BENHA MEDICAL JOURNAL bmj
Print ISSN 1110-208X.
Online ISSN 2357-0016

Original article

Weight and Shaft Length of Ventilation Tubes; Do They Affect the Results?

Ahmed M. Abdelghany [a], Ahmed M.Abdelfattah [b], Wael Metwally [c]

Abstract:

Background: : Otitis media with effusion (OME) is a prevalent condition among children. International guideline emphasises using of ventilation tubes (VTs) as a standard treatment for persistent OME. VTs differ in their features. Comparative studies assessed the impact of VTs variables on treatment outcomes.
Aim: To investigate the influence of VTs weight and shaft length on treatment outcomes in pediatric patients with OME. **Patients and methods**: A retrospective study included 318 children < 18 years who underwent VT insertion for treatment of OME from March 2020 to March 2023. Children categorized into two groups: Group A (grommet tubes) and Group B (T-tubes). Each group was divided into two subgroups based on VT weight (and shaft length in group B): A1 (heavier tubes), A2 (lighter), B1 (heavier T-tubes with longer shafts), and B2 (lighter, shorter shafts). We analyzed the relationship between tube weight (and shaft length in group B) and the rates of complications in each main group separately. **Results:** The study included 572 ears. Group A had 310 ears (A1: 174, A2: 136), B had 262 ears (B1: 148, B2: 114). The weight of each tube was 0.013 grams in A1 and 0.011 grams in A2, 0.026 grams in B1, and 0.017 grams in B2. B1 had more residual perforations (17.6%) than B2 (5.3%). **Conclusions:** Heavier and longer-shaft T-tubes were associated with higher residual perforation rates. This previously overlooked factor should guide the manufacture and use of lighter and potentially shorter T-tubes.
Keywords: Otitis media with effusion, shaft length, ventilation tube, weight.

[a] Otorhinolaryngology Department, Faculty of Medicine Benha University, Egypt.

[b] Otorhinolaryngology Department, Faculty of Medicine Azhar University, Cairo, Egypt.

[c] Consultant ENT Surgeon , James Paget University Hospitals.

Corresponding to:
Dr. Ahmed M. Abdelghany. Otorhinolaryngology Department, Faculty of Medicine Benha University, Egypt.
Email: ahmedent@gmail.com

Received:
Accepted:

Introduction

OME is characterized by the presence of fluid in the middle ear without manifestations of active ear infection. It is a prevalent condition among children following upper respiratory infections and significantly contributes to hearing impairment in school-aged children.[1] The therapeutic approaches to OME include a range of options, from pharmaceutical treatments like antibiotics, decongestants, mucolytics, antihistamines, and steroids to surgical interventions such as VT insertion and adenoidectomy.

International guidelines, such as those from the American Academy of Otolaryngology-Head and Neck Surgery, emphasise using VTs as a standard treatment for persistent OME to prevent long-term hearing loss and developmental delay in children.[2] Recent literature emphasizes the efficacy of VTs in treating symptomatic hearing loss resulting from persistent OME, marking it as the most effective strategy.[3] However, the management of OME remains a topic of ongoing debate in the medical community. The practice of inserting VTs, pioneered by Armstrong in 1954[4] has become one of the most common surgical procedures in pediatric otolaryngology.[5] VTs effectively alleviate symptoms associated with OME, such as conductive hearing loss, reduce the risk of recurrent acute otitis media and prevent the development of cholesteatoma.[6]

Despite the therapeutic advantages conferred by VT insertion, the procedure is not devoid of potential complications. Adverse outcomes include tube displacement into the middle ear, premature extrusion, cholesteatoma formation, myringosclerosis, segmental atrophy of the tympanic membrane (TM), external otitis media, suppurative otitis media, granulation tissue development, and persistent TM perforation.[7,8]

VTs come in various designs, broadly classified as short-term and long-term tubes, examples include Shepard, Donaldson, Paparella I, Armstrong, Sheehy, and Reuter bobbins tubes for short-term use, and Paparella II, Per-Lee, Armstrong bevelled tubes, Butterfly, and Goode T-tubes for long-term use. These tubes differ in material, length, width, internal diameter (ID), and other unique features. Comparative studies have assessed the impact of these variables on treatment outcomes [9-12].

