

## A STUDY ON PARAMETERS AFFECTING VENTILATION TUBE FUNCTION IN SECRETORY OTITIS MEDIA

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### ABSTRACT

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#### BACKGROUND

There are many parameters that are considered to affect function and the extrusion time of the ventilation tubes (Grommets) inserted for patients with secretory otitis media (glue ear/otitis media with effusion). Our objective is to study such parameters and their significance in order to better understand the disease process.

#### METHODS

A total of 84 patients who underwent grommet insertion were retrospectively evaluated for the relationship between various parameters such as extrusion time, age, gender, adenoid size, status of tympanic membrane at the time of insertion, the nature of the fluid aspirated during procedure, pre-operative impedance audiogram and combination of adenoidectomy procedure.

#### RESULTS

The mean time of extrusion of grommet in our study was found to be 254 days. Although rest of the parameters did not have much significance in the process of extrusion, we found that history of previous ventilation tube insertion took shorter time to extrude (mean, 203 days) and serous effusion (mean, 188 days) took shorter time to extrude than mucoid effusion (mean, 271 days).

#### CONCLUSIONS

The mean time for extrusion of ventilation tube (grommet) was 254 days in our study. The characteristics of the middle ear effusion and a history of previous ventilation tube insertion had significant impact on the extrusion time. The quality of effusion can give us a clinical clue to ventilation tube extrusion time, which in turn explains about the return of middle ear function.

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#### BACKGROUND

Secretory otitis media (SOM) is very common in the population worldwide. Two-thirds of all children by the age of 8 years would have experienced SOM. To prevent the development of atelectasis, erosion of ossicles or a retraction pocket formation, it may be necessary to insert ventilation tubes. There are many parameters, which can affect the functioning of ventilation tubes. There is no concrete evidence on which among them is the most important for proper functioning of middle ear and extrusion duration of the ventilation tube. The objective of this study was to determine which among the various parameters affecting

the ventilation tube function and its extrusion is more important.

#### METHODS

We conducted a retrospective review for the patients who had ventilation tube insertion from June 2015 to July 2017 in ENT outpatient department of our institution. We excluded those patients more than 16 years, patients with malformed ears, previous history of Acute Otitis Media (AOM), those with infection of the tubes post-insertion, manual removal of ventilation tube few weeks after insertion by the operating surgeon and those with combined craniofacial anomaly. The records of 84 patients who had ventilation tube inserted were followed up until the ventilation tube has extruded. For all patients who underwent the procedure, Myringotomy was done with myringotomy knife followed by insertion of a ventilation tube (Shepard s Ventilation Tube, SVT-101: PTFE material) was performed under general anaesthesia. Patients were reviewed every week for four weeks and monthly after four weeks until the time of extrusion. The date of extrusion was the mid-date between the last day when the tube was seen

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to be in position during routine follow up examination and the first day when the ventilation tube was seen lying in the external auditory canal outside the healed tympanic membrane. Parameters like the, Adenoid size, adenoidectomy (+/-), the tympanic membrane status, the content of the middle ear effusion,<sup>1,2</sup> the tympanogram and the air bone gap, age,<sup>3</sup> and gender are recorded. An independent t-test was used to compare the extrusion time between the patients who were younger (<8 year) and those who were older (≥8 - <16 years), the males and females, those with/without a previous history of insertion and those who had/had not undergone adenoidectomy. Before we did the procedure, tympanogram and AB gap were evaluated for cooperative group of patients. The threshold of hearing was determined by the classical division method, and then the air bone gap (dB) was documented. The ventilation tube extrusion time was also compared for the patients with preoperative tympanogram type B / type C curve and also compared between patients with pre-operative air bone gap of less than 25dB to patients with pre-operative air bone gap of more than 25dB. Before insertion of the ventilation tube, Lateral skull radiograph was taken for all the patients and the adenoidal nasopharyngeal ration measured and categorized into four grades (G0 is <0.25, G1 is 0.26-0.5, G2 - 0.51-0.75, G3 - > 0.75).<sup>4</sup> Examination and the procedure performed with visualization of tympanic membrane with 4 mm Hopkins Karl Storz Endoscope and Camera unit.

