

Tympanoplasty: Overlay versus Underlay Technique

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ABSTRACT

Objectives: To determine the rates of success of two different techniques of Tympanoplasty. **Study design:** Prospective comparison study. **Place and Duration of study:** Department of ENT and head and neck surgery, Pakistan institute of medical sciences, Islamabad. Period of study extended from January 1999 to December 2000. **Subjects and methods:** This study included 30 patients that underwent tympanoplasty in the department of otolaryngology, head and neck surgery, Pakistan Institute of Medical Sciences Islamabad. Out of these 30 patients, 20 were males and 10 females. 15 cases underwent underlay technique and 15 patients were operated on by overlay technique. Outcome was measured for healing, post operative hearing and incidence of complications. **Results:** According to this study, the success rate of tympanoplasty in graft uptake by underlay technique was 86% and by overlay technique was 70%. Hearing results were significantly different between overlay and underlay groups. Closure of Air Bone Gap with in 0 - 20 dB in underlay group was 86% while in overlay group it was 69%. **Conclusion:** The most significant finding in this study was high success rate with underlay technique with low incidence of complications. It was an ideal technique to repair perforations that are small and easily visualized in all quadrants, blunting and lateralization of the grafts were avoided.

Key words: Tympanoplasty, temporalis fascia, tympanic membrane, perforation, overlay, underlay, middle ear.

INTRODUCTION

Tympanoplasty is an operation to eradicate disease in the middle ear, protect it from recurrent infections and to improve hearing by restoring the hearing mechanism.

A tympanic membrane perforation arises usually as a result of either, trauma or otitis media¹. The tympanic membrane has powerful ability to heal itself and a substantial proportion of perforations do heal spontaneously². But chronically persistent perforation do occur which may require grafting. Tympanoplasty type-I, denotes that the surgery is confined to the drum alone. The concept of tympanoplasty is accredited to Berthold, who in 1878 was thought to have performed the first true tympanoplasty.

Two techniques of tympanoplasty are in practice, underlay and overlay. In underlay the graft is placed underneath the drum remnant. In overlay technique the epithelium of the surface of the drum

is removed and graft placed over the perforation. This technique was developed by Sheehy and Glasscock³.

Different types of graft materials used for tympanoplasty are temporalis fascia, tragal perichondrium, cartilage, connective tissue, vein and duramater. Out of these temporalis fascia graft is by far the most popular and is commonly used⁴.

A review of literature reveals that underlay and overlay techniques of tympanoplasty have been developed and employed successfully. To determine the difference in the success of two above techniques of tympanoplasty and the advantages or disadvantages of one technique over the other, the current study was designed.

PATIENTS AND METHODS

This study compares two techniques of tympanic membrane repair. This series is a prospective comparison study of 30 patients that

underwent tympanoplasty in the department of otolaryngology, Pakistan Institute of Medical Sciences Islamabad, from January 1999 to December 2000. The patients in this study were operated by two surgeons experienced in both the overlay and underlay techniques of tympanoplasty. One surgeon preferred the overlay technique and the other surgeon preferred the underlay technique to repair the drum.

Patients were selected regardless of age, perforation size, cause and location. The patients were included in the study on the basis of following inclusion criteria:

- 1- The ear must have remained dry for at least three months prior to surgery.
- 2- Sinusitis and tonsillitis, if present, were treated in all the patients prior to surgery.
- 3- A pre-operative audiogram was a pre-requisite in the cases.
- 4- X-rays of the PNS and mastoid were taken and assessed pre-operatively.
- 5- In all the patients, the procedure was done as in under general anaesthesia by post-auricular approach.

During the study the information regarding the type of procedure, date of operation, size and location of perforation, presence of infection, drainage at the time of surgery, cause of perforation, status of the other ear, previous surgery and presence of tympanosclerosis or cholesteatoma were recorded on an appropriately designed performa.

Hearing results were obtained at the same time and based on pre-operative and post-operative audiometric data and otologic examination at most recent follow-up.

Three frequencies (0.5, 1 and 2 KHz) pure tone average air and bone conduction thresholds were used to calculate air-bone-gap.

Outcomes were measured for healing, post operative hearing and incidence of complications. Healing was categorized as perforated or healed. For hearing results, Air Bone Gap (ABGs) for three pure tone average frequency thresholds were grouped as less than or equal to 10 dB or greater than or equal to 20 dB.

