

# Cartilage Tympanoplasty: the Outcome in 35 Patients

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## Abstract

This is a retrospective analysis of the cases that underwent cartilage tympanoplasty for the last 4 years. Thirty-five patients with perforated ear drums and chronic otitis media were included in the study. Twenty patients were females and 15 were males. The age ranged from 12-65 with a mean of 30.37 years. Three patients had bilateral ears operated on making the number of procedures 38 tympanoplasties. All patients except one had type 1 tympanoplasty. One patient had tympanoplasty after a previous mastoid surgery (type 3). One operation was done on a recently infected ear. Follow up periods were from 6-42 months with a mean of 15 months.

All patients had both pre- and post-operative audiograms. The graft take occurred in 30 patients (85.71%).

This paper discusses the operative procedure adopted and the outcome of these surgeries.

**Keywords:** Cartilage tympanoplasty, Tympanic membrane (TM).

*(J Med J 2012; Vol. 46 (1):45-51)*

Received

Accepted

August 9, 2011

November 1, 2011

## Introduction

Since the introduction of tympanoplasty, in the fifties, by Zoellner and Wullstein, numerous graft materials have been used for the closure of the defective membrane: skin, fascia lata, temporalis fascia, vein, perichondrium, dura mater.<sup>1</sup>

To date, temporalis fascia remains the most commonly employed material for tympanic membrane reconstruction with a success rate of 90-97% in primary tympanoplasties.<sup>2,3</sup>

In certain situations, such as recurrent perforation following myringoplasty, severe attic and/or posterior uncontrolled retraction pockets with cholesteatomatous formation, atelectasis of the tympanic membrane, fascia and perichondrium have been shown to undergo atrophy and subsequent failure, regardless of the placement technique used. In these cases, many surgeons

have used cartilage as a grafting material on account of its increased stability and resistance to negative middle ear pressure, even in cases with chronic Eustachian tube dysfunction.<sup>4,5</sup>

Four techniques have been described for cartilage tympanoplasty, namely the inlay butterfly graft, perichondrium/cartilage island flap, palisade flap, and cartilage shield tympanoplasty.<sup>6</sup>

The aim of this study is to report personal experience with cartilage tympanoplasty, which was performed as a modified island technique to repair tympanic membrane perforation.

## Patients and Methods

This study was conducted in the ENT department in Al-Jamhori teaching hospital. It is a retrospective study of patients operated on from the year 2006 up to 2010, and only operations

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which were done by the same surgeon (the author) were included in the study. Thirty-five patients with tympanic membrane perforation were included in the study.

There were 20 females (57.14%) and 15 males (42.14%). The age ranged from 12 up to 65 years with a mean of 30.37 years.

All patients were complaining of recurrent attacks of otorrhoea with tympanic membrane perforation. Two patients (17 and 23 years) had a cleft palate which was corrected during childhood.

All patients except one had dry ears at least one month prior to surgery. Only one patient had a recent ear infection prior to surgery.

All patients had a preoperative audiogram which showed a variable amount of hearing loss which was conductive in 31 patients and mixed with a sensorineural element in 4 patients. The average air-bone gap in the frequencies 500, 1000, 2000 Hz was 30 dB.

Three patients had bilateral tympanoplasties with a 6-month interval between the 2 operations.

All patients had type 1 tympanoplasty (with intact ossicular chain). In one patient (a 15 year old male), both ears were operated on where one ear had tympanoplasty and the other ear had a staged operation. The first stage was a modified radical mastoidectomy for cholesteatoma, and the next stage was a revision mastoid to clean the mastoid recurrence and cartilage tympanoplasty in which the graft was put over the stapes (type 3 tympanoplasty). Three patients had septoplasty with/without endoscopic sinus surgery about three months prior to tympanoplasty, and these surgeries were done by the same surgeon (author).

CT scans were done in 5 patients prior to surgery to check for mastoid opacity that might change the treatment plan and these scans were negative for mastoid disease.

## **The Operative Procedure**

All surgeries were performed under general endotracheal anesthesia. In 19 patients, the right side was done, and left side was operated in 13 patients. Three patients had bilateral tympanoplasty.

Povidone iodine was used to clean the area of operation. An injection of local anesthesia with diluted adrenalin 1:100000 was given after towelings. The area of the injection included the postauricular sulcus, into the junction between the cartilaginous and bony meatus, and into the posterior surface of the auricle.

