

# Surgery for otitis media among Indigenous Australians

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Otitis media is ubiquitous among children by the age of 12 months, so it is not surprising that most research has been devoted to controlling otitis media in infancy. Long-term oral antibiotic therapy<sup>1</sup> and pneumococcal vaccination<sup>2</sup> reduce the rate of tympanic membrane perforation during the first 12 months of life, but neither reduces the prevalence of otitis media. Because of the failure of these treatment strategies to significantly reduce the prevalence of otitis media, children in remote areas carry the burden of ear disease into their preschool years. Surgical treatment for otitis media is often considered at this stage. For older children and adults with a tympanic membrane perforation resulting from otitis media, surgery is the treatment of choice.

## Epidemiology

Otitis media becomes clinically apparent in infancy, with evidence suggesting that all Indigenous children develop a middle ear effusion within the first 3 months of life.<sup>1,2</sup> Over the next year of life, increasing numbers of Indigenous children suffer from aural perforation with concomitant discharge, to the extent that by the age of 2 years, about 60% of Indigenous children will have had at least one aural perforation. The incidence of new perforations plateaus by this age,<sup>3</sup> but the prevalence of otitis media, and associated conductive hearing loss, persists throughout early childhood.

The reported prevalence of otitis media, with or without aural perforation, among Indigenous children is between 68% and 91% in cross-sectional surveys;<sup>3-5</sup> similar levels of hearing loss are observed. The World Health Organization regards a prevalence of chronic otitis media above 4% as an emergency.<sup>6</sup> Among Indigenous children, the most conservative estimates place this figure at above 10%, and more recent data presented above suggest a much higher prevalence.<sup>3-5</sup> Through adolescence, the prevalence of otitis media appears to decrease, with some aural perforations closing spontaneously, but many others persist with a conductive hearing loss. Even spontaneous resolution of otitis media in adolescence occurs too late to prevent the major social and educational problems caused by the mild-to-moderate conductive hearing loss<sup>5,7</sup> associated with otitis media.<sup>4,8-11</sup> Surgery can be viewed as a tool to help limit the social consequences of hearing impairment by resolving the underlying disease at a younger age.

## Surgical treatment for otitis media

The surgical procedures that can be offered for otitis media with effusion or recurrent acute otitis media include myringotomy and insertion of tympanostomy tubes (also known as ventilation tubes, and colloquially as "grommets"), and myringotomy combined with adenoidectomy, with or without insertion of tympanostomy tubes.<sup>12</sup> These surgical options all reduce the incidence of otitis media, and in this way improve hearing and general health. There is evidence for improved quality of life within 6 months of grommet insertion.<sup>13-15</sup> The procedures described in this article are performed by surgeons serving remote populations, but the evidence base to support the choice of one over another is weak.

The principle underlying the recommendation for grommet insertion is to ventilate the middle ear when eustachian tube

## ABSTRACT

- Otitis media with effusion and recurrent acute otitis media are ubiquitous among Indigenous children.
- Otitis media causes conductive hearing loss that may persist throughout early childhood and adversely affect social interactions, language acquisition and learning.
- Control of otitis media usually restores hearing to adequate levels. Surgery is to be considered when otitis media has not responded to medical treatment.
- In non-Indigenous populations, tympanostomy tubes ("grommets"), with or without adenoidectomy, can control otitis media; how these findings relate to Indigenous Australians is not known.
- Tympanic membrane perforation is a frequent sequela of early childhood otitis media among Indigenous children. It occurs as early as 12 months of age and causes conductive hearing loss. Perforation is associated with recurrent aural discharge, particularly in the tropics and in desert regions.
- Medical and public health management is required until a child is old enough to undergo surgical closure of the perforation, usually by an age of 7–10 years.
- Surgical closure of the tympanic membrane stops the aural discharge and improves the hearing sufficiently to avoid the need for hearing aids in most cases.
- The success rate of surgery conducted in rural and remote Australia is below urban benchmarks; improving this will probably require funding for community-based follow-up.

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function has failed. In most cases, eustachian tube dysfunction is thought to be caused by adenoiditis leading to an ascending infection up the eustachian tube to the ear,<sup>16</sup> immaturity of the tube in children, and (less often) physical obstruction,<sup>17</sup> or mechanical failure of tubal function. By ventilating the middle ear with a grommet, middle ear effusion is cleared and the mucosa is exposed to air again, helping settle mucosal inflammation and biofilms that could have become established. Adenoidectomy is thought to reduce the burden of nasopharyngeal infection (which is much greater among Indigenous than among non-Indigenous children)<sup>18,19</sup> by resolving the adenoiditis.<sup>16</sup>

In urban non-Indigenous populations, the current recommendation is to insert tympanostomy tubes alone, reserving grommets with adenoidectomy for children requiring further surgical care (the approximately 20% of children who have undergone grommet insertion on at least once previous occasion).<sup>12</sup> Although the benefits of adenoidectomy in reducing the incidence of future otitis media are supported by a good level of evidence,<sup>20-22</sup> this procedure is reserved for those with recurrent otitis media with effusion because it is unnecessary in others (ie, in up to 80% of children for whom otitis media resolves after insertion of one set of tympanostomy tubes) to control the ear disease.

