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Postoperative Otorrhea as a Predictor of Early Ventilation Tube Extrusion in Children

Original Investigation

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Abstract

Objective: To evaluate the clinical and surgical factors influencing ventilation tube (VT) extrusion time in pediatric patients, using both univariate and multivariate analyses.

Methods: This retrospective study included 227 pediatric patients (128 males, 99 females; mean age 6.46±2.27 years) who underwent VT insertion, with or without adenoidectomy and/or tonsillectomy, between January 2021 and January 2024. Demographic data, surgical indication, middle ear effusion type, and presence of postoperative otorrhea were recorded. Extrusion time for each ear was compared using the Mann-Whitney U and Kruskal-Wallis tests. Variables with $p<0.20$ were included in multiple linear regression analyses to identify independent predictors of extrusion time.

Results: The mean extrusion time was 8.41±3.01 months for the right ear and 8.28±2.81 months for the left ear. Age, sex, surgery type, and effusion type were not significantly associated with extrusion time. Postoperative otorrhea was significantly related to shorter extrusion in both ears (right: -4.77 months, $p<0.001$; left: -4.08 months, $p=0.001$).

Conclusion: Postoperative otorrhea and recurrent otitis media were associated with shorter VT retention, whereas demographic factors and concurrent adenoidectomy/tonsillectomy had no effect. Closer follow-up could be beneficial in patients with these risk factors to detect early extrusion and potential disease recurrence.

Keywords: Otitis media with effusion, otitis media, ventilation tube, postoperative complications, otorrhea, regression analysis

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Introduction

Otitis media with effusion (OME) and recurrent otitis media (ROM) are among the most common otolaryngologic problems in childhood and represent a leading cause of hearing loss, delayed speech, and reduced quality of life in the pediatric population (1,2). When conservative management fails, ventilation tube (VT) insertion is a widely accepted surgical treatment that aims to restore middle ear aeration, improve hearing, and reduce the risk of long-term complications (3,4).

While VT insertion is beneficial, tube extrusion is usually part of the natural postoperative process. The timing of extrusion varies depending on patient characteristics, middle ear status, tube type, and surgical factors. Early extrusion may

be associated with a higher likelihood of disease recurrence, whereas prolonged retention can lead to complications such as persistent tympanic membrane perforation (5).

Previous studies have examined factors that may influence VT extrusion time, including age, sex, surgical indication, middle ear effusion type, and concomitant procedures such as adenoidectomy and/or tonsillectomy (6-8). However, the findings have been inconsistent, and many studies have not evaluated multiple potential predictors simultaneously.

The presented study aimed to investigate clinical and surgical factors influencing VT extrusion time in a pediatric population, using both univariate and multivariate analyses. Identifying independent predictors of extrusion time may help optimize patient selection, surgical planning, and follow-up strategies, ultimately improving clinical outcomes.

Methods

Study Design and Population

The study was approved by İzmir Bakırçay University Non-Interventional Clinical Research Ethics Committee (approval no: 2287, date: 04.06.2025) and was conducted in accordance with the principles of the Declaration of Helsinki. This retrospective observational study included pediatric patients who underwent VT insertion, with or without concomitant adenoidectomy and/or tonsillectomy, between January 2021 and January 2024. A total of 227 patients with complete clinical and follow-up data were included in the analysis. In all patients, a Shepard Grommet VT (Medtronic Xomed, Inc., USA) was inserted through a myringotomy performed in the anterior-inferior quadrant of the tympanic membrane. In indicated patients, when no effusion was present intraoperatively, VTs were still inserted if the tympanic membrane demonstrated significant retraction, atelectasis, or other signs of eustachian tube dysfunction.

Inclusion Criteria

- Age between 0 and 18 years at the time of surgery
- Underwent VT insertion for OME or ROM
- Complete medical records available
- Minimum follow-up period of 18 months

Exclusion Criteria

- Previous VT insertion or middle ear surgery
- Presence of craniofacial anomalies, cleft palate, or syndromic conditions
- Chronic suppurative otitis media or cholesteatoma
- Incomplete follow-up data
- VT type other than Shepard grommet

Data Collection

Demographic data (age, sex), surgical details, intraoperative effusion type for each ear, and presence of postoperative otorrhea were recorded from patient files. The indication for surgery was categorized as OME or ROM. Extrusion time was defined as the interval between tube insertion and the date of confirmed extrusion on otoscopic examination. The primary outcome was extrusion time (months) for the right and left ears. Secondary outcomes included identification of clinical and surgical factors affecting extrusion time. ROM was defined as ≥3 episodes in 6 months or ≥4 in 12 months with resolution between episodes. Postoperative otorrhea was defined as ear discharge clinically documented and/or requiring topical antibiotic therapy after tympanostomy tube insertion. Otorrhea was treated with topical quinolone ± steroid eardrops (no routine oral antibiotics).