The tympanic membrane was classified as retracted, bulged, congested and effusion with air pockets. During the procedure, the characteristics of middle ear effusion were recorded and classified as serous, mucoid or glue.<sup>5</sup> The surgeon characterised the effusion at the time of procedure. We classified the fluid as serous when thin fluid suctioned at low pressure (200 mmHg), mucoid when thick fluid suctioned at low pressure (200 mmHg) and glue when thick fluid suctioned with high pressure (400 mmHg). The extrusion time was compared by using one-way analysis of variance (ANOVA) according to the adenoid size, status of the tympanic membrane and nature of the middle ear effusion. The analysis and the statistics were done using SPSS ver. 12.0 (SPSS Inc). Accepted statistical significance was at the level of P<0.05. ANOVA, Independent t-test, multiple regression analysis and multivariate analysis were used during performing the statistical analysis.

**RESULTS**

A total of 177 ventilation tubes were inserted which includes 53 multiple / repeat intubation. Age (less than 8 years, 8-16 years), Gender (male vs. Female), positive history of ventilation tube placement (yes/no) and characteristics of the middle ear aspirate were among the parameters chosen to evaluate on multivariate analysis when a P-value was set at 0.2 as criterion. The extrusion time change was statistically explained by suitable regression line (P=0.0001). The analyses of various parameters are shown in Table 1.

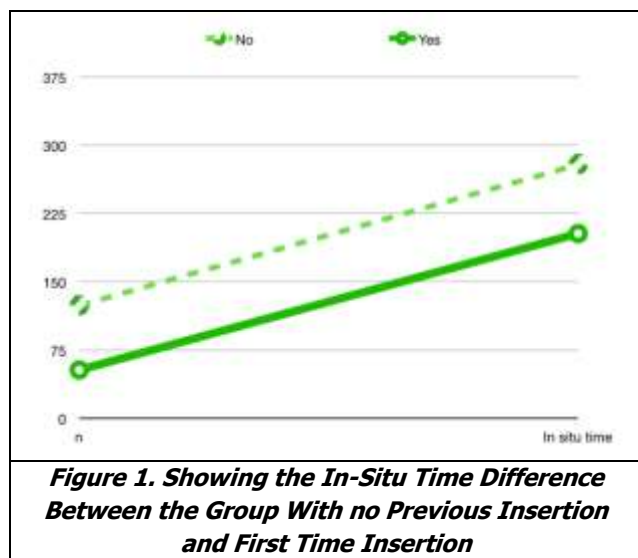
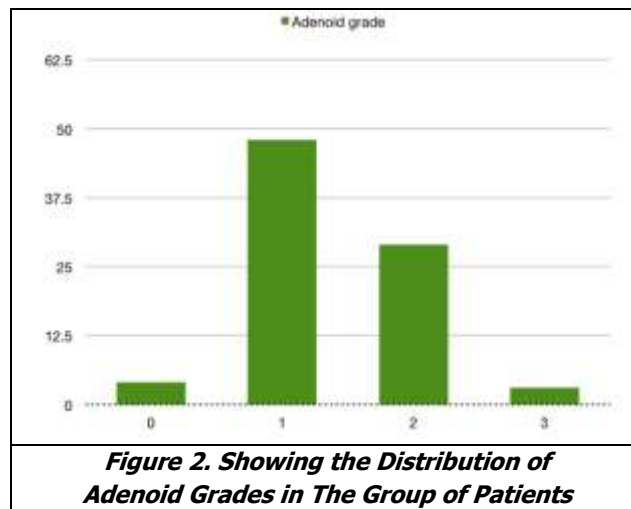
Parameters	Tympanic Membrane (n)	Tube Extrusion Time in Days	p-Value
<b>Age</b> <8 Yrs. >8 - <16 Yrs.	149 28	267 173	0.170
<b>Gender</b> Male Female	119 58	243 281	0.119
<b>Repeat Insertion*</b> No Yes	124 53	279 203	0.011
<b>Air Bone Gap</b> < 25 dB > 25 dB	46 41	181 159	0.691
<b>Tympanogram</b> B C	91 49	245 259	0.721
<b>Adenoids</b> 0 1 2 3	4 48 29 3	202 231 266 307	0.354
<b>Adenoidectomy</b> Yes No	30 54	272 252	0.616

