

ENDOSCOPIC INSERTION OF TYMPANOSTOMY TUBE IN CHILDREN

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Abstract— This study is meant for determining the safety of endoscopy followed by grommet insertion into the middle ear. Traditionally, otoscopy, or the surgery using microscope has been the preferred method of Myringology. But given the limitations of using microscope, surgical interventions such as postauricular access have turned popular for treating the ailments of middle ear.

A sum total of 178 cases of otitis media with effusion who had to undergo myringotomy along with or without tympanostomy tube insertion i.e. grommet were studied. The minimum age of the subject was 2.6 years while the maximum age was 44 years. The patients consisted of both male and female patients. 89 cases corresponded to that of right ear while another 89 cases were indications of left ear.

The result derived from this study is clearly an indicative of the fact that the comparatively novice practice of endoscopy in grommet insertion is quite safe and also provides an edge in the live demonstrations and group teaching methods. However, the study also determines that although, this method is apparently safer and efficient, there is no proof of patients have any gains during post operative care and hearing efficiency when compared to other traditional methods.

Key words —endoscopy, grommet, middle ear, Eustachian tube, myringotomy.

I. INTRODUCTION

Myringotomy is a surgical procedure involving eardrums (Latin *myringa* meaning eardrum). In this surgery, a tiny slit is cut open in the eardrum. This incision is primarily made to reduce any extra pressure built up or to get rid of any pus formation present in the middle ear. After this procedure, a tympanostomy tube is slipped into the middle in order to maintain the aeration for long time and to check the resettlement of fluid. Myringotomy is often required during Eustachian tube obstruction or in severe otitis media i.e. infection in middle ear. Chronic otitis media with effusion is also one of the causes of myringotomy.

Several techniques are invented for grommet insertion, but previously oto- microscope was the only way to visualize the drum which is still very popular worldwide for tympanostomy insertion. However, endoscopy has also emerged as a better and viable option to substitute microscope in the surgery. Ventilation tubes are generally inserted for refractory middle ear effusions with persistent conductive hearing loss found for at least 3 months and hearing loss greater than 25 dB. They may also be inserted as an additional procedure in acute mastoiditis secondary to acute otitis media.

Eustachian tube was first described by Bartomeus eustachius as pharyngo tympanic tube in 1562 and Antonio Valsalva named it as Eustachian tube. It is 36mm long in adults, inferiorly and medially from anterior wall of middle ear, forming an angle of 45 degree with horizontal. Later it enters naso- pharynx 1.25 cm behind posterior end of inferior turbinate.

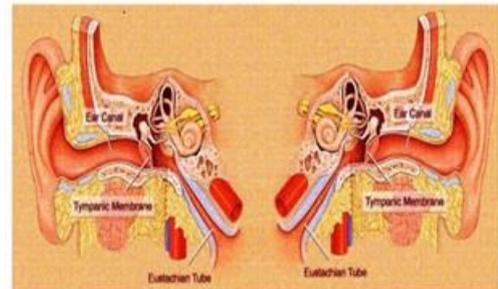


figure 1. angulation of eustachian tube

Lateral one-third is bony while medial two- third is fibro cartilaginous.

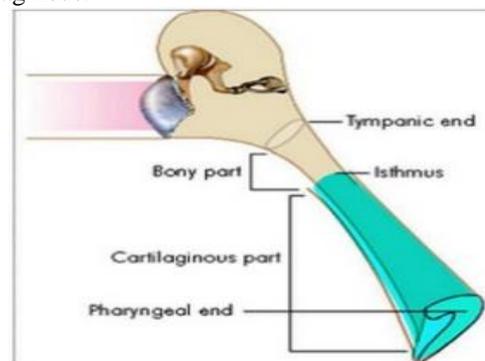
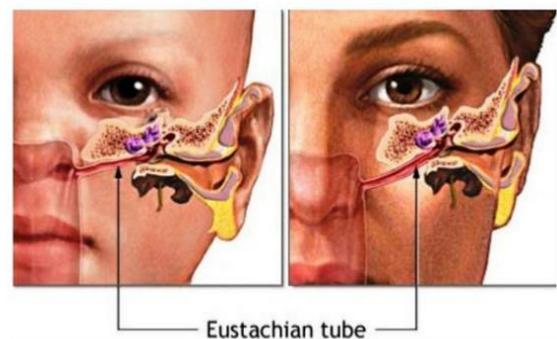


figure 2. parts of eustachian tube

Adult vs. Child (< 7 yr)



Eustachian tube is generally closed and opens during swallowing, yawning and sneezing

