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Original Article

Learning curve for endoscopic tympanoplasty: Initial experience of 221 procedures

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Abstract

Background: The learning curve for endoscopic tympanoplasty has never been quantitatively reported. The present study depicted the learning curve for endoscopic tympanoplasty and evaluated how many procedures an otologist requires to attain proficiency in this technique.
Methods: We reviewed the medical charts of consecutive patients who underwent endoscopic tympanoplasty between January 1, 2013 and June 1, 2015. We enrolled patients with simple perforations of the tympanic membrane and excluded those with ossicular chain disease. The main outcome was learning curves for endoscopic tympanoplasty, which illustrated changes in the mean operative time and graft success rate according to the patient numbers. We subsequently estimated and verified the threshold value using statistical methods.
Results: A total of 221 procedures were included. For the learning curve of the mean operative time, the time gradually decreased from 75 minutes to 55 minutes. After the 150th patient, the mean operative time stabilized to < 60 minutes. For the learning curve of the graft success rate, the rate sharply increased from 75% to 95%. After the 50th patient, the graft success rate reached a plateau and fluctuated between 85% and 100%. We subsequently verified that the 50th and 150th patients were appropriate threshold values. Moreover, the graft success rate of perforations < 50% was significantly higher than that of perforations > 50%.
Conclusion: These curves illustrate significant progress of the surgeon during the first 50 patients, considering the graft success rate, reaching an advanced level after the 150th patient, considering the mean operating time.

Keywords: endoscopy; learning curve; tympanic membrane; tympanoplasty

1. Introduction

Elucidating the learning curve for a new technique is essential. A learning curve for an operation refers to the number of patients required before achieving a stable operating time and surgical outcome.[1] Inexperienced surgeons can learn from the established learning curve and improve their learning process.

Since the 1950s, microscopic tympanoplasty has been the standard operation for repairing a perforated tympanic membrane.[2−4] The operation can be performed using three (postauricular, endaural, and transcanal) approaches. A postauricular incision facilitates greater visibility of the operating site, whereas the transcanal approach is reserved for patients with small tympanic perforations and a wide ear canal status.[3] Therefore, microscopic tympanoplasty through the postauricular approach has been performed worldwide.[3,4] Despite having a high graft take rate > 90%, this technique frequently requires hair shaving, deep postauricular incision, and general anesthesia.[3,4]

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article..

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In addition to conventional microscopic tympanoplasty, endoscopic tympanoplasty has been an emerging technique since the late 1990s.[5–15] The number of related reports steadily increased, peaking in 2014.[6] The major difference between microscopy and endoscopy is the surgical view. The view during microscopic surgery is defined and limited by the narrowest segment of the ear canal. By contrast, transcanal endoscopy bypasses the narrowest ear canal and provides a wider view, even when a 0-degree endoscope is used.[7,8] Because of this advantage, endoscopic tympanoplasty can avoid canalplasty, postauricular incision, and general anesthesia, and therefore, is less invasive than the microscopic technique.[5–15]

Several studies have reported the learning curve for endoscopic tympanoplasty; however, none of them have quantitatively described those curves.[7,8,10] Therefore, the present study depicted the learning curve for endoscopic tympanoplasty and evaluated how many procedures an otologist requires to attain proficiency in this technique.

2. Methods

2.1. Study design and patients

The Joint Institutional Review Board of the Taipei Medical University approved our study protocol. The present study was a retrospective medical chart review of consecutive patients who had undergone endoscopic tympanoplasty between January 1, 2013 and June 1, 2015 at our hospital. We enrolled patients who had simple perforations of the tympanic membrane and excluded those with ossicular chain disease and cholesteatoma. Those patients were followed up at the clinic for at least 6 months. All operations were performed under local and intravenous anesthesia by the same surgeon in an outpatient setting. The surgeon had performed approximately 50 microscopic tympanoplasties before performing endoscopic tympanoplasty. This study included the surgeon's initial practice of endoscopic tympanoplasty.

Preoperatively, we used a video recording system to visualize the status of the tympanic membrane using an endoscope (Storz, Tuttlingen, Germany; 4.0 mm, 0-degree, 18-cm long lens). The recorded image was obtained to evaluate the perforation size of the tympanic membrane and condition of the middle ear mucosa. The tympanic membrane was divided into quadrants according to the position of the malleus handle, and each quadrant accounted for 25% of the tympanic membrane. The perforation size was evaluated and divided into three groups: < 10%, 10–50%, and > 50%; the perforation location was classified as anterior or posterior to the malleus handle. If an anterior perforation extended posterior to the malleus handle, it was considered central. Perforations were considered inferior if they were inferior to the umbus of the malleus. We defined the operating time as the duration between the start of local anesthesia and end of wound dressing. Graft success was defined as the presence of an intact graft evaluated using a 0-degree endoscope, whereas graft failure was a residual or recurrent perforation at 6 months postoperatively. The patients were chronologically numbered according to the operating date and were equally divided into 11 groups, each comprising 20 patients. The graft success rate and mean operating time were calculated for each group.

Data on patient age, sex, site, perforation size, graft success rate, operating time, air–bone gaps in audiograms, and hearing loss were extracted for analysis. We recorded preoperative and postoperative audiograms of patients at frequencies of 0.5 kHz, 1 kHz, 2 kHz, and 3 kHz to access the closure of the air–bone gap. When a threshold at 3 kHz was unavailable, the average of 2 kHz and 4 kHz was calculated.

The main outcomes were learning curves for endoscopic tympanoplasty. The first learning curve illustrated changes in the mean operating time according to the patient numbers. The second learning curve depicted changes in the graft success rate according to the patient numbers.

We determined the threshold value according to three criteria. First, we searched for an apparent deflection point on our depicted curves. Second, we verified the estimated threshold value by using statistical methods. For example, we compared the data before the estimated threshold value to those after the value by using sample t tests. Third, we compared the estimated threshold value to data from previous reports. For example, the graft success rate of type I tympanoplasty is typically higher than 90%.[3,4]

Because the perforation size generally affects the operating time and graft success rate,[3,4] we subsequently stratified these two factors according to the perforation size in the analysis.

2.2. Surgical techniques

Two Storz rigid endoscopes were used in our surgical techniques (4.0 mm, 0-degree, 18-cm long lens and 3 mm, 0-degree, 14-cm long lens).

Patient ears were prepared and draped under sterile conditions without hair shaving. Each patient was administered intravenous sedation (50 mg meperidine + 5 mg midazolam) 10 minutes preoperatively by an anesthesiologist. The periaural area and external ear canal were infiltrated with 2% lidocaine with 1: 100,000 epinephrine.

We used the temporalis fascia or tragal perichondrium as graft materials. For harvesting the temporalis fascia graft, a 2.5-cm incision near the hairline superior and posterior to the helix was made to expose the areolar tissue or temporalis fascia; this connective tissue was harvested and then pressed using a fascia clamp. After achieving hemostasis, the postauricular incision was closed with absorbable sutures. For harvesting the tragal perichondrium graft, a 1-cm incision was made 2–3 mm medial to the free border of the tragal cartilage, cutting through the skin and cartilage. The perichondrium was free of the cartilage and prepared as a graft. The incision was sutured with an absorbable material.

We used two surgical techniques: endoscopic simple underlay myringoplasty (without elevation of the tympanomeatal flap), and endoscopic type I tympanoplasty (with elevation of the tympanomeatal flap), as described by Furukawa et al.[11]