To the best of our knowledge, *the variables of VT weight and shaft length have not been addressed in existing literature, nor detailed in product specifications.* Our study is poised to pioneer this area of research, thereby filling a critical gap in otological practice and device selection.

Objectives:

Our objective was to explore whether the weight and shaft length of VTs influence the rate of complications associated with their use.

Patients and methods:

1. *Design*: We conducted a multicenter retrospective cohort study analyzing clinical records of children who underwent VTs insertion between March 2020 and March 2023.

2. *Ethical Considerations:* The study was approved by the local research ethics committee (reference code: RC18323), adhering to established standard therapies without introducing new procedures or medications.

3. *Setting:* The research was conducted in the otorhinolaryngology departments of two University hospitals (Benha and Al-Azhar) and an accredited ENT center in Egypt.

4. *Inclusion Criteria:* Children under 18 years who underwent VT insertion to treat OME and were available for follow-up for at least six months post-extrusion/removal of VT or until complete healing of the TM perforation site. A total of 318 children met the criteria for inclusion.

5. *Exclusion Criteria:* Children with healed atrophic TM, atrophic TM, myringosclerotic patches, tube extrusions within the first month, suspicion of cholesteatoma or systemic diseases.
6. *Tube Types and Indications:* Grommet tubes (Sheehy-type collar button tubes) were predominantly used in cases of primary OME without retraction pockets. These tubes were constructed from Polytetrafluoroethylene, commonly known by its trade name Teflon®, with dimensions of 2.5 mm in length, 1.3 mm in inner diameter and 2.7 mm in outer diameter. T-tubes were the preferred option in cases of retraction pockets, recurrent OME without atrophic, calcified, or thin healed scars from previous procedures, in older children, or when adhesions or atelectasis were present. These T-tubes were composed of silicone, featuring a shaft length of 8 mm, flanges measuring 6 mm, and an ID of 1.14 mm. (table 1) *To ensure methodological consistency and minimize potential variables that could impact the study results, we exclusively included a single trademark for grommets and T-tubes (2M; Egypt), adhering to identical specifications and designs.*
7. *Patients' Groups and Interventions:*

Patient data was meticulously checked against the inclusion and exclusion criteria and then analyzed for the pertinent outcome measures. The diagnosis of OME was determined based on clinical findings and tympanometry assessments.

The surgical insertion of all tubes was carried out through a radial incision in the anterior inferior quadrant of the TM. These procedures were uniformly conducted under general anesthesia by senior staff members of both departments involved in the study and by the authors.

The patient cohort was categorized into two main groups: A and B. In Group A (Grommet Tubes), Subgroup A1 received heavier tubes that retained the metallic wire, whereas Subgroup A2 received lighter tubes with the wire removed (Figure 1) (Table 1). In Group B (T-Tubes), Subgroup B1 received heavier tubes with a full-length shaft, while Subgroup B2 received lighter tubes with a shortened shaft. (Figure 2) (Table 2)

8- *Tube weight measurement:*

In subgroup A1, each tube weighed 0.013 grams; in A2, the weight dropped upon wire removal to 0.011 grams. For subgroup B1, the weight was 0.026 grams, while in B2, it decreased to 0.017 grams after shortening the shaft. We used a gold scale for this purpose. (Table 1)

9- *Hearing assessment:* We had difficulties getting pre- and postoperative pure tone audiometry for most of children because the majority of the participants were not reliable for PTA testing and some parents did not cooperate reasonably. As a result, hearing evaluation following surgery was primarily based on stated subjective gains in hearing.

10- *Data Collection and Outcome Measures:* We recorded the following data: age, gender, side (unilateral or bilateral), associated procedures (adenoidectomy and/or tonsillectomy), operative history, operative details, nature of effusion (serous, mucoid, or mucopurulent), follow-up period, infections (bacterial, fungal, mixed), time of tube extrusion or removal, residual perforation rate, and recurrence of OME.

Grommet tubes were scheduled for removal between the 9^{th} and 18^{th} months after application. T-tubes were evaluated for removal between 18^{th} and 48^{th} months after placement, based on the surgeon's discretion and after confirming the resolution of the

indication. Removal was performed with or without anesthesia, depending on the child's level of cooperation.

Mandatory removal of any tube was indicated in the following cases: retained grommet tube, tube dislocated into the middle ear, recurrent infections, fungal colonization on the tube, tube blockage with unsuccessful attempts to restore patency, and enlarging perforation. No measures were taken to promote perforation closure during the removal process.