	ADULT	INFANT
Length	36 mm	18 mm
Angle with horizontal	45 °	10 °
Lumen	Narrower	Wider
Angulation at isthmus	Present	Absent
Cartilage	Rigid	Flaccid
Elastic recoil	Effective	Ineffective
Ostmann's fat	More	Less

table 1. comparison between adult and infant eustachian tubes

Flammation of the middle ear is known as otitis media. It may also involve inflammation of mastoid, petrous apex and perilabyrinthine air cells. Otitis media with effusion, OME, also known as serous otitis is the presence of fluid in the middle ear without signs and symptoms of acute infection, persisting for 3 months or longer from the date of presentation if we don't have the date of onset. Otitis media with effusion generally registers its presence in form of fullness, earache, pulling auricles, tinnitus, and conductive hearing loss or diagnosed during screening tests for hearing.

Adenoid hypertrophy is one of the commonest causes of Eustachian tube obstruction in children resulting in OME. In addition infective conditions, allergy and irritation from cigarette smoke are proven factors.

OME is accumulation of non-purulent fluid of various viscosities with in the middle ear cavity.

OME is due to dysfunction of Eustachian tube and reduced or missing aeration of middle air cavity which causes negative pressure to develop with in the middle ear cavity leading to formation of serous effusion and metaplasia of the middle ear mucosa to a secretory active epithelium and formation of viscous effusion, mucotympanum. Mucous effusion is common in children while serous effusion is seen in adults.

Long term studies show that the ear tube surgery are not really important, but current guidelines for American otaryngologists indicate tube placement in the following conditions-

- Chronic otitis media with persistent effusion for 6 months (one ear) or 3 months (both ears).
- Recurrent acute otitis media: 3 ear infections in 6 months or 4 infections in a year.
- Persistent eustachian tube dysfunction
- Barotrauma: Especially for prevention of recurrent episodes (e.g., after air travel, hypobaric chamber treatment).

II. MATERIALS AND METHODS

A. Population and collection of data

An ex post facto study of 178 patients was performed. All the patients underwent myringotomy and/ or tympanostomy tube insertion (grommet). The study was performed at Rzgary teaching hospital which is a tertiary care hospital in Erbil. The study dealt with age, symptomology, findings, time of operation using endoscopy and their complications. The patients fell in the age bracket of 2.6 years to 40 years. Out of the 178 patients, 89 patients were operated on left ear and the rest 89 on right ear. Main indication was OME due to adenoid hypertrophy resulting into mild hearing loss.

B. Surgical equipments used

Set of instruments used included- myringotomy knife, zero degree storz Oto endoscope that were 2.7 mm in length, ventilation tube which were mainly shepard short acting tympanostomy tube, grommet which are less than 2 mm in length, video camera and monitor for recording the endoscopy. An absorbent pad dipped in an antifogging solution and was mounted above the boundary of patient's ear.

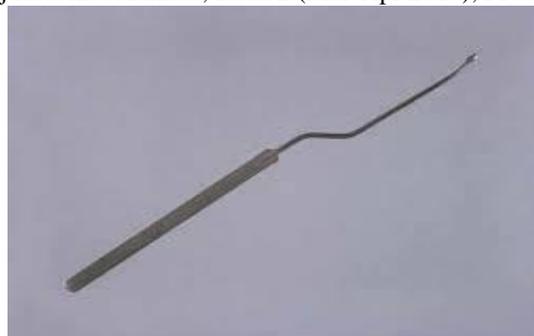


Figure 4. Myringostomy knife



Figure 5. Starz oto endoscope

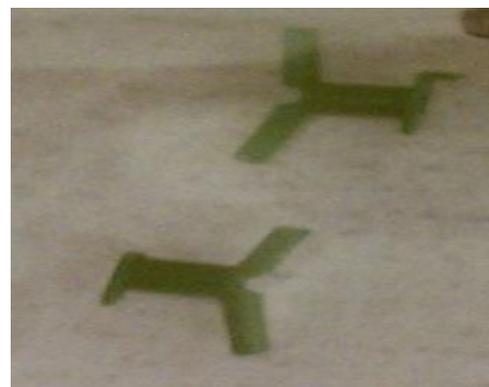


Figure 6. grommet

C. Pre surgical procedures and preparations

Before the operation occurred, patients generally underwent pneumatic otoscopy. This was the primary tool to determine that patient was suffering with otitis media with or without effusion. Other diagnostic elements used were physical examination, culture, audiometry etc. As a precaution, the medical history of the patient was carefully examined by anaesthesiologist present as a member in the surgical team. Most patients were admitted on the same day as of operation, and in some cases with severe procuring ailments, the patients were already admitted beforehand. In the cases where the case history files were missing, the patient or their parents were separately counselled to collect the required information.

