Evaluation of Results 0f Tympanoplasty versus Tympanostomy Tube Insertion in Cases of Bilateral Adhesive Otitis Media

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Abstract- Objective: There is no consensus among clinicians regarding the best treatment strategy for adhesive otitis media (AdOM). It is common practice to only intervene in the presence of recurrent infections or significant conductive hearing loss. In an attempt to provide evidence regarding the efficacy and safety of surgical intervention, we have analyzed the outcome of surgical intervention in cases of bilateral AdOM by doing tympanoplasty in one ear and tympanostomy with T-Tube insertion in the other ear.**Patients and methods**: Prospective comparative study. This study was conducted in the department of Otorhinolaryngology, Head and Neck Surgery, Al-Azhar university Hospital (New Damietta), From June 2014 till June 2017. This study was conducted on 30 patients with bilateral adhesive otitis media (60 ears) All patients are diagnosed as stage II (16 patient; 32 ears) or III (14 patients; 28 ears) according to classification of Bluestone [1]. All 30 patients (60 ears) underwent T- tube insertion in one ear and tympanoplasty using cartilage graft in the other ear in the same sitting.**Results:** This study was conducted on 30 patients (60 ears): 18 patients (36 ears) were males (60%) and 12 patients (24 ears) were females (40%) their age ranged from 10 to 50 years with mean 26.86 years and standard deviation 11.83 years; the median age was 31 years. As regard to postoperative air-bone gap, it was ranged from 3 to 25 dB; and there was significant improvement (decreased air bone gap) in tympanoplasty when compared to TT (7.76±1.63 vs 17.20±5.76) respectively) ($p<0.001$). In TT, there was statistically significant decrease of air-bone gap postoperatively when compared to corresponding preoperative values (10.7±3.1 vs 28.4±4.9 respectively). In addition, in tympanoplasty, there was statistically significant decrease of air-bone gap postoperatively when compared to corresponding preoperative values (7.76±1.63 vs 28.6±5.3 respectively) ($p<0.001$).**Conclusion:** Tympanoplasty is more effective than T-tube in treatment of adhesive otitis media in the short term follow up. However, results cannot be generalized due to study limitations.

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1. Introduction:

Adhesive otitis media is a result of abnormal healing mechanism after chronic inflammation of the middle ear. Chronic inflammation that may be present after prolonged middle ear effusion leads to the ingrowth of fibroblasts and the formation of scar tissue in the middle ear space. The mucous membrane is thickened by proliferation of fibrous tissue, which frequently impairs the movement of the ossicles, resulting in a conductive hearing loss. Adhesive otitis media is common after recurrent acute or chronic otitis media with effusion, atelectasis of the tympanic membrane, or both. In addition to impaired ossicular mobility, adhesive otitis media may result in ossicular discontinuity. The long process of the incus, because it has the most tenuous blood supply of all of the ossicular chain, is susceptible to erosion or rarefying osteitis. When there is severe localized atelectasis in the posterosuperior portion of the pars tensa of the tympanic membrane, adhesive changes may bind the eardrum to the incus, stapes, and other surrounding middle ear structures and cause resorption of the ossicles. Once a retraction pocket occurs, cholesteatoma formation is also possible [2].

Aim of study:

The aim of our study is to compare between the results of tympanoplasty operation in one ear and tympanostyomy tube insertion in the other ear in the same patients suffering from bilateral adhesive otitis media. The study will include evaluation of the clinical preoperative findings and the postoperative results in these cases taking in consideration the stage of the disease depending on Bluestone classification. The results will be analyzed statistically and the outcome may help in reporting the suitable treat in each case.

Classifications of adhesive otitis media

1) Bluestone Classifications:

Adhesive otitis media may be staged as follows:

• Stage I Adhesive otitis media within the middle ear, mastoid, or both, with no functional deficit secondary to the adhesive changes (i.e. hearing loss). The middle ear remains aerated.

