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Research Article

A Comparative Study of Circumferential Elevation of Tympanomeatal Flap and Conventional Tympanomeatal Flap Elevation Underlay Technique in Subtotal Perforation

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Abstract

Background: Chronic Otitis Media is defined as chronic inflammation of middle ear and mastoid cavity, which presents with recurrent ear discharge through tympanic membrane perforation. Most commonly caused by infections of middle ear, other causes are trauma and iatrogenic. Majority of the perforations are small and heal spontaneously, however; recurrent infections result in chronic perforation in which medical/conservative intervention is ineffective. Therefore, surgery i.e. Tympanoplasty is best modality of treatment. Type 1 tympanoplasty refers to repair of TM without altering the ossicular chain, includes exploration of middle ear to inspect and ensure normality of ossicles. The most commonly used graft material is temporalis fascia graft.

Objectives of Study

- Evaluation of hearing improvement in patients undergoing tympanoplasty with circumferential tympanomeatal flap elevation and conventional tympanomeatal underlay technique.
- To compare the incidence of graft uptake by circumferential tympanomeatal flap elevation and conventional tympanomeatal underlay technique.
- To study the incidence of post operative complications if any in both groups

Methods: 90 patients presenting with Chronic Otitis Media in ENT OPD at Vydehi Institute of Medical Sciences and Research Centre, Bangalore. Preoperative audiometry was documented. All 90 patients underwent type 1 Tympanoplasty. post operative audiometry and graft uptake. And the outcome of results of tympanoplasty with circumferential tympanomeatal flap elevation and conventional tympanomeatal underlay technique

Results: Our study revealed that type 1 tympanoplasty had equal success rates i.e. 95.6% patients in circumferential TM flap elevation technique group and 91.1% in conventional TM flap elevation technique group, in terms of graft up take and hearing improvement i.e., Hearing gain of more than 10 dB group was seen in 37 patients, 17 (37.8%) in conventional TM flap group and 20 (44.4%) in circumferential TM flap group. Hearing gain of less than 10 dB group was seen in 53 patients, 28 (62.2%) in conventional TM flap group and 25 (55.6%) in circumferential TM flap group. Most of the patients in both the groups had nil post- operative complications.

Conclusion: Taking into account the observations of our study and weigh against with similar studies we conclude that there will be equal success rates, in terms of graft up take and hearing improvement, whether it is conventional tympanomeatal flap elevation technique or circumferential tympanomeatal flap elevation technique underlay technique in subtotal perforation. The results of this study benefits the surgeon to make a choice to operate with conventional tympanomeatal flap elevation technique to get an equally prosperous result as comparable to circumferential tympanomeatal flap elevation technique.

Keywords: Chronic Otitis Media; Tympanoplasty; Temporalis Fascia Graft; Audiometry

Abbreviations

B/L: Bilateral; COM: Chronic Otitis Media; CN: Cranial Nerve; CTN: Chorda Tympani Nerve; CT scan: Computerized Tomography Scan; dB: Decibel; EAC: External Auditory Canal; ECG: Electrocardiogram; E.N.T: Ear Nose Throat;ET: Eustachian Tube; HBsAg: Hepatitis B Virus surface Antigen; HCV: Hepatitis C Virus; MEM: Middle Ear Mucosa; PTA: Pure Tone Audiometry; TM: Tympanic Membrane

Introduction

Hearing impairment is considered as a burden in society, as it affects an individual in terms of emotional, social and physical wellbeing. Reduced hearing could be due to congenital or acquired etiologies. One of the most common etiology of hearing impairment among acquired disorders ischronic otitis media (COM) which is both preventable and correctable.

Chronic otitis media (COM) is defined as a chronic inflammation of the middle ear and mastoid cavity, which presents with recurrent ear discharges or otorrhoea through a tympanic membrane perforation. Prevalence surveys show that the global burden of illness from COM involves 65-330 million individuals with draining ears, 60% of whom (39-200 million) suffer from significant hearing impairment. COM accounts for 28000 deaths and a disease burden of over 2 million DALYs [1].