A blunted or lateralized drum was considered

to be a complication. Pre-operative variables that might affect the outcome of tympanoplasty were also evaluated, including the age of the patient, the cause of the tympanic membrane disease, the size and location of the perforation, the preoperative status of the middle ear, and the presence of cholesteatoma.

RESULTS

There were 30 patients in this study out of which are 20 males and 10 females. 15 cases underwent underlay technique and 15 patients were operated on by overlay technique. The cases were evenly distributed between right and left ears. Their ages ranged from 18 to 45 years with a mean age of 25 years.

The middle ear status before surgery is shown in (Table 1). Most of the ears (27) were normal. Mucosal oedema was present in 2 ears. Ossicular pathology was seen in 1 ear. Cholesteatoma and granulation was not seen in any ear.

The distribution of location of perforation is shown in Table 2. The majority of perforations were central.

Table 1: Middle ear status.

Middle ear status	Underlay	Overlay
Normal	13	14
Mucosal	2	0
Cholesteatoma	0	0
Ossicular pathology	0	1
Granulation	0	0

Table 2: Perforation location.

Perforation location	Underlay	Overlay
Anterior	5	5
Posterior	2	3
Superior	1	0
Inferior	2	1
Central	5	6

In this study the underlay technique was used in 15 patients (12 Male, 3 Females). One of the 15 patients failed to return after surgery, thus only 14

ears were included in underlay technique. Using the underlay technique, a successful grafting was obtained in 12 out of 14 cases (86%) (Fig. 1).

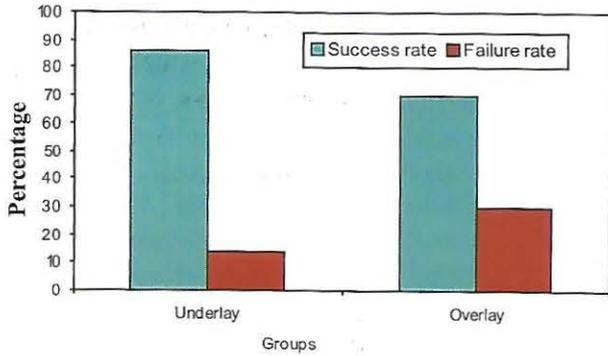


Fig. 1: Healing summary.

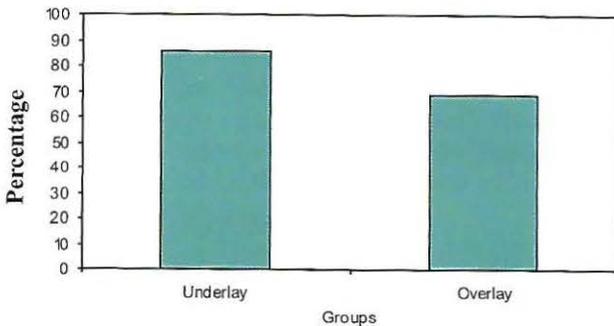


Fig. 2: Healing summary (% within 0-20 dB).

In this study the overlay technique was used in 15 patients. Eight male and 7 were female. Two patients did not return after surgery. Most of the ears were dry before surgery (Table 1). No significant granulation tissue was found in the middle ear at the time of surgery. Most of the perforation were central 6, 5 were anterior, 3 posterior and 1 inferior (Table 2).

Among these cases, 4 cases developed otitis externa after surgery, which was treated by local antibiotics. In one case tympanosclerosis was noted (Table 3). In one case atelactasis was noted. The underlay graft failed in 2 ears (14%). No significant relationship was found between the re-perforation and age of patients, perforation location and middle ear status.

According to this study there was improvement in hearing, closure of air bone gap. Within 0-10-dB is in 5 cases (36%). Closure to air

bone gap within 10-20-dB is in 7 cases (50%). 14 % had no improvement in hearing. No anacoustic ear resulted in this group (Fig. 2).

Table 3: Complication summary

Complications	Underlay	Overlay
Tympanosclerosis	7%	15%
Atelactatis	7%	15%
Granulation tissue	0	23%
Otorrhoea	29%	15%

Successful grafting was achieved in 9 out of 13 cases (70%). The overlay graft was failed in 4 cases (30%) (Fig. 1). Among these cases 3 developed granulation tissue around the incisional site, which was eventually healed. Post operative otorrhoea developed in 2 cases which was managed by topical medication. Among these cases 2 healed drums became atelactic (15%) (Table 3).

