

Combined approach tympanoplasty for cholesteatoma: impact of middle-ear endoscopy

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Abstract

Objective: The aims of this study were (1) to explore whether the experience at the Radcliffe Infirmary (Oxford, UK) supported the use of combined approach tympanoplasty for cholesteatoma, by determining the rate of disease at subsequent surgery, and (2) to assess whether this rate differed from findings reported elsewhere in the literature, possibly due to the effect of using an oto-endoscope.

Study design: Retrospective case review, with data entered prospectively for operations performed by a single surgeon.

Setting: Tertiary referral hospital.

Patients: Between January 1998 and December 2004 inclusive, 66 patients underwent 68 primary procedures, with data available for all 'second looks'.

Interventions: Diagnostic and therapeutic operations for cholesteatoma were performed.

Main outcome measures: All patients in this study attended follow up and underwent a second look operation, during which the rate of residual and recurrent cholesteatoma was determined. An oto-endoscope was used at all primary and subsequent surgery.

Results: The mean interval between the first and second combined approach tympanoplasty procedures was 16 months, and that between the second and third such procedures was 19 months (10 patients). One patient underwent a fourth combined approach tympanoplasty procedure, 17 months after a third such procedure. The rate of cholesteatoma at second combined approach tympanoplasty was 20.6 per cent (14/68); this was judged to be residual in 10 ears (14.7 per cent) and to be recurrent, with the redevelopment of retraction pockets, in four ears (5.9 per cent). The rate of cholesteatoma at third combined approach tympanoplasty was 20 per cent (two of 10); of these two, one patient had a small pearl in the middle ear removed with the aid of a potassium titanyl phosphate laser. There was no disease present in one patient at a fourth combined approach tympanoplasty. Only four patients required a modified radical mastoidectomy.

Conclusion: Cholesteatoma remains a disease with significant morbidity. Endoscope-assisted surgery may decrease the morbidity of second look surgery and may improve the clearance of disease in appropriately selected patients.

Key words: Chronic Otitis Media; Cholesteatoma; Otologic Surgical Procedures; Endoscopy

Introduction

Combined approach tympanoplasty has traditionally been associated with a higher risk of leaving residual cholesteatoma, compared with canal wall down procedures. In our experience, combined approach tympanoplasty offers several advantages, and provides an excellent view of the facial recess and incus region while maintaining an intact posterior ear canal. This avoids the inherent problems related to mastoid cavity formation and provides a physiological tympanic membrane position; it may also allow more numerous ossicular reconstruction techniques. The key disadvantage of the canal wall up approach

is a potentially increased risk of residual and recurrent disease.

In recent years, endoscopy has allowed better visualisation of the middle-ear space and may increase the ability to completely remove cholesteatoma during canal wall up surgery.^{1,2} The aims of this study were (1) to explore whether the experience at the Radcliffe Infirmary (Oxford, UK) supported the use of combined approach tympanoplasty for cholesteatoma, by determining the rate of disease at subsequent surgery, and (2) to assess whether this rate differed from findings reported elsewhere in the literature, possibly due to the effect of using an oto-endoscope.

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Methods

Between January 1998 and December 2004 inclusive, 66 patients underwent 68 primary combined approach tympanoplasty procedures, with data available for all 'second look' procedures. Data were entered prospectively for operations performed by a single surgeon. The rate of residual and recurrent disease was determined at second look surgery. Data were recorded for the site and extent of cholesteatoma at subsequent surgery and for the ossiculoplasty techniques used at second and third combined approach tympanoplasty procedures. The rate of modified radical mastoidectomy was determined. All patients underwent endoscopic evaluation of the mastoid cavity and middle ear during their second combined approach tympanoplasty, by post-auricular access (see Figures 1 to 3).

A Storz (Tuttingen, Germany), 2.7 mm, 45° oto-endoscope was used at all procedures. Endoscopy was useful, both for the initial assessment of the extent of cholesteatoma and for confirmation of clearance of disease at completion of surgery.

In our unit, the first combined approach tympanoplasty procedure included: initial microscopic ear examination; lifting of a tympanomeatal flap; assessment of the middle-ear cleft; cortical mastoidectomy and epitympanectomy; posterior tympanotomy (of sufficient size to allow inspection of the middle ear with the 2.7 mm endoscope); removal of the cholesteatoma; and, finally, tympanoplasty.

