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ORIGINAL ARTICLE

A Retrospective comparative Study of Endoscopic and Microscopic Tympanoplasty

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ABSTRACT

Aim: To investigate the outcomes of endoscopic vs. microscopic technique to tympanoplasty among patients.
Methods: It was a retrospective study in which outcomes of sixty one ears of sixty patients (thirty three male and twenty seven female) who experienced type-1 tympanoplasty were assessed. Patients age range was between 20-50 years. Patients in Group-1 experienced tympanoplasty together with endoscopic procedure (n=32) while patients in Group-2 experienced tympanoplasty along with conservative microscopic approach (n=29). Among both groups patients, a rebound-shaped temporalis fascia was utilized. The results were studied regarding surgery time, success rate of graft and hearing gain.
Results: Among both groups patients, postop ABG (air-bone gap) was considerably less than preop air-bone gap. Insignificant differences were found between pre- and post-op air-bone gap values (in decibel) in either cohort. Among Group-1 patients, mean surgery time was considerably less than Group-2 patients (51.37 versus 67.03 minutes)[2]. Among patients, this procedure was more frequently performed during current years[3,4].
Conclusion: Among patients experiencing type-1 tympanoplasty, particularly if external acoustic meatus is narrow and anterior canal wall is protuberant, endoscopic technique seems to offer results equivalent to microscopic technique for TM entire visualization while lack of additional interventions needed to assess the ossicular system.
Keywords: Tympanoplasty, endoscopy, micsoscopy

INTRODUCTION

During this study, outcomes were compared of endoscopic and more definitive microscopic technique to type-1 tympanoplasty among patients regarding surgery time, success rate of graft and hearing gain.

Study tried to assess whether transcanal endoscopic technique is an alternate tympanoplasty procedure regarding adulthood CSOM (chronic suppurative otitis media) treatment.

MATERIAL AND METHODS

It was a retrospective study carried out at LGH (Lahore General Hospital), Lahore as per Helsinki Declaration[5]. No any fund was provided by pharmaceutical companies or contributed for study design, outcome assessment, or paper writing.
Subjects: During study 75 patients with CSOM aged 20-50 years admitted at ENT Departments from Oct. 2019 to Oct. 2021 were retrospectively analyzed. All patients were found with central, anteroinferior / posteroinferior perforation of TM (tympanic membrane) and with normal mucosa of the middle ear. Among 5 patients, cholesteatomas were identified endoscopically while follow-up among 9 patients was unsatisfactory. Hence, these fourteen patients were not included in this study. The patients who underwent type-1 revision tympanoplasty and those with ear discharge >3 months were not included as well. Sixty one ears of sixty patients (thirty three male and twenty seven female) with follow-up time not less than ten months were included in this study and divided in 2 groups based upon surgical technique performed. Patients in Group-1 experienced ET (endoscopic tympanoplasty, n=32) while patients in Group-2 experienced conservative MT (microscopic tympanoplasty, n=29)

