The Journal of Laryngology and Otology
June 1991, Vol. **105**, pp. 417–420

Mastoid obliteration with the temporoparietal fascia flap

C. A. East, F.R.C.S.,* M. D. Brough, F.R.C.S.,† H. R. Grant, F.R.C.S.* (London)

Abstract
Obliteration of persistently discharging open mastoid cavities is one surgical option to achieve a dry ear. All the currently described techniques involve the use of random pattern local tissue flaps or free grafts. Ten patients have undergone obliteration procedures using the vascularized temporoparietal fascia flap. This resulted in rapid epithelialization by six weeks in seven out of 10 cases. The remaining three patients have persistent non healed areas over the medial attic wall, but are not troubled by otorrhoea. The indications, technique and complications of mastoid obliteration by this axial pattern flap are described.

Introduction

Open cavity mastoidectomy carries the potential for intermittent or chronic discharge following surgery. The percentage of cavities which continue to discharge is reported to be between 10 and 60 per cent (Beales and Hynes 1958; Beales 1959; Palva 1982; Mills, 1988). It was not long after the description of radical and modified radical mastoid operations by Stake (1893) and Bondy (1910) that techniques first appeared in the literature to obliterate the mastoid bowl (Mosher, 1911; Kisch, 1928). Sadé *et al.* (1982) have outlined the factors likely to result in a dry mastoid cavity: a small to medium sized cavity, a low facial ridge, an adequately large meatoplasty, and a closed middle ear segment which isolates the Eustachian tube from the cavity. These surgical goals, which have been reiterated by Sheehy (1985) are the aims in open cavity tympanomastoid procedures. However in a number of cases despite initial technical success, discharge persists. Although many patients can cope with this problem by adequate aural toilet, there remain a small number of cases where the mastoid bowl fails to heal. As a result, further complications may occur *e.g.* recurrent perichondritis of the pinna. In these cases mastoid obliteration is the surgical treatment, which may also be offered to patients with large cavities, or those who wish to swim regularly.

The techniques of mastoid obliteration used until now fall into two main categories, either local flaps of muscle or periosteum or free tissue grafts *e.g.* bone paté, cartilage. (Table I). The local soft tissue flaps formerly used have a random pattern blood supply. If they are raised with a length to width ratio greater than one to one, ischaemia of the distal portion may occur. Necrosis followed by contraction of the flap may result in inadequate coverage and an undesirable shape to the cavity. As the periosteal flaps lack bulk, their use has been supplemented by free graft material, e.g. autologous bone pate and more recently hydroxyapatite. (Palva, 1973; Grote and Kuijpers, 1983).

This paper describes mastoid obliteration using an axial pattern vascularized local flap alone. The technique was devised by collaboration of two of the authors (HRG & MDB) to help solve the problems of chronic end stage mastoid disease. We considered that the fundamental requirement for producing effective obliteration was the introduction of a well vascularized flap. The temporoparietal fascia flap first described by Byrd is a suitable axial pattern local flap.

Patients and surgical technique

Ten patients have undergone a total of 12 mastoid obliteration procedures over the past four years. All these patients had previous mastoid surgery, and at least one revision operation before they were referred to the ENT department at the Middlesex/UCH. The original operation note and pathological details were not available for every patient. Each individual had the cavity observed for persistent cholesteatoma. This often included an EUA with biopsy of granulation tissue prior to mastoid obliteration surgery. Each cavity was subjectively assessed by two of the authors for size of meatoplasty, shape of the cavity and extent of granulation tissue. Every patient had either a profuse or moderate ear discharge at each visit to the department and could not be controlled by suction, or antibiotic eardrops.

Surgical technique

The superficial temporal artery was carefully palpated on the temple for pulsation. Where pulsation could not be detected a Doppler probe was used to identify the vessel particularly if there was an endaural scar. The hair on the operative site was cut short to 1 cm and shaved com-

*Department of Otolaryngology, UCH/Middlesex Hospitals, London W1.
†Department of Plastic Surgery, UCH, London WC1.
Accepted for publication: 20 February 1991.

TABLE I

Muscle/periosteal flaps	
Kisch	1928
Muerman and Ojala	1949
Rambo	1958
Hilger and Hohmann	1963
Palva	1963, 1982
Posterior wall reconstruction/free grafts	
Schiller and Singer	1960
Shea M.	1972
Smyth	1972
Marquet	1976
Pulec	1976

pletely in the planned incision lines. The pattern of the incision varied but we favoured a Y incision where the lower limb of the Y curved in a lazy S shape over the artery to the point anterior to the upper attachment of the helix to the head.