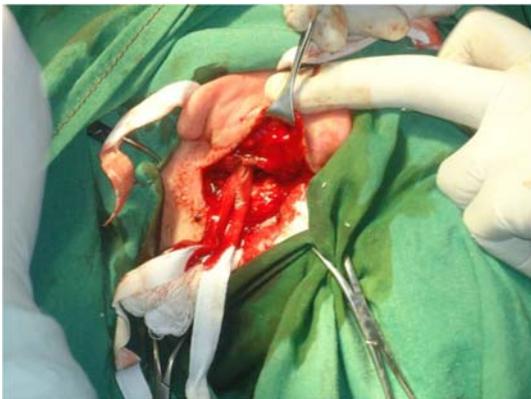
The next step was to freshen the edges of the perforation by using a curved needle (by denuding the edges of the tympanic membrane perforation), thus giving time for the local vasoconstrictor to work.

A postauricular skin incision was done extending from the superior border of the external canal down to the mastoid tip and about 0.5 cm from the postauricular sulcus. The incision was then continued using an electrocautery thus creating a flap of skin and subcutaneous tissue. A second incision was done by cautery down to the periosteum, creating a deeper flap (Fig. 1).



**Fig. (1): Postauricular incision with 2 flaps, superficial flap with skin and subcutaneous tissues, and deeper flap including the muscles and periosteum.**

Using a periosteal elevator, the periosteum was elevated anteriorly reaching the posterior canal wall and identifying the spine of Henley. At this stage, a smaller elevator was used to elevate a tympanomeatal flap to avoid a tear of the posterior canal skin. Dissection extended to the superior and inferior canal borders. Identifying the junction of the cartilaginous and bony canals, an incision was made in the skin of the bony canal just medial to its junction with the cartilaginous part. Applying the operative microscope, this incision was made medially obliquely and extended about half of the circumference of the canal. Tracheostomy tapes were used to retract the auricle and the cartilaginous canal anteriorly for better exposure of the bony canal. These tapes were inserted through the incision in the canal skin and pulled by a mosquito clamp (Fig. 2).



**Fig. (2):** Tracheostomy tapes through the external canal incision.

A self-retaining retractor was used to fully open the wound. Sometimes a second retractor might be needed.

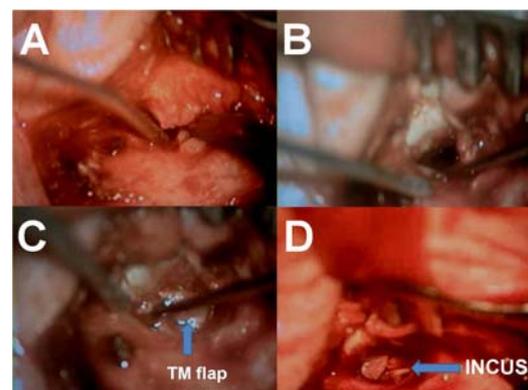
Two skin incisions were made extending from just lateral to the annulus up to the lateral incision of the bony canal skin. The site of incisions varied according to the site and size of the TM perforation. Generally the superior incision was made from 11-1 o'clock, while the inferior incision was made at 6 or 5 o'clock (when the right ear is operated). When the left ear was operated, the superior incision was also from 11-1 o'clock, while the inferior one was made at 6 or 7 o'clock.

A triangular tympanoplasty knife was used to start elevating the tympanomeatal flap at the lateral part of the external bony canal. The flap elevation was continued medially aided by cotton pieces soaked in adrenalin 1:1000 to help hemostasis and to avoid flap tear.

When reaching the annulus, it was elevated at 7 o'clock when the right ear was operated, and at 5 o'clock when the left ear was done, and the middle ear cavity was exposed. The tympanotomy was completed by inspecting the ossicles and checking the continuity of the ossicular chain. Every attempt was made to preserve the chorda tympani nerve, yet over traction an even cut of chorda happened in about half of the cases. To fully inspect the ossicular chain and stapes, the scutum (outer attic wall) needed to be removed in all patients, and this was done by a curette.

Inspection of the ossicular chain included, as mentioned previously, chain continuity, chain fixation, and inspection of the attic for hidden cholesteatoma that may change the treatment plan. All patients were negative for cholesteatoma on exploration.

Ossicular continuity was present in all patients, yet in 3 patients limited mobility due to fibrosis was present, and in one patient calcification was present in the TM and the middle ear. Figure 3 simply demonstrates these steps.