The date of *spontaneous (natural) expulsion* was determined as the midpoint between the final observation of the VT in place and the initial observation of its extrusion.

We defined residual TM perforation as a persistent TM perforation lasting *six months* after tube removal or spontaneous extrusion. Recurrent OME was determined by the presence of middle ear effusion resistant to conservative treatment for over three months following the re-accumulation of fluid. In group B, we separately analyzed the relationship between both tube weight and shaft length with complication rates, particularly residual perforation, in each subgroup to better understand their combined effect.

We followed the STROBE Statement

11- *Statistical Analysis:* Data were analyzed using SPSS version 24 (IBM Inc., Armonk, NY, USA). Qualitative data was expressed as frequency and percentage, and quantitative data as mean ±SD for normally distributed data or median and IQR (interquartile range) for abnormally distributed data. When comparing two groups, the independent sample T test (T) was used for normally distributed data and the Mann Whitney U test (MW) for abnormally distributed data. When comparing non-parametric data, the Chi-square test was employed. Probability (P-value): A P-value of less than 0.05 was considered significant. A P-value of less than 0.001 was regarded as highly significant. P-value greater than 0.05 was regarded as not significant. Multivariate regression was used to estimate the relationship between a dependent variable and more independent variables.

Results:

Our study encompassed 572 ears in 318 children undergoing VT insertion for OME treatment.

Group A (Grommet Tubes): Included 310 ears in 170 children aged 2 to 15 years. Subgroup A1, with heavier grommet tubes (0.013 grams/ tube), included 174 ears in 94 children (80 bilateral, 14 unilateral). Subgroup A2, with lighter tubes (0.011 grams/ tube), included 136 ears in 76 children (60 bilateral, 16 unilateral). A significant age difference was noted between the subgroups; A2 had a higher median age of 6 years (IQR 4-9 years) compared to A1's median age of 4.5 years (IQR 3.5-6 years) (Difference 0.5 – 3, p-value = 0.002). No statistically significant differences were found in gender distribution, history, operative details, effusion type, follow-up periods, infections, timing of tube removal, residual perforations, or recurrence rates between A1 and A2 (Table 3).

Table 1: Description of Grommet tubes used in group A

Group A (Grommet tubes)	Subgroup A1	Subgroup A2
Material	Teflon®	
Length	2.5 mm	
Internal diameter	1.3 mm	
Outer diameter	2.7 mm	
Trademark	2M™	
Attached wire	Yes	No
Weight	0.013 grams	0.011 grams

Table 2: Description of T tubes used in group B

Group B (T tubes)	**Subgroup B1**	**Subgroup B2**
Material	Silicone	
Flanges length	6 mm	
Internal diameter	1.14 mm	
Trademark	2M™	
Shaft Length	8 mm	4 mm
Weight	0.026 grams	0.017 grams

Table (3): Comparison of studied data in Group A (A1 vs A2)

Group A (170 children, 310 eras)		**A1 (N = 174 ears)**		**A2 (N = 136 ears)**		**Stat. test**	**P-value**
Age (years)	**Median**	4.5		6		MW =	0.002 S
	IQR	3.5 – 6		4 – 9		2120	
Gender	**Male**	86	49.4%	62	45.6%	X^2 =	0.635 NS
	Female	88	50.6%	74	54.4%	0.22	
Associated operation	**Adenoidectomy**	81	46.5%	50	36.8%	X^2 =	0.195 NS
	Adeno-tonsillectomy	76	43.7%	66	48.5%	1.67	
History of Previous operations	**Non**	146	83.8%	110	80.9%	X^2 =	0.886 NS
	Adenoidectomy	12	7%	12	8.8%	0.24	
	Adeno-tonsillectomy	16	9.2%	14	10.3%		
Type of Effusion (intraoperative)	**Mucoid**	62	35.6%	40	29.4%	X^2 =	0.383 NS
	Mucopurulent	26	14.9%	14	10.3%	1.92	
	Serous	86	49.4%	82	60.3%		
Follow-up period (months)	**Median**	11		10		MW =	1.0 NS
	IQR	9 - 13		8 – 14		2958	
	Average	6-18		5-18			
Infection	**Non**	160	92%	125	92%	X^2 =	0.993 NS
	Bacterial	6	3.4%	4	2.9%	0.09	
	Fungal	6	3.4%	4	2.9%		
	Mixed	2	1.1%	3	2.2%		
Type of tube removal/ extrusion	**Spontaneous**	118	67.8%	92	67.6%	X^2 = 0.8	0.669 NS
	Planned	54	31%	44	32.4%		
	Mandatory	2	1.1%	0	0%		
Spontaneous extrusion duration (months)	**Mean**	5.9		6.02		T = 0.17	0.861 NS
	±SD	1.7		1.3			
Planned removal duration (months)	**Mean**	10.5		12.2		T = 0.92	0.358 NS
	±SD	1.4		1.5			
	Average	9-18		9-18			
Residual perforation	**No**	170	97.7%	134	98.5%	X^2 =	0.710 NS
	Yes	4	2.3%	2	1.5%	0.13	
Recurrence of OME	**No**	162	93.1%	126	92.6%	X^2 =	0.913 NS
	Yes	12	6.9%	10	7.4%	0.012	