Parameters	Tympanic Membrane (n)	Tube Extrusion Time in Days	p-Value
<b>Tympanic Membrane Appearance</b>			
Retracted	61	249	0.553
Bulged	18	247	
Congested	3	163	
Effusion with air pocket	95	239	
<b>Effusion type *</b>			
Serous	52	188	0.0005
Muroid	10	292	0.98
Glue	115	271	-

**Table 1**

Epidemiologically the extrusion time was assessed in groups. The ventilation tubes were there for a longer duration for the younger patients (age, <8 yrs. old; mean extrusion time, 267 days) than that for the older patients (age, ≥8 - <16 years old; mean extrusion time, 173 days) on univariate analysis, which was not significantly different (P=0.180). The extrusion time was not significantly different between the female population and males (281 days vs. 243 days, respectively; P=0.121).

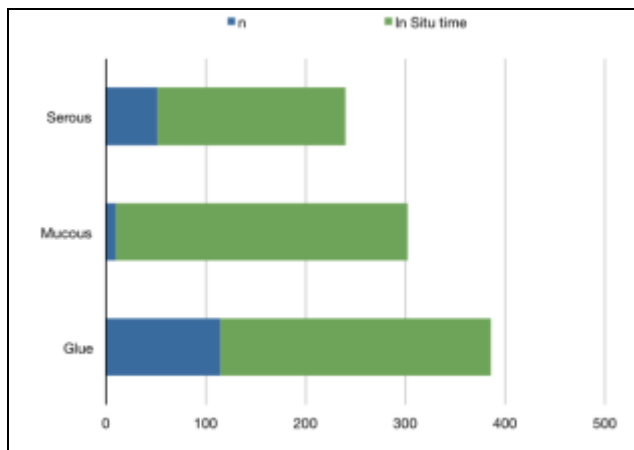
The group of patients with previous positive history of placement of ventilation tube had a shorter tube in-situ time than that of the patients who had no previous ventilation tube placement (mean was 203 days vs. 279 days, respectively), and this was statistically significant (P=0.01, multiple regression analysis) (Figure 1).



The more the size of the adenoids the longer was the extrusion time (grade 0 - 202 days; gr 1 - 231 days; gr 2 - 266 days; gr 3 - 307 days). We found there was no statistical significance (P=0.354). There was no major difference in the extrusion time between the group of patients who had ventilation tubes inserted accompanied by adenoidectomy (272 days) and those group of patients who had ventilation tube inserted without adenoidectomy (252 days; P =0.616) (Figure 2).

The extrusion time were not dissimilar among the four groups of patients based on the tympanic membrane appearance: retracted (249 days), bulged (247 days), congested (163 days) and effusion with air pockets (239 days) (P=0.553). Statistically there was no difference in extrusion time found between the type B impedance group (245 days) and the type C impedance group (259 days, P=0.721). There was no statistical difference between the two air bone gap groups: AB gap ≤25 dB (181 days) and AB gap >25 dB (159 days) (P=0.691).

Patients who had serous aspirate at the time of myringotomy had the shortest extrusion time of 188 days (mean) as compare to those with glue (271 days) and muroid (297 days) (Figure 3). When a dummy variable was set to glue like group, significant difference was noted between both glue like and serous group, and also glue like and muroid group.