There was improvement of hearing. Closure of air bone gap within 0-10- dB is in 3 cases (23%). Closure of air bone gap within 10-20 dB is in 6 cases (46%). 31% has no improvement in hearing. No anacoustic ear resulted in this technique (Fig. 2).

DISCUSSION

Tympanic membrane perforation as seen commonly in clinical practice, more in developing countries due to lack of basic health facilities. Some of the patients present with discharging ears, while others are seen because of hearing loss, majority of tympanic membrane perforation is due to recurrent acute or chronic otitis media but other are due to trauma or foreign bodies.

The aim of tympanoplasty is to protect the middle ear from recurrent infections and to improve hearing. Several techniques have been used to repair the tympanic membrane perforations. Now a days, persisted tympanic membrane perforation is closed by a micro surgical procedure using different materials such as, tragal perichondrium, with or without cartilage, temporalis fascia, septal cartilage, vein graft, fat, bone, dura, extracellular matrix substance. Temporalis fascia is the most commonly used as considered better graft material⁴⁻⁶.

According to this study the success rate with temporalis fascia as a graft material in underlay technique is near about 86% and in overlay technique is about 70%, however the Gibbs, Slung, Stars, Symith and Kerr reported the success rates of 65%, 86.7%, 90% and 91%. So this shows that success rate is variable to the experience and skill of the surgeons.

The success rate of tympanoplasty depends upon the size of perforation i.e. this is less when perforation involve more than half of total circumference of the tympanic membrane⁷. The anterior perforation of tympanic membrane has a success rate less than the perforation involving posterior half of tympanic membrane^{8,9}.

Literature review has also shown the variable results Vartiainen E in his study of 404 cases gives the success rate of 88%⁵. Jurovitzki in January 1988 in his post operative follow up cases of tympanoplasty has given in success rate of 70.8%. This study also reveals that anterior perforation is difficult to close than posterior perforation.

Ventilated middle ear space is another factor, which is directly related to successful outcome in tympanoplasty i.e. patent Eustachian tube. This is because of the fact that Eustachian tube dysfunction can lead to graft rejection and atelectasis due to persistent negative pressure in the middle ear cavity. So good Eustachian tube function should be present in pre and post operative period¹⁰⁻¹².

The primary goal of any grafting technique is to produce thin conically shaped vibrating membrane resembling the original drum head. This study compared overlay and underlay techniques in terms of healing, hearing and complications.

We found that underlay technique was significantly better than overlay technique in terms of drum healing (86% vs. 70%). This is in favour to both Doyle's and Glass-cocks results^{13,14}. The healing rates in this series is less than those reported by Doyle's and Glass-cock which were approximately 96%.

In this study the success rate of overlay technique was 70% which was significantly less than the study done by Aranklin-M Rizer which was 97%¹⁵.

Literature review has shown that overlay technique is associated with more complications

including bleeding, lateralization and thickening of the drum, squamous pearls and delayed healing. In this study 2 ears developed atelectasis.

Hearing results were significantly different between the overlay and underlay group. Closure of air bone gap within 0-20 dB in underlay group was (86%), while in overlay group it was 69%, which was in contrast to study of Rizer (Overlay 89%)¹⁵.

The most significant findings in this study are high success rate with underlay technique and low incidence of complications associated with it. Post-auricular approach was used for adequate exposure. It is an ideal technique to repair perforation that are small and easily visualized in all quadrants, blunting and lateralization of the graft are avoided, the drum heals at the correct level relative to annulus and ossicles. The technique is quicker and easy to perform. The underlay tympanoplasty heals faster than overlay procedure because of lesser amount of surgical trauma. The underlay technique is also technically less difficult and thus favours the occasional otologic surgeon.

CONCLUSION

The main goals of Tympanoplasty are to protect the middle ear from recurrent infections and to improve the hearing. The preferred graft most commonly used now a days is temporalis fascia due to its easy availability, quick vascularization & minimal nutritional requirement. Patent eustachian tube in the pre operative & post operative period is necessary for survival of graft. Preoperative audiogram is necessary before doing the tympanoplasty, the preoperative & postoperative audiogram are compared to see the improvement in hearing. The technique adopted depends upon the size & location of perforation, along with experience & skill of the surgeon.

It is clear from this study the success of tympanoplasty cannot be attributed to any single factor. When all the above factors are aligned excellent results can be expected from tympanoplasty with either an overlay or an underlay technique.

The most significant finding in this study was high success rate with underlay technique with low incidence of complications.

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