

# TYMPANOSCLEROSIS IN THE TYMPANIC MEMBRANE: INFLUENCE ON OUTCOME OF MYRINGOPLASTY

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## ABSTRACT

The effect of the presence of tympanosclerotic plaques in the tympanic membrane on the outcome of a myringoplasty procedure was evaluated in this retrospective study. Long-term results of 714 myringoplasties were analyzed, and of these, 555 were eligible for further study. Three groups were studied separately: ears without tympanosclerosis, ears with a plaque not exceeding one third of the tympanic membrane surface area, and ears with a plaque involving more than one third of the surface area extending to the border of the perforation. The latter group was subdivided into one in which during the operation the plaque was removed and one in which it was left in place. Take rate percentages as well as postoperative hearing results were calculated for each separate group of ears. Concerning graft take rate, it is concluded that the presence of tympanosclerosis in the tympanic membrane played no substantial part in the long-term outcome. With regard to postoperative hearing results, however, this study shows an average hearing gain of 6 dB when plaques exceeding one third of the tympanic membrane surface area were removed as part of the myringoplasty procedure.

Surgical closure of a tympanic membrane perforation is a well-established procedure. It may be either an operation in its own right or part of a more extensive procedure in chronic ear surgery. Many reports exist on short- and long-term results of myringoplasty. Short-term success rates are favorable almost without exception, varying from 81% to 96%,<sup>1-9</sup> whereas long-term results vary from 78% to 92%.<sup>10-13</sup> Factors that predispose to failure have been extensively studied in the past decades, but so far no uniform agreement exists on a number of them.

Some authors consider site of the perforation an important factor, stating either that anterior localization predisposes to an unfavorable take rate of the graft<sup>6,11</sup> or posteroinferior perforations carry a greater risk of reperforation.<sup>14</sup> Others have found perforation site not to be significant.<sup>7,8,12,13</sup> Also, the size of the perforation often has been mentioned as a determining aspect. Some reports indicate that large perforations are more prone to reperforation,<sup>15,16</sup> whereas other studies have failed to show any influence of perforation size on take rate.<sup>7,8,12,13</sup>

Other factors that have been debated include grafting techniques and graft material, condition of the middle ear during surgery, and the patient's age. Concerning these, the majority of studies have indicated that better results are obtained with autologous grafting material, using the underlay technique, and

that results are independent of the condition of the middle ear during surgery and the age of the patient.<sup>7,8,12,17</sup> It has been convincingly shown, however, that one of the main causes of failure is an immediate postoperative infection.<sup>10</sup>

It has been argued that deposition of tympanosclerotic plaques in the perforated tympanic membrane might also complicate grafting and influence the final outcome.<sup>7,18,19</sup> To determine whether presence or removal of calcareous plaques in the tympanic membrane compromised graft take rate and postoperative hearing results, a retrospective analysis of myringoplasties was performed by the authors between 1976 and 1986.

## PATIENTS AND METHODS

All patients who had a primary myringoplasty performed between January 1, 1976 and January 1, 1986, at the University Hospital Nijmegen were recalled, and 692 of them (70%) attended. Twenty-two patients underwent bilateral operations, bringing the total to 714 myringoplasty procedures in 361 male and 353 female subjects, aged between 12 and 56 years.

Inclusion criterion for ears to be accepted for this retrospective study was the presence of a tympanic

membrane perforation with an otherwise healthy middle ear that had not been operated on previously. Exclusion criteria were the presence of chronic otitis, a cholesteatoma, a follow-up of less than 2 years, and the absence of adequate data, which left 555 ears eligible for study (Table 1). Ears with tympanosclerosis in the tympanic membrane were subdivided into a group with a limited amount of tympanosclerosis (a plaque not exceeding 1/3 of the membrane surface) and a group with extensive tympanosclerosis (a plaque involving more than 1/3 of the membrane and extending to the border of the perforation). The latter group was further subdivided into two groups: one in which the plaque was removed during surgery and one in which the plaque remained in place. This required conclusive data concerning size and site of the tympanosclerotic plaque and whether it was removed during surgery. These data were assessed on the basis of preoperative drawings of the tympanic membrane and/or detailed surgical reports.