• Stage II. Adhesive otitis media within the middle ear (with or without mastoid involvement) with mild hearing loss secondary to adhesive pathology. This may involve fixation, discontinuity, or both, of the ossicular chain, limited tympanic membrane compliance, or both. The middle ear remains aerated.

• Stage III. Similar to stage II but with maximum conductive hearing loss secondary to ossicular pathology. No middle ear space is present [1].

2) Sade Classifications:

IN 1976 sade classify the tympanic membrane atelectasis to 5 grades:

Grade I: Mild tympanic membrane retraction.

Grade II: tympanic membrane retraction in contact with incus or stapes (tympanoincudopexy).

Grade III: tympanic membrane in contact with promontory (not adhered to it). Grade IV: tympanic membrane adhered to promontory (adhesive otitis media). Grade V: Grade III or IV with tympanic membrane peroration [3].

3) Tos Classifications:

Tos developed a different scheme and this is used for pars flaccida retractions [4].

Stage	Description
Stage I	Small attic dimple
Stage II	Pars flaccida retracted maximally and draped over neck of malleus
Stage III	As grade 2 with erosion of outer attic wall (scutum)
Stage IV	Deep retraction with unreachable accumulated keratin

Once adhesions between the TM and middle ear mucosa and ossicles have formed, treatment is difficult. As with many pathologic processes, prevention of the primary process is much easier [5].

2. Patients and Methods:

This study was conducted on 30 patients with bilateral adhesive otitis media (60 ears) at the Otorhinolaryngology Department of Al Azhar University Hospital (New Damietta) started at June 2014 till June 2017. All patients are diagnosed as stage II (16 patient; 32 ears) or III (14 patients; 28 ears) according to classification of Bluestone.

Inclusion criteria

• The patients with bilateral adhesive otitis media in the same stage in both ears.

• Stage II or III of Bluestone classification.

Exclusion criteria

• Any medical condition that interfere with the operation such as blood disease.

• Stage I of adhesive otitis media. Adhesive otitis media within the middle ear, mastoid, or both, with no functional deficit secondary to the adhesive changes (i.e, hearing loss). The middle ear remains aerated.

• Marked audiological differences between the two ears.

• Patients complicated with acute infection or cholesteatoma.

Preoperative patient evaluation

All patients were submitted to:

- Full complete history is taken from the patient or his parents.
- Examination: Complete E.N.T. examination with focusing on ear examination including otoscopic, microscopic and endoscopic examination by zero-degree Karlstorz endoscope.
- Audiological investigations including pure tone audiometry, tympanometry and Eustachian tube function tests.
- CT petrous bone.
- Examinations for fitness for operation, as full laboratory investigations, and evaluation of patient cardiac, chest and general conditions.
- All patients in this study were enrolled to sign a written consent either by the patient or his guardian.

Surgical technique

All 30 patients (60 ears) underwent T- tube insertion in one ear and tympanoplasty using cartilage graft in the other ear in the same sitting.

1- Anesthesia: General endotracheal anesthesia was used for all cases.

2-Operative procedures:

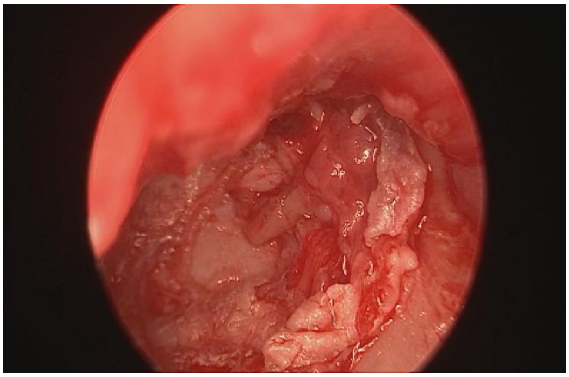
Tympanoplasty with cartilage graft.