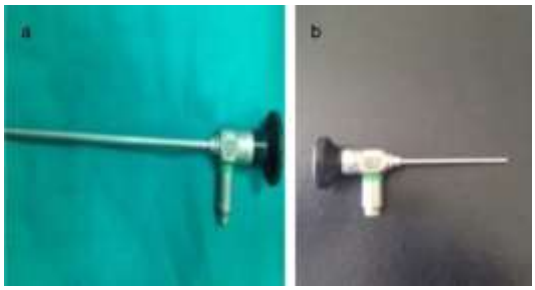
METHODS

Demographic information of patients, pre- and post-op audiometric test outcomes, surgical approach (MT or ET) and surgery time were evaluated. Follow-up assessments were carried out at one, six, and twelve months after surgery. Pure-tone audiometric examinations were carried out and graft status was assessed by otomicroscopy during these visits (Fig.1). The ABGs were assessed among all patients before surgery and at one, six, and twelve months after surgery[6]. Audibility thresholds were calculated at 0.5kHz, 1.0kHz, 2.0kHz, and 4.0kHz, and hearing mean values were computed. Permission was granted by IRB.
Surgical technique: General anesthesia was used among all patients and type-1 tympanoplasty techniques were carried out at LGH, Lahore. Among Group-2 patients, microscope (Opmi VarioS88; Carl Zeiss) was utilized and endaural was the favored technique. After endaural incisions creation, tympanomeatal flap was assessed, tympanic cavity was exposed and required surgical techniques were carried out for TM repair through grafting. Technique included usage of the rebound-shaped temporalis fascia graft (Fig.1)[7].

Among Group-1 patients, surgeries were carried out utilizing rigid endoscopes (2.7 millimeter [6.0 centimeter] and 4.0 millimeter [16.0 centimeter]; Karl Storz, Tuttlingen of Germany) as well as endoscopic system (Karl Storz, Tuttlingen of Germany) (Figure-2). During method, incision was carried out laterally (approximately 6–8 millimeter from tympanic membrane) in external acoustic canal posterior portion. The 2nd incision was carried out superior to first, vertical to tympanic membrane and equivalent to external acoustic canal. To protect inferior link the tympanomeatal flap was uplifted. The tympanic cavity was envisioned and tympanic membrane was mended through grafting.

Fig. 1: Endoscopic tympanoplasty (a) preoperative view (b) perioperative vies (c) postoperative view (d) temporalis fascia graft

Fig. 2: Endoscopes (a) 4-mm (16=cm) endoscope, (b) 2.7-mm (6.0-cm) endoscope



During this approach, graft utilized had identical characteristics as utilized during microscopic technique[7]. Graft was positioned medial to mallet and organized like ''underlayment'' graft (Fig.1).

Endoscopy and otomicroscopy were performed among all patients at one, six and twelve months after surgery. Patients were assessed for audiometric parameters, air–bone gaps and perforations.

RESULTS

Table-1 describes the demographic characteristics of both groups patients and found that among Group-1 patients, mean age was 34.70±2.36 years while the age range was 20 to 50 years. Likewise, among Group-2 patients, mean age was 29.89±2.07 years while the age range was also 20 to 50 years. Insignificant differences were observed in the patients ages between both groups (P value <0.05) as per independent t-test (Table-1).

Result shows that in Group-1, 14(45.2%) patients were male and 17(54.8%) patients were females while in Group-2, 19(65.5%) patients were male and 10(34.5%) patients were females. In both genders, difference between 2 groups was investigated by using chi-square test. An insignificant difference was found with P value 0.113 and chi-square 2.509).

ABG: Among Group-1 patients, pre-op air–bone gaps were 20.40±4.33 decibel while post-op air–bone gaps were 8.12±3.27 decibel. Among Group-2 patients, pre-op air–bone gaps were 21.34±3.90 decibel while post-op air–bone gaps were 8.13±2.43 decibel (Table-1, Fig.3). Among Group-1 & Group-2 patients, difference between pre-op and post-op air-bone gaps was separately investigated through paired t-test, post-op air–bone gap was found significantly less than pre-op air–bone gap (P value ≤0.05) (Table-1). Among both groups patients, difference between pre-op and post-op air-bone gaps were also separately investigated through independent samples t-test, insignificant differences were identified (P value >0.05) (Table-1).

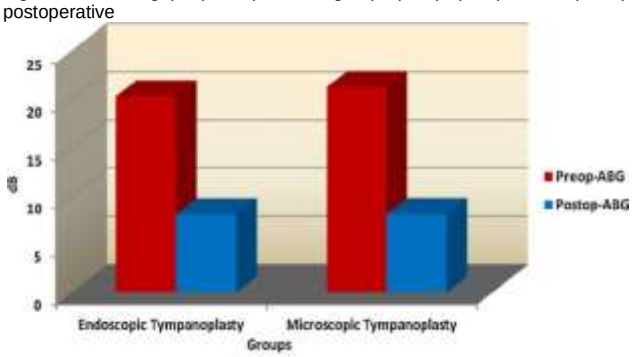
Duration of surgery: Among Group-1 patients, the surgery time was 51.37±5.91 minutes and the range was 40 to 58 minutes) while among Group-2 patients surgery time was 67.03±3.76 minutes and the range was 60 to 77 minutes) (Table-1). As per independent-samples t-test, the surgery time among Group-1 patients was found significantly less than the patients in Group-2 (P value ≤0.05) (Table-1).