Grafting took place in a similar manner in all cases. Temporal muscle fascia was obtained and inserted onto the medial surface of the drum remnant. Depending upon the site of the perforation (i.e., the visibility of the anterior perforation margin), either a postauricular or an endaural approach was used. As a rule, the ossicular chain was tested for its mobility in all cases.

The hearing result was evaluated by comparing the individual preoperative audiogram and the one that was made at the last visit to the clinic. The hearing thresholds were averaged over the frequency range 0.5, 1, and 2 kHz. Pure-tone audiometry was performed using standard procedures and equipment. The audiometer (Interacoustics AC-5 with TDH 39P headphones, Telephonics, Huntington, New York) was calibrated according to ISO Standards 389.

**Table 1. Myringoplasty Procedures Performed**

Total number of patients	985
Patients attending for long-term follow-up	692
Total number of ears	714
Excluded for various reasons (n = 159)	
Chronic otitis	69
Cholesteatoma	8
Short follow-up	54
Inadequate data	28
Ears selected for this study	555
Ears without tympanosclerosis	381
Ears with tympanosclerosis	174
Ears with small plaques (< 1/3 surface area)	112 of 174
Ears with large plaques (> 1/3 surface area)	62 of 174
Ears with tympanosclerosis left in place	38 of 62
Ears with tympanosclerosis removed	24 of 62

Tympanosclerotic fixation of the ossicular chain was found in 14 cases, all in ears with extensive tympanosclerosis, whereas interruption of the ossicular chain was found in four ears. In determining the postoperative hearing results, these ears with coexisting ossicular pathology were excluded.

The minimum follow-up period was 2 years with a maximum of 13 years 6 months and a mean follow-up of 7 years 6 months. The graft take rate of myringoplasties without tympanosclerosis and those with and without removal of the tympanosclerotic plaques from the tympanic membrane was calculated, and the results of these three groups were compared. Also, the individual hearing result in these three groups was compared to determine whether removal of tympanosclerotic plaques influenced the outcome.

## RESULTS

The etiology of the tympanic membrane perforations in this study was usually infection or prior ventilation tube insertion. Most myringoplasties were performed on dry ears. Perforations were usually located in the center of the tympanic membrane. The presence of an intact tympanic membrane at the last follow-up visit was designated as a success. The overall results of surgery are presented in Table 2.

The total number of re-perforations in 555 ears was 68 (12%), which amounts to an overall success rate of 88%. In the group without tympanosclerosis (n = 381), 41 re-perforations were noted (11%); that is, a take rate of 89%. Table 2 shows that in the tympanosclerosis group, including its subdivisions, take rates of between 83% and 85% were found. There were no significant differences in take rate detected among any of the (sub) categories (chi-square test, 5% probability level).

Table 3 summarizes the hearing results of the different groups. The average air conduction gain of the non-tympanosclerotic group and the group with limited depositions was 11 dB and 10 dB, respectively. In the group with extensive tympanosclerosis, 18 ears had coexisting ossicular pathology. They all were found in the group in which plaques were not removed. Most of these (14) had tympanosclerotic fixation of the ossicular chain attributable to deposits that were often continuous with those in the tympanic membrane. In these cases surgeons did not attempt removal.

When large plaques had been removed, the mean individual change in air-bone (A-B) gap was 16.79 dB (SD = 5.11), whereas when they were left in place, mean individual gain was 10.95 dB (SD = 2.86). It should be noted that both of these groups had a similar A-B gap before operation. The difference (about 6 dB) in change in A-B gap was significant (Student's t-test, 42 degrees of freedom,  $t = 4.55$ ,  $p < .05$ ). A postoperative increase of bone conduc-

Table 2. Take Rate in Ears with Tympanosclerosis

	Total Number of Ears with Tympanosclerosis	Moderate Amount of Tympanosclerosis	Tympanosclerosis in Border of Perforations	
			Removed	Not Removed
Myringoplasties	174	112	24	38
Reperforations	27	17	4	6
Take rate	147/174 (84%)	95/112 (85%)	20/24 (83%)	32/38 (84%)

tion level was noted in three ears, not exceeding 15 dB. There were no dead ears.

