

ORIGINAL ARTICLE

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Audiological results of myringoplasty performed by trainee surgeons (ENT residents) under supervision—analytic study

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Abstract

Background Myringoplasty is one of the most common surgeries performed in otology centers, with many factors influencing the success rate, including the size and site of perforation, function of the Eustachian tube, revision surgery, and expertise of the surgeons. It is well established that the perforation closure rate is lower when performed by trainee surgeons than by senior otologists. Myringoplasty performed by trainees tends to pose more iatrogenic trauma to middle ear mucosa, less gentle manipulation of ossicles, and prolonged operation time compared with operations performed by experienced surgeons, all of which might produce more damage to middle ear structures and consequently negatively affect the closure rate of TM and audiological outcome. This study aimed to assess the audiological outcomes of successfully closed perforation myringoplasty performed by a trainee under supervision.

Methods The study design was an analytic cross-sectional study of 35 patients aged between 6 and 62 years diagnosed with safe TM perforation. All patients had two audiograms, one before surgery and the other 3 months after surgery. The exclusion criteria included any case with cholesteatoma, tumor, tympanosclerosis, or ossicular erosion/fixation because this study aimed to study the sole effect of closing TM perforation without any other confounding factor.

Results The results indicate a mean hearing improvement of 12.25 dB of ABG and 10.6 dB of AC thresholds at the four frequencies of 500, 1000, 2000, and 4000 Hz. The mean of the residual ABGs at the four frequencies is 14.2 dB. There were no correlations between the amount of air conduction threshold improvement and age, gender, side of the affected ear, area of perforation, or duration of disease ($p > 0.05$ for all tests).

Conclusion Although the rate of perforation closure in myringoplasties performed by trainees is lower than that of experienced surgeons, the audiological outcomes of myringoplasties performed by trainees under supervision were acceptable; however, further research is recommended.

Keywords Tympanic membrane perforation, ENT residents, Audiological outcomes, Myringoplasty

Background

Perforations of the tympanic membrane (TM) are common incidents that often originate after traumatic or inflammatory middle ear diseases [1]. They tend to heal spontaneously if the insulting factor is no longer present, especially in children [2]. Failure to resolve is a result of failure of the blood supply to the perforation edges due to endarteritis, but there may be other factors related to the repairing mechanisms on the cellular level. Surgery is

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indicated when perforations fail to resolve spontaneously to restore the normal anatomy and function of the middle ear [3].

Myringoplasty is one of the most common surgeries performed in otology centers. It aims to close perforations by excising the scarred perforation edges, establishing a new proliferative phase allowing regrowth of the freshened edges on a scaffold of various graft materials [4]. There are many factors influencing the closure rate of TM perforations after myringoplasty, including the size and site of perforation, the function of the Eustachian tube, revision surgery in addition to the expertise of the surgeons [5–8]. Myringoplasty performed by trainees tends to pose more iatrogenic trauma to the middle ear mucosa, less gentle manipulation of ossicles, and prolonged operation time compared with operations performed by experienced surgeons, all of which might produce more damage to middle ear structures and consequently negatively affect closure rate of TM and audiological outcome.

Vartiainen et al. reported that the successful TM closure rate for trainees was 78% compared with 95% for senior staff [9]. However, Wilson reported that the closure rate of myringoplasty performed by appropriately supervised trainees is not vastly different from that of other published “expert” series [10]. This study aimed to assess the audiological outcomes of successful myringoplasty performed by a trainee under his/her supervision.

Methods

Participants

Thirty-five patients aged between 6 and 62 diagnosed with TM perforation were enrolled in the study. The study was approved by the scientific committee at the Faculty of Medicine, Al Mowasat. All of these patients underwent myringoplasty in the ENT department in Al Mowasat university hospital performed by trainee residents under supervision and patients have been followed for 3 months. All myringoplasties enrolled in the study have adopted the same surgical technique of underlay temporal fascial graft placement and access to the middle ear was obtained via a post-auricular incision.