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, NY, USA). Analyses were performed at the ear-level; right and left ears were modeled in separate cohorts, ensuring one observation per patient within any given model. Continuous variables were expressed as mean±standard deviation or median, and categorical variables as counts and percentages. The Mann-Whitney U test was used for two-group comparisons and the Kruskal-Wallis test for comparisons involving more than two groups. Candidate variables (univariable $p<0.20$ and/or a priori clinical relevance) were included in a multivariable linear regression; multicollinearity was assessed using variance inflation factors, and model assumptions were checked with residual diagnostics. A p-value of <0.05 was considered statistically significant.

Artificial Intelligence Declaration

Part of the manuscript text was edited for clarity and grammar using ChatGPT (OpenAI, San Francisco, CA, USA). The authors reviewed and verified all artificial intelligence (AI)-assisted content to ensure accuracy and originality. No AI-generated content was used as a primary source.

Results

A total of 227 patients were included in the analysis. Among 227 patients, tube placement was bilateral in 187 (82.3%), right-only in 19 (8.4%), and left-only in 21 (9.3%). The mean age was 6.46±2.27 years (range, 1-12 years). Of these, 128 (56.4%) were male and 99 (43.6%) were female. Regarding surgical procedures, 43 patients (18.9%) underwent VT insertion alone, 114 (50.2%) underwent adenoidectomy with VT insertion, and 70 (30.8%) underwent adenoidectomy with tonsillectomy and VT insertion (Table 1).

Table 1. Demographic and clinical characteristics of the study population (n=227)

Characteristic	n (%) or mean±SD (range)
Age (years)	6.46±2.27 (1-12)
Sex	
Male	128 (56.4)
Female	99 (43.6)
Surgical procedure	
VT only	43 (18.9)
Adenoidectomy+VT	114 (50.2)
Adenoidectomy+tonsillectomy+VT	70 (30.8)
Intraoperative effusion-right ear	
None	16 (7.0)
Serous otitis media	42 (18.5)
Glue ear	148 (65.2)
Intraoperative effusion-left ear	
None	14 (6.2)
Serous otitis media	37 (16.3)
Glue ear	157 (69.2)
Otorrhea-right ear	
Present	6 (2.9)
Absent	200 (97.1)
Otorrhea-left ear	
Present	5 (2.4)
Absent	203 (97.6)
Extrusion time-right ear (months)	8.41±3.01 (3-17)
Extrusion time-left ear (months)	8.28±2.81 (3-17)

SD: Standard deviation, VT: Ventilation tube

Intraoperative middle ear findings revealed that, in the right ear, 16 (7.0%) ears had no effusion, 42 (18.5%) had serous effusion, and 148 (65.2%) had glue ear. In the left ear, 14 (6.2%) ears had no effusion, 37 (16.3%) had serous effusion, and 157 (69.2%) had glue ear. Otorrhea occurred in 6 (2.9%) right ears and 5 (2.4%) left ears postoperatively. The mean extrusion time was 8.41±3.01 months (range, 3-17 months) for the right ear and 8.28±2.81 months (range, 3-17 months) for the left ear. Extrusion before six months occurred in 19/206 right ears [9.2%, 95% confidence interval (CI): 6.0-14.0] and 33/208 left ears (15.9%, 95% CI: 11.5-21.4).

Comparison of extrusion times according to sex revealed no statistically significant differences for either ear (right: Mann-Whitney U=5091.0, Z=-0.276, p=0.782; left: Mann-Whitney U=4861.5, Z=-1.018, p=0.308). Similarly, extrusion times did not differ significantly according to the type of surgery performed [right: $x^2(2)=2.056$, p=0.358; left: $x^2(2)=4.225$, p=0.121].

Regarding intraoperative effusion type, no statistically significant difference in right ear extrusion time was observed [$x^2(2)=0.291$, p=0.865]. For the left ear, extrusion time tended to be longer in patients without effusion, but the difference did not reach statistical significance [$x^2(2)=5.000$, p=0.082]. The presence of postoperative otorrhea was significantly associated with shorter extrusion time in both ears: right ear: Mann-Whitney U=61.5, Z=-3.795, p<0.001; left ear: Mann-Whitney U=45.5, Z=-3.502, p<0.001. When analyzed according to surgical indication, no statistically significant difference was found for the right ear (Mann-Whitney U=363.0, Z=-1.670, p=0.095). However, left ear extrusion time was significantly shorter in patients operated for ROM compared to those with OME (Mann-Whitney U=350.0, Z=-2.276, p=0.023).

