

Hyaluronic acid ester in myringoplasty

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Abstract

Objectives: To investigate the use of a new technique to close persistent tympanic membrane perforations under general anaesthesia, in patients in whom this has previously been considered impractical.

Design: Twenty patients aged 50 years and over were recruited. All had a persistent, symptomatic tympanic membrane perforation in at least one ear. Pre-operatively, an audiogram was performed and the tympanic membrane was assessed in order to establish the site and size of the perforation. Under general anaesthesia, the edges of the perforation were freshened and a sheet of Epifilm, trimmed to a size roughly 2 mm larger in diameter than the perforation, was tucked through the perforation. The ear was dressed appropriately. Patients were seen two weeks post-operatively in the out-patients department and reassessed.

Setting: The study was based at Poole General Hospital, a District General Hospital.

Participants: Twenty patients were recruited from the out-patients clinics of Poole Hospital ENT department.

Main outcome measures: (1) closure of the perforation, as a percentage of the original size; (2) improvement of hearing, as an average across all frequencies, expressed in dB hearing level; and (3) presence or absence of discharge.

Results: Five patients were operated upon and assessed six weeks post-operatively. The Epifilm had dissolved but the perforations remained the same size in all five patients. There were no other adverse effects. Pure tone audiometry at this stage was redundant. The study was subsequently aborted.

Conclusions: The authors conclude that repair of tympanic membrane perforations with hyaluronic acid ester films is not to be recommended.

Key words: Tympanic Membrane; Chronic Otitis Media; Otologic Surgical Procedures; Myringoplasty; Hyaluronic Acid

Introduction

Study aims

Many patients regularly attend ENT departments for review of their tympanic membrane perforations. Significant proportions of these are middle-aged or elderly and must wear hearing aids, often in the affected ear(s). These tympanic membrane perforations can be repaired surgically; however, doing so requires a general anaesthetic which is often protracted and/or hypotensive, and which can represent an unacceptable risk in older patients. If myringoplasty under local anaesthetic is inappropriate or refused, the patients may have to live with chronically discharging ears.

The aim of this study was to devise a successful surgical method which would relieve the patient's symptoms, but without involving the risk of intra-operative hypotension. A second aim was to develop a surgical method which would obviate the

need for follow up, thus substantially reducing the burden on out-patients department resources.

Scientific background

Persistent tympanic membrane perforations are common in general ENT practice, and a proportion are found in middle-aged and elderly patients. A persistent perforation increases the patient's risk of developing chronic or recurrent acute infection of the middle ear, conditions which are frequently associated with an unpleasant discharge. The damaged tympanic membrane will also be acoustically inefficient and the patient will thus have concomitant hearing loss.¹ This hearing loss, in addition to the normal progressive hearing loss from middle age onwards, means that the elderly patient with a perforation will often have to wear a hearing aid. Occlusion of the external auditory canal by the hearing aid

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earpiece will further exacerbate middle-ear infection and discharge.

This combination of factors often results in a chronically discharging ear which can be very difficult to treat effectively. Such patients can also require frequent follow up in clinic to treat infection and to keep the ear clean. It is therefore desirable to repair such perforations surgically in these patients.

There have been many methods proposed for repairing tympanic membrane perforations.^{2–8} Most of these involve applying a patch to the perforation, which then acts as a scaffold, allowing the surrounding epithelium to grow over the perforation. When successful, this procedure stops the discharge of recurrent or chronic infections, and will often improve hearing.⁹

Historically, many types of patch material have been used, including paper, cartilage, skin and soft tissue of various types. In the UK, the preferred material is the fascia covering the temporalis muscle, as it is effective and easy to manipulate and harvest.

The selected material needs to be applied to the eardrum. Either surface of the drum can be used, or the patch can be interleaved between the layers of the drum. Due to the way in which epithelium on the two surfaces of the drum meets at the edge of the perforation, keratinised epithelium is usually found on the inner surface of the drum.¹⁰ For this reason, laying patch material over the perforation has the potential to bury keratin in the middle ear, leading to future cholesteatoma; however, in practice, this risk seems no greater for on-lay grafts than for other methods.¹¹ Another problem is shrinkage of the patch with time, which can lead to the eardrum being pulled laterally.¹² This results in the drum being splinted between the tension of the graft and the tensor tympani muscle, reducing its acoustic compliance and causing hearing loss. Evidence on the actual clinical prevalence of these complications is, however, equivocal.