DISCUSSION

Myringoplasty is considered to be a routine operation with generally good results. A possible cause of failure is considered to be the presence of tympanosclerotic plaques in the tympanic membrane remnant. Tympanosclerotic plaques are situated in the lamina propria, and because blood vessels are also situated in this layer, blood supply may be compromised, which could have a negative influence on epithelial immigration. Analysis of the results of this retrospective study showed no significant difference in the graft take rate between the tympanosclerotic and the non-tympanosclerotic groups. This is in agreement with a previous study by Gibb and Chang.<sup>7</sup>

When borders of the perforation are involved, one is tempted to excise deposits, but this can result in tears in the tympanic membrane remnant and a large perforation that is technically more difficult to close. This study showed that excision of such plaques did not give better results concerning take rate. Overall, graft take rates in all groups in this report with a follow-up as long as 13 years 6 months are similar to other reports in the literature.

Hearing results in simple myringoplasty are, as a rule, favorable. The clinical importance of tympanosclerotic deposits in the tympanic membrane depends on their size. When only small deposits are present, hearing loss is usually insignificant.<sup>20,21</sup> In a study of children who had been previously treated with venti-

lation tubes for secretory otitis media, Tos and Poulsen found no difference in speech reception thresholds between ears with tympanosclerosis and ears with a healthy pars tensa.<sup>22</sup> Tos and Stangerup found a mean difference of maximally 1 dB at the frequencies 250, 1000, and 4000 Hz between thresholds of normal ears and ears with tympanosclerotic drums.<sup>23</sup>

A large plaque, however, may severely impair mobility of the tympanic membrane and result in a mild to moderate hearing loss.<sup>24</sup> It may be adherent either to the bony annulus or to the handle of the malleus or it may make contact with the promontory. When a large plaque involves the anterior half of the tympanic membrane, it may be fixed to the bony annulus in front and to the handle of the malleus behind, causing both immobility of the tympanic membrane and fixation of the ossicular chain. In this study this was the case in 14 ears.

Postoperative hearing results were as expected in the non-tympanosclerotic group and the group with small depositions with a mean A-B gap of 4 dB and 6 dB, respectively. This compares well with the hearing results in the group with a large plaque of tympanosclerosis that was removed during the operation, which resulted in a mean A-B gap of 5 dB. This is in accordance with the study of Emmett and Shea,<sup>25</sup> although the numbers in that study were too small to justify any conclusions. In the group in which the plaques were not removed, however, the postoperative hearing result was worse, with an average air conduction of 16 dB and a mean A-B gap of 12 dB.

In conclusion this study shows that neither small nor large tympanosclerotic plaques in a perforated tympanic membrane compromise graft take rate.

Table 3. Hearing Results of 555 Myringoplasty Procedures

	Preoperative		Postoperative	
	Air Conduction (dB)	A-B Gap (dB)	Air Conduction (dB)	A-B Gap (dB)
No tympanosclerosis in TM (n = 381)	19	15	8	4
Tympanosclerosis in TM				
Small plaques (n = 112)	20	16	10	6
Large plaques removed (n = 24)	26	22	10	6
Large plaques not removed (n = 20)*	26	22	16	12

TM = tympanic membrane

\*18 ears excluded due to coexisting ossicular pathology

When large plaques are present however, hearing will significantly benefit when depositions are removed.

