Surgical and Audiological Outcomes of Cartilage-Perichondrium Composite Graft Myringoplasty

*Bewar Hassan Ali, **Said Mustafa Said

*Rizgary Teaching Hospital, Erbil, Iraq

**Department of Surgery, Medical College, Hawler Medical University

Abstract:

Background: Although temporalis muscle fascia and perichondrium are the commonly used graft materials for the tympanic membrane reconstruction, cartilage-perichondrium graft may be an alternative in obtaining acceptable surgical and audiological outcomes.

Aim of study: To evaluate the effectiveness and success of tragal cartilage- perichondrium graft in myringoplasty regarding graft uptake and hearing improvement and to show the effect of patient demographics and perforation site and size on graft uptake rate.

Patients and Methods: This prospective study had been carried out on 50 patients who attended the outpatient clinic of otolaryngology, head and neck surgery department, at Rizgary Teaching Hospital in Erbil city/ Iraq during the period of January 2015 to January 2016. All the perforations selected for this study were dry for at least three months and central in type but variable in size. With tragal cartilage as a graft and underlay technique in all cases.

Results: Out of 50 patients, 20 were males and 30 were females, their ages range between 12-49 years with a mean age of 27 years old. Regarding surgical outcome, the overall graft take rate in our study was (86%). In relation to the perforation size; graft take rate in small perforations were (100%), medium-size perforations were (88.9%), large perforations were (85.7%), and subtotal perforations were (75%). In relation to the perforation site; highest graft take rate was in posterior perforations (95.2%) followed by anterior perforation (84.6%) then subtotal perforations (75%). Regarding the functional outcomes, the mean postoperative air-bone gap was decreased from 25.63 dB to 13.46 dB with a mean hearing gain of about 12.17 dB.

Conclusion: The success rate of cartilage-perichondrium graft in our study was (82%). Best results were obtained in those who were 22-31 years old, in smaller perforations, and in posterior perforations although the p value was statistically not significant. There was significant hearing improvement three months postoperatively.

Keywords: Tympanic membrane perforation, Cartilage myringoplasty, Graft take rate, Hearing improvement, Underlay technique, Overlay technique.

Introduction:

The presence of a perforation of tympanic membrane (TM) caused by a middle ear infection, an external ear infection, trauma, or iatrogenic accident that does not heal spontaneously represents a defect in the function and integrity of the eardrum that needs repairing in the majority of cases [(1)] because if it is left untreated, it leads to a pain, increased susceptibility to repeated infections associated with recurrent otorrhrea, varying degrees of hearing loss, and cholesteatoma formation [(2)]. Most acute TM perforations heal spontaneously, but chronic large perforations especially from chronic suppurative otitis media (CSOM), often fail to close and may need grafting [(3)].

Nowadays, although the choice of graft material normally depends on the surgeon's experience and his/her personal choice, [(4)] temporalis fascia and

perichondrium are considered to be the most commonly used graft materials in the reconstruction of a perforated tympanic membrane [5].

However, recently there is renewal of interest in the use of cartilage (with or without perichondrium) in the tympanic membrane repairs, as an alternative to the temporalis fascia [6] and perichondrium grafts, especially when graft atrophy and failure have been reported in certain situations in the latter two materials, although good surgical and functional outcomes are obtained from the usage of these materials [7].

Patients and Methods:

This study has been conducted at otolaryngology department of Rizgary Teaching Hospital in Erbil city in Iraq, for the period from January of 2015 to January of 2016. It is a prospective descriptive random study. It had been carried out on 50 patients (ears) who attended the consultation with perforated tympanic membranes. All the perforations selected for this study were dry for at least three months and central in type but variable in size.

The assessment of the patients was established on the basis of detailed history, a thorough otolaryngological examination, and audiological evaluation [tympanometry and pure tone audiogram]. Preoperative and postoperative air-bone gaps were calculated by taking the average of bone conduction and air conduction at the frequencies of 500, 1000, 2000 and 4000 Hz on pure tone audiometry (PTA).

Patients included in this study were 12 years and older, dry perforation for at least 3 months before surgery (inactive mucosal) or trauma, conductive hearing loss of up to 35dB, intact ossicular chain, and central perforations of different sizes.

Patients whom excluded from the study were those with, active mucosal or squamosal chronic otitis media,otitis externa, otomycosis and upper airway infection, severe sensorineural hearing loss, the only hearing ear,and extensive tympanosclerosis.

