

Role of Endoscopic Modified Inlay Butterfly Cartilage Perichondrium Myringoplasty in Hearing Outcome and Graft Uptake

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Citation

Shrestha BL, Dhakal A, Pradhan A, Rajbhandari P. Role of Endoscopic Modified Inlay Butterfly Cartilage Perichondrium Myringoplasty in Hearing Outcome and Graft Uptake. *Kathmandu Univ Med J.* 2017;59(3):197-202.

ABSTRACT

Background

The endoscopes have better optics and magnification with wide angle of view due to angled lenses. It provides the excellent resolution of image in surgeries having many difficult anatomic nooks and corners like; antero-inferior recess of external auditory canal, middle ear cavity and difficult areas to visualize under microscope like sinus tympani. Likewise, the use of cartilage has very low metabolic rate, provide support to prevent retraction and reacts minimally to inflammatory reaction, so it has advantageous role in closure of tympanic membrane perforations.

Objective

The main objective of our study is to see the graft uptake rate and hearing results after endoscopic cartilage myringoplasty with our own modification.

Method

This is a prospective, cohort study conducted among 37 patients who underwent endoscopic modified inlay butterfly cartilage perichondrium myringoplasty using tragal cartilage. The hearing was assessed by comparing pre with post-operative ABG (Air bone gap) and ABG closure in speech frequencies (500Hz, 1KHz, 2KHz, 4KHz).

Result

Among 42 patients, 37 (88.09%) had graft uptaken. Other five patients had residual perforation because of infection. The post-operative ABG was smaller than pre-operative ABG.(26.41±8.47dB and 36.57±12.13dB respectively). The mean ABG closure was 10.15±10.23dB. The ABG closure was ≤ 10dB in 28(75.6%) patients.

Conclusion

Endoscopic modified inlay butterfly cartilage perichondrium myringoplasty has advantages in terms of hearing results and graft uptake rate as it is comparable or even better than others. So, it is advisable to perform this technique without any difficulty.

KEY WORDS

Air bone gap, cartilage, endoscope, myringoplasty

INTRODUCTION

Since the perforation of tympanic membrane adversely affects the hearing and causes recurrent infection, there are various techniques (like microscopic and endoscopic) and grafting methods used to repair the tympanic membrane perforation. Various graft materials are skin, vein, perichondrium, temporalis fascia, dura and cartilage.¹⁻⁹ Treatment of patients with myringoplasty generally improves the disease, hearing status and prevents complications.

The introduction of endoscope in other area of medical field also finds its role in ear surgery. Endoscopes have better optics and magnification with wide angle of view due to angled lenses and provide the excellent resolution of image. This advantageous factor increases its role in surgeries having many difficult anatomic nooks and corners.¹⁰ The diagnostic and teaching role of endoscope in otological practice has already been proved. Apart from that, there are lots of other advantages of endoscope in otological surgeries like; it can visualize antero-inferior recess of external auditory canal, middle ear cavity and sinus tympani.^{11,12}

The use of cartilage has advantageous role in closure of tympanic membrane perforations. The main advantages of cartilage are very low metabolic rate, provide support to prevent retraction and reacts minimally to inflammatory reaction.¹³ Eavey was the first to repair the small tympanic membrane perforation with cartilage graft butterfly myringoplasty and Rourke et al. followed the similar technique to close the perforation.^{14,15} Since, there is still scarcity of study about cartilage myringoplasty using the endoscope, so, we performed the endoscopic cartilage myringoplasty with the zero degree rigid endoscope. For this, we had followed the technique performed by Rourke et al. but with our own modification.¹⁵

The main aim of our study is to see the graft uptake rate and hearing results after endoscopic cartilage myringoplasty with our own modification.