T= Independent sample T-test MW= Mann Whitney U test X2= Chi-square test. IQR= inter-quartile range P-value= Probability P-value < 0.05 was considered significant (S). P-value > 0.05 was considered insignificant (NS).

Group B (T-Tubes): Consisted of 262 ears in 148 children aged 3.5 to 16 years. Subgroup B1, with heavier and longer shaft tubes (0.026 grams/tube), included 148 ears in 84 children (64 bilateral, 20 unilateral). Subgroup B2, with lighter and shorter shaft tubes (0.017 grams/ tube), included 114 ears in 64 children (50 bilateral, 14 unilateral). A statistically significant difference was observed in the rate of residual perforations; B1 experienced residual perforations in 26 ears (17.6%), whereas B2 had only 6 ears (5.3%), (12.3% difference, p-value = 0.032). There were no statistically significant variations between B1 and B2 in the distribution of genders, histories, operational details, types of effusions, follow-up times, infections, type of extrusion, when the tubes were removed, or recurrence rates (Table 4).

A multivariate logistic regression analysis of factors predicting residual perforation in group B patients identified infection, the planned removal duration as significant predictive factors (p-value < 0.05). (Table 5)

In terms of hearing assessment, documented hearing tests suitable for analysis were unavailable.

Table (4): Comparison of studied data in group B (B1 vs B2)

Group B		**B1(N = 148 ear)**		**B2(N = 114 ear)**		**Stat. test**	**P-value**
Age (years)	**Median**	9		9		MW = 7350	0.073 NS
	IQR	5.5 - 11		6 – 12.2			
Sex	**Male**	62	41.9%	54	47.4%	$X^2 = 0.78$	0.376 NS
	Female	86	58.1%	60	52.6%		
Operation	**AD**	42	28.4%	40	35.1%	$X^2 = 1.34$	0.246 NS
	ADT	106	71.6%	74	64.9%		
Previous operations	**Non**	108	74%	74	64.9%	$X^2 = 3.76$	0.152 NS
	AD	22	15.1%	28	24.6%		
	ADT	16	11%	12	10.5%		
Effusion	**No**	22	14.9%	22	19.3%	$X^2 = 2.55$	0.465 NS
	Mucoid	54	36.5%	38	33.3%		
	MP	14	9.5%	6	5.3%		
	Serous	58	39.2%	48	42.1%		
FU (months)	**Median**	26		29			
	IQR	20 - 36		24 – 36		MW = 1823	0.183 NS
	Average	11-56		12-58			
Infection	**Non**	124	83.8%	102	89.5%	$X^2 = 3.11$	0.374 NS
	Bacterial	12	8.1%	4	3.5%		
	Fungal	4	2.7%	4	3.5%		
	Mixed	8	5.4%	4	3.5%		
Tube removal	**Spontaneous**	38	25.8%	14	12.3%	$X^2 = 3.6$	0.056 NS
	Planned	98	66.2%	90	78.9%		
	Mandatory	12	8%	10	8.8%		
Spon. Removal duration (months)	**Median**	9.5		10		MW = 216	0.298 NS
	IQR	6 - 12		9 – 12.7			
Planned removal duration (months)	**Median**	24		24		MW = 4174	0.6 NS
	IQR	18 - 36		20 – 36			
	Average	18-48		18-49			
Residual perforation	**No**	122	82.4%	108	94.7%	**$X^2 = 9.09$**	**0.003 S**
	Yes	26	17.6%	6	5.3%		
Recurrence	**No**	138	93.2%	104	91.2%	$X^2 = 0.37$	0.543 NS
	Yes	10	6.8%	10	8.8%		

Ad = Adenoidectomy, ADT = Adenotontonsillectomy, MP = mucopurulent, FU = follow up IQR = inter-quartile range, X2= Chi-square test MW= Mann Whitney U test. NS= Nonsignificant, S= Significant

Table (5): Multivariate logistic regression analysis for factors predictive of residual perforation in group B patients.