Study design

The study design was an analytic cross-sectional study. Exclusion criteria included any case with cholesteatoma, tumor, tympanosclerosis, or ossicular erosion/fixation as this study aimed to study the sole effect of closing TM perforation without any other confounding factor. We also planned to exclude cases with iatrogenic SNHL after myringoplasty whose bone conduction thresholds after surgery exceed the maximum power output of the bone vibrator transducer used during audiometry “Radioear

B-71” as this would make the postsurgery air–bone gap unpredictable and fortunately, we had none. Speech audiometry was done for all participants before surgery to ensure the sensorineural hearing function [11].

Data collection

Before surgery, each patient has undergone a full assessment including history, physical examination, and audiometry. 3 months after surgery, patients were recruited again and audiometry was repeated to assess the post-surgical audiological improvement. Audiograms were produced using Interacoustic® AD629 audiometer and thresholds were obtained using the bracketing technique in a sound-proof booth. Bone and air conduction thresholds from both ears were obtained before surgery and 3 months post-surgery and hearing improvement was assessed based on the calculation of means of audiometric changes at the four frequencies of 500, 1000, 2000, and 4000 Hz.

Statistical analysis

Using SPSS software version 19, we assessed the changes in air conduction thresholds, bone conduction thresholds, and air-bone gaps before and after surgery. These changes were then studied for any correlations with the characteristics related to patient and disease including the age, gender, side of the affected ear, status of perforation, and duration of disease.

Results

The study sample consisted of 35 participants, 28 females and 7 males whose ages ranged from 16 to 62 years old (29 ± 14 years). The study sample characteristics are shown in Table 1.

The mean and values of bone conduction (BC) thresholds, air conduction (AC) thresholds, and air–bone gap (ABG) at the different test frequencies before and after surgery are shown in Table 2.

The changes in AC thresholds (ΔAC) and ABG (ΔABG) after myringoplasty represent the hearing improvement due to the closure of perforation. All these results in addition to the residual ABG are shown in Table 3. They indicate a mean hearing improvement

Table 1 Characteristics of disease

Characteristic	Frequency
Gender (male/female)	7/28
Affected side (right/left)	13/22
Area of perforation (more than 50% of TM/less than < 50% of TM)	20/9—data of 6 cases was missed

Table 2 Pre- and post-operative audiometric thresholds

	500 Hz	1000 Hz	2000 Hz	4000 Hz	Mean of the four frequencies
Pre-operative BC	8.8 dB	7.1 dB	12 dB	13.7 dB	10.4 dB
Post-operative BC	11.4 dB	8.9 dB	13.2 dB	15.7 dB	12.3 dB
Pre-operative AC	38.5 dB	33.1 dB	35.1 dB	41 dB	36.9 dB
Post-operative AC	25.5 dB	25 dB	24 dB	30.4 dB	26.2 dB
Pre-operative ABG	29.7 dB	26 dB	23.1 dB	27.2 dB	26.5 dB
Post-operative ABG	14.4 dB	16.2 dB	11.1 dB	15.1 dB	14.2 dB

AC air conduction, BC bone conduction, ABG air–bone gap

Table 3 Hearing improvement after myringoplasty

	500 Hz	1000 Hz	2000 Hz	4000 Hz	Mean of the four frequencies
ΔAC	13 dB	8.1 dB	11.1 dB	10.5 dB	10.6 dB
ΔABG	15.3 dB	9.7 dB	12 dB	12.1 dB	12.2 dB

ΔAC change in air conduction thresholds after myringoplasty, ΔABG change in air–bone gap after myringoplasty

of 12.25 dB of ABG and 10.6 dB of AC thresholds at the four frequencies 500, 1000, 2000, and 4000 Hz (Fig. 1).

There were no correlations between the amount of air conduction threshold improvement and either age, gender, side of the affected ear, area of perforation, or duration of disease ($p > 0.05$ for all tests).

Discussion

The results indicate that successfully closed TM by our trainee surgeons have led to an improvement in hearing thresholds equal to 10.6 dB (AC improvement), which is consistent with the results of myringoplasty performed by experienced surgeons like the work of Palva on 33 cases reporting a mean hearing improvement of 10.5 dB (AC improvement) at octave frequencies from 500 to 4000 Hz [7]. Notably, myringoplasty produces only a minor improvement in hearing, and patients should be counseled accordingly.