Evaluation of the tympanic membrane perforation:

Photo-endoscopic images of each TM perforation were taken by a digital camera and using a 4 mm diameter, 6 cm length and 0 degree angulation endoscope (KarlStorz, Germany) connected to a Sony TV screen. All the photos were analyzed by the Adobe acrobat 8 professional software which computes the surface area of the perforation separately then the surface area of the whole TM. The percentage of the perforation iscalculated by the equation (Percentage of perforation /100 = Perforation area/TM area) as shown in the following example and figure (1):

TM area=181922.60 mm^2
Perforation area=76635.50mm^2
The percentage of perforation = 100*76635.50/181922.60 = 42.12%.

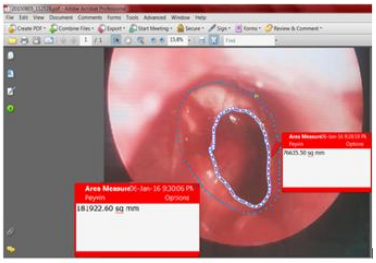

Figure (1): Percentage of TM perforation as measured by Adobe acrobat professional 8 software.

According to these measurements, the perforations were divided into 4 grades; Grade I (small), when up to (25%); Grade II (medium size), (25-50%); Grade III (large), (50-75%); and grade IV (subtotal), (75-100%). The perforations were also divided according to their site into; anterior, when the perforation was anterior to the handle of malleus; posterior, when the perforation was posterior to it; and subtotal when the perforation involved most of the ear drum.

Surgical technique:

All myringoplasties were performed under general anesthesia in supine position. Microscope used in 31 cases of the patients and endoscope in 19 cases. Forty one patients were operated via endaural incision and the other nine by transcanal approach. The technique applied was underlay grafting and the grafting material used was tragal cartilage with perichondrium in all patients. Patients were followed up at weekly interval for one month and monthly for three months after surgery. During each visit ear is examined for any infection, cleaned gently from any debris and the new membrane evaluated for any perforation.

Postoperative care:

Postoperatively the patients were put on oral antibiotics Amoxiclav tablets (Amoxicillin 500mg/ Clavulanic acid 125mg) three times daily for seven days and Panadol tablets 500 mg four times daily as analgesia. All the patients were discharged home on the same day. Next day the dressings were changed. The first postoperative visit was on the seventh day, during which time the ear dressing and skin sutures and Merocele pack were removed, after that ciprofloxacin (0.3%) drops five drops twice daily were prescribed for 14 day. And the patient was instructed to keep the ear dry.

The patients were followed up weekly for one month. At the end of the first month any gelfoam remnants were suctioned. Thereafter, the patient was monitored monthly for three months postoperatively. Assessment of graft uptake and dryness was done using the microscope and suction tools if needed for aural cleaning in all the visits of the patients.At follow upexamination, result of surgery was regarded as successful if the ear was dry and the TM intact with hearing gain of at least 10 dB hearing level.

Ethical considerations:

Informed and written consent was taken from each patient after explaining the purpose of the study by the researcher.

Data entry and statistical analysis:

Data were analyzed using the Statistical Package for Social Sciences version 20 (SPSS-20).A ‘p’ value of ≤ 0.05 was considered as statistically significant.

Results:

In this study, the age ranges of the patients at presentation were (12 to 49) years with mean age of (27.51±9.934) years. The greater number of patients were in 22 -31 years age group, 20 (40%) of the patients. Maximum graft take was also in 22 -31 years age group. There was no statistically significant difference between the age groups (P. value 0.707) regarding graft uptake as shown in table (1).

Patients’ distribution according to the site of perforation revealed greater number of patients had posterior perforations, 21 (42%) patients and the graft take rates were also better in posterior perforations (95.2%) than anterior (84.6%) and then subtotal

(75%) perforations. The statistics ensure no significant difference with a P. value of (0.210) shown in table (2).

Regarding the size of perforation, the larger number of patients had grade IV (subtotal) 16 (32%) patients, but the graft take rate was higher and was 100% in gradeI (small) perforations. Although there are better results towards the smallest grade of perforation, the P. value (0.326) is still not significant statistically table (3).

