

## Myringoplasty

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### Abstract

There is marked diversity in the reported success rates for achieving an intact tympanic membrane following myringoplasty. Controversy exists about the factors thought to influence surgical outcome. Both of these facts have important implications for obtaining informed consent prior to surgery.

This study reviews the factors thought to determine the likelihood of achieving complete closure of the tympanic membrane following surgical closure.

**Key words:** Perforation; Myringoplasty; Prognostic Factors; Tympanic Membrane

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### Introduction

Perforations of the tympanic membrane primarily result from middle-ear infections, trauma or iatrogenic causes. The literature suggests that up to 80 per cent of these perforations undergo spontaneous closure.<sup>1</sup> Myringoplasty is the term used to describe the surgical repair of a perforated tympanic membrane. The three principal indications for myringoplasty are (1) recurrent otorrhoea, (2) desire to swim without having to waterproof the ear, and (3) to improve a conductive hearing loss resulting from a non-healing perforation of the tympanic membrane.

Attempts to close perforations of the tympanic membrane date back to the sixteenth century. However, it was not until 1878 that successful closure of the tympanic membrane was achieved.<sup>2</sup> The advent of the operating microscope, antibiotics, advances in anaesthesia and use of inert graft materials have resulted in myringoplasty becoming today one of the more commonly performed otolaryngological ear procedures in adults and children.

However, there is still uncertainty about the prognostic factors in myringoplasty, and there are also significant variations in the reported success rates for achieving an intact tympanic membrane after surgery. The current literature reports variable success rates for closure of the tympanic membrane: 60–99 per cent in adults and 35–94 per cent in children.<sup>3</sup> Furthermore, it is now becoming apparent that re-perforation following myringoplasty may occur several years after the initial surgery; at present, very few studies have such long-term results.

### Factors influencing surgical outcome

The ultimate goal of a myringoplasty is to achieve complete closure of the perforation and to minimize the formation of retraction pockets. Several investigators have studied a variety of factors that may affect surgical outcome, and these are discussed in detail below.

#### *Surgical approach*

There are three recognized surgical approaches for accessing the tympanic membrane for myringoplasty: endaural, postaural and permealatal/transmeatal. In general, the site of the perforation and the surgeon's experience determines the favoured approach. The endaural approach is preferred for posteriorly based or central perforations, whereas the postaural approach allows more superior access to anteriorly based perforations and has the added advantage of avoiding incisions of the anterior canal wall skin. The permealatal approach is an option for small central perforations in which the ear canal is wide enough to allow good visualization of the tympanic membrane through an ear speculum.<sup>1,2</sup> Regardless of the approach used, the incision does not influence the surgical outcome.<sup>3</sup>

Myringoplasty may be performed using either a general or local anaesthetic. Factors influencing the choice of anaesthetic include patient preference, surgeon's experience and availability of resources.

#### *Site of perforation*

Several authors have reported a higher incidence of graft failure in anterior perforations (Quinn and

Ryan, personal communication, 2003).<sup>4,5</sup> This has been attributed to a combination of factors, including anterior perforations being technically more challenging to repair owing to more difficult access, resulting in an increased risk of graft misplacement; the anterior portion of the tympanic membrane also has relatively poorer perfusion. Hung *et al.*<sup>6</sup> recently proposed the anterosuperior anchoring technique to optimize closure for anterior perforations. Despite the difficulties highlighted with anterior perforations, other authors discount perforation site as having an effect on surgical outcome.<sup>7,8</sup> The reason for this disparity is not clear. It is possible that the sample sizes were not sufficient to minimize the effect of false negatives; patient selection criteria may also have differed.

#### *Size of perforation*

A degree of controversy and confusion surrounds the influence of perforation size on the surgical outcome.<sup>4,7–10</sup> The best available evidence to date is probably the results obtained from the prospective myringoplasty audit conducted by the Royal College of Surgeons of England and from the retrospective study of 423 myringoplasties in Edinburgh.<sup>4,11</sup> Each of these two papers contained a large sample size, increasing the power of the study and clearly demonstrating a higher success rate with smaller perforations (measuring less than 50 per cent of the tympanic membrane pars tensa).

#### *Graft*

A variety of grafts for use in myringoplasty have evolved since the full thickness skin graft, initially used by Berthold in 1878. Graft material used today include temporalis fascia (Quinn and Ryan, personal communication, 2003), fat,<sup>12,13</sup> perichondrium,<sup>14</sup> cartilage,<sup>15</sup> paper,<sup>16</sup> dura,<sup>17</sup> skin<sup>18</sup> and alloderm.<sup>19</sup> There is little evidence to support any one particular graft producing the most favourable results for all types of perforations, although temporalis fascia is universally the most common graft used for all perforation types. Fat and paper have been recommended for small perforations in an out-patient setting.<sup>12,13,16</sup> Free skin grafts have also shown promising results in the short term, with the advantage of not having to raise a tympanomeatal flap.<sup>18</sup> Homografts have been used in revision cases in which there may be insufficient temporalis fascia.<sup>17</sup> Alloderm is an allograft from human skin, the skin having been processed so that the graft is acellular, reducing the risk of graft rejection. Its use has been recommended for traumatic perforations.<sup>19</sup> Ahmed and Zaghoul<sup>15</sup> compared temporal fascia with cartilage and reported cartilage as the graft of choice in patients with evidence of eustachian tube dysfunction or anterior or subtotal perforations, and also in revision cases. Autologous temporalis fascia treated with formaldehyde has been suggested as the graft of choice for ears with total or subtotal perforations, with a 93 per cent success rate at six months.<sup>21</sup> In contrast, Karkanevatos *et al.*<sup>14</sup> reported that the type of graft used had no apparent effect on surgical outcome when using temporalis fascia, subcutaneous tissues or perichondrium.