- Infiltration of external auditory canal with a mixture of mepivacaine 2% with epinephrine 1/200000 about 3 minutes before the surgical approach.
- Longitudinal incision is done in the external auditory canal at 12 o`clock.
- Another longitudinal incision is done at 6 o`clock.
- Transverse incision of the EAC is made about 0.5 to 1 cm lateral to the fibrous annulus between the two longitudinal incisions.
- The tympanomeatal flap is detached from the bone using cottonoids soaked in epinephrine to avoid excessive bleeding. Flap dissection proceeds medially, pushing the skin medially and anteriorly, encompassing the incision until the fibrous annulus is identified.
- The fibrous annulus is raised using a

microhook and once raised allows a good view of the middle ear. Dissection of the flap proceeds from posterior to anterior.

- Examination of middle ear cavity for adhesions.
- Removing the adhesions inside the middle ear between the tympanic membrane and promontory, adhesions in front of Eustachian tube and adhesions between the ossicles to restore normal ventilation of the middle ear.
- Examination of ET and supratubal recess.
- Examination of hypotympanum recess.
- Harvesting the cartilage graft from the tragus.
- Putting the graft medial to the handle of malleus.
- Forcing site of retraction pocket if present by apiece of cartilage.
- Replace the tympanomeatal flap.
- Filling the external auditory canal with gelfoam.

Preoperative view



Final view

T-Tube insertion

- Examination of the ear at the start of the operation.
- Myringotomy at anteroinferior quadrant of tympanic membrane.
- Using suction to remove any fluid inside the middle ear.
- A firm silicone T-tube [length, 12 mm; internal diameter, 1.14 mm]; Medtronic Xomed, Inc) was inserted in the anteroinferior part of the middle ear throw the myringotomy. While the two brongs of the tube were in the middle ear and the extended limb was in the external canal.

Preoperative view

Final view

Postoperative care after tympanoplasty (30 ears):

- Antibiotics, decongestant nasal drops, mucolytic and analgesics were prescribed.
- Aural pack was removed after 2 weeks.
- Water is kept away from the ear during bathing by using ear plugs or piece of cotton soaked with Vaseline.
- Clinical evaluation for follow up was

performed at regular visits, every week till complete healing, then every month for three months.

- Evaluation for hearing improvement using pure tone audiometry and tympanometry was performed after six months.
- Any complications during the period of follow up were followed and treated.
- The patient can go back home after one day.

Postoperative care after T-tube insertion (30 ears):

- Antibiotics, decongestant nasal drops, mucolytic and analgesics were prescribed.
- Water is kept away from the ear during bathing by using ear plugs or piece of cotton soaked with Vaseline.
- Clinical evaluation for follow up was performed at regular visits, every week till complete healing, then every month for three months.
- Evaluation for hearing improvement using pure tone audiometry and tympanometry was performed after six months.
- Assuring tube function: Proper function of ventilation tube if it is seen in position and its lumen is unobstructed.
- When tube function cannot be confirmed by visual inspection, pneumatic otoscopy and tympanometry was done. If the TM is immobile and translucent on pneumatic otoscopy, the tube is functioning probably.
- A flat (type B) tympanogram with a large volume measurement and normal hearing confirm that the outer and middle ears are connected by functioning tube. A flat tympanogram with small volume indicate nonfunctioning tube.
- Any complications during the period of follow up were followed and treated.
- The patient can go back home after one day because of the surgery of the other ear. The patient can go home in the same operative day if has T-Tube insertion alone.

All patients' data were collected, analyzed and submitted for statistical analysis.

3. Results:

In the present study, table (1) revealed that, 18 patients out of 30 patients (60.0%) were males and 12 patients (40.0) were females, with male to female ratio of 1.5:1.

Table (1): Sex distribution in studied populations (n=30).