METHODS

This was prospective, cohort study conducted in the department of Otorhinolaryngology and Head and Neck surgery in Dhulikhel Hospital, Kathmandu University Hospital, Kavre from 1st June 2013 to 1st December 2015. The study was carried out in accordance with Helsinki Declaration as amended in 2004. Informed consent was taken from the patient before conducting the study. Inclusion criteria were: Chronic otitis media (COM) mucosal inactive type, age \pm 18 years, of either sex. Exclusion criteria were: graft failure, revision cases, mentally retarded, medical or surgical conditions or treatment having a chance to influence the outcome.

From the patients included in the study, data collection was done pre-operatively and then six months post-operatively. Clinical examinations (general ENT examination, microscopic examination of ear, tuning fork tests) and for the hearing assessment, pure tone audiogram performed by Midimate 602, diagnostic audiometer (Madsen electronics company) in sound treated double room set up was done within 7 days prior to operation and then 6 months after the operation. The audiological results were reported according to American Academy of Otolaryngology- Head and Neck Surgery guidelines.¹⁶ The hearing was assessed by comparing pre with post-operative ABG (Air bone gap) and ABG closure in speech frequencies (500Hz, 1KHz, 2KHz, 4KHz).

For the surgery

Patient pre-operative preparation:

The patient was given oral ciprofloxacin 500 milligram 12 hourly from one day prior to surgery and continued till 10th postoperative day. Since the surgery was performed under local anesthesia, so the patient was sedated with pethidine and promethazine intramuscularly as per body weight.

Surgical procedure:

The patient was given 5-10 ml of two percent xylocaine with 1:100,000 adrenalin as per the approach selected, for four quadrant canal wall block and also on tragus.

The rigid Hopkins II endoscope (Karl Storz) 0 degree and 30 degree with 4 millimeter diameter and 18 centimeter in length was passed through transcanal route to observe and assess the perforation, ossicular chain status, middle ear mucosa and also the eustachian tube orifice. Then, the margin of the perforation was refreshed with the straight needle as shown in fig. 1 and also the epithelial layer of the tympanic membrane was elevated off the fibrous layer with round knife around the perforation. When the handle of malleus was visible, it was well skeletonized. The gelatin sponge was kept in the middle ear cavity with crocodile forceps.



Figure 1. Refreshing of the tympanic membrane perforation margin.

For harvesting the graft, about 2 cm vertical incision was given by number 15 scalpel from incisura terminalis upto intratragal notch which was around 5mm medial to the tip of the tragus as shown in fig. 2. The single stroke skin



Figure 2. Incision on tragus.

incision was given upto tragus cartilage. The assistant held the tissue of the tip of the tragus by non tooth forceps and cleared the surgical field from blood by suction. Whereas the operating surgeon held the skin with non tooth forceps and then the canal side cartilage along with perichondrium was dissected with mosquito forceps. Similarly, cartilage along with perichondrium from the anterior aspect of tragal cartilage was dissected and thus made free at incisura terminalis. The cartilage along with the perichondrium was excised with number 15 scalpel giving incision from incisura terminalis. The skin was closed with 4/0 prolene interrupted suture. Then, the graft was kept on silastic block.



Figure 3. Showing harvesting of tragal cartilage and peeling perichondrium from periphery thus making centre contact point of perichondrium with cartilage intact

The perichondrium on the lateral side of the graft was elevated with part of perichondrium left intact on the central part of cartilage, whereas the medial perichondrial was left as such to avoid curling of cartilage as shown in fig. 3. Apart from that, the area of cartilage was removed to make place for the handle of malleus and incudostapedial joint. The cartilage graft was then placed around the perforated tympanic membrane by first inserting on the anterior end of perforation by mounting on the crocodile forceps. Then rest of the cartilage was placed in the middle ear with straight needle. The elevated perichondrium cover the later end of tympanic membrane around the perforation as shown in figure 4. The canal was then packed with wet gelatin sponge soaked in ciprofloxacin ear drops and followed by the ribbon pack medicated with soframycin was kept in the canal and mastoid bandage was applied.