Collectively, the graft take rate was (86%) (43 cases of 50) and graft failure rate was (14%) (7 cases of 50) regardless of hearing result of the graft table (4).

Audiological results:

Success in terms of hearing improvement was achieved in 41 of 50 cases and no improvement occurred in nine cases (according to what we previously considered to be success in hearing gain of at least 10 dB improvements in hearing), so the hearing gain rate was 82% and failure rate was (18%) table (5).

Regarding the closure of air-bone gap, the mean preoperative ABG was about 25.63 dB which was decreased to about 13.46 dB with a significant change in ABG of about 12.17 dB in successful cases table (6).

Finally, the success rate of the whole study taking into account the graft take and hearing gain was (82%) (41 of 50 cases) and failure rate was (18%) (9 of 50 cases). As shown in the table (7).

Table (1): Age distribution with relative frequency of graft uptake in different agegroups.

Age groups	Patients	Mean±SD	Graft uptake	Mean±SD	Graft failure	P. value
12 - 21	15 (30%)	27.51±9.934	13(86.6%)	29.00±7.394	2 (13.3%)	0.707
22 - 31	20 (40%)		18 (90%)		2 (10%)	
32 - 41	8 (16%)		7 (87.5%)		1 (12.5%)	
42 - 49	7 (14%)		5 (71.4%)		2 (28.5%)	
Total	50 (100%)		43 (86%)		7 (14%)	

Table (2): Relative frequency of graft take rate in relation to the site of perforation.

Site of the perforation	Patients	Graft uptake	Graft failure	Chi-Square	P. value
Anterior	13 (26%)	11 (84.6%)	2 (15.4%)	3.117	0.210
Posterior	21 (42%)	20 (95.2%)	1 (4.8%)		
Subtotal	16 (32%)	12 (75%)	4 (25%)		
Total	50 (100%)	43 (86%)	7 (14%)		

Table (3): Relative frequencies of graft take rate in relation to the size of perforation.

Size of the perforation	Patients	Graft uptake	Graft failure	Chi-Square	P. value
Grade I (small)	11 (22)	11 (100)	0 (0)	3.462	0.326
Grade II (medium)	9 (18)	8 (88.9)	1 (11.1)		
Grade III (large)	14 (28)	12 (85.7)	2 (14.3)		
Grade IV (subtotal)	16 (32)	12 (75)	4 (25)		
Total	50 (100)	43 (86)	7 (14)		

Table (4): Graft uptake result.

Graft uptake	Frequency	Percent
Graft take	43	86.0
Graft failure	7	14.0
Total	50	100.0

Table (5): Hearing gain result.

Hearing gain	Frequency	Percent
Success	41	82.0
Failure	9	18.0
Total	50	100.0

Table (6): Closure of air-bone gap.

	Preoperative ABG		Postoperative ABG			
Air-bone gap (dB) (n=41)	Patients	Mean±SD	Patients	Mean±SD	Change in ABG Mean±SD	P. value
0-15	1 (2.4)		31 (75.6)			
16-25	22 (53.7)	25.63 ±	10 (24.4)	13.46±	12.17 ±	< 0.001
26-35	18 (43.9)	5.535	0 (0)	4.702	2.854	
Total	41 (100)		41 (100)			

Table (7): Success rate.

Parameter	Successful	Failed	Success rate*	Failure rate**
Total	41	9	82 %	18%

*Success rate equals to the rate of cases successful in both graft take and hearing gain.
**Failure rate equals to the rate of cases failed in graft take &/or hearing gain.

Complications:

There were nine cases of failure of graft uptake and/or hearing gain. The seven failed cases where all in the form of residual perforations (partial graft failure), four were anteriorly located and two posteriorly and one inferiorly, no spontaneous healing occurred during the three months of follow up and no reperforation seen during the same time, three of the seven cases were accompanied by otorrhoea treated by topical drops and frequent cleaning. The other two cases, which were failed in hearing gain but had succeeded in graft uptake, these two cases were surgically straight forward cases and the cause of failure of hearing gain may be due to preoperative misdiagnosed ossicular chain discontinuity or intraoperative accidental trauma to the chain.

Discussion:

In this study, 50 patients underwent myringoplasty using underlay technique with tragal cartilage-perichondrium composite graft, which we found it easily accessible, available in sufficient size, easy for handling, and can be trimmed to the desired dimensions. Three months postoperatively, we obtained satisfying subjective and objective results regarding hearing improvement and graft uptake.

