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Main Articles

A long-term review of the Shah Permavent tube

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Abstract
A retrospective study of 74 Shah Permavent tube insertions is presented. These were inserted into 74 ears of 55 patients during the period between 1985 and 1988. At the time of review, 35 tubes had extruded spontaneously, 11 tubes had been removed for recurrent infections, 10 tubes had been removed electively and 10 tubes were still *in situ*. On examination of the ears approximately 12 months after the tubes had extruded, the overall rate of tympanic membrane perforation was 18.2 per cent. In ears in which the Permavent tube extruded spontaneously the perforation rate was 22.2 per cent. In ears in which the tube was removed because of infection the perforation rate was 20.0 per cent. However in ears in which the tube was removed electively the perforation rate was zero. This finding has implications in the use and management of long-term ventilation tubes.

Key words: Otitis media with effusion; Middle ear ventilation

Introduction

The use of long-term ventilation tubes in the treatment of middle ear effusion has been a contentious issue in otology. The disability caused by glue ear is usually significant and this may be so even in the presence of a normal pure tone audiogram (Shah, 1991). The insertion of a ventilation tube usually restores the hearing to normal levels. However with conventional grommets 30–40 per cent of children may require two or more insertions before the ears are free from effusions. With long-term ventilation tubes, although the need for repeated insertions is lower, there is a significant risk of residual perforation of the tympanic membrane. In a review of 1274 insertions of Goode T-tubes, a residual perforation occurred in 32.6 per cent of cases. Other problems included recurrent otorrhoea in 21.0 per cent and impacted wax in 10.9 per cent (Mangat *et al.*, 1993).

The Shah Permavent tube, developed by one of the authors (NSS), was an attempt to minimize the problems associated with long-term ventilation tubes. The original design, which is described in this paper was based on the House endolymphatic shunt tube. The Permavent tube is smaller and made from high grade silicone rubber. It has a mesh circular disc containing a reinforced flange. Emerging from the circular mesh disc at 45° is a circular tube of 1.55 mm in diameter. The Permavent tube is inserted under general anaesthesia; a curved myringotomy incision is made in the tympanic membrane and fluid is aspirated from the middle ear. Occasionally it may be necessary to enlarge the myringotomy incision and this is performed by fine microscissors to avoid tearing the thin atrophic tympanic membrane. The curved margin of the soft flange is inserted into the incised drum and gently, but firmly, pushed by a blunt needle until the flange is completely inside the middle ear. The external tube shaft may be gently rotated by forceps until the lumen of the tube is on the direct visual axis. In very small children the tube may be trimmed at an angle to shorten the length and alter the shape of the lumen.

In more recent years the circular disc of the Permavent tube has been trimmed and the 'trimmed' Permavent tube has been used in the same way as a Goode T-tube (Abdullah *et al.*, 1994). Figure 1 illustrates a Shah grommet, a 'trimmed' Shah Permavent tube and a conventional Shah Permavent tube.

However the authors believe that in addition to the design and the insertion technique, post-operative management of the tube whilst *in situ* is important in reducing the incidence of complications associated with its use. This includes the use of regular antibiotic steroid ear drops, to prevent the accumulation of migrating squamous epithelium around the shaft of the tube, regular outpatient attendance, with prompt treatment of any ear infection, and elective removal of the tube at an appropriate time.

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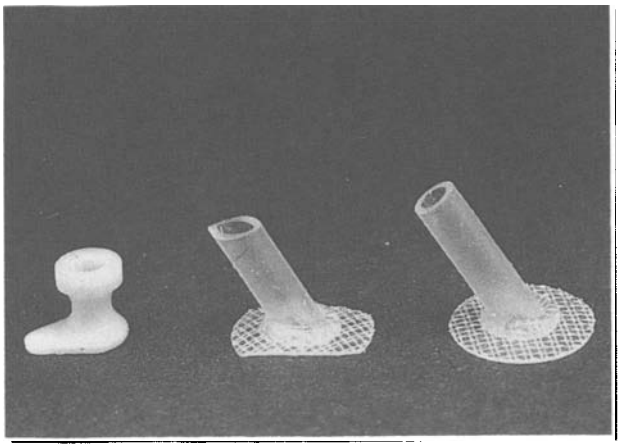

FIG. 1

A Shah grommet (left), a Shah Permavent tube (right) and a trimmed Shah Permavent tube (centre).