Post-operative care and follow up:

The patient was prescribed tab ciprofloxacin 500 mg 12 hourly for ten days. The ribbon gauge pack and the stitch was removed on 7th postoperative day. The remaining

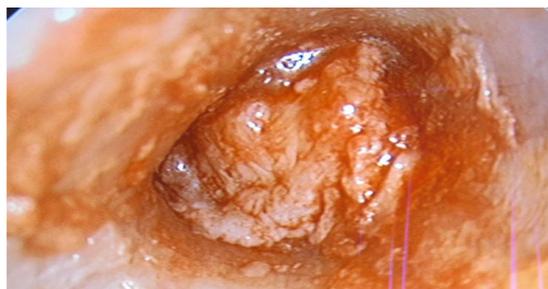


Figure 4. Placement of tragal cartilage in remnant of tympanic membrane.

gelatin sponge was also suctioned on the 7th postoperative day. Then, the patient was prescribed chloramphenicol and dexamethasone ear drops for six weeks. The patient was again followed up after two weeks, six weeks (fig. 5) and



Figure 5. Post-operative graft status (6th week)

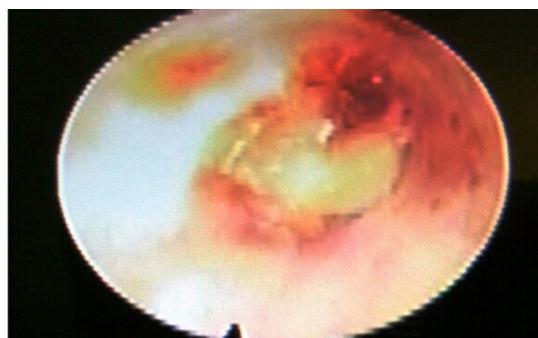


Figure 6. Post-operative graft status (6 months).

6 months (fig. 6). The hearing results and graft uptake rate noted on 6 months of follow up.

For the statistical data analysis, SPSS v. 20.0 for Windows (SPSS inc., Chicago, USA) was used. The significance of difference between 2 groups was evaluated by the student's t test. The significance level for all tests was set at $p < .05$.

RESULTS

The total number of patients enrolled for the surgery was 42. Among them only 37 patients were included. Five patients were excluded because of graft failure. So, the graft uptake rate was 88.09%

There were total 37 patients (males 19 and females 18) with the mean age of 24.32 ± 11.1 years, and age range of

Table 1. Gender distribution (n=37)

Gender	Frequency	Percent
Male	19	51.4
Female	18	48.6
Total	37	100

18-61 years. Regarding the gender distribution, 19 were male and 18 were female as shown in table 1.

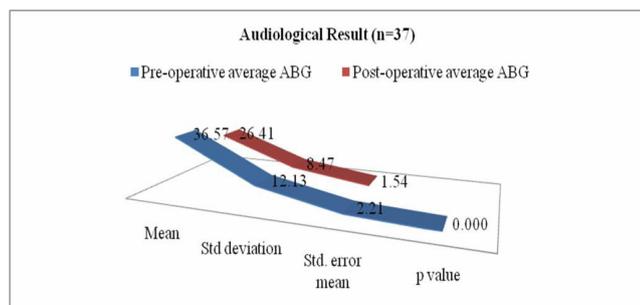


Figure 7. Showing audiological result (n=37)

The audiological result is shown in figure 7.

The result of post-operative ABG closure is as shown in table 2 with mean ABG closure of 10.15dB.

Table 2. Post-Operative ABG Closure (n=37)

Number	37
Mean	10.15
Std. Deviation	10.23
Range	25.23
Minimum	3.52
Maximum	28.75

The ABG closure of ≤ 10 dB was observed in 28 (75.6%) patients as shown in table 3.

