The Journal of Laryngology & Otology (2017), ***131***, *805–808*.

doi:10.1017/S0022215117001426

MAIN ARTICLE

Effectiveness of patching traumatic eardrum perforations with lens cleaning paper via an otoscope

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Abstract

Objective: To study the clinical effect of lens cleaning paper patching on traumatic eardrum perforations.

Methods: A total of 122 patients were divided into 2 groups, of which 56 patients were treated with lens cleaning paper patching and 66 acted as controls. The closure rate and healing time were compared between the two groups.

Results: The healing rate of small perforations was 96.4 per cent (27 out of 28) in the patching group and 90 per cent (27 out of 30) in the control group. The difference was not statistically significant ($p > 0.05$). The healing rate of large perforations was 89.3 per cent (25 out of 28) and 80.6 per cent (29 out of 36) in the two groups, respectively. The difference was statistically significant ($p < 0.05$). The healing time of large perforations was shorter in the patching group than in the control group ($p < 0.01$).

Conclusion: Patching with lens cleaning paper under an endoscope can accelerate the closure of large traumatic eardrum perforations.

Key words: Tympanic Membrane Perforation; Treatment; Otoscope

Introduction

Traumatic tympanic membrane perforations may have various causes (e.g. slapping against the ear, barotrauma or instrumental injury).[1,2] In clinical practice, the management of tympanic membrane perforations is mostly conservative,[3] and involves keeping the external auditory canal dry and clean, and preventing infection. Traumatic tympanic membrane perforations usually heal spontaneously. It is preferable to wait for at least three weeks prior to any intervention. During this period, patients endure hearing loss, ear stuffiness and tinnitus. Perforations that do not close spontaneously are treated with myringoplasty.

To our knowledge, very few experimental or clinical studies have reported the effect of patching tympanic membrane perforations with lens cleaning paper. This study was conducted to evaluate the effects of patching traumatic tympanic membrane perforations with lens cleaning paper via an otoscope, and compare these effects with spontaneous healing.

Materials and methods

Participants

Patients diagnosed with unilateral traumatic tympanic membrane perforation, without middle-ear infection, in the Department of Otolaryngology of the First Affiliated Hospital of Dalian Medical University between January 2013 and December 2015, were included in this study.

There were 78 females and 44 males. Patient age ranged from 18 to 46 years, with a mean age of 31.4 ± 6.7 years. Traumatic perforations were diagnosed between 1 and 15 days (average of 6.2 ± 4.3 days). Perforations were caused by slapping (91 cases), ear picking (21 cases) and explosion (10 cases).

The perforations were classified according to the size of the perforation area, as follows: a traumatic tympanic membrane perforation involving more than 25 per cent of the surface area was defined as a large perforation, and a traumatic tympanic membrane perforation involving less than 25 per cent of the surface area was defined as a small perforation.[4] There were a total of 64 large tympanic membrane perforations and 58 small tympanic membrane perforations.

All perforations were at the pars tensa, or anteroinferior or posterior part of the tympanic membrane. The perforations were a cervice, triangular or irregular in shape. The pure tone audiogram air conduction average increased by 15–40 dB.

A total of 122 patients were randomly divided into 2 groups using a computer-generated random table, and

Accepted for publication 15 May 2017 First published online 17 July 2017

odd-numbered patients were included in the patching group. The patching group had 56 cases, comprising 28 small and 28 large tympanic membrane perforations. The control group had 66 cases, comprising 30 small and 36 large tympanic membrane perforations (Table I). There were no significant differences between the two groups in terms of patient age, or tympanic membrane perforation size or cause.

Design and procedure

Control group. Patients in this group received no intervention, but were instructed to keep the ear dry at all times. The patients in this group underwent regular follow up (as in the patching group, described below).

Patching group. Before treatment, the ear canal was cleaned with a cotton bud soaked in povidone-iodine solution. Two per cent tetracaine was used for local anaesthesia; a few drops were applied to a small cotton ball, which was placed in the external canal wall over the surface of the tympanic membrane for about 10 minutes. The perforation rim of the tympanic membrane was carefully examined under otoscopy, and any inverted edges were aligned back to the original position with a needle. The pre-sterilised oval-shaped lens cleaning paper was cut to a suitable size according to the perforation. This paper patch was placed over the surface of the tympanic membrane perforation using ear polyp forceps, and flattened using a cotton bud soaked in ofloxacin otic solution, to completely cover the perforation.

Afterwards, one drop of ofloxacin otic solution was applied daily by the patients themselves at home, as instructed, to keep the lens cleaning paper moistened and prevent it from dropping.