A meta-analysis concluded that adenoidectomy reduces subsequent otitis media by 50%, that the benefit is apparent from the age of 2 years and most effective after the age of 3 years, and its efficacy is independent of the size of the adenoids.<sup>12</sup> On the basis of this meta-analysis, the joint practice guidelines of the American Academy of Family Physicians, the American Academy of Pediatrics and the American Academy of Otolaryngology — Head and Neck Surgery recommend adenoidectomy, concluding that there is a preponderance of benefit over harm.<sup>12</sup>

For remote populations in which otitis media is persistent and recurrent, many ear, nose and throat surgeons favour adenoidectomy for the initial surgical procedure, together with either tympanostomy tube insertion or myringotomy. But there are outstanding issues relating to adenoidectomy in children in remote areas that should be better supported by evidence. Foremost among these is whether adenoidectomy reduces the incidence of subsequent ear disease in remote populations as it does in urban centres,<sup>20–22</sup> given the exceedingly high burden of ear disease and the great extent of nasopharyngeal colonisation with bacteria in remote communities.<sup>19</sup> Whether a recommendation of adenoidectomy for the initial surgical procedure is a departure from the internationally accepted guidelines<sup>12</sup> is subject to debate, as adenoiditis is an indication for primary surgical treatment and is arguably present in most children living in remote regions because the postnasal space is colonised with bacteria in early childhood.<sup>19</sup>

Tympanostomy tubes may be complicated by chronic aural discharge. This is particularly frequent when the ears are allowed to become wet while swimming, especially in contaminated water, but discharge can also be seen in the absence of swimming or humidity for reasons that are not entirely understood. Clinical experience has found that the rates of aural discharge and grommet extrusion are high among children living in desert communities, and even higher among Indigenous and non-Indigenous children living in the tropics.<sup>23</sup> In the tropics, about a third of children with tympanostomy tubes will experience aural discharge,<sup>23</sup> and we estimate that the prevalence is half this in the desert. A chronically discharging grommet will cause a degree of conductive hearing loss.

Might it be possible to reduce the incidence of aural discharge by avoiding tympanostomy tubes through adenoidectomy without insertion of grommets? There is evidence that myringotomy and adenoidectomy can be effective in the treatment of otitis media with effusion.<sup>24</sup> If this is the case, it could be possible to avoid tympanostomy tubes in regions of Australia where grommets are prone to discharge, such as the tropics. Whether this is borne out clinically awaits further clinical research.

Tympanostomy tube insertion also carries with it a small but significant number of potentially adverse outcomes, principally related to postoperative (early and late) otorrhoea; thus, there is consideration for an expanded role of adenoidectomy in management. Other complications included early extrusion of the tube, retained middle ear tubes (especially with postoperative use of tissue spears), a 2% risk of residual perforation after the tympanostomy tube has extruded, and, rarely, cholesteatoma (0.5%).<sup>25</sup> Tympanosclerosis and focal atrophy may occur, but these have not been found to be of functional significance or to affect hearing.<sup>25</sup>

The mortality caused by the type of paediatric anaesthesia required for grommet insertion or adenoidectomy is estimated to be less than one in 50 000.<sup>26</sup> Although there is systematic evidence to conclude that adenoidectomy confers more benefit than harm,<sup>12</sup> there is added complexity resulting from this procedure. The most

significant risk is of postoperative bleeding, but the rate is very low (0.2%–0.5%),<sup>21,22</sup> and occurs most often in the first few hours after the procedure, when the child is still in hospital. Transient velopharyngeal insufficiency has an incidence of 2%.<sup>27</sup> Other potential risks, such as nasopharyngeal stenosis and persistent velopharyngeal insufficiency, are rarely seen and can be minimised with appropriate patient selection and surgical technique.<sup>12</sup>

### Closure of tympanic membrane perforations

The major consequences of tympanic membrane perforation are conductive hearing loss and, in many cases, particularly in the tropics and remote desert regions, recurrent aural discharge. Public health measures, such as the introduction of chlorinated communal swimming pools,<sup>28</sup> reduce the prevalence of tympanic membrane perforation to some extent, presumably by settling aural infection via a reduction in bacterial load achieved through cleansing of the face, hands, ears and nose. Although public health measures will be very important in reducing the future burden of disease, surgery is recommended for children who have established chronic otitis media with perforation. When successful, surgery can control aural perforation by eliminating the tympanic membrane perforation, and will also improve hearing.