Table 3. ABG closure (n=37)

ABG Closure	No. of patients
≤ 10 dB	28
11-20 dB	6
21-30 dB	3
Total	37

DISCUSSION

Our study mainly focus on the surgical outcome and audiological results following endoscopic tragal perichondrium cartilage myringoplasty in 37 patients. Since the endoscope provide good visualization of anterior end of perforation and 360 degree view of perforated tympanic membrane as compared to microscope, so the graft can be easily placed using endoscope in our modified technique. Regarding the hearing outcome after myringoplasty, study showed that it depends largely on incorporation of graft to

the tympanic membrane, the integrity of ossicular chain, absence of any residual perforation and also absence of graft medialisation or lateralization. So, it is irrespective of either endoscopic or microscopic method.¹⁷ However the endoscope has been used exclusively in otological surgical procedures in last two decades because of its certain advantages like it has 360 degree view of tympanic membrane perforations, no need for outer skin incision and exploration of covered recesses (sinus tympani, the protympanum and anterior epitympanum) without difficulty.^{18,19}

The main disadvantages with the use of endoscope is one hand technique, absence of stereoscopic view, potential risk of mechanical and thermal trauma, and along with that the learning curve is also important factor in endoscopic surgery as seen in sinonasal and skull base surgery.¹⁸⁻²²

We have used the tragal cartilage graft, as clinical and experimental study showed that the cartilage is well tolerated with minimal resorption time and survives for a long period with good hearing outcome.²³⁻²⁷ There were different methods of cartilage tympanoplasty popular for the grafting procedure like island technique, wheel technique, inlay butterfly technique, shield technique and palisade technique.²⁸⁻³⁰ This butterfly cartilage technique was 1st described by Eavey for small to medium perforation.¹⁴ Likewise, Rourke et al. and Ghanem et al. modified this technique to repair large perforation.^{15,30} We did the same technique but with the modification keeping both sides of perichondrium intact. The study showed that cartilage with perichondrium on one or both sides had better viability (better metabolism and strong enzymatic reaction) than naked cartilage.³¹ The main advantages of cartilage butterfly graft myringoplasty is less time consuming, more comfortable technique as no need to raise the tympanomeatal flap, the locking of butterfly edge maintained the graft position without support from the middle or external ear canal and the oozing was practically non existent.³¹

The graft uptake rate and hearing results in our study is comparable to the results in the literature as shown in table 4. The graft uptake rate in our study was 88.09% which is comparable to other study performed by endoscopically which showed success rate from 73 to 96% as shown in table 4.

Our study showed statistically significant reduction in post-operative ABG from 36.57 dB to 26.41 dB and also the ABG closure ≤ 10 dB in 75.6%, which is comparable to the study mentioned in literature as shown in table 4. In our study we made a modification in such a way that only perichondrium lies at the handle of malleus and at incudo-stapedial joint whenever visible, this could be the reason for good hearing because of better conduction of sound. The main limitation of our study was the sample size and the follow up. The result will be better if we do in large sample size and with the long term follow up.

Table 4. Graft uptake rate and hearing results in literatures

Author	Number	Graft material	Graft success rate (%)	ABG Closure </=10 dB(%)	Surgical techniques
Raj et al. ³²	20	cartilage	90	60	Endoscopic transcanal
Zhang et al. ³³	43	cartilage	95.2		Endoscopic modified sandwich technique
Ayache ³⁴	30	cartilage	96		Endoscopic underlay
Celik et al. ³⁵	32	cartilage	87.5	91	Endoscopic push through underlay
Omran ³⁶	30	cartilage	73.3	77.2	Endoscopic bivalve inlay
Ozgur et al. ³⁷	45	cartilage	97.8		Endoscopic butterfly
Mokbel et al. ³⁸	80 (40 in endoscopic group and 40 in microscopic group)	cartilage	100 in endoscopic and 90 in microscopic	85 in endoscopic and 80.7 in microscopic	Endoscopic transcanal and microscopic transcanal
Garcia et al. ³⁹	22	cartilage	86.4		Endoscopic inlay
Our study	37	cartilage	88.09	75.6	Endoscopic modified inlay butterfly cartilage perichondrium

CONCLUSION

Endoscopic modified inlay butterfly cartilage perichondrium myringoplasty has advantages of good cosmesis as no need of retroauricular incision and in terms of hearing results

and graft uptake rate it is comparable or even better than others. So, it is advisable to perform this technique without any difficulty.