		N	%	X^2	p
Sex	Male	18	60.0	1.20	0.27(ns)
	Female	12	40.0		
Male: female ratio		1.5: 1			

In the present study, age ranged from 10 to 50 years with mean 26.86 years and standard deviation 11.83 years; the median age was 31 year. The age of males ranged from 12 to 50 years with a mean of 24.61±11.90 years, while the age of females ranged from 10 to 43 years, the mean age was 30.25±10.85 years.

Table (2): Age (years) distribution in studied populations (n=30).

Statistics	All patients	Males	Females
Median	31.0	17.50	33.50
Mean	26.86	24.61	30.25
SD	11.83	11.90	10.85
Minimum	10	12	10
Maximum	50	50	43

As regard to preoperative air-bone gap, it was ranged from 19 to 30 dB; and there was no significant difference between right and left ear (28.4±4.9 vs 28.6±5.3 respectively) in the same patient. In addition, there was no significant difference between right and left ears for males (27.66±5.41 vs 29.41±4.07 respectively) or females (27.61±5.62 vs 30.0±4.47 respectively).

Table (3): Preoperative air bone gap in studied populations according to surgical intervention.

		Mean (dB)	S. D (dB)	Minimum (dB)	Maximum (dB)	t	p
Males	Right ears	27.66	5.41	20.00	35.00	0.95	0.34
	Left ears	29.41	4.07	23.00	35.00		
Females	Right ears	27.61	5.62	19.00	37.00	1.23	0.22
	Left ears	30.00	4.47	23.00	37.00		
Total patients	Right ears	28.4	4.9	20.00	35.00	0.15	0.88
	Left ears	28.6	5.3	19.00	37.00		

As regard to postoperative air-bone gap, it was ranged from 3 to 25 dB; and there was significant improvement (decreased air bone gap) in tympanoplasty when compared to TT (7.76±1.63 vs 17.20±5.76 respectively).

Table (4): Postoperative air bone gap in studied populations according to surgical intervention.

	Mean (dB)	S. D (dB)	Minimum (dB)	Maximum (dB)	t	p
TT	17.20	5.76	10.00	25.00	8.61	<0.001*
Tympanoplasty	7.76	1.63	3.00	10.00		
Total	9.25	2.88	3.00	25.00		

In TT, there was statistically significant decrease of air-bone gap postoperatively when compared to corresponding preoperative values (10.7±3.1 vs 28.4±4.9 respectively). In addition, in tympanoplasty, there was statistically significant decrease of air-bone gap postoperatively when compared to corresponding preoperative values (7.76±1.63 vs 28.6±5.3 respectively).

Table (5): Comparison between pre- and post-operative air bone gap in each group

	Preoperative		Postoperative		Paired (t)	P value
	Mean (dB)	SD (dB)	Mean (dB)	SD (dB)		
TT	28.4	4.9	17.20	5.76	9.40	<0.001*
Tympanoplasty	28.6	5.3	7.76	1.63	23.41	<0.001*

Table (6) demonstrated that, difference between pre-and post-operative air bone gap ranged from 0 to 30dB and there was statistically significant increase of this difference in tympanoplasty group when compared to TT group (20.80±4.86dB vs 11.16±6.50dB respectively).

Table (6): Comparison between TT and tympanoplasty as regard to difference between pre- and post-operative air bone gap.

	Mean (dB)	S. D (dB)	Minimum (dB)	Maximum (dB)	t	p
TT	11.16	6.50	0.00	25.00	6.49	<0.001*
Tympanoplasty	20.80	4.86	9.00	30.00		
Total	15.98	7.48	0.00	30.00		

As regard to percentage of decrease in air bone gap, it ranged from 0 to 85.71% and there was statistically significant increase of percentage of improvement in tympanoplasty when compared to TT (72.25±7.27% vs 38.49±20.35% respectively).

Table (7): Comparison between TT and tympanoplasty as regard to percentage of improvement of Air-bone gap [(preoperative – postoperative)/ preoperative) x 100].