Chronic suppurative otitis media is the most common disease presenting to ent OPD, and has a significant morbidity rate, most commonly seen within lower socio- economic class.

The most common cause for TM perforation is by infections of the middle ear, Other causes are trauma, and iatrogenic. The perforations caused due to infection are small and heal spontaneously; however, recurrent infections may impair the regenerative process and result in a chronic perforation in which medical or conservative intervention is ineffective. Therefore, surgical intervention i.e. Tympanoplasty is the best modality of treatment.

Repair of tympanic membrane perforation was attempted since as early as in the seventeenth Century [2].

The repair of the TM without altering the ossicular system is termed as Type 1 tympanoplasty. The procedure includes exploration of the middle ear to inspect and ensure normality of the ossicles.[3]Different graft materials like tragal perichondrium, temporalis fascia, fascia lata, split thickness skin graft and vein graft were used for tympanoplasty with varying success rates.

Temporalis fascia as a graft material is the main stay in reconstruction of perforated tympanic membrane in all cases which was first used by Heermann in 1958. The graft uptake with temporalis fascia graft range between 93- 97%, Regardless of the technique employed [2].

The most commonly used autogenous graft material is Temporalis fascia.It was used first in myringoplasty by Ortegren (1958-59), Heerman (1961) and Storss (1961). It is very popular for several reasons: 1] it is available in the same site of post aural incision and easy to harvest 2] it can be used as an overlay or underlay graft 3] Required amount of graft can be harvested. Several authors have suggested that temporalis fascia should be replaced by perichondrium or strengthened by cartilage, as the temporalis fascia can eventually become thin and atrophic leading to reperforation 4]. Some surgeons harvest temporalis fascia at the end of the procedure and use when it is still wet (soft).Some surgeons prefer to harvest temporalis fascia at the beginning of surgical procedure and use it when it becomes dry (rigid).

Underlay and overlay techniques refer to the placement of the graft material either medial or lateral to the annulus [4]. Elevation of tympanomeatal flap with placement of temporalis fascia graft is crucial for successful uptake of graft. In the past various Tympanomeatal flaps have been designed for reconstruction of the subtotal perforations to overcome the poor success rate.

Circumferential elevation of tympanomeatal flap and underlay graft placement is thought to be a good surgical technique as it ensures elevation of canal skin Over the Eustachian tube area to form a good assemble between the temporalis graft and the flap to increase the success rate. Since the introduction of tympanoplasty, there has been many modifications in terms of technique ,approach and materials used for grafting the tympanic membrane; each with their respective advantages and disadvantages. But irrespective of procedure done very large and subtotal perforation have always posed a problem with failure after surgery [3].

In this study we are comparing the graft uptake, hearing Improvement after 3 months post operatively In circumferential tympanomeatal flap tympanoplasty and conventional tympanomeatal flap in subtotal perforation.

Materials and Methods

- **Source of data:** The study was conducted on admitted patients in the Department of ENT, Vydehi Institute of Medical Sciences and Research Centre, Whitefield, Bangalore, Karnataka.
- **Sample size:** 90.
- Method of collection of data
- **Study Design**: Prospective clinical study.

Inclusion criteria

- Patients above 16 years of age, of both male and female sex
- Patients with subtotal central perforations
- Patients having mild to moderate conductive hearing loss
- Written informed consent from the patient.

Exclusion criteria

- Age less than 16 years
- Patients with attic perforation or cholesteatoma
- Medical contraindications to undergo surgery.
- Patients undergoing revision tympanoplasty
- CSOM with complications (Intracranial and Intra-temporal)
- Patients with sensorineural hearing loss.