The patients were followed up every 5–7 days, until complete closure of the perforation was achieved, or for up to 3 months. The tympanic membrane perforations and lens cleaning paper were observed under an endoscope and recorded by video imaging. The lens cleaning paper was replaced when displaced or trapped in the tympanic cavity.

TABLE I
DEMOGRAPHIC DATA OF PATCHING AND CONTROL GROUP PATIENTS

Parameter	Patching group	Control group	*p*
Patients (*n*)	56	66	
Male (*n*)	19	25	0.71
Age (years; mean ± SD)	32.6 ± 8.1	30.4 ± 7.6	1.15
Small perforation (*n*)	28	30	0.73
Large perforation (*n*)	28	36	0.73
Cause of perforation (*n*)			
– Slapping	43	48	0.88
– Ear picking	8	13	0.67
– Explosion	5	5	0.58

$p < 0.05$ was considered to indicate statistical significance.
SD = standard deviation

All the participants were given oral antibiotic tablets for one week. They were advised to avoid getting water in the external ear canal and not to strongly blow their nose.

Curative effects evaluation

Therapeutic effects (healing outcomes, healing time and hearing) were recorded and compared between the two groups. The following criteria were used to assess the curative effects during the three-month follow-up period: (1) healed – the perforation was completely closed and the average auditory threshold returned to a normal level; (2) improved – the perforation nearly closed, or the average auditory threshold decreased to less than 15 dB; (3) unchanged – the perforation remained, or the average auditory threshold improved to more than 15 dB.

Statistical methods

Tympanic membrane morphological changes, perforation size and healing outcomes of the two groups were compared by chi-square test. The healing times of the two groups were compared by *t*-test. SPSS software (version 11.0 for Windows; SPSS, Chicago, Illinois, USA) was utilised for statistical analysis. Differences were considered statistically significant when $p < 0.05$.

Results

A total of 122 patients were included in this study, with a male-to-female ratio of 1:1.77. Follow-up duration ranged from one to three months. Most patients felt that symptoms such as tinnitus and ear stuffiness subsided after patching management. The demographic data are summarised in Table I.

Healing outcomes

The healing rate of small perforations in the patching group was 96.4 per cent (27 out of 28). Nearly all small perforations had complete closure and 89.3 per cent (25 out of 28) of large perforations had complete closure. In the control group, 90 per cent of small perforations healed (27 out of 30) and 80.6 per cent (29 out of 36) of large perforations healed, while seven perforations failed to close. We compared the healing rate of small perforations between the two groups, and the chi-square test value was 0.0172 ($p > 0.05$, Figure 1a). When the healing rate of large perforations was compared between the two groups, the chi-square test value was 1.106 ($p < 0.05$, Figure 1a).

Healing times

The mean closure time of small perforations was 11.3 ± 6.3 days in the patching group and 13.4 ± 7.2 days in the control group. Although lens cleaning paper patching seemingly shortened the closure time of small perforations as compared to the control group, the difference was not significant ($p > 0.05$, Figure 1b). However, lens cleaning paper patching

https://doi.org/10.1017/S0022215117001426 Published online by Cambridge University Press

dramatically shortened the closure time of large perforations as compared to the control group, with healing times of 14.7 ± 5.6 and 36.6 ± 9.2 days, respectively ($p < 0.01$, Figure 1b).