### REFERENCES

1. Strahan RW, Acquarelli M, Ward PH, Jafek B: Tympanic membrane grafting. Analysis of materials and techniques. *Ann Otol Rhinol Laryngol* 1971; 80:854-859.
2. Glasscock ME: Tympanic membrane grafting with fascia: overlay vs. undersurface technique. *Laryngoscope* 1973; 83:754-770.
3. Strauss P, Kress M, Hinz R, Wöhl K: Auflage oder Unterlage des transplantates bei der Myringoplastik. *Z Laryngol Rhinol Otol* 1975; 54:183-190.
4. Stangeland N: Sentrale trommehinneperforationer. *Tidsskrift for norske laegeforening* no. 15. Oslo, 1989.
5. Smyth GDL, Hassard TH: Tympanoplasty in children. *Am J Otol* 1980; 1:199-205.
6. Sadé J, Berco E, Brown M, Weinberg J, Avraham S: Myringoplasty. Short- and long-term results in a training program. *J Laryngol Otol* 1981; 95:653-665.
7. Gibb AG, Chang S-K: Myringoplasty: a review of 365 operations. *J Laryngol Otol* 1982; 96:915-930.
8. Packer P, Mackendrick A, Solar M: What's best in myringoplasty: underlay or overlay, dura or fascia? *J Laryngol Otol* 1982; 96:25-41.
9. Mendel L, Kuylenstierna R: A clinical comparison of the results of two different methods of closing tympanic membrane perforations. *J Laryngol Otol* 1985; 99:339-342.
10. Lau T, Tos M: Tympanoplasty in children. An analysis of late results. *Am J Otol* 1986; 7:55-59.
11. Halik JJ, Smyth GDL: Long-term results of tympanic membrane repair. *Otolaryngol Head Neck Surg* 1988; 98:162-169.
12. Blanshard JD, Robson AK, Smith I, Maw AR: A long-term view of myringoplasty in children. *J Laryngol Otol* 1990; 104:758-762.
13. Vartiainen E, Nuutinen J: Success and pitfalls in myringoplasty: follow-up study of 404 cases. *Am J Otol* 1993; 14:301-305.
14. Koch WM, Friedman EM, McGill TJI, Healy GB: Myringoplasty and type I tympanoplasty in children. Presented at the Annual Meeting of the American Society of Paediatric Otolaryngology, San Diego, CA, May 18-20, 1989.
15. Puhakka H, Virolainen E, Rahko T: Long-term results of myringoplasty with temporalis fascia. *J Laryngol Otol* 1979; 93:1081-1086.
16. Vartiainen E, Kärjä J, Karjalainen S, Härmä R: Failures in myringoplasty. *Arch Otolaryngol* 1985; 242:27-33.
17. Glasscock ME, Jackson CG, Nissen AJ, Schwaber MK: Postauricular undersurface tympanic membrane grafting: a follow-up report. *Laryngoscope* 1982; 92:718-727.
18. Sheehy JL, Anderson RG: Myringoplasty. A review of 472 cases. *Ann Otol Rhinol Laryngol* 1980; 89:331-334.
19. Austin DP: Reconstructive techniques for tympanosclerosis. *Ann Otol Rhinol Laryngol* 1988; 97:670-674.
20. Mawson SR, Fagan P: Tympanic effusions in children. Long-term results of treatment by myringotomy, aspiration and indwelling tubes (grommets). *J Laryngol Otol* 1972; 92:105-119.
21. Kinney SE: Postinflammatory ossicular fixation in tympanoplasty. *Laryngoscope* 1978; 88:821-838.
22. Tos M, Poulsen G: Changes in pars tensa in secretory otitis. *ORL J Otorhinolaryngol Relat Spec* 1979; 41:313-328.
23. Tos M, Stangerup SE: Hearing loss in tympanosclerosis caused by grommets. *Otolaryngol Head Neck Surg* 1989; 115:931-935.
24. Holt GR, Watkins TM, Yoder MG: Assessment of tympanometry in abnormalities of the tympanic membrane. *Am J Otol* 1982; 3:112-116.
25. Emmett JR, Shea JJ: Surgical treatment of tympanosclerosis. *Laryngoscope* 1978; 88:1642-1648.

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