Methods and materials

This paper presents a retrospective review of 55 patients who underwent 74 Shah Permavent tube insertions at the Royal National Throat, Nose and Ear Hospital, London, during the period between 1985 and 1988. On review of the notes the following information was obtained: (i) The age of the patient; (ii) indication for insertion of the tube; (iii) details of previous ear surgery; (iv) the result of the post-operative audiogram; (v) information on post-operative otorrhoea when present for a period of more than three months; (vi) the length of time the tube was *in situ*; (vii) whether the tube was removed, extruded spontaneously or was *in situ* and the presence of a residual tympanic membrane perforation at six weeks, three, six and 12 months after the tube had extruded or was removed.

A frequently discharging ear was placed in the otorrhoea category, if otorrhoea was documented in the notes at three or more outpatient visits over a period of three months. The three documented episodes of otorrhoea could be separate individual episodes or a continuous process. The length of time a tube was *in situ* was taken as the midpoint between the date of the last clinic visit when the tube was found to be *in situ*, and the date when it was found to be extruded. Both of the above criteria are somewhat arbitary but are used by most other workers in the field.

Results

The 74 Permavent tubes were inserted into 30 male and 25 female patients with an age range from three to 51 years (mean age 11 years). In 18 of the ears there had been no previous ventilation tube insertions. In 16 of the ears there had been three or more previous ventilation tube insertions. The indications for insertion of the permavent tubes are illustrated in Table I. Post-operatively 86 per cent of patients tested had an audiogram showing 15 dB or better. Twelve (18.5 per cent) of the ears developed otorrhoea within the criteria mentioned. Of these, nine tubes were removed, two extruded spontaneously and one tube was still *in situ*. There was insufficient information in the case notes to include nine patients in these figures. At the time of review 35 tubes had extruded spontaneously (average time *in situ* 36 months; range seven to 88 months), 11 tubes had been removed due to recurrent infection (average time *in situ* 35 months; range 19 to 60 months), 10 tubes had been removed electively (average time *in situ* 46 months; range six to 88 months) and 10 tubes were still *in situ* (average time *in situ* 58.2 months; range 12 to 96 months). Eight ears were lost to follow-up at this stage. The number of residual perforations of the tympanic membrane for the group as a whole is shown in Table II. The number of residual perforations of the tympanic membrane for the group were separated into tubes which extruded spontaneously, tubes which were removed due to recurrent infection and tubes which were removed electively are shown in Table III. Thus at 12 months after the Permavent tube was out of the tympanic membrane, the perforation rate for tubes which extruded spontaneously was 22.2 per cent. For tubes which were removed for recurrent infections, the perforation rate was 20.0 per cent. However, for tubes which were removed electively, the perforation rate was zero. Therefore the incidence of residual perforation can be reduced if ear infections are adequately treated and the tube is electively removed at an appropriate time.

TABLE I

INDICATIONS FOR INSERTION OF THE PERMAVENT TUBE

Indication for insertion	Number
Recurrent middle ear effusion (MEE)	58
Cleft palate with MEE	11
Tympanic membrane retraction	4
Post-microsuction of cholesteatoma	1

Discussion

This paper reports the first long-term follow-up of the Shah Permavent tube. Similar studies have been undertaken on other long-term ventilation tubes in particular the Goode T-tube and the Per-Lee tube. In this study we have assessed the length of intubation and the incidence of complications in a group of patients who initially presented between

TABLE II

THE OVERALL PERCENTAGE RATE OF RESIDUAL PERFORATION FOR ALL TUBES COMBINED

All tubes	Six weeks	Three months	Six months	Twelve months
No residual perforation	30 (55.6%)	38 (74.5%)	36 (76.6%)	36 (81.8%)
Residual perforation	24 (44.4%)	13 (25.5%)	11 (23.4%)	8 (18.2%)
Tube *in situ*	10	10	10	10
No follow-up	10	13	17	20
Total	74	74	74	74

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TABLE III
THE PERCENTAGE RATES OF RESIDUAL PERFORATION FOR TUBES WHICH SPONTANEOUSLY EXTRUDED OR WERE REMOVED

Tubes spontaneously extruded	Six weeks	Three months	Six months	Twelve months
No residual perforation	22 (62.9%)	22 (68.7%)	21 (72.4%)	21 (77.8%)
Residual perforation	13 (37.1%)	10 (31.3%)	8 (27.6%)	6 (22.2%)
Tubes removed due to infection				
No residual perforation	5 (45.5%)	9 (81.8%)	9 (81.8%)	8 (80.0%)
Residual perforation	6 (54.5%)	2 (18.2%)	2 (18.2%)	2 (20.0%)
Tubes removed electively				
No residual perforation	3 (37.5%)	7 (87.5%)	6 (85.7%)	7 (100.0%)
Residual perforation	5 (62.5%)	1 (12.5%)	1 (14.3%)	0 (0.0%)
Tube *in situ*	10	10	10	10
No follow-up	10	13	17	20
Total	74	74	74	74

1985 and 1988. As with other studies on long-term ventilation tubes the main complications are recurrent otorrhoea and residual perforation.