A wide postaural incision is made excising previous scars. The anterior limit of this incision should not reach the surface marking of the vessel. The pinna is reflected forwards, and the mastoid lining elevated from the bowl. Using a cutting burr, the cavity is widely saucerized to remove any overhanging bone. The middle fossa dura is then skeletonized in the region above the ear canal and the ridge formed by the root of the zygomatic arch removed. This step is important to avoid compression of the pedicle of the flap when it is rotated into the cavity. The mastoid bowl is smoothed with diamond burrs removing any pockets of granulation tissue. In radical cavities, the skin of the anterior meatal wall is elevated from the deep meatus to hold a fascial graft across to the promontory and close the Eustachian tube orifice. In modified radical cavities, when appropriate, the drum is elevated to inspect the ossicular mechanism. A gauze dressing is placed in the ear cavity and the retractors removed.

The temporoparietal fascia flap is raised by extending the postaural incision vertically over the approximate line of the artery in the pattern described above. Skin flaps are raised by sharp dissection using a number 15 blade and skin hooks for retraction. The plane of dissection is immediately deep to the hair follicles, staying lateral to the temporal vessels (Fig. 1). It is important not to transect the follicles as this will result in areas of alopecia postoperatively. Bipolar diathermy is essential for haemostasis. The flaps created should be large enough to expose an area of temporoparietal fascia 8 × 7 cm. The fan-shaped flap with its narrow pedicle including the posterior branch of the superficial temporal vessels is then raised from its edge by incising *through to* the temporalis muscle fascia. Separation of the temporoparietal flap from the temporalis fascia is easily achieved (Fig. 2). At this point a temporalis fascia graft is harvested, trimmed, and placed medial to the tympanic membrane remnant, or tucked under the anterior canal wall skin. A small piece of ribbon gauze is placed against the anterior wall of the ear canal and the temporalis fascia reflected forward.

The temporoparietal fascia flap is tranposed to slightly overfill the mastoid cavity and lie up against the temporalis fascia. The pliability of this flap allows it to conform very readily to the shape of the mastoid cavity. A small tacking suture of absorbable material is used to anchor the flap to the temporalis muscle as it tends to 'flow' from the mastoid bowl. The skin is closed with a single layer of non absorbable suture with a small suction drain under the scalp flaps. A light dressing is applied to the post auricular wound. Finally the ear canal packing is checked and cotton wool placed in the concha. Pressure dressings are avoided.

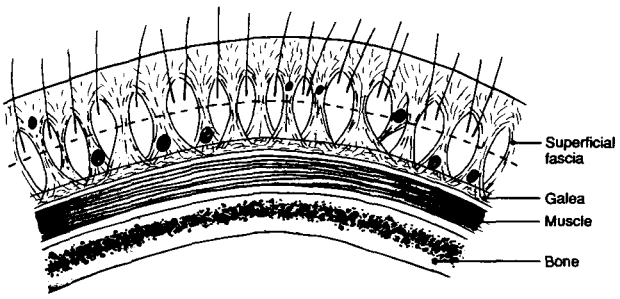


FIG. 1
Plane of dissection is indicated by the dotted line.

Results

Table II illustrates the ten patients studied. Their ages ranged from 15 to 60, and the follow-up period ranged between two and four years. Four patients underwent concomitant tympanoplasty procedures, most frequently to close the Eustachian tube orifice. One patient had a single channel extra cochlea-implant (UCH/RNID) inserted which was covered by the temporoparietal flap. Figures 3 and 4 show the same ear before obliteration and two years afterwards. Nine out of 12 ears were dry and lined with stable epithelium at two years. Three ears had a moist area in the region of the medial attic/antral wall, an area which was difficult to obliterate. In one case a significant hearing improvement was achieved by simultaneous tympanoplasty with a 20dB gain in the speech frequencies to 15dB thresholds. Three of the patients had dead ears pre-operatively but none of the remaining cases were suitable for ossicular reconstruction because the ossicles were absent and the mucosa was scarred.