Extrusion outcomes did not differ by surgical procedure. For the right ear, one-way analysis of variance showed no between-group difference [$F(2,203)=0.724$, p=0.486, $n^2=0.007$]; for the left ear, results were likewise non-significant [$F(2,205)=1.842$, p=0.161, $n^2=0.018$]. Mean extrusion values by group were: right—VT 8.41, VT+adenoidectomy 8.19, VT+adenotonsillectomy 8.77; left—VT 7.49, VT+adenoidectomy 8.48, VT+adenotonsillectomy 8.42.

Multivariate Analyses

Right ear: the presence of right otorrhea was the only independent predictor, associated with a 4.77-month shorter extrusion time (B=-4.773, 95% CI: -7.154 to -2.391, p<0.001).

Left ear: independent predictors were ROM indication (B=-3.525, 95% CI: -5.657 to -1.393, p=0.001), left otorrhea (B=-4.076, 95% CI: -6.449 to -1.704, p=0.001), and effusion type (no effusion to glue ear) (B=-0.898, 95% CI: -1.536 to -0.259, p=0.006). Age and sex were not significant predictors in either ear (Table 2).

Discussion

In this study, we evaluated clinical and surgical factors influencing VT extrusion time in pediatric patients. Ears were analyzed as two independent cohorts (right vs. left), ensuring one observation per patient within each model and thereby preserving independence. Consequently, coefficients reflect ear-level effects and are not directly generalizable to pooled patient-level outcomes. The mean extrusion time in our cohort was approximately eight months for both ears. This retention period was shorter than the findings of Alaraifi et al. (8) which is 13.96 months and aligned with the findings of Lin et al. (7), and Song et al. (6) who also observed average extrusion times between seven and nine months. Extrusion before six months occurred in 19/206 right ears and 33/208 left ears in our study and this was similar to the findings of Alaraifi et al. (8) (12.8%).

These differences in retention time could be related to variations in tube design, insertion site, patient demographics,

Table 2. Multivariate analysis of factors affecting tube extrusion time (bold indicates statistical significance) (p<0.05)

Variable	Ear	Multivariate B (95% CI)	Multivariate p-value
Age	Right	0.116 (-0.059 to 0.291)	0.194
Sex (male compared to female)	Right	-0.017 (-0.826 to 0.791)	0.966
Effusion type (glue compared to absent)	Right	-0.198 (-0.868 to 0.472)	0.560
Otorrhea	Right	-4.773 (-7.154 to -2.391)	**<0.001**
Indication (ROM compared to OME)	Right	-2.390 (-4.879 to 0.100)	0.060
Age	Left	0.126 (-0.045 to 0.297)	0.147
Sex (male compared to female)	Left	0.569 (-0.166 to 1.303)	0.129
Effusion type (glue compared to absent)	Left	-0.898 (-1.536 to -0.259)	**0.006**
Otorrhea	Left	-4.076 (-6.449 to -1.704)	**0.001**
Indication (ROM compared to OME)	Left	-3.525 (-5.657 to -1.393)	**0.001**

OME: Otitis media with effusion, ROM: Recurrent otitis media, CI: Confidence interval

and surgical indications. The relatively short persistence time observed in our cohort could partly be attributable to the use of Shepard grommet tubes, which are known to extrude earlier than long-term designs such as Paparella tubes and T tubes.

In agreement with several previous reports, neither age nor sex significantly affected tube extrusion time in our analysis (6,9). This suggests that demographic variables alone are unlikely to be major determinants of retention time when other clinical factors are accounted for. Similarly, the type of primary surgery—whether VT insertion alone, adenoidectomy with VT, or adenotonsillectomy with VT—did not significantly influence extrusion duration. This is consistent with the findings of Alaraifi et al. (8) who reported no significant difference in extrusion timing between patients undergoing VT alone and those receiving concurrent adenoidectomy.

While some earlier studies claimed that effusion type did not significantly affect extrusion time, Song et al. (6) reported that serous effusions were associated with shorter extrusion times compared to mucoid effusions (8,10). In our cohort, the extrusion time decreased as the effusion type progressed from no effusion to serous effusion to glue ear, indicating that mucoid effusion was associated with the highest risk of early extrusion; however, this difference was only significant for the left ears with a relatively small effect (B=-0.898, 95% CI: -1.536 to -0.259, p=0.006). Differences in effusion classification methods and sample composition may account for these inconsistencies.