Follow-up time range was 10-28 months after surgery. The mean follow-up duration among Group-1 patients was 11.6 and among patients in Group-2 was 16.4 months.

Perforation conditions

Preoperative period: Among Group-1 patients, 21(65.6%) were found with large perforations (above 50% of tympanic membrane area), while 11(34.4%) patients were found with small perforations (less than 50% of tympanic membrane area). Out of 21 patients who had large perforations, 15(46.9%) had perforation like kidney-type comprising anteroinferior part, posteroinferior part as well as central part of tympanic membrane, however, 6(18.8%) patients were found with central perforations. Out of 11 patients who had small perforations, 9(28.1%) and 2(6.2%) patients had anteroinferior quadrant and central perforations, respectively.

Fig. 3: Air-borne gaps (ABGs) in both groups preop, preoperative, postop: postoperative



Preop: Preoperative, Postop: Postoperative

Among Group-2 patients, 17(58.6%) were found with large perforations (above 50% of tympanic membrane area), while 12(41.3%) patients were found with small perforations (less than 50% of tympanic membrane area). Out of 17 patients who had large perforations, 9(31%) had perforation like kidney-type comprising anteroinferior part, posteroinferior part as well as central part of tympanic membrane, however, 8(27.5%) patients were found with central perforations. Out of 12 patients who had small perforations, 10(34%), 1(3.5%) and 1(3.5%) patient had anteroinferior quadrant, posterosuperior quadrant and central perforations, respectively.

Postoperative period: Among Group-1 patients, perforations were identified among 2(6.25%) patients at one month follow-up, among 4(12.5%) patients at six month follow-up, among 4(12.5%) patients at twelve month follow-up. At 12 month follow-up, 1(25%) and 3(75%) patients were found with posterosuperior quadrant and central perforation, respectively. All the post-op perforations among patients were observed small (less than 50% of tympanic membrane area).

Among Group-2 patients, perforations were identified in 2(5.71%) patients at one month, six month and twelve months follow-ups. 100% (2) patients at follow-up of 12 month follow-up had perforation of posterosuperior quadrant, however, both were found small (less than 50% of tympanic membrane area). At twelve months after surgery, the condition of perforation in both groups was analyzed and insignificant difference was found (P value >0.05).

Associations among several patient & surgical factors: Associations in gender, age, operative technique, pre-op & post-op ABGs, surgery time as well as condition of graft were evaluated using Pearson's correlation/Spearman's correlation rho efficient tests (Table-2). As the preop ABG enhanced, the postop ABG enhanced as well (p <0.05). The surgery time was less among patients of Group-1 than Group-2 (P value <0.05).

Factors affecting post-op air–bone gap were affected by backward linear regression test. Covariates were patient's age, operative technique, pre-op air–bone gap, surgery time and condition of graft. As preop ABG enhanced, postop ABG enhanced as well (P value=0.021, beta=0.295).