	B	SE	p-value	Odds	95% CI	
Age	-0.005	0.055	0.929	0.99	0.89	1.1
Sex	-0.54	0.38	0.149	0.57	0.27	1.21
Operation	0.003	0.4	0.995	1.0	0.45	2.22
Past operation	-0.73	0.39	0.059	0.47	0.22	1.02
Effusion	0.18	0.16	0.255	1.2	0.87	1.67
Infection	**0.62**	**0.19**	**0.001**	**1.86**	**1.28**	**2.7**
Spontaneous extubation duration	-0.03	0.1	0.734	0.96	0.79	1.17
Planned removal duration	**0.088**	**0.26**	**0.001**	**1.09**	**1.03**	**1.14**

B: Regression coefficient, SE: Standard error, CI: Confidence interval.

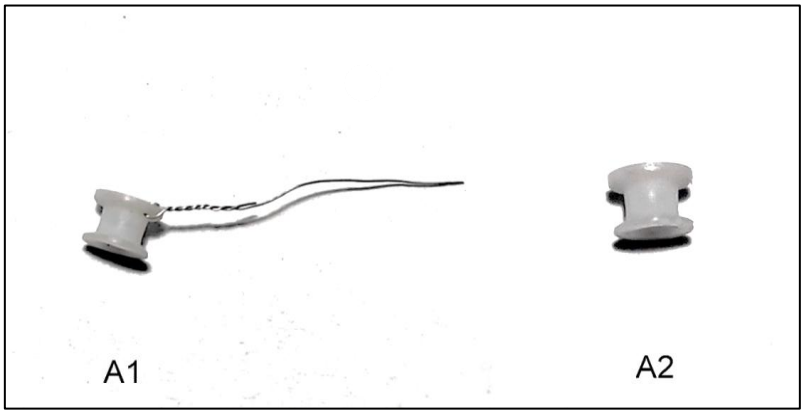

Figure 1

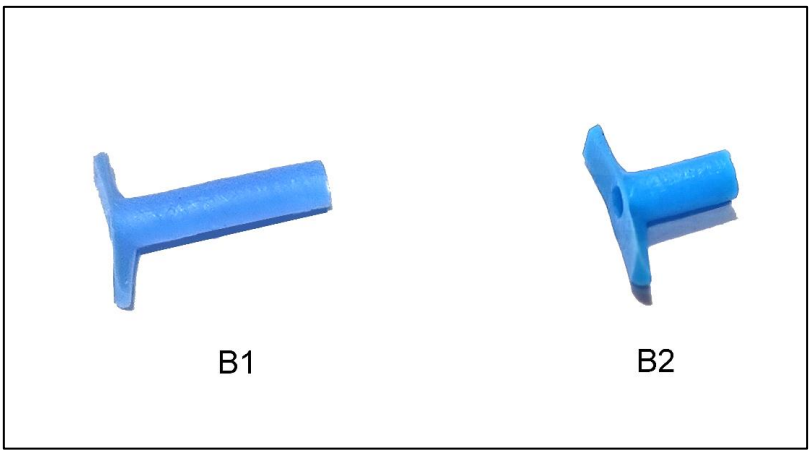

Figure 2

Discussion:

OME can manifest in individuals of all age groups, but it is more prevalent among children, particularly those between the ages of 2 and 7. Its insidious nature often leads to underdiagnosis, making it a leading contributor to childhood hearing impairment and the need for surgical interventions.[13,14] VTs are primarily recommended as a therapeutic option for cases of OME persisting beyond three months [8].

A comprehensive systematic review by Hellström et al.[15], encompassing 63 studies, has furnished substantial evidence supporting the advantages of VT usage in improving hearing and enhancing the quality of life. However, utilizing VTs for managing OME is not devoid of potential complications. Among these, one of the most vexing is the development of residual perforations, which can carry significant morbidity and necessitate further corrective surgical interventions.