Due to these perceived dangers, in the UK the graft is usually laid on the medial surface of the tympanic membrane (i.e. the underlay technique).¹³ This approach requires the raising of a tympanomeatal flap, whereby the skin of the ear canal is lifted up in continuity with the tympanic membrane, in order to gain access to the medial side of the tympanic membrane. Due to the small scale of this procedure, it is always performed with the aid of an operating microscope. Thus, any amount of bleeding will compromise the surgeon's view of the operative field. For this reason, when performing a myringoplasty under general anaesthetic, the patients' blood pressure is often lowered pharmacologically (i.e. the patient is made hypotensive) in order to create optimal operating conditions. This makes the procedure hazardous for patients with cardiovascular disease or poor cardiovascular homeostasis. For this reason, in the UK such myringoplasty procedures are offered infrequently to elderly patients.

However, it should be noted that hypotensive anaesthesia is not essential for myringoplasty; similar operative conditions can be obtained under general anaesthesia by gently ventilating the patient in the head-up position. Myringoplasty via the

end-aural approach under local anaesthesia can also be performed. Such techniques can supply an alternative to general anaesthesia for patients with otherwise prohibitive co-morbidities.

When performing myringoplasty under general anaesthesia, application of the graft to the medial surface of the tympanic membrane through the perforation itself (i.e. the through-lay technique) avoids the necessity of a tympanomeatal flap, with its associated hypotensive anaesthesia. Unfortunately, this technique does not allow inspection of the ossicular chain, but the benefits in selected patients may well outweigh this disadvantage.

A through-lay graft will still need to be harvested, requiring an external incision. While this is not problematic, the use of a synthetic graft material would be simpler, and would also avoid the complication of wound infection. Hyaluronic acid ester (Epifilm[®]; Xomed Surgical Products, Sherbourne House Croxley Business Centre Watford, UK) is a suitable such material, and has been licensed for use in the middle ear.¹⁴ Hyaluronic acid in its liquid form has been used in the middle ear without appreciable problems.¹⁵ However, there are no reports of use of the solid polyester form, which is known to be fully reabsorbed within eight weeks.¹⁴ It is possible that use of this material may enable healing rates comparable with those of other methods of myringoplasty (i.e. approximately 80 per cent).¹³

This study sought to establish whether use of Epifilm as a tympanic membrane graft could enable safe, effective and rapid closure of tympanic membrane perforations in patients who hitherto had been denied surgical myringoplasty.

Materials and methods

Project design

Twenty patients aged 50 years and over were recruited from the out-patients clinic of the Poole Hospital ENT department, a District general Hospital. All patients had a persistent, symptomatic perforation in at least one ear. Each patient was recruited and counselled, and consent sought and obtained.

Pre-operatively, patients underwent audiometry and tympanic membrane assessment to establish the site and size of the perforation.

On admission, patients were suitably prepared and investigated. Following establishment of general anaesthesia, the edges of the tympanic membrane perforation were trimmed, both to remove squamous epithelium from the inner surface of the perforation edge, and to create a raw epithelial edge that could provide tissue to grow across the graft. The middle ear was then filled with Spongistan (Johnston and Johnston Medical, Skipton, UK), an absorbable gelatine sponge usually used for middle-ear surgery. A sheet of Epifilm was then trimmed to a size roughly 2 mm larger in diameter than the perforation, and tucked through the perforation. The graft was then dressed with more Spongistan and Bismuth Iodoform Parafin Paste (BIPP), as per routine practice.

Following discharge from hospital, patients were assessed two weeks post-operatively in the out-patients

clinic and the BIPP removed. The state of the tympanic membrane was also examined. A repeat audiogram was taken at six weeks post-operatively.

Outcome measures

We used the following outcome measures: (1) closure of the perforation, as a percentage of the original size; (2) improvement in hearing, as an average across all frequencies, in dB hearing level; and (3) the presence or absence of discharge.

Results

The first five patients fitting the inclusion criteria underwent surgery as described above. In each case, the procedure was uneventful.