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Table 1:

	Endoscopic Tympanoplasty (Group 1) (n=32)			Microscopic Tympanoplasty (Group 2) (n=32)			t	p
	Mean SD	Min	Max	Mean SD	Min	Max	t	p
Age in yrs	34.70 2.36	22.00	49.00	29.89 2.07	20.00	50.00	0.890	0.377
ABG (decibel) Pre op	20.40 4.33	10.00	30.00	21.34 3.90	15.00	30.00	0.885	0.380
Post op	8.12 3.27	5.00	15.00	8.13 2.43	5;00	15.00	0.017	0.986
p**	p = 0.000, t = 18.473			p = 0.000, t = 14.775				
Surgery time (minutes)	51.37 5.91 40.00		58.00	67.03 3.76 60.00		77.00	12.193	0.000
Graft condition	n		%	n		%		p***
Graft Perforated	4		12.5	2		6.9		p =0.467
Healthy (non perforated)	28		87.5	27		93.1		X^2 = 0.530

P-value by -independent-samples t-test. ** -paired t-test. *** -chi-squared test

Table 2: Correlation test results.

Gender	Age	Group		Airborne gap		Operation duration	Graft condition
				Pre op*	Postop*		
Gender** r		0.118	0.218	0.028	0.191	0.177	0.027
P		0.363	0.091	0.833	0.140	0.172	0.835
Age* r	0.118		0.115	0.017	0.186	0.030	0.122
P	0.363		0.377	0.895	0.151	0.819	0.348
Group* r	0.218	0.115		0.114	0.002	0.846	0.094
P	0.091	0.377		0.380	0.986	0.000	0.471
ABG Preop* r	0.028	0.017	0.114		0.295	0.192	0.181
P	0.833	0.895	0.380		0.021	0.138	0.163
Postop* r	0.191	0.186	0.002	0.295		0.017	0.006
P	0.140	0.151	0.986	0.021		0.896	0.960
Surgery time* r	0.177	0.030	0.846	0.192	0.017		0.080
P	0.172	0.819	0.000	0.138	0.896		0.540
Condition of graft ** r	0.027	0.122	0.094	0.181	0.006	0.080	
P	0.835	0.348	0.471	0.163	0.960	0.540	

*P-value by -Pearson's correlation test** -Spearman's correlation rho efficient test.

Factors affecting surgery time were affected by backward linear regression test. Covariates were patient's age, operative technique, pre- & post-op ABGs and condition of graft. The surgery time was less among patients in Group-1 than Group-2 (P value=0.000, beta=0.846).

DISCUSSION

During CSOM treatment, main aim is to attain symptomatic relief, alleviate drainage, reduce complications and rehabilitate hearing. Meeting these objectives is mostly significant among adults who have CSOM because these patients could develop deafness because of CSOM, mostly those patients whose both ears have been affected during early adulthood. An efficient therapy of CSOM has great significance in improving the communication as well as making patients overall life quality better[8,9].

Numerous surgical techniques and medical treatments of CSOM are available. Several factors play important role in surgery outcome such as disease condition, skills of surgeon, patient age and health facility where surgery is performed. Approach to CSOM during adulthood is trending to application of the minimally invasive surgeries (MIS) under suitable conditions[10].

During tympanoplasty, several materials are utilize for TM repair[11]. During current years, temporalis fascia grafts utilization has been common and is applied most commonly among patients with CSOM[12]. During this study, boomerang temporalis fascia grafts was applied[7].

Under surgical microscope, most of the ENT surgeons carry out tympanoplasty. Although, in spite of offering direct exposure, microscopy during surgery could be deficient in viewing specific areas. However, no exposure issues are found in posterior as well as inferior parts, there could be exposure issues due to eminence of anterior wall. Under microscope, the hidden areas that are unable to observe could be seen better through rigid & thin endoscopes with varied angles. During endoscopic tympanoplasty (ET) technique, a rigid & thin endoscope permits for functional rebuilding during surgical treatment and performance of MIS and conventional surgical treatment with anatomy protection[13].

During the middle ear surgical treatment, main benefit of the endoscopic surgical treatments is reduction in surgery time. Endoscopic technique offers equal outcomes to microscopic technique regarding pain level, dressing need and cosmetic appearance. Though, this technique has numerous drawbacks comprising insufficient microscopic enlargement & focus, requirement to carry out one-handed surgeries as surgeon must utilize his one hand to grip the endoscope, common surgical site infection due to bleeding and crowding of instrument in surgical area[14].