The average intubation time of the 34 Permavent tubes which extruded spontaneously was 36 months. The 10 tubes still *in situ* have an average intubation time of 58.2 months. Therefore on average a Permavent tube can give at least three years improvement in middle ear ventilation. The extrusion rate for short-term ventilation tubes is about six to nine months for Shepard grommets (Hampal *et al.*, 1991) and nine to 15 months for Shah grommets (Hussain, 1992). The average length of intubation of the Goode T-tube varies in the literature from a mean duration of intubation of 24 months (Prichard *et al.*, 1992) to a spontaneous extrusion rate of 33.4 per cent at 48 months (Mangat *et al.*, 1993).

The rate of otorrhoea in this study was 18.5 per cent and this compared favourably with studies on the Goode T-tube i.e. 21 per cent (Mangat *et al.*, 1993), 28 per cent (Brockbank *et al.*, 1987), 54.9 per cent (Prichard *et al.*, 1992), 70.4 per cent (Von Schoenberg *et al.*, 1989). The large variation in otorrhoea rates may be due to the somewhat arbitary nature in which otorrhea is recorded in retrospective studies. However, from this study on Permavent tubes, the importance of keeping the number of ear infections to a minimum is clear. Not only does it reduce the morbidity with consequent hearing impairment of the patient, but it also reduces the need for tube removal due to recurrent infection which is associated with a high rate of residual perforation.

In order to reduce the incidence of otorrhoea this unit employs the following measures: (1) The Permavent tube is inserted under a general anaesthetic using a no-touch technique; (2) at this point a few clear antibiotic/steroid drops are instilled into the operated ear in order to prevent any clotted blood from blocking the tube; (3) If the fluid aspirated is profuse or infected, further drops and oral antibiotics are used for one week; (4) The patient is then reviewed in six weeks. If otorrhoea develops the patient is instructed to attend their GP promptly. The GP is advised to take a microbiological swab if possible and commence empirical antibiotic/steroid drop treatment. Patients can be referred to our daily casualty clinic if the GP feels specialist treatment is necessary. We advise patients to use ear protection when swimming and to avoid diving and prolonged underwater swimming. The patients are also followed up at six monthly intervals in the Otology clinic.

Experience with long-term ventilation tubes has revealed that migrating squamous epithelium may accumulate around the tube as crusting and this may predispose to secondary infection (otitis externa) with discharge. These problems are minimized, or avoided, by the regular use of a few antibiotic/steroid drops every week to keep the tube clean, dry and free from blockage. This is complimented by microsuction at the six monthly outpatient visit.

The other major complication of long-term ventilation tubes has been the development of a residual perforation of the tympanic membrane. For short-term grommets this complication is rare. However for long–term ventilation tubes the perforation rate is high: for the Per-Lee tube 25 per cent (Per-Lee, 1981); Paparella II tube 8.5 per cent (Klingensmith *et al.*, 1985); and the Goode T-tube 21.1 per cent (Prichard *et al.*, 1992), 32.6 per cent (Mangat *et al.*, 1993) and 47.5 per cent (Von Schoenberg *et al.*, 1989). The overall rate of residual perforation in the Permavent study was 18.2 per cent. This ranged from 22.2 per cent for tubes which extruded spontaneously and 20.0 per cent for tubes removed for recurrent infection, to zero per cent for tubes removed electively. Therefore the best results are obtained in an ear where there are few infections and the tube is removed electively. The decision to remove a long-term ventilation tube is based on two opposing factors. Firstly there is the possibility that the original problem requiring a ventilation tube will return necessitating reinsertion and secondly the incidence of complications increases if the tube is left *in situ* for a long period of time. This was confirmed for the Goode T-tube by the Mangat *et al.* (1993) study of 1274 T-tube insertions in which the incidence of complications was found to increase dramatically after the tubes had remained *in situ* for 36 months. In our unit the decision and time of removal of a Shah Permavent tube is based on one of the author's (NSS) clinical experience. The average time before spontaneous extrusion of a Permavent tube has been found to be 36 months and so prior to this stage the tube may be considered for removal. At around the age of 12 years, most children seem to recover from middle ear effusions. Therefore if the

Permavent tube has been *in situ* approaching 36 months in a child who is 12 years of age or more, the tube may often be removed.

