

# Tympanoplasty

## —A Sack Graft Technic—

Nobuhiro MITANI, M.D. and Muneaki TANAKA, M.D.

*Department of Otolaryngology,  
Yamaguchi University School of Medicine,  
Ube, Japan*

Perforations of the tympanic membrane, usually associated with hearing loss and intermittent otorrhea, afflict the patients for a long period. Various problems on closing defective eardrum are remained as old as otology, and have always been and still are a challenge to the otologists.

There are several procedures (modification) to close the perforations of the tympanic membrane reported already<sup>(1)-(20)</sup>. Each procedure has an advantage and disadvantage, yet.

We have performed tympanoplasty, mainly on myringoplasty, using the skin of the external auditory canal as so called "Sack-form graft with Pedicle", obtaining the favorable results.

The purposes of this paper are to mention the technique of tympanoplasty We used and to report the follow up results of 52 cases operated in a 2 year period.

### CASE MATERIAL

The date of all patients underwent tympanoplasty with pedicled sack-form skin graft at the Department of Otolaryngology Yamaguchi University Hospital in a 2 year period ending April in 1975 were listed in Table I to Table IV.

The causes of the eardrum perforations were due to chronic middle ear infection in 49 cases and remaining 3 were due to traumatic eardrum perforations. The age distribution of the patients in this paper ranged from 10 years old to 58 years old.

### TECHNIQUE OF SURGERY

All operations were done with the postaural approach to gain an adequate operation field under general anesthesia. Operation technique consists as follows:

1) An incision is made along the postaural fold from the upper attachment of the auricle to the tip of the mastoid process, as usual way, and the cortex of the mastoid process is exposed.

2) The self-retaining retractor is laid in place, and the skin of the external ear canal is circularly incised at the bony and cartilaginous junction of the ear canal, remaining only a few millimeter for the vascular bed as a pedicle.

3) The skin of the external ear canal and the remains of the eardrum with annulus are separated from the bony canal wall and malleus. During this procedure, the anterior part of the annulus can be seen usually enough without extensive removal of the anterior wall of the ear canal. The anterior canal wall bulge is removed with a diamond burr to facilitate exposure, if needed. In this occasion, the auditory canal is enlarged at the posterior wall with a small cutting burr thereafter to check the ossicular joints and their condition.

4) On the next special step, the free margin of the defective tympanic membrane and annulus is removed through the separated canal tube and the perforated margin is approximated and sutured with NO. 5 silk threads, which is ordinarily used for corneal suture. If needed, the margin of the perforation is trimmed to obtain the refreshed end for suturing. After this suturing, the reversed graft is turned back properly to the side of middle ear, forming as "Sack-form canal graft with pedicle" and it is re-attached on the head of malleus. Consequently, the knots of the threads are seen through the proper external auditory canal. The first circular incision wound of the external ear canal skin is remained open for relaxing incision to help the adequate approximation of the newly

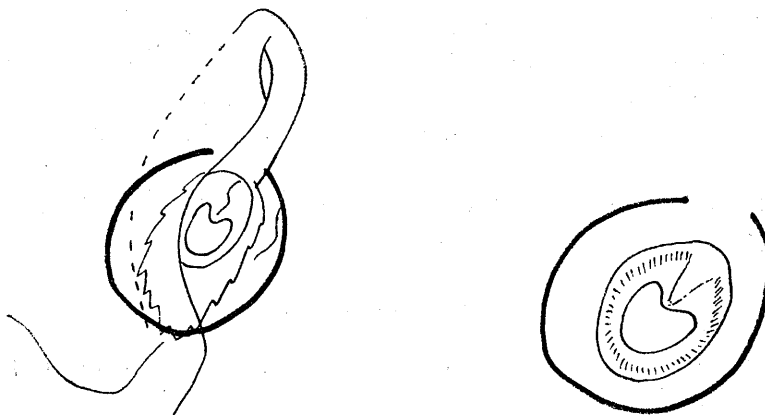


Fig. 1. Incision line at the skin of external auditory meatus

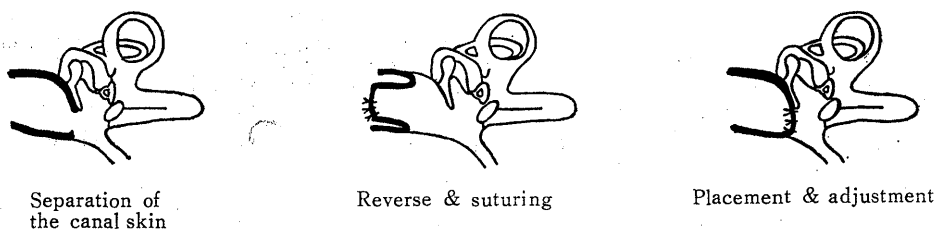


Fig. 2. Procedure of suturing the perforated tympanic membrane

made tympanic membrane to the annulus and the head of malleus. After the completion of tympanoplasty, the external ear canal is filled with Achromycin-soaked cotton pledgets. The postaural incision is sutured primarily and the operation is finished.

