 94.8% (39/37). In five patients two of whom were in the microscopic group and three were in the endoscopic group, the tympanoplasty procedure didn"t work well, leading to recurrence of the perforation.

There was no significant difference between the above two groups in terms of the success rate. No statistically significant difference was found between the groups respectively in terms of the mean ABG before and after surgery (24.9±7.5 dB vs. 23.7±6.5 dB; 16.7 dB ± 5.2 vs. 15.9 dB ±5.8dB). In each studied group, the difference between ABG before and after surgery was analyzed. Both groups showed significantly lower ABG after surgery than that before surgery (p<0.05). As shown in Table 2, no statistically significant difference was found between the endoscopic tympanoplasty group and the microscopic tympanoplasty group (7.8±5.3 dB vs. 8.2±5.9 dB) in terms of mean improvement of ABG (p=0.896).

Table 1. Demographic and clinical characteristics of the patients

	Microscopic group (n:39)	Endoscopic group (n:48)	P value
Mean age (years)	43.04±16.31	45.10±16.20	0.594
Gender			
male	22	28	0.174
female	17	20	
Size of perforation			
small	19	24	
medium	11	14	0.879
large	9	10	
graft failure	2	3	0.832
Perforation location			
anterior	24	27	0.765
posterior	15	21	
Operating time (min)	42.20±12.20	47.87±12.59	0.573

Table 2. Preoperative and postoperative hearing gains, air conduction, air-bone gaps of the groups

	Air conduction PTA (dB)	Air-Bone gap (dB)	Air-Bone gap reduction	500 Hz % ± SD	1000 Hz % ± SD	2000 Hz % ± SD	4000 Hz % ± SD	P value
Preoperative microscopic	36.9±13.7	24.9±7.5		42.3±18.2	43.7±18.6	42.9±17.4	43.2±18.1	p>0.05
Preoperative endoscopic	37..5 ±12.3	23.7±6.5		41.7±16.3	42.9±16.7	42.3±17.1	43.1±17.3	
Postoperative month 6 microscopic	26.4 ±7.2	16.7 dB ± 5.2	7.3±7.4	24.1±9.3	23.3±9.7	24.7±8.9	23.9±9.4	p>0.05
Postoperative month 6 endoscopic	24.2 dB ± 6.7	15.9 dB ±5.8	7.6±6.3	25.4±9.4	23.9±8.9	24.8±9.1	24.3±9.7	

PTA; Pure tone audiometry dB; Decibel SD; Standard deviation

DISCUSSION

Eavey described the butterfly cartilage myringoplasty technique as one of the well-known techniques[4] but this technique was applied on only small-sized perforations.

As the next studies reported, the patients with near-total central perforations were also cured with this technique[2]. The patients with small and medium-sized and near-total sized perforations with the remainder of enough membrane were included in our study. The success of the butterfly cartilage tympanoplasty graft depends on the support of the remaining tympanic membrane.

High graft success is one of the main advantages of the butterfly cartilage technique. Other advantages of this technique are the shorter operative time and the absence of tympanomeatal flap elevation. Other advantages of the butterfly cartilage tympanoplasty which encourage the surgeons to apply this technique are shorter recovery time and also low pain after surgery.

Similar rates have been reported in several studies that have been conducted on the graft success rates of the butterfly cartilage tympanoplasty technique. 96.4% graft success rate for the perforations with any size was reported by Kim, et al.[7]. Additionally, endoscopic surgery achieved a high success rate. In a study[9], the graft success rate 95.6% was reported by the authors and as Akyigit, et al. found, the intact grafts had a success rate of 93.7%[10]. Authors recently showed that no significant difference was found between endoscopic inlay tympanoplasty and microscopic inlay tympanoplasty (92.3% vs. 95.8%) in terms of the graft success rate[11].

In this study, the results of microscopic and endoscopic inlay cartilage tympanoplasty were compared. No significant difference was found between two endoscopic tympanoplasty and microscopic tympanoplasty (93.7% vs. 94.8%, respectively) in terms of the graft success rate. There were five failed cases in which graft perforations recurred. Ear discharge and smoking were reported in these patients. The patients who have experienced otorrhea and smoking may fail, which can be discussed later.

A study by Kuo and Wu[12] showed that the microscopic operating time was longer than the endoscopic operating time (101.9 min vs. 74.4, p-value <0.001). However, the present study found no significant difference between the endoscopic tympanoplasty and the microscopic tympanoplasty in terms of the operating time. All small-sized perforations had high graft success rate but two microscopic and one endoscopic case had pint point residual perforation with the graft being absorbed in two patients experiencing the medium-sized perforations. One of these patients underwent endoscopic surgery and another one underwent microscopic surgery. Because of the absence of a tympanic membrane remainder, the underlay endaural tympanoplasty was conducted on three patients. In the case of the first surgery, ear discharging and smoking, the patients with developed residual perforation showed perforation greater than 50% of the TM. Fat myringoplasty technique was applied to the patients who showed pinpoint perforation.

The present study sought to analyze the difference between the ABG before surgery and ABG after surgery, indicating that ABG before surgery was higher than ABG after surgery in both groups. There was no significant difference between the two groups in terms of ABG improvement. The achieved hearing gain and hearing loss can also be determined by the

perforation quadrant regardless of the approach choice or the microscope or endoscope use and perforation size. On the contrary, a study by Mehta et al.[13] showed that there was no significant relationship between the perforation localization and hearing loss. Park et al.[14] similarly concluded that there was no relationship between the ABG and perforation localization. In this study, no relationship between the ABG and perforation localization and hearing gains were found. Open tympanoplasty can be used in total perforations because of the lack of tympanic membrane remnant. On the contrary, the butterfly cartilage tympanoplasty can be used for small, medium and large-sized perforations.

Additionally, there is a low graft success rate of the anterior perforations found in the tympanic membrane. It is necessary to elevate and adjust the light of the microscope toward the front or direct the patient's head more towards the other side. Observing the perforation through the outer ear canal with a microscope is very difficult due to the insufficiency of the residual membrane, narrow-viewing anterior tympanomeatal angle, and anterior bone protrusion. However, an endoscopic approach can be used to perform the surgery easily.

Further research is needed to deal with the limitations of the present study. The most important limitations include the prediction of the success rate of surgical techniques or quality of life as well as the retrospective type of this study.

It can be concluded that there is a similarity between the endoscopic method and microscopic method in terms of successful closure rate and hearing outcomes. The advantages of using the endoscopic cartilage tympanoplasty are that it is an easily applicable method and has shorter recovery time while microscopic tympanoplasty has no such advantages. Besides, the patients suffering from the bony spur, narrow external ear canal and anterior perforation sensibly should experience the endoscopic method.

Disclosure of interest: The authors report no conflict of interest

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