	N	Mean %	S. D %	Minimum %	Maximum %	t	p
TT	30	**38.49**	**20.35**	**0.00**	**71.43**	8.55	<0.001*
Tympanoplasty	30	**72.25**	**7.27**	**47.37**	**85.71**		
Total	60	**55.37**	**22.79**	**0.00**	**85.71**		

In TT group, the difference between stage II and stage III as regard to percentage of improvement of ABG was statistically non-significant; while in tympanoplasty group, the percentage of improvement was statistically increased in stage III when compared to stage II (75.01±3.09% vs 69.84±8.97% respectively).

As Table (8), In stage II adhesive otitis media, the percentage of improvement of air bone gap ranged from 0.0 to 85.71% and there was statistically significant increase of this percentage in tympanoplasty when compared to TT (69.84±8.97% vs 35.87±19.97% respectively).

Table (8): Comparison between stage II and stage III as regard to percentage of improvement of ABG in each group

	N	Mean	S. D	Min.	Max.		p

			%	%	%	%		
TT group	Stage II	16	35.87	19.970	0.00	60.00	0.75	0.45
	Stage III	14	41.50	21.11	0.00	71.43		
Tympanoplasty Group	Stage II	16	69.84	8.97	47.37	85.71	2.07	0.048*
	Stage III	14	75.01	3.09	70.97	81.08		

Table (9): Comparison between TT and tympanoplasty as regard to air bone gap percentage of improvement in stage II.

	Mean %	S D %	Minimum %	Maximum %	t	p
TT	35.87	19.97	0.00	60.00	6.20	0.044*
Tympanoplasty	69.84	8.97	47.37	85.71		

In stage III, the air bone gap percentage of improvement ranged from 0.0% to 81.08% and there was statistically significant increase of this percentage in tympanoplasty when compared to TT (75.01±3.09% vs 41.50±21.11% respectively).

Table (10): Comparison between TT and tympanoplasty as regard to air bone gap percentage of improvement in stage III.

	Mean %	S D %	Minimum %	Maximum %	t	p
TT	41.50	21.11	0.00	71.43	6.79	<0.001*
Tympanoplasty	75.01	3.09	70.97	81.08		

As regard to complications in the present work, 2 cases reported tube extraction and one case reported residual perforation; cases with tube extraction were in TT group and case with residual perforation was in tympanoplasty group; and there was no significant difference between both groups regarding postoperative complications.

Table (11): Comparison between TT and tympanoplasty as regard to postoperative complications

	Group				Total (n=60)	
	TT (n=30)		Tympanoplasty (n=30)			
	n	%	n	%	n	%
None	28	93.3%	29	96.7%	57	95.0%
Extraction	2	6.7%	0	0.0%	2	3.3%
Residual perforation	0	0.0%	1	3.3%	1	1.7%
Statistics	Z= 0.54 p =0.58					

In the present study, operative time without time of anesthesia and recovery (mean surgical time) in TT group ranged from 15 to 25 minutes, and in tympanoplasty group ranged from 30 to 45 minutes and there was statistically significant decrease of operative time in TT group when compared to tympanoplasty group (16.70±2.70 vs 38.00±4.31 minutes respectively).

Table (12): Comparison between TT and tympanoplasty as regard to operative time

	Mean	S. D	Minimum	Maximum	t	p
TT	16.70	2.70	15.00	25.00	24.3	<0.001*
Tympanoplasty	38.00	4.31	30.00	45.00		
Total	22.26	16.18	15.00	45.00		

4. Discussion:

In the present study, age ranged from 10 to 50 years with mean 26.86 years and standard deviation 11.83 years; the median age was 31 year. In addition, 18 patients out of 30 patients (60%) were males and 12 patients (40) were females, with male to female ratio of 1.5:1; and there was no significant difference between males and females.