Methodology

After obtaining approval from Vydehi Institute of Medical Sciences and Research Center Ethics Committee and written informed patient consent, 90 patients aged 16 years and older undergoing Tympanoplasty in Vydehi Institute of Medical Sciences and Research Centre were included in this prospective study.

The patients selected into Circumferential and Conventional Tympanomeatal elevation groups by computer generated randomization table.

The selected patients are subjected to detailed clinical examination, audiological evaluation and laboratory Investigation carried out preoperatively:

- Detailed history of patient, General and systemic examination of patient.
- Examination of ear under microscope was done.
- Hearing evaluation (PTA) done by audiometry.
- Relevant Laboratory investigation including Hb, RBS, Serum. creatinine, Blood Urea, X-ray mastoids, Chest x-ray and ECG.
- All patients underwent tympanoplasty with tympanic membrane grafting using temporalis fascia graft placed underlay technique.
- Follow up of patients in postoperative period on 3rd month to determine the graft.

After a thorough pre-anaesthetic evaluation, an informed written consent was obtained from all patients selected for the study. Patients who did not consent for the procedure, patients who have undergone previous surgery, those below 16 years of age, patients with attic perforation or cholesteatoma and complications of COM were excluded from the study.

Duration of study

Prospective study from September 2019 to August 2021.

Surgical technique

Type 1 tympanoplasty

Premedication

- The patient is premedicated 30 minutes prior to the procedure with Phenergan 50 mg, Atropine 0.5 mg and Pethidine (according to weight - 1 mg/kg body weight) given intramuscularly.
- All procedures were performed under Local Anesthesia.
- Position of the Patient: Patient placed in supine position with head partially rotated to the opposite side.

Local anesthetic solution consisting of 15 ml 2% lignocaine with 0.4 ml adrenaline and 10 ml of distilled water was used for Infiltration. Post-aural and canal infiltration was given.

- Postaural William Wilde's incision was used in all cases.
- Temporalis fascia graft was harvested through the same incision.
- After obtaining the graft, it was teased to remove excessive muscle fibres, fat and fibrous tissue.
- After obtaining the graft, It was placed on a small stainless steel cup and was teased to remove excessive muscle fibres, fat and fibrous tissue (Figure) using an elevator or back of the knife until it forms a thin uniform layer.
- Another small stainless steel cup is filled with hot boiling water and the cup with graft is placed over it until it became rigid at room temperature [15].
- Periosteum over the mastoid cortex incised and mastoid cortex is exposed.
- Then posterior wall of external auditory canal incised.
- After freshening the margins of Tympanic membrane perforation, gentle scraping of undersurface of remnant of TM was done.
- Canal incision was given at bony cartilaginous junction from 12o' clock position to 6o' clock position (conventional technique) is followed in 45 patients (out of total 90 patients)
- Circumferential tympanomeatal flap along with fibrous annulus was elevated all around from bony annulus, keeping it pedicled at 11-12O clock position in another 45 patients (out of total 90 patients). The flap anterior to handle of malleus was cut and released.
- Middle ear was inspected and the ossicular chain status was checked.

- Temporalis fascia graft was placed underlay technique.
- And stablised with gelfoam.
- The tympanomeatal flap positioned back in place.
- Entire graft and flap assembly is reflected forwards and the middle ear is packed with gelfoam. EAC also packed with same gelfoam.
- Periosteal incision and skin Incision was closed using 3.0-mersilk suture material.
- Mastoid dressing applied.

Post-operative treatment and follow up

- Post operatively intravenous antibiotics for 3 days and followed by oral antibiotic and antihistaminic for a period of 2 weeks.
- Mastoid dressings changed on 2nd postoperative day, sutures were removed on 7th postoperative day.
- Aural pack was removed on the 21st day and there after asked to instill topical antibiotics drops for period of 3 to 4 weeks.
- All patients are followed up in OPD every 2-week for period of 3 months.
- Oto-microscopy was done to assess the graft status.

All patients underwent post op PTA to asses hearing gain at 3rd month.