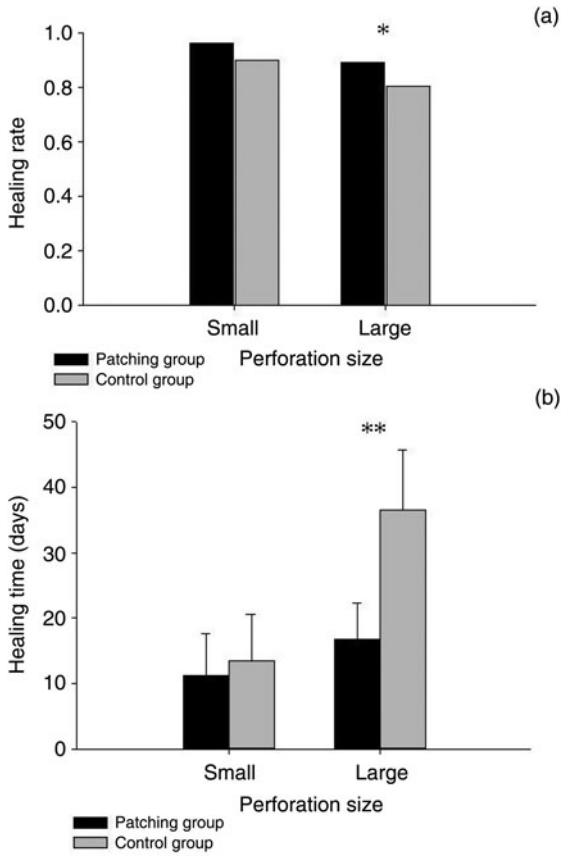

FIG. 1

Graphs of (a) healing rate and (b) healing time for the patching and control groups. *Large perforation closure rate was significantly higher in the patching group (89.3 per cent) than in the control group (80.6 per cent, $p < 0.05$). **Large perforation closure time was significantly shorter in the patching group than in the control group ($p < 0.01$).

In both groups, larger perforations were associated with longer closure times. Seven of the 10 patients with an unchanged large perforation underwent tympanoplasty after 3 months, while the other 3 patients refused further treatment for financial reasons.

Figure 2 shows the representative otoscopic images of a male patient (37 years old) during the lens cleaning paper patching process.

Discussion

Traumatic tympanic membrane perforation is a common condition seen in the department of otorhinolaryngology. The tympanic membrane has a strong capacity for repair and regeneration, as it has a rich anastomotic vascular network on both sides. As most traumatic tympanic membrane perforations tend to heal spontaneously, the typical treatment is drying therapy. Tympanoplasty is performed for unhealed perforations. However, hearing loss, tinnitus or ear stuffiness associated with the tympanic membrane perforation may cause mental stress to patients, and influence their normal lives or work. In addition, patients undergoing surgery bear certain economic burdens. Hence, many otolaryngologists suggest that early myringoplasty should be performed to improve the healing rate.[5,6]

Patching methods, with paper, egg shell membrane, Gelfoam or other materials, have been utilised to promote the healing of traumatic tympanic membrane perforations, all of which have achieved effective outcomes.[3,7,8] In this study, symptoms such as tinnitus or ear stuffiness were immediately alleviated after patching with lens cleaning paper. For large perforations, the patching procedure not only improved the overall healing rate (89.3 per cent *vs* 80.6 per cent), but also shortened the closure time (14.7 ± 5.6 days *vs* 36.6 ± 9.2 days), when compared to the control group. However, the patching method showed no obvious advantages for small perforations.

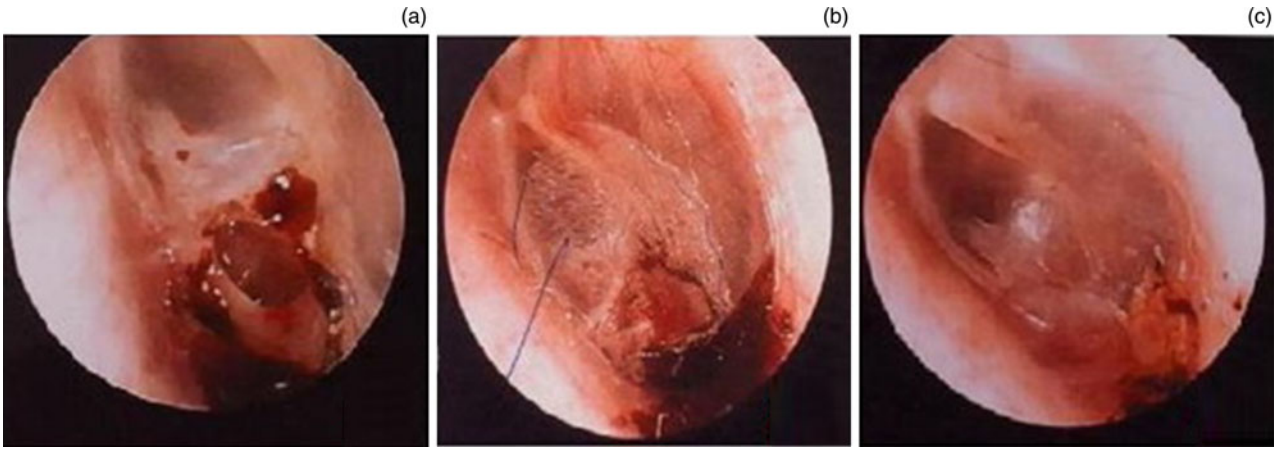

FIG. 2

Otoscopic images at different time points. (a) Tympanic membrane perforation surrounded by dry blood when the injury was 15 days old. (b) A lens cleaning paper completely covered the perforation after patching. (c) The tympanic membrane perforation healed completely 25 days after patching.