Larem et al. (2016), [6] In their work for evaluation of tympanoplasty for adhesive otitis media,

reported that, the age range was from 18 to 68 years, with the average age being 31.6±15.9 years. Their patients were slightly older than those of the present work and can be attributed to difference in inclusion criteria. However, the sex distribution in their study was comparable to that of the present work with male predominance. They reported that, males presented more than females with this condition at a ratio of 3:1.

In addition, Daudia et al. (2010) [7] reported that, a total of 57 tubes were placed in 45 patients: 27 (60%) males and 18 (40 %) females. Patients' mean age at surgery was 23 years (range, nine to 64 years). The results of the present study are consistent with them as regard to male predominance but their patients were younger than those of the present work.

Adhesive otitis media represents one of the most common indications of tympanoplasty as done in the present work. Alicandri-Ciufelli et al. (2012) [8] reported that, the indications for tympanoplasty are mainly chronic ear pathologies, such as cholesteatoma, atelectasis, adhesive otitis media, and chronic tympanosclerotic otitis.

On the other hand, the Rosenfeld et al. (2016) [9] reported that, the most common indication for ear tube insertion remains persistent (> 3 monthes) otitis media with effusion (OME), or serous otitis media (SOM), that does not resolve after 3 months of clinical observation or does not improve with antibiotic therapy. Additional indications for prompt ear tube insertion include complications of AOM, such as meningitis, facial nerve palsy, and otomastoiditis. In patients with these complications, ear tubes can help halt tympanic membrane injury (eg, from retraction pockets, which distort the eardrum, and the subtle process of adhesive otitis media, which limits ossicular vibrations and can lead to permanent hearing loss). Prompt insertion of tympanostomy tubes ventilates the middle ear space and prevents further retraction of an eardrum under the negative pressure.

In the present study, preoperative air-bone gap was ranged from 19 to 30 dB; and there was no significant difference between both ears (28.4±4.9 dB vs 28.6±5.3 dB respectively).

These results are comparable to those reported by Larem et al. (2016) [6] who reported that, preoperative audiological evaluation demonstrated a mean preoperative air conduction of 33.9 ± 10.8 dB and mean ABG of 27.3 ± 9.3 dB.

In 2004, Yu and Qi**.** [10] studied 69 cases of adhesive otitis media that underwent tympanoplasty. Preoperative average ABGs were 43.8 ± 4.2 dB. Postoperative average ABGs were 27.9 ±10.7 dB; 21 patients (58.5%) had a nearly normal tympanum. These results are in agreement with that of the present study.

In 2009, Ichimura et al. [11] reported nine ears having adhesive otitis media with cartilage palisade tympanoplasty performed on them. Seven of the nine ears (78%) showed decrease in postoperative air-bone gap when compared to corresponding preoperative values.

In 2010, Shen et al. [12] reported 18 ears treated with tragus cartilage tympanoplasty. The patients showed an obvious decrease of the ABG by over 10 dB at 1 month after the operation, and by over 25 dB at 1 year.

The results of this study are comparable to previous studies or even better. This could be attributed to the presence of permanent ventilation of the middle ear after surgery in studied patient`s ears.

Summarizing results of the present work, it can be said that, both tympanoplasty and T-tube were effective in treatment of adhesive otitis media and results in both techniques were correlated with the stage of disease. In addition, tympanoplasty is associated with significantly better outcome regard reduction of air bone gap.

As regard to complications in the present work, 2 cases 6.6% reported tube extraction in TT group and one case reported residual perforation in tympanoplasty group. there was no significant difference between both groups regarding postoperative complications. These results are comparable to those reported by Selvan and Karuppasamy (2017) [13] who reported that, there were no significant complications seen in any patient underwent tympanoplasty. They added, lll patients who had bony curetting of postero-superior meatal wall had an intact taste sensory perception. All ears showed intact grafts except 2 patients at the most recent follow-up. There were no significant retractions. Small, local retractions around the edge of the cartilage graft were seen in two ears. These have remained stable and are believed to be clinically insignificant. All patients had significant hearing improvement. No patient required ventilation tubes for persistent effusion in the post-operative period.