Second combined approach tympanoplasty procedures commenced with microscopic examination of the ear. We then proceeded to post-auricular stab incision (see Figures 1 and 2) and evaluation of the mastoid cavity with a 45° oto-endoscope. The middle-ear cleft was evaluated with a 45° oto-endoscope through the posterior tympanotomy slot, and then via a permeatal access tympanomeatal flap when appropriate. When there was no evidence of disease, these approaches allowed limited patient discomfort post-operatively, and discharge from

hospital on the same day as surgery was possible. When disease was detected, it was sometimes possible to remove it endoscopically; however, when needed, we opened the post-auricular wound and proceeded as appropriate.

Results

The mean age at operation was 18 years (range five to 63 years). The mean interval between the first and second combined approach tympanoplasty procedures was 16 months, and that between the second and third such procedures was 19 months (10 patients). One patient underwent a fourth combined approach tympanoplasty procedure, 17 months following a third such procedure. The rate of cholesteatoma detection at second combined approach tympanoplasty was 20.6 per cent (14/68). Residual disease was present in 10 ears (14.7 per cent) as follows: pearl over the stapes (four); middle-ear pearl <3 mm (two); round window niche (one); epitympanum (one); hypotympanum (one); and around an incus banked in the mastoid (one). In four ears, disease was recurrent at the second combined approach tympanoplasty procedure, with the redevelopment of retraction pockets (four out of 68 = 5.9 per cent recurrent).

Seven children aged between five and eight years underwent a first combined approach tympanoplasty. Of these seven, three had cholesteatoma detected at a second combined approach tympanoplasty. All three of these children had limited disease and did not require conversion to modified radical mastoidectomy.

The rate of cholesteatoma at third combined approach tympanoplasty was 20 per cent (two of 10). Of these two patients, one had a small pearl on the cochlear promontory, removed with potassium titanyl phosphate (KTP) laser. There was no disease present in one patient at a fourth combined approach tympanoplasty procedure.



FIG. 1

The mastoid cavity was evaluated with a 45° oto-endoscope, using a post-auricular stab incision.



FIG. 2

Closer view of the post-auricular stab incision shown in Figure 1.

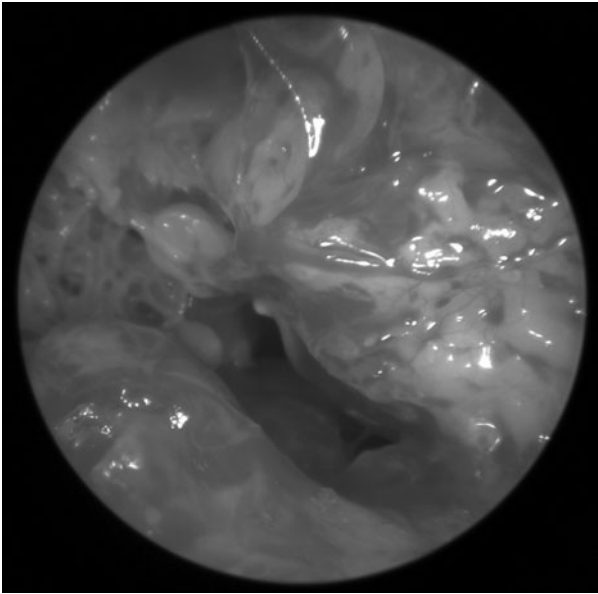


FIG. 3

Endoscopic view of a right posterior tympanotomy slot, viewed from the mastoid cavity. This demonstrates the head of the malleus and the under-surface of the tympanic membrane, and provides good visualisation of the middle ear.

A total of four modified radical mastoidectomies were performed in this series. One patient required this procedure bilaterally for cholesteatoma located in the mastoid, in both the left ear (as the second operation) and the right ear (as the third operation). Two other patients required conversion to modified radical mastoidectomy as a second procedure, for cholesteatoma located in the epitympanum.

An ossiculoplasty was performed in 24 patients during their second combined approach tympanoplasty procedure, and in three patients during their third such procedure. The ossiculoplasty options used included: endoscopic incus interposition (13); Xomed® (Medtronic, Jacksonville, Florida) partial ossicular replacement prosthesis (PORP) and total ossicular replacement prosthesis (TORP) (eight); the Cause Flex H/A® (Medtronic, Jacksonville, Florida) PORP and TORP (three); and SerenoCem™ for limited long process of incus erosion (three). A type III tympanoplasty was otherwise routinely performed if ossiculoplasty was not possible.