REFERENCES

- Berthold E. Uber Myringoplastic. *Med-chir centralb.* 1879; 14:195-207.
- Tabb HG. Closure of perforations of the tympanic membrane by vein grafts: a preliminary report of 20 cases. *Laryngoscope.* 1960; 70:271-86.
- Linde RE. The cartilage-perichondrium graft in the treatment of posterior tympanic membrane retraction pockets. *Laryngoscope.* 1973;83:747-53.
- Storrs L. Myringoplasty with the use of Fascia Grafts. *Arch Otolaryngol.* 1961;74:45-49.
- Yetiser S, Tosun F, Satar B. Revision myringoplasty with solvent dehydrated human dura mater. *Otolaryngol Head Neck Surg.* 2001 May;124(5):518-21.
- Heermann J, Heermann H, Kopstein E. Fascia and cartilage palisade tympanoplasty. *Arch Otolaryngol Head Neck Surg.* 1970;91:228-41.
- Couloigner V, Baculard F, El Bakkouri W, Viala P, Francois M, Narcy P et al. Inlay butterfly cartilage tympanoplasty in children. *Otol Neurotol* 2005;26:247-51.
- Gerber MJ, Mason JC, Lambert PR. Hearing results after primary cartilage tympanoplasty. *Laryngoscope* 2000 Dec;110(12): 1994-9.
- Adkins WY. Composite autograft for tympanoplasty and tympanomastoid surgery. *Laryngoscope* 1990;100:244-7.
- Mattox DE. Endoscope-Assisted Surgery of the petrous Apex. *Otolaryngol Head Neck Surg* 2004;130:229-41.
- Patil RN. Endoscopic tympanoplasty - Definitely advantageous (preliminary reports). *Asian J Ear Nose Throat* 2003;25:9-13.
- Khan I, Jan AM, Shahzad F. Middle ear reconstruction: a review of 150 cases. *J Laryngol Otol* 2002; 116: 435-9.
- Yung M. Cartilage tympanoplasty: literature review. *J Laryngol Otol* 2008 Jul; 122(7): 663-72.
- Eavey RD. Inlay tympanoplasty: cartilage butterfly technique. *Laryngoscope* 1998;108:657-61.
- Rourke T, Snelling JD, Aldren C. Cartilage graft myringoplasty: how we do it. *Clin Otolaryngol* 2010; 35: 135-46.
- American Academy of Otolaryngology-Head Neck Surgery Foundation, Inc. Committee on Hearing and Equilibrium guidelines for the evaluation of results of treatment of conductive hearing loss. *Otolaryngol Head Neck Surg* 1995;113:186-7.
- Lade H, Choudhary SR, Vashishth A. Endoscopic vs microscopic myringoplasty: a different perspective. *Eur Arch Otorhinolaryngol* 2014 Jul;271(7):1897-902.
- Marchioni D, Molteni G, Presutti L. Endoscopic anatomy of the middle ear. *Indian J Otolaryngol Head Neck Surg* 2011 Apr;63(2):101-13.
- Pollak N, Azadarmaki R, Ahmad S. Endoscopic Treatment of Middle Ear Myoclonus with Stapedius and Tensor Tympani Section: A New Minimally-Invasive Approach. *Br J Med Med Res* 2014;4(17):3398-405.
- Karchier EB, Niemczyk K, Orłowski A. Comparison of visualization of the middle ear by microscope and endoscopes of 30° and 45° through posterior tympanotomy. *Wideochir Inne Tech Maloinwazyjne.* 2014; 9(2): 276-81.
- Tarabichi M. Endoscopic transcanal middle ear surgery. *Indian J Otolaryngol Head Neck Surg.* 2010 Jan;62(1):6-24.
- Smith S, Eralil G, Woon K, Sama A, Dow G, Robertson I. Light at the end of the tunnel: the learning curve associated with endoscopic transsphenoidal skull base surgery. *Skull Base* 2010 Mar;20(2):69-74.
- Dornhoffer JL. Hearing results with cartilage tympanoplasty. *Laryngoscope* 1997; 107: 1094-99.
- Zahnert T, Huttenbrink K, Murbe D, Bornitz M. Experimental investigations of the use of cartilage in tympanic membrane reconstruction. *Am J Otol* 2000; 21: 322-28.
- Kerr AG, Byrne JET, Smyth GDL. Cartilage homografts in the middle ear: a long term histologic study. *J Laryngol Otol* 1973; 87: 1193-99.
- Matthew JG, Mason JC, Lambert PR. Hearing results after primary cartilage tympanoplasty. *Laryngoscope* 2000; 110: 1994-9.
- Kirazli T, Bilgen C, Midilli R, Ogut F. Hearing results after primary cartilage tympanoplasty with island technique. *Otolaryngol Head Neck Surg* 2005; 132: 933-7.

