

# THE USE OF TEMPORAL FASCIA AND MEATAL SKIN IN TYMPANOPLASTY

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Surgical ablation of middle ear and mastoid disease has been successfully practised ever since the basic principles of surgery for infection were conceived. During the pre-antibiotic era so much of the otologist's time was taken up in rendering an infected ear 'safe' that he had no time left to divert his attention to techniques for preservation of function. The central perforation with intermittent otorrhoea was dismissed as relatively innocuous and was certainly not regarded as operable; in fact the teaching until quite recently has been that the central perforation with so-called tympano-tubal disease could only be made worse by surgery. Treatment therefore was entirely conservative.

During the past decade microsurgical techniques have been developed. The concepts of the principles of surgery for chronic aural suppuration have changed radically and the outlook has improved greatly. The original changes in thought came primarily from Wullstein and Zöllner. Their classification of tympanoplasty has become universally accepted.

In the years that have followed their original papers, the variety and sources of technical contributions to these procedures have been legion. As the better ideas have been sifted out and retained, so the more complex techniques have been discarded. Although tympanoplasty has by no means become a standardized procedure, the results, both with regard to hearing improvement and the achievement of dry ears, are now good. The operation can therefore be recommended in most cases with confidence.

## TYMPANOPLASTY

Tympanoplasty aims firstly at eradication of disease in chronic otitis media; secondly, at reconstruction of a functioning middle ear which will withstand the onslaughts of everyday life, such as upper respiratory infections from within and seawater and sand from without; and thirdly, at the restoration of as much hearing as is compatible with such permanent destruction as has already taken place. These objectives are achieved in a high proportion of cases by the use of a variety of free

grafts after a meticulous surgical attack on the disease processes.

### *Classification of Operations*

The operation is classified, according to Wullstein, into 5 types, depending on the method used to reconstruct what is left of the sound-conducting apparatus:

1. The *type I* operation entails the repair of a central perforation where the ossicular chain is intact and mobile.

2. The *type II* operation is similar to type I, but differs in that the graft is utilized to bridge a small gap in an almost normal ossicular chain.

3. The *type III* operation is employed when the ossicular chain is grossly diseased, but the stapes crura are intact and the footplate is mobile. The graft is then placed so that it is in contact with the head of the stapes, to provide a direct columella effect. A modification of this operation can be used when the stapes crura are missing. In this artificial type III operation a polyethylene or stainless steel wire prosthesis is placed on the stapes footplate and the graft is placed in contact with the prosthesis. An artificial columella effect is produced.

4. The *type IV* operation is an alternative to the artificial type III procedure when the stapes footplate is all that remains of the ossicular chain. The graft is placed from the antero-inferior tympanic remnant to the promontory. This encloses an air space in the hypotympanum and round-window region. A second graft, trimmed very thin, is placed over the footplate and into the exposed attic region. This procedure produces a load differential between round and oval windows and has been found to give reasonably good hearing.

5. The *type V* operation is employed when the footplate of the stapes is fixed through otosclerosis, tympanosclerosis or fibrous adhesions. Grafting is carried out purely to produce a dry healthy ear with an air-containing middle-ear cavity. Lateral semicircular canal fenestration is then carried out as a second-stage procedure. It has been the practice in this series to remove the footplate at the second stage rather than fenestrate the lateral canal. The oval window is then grafted with fat, and this is linked either to the incus or direct to the tympanic

membrane, using stainless-steel wire. This procedure is a much closer approach to the normal than lateral canal fenestration, and its performance has given no cause for regret.

#### Grafting Materials

The original graft used in tympanoplasty was full-thickness postauricular skin. This provided a satisfactory graft in many cases, but the main disadvantage was the tendency for graft cholesteatoma to form. This resulted in recurrent discharge and graft failure. Split and full-thickness skin grafts from other regions were even less successful, and the failure rate in tympanoplasty using these techniques was depressingly high.

*Meatal skin* is used by many workers and methods vary from removing a portion of the canal skin to removing the entire canal skin and using it as a free graft. This technique has yielded excellent results. Skin from this area is free from hair follicles, glandular elements are minimal, and there are no elastic fibres. This means that troublesome cholesteatoma formation does not occur, and also recurrent perforation from graft shrinkage is not common. Plester's very large series of cases using meatal skin bears testimony to the enormous superiority which it has over other types of skin.