- Documentation of complications like bleeding, loss or abnormal taste and Graft rejection or failure were noted.

Statistical analysis

- Statistical Package for Social Sciences [SPSS] for Windows Version 22.0 Released 2013.
- Armonk, NY: IBM Corp., will be used to perform statistical analyses.

Descriptive statistics

Descriptive analysis of all the explanatory and outcome parameters will be done using frequency and proportions for categorical variables, whereas in Mean & SD for continuous variables.

Inferential statistics

- Chi Square Test was used to compare different study variables with categorical data Conventional to circumferential tympanomeatal flap elevation groups.
- Mann Whitney Test was used to compare the mean PTA scores and mean PTA Gain (in db) during Postoperative period between Conventional to circumferential tympanomeatal flap elevation during Pre and Post-OP time intervals.

Results and Discussion

In our study, we have compared two groups of patients with conventional tympanomeatal flap elevation and circumferential tympanomeatal flap elevation with 45 cases in each group.

Gender

In our study, out of 90 patients, 52 were male and 38 were females. conventional tympanomeatal flap elevation group included 26 (57.8%) male and 19 (42.2%) female patients. circumferential tympanomeatal flap elevation group, there were 26 (57.8%) males and 19 (42.2%) were female.

In the study conducted by S S Rulania., *et al*. total of 100 patients 66 were males and 34 were female. In the circumferential tympanomeatal flap elevation group comprised of 50, there were 35 males (70%) and 15 females (30%). In the conventional tympanomeatal flap elevation group, there were 31 males (62%) and 19 females (38%).

Age

Patients between the age group of 18 to 60 years were included in this study. In conventional tympanomeatal flap elevation group 3 patients were above 50 years (6.7%) of age, 4 patients were between age group of 41-50 years (8.9%) and 16 patients in 31-40 years (35.6%), 22 patients in the age group 21-30 years (48.9%).

In circumferentiall tympanomeatal flap elevation group, 1 patient was above 50 years (2.2%) of age, 7 patients were between age group of 41-50 years (15.6%) and 14 patients in 31-40 years (31.1%), 23 patients in the age group 21-30 years (51.1%).

The study conducted by S S Rulania., *et al*. done in 2021 observed majority were between the age group of 20 to 25 (68%) and 26 to 30 (17%) and 8% were in the age group of 31-35 years and 7 were above 35 year.

Laterality

In our study Right sided disease is seen in 16 patients (35.6%) in conventional technique of TM flap group and in 13 patients (28.9%) in circumferential technique of TM flap group. Left sided disease is noted in 21 patients which amounts to 46.7% in conventional technique of TM flap group and 24 (53.3%) in circumferential technique of TM flap group. Bilateral disease noted in 8 patients (17.8%) in conventional technique of TM flap group and 8 patients (17.8%) in circumferential technique of TM flap group.

In a study by Kumar., *et al*. unilateral involvement of ears in the entire study was seen in 72%, while bilateral involvement is in 28%.

Duration of discharge

Majority of the patients in this study show the duration of discharge less than 5 years.

Amounting to 20% that is 9 patients having the disease for less than 1 year in conventional technique of TM flap elevation group and 11 patients (24.4%) in circumferential technique of TM flap elevation group. 16 Patients (44.4%) having discharge for 1-5 years in conventional technique of TM flap elevation group and 20 patients (33.3%) in circumferential technique of TM flap elevation group. 12 patients (26.7%) had disease for 5-10 years in conventional technique of TM flap elevation group and 11 patient (24.4%) circumferential technique of TM flap elevation group. 8 patients (17.8%) in conventional technique of TM flap elevation group and patients 3 (6.7%) in circumferential technique of TM flap elevation group have a diseased for more than 10 years.

Pre-operative ear pain

Pre operatively total of 4 patients complained of ear pain, 2 (4.4%) patient from conventional technique of TM flap elevation and 2 (4.4%) circumferntional technique of TM flap elevation.