28. Kazikdas KC, Onal K, Boyraz I, Karabulut E. Palisade cartilage tympanoplasty for management of subtotal perforations: a comparison with the temporalis fascia technique. *Eur Arch Otorhinolaryngol* 2007; 264: 985-89.
29. Ozbek C, Cifci O, Tuna E, Yazkan O, Ozdem C. A comparison of cartilage palisades and fascia in type I tympanoplasty in children: anatomic and functional results. *Otol Neurotol* 2008; 29: 679-83.
30. Ghanem MA, Monroy A, Alizadeh FS et al. Butterfly cartilage graft inlay myringoplasty for large perforations. *Laryngoscope* 2006; 116: 1813-16.
31. Mauri M, Neto JFL, Fuchs SC. Evaluation of inlay butterfly cartilage tympanoplasty: A randomized clinical trial. *Laryngoscope* 2001; 111: 1479-85.
32. Raj A, Meher R. Endoscopic transcanal myringoplasty: a study. *Indian J Otolaryngol Head Neck Surg.* 2001 Jan;53(1):47-9.
33. Zhang H, Wu B, Xu M. A clinical research of endoscopic myringoplasty with modified sandwich technique. *Lin Chung Er Bi Yan Hou Tou Jing Wai Ke Za Zhi.* 2012 Apr;26(7):293-4, 299.
34. Ayache S. Cartilaginous myringoplasty: the endoscopic transcanal procedure. *Eur Arch Otorhinolaryngol.* 2013 Mar;270(3):853-60.
35. Celik H, Samim E, Oztuna D. Endoscopic "Push-Trough" Technique Cartilage Myringoplasty in Anterior Tympanic Membrane Perforations. *Clin Exp Otorhinolaryngol.* 2015 Sep; 8(3): 224–229.
36. Omran AA. Endoscopic bivalve inlay cartilage myringoplasty for central perforations: Preliminary report. *Egyptian J Ear Nose Throat Allied Sciens.* 2012; 13 (1): 37–42.
37. Özgür A, Dursun E, Terzi S, Erdivanlı ÖÇ, Coşkun ZÖ, Oğurlu M et al. Endoscopic butterfly cartilage myringoplasty. *Acta Otolaryngol.* 2016;136(2):144-8.
38. Mokbel KM, Moneir W, Elsisy H, Alsobky A. Endoscopic transcanal cartilage myringoplasty for repair of subtotal tympanic membrane perforation: A method to avoid postauricular incision. *J Otolaryngol Rhinol* 2015;1:1-4.
39. Garcia LB, Moussalem GF, de Andrade JSC, Mangussi-Gomes J, Cruz OLM, Penido NO, et al. Transcanal endoscopic myringoplasty: a case series in a university center. *Braz J Otorhinolaryngol.* 2016;82:321-5.