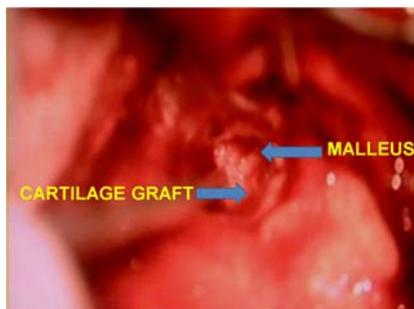
**Fig. (3):** Steps of the procedure, A: incision of the external canal, B & C: elevation of the tympanomeatal (TM) flap, D: inspection of the ossicular chain.

The next step was to take the cartilage graft, and harvesting the cartilage was done by dissecting the subcutaneous space through the postauricular incision. Exposure of the conchal cartilage was done and about a 1 cm diameter coin of cartilage was harvested. The perichondrium over the concave side of the cartilage graft (which would be the outer surface) was preserved, while the stripping of the perichondrium was done on the convex side (the inner side). Thinning of the graft was done by shaving the cartilage to reduce its thickness, together with the removal of about 2 mm of cartilage while keeping the perichondrium at the periphery of the graft to create an island of cartilage attached and surrounded by its perichondrium. This step is done under a microscope (Fig. 4).



**Fig.(4): Cartilage manipulation.**

The graft was then introduced as an underlay beneath the TM and the handle of the malleus, and above the incus long process. There was adhesion between the malleus and the promontory in 5 patients, and trimming of the handle by malleus nibbler was needed in these patients to allow graft placement (Fig. 5).



**Fig.(5): The placement of cartilage graft beneath the malleus handle and above the incus short process.**

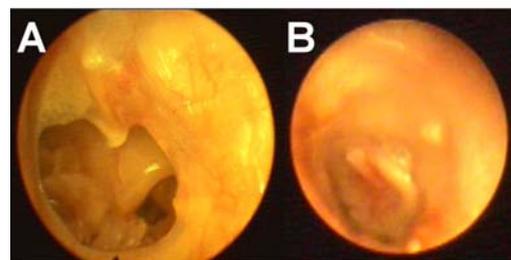
After the graft placement, the tympanomeatal flap was reflected back again and both the graft and the flap were manipulated to have the complete closure of the perforation. No gelfoam was inserted in the middle ear in the majority of cases, while gelfoam pieces soaked with antibiotic eye drops (norfloxacin) were applied on the graft and over the flap to help the stabilization of the flap on the external canal bone. Traction tapes were removed and the auricle together with the cartilaginous canal was reflected back again and gelfoam pieces were introduced in the rest of the external canal with ensuring the continuity of the skin of the external canal.

The skin incision was closed in 2 layers, the deeper layer included the periosteal flap and the auricular muscle using interrupted vicryl, and the skin layer with interrupted sutures using nylon or silk. This was followed by the application of an ear bandage.

The bandage was removed the second day and was replaced by a lighter cover, and topical antibiotic ear drops were commenced and continued for about 4 weeks. Oral antibiotic was given for 10 days. Sutures were removed 7-10 days after the operation, and regular follow-ups were continued till resolution of the gelfoam which took about 4 weeks, after which suction of the gelfoam remnants was done.

A postoperative audiogram was usually done 3-6 months after surgery and compared with a preoperative one. A follow up period ranged from 6- 42 months, with an average of 15 months.

Figure 6 shows the postoperative results one year after surgery.



**Fig.(6): A: preoperative and B: postoperative results after cartilage tympanoplasty.**

## **Results**

Thirty-five patients, with age range from 12-65 years (average 30.37 years) had cartilage tympanoplasty in the period from 2006-2010, and the results were retrospectively studied.

There were 20 females (57.14%) and 15 males (42.85%).

TM perforation was at least 50% of its surface area, and it was anterior in 6 patients (17.14%), posterior in 12 patients (34.28%), central kidney shaped in 11 patients (31.42%), and subtotal in 6 patients (17.14%).

One patient (2.85%) had reconstruction after a modified radical mastoidectomy (type 3 tympanoplasty). In 34 patients (97%), type one tympanoplasty was done with intact ossicular chain.

Preoperative audiograms showed conductive hearing loss in 31 patients (88.57%) and mixed hearing loss in 4 patients (11.42%). An average of 30 dB air-bone gap was found (the pure tone average of 500, 1000, 2000 Hz).

Two patients (5.7%) had cleft palate repair during childhood. Three patients (8.57%) had bilateral tympanoplasty, and 32 patients (91.42%) had unilateral tympanoplasty.