The cotton pledgets packed in the external ear canal are usually removed on the eighth postoperative day. The schemas of the surgical technique above mentioned are shown in Fig. 1 and Fig. 2.

The patients are then seen and any dry crusts present are removed from the ear canal. Postoperatively, a broad-spectrum antibiotic is prescribed for a week period. Tubal inflation is done after removal of all cotton pledgets.

## RESULTS

Details of the records of 52 eardrums perforation in 44 patients performed on tympanoplasty by "Sack-form graft with pedicle" are listed in Table 1 to Table 4. The types of tympanoplasty in 52 cases consists of Type I; 42 cases, Type II; 8 cases and Type III; 2 cases, respectively. The mucosa of the meso- and hypo-tympanum was untouched during surgery in 30 cases and the mucosa was removed as completely as possible in 22 cases.

Re-perforation of the tympanic membrane occurred in 4 cases (Case NO. 8, 11, 13 & 36). Clinical judgement of postoperative hearing was decided by comparison between the pre- and postoperative air conduction hearing level. Criteria applied here consists of "Better", "Worse" and "Unchanged". "Better" means more than 10 dB gain of the averaged postoperative hearing level compared with the preoperative hearing level. "Worse" means more than 10 dB aggravation of postoperative hearing level compared with the preoperative hearing level. "Unchanged" means that the change in hearing acuity between pre- and postoperative hearing stayed within 10 dB. Averaged hearing was gained with the














Case No.	Age & Sex	Eardrum Findings	Operation Method	Management of Tympanic mucosa	Audiogram (dB)		Clinical Judgement of Postoperative Condition
					Pre-op.	Post-op.	
1	21F		W-II antrum ;pened	removed	43	34	unchanged
2	22F		W-I atticotomy	preserved	35	25	better
3			W-I	〃	44	22	〃
4	14F		W-I	〃	46	32	〃
5	40F		W-I ossicular reconstruction	removed	60	45	〃
6	24M		W-I 〃	preserved	52	24	〃
7	24M		W-I	removed	36	34	unchanged
8	12F		W-I atticotomy	preserved	20	25	〃
9	35F		W-II	removed	72	56	better
10			〃	〃	50	50	unchanged
11	16M		W-I atticotomy	preserved	12	?	worse
12	36M		W-III antrotomy	removed	82	90	unchanged
13	22M		W-I	〃	15	?	worse

Table. 2.














Case No.	Age & Sex	Eardrum Findings	Operation Method	Management of Tympanic mucosa	Audiogram (dB)		Clinical judgement of Postoperative condition
					Pre-op.	Post-op.	
14	14M		W-I	preserved	13	13	unchanged
15			〃	removed	7	10	〃
16	45M		〃	〃	55	40	better
17	45F		〃	preserved	44	40	unchanged
18	20M		〃	removed	15	36	worth
19	31F		〃	preserved	42	15	better
20	42M		〃	removed	19	15	unchanged
21	23F		〃	preserved	25	28	〃
22	32F		〃 (ossicular reconstruction)	〃	42	12	better
23	24M		〃	〃	19	10	unchanged
24	17F		〃	〃	25	22	〃
25	22F		W-II	removed	41	41	〃
26	37F		W-I	preserved	32	24	〃

Table. 3.














Case No.	Age & Sex	Eardrum Findings	Operation Method	Management of Tympanic mucosa	Audiogram (dB)		Clinical Judgement of Postoperative Condition
					Pre-op.	Post-op.	
27	21F		W-I	preserved	48	37	better
28	21F		∕	∕	40	30	unchanged
29	41M		W-II ossioular reic-constructn	removed	40	25	better
30	42F		∕	∕	38	54	worse
31	12M		W-I	∕	26	28	unchanged
32			∕	∕	15	18	∕
33	20M		∕	preserved	29	25	∕
34			∕	∕	26	30	∕
35	31M		∕	∕	16	25	∕
36	32M		W-II	∕	31	24	∕
37	31M		∕	removed	80	95	worse
38	10M		W-I	preserved	15	5	better
39	37M		∕	removed	7	10	unchanged

Table. 4.