When there is only one tube *in situ*, a full audiological assessment, including tympanometry is performed on the opposite ear to assess middle ear aeration and function of the eustachian tube. If these results prove satisfactory then the tube is removed. In the case of bilateral Permavent tubes, one tube is removed initially and the progress of this ear is monitored. The tympanic membrane must heal and eustachian tube function must be satisfactory for six to nine months prior to removal of the second tube. The authors caution against removal of both tubes simultaneously as this can lead to hearing problems.

In order to reduce the rate of residual perforation and to reduce any discomfort to the patient, the Permavent tubes are removed under general anaesthesia. The ear is thoroughly cleaned and the original myringotomy incision is extended with a sickle knife. The Permavent tube is gently retrieved from the tympanic membrane without undue force. After the tube is removed the edges of the perforation are freshened. A piece of gelfoam is placed onto the perforation and a few antibiotic/steroid ear drops instilled. The patient is seen as an outpatient after six weeks and no swimming is allowed until the perforation has healed which may take six to 12 months after the tube has been removed. One more recent development has been the use of the 'trimmed' Permavent tube in the management of glue ear. Abdullah *et al.* (1994) have reported that although the 'trimmed' Permavent tube may have a shorter duration of intubation, it can be left to extrude spontaneously with a reduced chance of residual perforation. It also causes less tympanosclerosis than the conventional Shah grommet.

One regimen which could be adopted is to insert a standard Shah grommet for short-term ventilation, a 'trimmed' Shah Permavent tube for medium-term ventilation and an original Shah Permavent tube for long-term ventilation. This would need to be removed under a general anaesthetic within three years.

Conclusion

The authors recommend the use of the Shah Permavent tube for long-term ventilation of the middle ear as an alternative to the Goode T-tube or the Per-Lee tube. It is imperative however that the patient is adequately managed whilst the tube is in place and the tube electively removed at an appropriate time. In this way, the complications of recurrent otorrhoea and residual perforation can largely be avoided.

References

Abdullah, V. A., Pringle, M. B., Shah, N. S. (1994) Use of the 'trimmed' Shah Permavent tube in the management of glue ear. *Journal of Laryngology and Otology* **108:** 305–308.

Brockbank, M. J., Jonathan, D. A., Grant, H. R., Wright, A. (1987) Goode T-tubes: do the benefits of their use outweigh their complications? *Clinical Otolaryngology* **13: 351–356.**

Hampal, S., Flood, L. M., Kumar, B. U. (1991) The mini-grommet and tympanosclerosis. *Journal of Laryngology and Otology* **105(3):** 161–164.

Hussain, S. S. (1992) Extrusion rate of Shah and Shepard ventilation tubes in children. *Ear, Nose and Throat Journal* **71(6):** 273–275.

Klingensmith, M. R., Strauss, M., Conner, G. H. (1985) A comparison of retention and complication *rates* of large-bore (Paparella) and small-bore middle-ear ventilating tubes. *Otolaryngology-Head and Neck Surgery* **93:** 322–330.

Mangat, K. S., Morrison, G. A. J., Ganniwalla, T. M. (1993) T-tubes: a retrospective review of 1274 insertions over a 4-year period. *International Journal of Pediatric Otorhinolaryngology* **25:** 119–125.

Per-Lee, J. H. (1981) Long-term middle ear ventilation. *Laryngoscope* **91:** 1063–1072.

Prichard, A. J. N., Marshall, J., Skinner, D. W., Narula, A. A. (1992) Long-term results of Goode's tympanostomy in children. *International Journal of Pediatric Otorhinolaryngology* **24:** 227–233.

Shah, N. S. (1991) Otitis media and its sequelae. *Journal of the Royal Society of Medicine* **84:** 305–308.

Von Schoenberg, M., Wengraf, C. L., Gleeson, M. (1989) Results of middle ear ventilation with Goode's tubes. *Clinical Otolaryngology* **14:** 503–508.

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