A study done by Karhuketo and coworkers[15] reported that endoscopic methods utilization during ear operation fulfills MIS requirements and minimum trauma to common tissue could be attain in this manner. Lade and colleagues[16] carried out a study in which sixty patients were compared experiencing type-1 tympanoplasty (myringoplasty) utilizing either a endoscopic technique or microscopic procedure. Out of thirty patients who experienced microscopic technique, canalplasty was carried out to assess ossicular system among five patients while external auditory canal (EAC) curettage among four patients. Though, no any patient among those thirty patients who experienced endoscopic technique needed such interventions, and ossicular system may easily be evaluated. Authors concluded that ET outcomes are comparable with MT (microscopic tympanoplasty), however, ET is observed more tolerable regarding cosmetic appearance. Therefore, this method was believed a potential alternate to MT (post-aural approach). During this study, similar results were obtain to those of Lade and colleagues[16].

During post-aural approach microscopic technique, chordal crest curettage was carried out to evaluate ossicular system while in only one patient, the canalplasty was carried out because of anterior wall eminence. Although, the patients who experienced endoscopic transcanal technique needed no additional interventions involving EAC.

A study done by Ayache[17] demonstrated that success rate of graft was 96% among patients experiencing endoscopic transcanal cartilage tympanoplasty while this method was reported as safe, effective and minimally invasive treatment technique. The current study confirmed that success rate of graft was 87.5% in ET procedure.

Gasline and teammates[18] conducted conservative microscopic technique for grafting of cartilage among 42 patients aged 3 to 16 years and the success rate of graft was 83.3%. A study performed by Albirmawy[12] indicated that success rate of cartilage graft was 95% among 82 adults. In another study undertaken by Nevoux and fellows[19] confirmed that among 268 patients success rate of cartilage tympanoplasty was 87.3%. The success rate of graft in our study was 87.5% among thirty two patients who experienced endoscopic technique and 94.3% among those who experienced microscopic technique (post-aural approach).

Hearing gain after surgery is considered a significant marker among patients regarding treatment success who have experienced tympanoplasty. Particularly among patients, the hearing gain is significant regarding future life quality. Several researcher have demonstrated successful outcomes for hearing gain among these patients after surgery. Friedman and comrades[20] carried out type-1 tympanoplasty among 119 patients. Utilizing cartilage grafts, pre-op & post-op ABGs were computed to be 20.7 decibel and 8.5 decibel, respectively. Yilmaz and companions[21] indicated in their study that before surgery ABGs were observed 30.6 decibel while after surgery were 17.8 decibel among forty five patients who experienced type-I cartilage tympanoplasty. During our research, pre-op & post-op air–bone gaps were 20.40 decibel & 8.12 decibel, respectively, among patients in ET group 21.34 decibel and 8.13 decibel, respectively, among patients in MT group.

Surgery time is a significant parameter regarding anesthesia duration, concentration of surgeon and iatrogenic complications enhanced risk. Ghaffar and associates[22] reported in their study that in 34 patients mean surgery time was 62.85 minutes who experienced ET. Among these patients, 24 patients had surgery time <60 minutes.

In our research, surgery time in 26 respondents who experienced endoscopic transcanal tympanoplasty was <60 minutes while mean surgery time in 32 who experienced ET was 51.37 minutes. The mean surgery time was 69.03 minutes for preferred technique utilizing microscopes. For the differences, reason could be associated with fact that neither the suturing nor the additional time to observe the obscured areas is required during the endoscopic techniques.

CONCLUSION

Among patients experiencing type-1 tympanoplasty, particularly if external acoustic meatus is narrow and anterior canal wall is protuberant, endoscopic technique seems to offer results equivalent to microscopic technique (post-aural approach) for TM entire visualization while lack of additional interventions needed to assess the ossicular system.

Conflict of interest: No clash of interest was declared by authors.

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