In addition, Ciodaro et al. (2016) after insertion of tympanostomy tube for treatment of adhesive otitis media reported that, no intra-operative complications were recorded. Three days after surgery, good ventilation of tympanic cavity was noted in the anterior portion of TM of all patients, and no complications were recorded in the first month postoperative. However, two months after surgery, only two cases (9.09%) presented with otorrhoea. These patients were successfully treated with antibiotic therapy.

Furthermore, Saki et al. (2012) [14] reported that, after tympanostomy tube insertion, transient otorrhea was seen in 26 cases (12.5%), delayed

otorrhea in 17 cases (8.2%) and chronic otorrhea nonresponsive to medical treatment in 4 cases (1.9%). In one case of chronic otorrhea, a second surgery on the mastoid cavity was required, and in three cases, otorrhea was stopped upon the extrusion of the VT. The obstruction of the VT on the tympanic membrane was reported in eight cases (3.8%), granulation tissue in seven cases (3.4%), early extrusion from the membrane in 12 cases (5.7%), and displacement into the middle ear in one case (0.4%). After the extrusion of the VT, myringosclerosis was seen in 79 cases (37.9%), tympanic membrane atrophy in 58 cases (27.8%), and persistent perforation of the tympanic membrane in 5 cases (2.4%). These results are very high when compared to the present work. The possible explanation for this contradiction is due to the fact that, their study included only children and large number of cases.

The success of ear surgery is in a large part dependent on the function of the Eustachian tube and aeration of the middle ear. Among the factors correlated with successful surgical outcome for treatment of chronic ear disease, Eustachian tube function is thought to be one of the most important. Creating and maintaining an aerated middle ear is central to the success of surgical treatment of adhesive otitis media. Patients with Eustachian tube dysfunction (ETD) often require surgery, the success of which is significantly dependent on maintaining an aerated middle ear [15].

When comparing T-tube and tympanoplasty in the present study, results revealed that, TT-insertion had a short operative time, no or minimal intraoperative bleeding, and patients with T-tube the patient can go back home after one day because of the surgery of the other ear. The patient can go home in the same operative day if has T-Tube insertion alone. On the other hand, tympanoplasty operation needs longer operative time, more bleeding than T-tube insertion, and patients usually discharged in the second postoperative day. Thus, the total cost of T-tube insertion seems to be lower than tympanoplasty.

In 1985, Vartiainen et al. [16] provided analysis of results of tympanoplasty operations in 55 ears with chronic AdOM. Only in 34% of the ears was the tympanic cavity found to be aerated on follow-up examination. Hearing improved significantly in only 13 ears (24%).

For Vartiainen et al. [16]**,** tympanoplasty is not recommended in the treatment of chronic AdOM; prevention of chronic AdOM is the best approach. The VT also acts as middle ear spacer and prevents adhesion of the graft on the medial wall.

An alternative to transtympanic VT is to place the tube between the fibrous annulus and bony canal wall (subannular tympanostomy tube) [17,18,19]; subannular T-tube (SAT) is said to have a lesser risk of perforation, but it carries risks of chronic plugging of the ventilation tube, skin overgrowth, or tracking of squamous epithelium into the middle ear.

Although the present study is unique in its design comparing T-tube with tympanoplasty in chronic adhesive otitis media in the same patient, it had some limitations such as the small number of included subjects (it may be attributed to the low incidence of bilateral adhesive otitis media). In addition, the short period of follow up due to time factor for researcher. Thus, it is advised in the future to increase number of subjects and lengthen the duration of follow up. However, we can conclude that, tympanoplasty is more effective than T-tube in treatment of adhesive otitis media in the short term follow up. However, results cannot be generalized due to study limitations.

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