VTs, commonly made of plastics and metals, must be biocompatible to minimize foreign body responses [16]. Materials like PTFE for grommet tubes and silicone for T-tubes are frequently used due to their compatibility and ease of removal[17].

Our study uniquely examined the impact of VT weight in conjunction with an inseparable variable—either the presence or absence of a wire in group A, or shaft length in group B—factors that have not been previously investigated in the published literature. In our initial efforts to ensure precision, we aimed to measure the weights of various VTs to select the lightest and heaviest for comparative analysis without including other different factors like shaft length. However, finding VTs with notable weight differences *yet identical in other specifications* proved unsuccessful, rendering a direct comparison between them impractical due to these varying specifications.

Considering this challenge, we shifted our focus towards minimizing factors related to VTs that could influence the results. We intentionally stabilized the trademark, material, original dimensions, and shape. We limited the differing factors to just two categories: 1) the difference in weight and the presence or absence of wire in grommet tubes (Group A) that proved to have no effect on results, and the difference in weight and the length of the shaft in T-tubes (Group B). *Given that the entire tube is secured to the TM by its weight, the impact of weight emerged as the primary consideration when comparing the subgroups within each group. However, regarding group B, shaft length cannot be completely disregarded as a potential contributing factor.*

Regarding the results, in Group A, a significant age difference was observed between A1 and A2. Our analysis revealed that this difference did not impact the results. Furthermore, a key finding from our study is that the weight of grommet tubes does not significantly influence the outcomes, nor does the presence or absence of a wire.

Each tube in A1 weighed around 0.013 grams, whereas in A2, it weighed 0.011 grams. This discrepancy of 0.002 grams represents a decrease in weight of 15.4% from A1 to A2. Perhaps because of this little weight difference, this variation did not affect the outcomes.

Prior studies [18,19] have shown that grommet tubes are linked to a reduced likelihood of residual perforations, with observed rates spanning from 0% to 3% of insertions. This observation is consistent with the results of our current study. We found that the incidence of residual perforations within our subgroups A1 and A2 was 2.3% and 1.5%, respectively.

In group B, the tube's weight in B1 was 0.026 grams, whereas in B2, it was 0.017 grams. This discrepancy of 0.009 grams represents a decrease in weight of 34.6% from B1 to B2. This difference was linked to a significant change in residual perforation rates from B1 (17.6%) to B2 (5.3%), which is a considerable difference in terms of safety. In some publications,

[20–22] residual TM perforation rates with T-tubes were as high as 24%. The shaft length was reduced by half from B1 to B2, which, as previously noted, was associated with a decrease in the residual perforation rate. This change did not correlate with an increased incidence of infection or other complications aside from residual perforation. In our view, this effect is more likely attributed to the increased tube weight rather than other potential contributing factors.

Comparisons to other studies:

Our findings regarding residual perforations are consistent with the results of Kay et al. [23] in their meta-analysis. The observed incidence rates of residual perforations in grommets and T-tubes closely align with the results from our subgroups A1 and B1, which employed tubes of heavier weight. Short-term tubes exhibited an average rate of 2.2%, while long-term tubes had an average rate of 16.6%. Additionally, in a study conducted by Lentsch et al. [24]involving 201 patients, their findings indicated a perforation rate of 4% for short-term tubes and 22% for long-term tubes, further corroborating our results. We may owe the relatively wide range of published rates of residual perforations to tubal factors that may include the underestimated weight effect.

Clinical applicability and generalizability:

One of our key findings underscores that the weight of grommet tubes (and presence or absence of wire) does not emerge as substantive determinants influencing the outcomes. This observation may be attributed to our study's relatively brief duration of both wired and non-wired tubes. It is also plausible that the marginal increase in weight associated with wired grommet tubes, or the cumulative weight of the wired tubes, did not attain a *critical threshold* conducive to the development of persistent perforations.

Our study also suggests that using T-tubes with shorter shafts is associated with a lower rate of residual perforations. This finding raises the possibility that the shorter T-tube shaft may improve the results by either reducing tube weight or making it less susceptible to biofilm formation or colonization.