Complications

One patient developed a seroma under the scalp flaps which required aspiration. In one patient, it was dis-

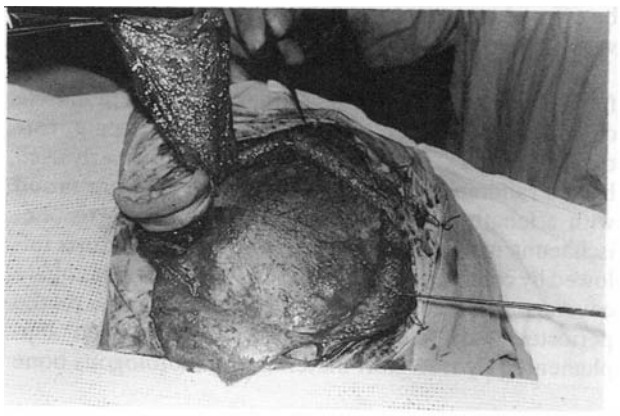


FIG. 2
Raising a large temporoparietal fascia flap.

https://doi.org/10.1017/S0022215100116184 Published online by Cambridge University Press

TABLE II

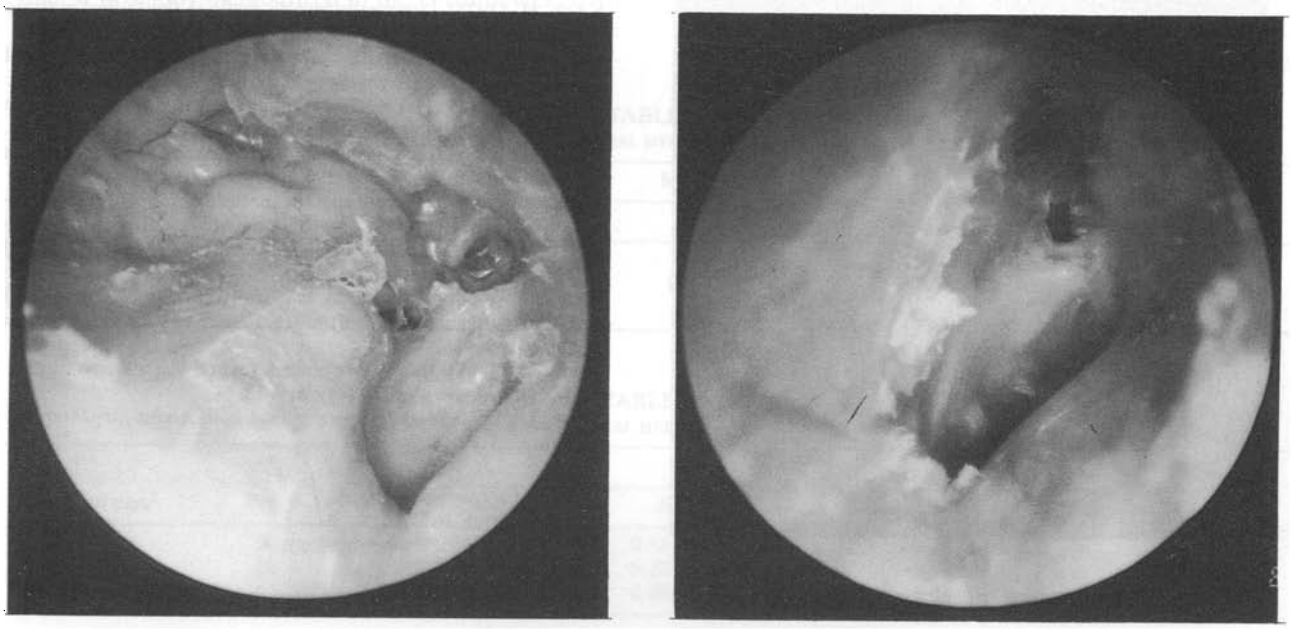
No.	Age	Sex	Surgery	Revisions	Obliteration	Additional procedures	Follow up 6 months	Follow up 24 months
1	15	F	Bilateral MRM 1982	Bilateral Palva flap	1986 (L) 1987 (R)	L Myringoplasty	Moist Moist	Moist Moist
2	57	M	Bilateral Radical Mastoids	Multiple Bilateral	1987 (R) 1988 (L)	–	Dry Moist	Dry Moist
3	52	F	MRM 1983	1986	1987	–	Dry	Dry
4	31	F	MRM 1978	1980	1987	Ossiculoplasty	Dry	Dry
5	60	M	MRM 1975	1982	1987	–	Dry	Dry
6	43	M	Bilateral MRM	Bilateral	1987 (L) Left	Myringoplasty	Dry	Dry
7	24	M	MRM 1982	Meatoplasty 1984	1987	–	Dry	Dry
8	27	M	MRM 1981	Aural Polypectomies	1987	Myringoplasty	Dry	Dry
9	48	M	MRM 1978	2 revisions	1988	–	Dry	Dry
10	35	M	Bilateral MRM	–	1988	L Cochlea implant	Dry	Dry

covered at surgery that the posterior branch of the superficial temporal vessels had previously been divided by an endaural incision. The more anterior vessel was identified and used, but in raising the fascia flap, damage occurred to the frontal branch of the facial nerve. This did not recover at six months and the patient underwent and eyebrow lift to correct his frontal palsy.