The maximum graft take rate was (90%) recorded in 22-31 years age group followed by (87.5%) in 32-41

years age group, but the difference was not significant statistically so as the similar results were found by Kumar et al (2014) [8]. Koch et al (1990) [9] reported a low success rate (30%) in children younger age eight due to immature Eustachian tube function and more upper respiratory tract infections and otitis media in the young age group and an (81%) success rate for children age eight and older.Callioglu et al (2013) [10] found that the age of the patient has no effect on the success rate of the operation in adults.

In our study the graft was taken up in 43 cases of 50 (86%) and was failed in seven cases (14%). This graft take rate is more or less similar to Mauri et al (2001)[11] (86.1%). Comparing to this, much better graft take results were recorded by Gamra et al (2008) [12] (97.7%). In other studies of cartilage myringoplasty, when we compare our results, lower graft take rates had been reported as in Couloigner et al (2005) [13] (71%).

So we can say that the graft take results of our study in Rizgary teaching hospital are comparable to the above series results in which as in our study, type 1 tympanoplasty is performed, and the difference in graft take rates may be related to the surgical techniques used, method of cartilage preparation, instrumentation and the approach of surgery. In our study higher graft take rates were recorded in posterior perforations (95.2%) followed by anterior (84.6%) which were much better than subtotal perforations (75%). So it appears that the site of perforation affects the graft take rate although it was not significant statistically and similar to a study done by Demirpehlivan et al (2011) [14] in which he used different TM reconstruction techniques like palisade and island techniques. While in study done by Tek A et al (2012) [15], they found that graft take rates were higher in subtotal (100%) and anterior perforations (87.5%) than in posterior perforations (75%), in which they used a new technique by using symba concha cartilage as reinforcement under temporalis muscle fascia, called cartilage reinforcement tympanoplasty which may be the cause of different results.

Regarding the size of perforations, graft take rate was higher in grade I (100%) followed by grade II, grade III, and lastly grade IV; (88.9%); (85.7%); (75%) respectively. Although there is effect of perforation size and difference in graft take rate especially between grade I and IV, this difference was statistically not significant. This was due to decreased support provided by the TM remnants from the first towards the last grade, especially thesubtotal perforations. In a retrospective analysis of 130 case notes, Wasson et al (2009) [16] noted that small perforation have better success rate than large ones but no statistically significant determinant effect. Contrary to this, Lee P et al (2002) [17] in a retrospective study of 423 myringoplasty operations showed that size does influence success and the cause of this may be related to the large study sample in comparison to our study sample.

In our study the mean three months postoperative ABG was decreased from 25.63 dB to 13.46 dB with a mean hearing gain of about 12.17 dB (closure of ABG), this is considered a statistically significant improvement in hearing level of the patients as P. value is < 0.001. These results are similar to the study performed by Ulku etal (2010) [18] 12.30 dB. Our hearing results were

much lower than those obtained by Gamra et al(2008) [12] who gained 21 dB in their study in which they made the cartilage thinner before grafting which may be the cause of their better hearing results. Compared to other studies, we found that our results of hearing improvement were much higher than that reported by Stephane Ayache (2013) [19], who gained 9.8 dB in his study in which he operated his patients exclusively by endoscopic transcanal approach. Lastly in our study we found no significant difference in graft take rate regarding gender of the patient, side of operation, approach of myringoplasty and whether the operation is done by endoscope or microscope guidance.

Conclusion And Recommendation:

Conclusion:

The success rate of cartilage-peri-chondrium graft in our study was (82)%. Best graft uptake results were obtained in those who were 22-31 years old, in smaller and in posterior perforations, although the p value was statistically not significant. There was significant hearing gain of about 12.17 dB three months postoperatively.

Recommendation:

Many cartilage preparation techniques are available, to know which of them is more effective; we recommend more research work in comparing one to another in myringoplasty.

References:

[1]. Sanna M., Sunose H., Mancini F., Russo A. Taibah A. Myringoplasty. Middle Ear and Mastoid Microsurgery. 2nd Edition. Stuttgart. Thieme; 2003. P. 106-165.

[2]. Parekh A, Mantle B, Banks J, Swarts JD, Badylak SF, Dohar JE, et al. Repair of the Tympanic Membrane with Urinary Bladder Matrix. The Laryngoscope. 2009Jun 1; 119(6):1206-13.