**Figure 3. Showing the Quality of Effusion and Duration of Stay in Tympanic Membrane**

The mucoid effusion patients did not show a significant difference from the serous effusion patients for the extrusion time ( $P=0.0675$ ). This showed that the serous group was different from the other groups on multiple regression analysis.

## DISCUSSION

Many studies have been made to determine the exact factor responsible for return of middle ear function and extrusion of ventilation tube from tympanic membrane. We did this study to understand the extrusion time of the ventilation tube, which in turn will give us an indication of return of middle ear function. We also assessed other parameters during the study, which gave us a better understanding of the disease process.

Gibb et al<sup>2</sup> in their study found there were no significant effect of age on extrusion time of the ventilation tube. On the contrary, Leopold et al<sup>6</sup> documented a negative correlation between the longevity of tube functioning and an age  $\geq 10$  yr. Bylander et al<sup>7</sup> and Tos et al<sup>8</sup> reported an improvement of the ET function at the age of 6-7. The incidence of Otitis media with effusion recurrence decreases when the patient's age at extrusion is 7-8 years.<sup>9</sup>

Leopold et al<sup>6</sup> documented that the ventilation tubes remained in the tympanic membrane of those patients with no previous history of ventilation tube insertion significantly longer than those patients who previously had tube insertion procedure. The same findings were documented in our study as well.

Effusion in the middle ear can vary in its consistency and nature. It can be serous secretion to the consistency of thick glue. Carrie et al<sup>10</sup> reported after their study that the viscosity of the mucoid effusion from middle ear was significantly more than serous effusion. They described it is mucin not protein or lipid that determines the viscosity of the effusion. They also described that operating surgeon can differentiate thick mucin from thin serous effusion on basis of visible inspection and the flow properties.

A previous study suggested that different effusions with various levels of enzymes and proteins were correlated with recurrent cases of OME.<sup>11</sup> In contrast, Gibb and Mackenzie, reported that there was no significant difference of the

ventilation tube extrusion time when the middle ear fluid was divided into serous, glue and very thick glue.<sup>2</sup>

In the study conducted in our institution, the extrusion time in the serous (188 days) was shorter than that in the mucoid (292 days) and glue (271 days) group of patients. Serous effusion has a lower viscosity as compared to that of glue or mucoid effusions. Takahashi et al<sup>1</sup> suggested that viscosity of the effusion aggravates the ET function as a result of OME. In evaluating the pathogenesis of the course of OME, Hormann concluded that the viscosity of the effusion reflects the stage and progression of OME.<sup>12</sup> A serous effusion possibly suggests an early stage of OME and the patients with a serous effusion have better ET function; the patients with serous OME heal faster than do the patients with OME with highly viscous effusion (which is in a more advanced stage of the disease with a higher mucin concentration and cytokine interaction).<sup>7,8,11</sup>

Mackenzie & Gibb et al<sup>2</sup> reported that simultaneous operative procedures, including adenoidectomy, had no significant effect on the extrusion rate of ventilation tubes. The study in our institution had similar results with no major difference in the extrusion time between the patients who had an accompanying adenoidectomy (272 days) and those who did not (252 days,  $P=0.616$ ), and size of the adenoid did not have any influence in the outcome of ventilation tube stay in tympanic membrane.

Sichel et al<sup>13</sup> analysed the viscosity of ear effusion and tympanometry, along with the AB gap on audiometry. There was no significant correlation between the viscosity of the middle ear effusion, tympanogram and AB gap. Data from our study shows similar results as we found that there is no significant correlation between pre-operative tympanogram of type B and Type C.

Gibb and Mackenzie examined and documented the tympanic membrane into various categories based on physical appearance as normal, thin scarred, tympanosclerosis, thick and gross retraction; they concluded that the tympanic membrane status did not affect the extrusion rate.<sup>2</sup> Even in our study, the tympanic membranes were grouped as retracted, bulged, congested and effusion with air pockets in which there was no significant relationship ( $P=0.553$ ).