Case No.	Age & Sex	Eardrum Findings	Operation Method	Management of Tympanic mucosa	Audiogram (dB)		Clinical Judgement of Postoperative Condition
					Pre-op.	Post-op.	
40	33M		W-I	preserved	25	19	unchanged
41			W-III	∕	80	50	better
42	25M		W-I	∕	33	18	∕
43	34M		∕	∕	41	32	unchanged
44	35M		∕	removed	45	18	better
45			∕	preserved	36	25	∕
46	30M		∕	∕	35	20	∕
47	11M		∕ (mastoidectomy)	removed	40	20	∕
48	34F		∕ (antrotomy)	preserved	30	30	unchanged
49			∕	∕	13	18	∕
50	58M		∕	∕	20	18	∕
51	25M		∕	removed	20	35	worse
52	28M		∕ (antrotomy)	∕	20	17	unchanged

Table 5. Results of hearing test (1)  
Comparison between pre- and post-operative hearing level

Management of tympanic mucosa	Preserved	Removed	Total
Better	12	6	18
Unchanged	17	11	28
Worse	1	5	6
Total	30	22	52

Table 6. Results of hearing test (2)  
Comparison between pre- and Post-operative hearing level

Management of tympanic mucosa	Preserved	Removed	Total
Better	27	12	39
Unchanged	2	5	7
Worse	1	5	6
Total	30	22	52

division by 4 at the hearing level of 500 Hz, 1 kHz and 2 kHz.

Under the criteria above mentioned, clinical judgement of hearing test was evaluated in Table 5. Of the 52 cases, 18 cases (38%) gained the satisfactory results ("Better"). No significant difference between the tympanic mucosa preserved group and the tympanic mucosa removed group. According the another criteria used by others <sup>(3) (4)</sup> i. e. when the standard of "Better or Success" is defined as less than 30 dB postoperative air conduction hearing level, success rate was 39/52 (75%). In this case, tympanic mucosa preserved group showed a remarkable satisfactory result (Table 6).

## DISCUSSION

Tympanoplasty is originally proposed as operation to repair a perforation of the tympanic membrane and to yield the ear free from discharge.

Before doing a tympanoplasty, the ear should be dry and the middle ear mucosa must be seemingly normal to the naked eye. If the ear

infection is not subsided before operation, much efforts are needed to gain the dry tympanic cavity.

Reviewing the literature concerning the material of graft, there were many kind of materials used. Mesodermal tissues such as fascia of the temporal muscle<sup>5)-8)</sup>, perichondrium of the auricle<sup>9)</sup>, vein graft<sup>10)</sup> and cartilage<sup>11)</sup> have been used for closing of defective eardrum. Furthermore, in Europe and in America, recently some of surgeons have using "preserved homologous graft" such as perichondrium of the nasal septum<sup>12)</sup>, heart valves<sup>13)</sup>, corneal graft<sup>14)</sup> and dural graft<sup>15)</sup>; some of those graft were obtained from the cadaver.

The weakness of using free graft for closing of eardrum perforation is seemingly the lack of an adequate vascularization for the graft, which will cause a re-perforation quite oftenly.

To prevent the re-perforation due to the lack of adequate vascularization, the author designed to apply the pedicled sack form skin graft from the external ear canal for accomplishing the tympanoplasty.

W. F. House and J. L. Sheehy<sup>16)</sup> emphasized in their canal wall skin technique that a satisfactory tympanic membrane perforation closure should be a 3-layer closure. If the closure consists of only a thin 2-layer external and middle ear epithelium, it is easily ruptured even by blowing the nose and, if large, is often too thin to vibrate well. Therefore, any technique used to close the tympanic membrane perforation should accomplish the redevelopment of a vascularized middle fibrous layer as well as the external and middle ear epithelium.

Further, Plester<sup>17)</sup> encourages the author from his over 1000 experiences of myringoplasty and tympanoplasty that the meatal skin is the most usefulest material for closure of the eardrum perforation.

Goto<sup>18)</sup> reported the free (non-pedicled) sack form skin graft with meatal skin as some similar operation method. But his method will be inferior to the author's method on the view-point of vascularization in the graft. The delayed vascularization will mean that healing will be in behind.

The follow-up results of postoperative hearing gain in this paper showed the similar findings in the results reported by others<sup>3),4)</sup>. In only 4 cases (Case No. 8, 11, 13 & 36) of 52 cases presented in this paper re-perforation occurred. In three of them (Case No. 8, 11 & 13), cholesteatoma epithelium at the attic was observed. These findings suggested that the cause of re-perforation is probably due to incompleteness of the surgical management of the attic and is probably not due to inclusive cholesteatoma formation.