Postoperative otorrhea is one of the most frequently reported complications after VT insertion, with incidence rates in the literature ranging from 15% to over 50%, depending on study design, follow-up duration, and patient population (11,12). In our cohort, postoperative otorrhea was observed in 2.9% of the right ears and 2.4% of the left ears, which is markedly lower than most published series. This difference may be related to the uniform use of the Shepard grommet tubes, careful postoperative care protocols, and possibly underreporting of mild or transient episodes by patients or caregivers. Because our definition prioritized clinically documented and treatment-requiring episodes, mild, self-limited discharges may have gone unrecorded, potentially underestimating otorrhea incidence and yielding conservative effect estimates. One of the notable findings of our study was the significant association between postoperative otorrhea and shorter extrusion times in both ears. This is biologically plausible, as chronic inflammatory processes can accelerate epithelial migration, thereby hastening tube expulsion (13). While most studies have emphasized the role of effusion viscosity or adenoid size, fewer have focused on postoperative otorrhea as a predictor of extrusion time (6). Our results suggest that postoperative otorrhea may be an important factor in early extrusion. Valtonen et al. (14) also stated that postoperative otorrhea is related to earlier VT extrusion and recurrent OME. Postoperative otorrhea should be interpreted as a clinical marker of mucosal inflammation and impaired middleear ventilation rather than a sole causal pathway for extrusion.

In our cohort, early extrusion was more frequent among patients who were operated on for ROM compared with those with OME. This difference may reflect the higher inflammatory burden and epithelial remodeling that accompany ROM, which could facilitate faster epithelial migration and earlier tube rejection. Although ROM as the surgical indication was significantly associated with shorter retention time in the left ear, this relationship did not reach statistical significance in the right ear (p=0.060). Given the proximity of the p-value to the significance threshold, it is possible that the observed side-to-side difference reflects a limitation in statistical power rather than a true biological asymmetry. The sample size, when stratified by ear and surgical indication, may have been insufficient to detect a modest but clinically relevant effect on the right side. Future studies with larger cohorts are warranted to clarify whether this association is bilateral and to determine whether ear-

specific anatomical or physiological factors contribute to extrusion timing.

Unlike some previous studies, our cohort was homogeneous with respect to tube placement—all tubes were inserted in the anteroinferior quadrant. This eliminates one potential confounding factor. Yoo et al. (10), Alaraifi et al. (8), and Lin et al. (7) have emphasized that tube material, design, and flange diameter could significantly influence retention time, with long-term tubes such as Paparella type II persisting significantly longer than Shepard grommets. We could not assess these effects, as tube type was not varied in our series.

Patients with postoperative otorrhea or ROM may warrant closer follow-up, as they appear at increased risk for early tube loss. Future prospective studies should incorporate standardized tube types, document insertion site, and assess middle ear parameters in more detail. Including these variables could clarify their relative contributions and help tailor surgical approaches for individual patients.

Study Limitations

This study has several limitations. Firstly, its retrospective design may be subject to incomplete documentation and recall bias, particularly regarding postoperative complications such as transient otorrhea, which could lead to underreporting. Secondly, all patients had the same tube type (Shepard grommet) placed in the anteroinferior quadrant, which, while reducing variability, also limits the generalizability of findings to other tube designs or placement sites. Thirdly, extrusion time was based on the date of clinical detection rather than continuous monitoring, so the exact extrusion date may be imprecise. Some clinically important factors such as allergic rhinitis and eustachian tube disfunction were not included in the analysis due to lack of data. Moreover, detailed tympanic membrane findings such as retraction or atelectasis were not uniformly documented, and their potential relationship with extrusion time could not be evaluated. Finally, the relatively small number of patients operated on for ROM and the low incidence of postoperative otorrhea in our cohort may have reduced the statistical power to detect certain associations. As a result, some clinically relevant effects may not have reached statistical significance.

Conclusion

In our pediatric cohort, the average VT retention time was approximately eight months, which is within the lower range reported in the literature. Age, sex, surgical procedure type, and effusion type were not significant predictors of extrusion time. However, postoperative otorrhea and ROM were independently associated with earlier extrusion, highlighting the need for closer postoperative monitoring in these patients. Standardized prospective studies considering tube type, insertion site, and middle ear pathology in detail are needed to better understand modifiable factors that could optimize retention time and reduce recurrence rates.

Ethics

Ethic Committee Approval: The study was approved by İzmir Bakırçay University Non-Interventional Clinical Research Ethics Committee (approval no: 2287, date: 04.06.2025) and was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent: Not required due to the retrospective design of the study, as approved by the Ethics Committee.

Footnotes

Authorship Contributions

Surgical and Medical Practices: T.U., T.M., Concept: E.U., T.U., M.K.G., Design: E.U., T.M., Data Collection and/or Processing: E.U., M.K.G., T.M., Analysis or Interpretation: E.U., T.U., M.K.G., Literature Search: E.U., T.U., M.K.G., Writing: E.U., T.M.

Conflict of Interest: The authors declare that they have no conflict of interest.

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Main Points

- Postoperative otorrhea is an independent predictor of early ventilation tube extrusion, reducing tube retention time by approximately four months in both ears.
- Age, sex, and additional surgeries like adenoidectomy with or without tonsillectomy do not significantly influence extrusion time.
- Close postoperative monitoring is crucial in children with postoperative otorrhea or a history of recurrent otitis media to detect early tube loss.

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