Pre-operative giddiness

Pre operatively total of 4 patients complained of giddiness, 3 (6.7%) patient from conventional technique of TM flap elevation and 1 (2.2%) circumferntional technique of TM flap elevation.

Pre-operative tinnitus

Pre operatively total of 8 patients complained of tinnitus 4 (8.9%) patient from conventional technique of TM flap elevation and 4 (8.9%) circumferntional technique of TM flap elevation.

Ossicles involved

In Majority of the patients all 3 ossicles were intact/present that is in a total of 74 patients, out of which 37 patients (82.2%) underwent conventional technique of TM flap and 37 patients (82.2%) underwent circumferential technique of TM flap In 16 patients only incus was absent, out of which 8 patients (17.8%) underwent conventional technique of TM flap and 8 patients (17.8%) underwent circumferential technique of TM flap group.

In this study it was observed that status of ossicles did not influence both conventional and circumferential tympanomeatal flap elevation technique in temporalis fascia graft uptake.

Middle ear mucosa

In our study most of the cases had Normal middle ear mucosa, 34 patients (75.6%) in conventional technique of TM flap elevation group and 34 patients (75.6%) in circumferential technique of TM flap elevation group.

9 patients had Hypertrophic middle ear mucosa, out of which 5 patients (11.1%) underwent conventional technique of TM flap elevation, rest 4 patients (8.9%) underwent circumferential technique of TM flap elevation.

13 patients had Edematous middle ear mucosa, 6 patient (13.3%) underwent conventional technique of TM flap elevation and 7 patients (15.6%) underwent circumferential technique of TM flap elevation.

In our study it has been observed that irrespective of the nature of the tympanomeatal flap elevation, all 5 patients with inflamed or edematous middle ear mucosa, 3 patients in conventional tm flap elevation technique and 2 patients circumferential tm flap elevation technique group had graft failure.

Pre-operative audiometry

Pure tone audiometric evaluation was done and hearing loss was assessed. 4 (8.9) patients had normal Hearing, 30 (66.7%) patients with mild hearing loss, 11 patients (24.4%) with moderate hearing loss and no patient with severe hearing loss in conventional technique of TM flap elevation 5 patients (11.1%) had Normal hearing, 32 (71.1%) patients had mild hearing loss, 8 (17.8%) patients with moderate hearing loss and no patients with severe hearing loss in wet circumferential technique of TM flap elevation group.

This shows that majority of patients will have mild to moderate hearing loss.

In a similar study by Maharjan M., *et al*. done on 2009 in which majority had mild hearing loss (34.37%), moderate hearing loss (52.94%) and severe hearing loss (12.6%) which is comparable to our study that the majority of patients were having mild to moderate hearing loss.

Pre-operative degree of hearing loss

Degree of hearing loss evaluation was done and hearing loss was assessed.4 (8.9) patients had normal Hearing, 30 (66.7%) patients with mild hearing loss, 11 patients (24.4%) with moderate hearing loss and no patient with severe hearing loss in conventional technique of TM flap elevation 5 patients (11.1%) had Normal hearing, 31 (68.9%) patients had mild hearing loss, 9 (20%) patients with moderate hearing loss and no patients with severe hearing loss in wet circumferential technique of TM flap elevation group.

Type of hearing loss

Type of hearing loss evaluation was done and assessed. 42 (93.3%) patients had conductive Hearing loss, 3 (6.7%) patients

had mixed hearing loss in conventional technique of TM flap elevation 43 patients (95.6%) had conductive hearing loss. 2 (4.4%) patients had mixed hearing loss, in circumferential technique of TM flap elevation group.

Comparison of post-operative audiological assesment

Pure tone audiometric evaluation done post operatively 3 months after surgery to assess hearing improvement. There was an improvement in hearing in majority of patients, 23 patients (51.1%) had >25 db hearing gain in conventional technique of TM flap elevation, 9 patients (20%) had >25 db hearing gain circumferential technique of TM elevation group and 22 patients (48.9%) had a hearing gain of <25 db in conventional technique of TM flap elevation,36 patients (80%) in circumferential technique of TM flap elevation group.