For the management of tympanic mucosa, Wullstein<sup>19)</sup> stressed the every efforts should be made to preserve the mucosa.

Author compared the results of post-tympanoplasty findings between the cases with "preserved mucosa in the tympanic cavity" (mucosa preserved group) and the cases with "removed mucosa as complete as possible" (mucosa removed group).

As the results, mucosa preserved group showed better results than the removed group. Morimitsu<sup>4)</sup> and Tanaka<sup>20)</sup> also agreed with the opinion that the mucosa preserved group presented a better results.

### SUMMARY

A technique of tympanoplasty with "Sack-form skin graft with pedicle", which the auther newly designed and performed, was introduced and the results of 52 cases performed with this method were presented.

Success rate in hearing gain was 75%. Only 4 cases in this series showed occurrence of re-perforation of the repaired tympanic membrane.

Indication of this operation method will be in the case indicated for so-called Wullstein's type I tympanoplasty (myringoplasty).

The tympanic mucosa should be preserved as possivle, in general.

Under more restrictive indication, this method is very promising method in tympanoplasty.

Grateful acknowledgement is made to Profesor Shoichi Honjo, M. D. for his kind guidance and careful review of manuscript. And also thanks to Toru Sekitani, M.D. Associate Professor for helpful discussion.

### REFERENCES

- 1) Shambaugh, G.E. Jr.: *Surgery of the ear* 2nd Ed. W. B. Saunders Company, Philadelphia & London, 1967.
- 2) Rijnen, C. J.H. and Kuijpers, W.: Analysis of the literature on myringoplasty. *Acta. Otolaryng.*, Suppl., 287 : 7-10, 1971.
- 3) Ohuchi, J. and Honjo, S.: Tympanoplasty. (Japanese) Kanehara Shuppan K.K., Tokyo, 1973.
- 4) Morimitsu T.: Indication of tympanoplasty. (Japanese) *Otologia* (Fukuoka), 21 : 450-456, 1975.
- 5) Storrs, L. A.: Myringoplasty with the use of fascia graft. *Arch. Otolaryng.*, 74 : 45-49, 1961.
- 6) Patterson, M.E., Lockwood, R.W. and Sheehy, J.L.: Temporalis fascia in tympanic membrane grafting. *Arch. Otolaryng.*, 85 : 287-291, 1967.
- 7) Sheehy, J. L. and Glasscock, M.E.: Tympanic membrane grafting with temporalis fascia. *Arch. Otolaryng.*, 86 : 391-402, 1967.
- 8) Palva, T., Palva, A. and Karja, J.: Myringoplasty. *Ann. Otol.*, 78 : 1074-1080, 1969.
- 9) Goodhill, V., Harris, I. and Brockman, S. J.: Tympanoplasty with perichondralgraft- a preliminary report. *Arch. Otolaryng.*, 79 : 131-137, 1964.



- 10) Shea, J. J. Jr.: Vein graft closure of eardrum perforations. *J. Laryng. & Otol.*, 74 : 358-362, 1960.
- 11) Heermann, J. Jr., Heermann, H. and Kopstein, E.: Fascia and cartilage palisade tympanoplasty-nine years experience. *Arch. Otolaryng.*, 91 : 228-241, 1970.
- 12) Jansen, C.: Cartilage tympanoplasty. *Laryngoscope*, 73 : 1288-1302, 1963.
- 13) Cornish, C. B. and Scott, P. J.: Freeze dried heart valves as tympanic graft. *Arch. otolaryng.*, 88 : 350-356, 1968.
- 14) Forman, F. S.: Corneal Graft in middle ear surgery - a preliminary report. *Laryngoscope*, 70 : 1691-1698, 1960.
- 15) Albrite, J. P. and Leigh, B. G.: Dural homograft (allostatic) myringoplasty (preliminary report). *Laryngoscope*, 76 : 1687-1693, 1966.
- 16) House, W. F. and Sheehy, J. L.: Myringoplasty - use of ear canal skin compared with other techniques. *Arch. Otolaryng.*, 73 : 407-415, 1961.
- 17) Plester, D.: Myringoplasty method. *Arch. Otolaryng.*, 78 : 310-316, 1963.
- 18) Goto, Y.: *Surgery of otolaryngology*, (Japanese) Kanehara Schuppan K. K. (Tokyo): 32-33, 1967.
- 19) Wullstein, H.: Tympanoplasty today. - large and small cavities, closed tube, combined skin graft. *Arch. Otolaryng.*, 76 : 295-297, 1962.
- 20) Tanaka, T.: *Management of the tympanic mucosa*. (Japanese) *Tympanoplasty*, Kanehara Schuppan K. K. (Tokyo): 99-105, 1973.