

An observational study of the management of traumatic tympanic membrane perforations

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Abstract

Controversies of how best to treat fresh tympanic membrane perforations have always existed. While some otolaryngologists prefer the paper patch method, others prefer modified myringoplasty. A prospective study is needed to investigate the most effective and least expensive management of this common ear trauma.

This study examined prospectively, in three sections, a group of patients with a cellophane patch ($n = 6$), another group with a gentamicin ointment seal ($n = 15$) and a control group ($n = 9$) with a gentamicin plug placed at the distal end of the external auditory cavity. Successful healing of the traumatic tympanic membrane perforations was achieved in 50 per cent of the cellophane seal group, 86.7 per cent of the gentamicin ointment seal group and 77.8 per cent of the control group.

This study shows that the management of a fresh tympanic membrane perforation should be limited to cleaning the traumatized ear and preventing infection.

Key words: Tympanic Membrane Perforation;

Introduction

Traumatic perforation of the tympanic membrane (TM) can result from accidents, a slap on the face or iatrogenic exploration during foreign body removal. Perforation of TM results in conductive hearing loss, tinnitus and possible infection of the middle-ear space.

The otolaryngologist is often consulted to effect a closure of the perforation. In general, TM perforations can be closed by the standard tympanoplasty technique which has a high success rate. Since a percentage of small traumatic perforations tend to heal spontaneously, the risk, costs and inconveniences of operation are avoided and non-surgical office procedure is the usual management of choice. Otolologists have, for well over a century, tried to close tympanic membrane perforations. Toynebee's placement of a rubber disk in 1857¹ was phenomenal and other attempts were made using paper and plastic.^{2–5} Unfortunately, these materials quickly fall away from the perforation during yawning, swallowing and chewing.

The author noticed that a number of adult patients reporting with hearing loss, discharging ears and tinnitus usually had a history of trauma to their ears. Most of these patients have either engaged in self-treatment with antibiotic eardrops or had these

prescribed for them by their primary care physicians after the accident. Infection inadvertently ensues and protracted healing is often the case.

The purpose of this present prospective study was to try another non-surgical procedure that is simple to perform, inexpensive and which would permit healing of these traumatic TM perforations in the shortest possible time while ensuring good hearing acuity.

Materials and methods

Twenty-two patients (22 ears) seen in our out-patient clinic with recently acquired traumatic TM perforations were studied prospectively. Seventeen of these were victims of hand slaps or a box on their ears, two had received their injuries from sharp instruments (pencils) and one each from welding sparks, diving and a forceful ear syringing. There were 15 males and seven females. The ages ranged from 15 to 45 years (mean 30.9 years).

The following criteria were used to estimate the relative size of the perforations:

- (1) small = perforation in only one quadrant, extending from the umbo but not reaching the margin of the TM;
- (2) medium = perforation in one quadrant, extending from umbo and reaching the TM-margin;

TABLE I
SHOWS RELATIVE SIZE OF THE TM PERFORATIONS IN THE TWO GROUPS

	Small	Medium	Large	Total
Group I	2	3	1	6
Group II	7	6	2	15
Total	9	9	3	21

(3) large = perforation involving more than one quadrant.

The TM perforations were restricted to the posterior-inferior quadrant of the drum in 19 ears; two ears had perforations in the posterior-superior quadrant extending to the anterior-superior quadrant and one, in the posterior-inferior quadrant extending to the posterior-superior quadrant.

All patients were examined with a Zeiss otomicroscope and the site and estimated relative size of the perforations were documented (Table I). Both air and bone conduction thresholds of each patient in the frequencies 0.25, 0.5, 1, 2, 4 and 8 KHz were recorded in a pure tone audiogram.

The external auditory canal (EAC) of each traumatized ear was carefully cleaned with a cotton bud soaked in methylated spirit, and left to dry.

A cellophane sheet, approximately 0.25 mm thick, was cut to a size that could effectively seal the perforation when applied with Hartmann's ear forceps under microscopic guidance. A few drops of gentamicin (United Biochem) ear drops and hydrocortisone solution (Betnosol®) were instilled (n = 7). Sterile cotton gauze was used to close up the ear vestibule.

One patient in this group (group I or cellophane group) did not report for follow-up, six patients were evaluated.

The second group (n = 15) had a semi-solid gentamicin ointment (Gentalek®) plug applied to their perforations to effectively seal them, after which cotton gauze impregnated with gentamicin ointment was used to pack the EAC.

Later, 11 patients, who reported to our ENT clinic with fresh traumatic tympanic membrane perforations, were used as a control group (group III). Two of them did not attend the prescribed number of weekly scheduled follow-up sessions and were excluded from the study. The remaining nine patients underwent the same otomicroscope examination and cleaning of the EAC as the patients in the other two groups. In this control group, the gentamicin ointment plug was placed in the distal one third of the EAC, relatively far from the TM. Of the nine, eight were males and one was a female. The ages ranged from four to 43 years with a mean of 25.7 years. Seven of the nine had small perforations and two large. Three of the perforations were located in the posterior-inferior quadrants, three in the anterior-inferior, one in the posterior-superior and two involved both posterior quadrants.