Post-operative hearing gain group

Pure tone audiometric gain group evaluation done post operatively 3 months after surgery to assess hearing improvement. There was an improvement in hearing in majority of patients, 17 patients (37.8%) had >10 db hearing gain group in conventional technique of TM flap elevation, 20 patients (44.4%) had >10 db hearing gain group in circumferential technique of TM elevation group and 28 patients (62.2%) had a hearing gain of <10 db group in conventional technique of TM flap elevation, 25 patients (55.6%) in circumferential technique of TM flap elevation group.

Total 37 patients (41.1%) belongs to >10 db gain group and 53 (58.9%) patients belongs to <10 db gain group.

Comparison of graft uptake

In this study during postoperative follow up by otomicroscopy examination after one month showed intact graft in 41 (91.1%) patients in conventional technique of TM flap elevation group and 43 (95.6%) patients in circumferential technique of TM flap elevation group graft group.

4 patients (8.9%) in conventional technique of TM flap elevation group and 2 (4.4%) patient in conventional technique of TM flap elevation group showed residual perforation/graft failure.

Conventional Circumferential			**Technique of TM flap elevation**		**Total**
Side	Right	Count	16	13	29
		% within technique of TM flap elevation	35.6%	28.9%	32.2%
	Left	Count	21	24	45
		% within technique of TM flap elevation	46.7%	53.3%	50.0%
	Bilateral	Count	8	8	16
		% within technique of TM flap elevation	17.8%	17.8%	17.8%
Total		Count	45	45	90
% within technique of TM flap elevation		100.0%	100.0%	100.0%	

Table 1: Comparison of side of ear affected.

Conventional Circumferential			**Technique of TM flap elevation**		**Total**
Age group	21-30	Count	22	23	45
		% within technique of TM flap elevation	48.9%	51.1%	50.0%
	31-40	Count	16	14	30
		% within technique of TM flap elevation	35.6%	31.1%	33.3%
	41-50	Count	4	7	11
		% within technique of TM flap elevation	8.9%	15.6%	12.2%
	>50	Count	3	1	4
		% within technique of TM flap elevation	6.7%	2.2%	4.4%
Total		Count	45	45	90
% within technique of TM flap elevation		100.0%	100.0%	100.0%	

Table 2: Distribution of age of the patients.

Conventional Circumferential			Technique of TM flap elevation		Total
Duration	1	Count	9	11	20
		% within technique of TM flap elevation	20.0%	24.4%	22.2%
	2	Count	16	20	36
		% within technique of TM flap elevation	35.6%	44.4%	40.0%
	3	Count	12	11	23
		% within technique of TM flap elevation	26.7%	24.4%	25.6%
	4	Count	8	3	11
		% within technique of TM flap elevation	17.8%	6.7%	12.2%
Total		Count	45	45	90
% within technique of TM flap elevation		100.0%	100.0%	100.0%	

Table 3: Comparison of duration (in years) among the 2 group.

Conventional Circumferential			Technique of TM flap elevation		Total
Ossicles	No incus	Count	8	8	16
		% within technique of TM flap elevation	17.8%	17.8%	17.8%
	All intact	Count	37	37	74
		% within technique of TM flap elevation	82.2%	82.2%	82.2%
Total		Count	45	45	90
% within technique of TM flap elevation		100.0%	100.0%	100.0%	

Table 4

Conventional Circumferential			Technique of TM flap elevation	
Middle ear mucosa	Edemateous	Count	6	7
		% within technique of TM flap elevation	13.3%	15.6%
	Hypertrophy	Count	5	4
		% within technique of TM flap elevation	11.1%	8.9%
	Normal	Count	34	34
		% within technique of TM flap elevation	75.6%	75.6%
Total		Count	45	45
% within technique of TM flap elevation		100.0%	100.0%	

Table 5: Comparison of Middle Ear Mucosal Status between 2 groups.