As a precautionary measure, intake of aspirin was prohibited at least 2 days before the operating time. Anti-inflammatory and non-steroidal medicines such as ibuprofen were also debarred. All types of oral intake including food, chewing gums and water was advised not be taken 6 hours before the surgery lest it should increase anaesthetics complications.

D. Surgical proceeding

All the surgeries were accomplished with general anaesthesia. The patient was given intravenous infusion along with medication to be relaxed. The heart rate and

pulse were observed using a pulse oximeter and heart rate monitor.

The patient's head was tilted sideways a little to the opposite side of the ear being operated to provide more ease during operation. A zero degree Storz endoscope with diameter 2.7 mm was inserted into the middle ear and then a radial slit is made. The incision was made in the antero inferior- quadrant around the light reflex region with a myringotomy knife. Incisions were not made in the posterosuperior quadrants in order to rule out the damaging of ossicular chain or chorda tympani.

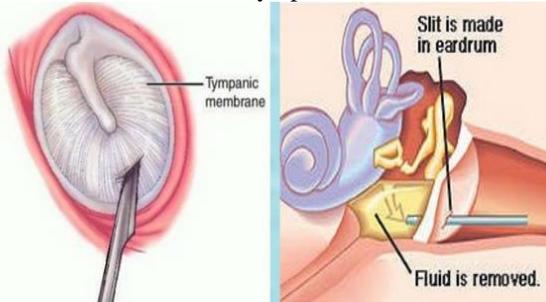


Figure 7. myringotomy surgery

Thereafter, the secretions from the middle ear were sucked and then the grommets were positioned by the forceps on the site of incision. Three types of grommets were used ,shipt ,shah and T tube.

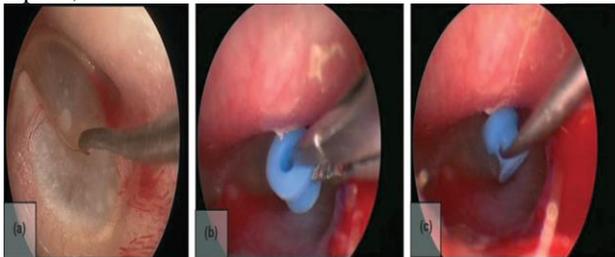


Figure 8. (a) incision of membrane (b) positioning of grommet (c) insertion

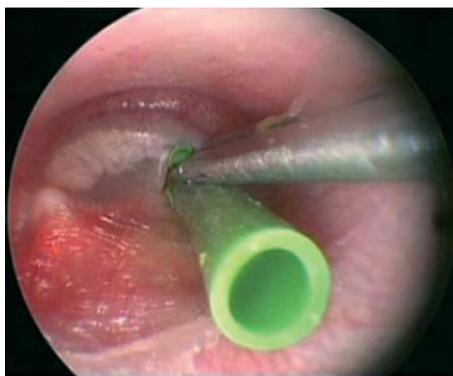


Figure 9. Insertion of T-tube

E. Post surgical precautions and medications

The post operative care included a minimum of two day resting period of all the patients. The head was placed atop the level of heart by resting the head on multiple pillows. Excoriation of the outer ear was scrupulously prevented through application of zinc oxide. Acetaminophen was orally given in cases of analgesia. The pain was treated simply using epinephrine. It was advised to all the patients that water entry be avoided by all means from entering into the middle ear as it could damage tympanostomy tube and promote bacterial attack.

If there is prolonged discomfort, then hot water bags can be applied on the affected side. Edema cases were reduced by putting ice bags b over the affected area. The external canal, if showed the signs of any leakage, were cleaned using cotton swabs soaked in hydrogen peroxide. Tylenol was used if the pain persisted. Antibiotics along with eardrops were used to allow proper functioning of the middle year.

III. RESULTS

A comprehensive study was performed upon 178 patients under the premises of Rzgary teaching hospital. All the patients were suffering from otitis media with effusion. The study was statutorily based upon the success of endoscopy of middle ear in a myringotomy operation along with ventilation tube insertion.

The following table represents the primary data of the patients under observation-

Range of Age	2.6-44 years
Average age	8.6 years

Table 2. Patient Information (age)

As visible from the table, the patients who were operated belonged to the age group ranging from as low as 2.6 years to the mid age of 44 years. On an average basis the patient was aged 8.6 years. This is clearly an indicative of the fact that myringotomy was more immediately required in patients of younger age. In fact, it has been established according to various studies conducted worldwide that within 3 years of age, over 90% of children are found inflicted with otitis media with or without effusion.