All patients were given a course of ampicillin/cloxacillin (Ampicloxx®) 500 mg t.i.d. and metronidazole 200 mg t.i.d. for the first six days and the ear was examined weekly. If complete closure of the

perforation had not taken place, the ear was either left alone if progress was seen, or the procedure was repeated.

The time until complete healing of the TM or formation of a permanent fistula and the status of the ear drum were registered. Every patient was asked to give an estimate of his or her hearing acuity as ('improved' 'same as when first seen' or 'worse than before'). The post-treatment audiogram was made in each case where healing had taken place.

Result

Endoscopic observations

In group I, complete closure of the tympanic membrane was achieved in three out of six patients (50 per cent), 13 out of 15 (86.7 per cent) in group II and seven out of nine (77.8 per cent) in group III, within 48 days. Table II shows the ages of the patients, time (in days) until complete healing or otherwise, status of the TM, patient's subjective rating, and mean threshold in dB at 0.5, 1, 2 KHz after complete healing. Also post-treatment audiogram results show that two out of three (66.7 per cent) of group I and eight out of 11 (72.7 per cent) of group II of the completely healed traumatized ears became the better hearing ears.

Because of its simplicity of application, the gentamicin group (groups II and III) had more patients allocated to it, each group however consisted of patients who reported in a given period of time.

The common trend in most of the audiograms was that apart from the closure of the air-bone-gap (ABG) to below 10 dB, the air conduction after treatment recovered well above the bone conduction before the treatment. Figure 1 is the pure tone

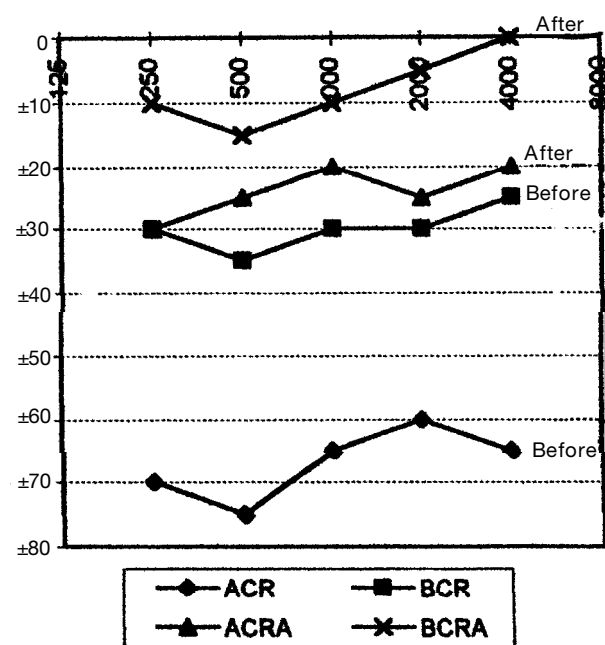


FIG. 1
Group II. Worst ear/healed TM

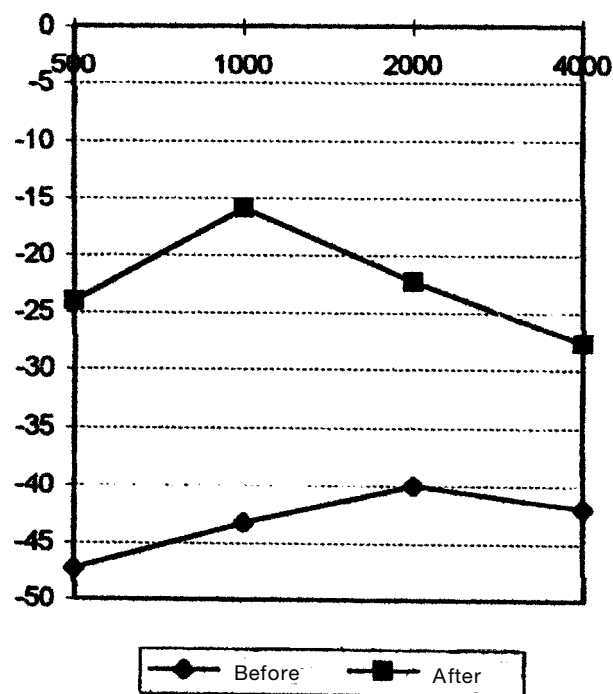


FIG. 3

Mean-value audiogram of group II

audiogram of the worst traumatized TM in group II. This would imply that the trauma, hand slap in this case, affected not only the sound-conducting apparatus but also the sensory/cochlear elements which recovered with time.

The mean-value-audiogram of the 11 patients in group II (two patients with endoscopically registered normal TM claiming normal hearing, did not report for the final audiometric test) is shown in Figure 3.

The satisfactory healing of the traumatized TM in groups II and III (82.7 per cent and 77.8 per cent respectively) is noteworthy.

Discussion

Tympanic membrane perforations close by the proliferation of the hyperplastic keratinizing squamous epithelium advancing ahead of in-growing connective tissue. Permanent TM perforation arises when this keratinized epithelium advances inward over the border to the endothelium of the middle ear.