The mean of residual postoperative ABGs at frequencies 500, 1000, 2000, and 4000 was 14.2 dB, which is close to the results reported by Palva (9.3 dB) [7]. The small residual gap is deemed reasonable because myringoplasty cannot produce a nanomembrane with anatomical and histological features identical to a normal membrane.

The rate of successful closure of perforation was not one of our main objectives in this study; however, it was calculated and estimated to be approximately 80%, which is consistent with the closure success rate of myringoplasty performed by trainees in a study by Vartiainen [9].

There were no correlations between hearing improvement after myringoplasty and other characteristics related to patient and disease, including age, gender, side of the affected ear, perforation status, and disease duration. However, Lee et al. found a difference in the Four-frequency audiometric improvement (500, 1000, 2000, and 4000 Hz) of 7.2 for small perforation (< 50%) and 10.2 for large perforation (> 50%) [12].

The greater loss for large perforations was explained in the work of Glenna et al. by the reduction in the effective/inertial mechanical drive to the umbo, consequently leading to reduced middle ear pressure gain [13]. Although these values were found to be statistically significant,

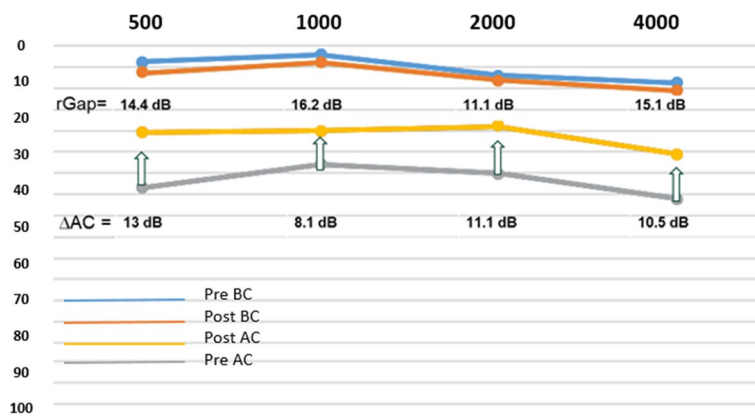


Fig. 1 Means of pre- and post-operative BC and AC conduction thresholds. Illustration: this figure shows the means of AC and BC conduction thresholds before and after myringoplasty. It indicates the four main frequencies AC improvement of 10.6 dB and a residual gap of 14.2 dB which is comparable to the results of Palva [7] (10.5 dB, 9.3 dB) consequently

these differences have no significant impact on patients' hearing from a clinical perspective.

Conclusion

Although the rate of perforation closure in myringoplasty performed by trainees is lower than that of experienced surgeons, the audiological outcomes of myringoplasty performed by trainees under supervision are as good as those performed by experienced surgeons. However, this study has many limitations that cannot be avoided, the small sample size due to the limited duration of our study and also the absence of a comparison group from within the same study because the surgeries in our center are performed only by trainees under supervision are the two main limitations. Thus, the findings of this study cannot be generalized to the clinical practice and we recommend doing further research with larger sample sizes and a comparison group from the same study.

Acknowledgements

This study is a part of the Master Thesis of Otolaryngology, approved by the Faculty of Medicine, Damascus University. The authors thank all participants and colleagues who helped in the data gathering.

Authors' contributions

OS: data collection, analysis, and writing the paper; MS: supervision, data analysis, and writing the paper.

Funding

No funding was received to assist with the preparation of this manuscript.

Availability of data and materials

All data related to the research is preserved in the Otolaryngology Department et al.-Mowasat University Hospital, and a copy can be provided to the editors upon request.

Declarations

Ethics approval and consent to participate

This study was part of a master's degree dissertation project in Otolaryngology that was accepted and approved by the Faculty of Medicine Damascus University (812, 11/4/2023). All the research procedures are compatible with the ethics of medical research and the principles of Helsinki. Consent to Participate: The authors confirm that all participants (or their parent or legal guardian in the case of children under 16) provided informed written consent to participate in the study.

Consent for publication

Not applicable.

Competing interests

The authors have no competing interests to declare relevant to this article's content.

Received: 20 April 2024 Accepted: 12 July 2024

Published online: 14 August 2024

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