Discussion

The number of combined approach tympanoplasty procedures performed for the management of cholesteatoma at the Radcliffe Infirmary has increased over the past decade. This has been guided by a drive to avoid creating a mastoid cavity when possible. Traditionally, patients with cholesteatoma were treated with canal wall down mastoidectomy.³ Today, technological advancements which may facilitate the selection of patients for combined approach tympanoplasty include: pre-operative imaging; intra-operative facial nerve monitoring;

oto-endoscopy; and the use of an intra-operative laser to assist with disease clearance. The use of oto-endoscopy may improve visualisation of the middle-ear space and may increase the ability to completely remove cholesteatoma during canal wall up surgery.^{1,2} This study explored whether our experience supported the use of combined approach tympanoplasty for cholesteatoma, by determining the rate of disease seen at subsequent surgery and investigating whether this rate differed from other reported findings, possibly due to the effect of using an oto-endoscope.

The use of an oto-endoscope may increase the surgeon's ability to completely visualise and remove cholesteatoma. Based on our experience, we suggest that oto-endoscopy may improve the early detection of small volume disease during the second combined approach tympanoplasty procedure. Furthermore, performing second look surgery lowers the risk of morbidity for patients with persistent or recurrent cholesteatoma. Positive reasons for carrying out combined approach tympanoplasty surgery include: the presence of a relatively well pneumatised mastoid and middle-ear cleft; adequate epitympanic aeration and a high-lying middle fossa dura; healthy middle-ear mucosa; the presence of an open tympanic isthmus; and, preferably, limited volume cholesteatoma. Today, we reserve canal wall down mastoidectomy for patients who do not commit to having two procedures, or for those patients who have had unsuccessful combined approach tympanoplasty.

Combined approach tympanoplasty has traditionally been associated with a higher risk of residual disease, compared with canal wall down procedures. Historical studies indicate a residual cholesteatoma rate after combined approach tympanoplasty of around 26⁴ to 40 per cent⁵. The oval window, anterior epitympanic space and sinus tympani areas may be difficult to visualise with an intact canal wall. Incomplete visualisation may allow disease in the epitympanum and mastoid to progress unseen, and endoscopic visualisation may assist with disease clearance in these sites. McKennan² reported results for endoscopic assessment in 15 patients, nine to 16 months following first stage intact canal wall mastoidectomy with tympanoplasty, for primary, acquired epitympanic cholesteatoma. Three of the 15 patients (20 per cent) had residual cholesteatoma. The use of an endoscope may allow improved visualisation and reduce the morbidity of the second look procedure. The attic, medial scutal wall, sinus tympani, facial recess, hypotympanum and other recesses are visualised with angled endoscopes, using minimal dissection and without the time-consuming removal of overlying bone.⁶ New data from Hamilton⁷ suggest that the use of KTP laser can diminish the rate of residual disease following intact canal wall cholesteatoma surgery and can significantly improve the rate of complete disease removal. In our unit, we now routinely use the KTP laser during combined approach tympanoplasty surgery and find it especially helpful in removing disease over the stapes/oval window region.

Cholesteatoma may be detected many years after primary surgery. Residual cholesteatoma represents keratin epithelium that was not removed during the initial surgery. This may manifest during the second combined approach tympanoplasty procedure as an encapsulated, squamous pearl. Recurrent cholesteatoma appears because of inadequate temporal bone ventilation via the eustachian tube. With an uncorrected underlying disease process, a second, recurrent cholesteatoma may develop. The most important factor behind cholesteatoma recurrence after combined approach tympanoplasty is the redevelopment of retraction pockets, which result from the inherently unstable nature of the reconstructed attic and pars tensa. These retractions may be associated with long-term problems of middle-ear aeration and eustachian tube dysfunction.⁸ Gristwood and Venables⁹ studied the natural history of cholesteatoma and reported follow up after atticotomy and attico-antrostomy. The age of the patient at operation had a very strong effect on the probability of residual disease, with the young patient being more at risk than the older patient. Overall, this work revealed that 45 per cent of residual disease was detected within two years of surgery, and 80 per cent had appeared within five years. Long-term follow up is recommended following surgery for cholesteatoma.