Discussion

In most series, the commonest cause of failure in mastoid cavities is inadequate primary surgery. Charachon *et al.* (1989) reviewing their 117 cases of functionally reconstructed old mastoid cavities found that in 70 per cent of patients the cavities were poorly shaped and irregular.

The mastoid bowl heals by secondary intention following open cavity surgery. Epithelialization across granulation tissue occurs from skin around the periphery of the cavity and a stable lining is dependent on an adequate blood supply. In long-standing chronic ear disease, fibrosis and sclerosis can result in poor vascularity in the middle ear and mastoid. Repeated surgery will further contribute to ischaemia in the cavity. In the presence of aggressive mucosal disease, breakdown and ulceration of the skin lining will lead to persistent discharge. If obliteration of the cavity is considered, there are several disadvantages to the use of muscle or periosteum. Local muscle or periosteal flaps have a random pattern blood supply but are rarely of sufficient size or plasticity to line completely and fill a large mastoid cavity. This is particularly true for temporalis muscle flaps which become denervated and are in effect free tissue grafts to a cavity. Sup-



FIGS. 3 AND 4

Pre and 2 years post obliteration.

https://doi.org/10.1017/S0022215100116184 Published online by Cambridge University Press

plementation of a local musculoperiosteal flap with free grafts e.g. bone paste or hydroxyapatite does not improve the vascularity of the area. Previous ear incisions may also preclude the use of local post auricular flaps in many patients.

The temporoparietal fascia flap (Byrd, 1980) is based on the posterior branches of the superficial temporal vessels and can be raised on a narrow pedicle. It can be used for reconstruction around the head and neck as either a pedicled or free microvascular graft (Brent and Byrd, 1983; East *et al.*, 1990). It is suitably plastic to completely obliterate a mastoid cavity whilst retaining its vascular supply. Epithelialization over the fascia flap occurred rapidly and was complete within six weeks in nine out of 12 cases. A stable lining has been maintained for a minimum two year follow-up. Our experience with attempting to obliterate the attic region is similar to that reported by Sheehy (1985) and Palva (1982). The distal supply of our first two flaps appears to have been compromised by pressure at the pedicle. Necrosis of tissue in the attic region was noted and resulted in a small non-epithelialized area. Over the period of a year this progressed to involve the medial attic and antral walls, as the flap retracted. Since then we have routinely skeletonized the middle fossa dural plate at the pedicle to prevent undue pressure on the vessels. There have been no more cases of distal flap necrosis subsequently.

Ear canal widening does occur with this technique (Fig. 5) although it is minimal but the skin has not broken down in any ear which was completely epithelialized at six weeks. We have not confirmed the vascularity of the flap post-operatively but it is common to see small vessels subcutaneously in the posterior wall of the ear canal. This technique therefore has several advantages over musculoplasty operations which produce quite severe pain above the ear, often necrose and invariably shrink (Bartells and Sheehy, 1981). This technique of obliteration was applied to a patient with total deafness following bilateral mastoid surgery. He received a UCH/RNID single channel extra cochlea device which was then covered with the flap (Graham *et al.* 1989). The implant has been functioning for two years.

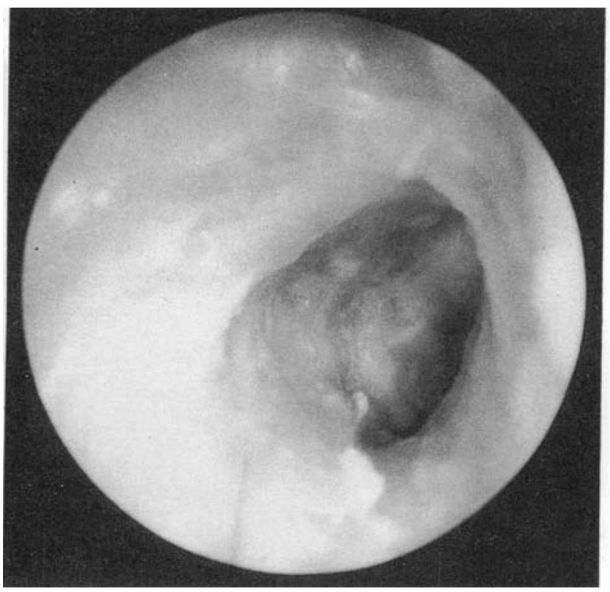


FIG. 5
Slight ear canal widening at two years.