#### *Technique*

Graft overlay and underlay are the two commonly accepted surgical techniques for myringoplasty. A recent randomized, prospective study<sup>20</sup> yielded comparable results by either technique in experienced hands, in accord with the results of other investigators.<sup>7</sup> Additional studies reserve the underlay technique for posterior perforations and the overlay technique for large, central and anterior perforations.<sup>22</sup> It is generally accepted that the overlay technique provides excellent exposure of the anterior meatal recess; however, it is technically more difficult and has been associated with a higher rate of infection and delayed graft uptake. Hence, the underlay technique is the preferred method in most hands.<sup>20</sup> Controversy exists regarding whether or not the overlay technique results in improved hearing post-operatively.<sup>20</sup> The over-under technique is a combination of the above two techniques, in which the graft is placed medial to the remnant tympanic membrane but lateral to the handle of the malleus. Post-surgical results with this technique have been comparable to those using the underlay or overlay method. This approach is suitable for all perforations<sup>22</sup> in which the handle of the malleus is present and is the method of choice in cases in which ossicular reconstruction is a possibility. However, this technique is not possible in the absence of the handle of the malleus.

#### *Antibiotics*

Infection is one of the most common causes of failure in myringoplasty.<sup>23</sup> Earlier studies researched the influence of pre-, peri- and post-operative antibiotics on the graft uptake rate. All authors concluded that there was not any significant difference in the graft take rate between subjects who had been treated with prophylactic antibiotics and those who had not.<sup>4,24–26</sup> Although these studies were randomized, the total duration of follow up was only eight weeks; further studies with at least a 12-month follow up are likely to be more informative.

#### *Condition of the ear*

The condition of the ear at the time of surgery is not a reliable predictor of subsequent post-operative graft infection. Carlin *et al.*<sup>25</sup> demonstrated that 20 per cent of perforated ears (both wet and dry) grew pathogens on culture. *Staphylococcus Aureus* was the most common pre-operative pathogen isolated. The influence of a discharging ear on the graft take rate remains in dispute, as some authors believe surgery produces optimal results in dry and uninfected ears<sup>4</sup> while others believe wets ears to be preferable.<sup>27</sup> Furthermore, some studies have not considered the peri-operative condition of the ear to be a prognostic factor in myringoplasty.<sup>4</sup> Further research on the effect of the condition of the ear on the graft uptake rate is necessary, as the information available at present has been obtained from retrospective case reviews.

### Mastoid

It is generally accepted that eustachian tube dysfunction and poor pneumatization of the mastoid predispose to chronic suppurative otitis media. A well aerated mastoid is thought to act as an air reservoir for the middle ear, thus minimizing the development of negative pressures during periods of eustachian tube dysfunction.<sup>23,28</sup> A recent retrospective study compared myringoplasty alone with myringoplasty combined with simple mastoidectomy.<sup>28</sup> Statistically, neither procedure proved superior in achieving successful closure of the tympanic membrane. However, in subjects in whom a mastoidectomy was performed, subsequent hearing significantly improved and the absence of disease progression resulted in fewer subsequent ear procedures.

An earlier study<sup>23</sup> also supported mastoidectomy as a useful adjunct to myringoplasty, particularly in cases of chronic otitis media. In cases in which the graft had failed, a subsequent computed tomography scan of the temporal bones revealed residual mastoid disease. In addition, the authors commented that good pneumatization of the contralateral ear was an accurate predictor of successful outcome.

Both these studies highlighted the fact that combining mastoidectomy with myringoplasty was safe, and the procedure did not significantly increase operating time or result in further complications.

### Paediatric patients

Successful closure of the tympanic membrane following myringoplasty in children is variable, with reported success rates of between 35 and 94 per cent.<sup>27</sup> The higher incidence of upper respiratory tract infections and the unpredictable function of the eustachian tube are thought to contribute to the lower graft take rate in children.<sup>5,27</sup> In the past, surgeons recommended that any surgical attempts to close ear perforations in children should be delayed until the age of 10 years. However, in more recent studies, age at surgery did not affect the final outcome, and the current opinion is that any child in whom chronic infections and otorrhoea pose a risk to hearing or (substantially) to quality of life should be considered for myringoplasty.<sup>6</sup>

The role of adenoidectomy or adenotonsillectomy in children prior to a myringoplasty remains controversial. It has been proposed that removal of adenoids or tonsils may reduce the frequency of upper respiratory tract infections and improve eustachian tube function in children, thus optimizing middle-ear aeration and reducing the incidence of graft failure after a myringoplasty. Long-term results following a myringoplasty were significantly more favourable in children who had undergone previous adenoidectomy or adenotonsillectomy, in one retrospective study.<sup>29</sup> However, two subsequent, similar studies,<sup>30,31</sup> in addition to a meta-analysis of paediatric tympanoplasty,<sup>32</sup> found that prior adenoidectomy or adenotonsillectomy conferred no advantage to children following a myringoplasty.

### Others

Grade of surgeon, revision surgery and age of patient have been proposed as additional factors influencing the outcome of surgery. Once again, the evidence is conflicting.<sup>4,7,11,19</sup>

### Conclusion

The successful closure of a tympanic membrane perforation following a myringoplasty is dependent upon several factors. Currently, much of the relevant information is based on retrospective studies with conflicting results. Further randomized or case-controlled studies are necessary to determine the prognostic factors in myringoplasty and their effect on surgical outcome. It is important to bear in mind that re-perforation of the tympanic membrane may occur up to two years after the original surgery, hence the need to follow up patients for longer periods.

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