Original Article

Success Rate of Paper Patch Myringoplasty in Patients with Tympanic Membrane Perforation: A Retrospective Analytics Study of 110 Cases

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Background: Paper patch myringoplasty is a simple procedure to close perforated tympanic membranes, however, the success rate varies between 12.5% and 84.2%.

Objective: To evaluate the success rate of paper patch myringoplasty and identify the factors relating to the successful patching.

Materials and Methods: A retrospective medical chart review of 110 patients that underwent paper patch myringoplasty was done. The factors affecting successful paper patching, including etiologies of the tympanic membrane perforation, location of the perforation, last infection, perforation size, characters of perforation edge, and middle ear mucosa, were statistically analyzed.

Results: The success rate of paper patch myringoplasty was 27.27%. Factors affecting successful paper patching were statistically analyzed and showed no significant difference. However, the success rate tended to be higher in patients with perforation less than 5% of total area (*p*-value 0.431), posteroinferior perforation (*p*-value 0.086), and traumatic perforation (*p*-value 0.153). The patients with successful closure significantly improved hearing in average air conduction (*p*-value <0.001), average bone conduction (*p*-value 0.014), and air bone gap (*p*-value 0.006).

Conclusion: Although the present study showed low success rate of paper patch myringoplasty, this procedure may be beneficial in selected patients, including patients with small perforation, posteroinferior perforation, or traumatic perforation.

Keywords: Paper patch myringoplasty, Office-based myringoplasty, Tympanic membrane perforation, Chronic tympanic membrane perforation

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There are many etiologies of tympanic membrane [TM] perforation such as recurrent infection in the middle ear, trauma, or iatrogenic causes (due to myringotomy or intratympanic drug injection)[1-4]. Eighty to eighty-nine percent of traumatic perforated TMs heal spontaneously[5,6]. However, recurrent infection usually causes the TM perforation to remain, and this may cause hearing loss and further recurrent infection of the middle ear. Myringoplasty is the standard treatment to close the perforation on TMs. The autologous grafts including temporalis fascia, cartilage, and perichondrium are used in standard myringoplasty[7-10]. Although these are the standard procedures to treat the perforated TMs, they are complicated surgical procedures. Most all patients need to be hospitalized and the procedure should be done in the operating room with post-operative surgical wound. The paper patch myringoplasty is also a procedure to close perforated TMs but is less invasive. It was introduced in 1887 by Blake[3]. Due to the cost effectiveness and uncomplicated procedure, paper patching is a popular procedure[11]. This procedure could be done at the outpatient unit. The paper patch serves as a bridge and let the epithelium at perforation edge migrates[11]. However, the success rate of paper patching varies between 12.5% and 84%[2-4,8,11,12]. Although paper patch myringoplasty is mentioned in the standard textbooks as an office-based myringoplasty, there is little information of this procedure, including selection criteria for suitable patients, surgical technique, and result[12,13].

In the authors' center, there are almost 700 patients per year presenting with chronic otitis media. The paper patch myringoplasty has been done in some patients with small chronic TM perforation. The objective of

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the present study was to evaluate the success rate of TM closure after paper patching and identify the factors that relate to the successful patching.

Materials and Methods

A retrospective medical chart review was done on the patients that underwent paper patch myringoplasty at the outpatient unit of Department of Otolaryngology, Faculty of Medicine, Chiang Mai University Hospital between March 2009 and March 2015. The medical records of patients with TM perforation of more than three months from any etiology and that underwent paper patching were recruited. Patients who had the histories of previous ear surgery were excluded. The informed consent was signed in every patient before the procedure was started. Patient demographics were recorded including age, sex, underlying diseases, perforation size, onset of last infection, and other otologic findings.

The procedure was done under the microscope with local anesthesia, 1% xylocaine with adrenaline (1:100,000) was injected at external auditory canal. The perforation edge was cauterized by using 10% of trichloroacetic acid. The paper patches were prepared from sterilized thin paper soaked with Terramycin® ointment. The paper patches were placed over the perforation edge. After patching was done, the patients were prescribed short course oral antibiotic and advised not to do the Valsalva maneuver. Routine follow-up was done at two weeks, one month, and three months. Only complete closure of TM perforation was considered as successful repair. The audiogram was done before the procedure and repeated only in the patients with successful patching. Ethical approval was granted by the Hospital Ethics Committee (IRB STUDY CODE: ENT-2559-04091 Research ID: 4091).

The success rate of paper patch myringoplasty is shown in percentage. The factors affecting successful paper patching were statistically analyzed with Chi-square test or Fisher's exact test for qualitative data and independent t-test or Mann-Whitney U test for quantitative data, with statistically significant when *p*-value was less than 0.05. SPSS version 22.0 was used for statistical calculation.