Complications with this procedure related to raising the flap, and these have been overcome by the descriptions above. Although there are limited indications for mastoid obliteration, this procedure is the only method described of introducing well vascularized tissue into the relatively ischaemic area of the mastoid to promote rapid epithelialization. It has proved to be reliable and durable for a minimum follow up period of two years in 10 patients.

References

Bartells, L. J., Sheehy, J. L. (1981) Total obliteration of the mastoid, middle ear, and external auditory canal. A review of 27 cases. *Laryngoscope*, **91:** 1100–1108.

Beales, P. H., Hynes, W. (1958) Rapid healing after mastoid surgery by the use of the post-auricular flap. *Journal of Laryngology and Otology*, **72:** 888–901.

Beales, P. H. (1959) The problem of the mastoid segment after tympanoplasty. *Journal of Laryngology and Otology*, **73:** 527–531.

Bondy, G. (1910) Totalaufmeisselung mit Erhaltung von Trommesfell und Gehörknöchelchen. *Monatsschrift für Ohrenheilkunde*, **44:** 15–23.

Brent, B., Byrd, H. S. (1983) Secondary ear reconstruction with cartilage grafts covered by axial, random and free flaps of temporoparietal fascia. *Plastic and Reconstructive Surgery*, **72:** 141.

Byrd, H. S. (1980) The use of subcutaneous axial pattern flaps in reconstruction of the head. *Annals of Plastic Surgery*, **4:** 191, 1980.

Charachon, R., Gratacap, B., Elbaze, D. (1989) Anatomical and functional reconstruction of old mastoidectomy cavities by obliteration tympanoplasty. *Clinical Otolaryngology*, **14:** 121–126.

East, C. A., Jones, B. M., Grant, H. R. Reconstruction of the cervical trachea with a free temporoparietal fascia flap. British Journal of Plastic Surgery. In press.

Graham, J. M., East, C. A., Fraser, J. G. (1989) Single channel round window cochlea implants: surgical technique and complications. *Journal of Laryngology and Otology*, **Supplement No. 18:** 14–19.

Grote, J. J., Kuijpers, W. (1983) The use of biomaterials in reconstructive middle ear surgery. In: Biomaterials in Reconstructive Surgery, (Ruben, L. R. ed.) C. V. Mosby: St Louis, p 987–995.

Kisch, H. (1928) Temporalis muscle grafts in the radical mastoid operation. *Journal of Laryngology and Otology*, **43:** 735–736.

Mills, R. P. (1988) Surgical management of the discharging mastoid cavity. *Journal of Laryngology and Otology*, **Supplement No. 16.**

Mosher, H. P. (1911) A method of filling the excavated mastoid with a flap from the back of the auricle. *Laryngoscope*, **21:** 1158–1163.

Palva, T. (1973) Operative technique in mastoid obliteration. *Acta Otolaryngologica*, **75:** 289–290.

Palva, T. (1982) Obliteration of the mastoid cavity and reconstruction of the canal wall. In: International Medical Reviews; Otolaryngology 1: Otology. (Gibb, A. G., Smith, M. F. M., eds.) Butterworths: London. p 19–29.

Sade, J., Weinburg, J., Berco, E., Brown, M., Halvey, A. (1982) The marsupialized (radical) mastoid. *Journal of Laryngology and Otology*, **96:** 869–875.

Sheehy, J. (1985) Obliterative procedures in cholesteatoma surgery. *American Journal of Otology*, **6:** 9–12.

Stake, L. (1893) Stacke's operation method. *Archiv für Ohrenheilkunde*, **35:** 198–230.

Address for correspondence:
Charles East, F.R.C.S.,
Ferens Institute of Otolaryngology,
Cleveland Street,
London W1P 5FD.

Key words: Mastoid surgery; Flap, temporoparietal fascia