The following table aims to determine more closely the case of the operated patients-

Right ears	89
Left ears	89
Total number	178

Table 3. Number of patients of each ear

Among all the patients who were subjected to myringotomy, the probability of operating left and right ear was same for any approaching case. As indicated in the table above, from a total of 178 patients, the patients whose left ear were operated ranged to 89 in number and an equal number of patients got their right ear operated. Therefore the share of operating any one of the ears was 50%

The following table highlights roughly, the cause for oitis media with effusion and hence myringotomy-

Cause	Number of patients
Adenoid hypertrophy	140
lergy	38
Not known	1

Table 4. Causes for otitis media

Upon a vigorous examination of the case history of the patients, it turned obvious that adenoid hypertrophy was one of the leading causes of the ailment, leading to trailing symptoms and the surgery. As already established by the studies conducted across different parts of the world, most of the cases were triggered by adenoid hypertrophy and the rest being the cases of allergy and other causes. Among 178

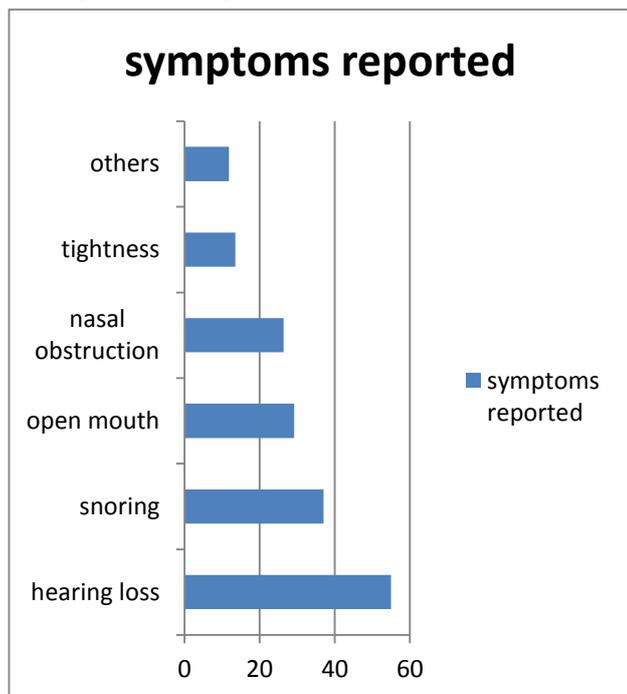
patients undergoing the surgery, almost three- fourths of them were suffering from adenoid hypertrophy, their number being 140. The second major cause was allergy, probably pulmonary allergies accounting to 38 patients, to be precise. In 1 patient, the cause could not be clearly established.

After the case history and external examination, the symptoms of the patients were studied. The following tables depicts the symptoms that the patients were suffering from-

Symptoms	
Hearing loss	97
Tightness	24
Pulling ear	11
Ear ache	4
Nasal obstruction	47
Snoring	66
Open mouth	52
Fever	5
Nasal speech	1

Table 5. Symptoms in patients

As indicated in the table above, there were varied number of symptoms that the patients had to go through. The highest number of patients reported hearing loss, while the minimum number of patients grieved ear ache, fever and nasal speech. The patients suffering from hearing loss were 97 in number, those experiencing tightness were 24 in number and the patients who complained about nasal obstruction were forty seven in number. A considerable amount of patients were also found inflicted with snoring, ranging to sixty six in number. Only one patient was found suffering with nasal speech.



After general examination of the symptoms of all the patients, otoscopy and or endoscopy was performed to confirm the specific signs and to establish that surgery was required in the patients. The following table depicts the data of the drum examination of the patients-

Otoscopy	
Disturbed cone of light	87 ears
Retraction	48 ears
Transverse position of handle of malleus	8 ears
Fluid level	8 ears
Bubbles	14 ears
Meniscus	3 ears
Atelectasis	3 ears

Table 6. Result of otoscopy

As obvious from the table, disturbed cone of light in otoscopy was most common among the patients. It was retraction in 48 patients and bubbles in 14 ears. Other signs such as transverse position of handle of malleus, fluid level increment, meniscus and atelectasis were also seen.

After the final affirmation of the persistence of otitis media with effusion, the patients were operated. Here is a table depicting the time taken during surgery-

Right side (average time of operation)	2.5 minutes
Left side (average time of operation)	2.2 minutes
Average time of operation	2.4 minutes

Table 7. Operating time

The average time of operation for the right side was 2.5 minutes, while that of the left side was 2.2 minutes. On an average, it took almost 2.4 minutes to accomplish a single operation.