Results

Between March 2009 and March 2015, there were 136 patients with perforated TMs that underwent paper patch myringoplasty at out-patient unit of Department of Otolaryngology, Faculty of Medicine, Chiang Mai University Hospital. Twenty-two patients were excluded due to the history of previous ear surgery on the side of the TM perforation. Other four patients were excluded due to loss follow-up. Therefore, 110 patients were recruited to the present study, 36 males and 74 females. All patients were followed up at least six months. Mean age of the patients was 43.18 years (range from 12 to 77 years). Fifty-six patients had TM perforation on the left ear, and 54 patients on the right ear. The etiologies of TM perforation were recurrent infection (105 patients, 95.45%), trauma (3 patients, 2.73%), and post-myringotomy (2 patients, 1.82%). The average size of TM perforation was 14.95% (±9.338) of total TM area (range from pinpoint perforation to 40% of total TM area). The median duration of last infection before paper patch myringoplasty was three months (range from 1 to 12 months). Around one third of recruited patients (39 patients, 35.45%) underwent repeated paper patch myringoplasty, ranged varied between two and four times. The number of patch applications is shown in Table 1.

From the present study, the success rate of paper patch myringoplasty was 27.27% (30 of 110 patients). Twenty patients succeeded the first time, seven succeeded the second time, and three succeeded the third time. Age, sex, etiologies of TM perforation, side and size of the TM perforation, location of the perforation on TM, onset of the last infection before patching, character of middle ear mucosa and perforation edge, and presence or absence of myringosclerosis were analyzed as factors between the success and failure group. There was no significant difference of these factors between the two groups as shown in Table 2. Even though paper patch myringoplasty tended to be more successful in patients with posteroinferior perforation, it was not statistically significant (p-value 0.086). The comparative data of success and failure groups are shown in Table 2.

The perforation size was divided into four groups (Table 3). The perforation size less than 5% tended to be more successful, but it was not statistically significant.

Table 1. Number of patch applications in success and failure group

Number of patch applications	Success group, n (%)	Failure group, n (%)	Total
1	20 (38.3)	51 (61.7)	71
2	7 (22.6)	24 (77.4)	31
3	3 (42.9)	4 (57.1)	7
4	0 (0.0)	1 (100)	1
Total	30	70	110

Table 2. Factors between the success and failure group

	Success group (total = 30) n (%)	Failure group (total = 80) n (%)	*p*-value
Age (years), mean ± SD	44.97±2.89	42.51±1.84	0.424
Sex			0.548
Males	8 (22.2)	28 (77.8)	
Females	22 (29.7)	52 (70.3)	
Etiologies of TM perforation			0.153
Recurrent infection	27 (25.7)	78 (74.3)	
Trauma	2 (33.7)	1 (66.7)	
Post-myringotomy	1 (50.0)	1 (50.0)	
Side of TM perforation			0.448
Right ear	17 (31.5)	37 (68.5)	
Left ear	13 (23.2)	43 (76.8)	
Location of perforation on TM			0.086
Inferior	21 (26.6)	58 (73.4)	
Anteroinferior	4 (18.2)	18 (81.8)	
Posteroinferior	5 (62.5)	3 (37.5)	
Anterosuperior	0 (0.0)	1 (100)	
Last infection (months), median (range)	3 (1 to 12)	3 (1 to 12)	0.758
Perforation size (percent of perforation area), mean ± SD	13.43±9.17	15.52±9.39	0.302
Perforation edge			0.871
Thin	24 (28.2)	61 (71.8)	
Thick	6 (24.0)	19 (76.0)	
Middle ear mucosa			1.000
Thin	25 (27.5)	66 (72.5)	
Thick	5 (26.3)	14 (73.7)	
Myringosclerosis			1.000
Presence	3 (23.1)	10 (76.9)	
Absence	27 (27.8)	70 (72.2)	

TM = tympanic membrane

Table 3. Range of perforation size in success and failure group

Perforation size	Success group (total = 30), n (%)	Failure group (total = 80), n (%)	*p*-value
<5%	3 (60.0)	2 (40.0)	0.431
5% to 10%	13 (26.5)	36 (73.5)	
11% to 20%	8 (25.0)	24 (75.0)	
>20%	6 (25.0)	18 (75.0)	

Table 4. Pre- and post-operative audiogram in successful paper patch myringoplasty

	Pre-op (dB) mean ± SD	Post-op (dB) mean ± SD	*p*-value
Average air conduction	38.07±17.69	31.79±15.96	<0.001
Average bone conduction	29.76±12.12	27.10±14.51	0.014
Average SD score	92.55±12.32	93.24±12.92	0.113
Air bone gap	8.52±0.10	4.55±5.90	0.006

The pre- and post-operative hearing test of the success group is shown in Table 4. There were significant hearing improvement in average air conduction (pure tone average), average bone conduction (pure tone average), and air bone gap (*p*-value <0.001, 0.014, and 0.006, respectively). No intra- or post-operative complication were found in the patients.