Conventional Circumferential			Technique of TM flap elevation		Total
Pre op PTA(db)	Normal	Count	4	5	9
		% within technique of TM flap elevation	8.9%	11.1%	10.0%
	Mild	Count	30	32	62
		% within technique of TM flap elevation	66.7%	71.1%	68.9%
	Moderate	Count	11	8	19
		% within technique of TM flap elevation	24.4%	17.8%	21.1%
Total		Count	45	45	90
% within technique of TM flap elevation		100.0%	100.0%	100.0%	

Table 6: Comparison of pre-operative pure tone audiometry.

Conventional Circumferential			Technique of TM flap elevation		Total
Type of hearing loss	chl	Count	42	43	85
		% within technique of TM flap elevation	93.3%	95.6%	94.4%
	mhl	Count	3	2	5
		% within technique of TM flap elevation	6.7%	4.4%	5.6%
Total		Count	45	45	90
% within technique of TM flap elevation		100.0%	100.0%	100.0%	

Table 7: Comparison of type of hearing loss.

Conventional Circumferential			Technique of TM flap elevation		Total
Post op PTA	<25	Count	22	36	58
		% within technique of TM flap elevation	48.9%	80.0%	64.4%
	>25	Count	23	9	32
		% within technique of TM flap elevation	51.1%	20.0%	35.6%
Total		Count	45	45	90
% within technique of TM flap elevation		100.0%	100.0%	100.0%	

Table 8: Comparison of post-operative pure tone audiometry.

Conventional Circumferential			Technique of TM flap elevation		Total
PTA gain	<15	Count	38	34	72
		% within technique of TM flap elevation	84.4%	75.6%	80.0%
	>15	Count	7	11	18
		% within technique of TM flap elevation	15.6%	24.4%	20.0%
Total		Count	45	45	90
% within technique of TM flap elevation		100.0%	100.0%	100.0%	

Table 9: Comparison of post-operative hearing gain.

Conventional Circumferential			Technique of TM flap elevation		Total
Graft uptake	Intact	Count	41	43	84
		% within technique of TM flap elevation	91.1%	95.6%	93.3%
	Failure	Count	4	2	6
		% within technique of TM flap elevation	8.9%	4.4%	6.7%
Total		Count	45	45	90
% within technique of TM flap elevation		100.0%	100.0%	100.0%	

Table 10: Comparison of graft uptake.

Conventional Circumferential			Technique of TM flap elevation	
Complications	Abnormal taste	Count	1	1
		% within technique of TM flap elevation	2.2%	2.2%
	Bleeding	Count	1	3
		% within technique of TM flap elevation	2.2%	6.7%
	Graft failure	Count	3	2
		% within technique of TM flap elevation	6.7%	4.4%
	Nil	Count	40	39
		% within technique of TM flap elevation	88.9%	86.7%
Total		Count	45	45
% within technique of TM flap elevation		100.0%	100.0%	

Table 11: Comparison of post-operative complications.

Figure 1: Wet Temporalis fascia graft.

Figure 3: Incision for Conventional tympanomeatal flap elevation.

Figure 2: Dry Temporalis fascia graft.

Figure 4: Incision for Circumferential tympanomeatal flap elevation.

Conclusion

Taking into account the observations of our study and weigh against with similar studies we conclude that there will be equal success rates, in terms of graft up take and hearing improvement, whether it is conventional tympanomeatal flap elevation technique or circumferential tympanomeatal flap elevation technique underlay technique in subtotal perforation.

The results of this study benefits the surgeon to make a choice to operate with conventional tympanomeatal flap elevation technique to get an equally prosperous result as comparable to circumferential tympanomeatal flap elevation technique.

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