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Original article

Butterfly-cartilage tympanoplasty in children: A 28-case series and literature review



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ABSTRACT

Objective: This study presents results for a pediatric series of tympanoplasty using the butterfly-cartilage technique, with comparison to literature reports.

Methods: A retrospective study included patients aged between 2 and 12 years receiving tympanoplasty performed by a single senior surgeon in our department between 2003 and 2012, for whom pre- and post-operative tympanum imaging was complete. Results were analyzed at a minimum 10 months' follow-up in terms of graft healing and auditory data, with pre- and postoperative audiograms and calculation of mean hearing loss.

Results: Twenty-eight tympanoplasties were performed in 27 children: 16 males, 11 females; in 1 case, perforation was bilateral. Perforation location was inferior or antero-inferior in 14 cases (50%), antero-superior in 9 (32.1%) and anterior in 5 (17.9%). Perforation size on otoscopy ranged from 11.1% to 36.4% of tympanum area (mean, 26.3%). Mean follow-up was 25 months. Closure of the perforation was achieved in 87.7% of cases. Mean hearing loss was 20.2 dB (range, 10–31.25 dB) preoperatively and 14 dB (range, 5–31.25 dB) postoperatively.

Discussion: We analyze our results and compare them with the international literature to refine indications for this technique of tympanic repair.

Conclusion: Tympanoplasty using the butterfly-cartilage technique was reliable and easy to perform. It should be included in the therapeutic armamentarium for moderate non-marginal tympanic perforation. In the present series, the technique was reserved to perforations involving less than 40% of tympanum area.

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1. Introduction

Since first described by Zollner [1] and Wullstein [2] in the 1950s, numerous techniques of surgical tympanum repair have been used and reported. Whether autologous, using temporal muscle fascia superficialis, perichondrium, or fat, etc., or, more rarely, heterologous, using a paper, rice or silk patch, most techniques required a tympanomeatal flap.

Auditory canal approaches not involving tympanomeatal flap detachment were introduced in the late 1970s by Ringenberg [3]; results, however, were unreliable, with no real predictive factor for success, and the technique was indicated only in very small non-marginal perforations.

Eavey [4], in 1998, was the first to describe the use of tragal cartilage and perichondrium sculpted into a butterfly shape for type-I tympanoplasty, to remedy the unreliability of fatty graft using the “champagne cork” technique. This radically novel butterfly-cartilage technique was easy and quick to implement and soon became widespread. As of the early 2000s, it became standard practice in our institution.

The present study reports and analyzes anatomic and functional results in a homogeneous series of 28 tympanoplasties, with comparison to the literature, to determine good practice.

2. Material and methods

A retrospective study included 27 patients (28 ears), aged 2 years 10 months to 12 years 11 months, operated in our department by a single senior surgeon between 2003 and 2012, and having complete pre- and postoperative tympanum imaging files (Sony UP-25MD color video printer).

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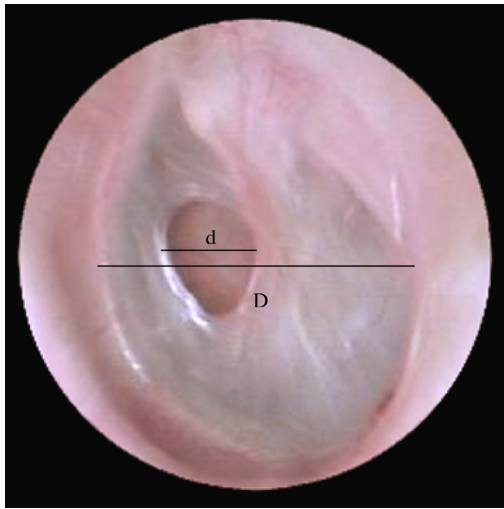


Fig. 1. Left tympanum perforation: perforation size relative to tympanum area (%) = $d \times 100/D$, where d is the diameter of the perforation and D that of the tympanum. Here, the perforation involved 29.1% of tympanum area.

Patients presented with stable non-marginal tympanic perforation without associated otorrhea, of at least 3 months' progression, in an ear free of chronic pathology. Preoperative photographs of the tympanic membrane were taken to locate the perforation objectively on the tympanic quadrants, and to measure its size relative to the tympanum as $d \times 100/D$, where d is the diameter of the perforation and D the diameter of the tympanum (Fig. 1). Perforations managed by tympanoplasty but without complete pre- and postoperative tympanum imaging files were excluded from the study.

