

Pediatric tympanostomy tube removal: factors affecting rate of persistent tympanic membrane perforation

Original Article

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Abstract

Objectives: To identify factors associated with persistent tympanic membrane (TM) perforation after elective removal of short-term tympanostomy tubes (TT) in children and to compare removal/repair techniques.

Study Design: Retrospective cohort.

Materials and Methods: Children undergoing elective TT removal in a tertiary center (2015-2024) were included. Persistent perforation was defined as lack of TM closure at 6 months. Demographic, clinical and surgical variables were assessed, including tube dwell time, indication and technique (removal only, edge freshening, myringoplasty with Epidisc® patch, or both).

Results: Twenty-five patients were included (60% female), mean age at removal 8.4 years and mean tube dwell time 42.2 months. Persistent perforation occurred in 28%. No significant differences were found according to technique or TM intervention.

Conclusions: Persistent perforation after elective TT removal was frequent. Older age, female sex and prolonged tube retention may increase risk, with no clear benefit from concomitant local TM interventions.

Keywords: Pediatrics; Tympanostomy tube; Removal; Tympanic membrane perforation.

Introduction

Myringotomy with the placement of tympanostomy tubes (TTs) is one of the most frequently conducted pediatric surgical procedures worldwide. Numerous clinical indications for this procedure have been established in the literature, including persistent otitis media with effusion, complicated acute otitis media, and certain anatomical abnormalities.¹ In most cases, short-term TTs are spontaneously extruded from the tympanic membrane (TM) 6 to 18 months after placement.² However, in some cases, surgical removal is required.

Accordingly, established indications for removal include chronic otorrhea refractory to topical antibiotic therapy, granulation tissue surrounding or within the TT, a nonfunctioning TT, or TT migration into the middle ear.

The literature has increasingly indicated elective intervention for retained tubes, particularly when they have remained in the TM for more than 2–3 years,^{3,4} because spontaneous extrusion beyond this point appears unlikely. However, the child's age and eustachian tube function must be considered at the time of this intervention to avoid the need for TT reinsertion.

Defining the timing of elective TT removal, identifying the patients who benefit from it, and determining the surgical technique to be used have been the subject of several studies; however, the evidence remains unclear.

Therefore, this study aimed to analyze and identify the clinical and surgical factors and characteristics associated with the TM perforation rate after elective TT removal in the pediatric population.

Material and methods

This retrospective study was conducted at Centro Hospitalar Universitário de Santo António in accordance with the institution's ethical principles. All pediatric patients who underwent surgical removal of short-term TTs between 2015 and 2024 were included. Electronic and paper medical records were obtained through a search using the ICD-9 and ICD-10 codes for the surgical intervention. Cases including long-term TTs, duplicate records, or follow-up of <6 months were excluded. Subsequently, sociodemographic and clinical data were collected, including age, sex, and associated comorbidities. Allergic rhinitis was recorded when confirmed by allergy testing (skin prick test).

The presence or absence of TM perforation was determined from the attending physician's otoscopy findings recorded 6 months after surgery. The data were also extracted on procedures associated with TT placement, such as adenotonsillectomy.

The indication for TT removal was classified into four categories: otorrhea, granulation tissue, loss of TT patency, and TT persistence for >3 years. The surgical intervention at the time of elective TT removal was classified into four groups: isolated TT removal, freshening of the perforation margins, myringoplasty with Epidisc®, and freshening of the perforation margins combined with myringoplasty with Epidisc®. A statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS, version 27). Descriptive analyses of the variables described above were conducted, along with Student *t*-tests for continuous variables and chi-square tests for categorical variables. The significance level was set at $P < .05$.

Results

Initially, 31 medical records were reviewed. After application of the exclusion criteria, the final sample comprised 25 patients, whose characteristics are summarized in Table 1. All patients underwent unilateral surgery.

The children's mean age at TT placement was 4.5 years. The mean age at surgical removal was 8.4 years, with a mean TT retention time in the TM of 42.2 months, or approximately 3.5 years. Only two patients had previously undergone TT placement, and neither had a TM perforation after elective removal.

Regarding the data in Table 2 on the relationship between TM perforation and the other study variables, the mean age at TT placement was higher in the perforation group, although the difference was not statistically significant. Likewise, the TT retention time was longer in the perforation group (43.7 vs 41.6 months), as was the average age at surgical removal (9.4 vs 8.1 years), compared with the group in which the perforation closed.

Otorrhea and loss of TT patency were the most frequent indications for removal (40% each).