After the normal endoscopic myringotomy, the ventilation tube was inserted into the tympanum based on which the operation could be classified into four types. The following table shows the highlights-

Type of operation	
TSAD Grommet	8
AD Grommet	82
T tube	2
Grommet	5

Table 8. Type of ventilation tube

The most common type of operation used was adenoideotomy with grommet insertion, 82 ears, while the least common were T tubes which were placed only in 2 ears. Tonsillectomy, and adenoideotomy with grommet insertion, 8 ears, while grommets alone were inserted into 5 ears.

After the surgery, a clear follow up was maintained for all the patients except 18 whose follow up could not be feasible.

The study of post surgical complications revealed that there were quite less number of complications involved. The table for the same is below-

Complications	
Infection	8 patients
Early extrusion (1 month)	6 patients
Tympanosclerosis	2 patients
Recurrent effusion	2 patients
Retraction	2 patients
Late extrusion (more than one year)	3 patients

Table 9. Complications after surgery

The analysis of the data reveals that infection was amongst the most common complication arising after the surgery. 8 patients were found suffering from infections post surgery. 6 patients witnessed early extrusion of ventilation tube 2 patients each complained of recurrent effusion, retraction and tympanosclerosis. It took more than one year in the extrusion of ventilation tube in 3 patients.

The extrusion time of the ventilation tubes was studied extensively based on which, the following data was emancipated-

Average extrusion time /months (Right ears)	Average extrusion time /months (left ears)	Average extrusion time /months
7.1	7.8	7.5

Table 10. Average extrusion time

This table indicates that the average extrusion time for the ventilation tube was 7.5 months for both years. Separately, average extrusion time for right ear was 7.1 months and that for left ear was 7.8 months.

IV. DISCUSSIONS

The oto- endoscopic technique has opened up multitudes and possibilities and a change in surgical approaches in middle ear. The use of an otoendoscope for myringotomy and grommet insertion was first reported by Thomassin in 1998 (0 Thomassin JM. Endoscopically Assisted Diagnostics and Surgery in Otolaryngology. Volume 1: Technique, Equipment and Indications. Tuttingen: Endo-Press, 1998) but did not become popular because the operating microscope had the major advantage of providing binocular vision.

This procedure was first used in children due to its ease and efficiency, and since this procedure can be easily followed, this procedure is now gaining commendable importance. The feasibility of this surgery is highly magnified and the complications are relatively minor and negligible. In addition to endoscopic ventilation tube insertion rigid endoscopes have been used as an adjunct to standard otologic and neuro-otologic including ventilation tube myringoplasty,(1) , cochlear implant(2) cholesteatoma surgery(3)ENDOSCOPIC STAPEDOTOMY (4)

1. European Archives of Oto-Rhino-Laryngology July 2014, Volume 271, Issue 7, pp 1897-1902 Date: 03 Sep 2013

Endoscopic vs microscopic myringoplasty: a different perspective Himani Lade, Santosha Ram Choudhary, Ashish Vashishth

2. European Archives of Oto-Rhino-Laryngology May 2014, Volume 271, Issue 5, pp 959-966 Date: 18 Apr 2013 Endoscopic cochlear implant procedure

Daniele Marchioni, Alberto Grammatica, Matteo Alicandri-Ciuffelli, Elisabetta Genovese, Livio

Presutti Endoscopic CI is a safe and viable technique with a low rate of complications and with good outcomes.

3. Int J Pediatr Otorhinolaryngol. 2015 Mar; 79(3):316-22. doi: 10.1016/j.ijporl.2014.12.008. Epub 2015 Jan 7.

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In Our study The average time of operation for the right side was 2.5 minutes, while that of the left side was 2.2 minutes. On an average, it took almost 2.4 minutes to accomplish a single operation. In a study by FEI-PENG LEE on 37 ears The operation time for each ear ranged from four to 13 minutes, with an average of seven minutes. **(An alternative use of video-telescopic guidance for insertion of myringotomy tube**

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In Another study by Nassif, he mean duration of the VT placement unilaterally by endoscope was 18 min and that by microscope was 11 min. For bilateral placement, mean duration was comparable (microscope/endoscope = 26/27 min **(Endoscopic ventilation tube placement in the pediatric age Clinical Otolaryngology Volume 39, Issue 1, pages 50-53, February 2014 N. Nassif1,* , L.O. Redaelli De Zinis2, M. Berlucchi1 andD. Zanetti3**

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