Our analysis reveals a notable correlation between the weight of VTs and the incidence of residual perforations, irrespective of tube type. We observed a direct relationship: the incidence of residual TM perforations augmented in direct proportion to the VT's weight. Specifically, we recorded a residual perforation rate of 1.5% for tubes weighing 0.011 grams, which rose to 2.3% for those at 0.013 grams, further escalated to 5.3% for tubes at 0.017 grams, and peaked at 17.6% for the heaviest tubes at 0.026 grams.

This pivotal finding suggests that tube weight exerts a comparable influence on residual perforation rates, *as does the duration of tube application*. It posits that the disparity in residual perforation rates observed between grommets and T-tubes could be attributed not only to the duration of placement in the TM but also to the weight of the tubes themselves. Such insights propose that a T-tube designed with a weight of 0.011 grams might achieve residual perforation rates akin to those of grommet tubes, even when retained in the TM for extended periods.

Strengths and limitations:

Our study stands out for being the inaugural investigation into the effects of VTs weight and T tubes shaft length, benefiting from a multicenter approach and a sufficient study population. We established specific inclusion and exclusion criteria to minimize variability related to different medical conditions and ensure consistency. Cases with healed atrophic TMs, myringosclerotic patches, systemic diseases, and tube extrusions within the first month, which may indicate an operative error, were excluded. All study participants were children under the age of 16 years, and the surgeries were performed exclusively by senior staff members, ensuring uniform surgical

expertise. Surgical technique heterogeneity was not a concern as our surgeons consistently employed the same technique, which involved a radial incision in the anterior inferior quadrant of the TM.

Nevertheless, it is important to recognize certain limitations. We found that residual perforation rates were significantly higher in subgroup B1, compared to subgroup B2. The weight variations were linked to differences in shaft length. This introduced a level of heterogeneity to our study and compelled us to consider the potential effect of shaft length when interpreting the results, as we cannot entirely rule out its influence. Also, the retrospective study design could potentially bias the results and affect the precision of data. Additionally, we did not recognize colonization studies on the extracted tubes to assess their impact on findings and its relation to T-tubes shaft length.

Conclusions and recommendations:

Our study demonstrates that weight and shaft length of T-tubes, either individually or in combination, influence treatment outcomes for OME. Specifically, we observed that heavier T-tubes (with longer shafts) are associated with a higher incidence of residual perforations. We also found that weight of grommet tubes (and presence or absence of attached wire) does not significantly influence clinical outcomes.

However, *when examining the study groups without considering tube type, we observed a direct proportionality between VT weight and the rates of residual TM perforations; as the weight of the VTs increased, so did the incidence of perforations.*

Based on these findings, we strongly recommend the manufacturing and utilization of the lightest possible T-tubes in clinical practice. Up until this point, we would also recommend using T-tubes with shorter shafts. This approach could potentially reduce the rate of residual perforations, thereby enhancing the safety and effectiveness of OME treatment in pediatric patients.

Additionally, our study paves the way for further research. It would be valuable for future investigations to determine whether there is a specific weight threshold at which the risk of complications escalates. We also suggest that future studies explore the impact of T-tube weight and shaft length as separate factors on safety outcomes. Such focused research could yield more profound insights into refining T-tube design to enhance clinical effectiveness and minimize complications.

References:

1. Fireman P. Allergy induced eustachian tube and middle ear pathophysiology. N Engl Reg Allergy Proc. 1986;7(3):246–52.
2. Rosenfeld RM, Tunkel DE, Schwartz SR, Anne S, Bishop CE, Chelius DC. Clinical Practice Guideline: Tympanostomy Tubes in Children (Update). Otolaryngol Head Neck Surg. 2022 Feb;166(1_suppl):S1–55.
3. Kim WJ, Kim BG, Chang KH, Oh JH. Detection of bacteria in middle ear effusions based on the presence of allergy: does allergy augment bacterial infection in the middle ear? J Otolaryngol Head Neck Surg. 2015 Dec 29; 44:58.
4. ARMSTRONG BW. A new treatment for chronic secretory otitis media. AMA Arch Otolaryngol. 1954 Jun;59(6):653–4.
5. Vanneste P, Page C. Otitis media with effusion in children: Pathophysiology, diagnosis, and treatment. A review. J Otol. 2019 Jun;14(2):33–9.
6. Morris MS. Tympanostomy tubes: types, indications, techniques, and complications. Otolaryngol Clin North Am. 1999 Jun;32(3):385–90.
7. Klingensmith MR, Strauss M, Conner GH. A comparison of retention and complication rates of large-bore (Paparella II) and small-bore middle ear ventilating tubes. Otolaryngol Head Neck Surg. 1985 Jun;93(3):322–30.
8. Vlastarakos P V, Nikolopoulos TP, Korres S, Tavoulari E, Tzagaroulakis A, Ferekidis E. Grommets in otitis media with effusion: the most frequent operation in children. But is it associated with significant complications? Eur J Pediatr. 2007 May;166(5):385–91.
9. Anderson JM, McNally AK. Biocompatibility of implants: lymphocyte/macrophage interactions. Semin Immunopathol. 2011 May;33(3):221–33.
10. Teo AJT, Mishra A, Park I, Kim YJ, Park WT, Yoon YJ. Polymeric Biomaterials for Medical Implants and Devices. ACS Biomater Sci Eng. 2016 Apr 11;2(4):454–72.