The vast majority of children included in the study had no comorbidities; allergic and nonallergic rhinitis were the most frequently observed comorbidities. An intervention on the TM was conducted concurrently in most

Table 1
Sample demographic characteristics

Variable	Value
Sex, n (%)	
Female	15 (60%)
Male	10 (40%)
Age at TT placement, mean (standard deviation [SD]), years	4,68 (1,7)
Age at elective removal, mean (SD), years	8,4 (2,3)
TT retention time, mean (SD), months	42,2 (18,2)
Tympanic membrane perforation, n (%)	7 (28%)
Laterality, n (%)	
Left ear	14 (56%)
Right ear	10 (40%)
Previous TT placement, n (%)	2 (8%)

Table 2
Relationship between tympanic membrane perforation and sample parameters

	Total	Tympanic membrane perforation		p
		Yes	No	
Age at TT placement, mean (SD)	4,68 (1,7)	5,4 (2,4)	4,4 (1,3)	0,169
Age at elective TT removal surgery, mean (SD)	8,4 (2,3)	9,4 (2,4)	8,1 (2,3)	0,195
TT retention time (months), mean (SD)	42,2 (18,2)	43,7 (15,3)	41,6 (19,6)	0,802
Past medical history				0,561
– None	16 (64%)	6 (24%)	10 (40%)	
– Allergic rhinitis	3 (12%)	-	3 (12%)	
– Nonallergic rhinitis	2 (8%)	-	2 (8%)	
– Malformation syndrome	2 (8%)	1 (4%)	1 (4%)	
– Asthma	1 (4%)	-	1 (4%)	
– Asthma and allergic rhinitis	1 (4%)	-	1 (4%)	
TT placement surgery				0,021
– TT placement alone	4 (16%)	1 (4%)	3 (12%)	
– Adenoidectomy (with or without tonsillectomy) + TT	21 (84%)	6 (24%)	15 (60%)	
Indication for surgical TT removal				0,220
– Otorrhea	10 (40%)	5 (20%)	5 (20%)	
– Loss of patency	10 (40%)	1 (4%)	9 (36%)	
– TT >3 years	4 (16%)	1 (4%)	3 (12%)	
– Granulation tissue	1 (4%)	-	1 (4%)	
Type of elective surgery performed				0,525
– Isolated removal	8 (32%)	1 (4%)	6 (24%)	
– Myringoplasty with Epidisc®	8 (32%)	1 (4%)	7 (28%)	
– Myringoplasty with Epidisc® and freshening of the perforation margins	7 (28%)	3 (12%)	4 (16%)	
– Freshening of the perforation margins	2 (8%)	1 (4%)	1 (4%)	

cases (68%), with no statistically significant difference in the TM perforation rate between these groups. In this study, the TM perforation rate at 6 months of follow-up was 28%.

Discussion

The rate of TM perforation after elective TT removal (0%–57%)^{5,6} is considerably higher than after spontaneous extrusion (1%–4%).⁷ The perforation rate in this study was 28%, which is consistent with the literature.

Among the most extensively studied factors, TT retention time has the strongest consensus in the literature. In the present sample, the mean TT retention time was similar between the groups with and without perforation (43.7 vs 41.6 months), and no statistically significant association with this outcome was observed.

Another factor commonly associated with post-TT perforation is the number of previously placed tubes. In the sample analyzed here, only two patients had a history of previous TT placement, and neither developed a perforation after removal.

Mean patient age—both at TT placement and at removal—was higher in the group with TM perforation (5.4 vs 4.4 years and 9.4 vs 8.1 years, respectively) because older children are more likely to have pathological middle ear changes that predispose them to TM perforations.⁸

Nevertheless, patient age is a controversial factor in the literature: some authors report that younger ages (under 5 years) are associated with higher TM perforation rates because of impaired middle ear ventilation secondary to eustachian tube immaturity.^{9,10}

A history of adenoidectomy is a controversial factor across studies because it may reduce the need for TT reinsertion¹ and thus indirectly reduce the perforation rate. Conversely, adenoidectomy may impair eustachian tube function, thereby increasing the risk of TM perforation. In this study, only four patients underwent myringotomy with TT placement alone, precluding statistical conclusions.

A recent meta-analysis¹¹ on the optimal timing of elective TT removal concluded that TT removal before 3 years of TT retention in the

TM was associated with a lower perforation rate; however, it could not determine the utility of performing any type of myringoplasty concurrently—a finding consistent with the results presented here.

This study has several drawbacks, particularly the small number of patients included, which limits the statistical validity of the results. In addition, considering its retrospective design, the study was restricted to the clinical records documented by the otolaryngologists who followed these children. Moreover, trophic TM changes, such as myringosclerosis as well as TT location and perforation size, were not considered, and the evidence supporting their role in perforations is unclear.⁸

Conclusions

Elective TT removal should be considered once a tube has been retained for 3 years in the TM, particularly in the absence of other complications that might justify earlier intervention.

Although the TM was manipulated during removal in most cases (68%) in this study, this had no statistically significant impact on the perforation rate. Notably, 7 of 25 patients (28%) who underwent elective surgical TT removal had a persistent TM perforation, regardless of the removal technique.

Future randomized studies on the timing of elective TT removal and additional TM interventions are therefore needed to clarify and assess their true impact on perforation rates.

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Conflicts of Interest

The authors declare that there are no conflicts of interest.

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Ethics Approval and Informed Consent

The study was approved by the local

Ethics Committee. Given the retrospective nature of the study and the use of anonymized data, informed consent from the study participants was waived.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

No AI-assisted technologies were used in the preparation of the manuscript.

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