Shea and others have reported good results using vein for closure of tympanic defects. The principle in this type of grafting is that a scaffold is provided for normal epithelization to occur from the edges of the grafted area. At the same time a normal mucosal coverage takes place on the medial aspect. In principle this is excellent, but vein tends to shrink and thus there is a tendency for graft perforations to occur, particularly at the periphery of the original defect. Furthermore, vein is delicate and once graft perforation has occurred the chances of spontaneous healing are negligible.

*Temporal fascia* provides a scaffolding similar to vein, but has the following advantages: It is more readily accessible. It is much stronger than vein and has no tendency to contract. It has exceptionally low metabolic requirements, and this greatly enhances the chances of 'take' in the presence of infection or in a bed with a poor blood supply. It therefore allows a large area of unsupported graft to bridge a defect with minimal risk of central graft failure.

#### OPERATIVE TECHNIQUE

In more than 50 cases a combination of temporal fascia and free meatal skin graft has been used. The method employed has been as follows:

The approach may be either endaural or postauricular. The latter allows greater exposure of the anterior tympanic border and has been found to be distinctly superior in dealing with central perforations. The posterior half of the meatal skin is carefully dissected free from the bony meatus towards the drum. When the annulus is reached, the dissection is carried forward superficial to the lamina propria. The surface epithelium of the drum is removed in continuity with the meatal skin. In large defects, a semi-circumferential incision is made in the anterior half of the meatus 2-3 mm. from the annulus. This cuff of anterior canal skin is dissected medially towards the drum and again the surface epithelium is removed in continuity. This procedure allows a greater bed for grafting than if the tympanic remnant alone were de-epithelized. The meatal skin is trimmed and placed on a gauze swab soaked in saline.

The middle ear is carefully inspected. The round window and hypotympanum are examined, and if the size of the perforation makes this difficult there should be no hesitation in increasing the size of the defect for the sake of exposure. The annulus is elevated in the postero-superior quadrant of the drum remnant and the incudo-stapedial joint is examined. If necessary a limited atticotomy is carried out, and where cholesteatoma is present this may be extended to an attic-antrotomy. In central perforations which are discharging, a routine antrotomy burrhole is made. Middle-ear drainage is established *via* this route until the discharge has subsided and the grafts are secure. Provided tubal patency has been established pre-operatively and there is no nasopharyngeal sepsis, there need be no hesitation in operating by this method even in the presence of mucopurulent otorrhoea.

When the middle-ear dissection has been completed, it is packed with 'gelfoam' soaked in adrenaline. This ensures an absolutely dry graft bed. At the upper limit of the skin incision, whether this be endaural or postauricular, the temporal fascia is exposed and is then carefully cleaned of areolar tissue. A graft is dissected off the surface of the muscle. Care is taken that this graft is as thin as possible and that it has no areolar tissue or muscle attached to its surfaces. The graft is tailored to fit the prepared bed and is so placed that its anterior margin meets, but does not overlap, the remaining cut edge of the anterior canal skin. Posteriorly it is cut so that it just reflects on to the posterior bony meatus for 2 mm. Next, the previously removed meatal skin is replaced on the posterior meatal wall, but at a more medial level so that the medial margin of the skin graft overlaps the posterior third of the fascia graft. The whole meatus is then packed with gelfoam soaked in a penicillin-saline solution. These dressings are left *in situ* for three weeks and when they are removed it is found that epithelization is well advanced and in fact is sometimes complete.

#### DISCUSSION

Using this technique as described, it has been found that the fascia graft which forms the new tympanic membrane gains a very thin epithelial layer which is quite stable. Removing the posterior canal skin facilitates de-epithelization of the drum. It also allows improved exposure of the middle ear. Replacing it to overlap the fascia graft in its posterior third promotes rapid epithelization; but nevertheless allows the vibrating portion of the fascia to epithelize largely on its own. This ensures a thin but stable epithelial covering not unlike that of the normal tympanic membrane. The new drum becomes a membrane with good functional quality. There is no tendency to desquamation. This makes aftercare minimal and the ear virtually returns to its normal state.

In the cases where fascia grafting has been employed there has been no instance of complete graft failure. In one case the meatal skin sloughed, but the fascia remained. Although epithelization was slower than usual the end result was satisfactory. Graft perforation has occurred in less than 10% of cases and for most of these failures faulty technique has been to blame. In two cases where primary cholesteatoma was present it was found that the removal of matrix had been incomplete and that graft perforation had been caused by recurrence of cholesteatoma. It is significant that in the later cases in this series, owing to improved surgical technique, graft perforations have become exceedingly rare.