Combined approach tympanoplasty for cholesteatoma is more appropriate for the patient with a well pneumatised mastoid. Austin¹⁰ reported that, if single-stage canal wall up procedures were used with larger mastoids and canal wall down procedures with smaller mastoids, 80 per cent of patients could be controlled without the appearance of residual or recurrent disease. Potential reasons for unsuccessful combined approach tympanoplasty include: inadequate epitympanic aeration; diseased residual middle-ear mucosa; and a closed tympanic isthmus.¹¹ Indications for canal wall down surgery include: extensive, recurrent cholesteatoma after canal wall up surgery; an extremely contracted mastoid; matrix overlying a semi-circular canal fistula;¹² situations in which no healthy mucosa can be preserved;¹³ low-lying middle fossa dura; or, obviously, a severely destroyed posterior canal wall.

In our series, the rate of cholesteatoma found at second combined approach tympanoplasty was 20.6 per cent (14/68). This was limited to one site in 10 ears (10/68 = 14.7 per cent residual) and was detected in the following sites: pearl over the stapes (four); pearl on the promontory (<3 mm) (two); round window niche (one); epitympanum (one); hypotympanum (one); and around an incus banked in the mastoid (one). In four ears, at second combined approach tympanoplasty, the disease was associated with the redevelopment of retraction pockets (four of 68 = 5.9 per cent recurrent) and was found in the mesotympanum and mastoid cavity. In a series of 40 cases of failed combined approach tympanoplasty, the commonest cause of failure was adhesions between the facial ridge and the tympanic membrane, causing segmental attico-mastoid mal-aeration in 51.3 per

cent of cases followed up continually. Other causes were large dermoids, incomplete removal of squamous epithelium and eustachian tube obstruction.¹⁴

In our series of 66 patients, seven children aged between five and eight years underwent combined approach tympanoplasty. Of these seven, three had cholesteatoma detected at a second combined approach tympanoplasty procedure. All three of these children had limited disease and did not require conversion to modified radical mastoidectomy. Stangerup *et al.*¹⁵ reported an increased risk of cholesteatoma recurrence in children under eight years of age. The risk factors for recurrence identified in this series were: poor middle-ear ventilation; large volume of cholesteatoma; and ossicular erosion. Iino *et al.*¹⁶ reported the reasons for recurrence as including attic cholesteatoma and otitis media with effusion in the ipsilateral or contralateral ear.

- **This study explored the use of oto-endoscopy as a tool for assessing the state of the ear during second stage intact canal wall cholesteatoma surgery, in 68 ears**
- **Use of endoscopes for second stage surgery allowed a small, postaural incision to be utilised, thus reducing potential morbidity**
- **The use of an oto-endoscope may improve visualisation of the middle-ear space and may increase the ability to completely remove cholesteatoma during intact canal wall approaches**

We consider the combined approach tympanoplasty as a two-stage procedure, and we obtain consent for a second operation (in order to exclude residual or recurrent disease) prior to the initial surgery. Syms and Luxford¹⁷ reported patient reliability with this procedure. Of 486 patients undergoing surgery (70 per cent canal wall up procedure), 341 had a planned second stage. Of these, 107 (28.80 per cent) did not attend. Patient follow up must be assured before embarking on combined approach tympanoplasty for cholesteatoma; otherwise, modified radical mastoidectomy is the safer option. As a guide to timing the second look in the asymptomatic patient, Gristwood⁹ recommended that re-exploration be performed no earlier than two years and no later than three years after the primary operation. The timing of the second combined approach tympanoplasty procedure should be such that residual or recurrent disease is of sufficient volume to be straightforwardly detected and removed. We suggest that an interval of around 12 to 18 months is reasonable for adults, and that for paediatric patients the second look should be performed after around 12 months. These intervals should be adjusted based on the extent of disease at the initial surgery.

Cholesteatoma remains a disease with significant morbidity. The use of oto-endoscopy may improve visualisation of the middle-ear space and may increase the surgeon's ability to completely remove cholesteatoma during canal wall up surgery. Based on our results and a review of the international literature, we suggest that combined approach tympanoplasty is appropriate for those patients who have preserved attic mucosa, and who are reliable and committed to undergoing repeated procedures as necessary. Today, we reserve canal wall down mastoidectomy for patients who do not commit to having two procedures, and for those patients who have had unsuccessful combined approach tympanoplasty. Endoscope-assisted, combined approach tympanoplasty may enhance the clearance of disease in appropriately selected patients.

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