https://doi.org/10.1017/S0022215117001426 Published online by Cambridge University Press

Microscope lens cleaning paper made of 100 per cent wood fibre was used in this study, as it is soft, has low dust and high water absorbing properties, and low irritation. Lens cleaning paper has advantages over egg shell membrane and Gelfoam. For instance, lens cleaning paper can easily be sterilised in a glass dish by high temperature and high pressure, but egg shell membrane use is associated with potential contamination. Moreover, lens cleaning paper can be cut to a suitable size, and its position is easily adjusted when patching. Furthermore, a lens cleaning paper patch can stick to the remnant tympanic membrane closely for a flattened surface, which facilitates the growth of the remnant tympanic membrane along the normal plane. In contrast to the thin lens cleaning paper, Gelfoam swells when absorbing water, which may lead to ear stuffiness or other discomforts.

The tympanic membrane perforation was magnified with an otoscope while patching; the perforation rim was clearly observed and the inverted edges were gradually adjusted back to the original position. For large tympanic membrane perforations, timely adjustment under an otoscope was critical when displacement or suspension of the patch was apparent.

- **Microscope lens cleaning paper is advantageous for patching tympanic membrane perforations**
- **It is soft, has low dust and high water absorbing properties, and low irritation; it can be suitably sized and its position easily adjusted**
- **The tympanic membrane perforation was magnified and patched via otoscope**
- **The perforation rim was clearly observed and inverted edges were gradually adjusted back to the original position**
- **For large perforations, lens cleaning paper patching via otoscopy improved healing rate and shortened healing time**

In this study, lens cleaning paper patching improved the overall healing rate and shortened the average healing time for large tympanic membrane perforations, as compared to spontaneous healing. These findings are consistent with results from other clinical and experimental studies.[9–11] The patching of traumatic tympanic membrane perforations with lens cleaning paper via otoscopy is simple and convenient. No adverse effects were observed in this study. As this treatment is inexpensive and easy to perform, it can be widely adopted in all hospitals.

Acknowledgement

This work was supported by a grant from the National Natural Science Foundation of China (NSFC) (81503372).

References

1 Lou ZC, Lou ZH, Zhang QP. Traumatic tympanic membrane perforations: a study of etiology and factors affecting outcome. *Am J Otolaryngol* 2012;**33**:549–55
2 Lou ZC, Tang YM, Yang J. A prospective study evaluating spontaneous healing of aetiology, size and type-different groups of traumatic tympanic membrane perforation. *Clin Otolaryngol* 2011;**36**:450–60
3 Saito H, Kazama Y, Yazawa Y. Simple maneuver for closing traumatic eardrum perforation by micropore strip tape patching. *Am J Otol* 1990;**11**:427–30
4 Zhengcai L, Zihan L, Yongmei T. Comparative study on the effects of EGF and bFGF on the healing of human large traumatic perforations of the tympanic membrane. *Laryngoscope* 2016;**126**:E23–8
5 Sprem N, Branica S, Dawidowsky K. Tympanoplasty after war blast lesions of the eardrum: retrospective study. *Croat Med J* 2001;**42**:642–5
6 Conoyer JM, Kaylie DM, Jackson CG. Otologic surgery following ear trauma. *Otolaryngol Head Neck Surg* 2007;**137**:757–61
7 Park MK, Kim KH, Lee JD, Lee BD. Repair of large traumatic tympanic membrane perforation with a Steri-Strips patch. *Otolaryngol Head Neck Surg* 2011;**145**:581–5
8 Winerman I, Man A, Segal S. Early repair of traumatic perforations of the tympanic membrane in children. *Int J Pediatr Otorhinolaryngol* 1982;**4**:23–7
9 Fina M, Baird A, Ryan A. Direct application of basic fibroblast growth factor improves tympanic membrane perforation healing. *Laryngoscope* 1993;**103**:804–9
10 Hakuba N, Iwanaga M, Tanaka S, Hiratsuka Y, Kumabe Y, Konishi M *et al*. Basic fibroblast growth factor combined with atelocollagen for closing chronic tympanic membrane perforations in 87 patients. *Otol Neurotol* 2010;**31**:118–21
11 Kanemaru S, Umeda H, Kitani Y, Nakamura T, Hirano S, Ito J. Regenerative treatment for tympanic membrane perforation. *Otol Neurotol* 2011;**32**:1218–23

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Dr L Shi takes responsibility for the integrity of the content of the paper
Competing interests: None declared

https://doi.org/10.1017/S0022215117001426 Published online by Cambridge University Press