[3]. Lindeman P, Edstrom S, Granstrom G., Jacobsson S., Von Sydow C, et al. Acute Traumatic Tympanic Membrane Perforations: Arch Otolaryngol Head Neck Surg. 1987. 113, 1285.

[4]. Mohamad SH, Khan I, Hussain SM. Is Cartilage Tympanoplasty More Effective Than Fascia Tympanoplasty? A Systematic Review. Otology & Neurotology. 2012 Jul1; 33(5):699-705.

[5]. Dornhoffer J. Cartilage Tympanoplasty: Indications, Techniques, and Outcomes InA 1,000-Patient Series. The Laryngoscope. 2003 Nov 1; 113(11):1844-56.

[6]. Boone RT, Gardner EK, Dornhoffer JL. Success of Cartilage Grafting In Revision Tympanoplasty without Mastoidectomy. Otol Neurotol 2004; 25: 678-81.

[7]. Buckingham RA: Fascia And Perichondrium Atrophy In Tympanoplasty And Recurrent Middle Ear Atelectasis. Ann Otol Rhinol Laryngol 1992; 101:755.

[8]. Kumar R, Suman RK, Garje YA, Rao SP. Comparative Study Of Underlay Tympanoplasty with Temporalis Fascia and Tragal Perichondrium. IOSRJournal of Dental and Medical Sciences. 2014 May 13; 5 (3): 2279-0861.

[9]. Koch Wm, Friedman Em, Mcgill Tj, Healy Gb. Tympanoplasty in Children: The Boston Children's Hospital Experience. Archives of Otolaryngology–Head & Neck Surgery. 1990 Jan 1; 116(1):35-40.

[10]. Callioglu EE, Ceylan BT, Kuran G, Demirci S, Tulaci KG, Caylan R. Cartilage Graft Or Fascia In Tympanoplasty In Patients With Low Middle Ear Risk Index (Anatomical And Audological Results). European Archives of Otorhinolaryngology.2013 Nov 1; 270(11):28 33-7.

[11]. Mauri M, Lubianca Neto Jf, Fuchs Sc. Evaluation of Inlay Butterfly CartilageTympano-
plasty: A Randomized Clinical Trial. Laryngoscope. 2001 Aug; 111(8):1479-85.

[12]. Gamra OB, Mbarek C, Khammassi K, Methlouthi N, Ouni H, Hariga I et Al. Cartilage Graft In Type I Tympanoplasty: Audiological and Otological Outcome. Eur Arch Otorhinolar -yngol. 2008 Jul; 265(7):739-42.
[13]. Couloigner V, Baculard F, El Bakkouri W, Et Al. Inlay Butterfly Cartilage Tympanoplasty in Children. Otol Neurotol 2005; 26: 247y51.
[14]. Demirpehlivan IA, Onal, K, Aslanoglu S, Et Al. Comparison of DifferentTympanic Membrane Reconstruction Techniques In Type 1 Tympanoplasty. Eur Arch Otorhinola-ryngol 2011;268:471y4.
[15]. Tek A, Karaman M, Uslu C, Habeşoğlu T, Kılıçarslan Y, Durmuş R, et al. Audiological And Graft Take Results Of Cartilage Reinforcement Tympanoplasty (A New Technique) Versus Fascia. European Archives Of OtoRhinoLaryngology.2012 Apr 1; 269(4):1117-26.
[16]. Wasson JD, Papadimitriou CE, Pau H. Myringoplasty: Impact of Perforation Size on Closure and Audiological Improvement. The Journal Of Laryngology &Otology. 2009 Sep 1; 123(09):973-7.
[17]. Lee P, Kelly G, Mills R. Myringoplasty: Does The Size Of The PerforationMatter? Clinical Otolaryngology & Allied Sciences. 2002 Oct 1; 27(5):331-4.
[18]. Ulku Ch. Cartilage Tympanoplasty with Island Technique for Reconstruction OfTympanic Membrane Perforation: Anatomic and Audiologic Results. Kulak Burun Bogaz Ihtis Derg 2010; 20:7y12.
[19]. Ayache S. Cartilaginous Myringoplasty: The Endoscopic Transcanal Procedure.European Archives of Oto-Rhino-Laryngology. 2013 Mar 1; 270(3):853-60.