Discussion

Paper patch myringoplasty is a simple operation for patients with TM perforation. Success rate varied between 12.5% and 84.2%[2-4,8,11,12]. The present study recruited more patients than most previous studies[2,3,8,11] and showed a 27.27% overall success rate. However, the patients with perforation size less than 5% tended to succeed more than the larger perforation size, but it was not statistically different. The previous studies also reported the smaller perforation size tended to be more successful. Golz et al[3] reported a 63.2% success rate in small perforation size (less than 3 mm). Park et al[11] reported a 78.3% success rate in the patients with perforation smaller than 5%. Dursun et al[8] reported 100%, 60%, and 40% success rate in patients with 1-mm, 2-mm, and 3-mm perforation, respectively. Trimming perforation edge is one of the key for successful patching. There are several methods of freshened perforation edge such as excising with micro-instruments[3,8,11,12], with CO_2 laser[2], or with chemical substances (silver nitrate, trichloroacetic acid, or urea)[15]. In the present study, the authors used 10% of trichloroacetic acid to freshen the perforation edge, which is different from the previous higher success rate studies[2,3,8,11,12].

There were no significant difference in the age, sex, etiologies of TM perforation, side and size of TM perforation, location of perforation on TM, onset of last infection before patching, character of middle ear mucosa and perforation edge, and presence or absence of myringosclerosis between the success and the failure group. Park et al[4] reported a high success rate (84.2%) of paper patching in patients with TM perforation from trauma. Lee et al[12] reported the higher proportion of cases with traumatic TM perforation in the success group than in the failure group. Lou et al[6] studied etiology and factors that affecting outcome of spontaneous healing in traumatic TM perforation and found 89% spontaneously closure of TM. Due to high spontaneous healing rate of traumatic TM perforation, paper patch myringoplasty in these patients is more likely to be succeed. However, the most common

etiologies of TM perforation in the present study was from chronic middle ear infection, and this may cause lower overall success rate than the previous studies.

In the present study, there was no statistical difference in the location of perforation on TM between the success and failure group. However, the paper patch myringoplasty in the patients with posteroinferior perforation tended to be more successful (60%) than the other location (26.6%, 18.2%, and 0.0% in inferior, anteroinferior, and anterosuperior location, respectively). Park et al[11] also reported higher proportion of patients with posterior perforation in the success group, compared to the failure group (83.3% versus 16.7%, respectively) but it was not statistically significant.

Pre- and post-operative audiometry was done in the success group, and there was significant post-operative hearing improvement in pure tone average air and bone conduction, and air bone gap.

Although the overall success rate of paper patch myringoplasty in the present study was lower than in the previous studies, the success rate was higher to 60% in the patients with perforation size less than 5%. Furthermore, there were some differences between the present study and the previous studies. First, the authors used 10% trichloroacetic acid as chemical substance for trimming perforation edge while the previous studies used mechanical trimming. Second, the present study found that chronic otitis media was the most common cause of TM perforation, while other studies found that trauma was the most common cause. The traumatic TM perforation tended to heal spontaneously without any surgical treatment. In addition, there was higher success rate in patients with posteroinferior TM perforation, although it was not statistically significant.

Conclusion

The paper patch myringoplasty is an office-based myringoplasty and still a non-invasive surgical management for TM perforation. The success rate tended to be higher in patients with small TM perforation of less than 5%, posteroinferior perforation, and traumatic perforation. Perforation trimming with mechanical method may increase the success rate.

What is already known on this topic?

Myringoplasty with autologous grafts (temporalis fascia, cartilage, and perichondrium) is a standard treatment to close a perforation on TM. However, paper patch myringoplasty, the office-based myringoplasty, is an alternative treatment for patients with small TM perforation. It is less invasive than the standard myringoplasty. From previous studies, the success rate varied between 12.5% and 84.2%.

What this study adds?

From this study, the success rate of paper patch myringoplasty was 27.27%. The authors recruited more patients than other previous studies and the etiology of TM perforation was mainly from infection while the major cause of TM perforation in other studies was from trauma. Furthermore, traumatic perforation tends to heal spontaneously. Although the factors of success patching are not significantly different between the success and the failure groups, the success rate tended to be higher in patients with perforation of less than 5% of total area, posteroinferior perforation, and traumatic perforation.

Therefore, selection of patients with a small perforation, posteroinferior perforation, or traumatic perforation is the key to increase the success rate of paper patching myringoplasty.

Potential conflicts of interest

The authors declare no conflict of interest.

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