At revision operations the opportunity has been available to examine the fascia grafts more closely. This has confirmed that the new tympanic membrane resembles the normal to a remarkable degree. Adhesion formation in the middle ear has been found to be minimal. A

healthy mucosal covering of the medial aspect of the fascia graft is rapidly attained.

When using skin grafts to bridge large defects, it has always been a deliberate manoeuvre to obtain adhesion of the graft to the promontory. This provides an additional nutritional bed, but is unnecessary when fascia is used. In fact all possible steps should be taken to avoid adhesion to the promontory. Experimental procedures are now being carried out with stainless-steel wire prostheses to ensure that grafts are kept free from the promontory. In this way even in very large defects complete mobility of the graft should be achieved. It is conceded that graft attachment to the promontory is not greatly detrimental to the hearing result. In fact it may even be possible that the higher frequencies are improved by promontory adhesion, particularly in type III operations. It is believed by some that the smaller resonating area of the tympanic graft is more efficient in the higher frequencies than a larger area of a completely mobile graft would be. Nevertheless it must always be the objective in tympanoplasty to produce a middle ear as nearly normal as possible. Therefore if grafts can be used which anatomically and functionally resemble the normal tympanic membrane closely, then the optimum hearing result must be achieved. To do this, adhesion formation must be eliminated and an air-containing middle ear space must be established.

One patient in this series had otosclerosis in addition to chronic otitis media. A type I tympanoplasty successfully closed an almost total tympanic defect. Subsequently it was possible to reopen this ear to carry out stapedectomy. The fascia graft appeared only a little thicker than a normal drum. Its medial aspect was completely covered with mucosa and there was no adhesion to the promontory. Very satisfactory hearing improvement followed stapedectomy and the healing of the tympano-meatal flap followed the usual course.

#### CONCLUSION

From a review of the literature and observations in these procedures it becomes evident that the external auditory meatus is by far the best donor site for skin used in tympanic reconstruction. Plester found, on changing from postauricular to meatal skin for grafting defects, that his graft perforation rate dropped from 12% to 8%. Furthermore, apart from the problem of recurrent per-

foration he has found that graft cholesteatoma does not occur and desquamation is negligible. Of non-epithelial free grafts only vein and fascia are really suitable and vein grafts suffer from a tendency to contraction.

It has been concluded from the experience gained in this series that the ideal method of grafting in tympanoplasty is a combination of temporal fascia and meatal skin as described. A good functional tympanic membrane is achieved, and healing is rapid and complete. More important is the fact that once healing is complete the grafts are completely stable and show no tendency to break down or cause further trouble. Patients may resume any form of sport and even swimming without the fear that their surgically treated ear will suffer.

#### SUMMARY

The various materials used for grafting in tympanoplasty are reviewed. Postauricular skin and skin from other donor areas is regarded as inferior to meatal skin. Of non-epithelial grafts, vein and fascia are both suitable for use as free grafts, but fascia is stronger and shows less tendency to contract. It is believed that fascia is preferable to vein.

A technique is described for combining temporal fascia with free meatal skin grafting. This results in a stable and efficient new tympanic membrane and epithelization is rapid.

Patients who have required revision operations are discussed and it is found that the fascia-graft tympanic membrane is a good substitute for the normal drum, that middle-ear adhesions are minimal, and that even in large tympanic defects adhesion to the promontory can be avoided.

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#### BIBLIOGRAPHY

- Beales, P. H. (1961): *J. Laryng.*, **75**, 897.  
 Brandon, E. C. and Iandoli, E. W. (1960): *Arch. Otolaryng.*, **72**, 77.  
 Goto, S. (1960): *Acta oto-laryng. (Stockh.)*, **51**, 143.  
 House, W. F. and Sheehy, J. L. (1961): *Arch. Otolaryng.*, **73**, 407.  
 Plester, D. (1960): *Ibid.*, **72**, 718.  
*Idem* (1961): *J. Laryng.*, **75**, 879.  
 Schlosser, W. D. (1961): *Arch. Otolaryng.*, **74**, 656.  
 Shea, J. J. (1960): *Ibid.*, **72**, 445.  
 Wullstein, H. (1960): *Ibid.*, **71**, 424.  
*Idem* (1960): *Ibid.*, **71**, 451.

#### Personal Communications

- Colman, B. H.  
 Plester, D.