The type of the ventilation tube has been reported to be a significant determinant of the extrusion rate without any debate.<sup>14,15,16</sup> Our study was done using Shepard's Ventilation Tube, SVT-101: PTFE material for all the patients. Operator experience and general anaesthesia are parameters that have been reported to prolong the ventilation tube extrusion time.<sup>2,4</sup> There is also controversy about the effect of the quadrant of the TM where the ventilation tube is inserted on the extrusion time. Shah reported that inserting the ventilation tube in the anterior segment of the TM prolongs the ventilation tube functioning time.<sup>16</sup> However, Mackenzie & Gibb<sup>2</sup> and Hern<sup>14</sup> and Jonathan<sup>15</sup> reported that the portion of the TM portion where it is incised had no significant effect.

**CONCLUSIONS**

The extrusion time of ventilation tube was 254 days in our study. The important predictors of the extrusion time were the characteristics of the middle ear effusion and a previous history of tube insertion. We would recommend a randomised prospective study with large number of patients to understand the difference in extrusion rates of the ventilation tubes.

**REFERENCES**

- [1] Takahashi H, Honjo I, Yagi N, et al. Viscosity of effusion in the middle ear and eustachian tube in patients with otitis media with effusion. *Auris Nasus Larynx* 1990;17(1):11-16.
- [2] Gibb AG, Mackenzie IJ. The extrusion rate of grommets. *Otolaryngol Head Neck Surg* 1985;93(6):695-699.
- [3] Teele DW, Klein JO, Rosner B. Epidemiology of otitis media during the first seven years of life in children in greater Boston: a prospective, cohort study. *J Infect Dis* 1989;160(1):83-94.
- [4] Fujioka M, Young LW, Girdany BR. Radiographic evaluation of adenoidal size in children: adenoidal-nasopharyngeal ratio. *AJR Am J Roentgenol* 1979;133(3):401-404.
- [5] Valtonen H, Qvarnberg Y, Nuutinen J. Tympanostomy in young children with recurrent otitis media. A long-term follow-up study. *J Laryngol Otol* 1999;113(3):207-211.
- [6] Leopold DA, McCabe BF. Factors influencing tympanostomy tube function and extrusion: a study of 1,127 ears. *Otolaryngol Head Neck Surg* 1980;88(4):447-454.
- [7] Bylander A, Ivarsson A, Tjernstrom O. Eustachian tube function in normal children and adults. *Acta Otolaryngol* 1981;92(5-6):481-491.
- [8] Tos M, Holm-Jensen S, Stangerup SE, et al. Changes in point prevalence of secretory otitis in preschool children. *ORL J Otorhinolaryngol Relat Spec* 1983;45(4):226-234.
- [9] Iwaki E, Saito T, Tsuda G, et al. Timing for removal of tympanic ventilation tube in children. *Auris Nasus Larynx* 1998;25(4):361-368.
- [10] Carrie S, Hutton DA, Birchall JP, et al. Otitis media with effusion: components which contribute to the viscous properties. *Acta Otolaryngol* 1992;112(3):504-511.
- [11] Juhn SK. Studies on middle ear effusions. *Laryngoscope* 1982;92(3):287-291.
- [12] Hormann K. Pathogenesis and pathophysiology of middle ear effusions. *Acta Otolaryngol Suppl* 1987;440:1-59.
- [13] Sichel JY, Priner Y, Weiss S, et al. Characteristics of the type B tympanogram can predict the magnitude of the air-bone gap in otitis media with effusion. *Ann Otol Rhinol Laryngol* 2003;112(5):450-454.
- [14] Hern JD, Jonathan DA. Insertion of ventilation tubes: does the site matter? *Clin Otolaryngol Allied Sci* 1999;24(5):424-425.
- [15] Hussain SS. Extrusion rate of Shah and Shepard ventilation tubes in children. *Ear Nose Throat J* 1992;71(6):273-275.
- [16] Shah N. Use of grommets in 'glue' ears. *J Laryngol Otol* 1971;85(3):283-287.