In 2 patients (5.7%), the contralateral ear underwent a mastoid surgery (one of them by the author).

The average follow up period was 15 months (6-42 months).

The graft take with complete closure of TM perforation was found in 30 patients (85.71%). In 3 patients (8.57%) a residual perforation was found in the anterior part of the TM, which was small in size and measured roughly 1-2 mm in longitudinal dimension and about 1 mm in width. In 2 patients (5.7%), lateralization of the posterior segment of the graft was found with posterior blunting.

A postoperative audiogram was done about 3-4 months postoperatively and showed an improvement in air conduction by an average of 15 dB in 17 patients (48.57%), 20 dB in 9 patients (25.71%), and 10 dB in 7 patients (20%). In 2 patients (5.7%) there was no improvement in air conduction audiogram, and this is explained by tympanosclerosis in one patient and persistent TM perforation in the other.

No serious complication was reported namely facial nerve injury, sensorineural deafness or labyrinthitis.

## **Discussion**

For cases at high risk for failure, such as recurrent perforations, total perforations, and severely atelectatic tympanic membranes, many surgeons have used cartilage as a grafting material because of its increased stability and resistance to negative middle ear pressure. Cartilage has been shown to reduce recurrent retraction pockets when used for the reconstruction of the posterosuperior quadrant of the tympanic membrane.<sup>7,8</sup>

It has been shown, both in experimental and clinical studies, that cartilage was well tolerated by the middle ear and shows long-term survival. However, acceptance of routine reconstruction of the tympanic membrane with cartilage has been hampered by its reputation of sacrificing maximum hearing improvement although various authors have shown that the hearing results are good, regardless of the thickness of the grafts.<sup>9-13</sup> In the island technique, tragal cartilage was utilized to reconstruct the tympanic membrane.<sup>1,14</sup>

In our study, a modification was done utilizing the conchal cartilage as a grafting material, thus avoiding another incision over the tragus. Shaping and thinning of the graft to mimic the circular tympanic membrane and applying it as an underlay manifested the procedure.

The success was measured by the graft take and hearing improvement and was compared to results found in literature.

In our study, the graft take was found in 30 patients out of 35 (85.71%), and hearing improvement in 33 (94.3%). The reported graft take was found 90-95%.<sup>1, 8, 14- 16</sup>

It could be the lesser experience in cartilage tympanoplasty by the surgeon in this study that might explain the lower success rate from that obtained in the literature review. That may be understood if it is known that cartilage tympanoplasty has been practiced for the first time by the author in our center. Yet it was the ease of cartilage harvesting and application as an underlay graft with little difficulty in manipulation that encouraged the author to continue the cartilage tympanoplasty.

### **Conclusion**

Cartilage tympanoplasty is a reliable and safe technique in the reconstruction of the TM. Hearing results after cartilage tympanoplasty is comparable to a temporalis fascia graft. It is strongly recommended as the primary procedure for the reconstruction of a high risk perforation of the TM.

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## رأب الطبلية باستخدام الغضروف: النتيجة في 35 مريض

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### الملخص

هذه الدراسة هي تحليل استعادي للمرضى الذين تم رأب الطبلية لديهم باستخدام الغضروف خلال أربع سنوات. تضمنت الدراسة خمسة وثلاثين مريضاً لديهم ثقب في طبلية الأذن. عشرون مريضاً كانوا من الإناث، وخمسة عشر مريضاً كانوا من الذكور. متوسط العمر لدى المرضى كان 30.37 سنة (العمر يتراوح بين 12-65 سنة). في ثلاثة مرضى، تم إجراء العملية في كلتا الأذنين، مما يجعل مجمل العمليات 38 عملية. في مريض واحد كان نوع العملية هو (نوع 3 من رأب الطبلية)، وفي باقي المرضى تم إجراء (نوع 1 من رأب الطبلية). في مريض واحد تم إجراء عملية رأب الطبلية بعد عملية سابقة للخشاء (نوع 3). في مريض واحد تم إجراء العملية في وجود التهاب حديث للأذن الوسطى. فترة المتابعة كانت من (6-42 شهراً)، بمعدل (15 شهر).

تم إجراء فحص تخطيط السمع قبل وبعد إجراء العملية لكل المرضى. كانت نسبة التصاق الرقعة في 30 مريضاً (85,71%).

هذا البحث يناقش طريقة الجراحة المتبعة في العملية مع مناقشة نتائج العملية.

الكلمات الدالة: رأب الطبلية، الغضروف.