11. Shone GR, Griffith IP. Titanium grommets: a trial to assess function and extrusion rates. J Laryngol Otol. 1990 Mar;104(3):197–9.
12. Sherman EG, Antonelli PJ, Tran-Son-Tay R. Development of a calcium alginate tympanostomy tube. Laryngoscope. 2010 Dec;120(12):2473–7.
13. Sanli A, Tasdemir O, Eken M, Celebi O, Yilmaz SH. Prevalence of otitis media with effusion among primary school age-children and etiopathogenic examination. Indian J Otolaryngol Head Neck Surg. 2014 Jan;66(Suppl 1):95–8.
14. Riaz N, Ajmal M, Khan MS. Frequency of otitis media with effusion among children aged 1-5 years presenting to immunization center of tertiary care hospitals, Rawalpindi. World J Otorhinolaryngol Head Neck Surg. 2022 Dec;8(4):315–20.
15. Hellström S, Groth A, Jörgensen F, Pettersson A, Ryding M, Uhlén I, et al. Ventilation tube treatment: a systematic review of the literature. Otolaryngol Head Neck Surg. 2011 Sep;145(3):383–95.
16. Mai JP, Dumont M, Rossi C, Cleary K, Wiedermann J, Reilly BK. Biocompatibility of "On-command" dissolvable tympanostomy tube in the rat model. Laryngoscope. 2017 Apr;127(4):956–61.
17. Karlan MS, Skobel B, Grizzard M, Cassisi NJ, Singleton GT, Buscemi P, et al. Myringotomy tube materials: bacterial adhesion and infection. Otolaryngol Head Neck Surg (1979). 1980;88(6):783–94.
18. Strachan D, Hope G, Hussain M. Long-term follow-up of children inserted with T-tubes as a primary procedure for otitis media with effusion. Clin Otolaryngol Allied Sci. 1996 Dec;21(6):537–41.
19. Barfoed C, Rosborg J. Secretory otitis media. Long-term observations after treatment with grommets. Arch Otolaryngol. 1980 Sep;106(9):553–6.
20. Brockbank MJ, Jonathan DA, Grant HR, Wright A. Goode T-tubes: do the benefits of their use outweigh their complications? Clin Otolaryngol Allied Sci. 1988 Oct;13(5):351–6.
21. Van Heerbeek N, De Saar GMAC, Mulder JJS. Long-term ventilation tubes: results of 726 insertions. Clin Otolaryngol Allied Sci. 2002 Oct;27(5):378–83.
22. Todd GB. Audit of the incidence of persistent perforation of the tympanic membrane following T-tube removal or extrusion. J Laryngol Otol. 1993 Jul;107(7):590–2.
23. Kay DJ, Nelson M, Rosenfeld RM. Meta-analysis of tympanostomy tube sequelae. Otolaryngol Head Neck Surg. 2001 Apr;124(4):374–80.
24. Lentsch EJ, Goudy S, Ganzel TM, Goldman JL, Nissen AJ. Rate of persistent perforation after elective tympanostomy tube removal in pediatric patients. Int J Pediatr Otorhinolaryngol. 2000 Aug 31;54(2–3):143–8.

To cite this article: Ahmed M. Abdelghany, Ahmed M. Abdelfattah, Wael Metwally. Weight and Shaft Length of Ventilation Tubes; Do They Affect the Results?. BMFJ XXX, DOI: 10.21608/bmfj.2025.375495.2368.