Surgery was systematically performed under general anesthesia in this pediatric population. The external auditory canal was cleansed and the middle ear washed with an antibiotic solution. The perforation edges were freshened with a blunt dissector and micro-hook, pulling back the epidermis in contact with the edge to avoid risk of inclusion within the eardrum. Perforation diameter was measured by using 2–5 mm diameter microsurgical spatulas, and a tragal cartilage graft was harvested, including the perichondrium on both sides. The cartilage was then trimmed to fit the perforation, with 2 mm extra diameter to ensure good stability in positioning. A 1-mm incision was then made using a 15-mm knife around the edge of the cartilage to achieve the butterfly shape, and the graft was positioned, ensuring that the medial wing of the “butterfly” was well inserted through the perforation around the entire circumference. The external auditory canal was then enlarged using a pop-otowick® impregnated with antibiotic solution, to protect the

back of the canal, and thus the tympanum, mainly against external aggression.

All patients were systematically followed up 2 weeks after surgery to remove the pop-otowick, and then at 1 and 6 months and around 10 months, if there were no adverse events. Results were analyzed at a minimum 10 months' follow-up: graft healing, perforation closure quality, and hearing, calculating mean hearing loss on pre- and postoperative audiograms at 500, 1000, 2000 and 4000 Hz in line with the Committee on Hearing and Equilibrium for the evaluation of results of treatment of conductive hearing loss [5].

3. Results

The study population comprised of 27 children aged between 2 years 10 months and 12 years 11 months (mean, 7.7 years): 16 boys (59.3%), 11 girls (40.7%). Perforations had been present for more than 3 months in all cases, without associated otorrhea. Location was inferior or antero-inferior in 14 cases (50%), antero-superior in 9 (31.1%) and anterior in 5 (17.9%). History-taking noted transtympanic aerator insertion in 22 out of 28 cases (78.6%). Five children had history of iterative otitis or seromucous otitis, without tympanic aerator or paracentesis. In 1 case, perforation was traumatic, and a 6-month interval was left before surgery to allow for possible spontaneous healing. The right ear was involved in 17 children and the left ear in 10; 1 child underwent the same procedure in both ears, with a 10-month interval. Perforation size on otoscopic images was between 11.1% and 36.4% of tympanum area (mean, 26.3%). Mean preoperative hearing loss was 20.2 dB (range, 10–31.25 dB).

Mean follow-up was 25 months (range, 10–96 months). Success, defined as total graft healing, was found in 24 out of 28 cases (85.7%). Two examples of successful butterfly-cartilage tympanoplasty are shown in Figs. 2 and 3.

There were 3 cases of residual perforation, with posterior graft positioning, and 1 of cartilage expulsion (due to sneezing stress, according to the family); all were managed by secondary conventional tympanoplasty using the fascia superficialis of the temporal muscle, achieving closure in all cases. In these children, preoperative perforation size on otoscopy was between 14% and 26.6% of tympanic area: i.e. a mean, 20.6%, compared to 26.3% in the series as a whole. There was 1 case of late “relative” failure, in a child whose ENT physician had removed the cartilage in consultation 2 months after surgery, mistaking it for a cerumen plug.

No early or late complications occurred during follow-up: no graft detachment falling into the middle ear, tympanic retraction pocket, epidermal graft or tragal donor site morbidity. Last audiometric check-up found a mean Rinne of 13.7 dB (range, 5–31.25 dB). Mean postoperative pure-tone audiometry gain was 6.5 dB. For

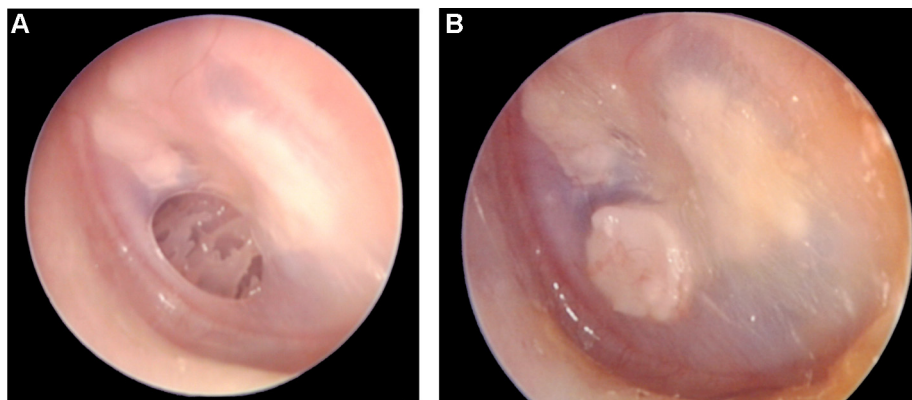


Fig. 2. Six year-old boy with perforation involving 35.7% of the left tympanum. A. Preoperative photograph. B. Postoperative photograph at 21 months.

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