Two weeks post-operatively, these patients were seen in the out-patients department and their BIPP packs removed. At this time, aural examination revealed that all five patients' tympanic perforations had not healed. In two cases, the Epifilm was in situ on the medial side of the tympanic membrane. In the other three cases, the film had moved. In all five patients, the freshened edges of the perforation were visible and there were no signs of infection, but the perforations had not reduced in size, compared with their pre-operative state. The situation had not improved by the time of the patients' six week follow-up appointments. By this time, the Epifilm had dissolved, but the perforations remained the same size in all five patients. No other adverse effects were detected. At this stage, pure tone audiometry was considered redundant.

The success rate of myringoplasty using temporalis fascia is approximately 80 per cent.¹³ As the success rate for our five patients was 0 per cent, the study was aborted at this point.

Discussion

The quest for new, improved graft materials for tympanic membrane perforation repair is as old as myringoplasty itself. In this study, the Epifilm material used contained hyaluronic acid, a natural constituent of the extracellular matrix, and in theory should have been an ideal graft material. However, even though Epifilm has been used successfully as a graft in the treatment of other otological problems,¹⁵ our patients' tympanic membrane perforations showed no signs of closure six weeks post-operatively. Further study would be needed to assess the reasons for this failure.

The authors conclude that repair of tympanic membrane perforations with hyaluronic acid ester films is not to be recommended.

References

- Booth J, ed. Scott-Brown's Otolaryngology, 6th edn. Oxford: Butterworth-Heinemann, 1997:4
- Austin DF, Shea JJ. A new system of tympanoplasty using vein graft. *Laryngoscope* 1961;**71**:596–611
- Williamson PA, Thomas DM, Beasley P. Posterior tragal perichondrium harvesting for myringoplasty. *Clin Otolaryngol* 1999;**24**:252–4
- Cross CW, Bassila M, Lazar RH, Long TE, Stagner S. Adipose tissue plug myringoplasty techniques in children. *Otolaryngol Head Neck Surg* 1999;**101**:617–20
- Inamoglu M, Isik AU, Acuner O, Harova G, Bahadir O. Fat-plug and paper-patch myringoplasty in rats. *J Otolaryngol* 1999;**27**:318–21
- Maeta M, Saito R, Nakagawa F, Miyahara T, Uno K, Sonobe N. A clinical comparison of orthodox myringoplasty and a simple method with fibrin glue. *Journal of the Oto-Rhino-Laryngological Society of Japan* 1998;**101**:1062–8
- Sakai N, Kokobun T, Asai T, Kurihara H, Nishizawa N, Matsushima J *et al.* Simple in-office closure of small intractable tympanic membrane perforations after myringoplasty. *Auris Nasus Larynx* 1997;**24**:43–6
- Puls T. Myringoplasty: is molded collagen xenograft a valid alternative for fresh temporalis fascia? *Acta Otorhinolaryngol Belg* 1996;**50**:111–14
- Sheehy JL, Anderson RG. Myringoplasty: a review of 472 cases. *Ann Otol Rhinol Laryngol* 1980;**89**:331–4
- Somers TH, Houben V, Goovaerts G, Govaerts PJ, Offeciers FE. Histology of the perforated tympanic membrane and its muco-epithelial junction. *Clin Otolaryngol* 1997;**22**:162–6
- Rizer FM. Overlay versus underlay tympanoplasty. Part II: the study. *Laryngoscope* 1997;**107**:26–36
- Doyle JP, Schleuning AJ, Echevarria J. Tympanoplasty: should grafts be placed medial or lateral to the tympanic membrane? *Laryngoscope* 1992;**82**:1425–30
- Kotecha B, Fowler S, Topham J. Myringoplasty: a prospective audit study. *Clin Otolaryngol* 1999;**24**:126–9
- Xomed Surgical Products Inc. *Epifilm Product Information*. Watford, UK: Xomed Surgical Productions, 2001
- Chauvin K, Bratton C, Parkins C. Healing large tympanic membrane perforations using hyaluronic acid, basic fibroblast growth factor, and epidermal growth factor. *Otolaryngol Head Neck Surg* 1999;**121**:43–7

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