While persistent or permanent TM perforations may be closed by a surgical procedure (myringoplasty) using fascia as transplants with good results, a

TABLE II

TIME UNTIL CLOSURE, STATUS OF TM, SUBJECTIVE HEARING RATING AND MEAN THRESHOLD (AT 0.5, 1, 2 KHZ) OF THE AFFECTED EARS AFTER HEALING

Group I (with Cellophane® sheet)

Patient	Age	Time until closure	Status of TM	Subjective hearing rating	Mean threshold at 0.5, 1, 2 KHz
1	33	11 days	Normal	Improved	26.7 dB (25.0 dB)*
2	45		CSOM	Worse	
3	18		Cellophane® adherent	Same	
4	22	8 days		Normal	Improved
5	34	25 days	Normal	Improved	23.3 dB*
6	27		TM fistula dry ear	Same	

Group II (with Gentamicin ointment plus)

Patient	Age	Time until closure	Status of TM	Subjective hearing rating	Mean threshold at 0.5, 1, 2 KHz
1	34	14 days	Normal	Improved	20.0 dB (18.3 dB)*
2	35	32 days	Normal	Improved	15.0 dB*
3	42	7 days	Normal	Improved	18.3 dB*
4	36	8 days	Normal	Improved	20.0 dB*
5	29		TM fistula dry ear	Same	
6	22	22 days		Normal	Improved
7	45	14 days	Normal	Improved	43.3 dB*
8	24	14 days	Normal	Improved	20.0 dB*
9	13	14 days	Normal	Improved	8.0 dB*
10	39	8 days	Normal	Improved	
11	32	21 days	Normal	Improved	15.0 dB*
12	19		TM fistula dry ear	Same	
13	33	38 days		Normal	Improved
14	43	12 days	Normal	Improved	26.7 dB*
15	24	48 days	Normal	Improved	7.5 dB

*Mean threshold in better ear.

Group III (Control)

Patient	Age	Time until closure	Status of TM	Subjective hearing rating	Mean threshold at 0.5, 1, 2 KHz
1	37	14 days	Healed normal	Improved	24 dB
2	20	21 days	Healed normal	Improved	23 dB
3	19	10 days	Healed normal	Improved	12 dB
4	4		Permanent fistula dry		
5	20	34 days		Healed normal	Improved
6	16	41 days	Healed/dull	Improved	10 dB
7	43	24 days	Healed normal	Improved	10 dB
8	42		Permanent fistula dry	Same	
9	30	15 days		healed normal	Improved

simple, non-surgical and inexpensive method has been advocated even in these cases. Hyaluronic acid⁶ and hydrocolloidal dressings⁷ have been used with good results in long-standing TM perforations. Recent reports have shown epidermal growth factor (EGF) to stimulate healing⁸ in approximately 80 per cent of chronic TM perforations in chinchillas when applied in three doses over one week.⁹ Dvorak *et al.* (1995)¹⁰ evaluated the efficacy of long-term EGF in the closure of TM perforations in which they treated chronic chinchillas TM perforations with EGF for up to six weeks and had 100 per cent completely healed. Ramsey *et al.* (1995)¹¹ found in their study with EGF that a simple paper patch in humans failed to result in closure of any perforation in 11 patients. Nevertheless, EGF may prove important in future in both chronic and fresh TM perforations.

From this study, however, it appears that fresh traumatic TM perforations should be treated conservatively. Office procedure that prevents infection is all that is needed. Taylor and McMinn (1965)¹² described primary covering of the TM defect by granulation tissue, followed by epithelial migration. Olsen *et al.* (1993)¹³ confirmed that the absolute prerequisite for complete covering of the TM perforation is the subsequent formation of supporting tissue beneath the proliferating squamous epithelium. The present study did not support these hypotheses vividly since the cellophane sheet method resulted in only 50 per cent healed rate as against 77.8 per cent in group III where no supporting tissue or scaffold of the traumatized ear drums was applied.

It is generally accepted that many of these TM perforations, although far from all, may heal spontaneously over months or years. Important to the physician and his patients with fresh traumatic TM perforations are the healing rate and time, the quality of the healed TM and the hearing acuity after the healing. Any non-surgical method should be non-cumbersome, inexpensive, and if possible could be undertaken without the use of the operating microscope or delicate instruments.

This present study with a gentamicin ointment plug directly on the traumatized drum which gave an impressive result of 86.7 per cent (13 of 15) within 48 days (mean average 18.5 days) and normal hearing acuity, 72.7 per cent of which became the better hearing ears, or with gentamicin ointment plug at the distal one third of the EAC, which resulted in a 77.8 per cent healing rate within 41 days (mean average 27.7 days), fulfilled these criteria.

Conclusion

This study shows that the repair of a fresh tympanic membrane perforation should be limited to cleaning

the traumatized drum and preventing infection. This study found the gentamicin ointment plug, either directly on the traumatic perforation as a seal or at the distal one third of the external auditory canal, very useful.

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