Hearing aids are an alternative to surgical closure of the tympanic membrane perforation (myringoplasty) for the correction of a conductive hearing loss, but there are good reasons to prefer the surgical option. First, the presence of a hearing aid increases the prevalence of aural discharge,<sup>29</sup> especially in the presence of a tympanic membrane perforation.<sup>30</sup> Second, there is a significant cost involved in purchase and maintenance of hearing aids, including fitting, repairs and regular purchase of batteries. Third, Aboriginal adolescents are reluctant to wear hearing aids; this may be because of a perceived negative stigma associated with wearing them.<sup>31</sup>

The conductive hearing loss in chronic otitis media may be entirely due to the aural perforation, in which case successful myringoplasty will restore hearing. However, ossicular erosion with discontinuity or scarring of the middle ear, leading to reduced mobility of the ossicles may also accompany chronic otitis media, in which case a residual conductive loss may persist after surgical correction. Recurrent chronic otitis media manifesting as otitis media with effusion, or recurrent acute otitis media, may follow myringoplasty.<sup>24</sup> The latter is seldom seen in adults but is a major risk in young children.

The chronic otitis media observed in Indigenous populations is usually tympanic membrane perforation without ossicular discontinuity, but there is often a degree of middle ear scarring.<sup>32–37</sup> Myringoplasty is usually the surgery of choice, but a mild or moderate conductive deficit may persist after successful closure of the tympanic membrane. In children, the age at which surgery is recommended (typically 7–10 years) will depend on patient-specific factors, including the degree of hearing loss, the morbidity associated with recurrent aural discharge, and the likelihood that the child has outgrown regular bouts of acute otitis media.<sup>38</sup>

The success of myringoplasty is judged by closure of the tympanic membrane perforation and improvement in hearing. Few studies have reported the degree of success of myringoplasty in Indigenous populations, and the interpretation of most studies is complicated by retrospective experimental design, small sample sizes, and high rates of participants lost to follow-up.<sup>32–37</sup> Of patients who are followed up, the success rate of closure of the

**Recovery of hearing after myringoplasty for chronic otitis media among patients who acquired their disease in a developing country or urban Australia**

**Methods**

A retrospective audit (conducted from 2003 to 2007) of the outcomes of myringoplasty for non-cholesteatomatous chronic active otitis media. Ethics approval was granted by the Human Research Ethics Committee of the Royal Victorian Eye and Ear Hospital, Melbourne, Victoria.

A total of 199 patients were grouped according to the demographic in which they acquired the disease, either urban Australia or a developing country. The success of surgery was defined in terms of the percentage of patients who achieved adequate hearing in the ear that had been operated on (defined as air conduction pure tone average < 30 dB hearing loss), following a minimum of 6 months' follow-up after surgery.

**Results**

Otitis media acquired in	Patients, no. (% with adequate hearing)	
	Before surgery	After surgery
Developing country (n = 127)	38 (30%)	97 (76%)
Urban Australia (n = 72)	32 (44%)	50 (69%)

tympanic membrane perforation is 50%–70%, which is lower than expected when compared with similar surgeries conducted in city-based hospitals, where 80%–90% is the norm.<sup>39,40</sup> Hearing results are more encouraging, with the best controlled study (a prospective case series) showing that normal hearing (defined as an air-bone gap of < 25 dB) was achieved in 69% of patients, improving from 28% preoperatively.<sup>37</sup> In the same study, tympanic membrane closure was achieved in 49% of patients, implying that complete closure of a perforation is not required to achieve good postoperative hearing.<sup>37</sup>

The major challenge ahead is to improve the success rates of myringoplasty performed on Indigenous people, and bring these up to the benchmarks expected of city hospitals. The potential causes for this poorer-than-expected success rate are difficult to unravel. We present indirect evidence that the poorer outcomes from myringoplasty performed in outback Australia are unlikely to be related to the inherent nature of the chronic otitis media seen in this setting, as at our institution (the Royal Victorian Eye and Ear Hospital), surgery for chronic otitis media is at least equally successful among patients who acquired their disease in developing countries compared with those from urban Australia (Box). It has been suggested that surgery is less likely to succeed because of the poorer general health status and environmental health conditions experienced by many Indigenous people,<sup>41</sup> and although these factors no doubt affect surgical success, there is some indication that the quality and cultural appropriateness of postoperative follow-up could be more important determinants of the outcome.

To be successful, it is essential that the ear that has been operated on is kept dry after surgery, that there is an early review to ensure that healing is not complicated by infection, and that there is a late review to confirm surgical success and adequate hearing. In practice, there is often little or no postoperative follow-up, and patient compliance with keeping the ear dry is unknown. Hospital-based follow-up can be problematic, as early postoperative

review may be impractical or too costly for people living in remote communities, and there are high rates of failure to attend later follow-up appointments. It has been recognised that follow-up is much more likely to be timely and successful when it is community-based, and that community engagement through local education before surgery offers the best chance of achieving compliance with postoperative care instructions. Where such programs have been instigated, it would appear (anecdotally) that the success rate of myringoplasty has improved. Improving the results of myringoplasty at a national level requires acknowledgement that postoperative care is imperative for good clinical outcomes, but that it is costly and must be appropriately funded.

**Competing interests**

None identified.

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