



USE OF PLATELET RICH FIBRIN IN REPAIR OF SMALL, NON-HEALING TRAUMATIC PERFORATIONS OF TYMPANIC MEMBRANE

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INTRODUCTION

The tympanic membrane (TM) is a delicate translucent fibrous membrane that separates the external ear from the middle ear, and serves as an integral part of the tympano-ossicular system for sound transmission. TM perforation is a common presentation in the ENT clinic and can result from various causes such as trauma, infections of the middle ear and malignant tumours of the ear.¹ Traumatic perforations often develop because of a slap injury, blast injury, accident, sporting injury, or instrumental injury, and 53–94% recover spontaneously¹⁻⁷. Although the rates of closure of traumatic TM perforation are favourable, some otolaryngologists prefer immediate microsurgical procedures to expedite the recovery process. Albeit most traumatic TM perforations heal spontaneously, some cases can result in persistent perforation and hearing loss.⁸

TM injury can predispose to middle ear infections which in turn can result in serious complications such as facial nerve paralysis, formation of cholesteatoma, perilymph fistula, intracranial infections and may require ear and intracranial exploration. Significant morbidity or mortality can occur when traumatic ear injuries are associated with damage to contiguous facial structures and the brain. Effective management is desirable while prevention and reduction of complications must be given utmost attention to achieve a good outcome.⁹

Non-healing perforations typically require tympanoplasty for closure. Medical costs associated with tympanoplasty have recently led investigators to search for less expensive, less invasive and simple nonsurgical methods that are OPD-based and do not require hospitalization. Simple methods have other advantages such as they require less time, including the time for anesthesia, which is limited locally to the ear canal and the eardrum; hence, there is very little risk of systemic side effects by the anesthetic, and thus can be applied to the elderly with comorbid disease.¹⁰

Simple non-surgical methods can also bring down the waiting list for cases scheduled for tympanoplasty for smaller tympanic membrane perforations. The goals of closing chronic perforations of the tympanic membrane are to improve hearing and prevent middle ear infections, as these problems can limit the patient's participation in water sports and job recruitment in the military service and as a motor vehicle driver. Closure isolates the middle ear from the external environment

and prevents exposure to pathogens, restores the vibratory area of the membrane and affords round window protection. Closure of these perforations is gratifying to both the patient and the surgeon. The patient stands to gain as much as 15–25 dB of hearing. In some cases, even tinnitus gets relieved.¹¹

Platelet-rich fibrin (PRF), extracted from the middle layer of patients' own centrifuged venous blood, is the second generation of platelet concentrate products. It contains platelets, white blood cells and various growth factors and was found to be effective in wound healing.¹² PRF also consists of an intimate assembly of cytokines, glycanic chains and structural glycoproteins enmeshed within a slowly polymerized fibrin network.^{13,14}

It differs from Platelet-rich Plasma (PRP) in that no synthetic material or anticoagulant is added; it can also be obtained readily in a short time and at low cost. Highly resistant, flexible, elastic autologous fibrin membranes can be obtained.⁸

These natural biomediators are cheaper, less invasive and readily obtained which may correct cellular events in wound healing, such as cell proliferation, differentiation and chemotaxis.¹¹

The mechanism by which PRF repairs the TM is based on its high content of growth factors (e.g., platelet-derived growth factor), which can effectively promote wound healing and enhance the homeostasis in autografts.¹²

Growth factors, such as TGFb-1, EGF, PDGF, IGF-1, and VEGF, which function in the healing stages, are found in the alpha granules of thrombocytes. Thrombocytes also have cell adhesion molecules that function in cell migration, such as fibrin, fibronectin, and vitronectin. The positive effects of autogenous materials on both the quantity and quality of wound healing—that they are cheaper, less invasive, and readily obtained—suggest that they may be used more often in the future for TM repairs.⁸

The objective of this study was to prospectively evaluate the efficacy of PRF myringoplasty technique for the repair of small, non-healing traumatic TM perforations with regard to success rates of closure and correction of the mean air-bone gap.

KEYWORDS:- Platelet-rich fibrin (PRF) ,Myringoplasty,Traumatic tympanic membrane perforation , Air-bone gap (ABG)

OBJECTIVES

1. To evaluate the efficacy of PRF Myringoplasty technique for the repair of small, non-healing traumatic TM perforations.
2. To determine the success rate of closure and correction of mean air-bone gap.

MATERIALS AND METHODS

Study design:

Prospective study.

Study setting:

The study was carried out in Regional Institute of Medical Sciences (RIMS), a tertiary care teaching hospital located in Imphal, Manipur. The study was executed in the Department of Otorhinolaryngology (ENT) in collaboration with the Department of Transfusion Medicine of this tertiary care hospital.

Study duration:

The procedure and data collection were carried out for two calendar years with effect from April 2023 to March 2025.

Study population:

All patients (aged 18 years & above) who presented to the OPD and Casualty with small, non-healing traumatic TM perforations in the Department of Otorhinolaryngology, Regional Institute of Medical Sciences, Imphal.

Inclusion criteria:

1. Traumatic tympanic membrane perforation involving 1 quadrant which failed to heal spontaneously after 4 weeks.
2. Inactive middle ear cleft.
3. Functional eustachian tube.
4. Well-pneumatized mastoid air cell system.
5. Pure tone audiogram with conductive hearing loss and ≤ 40 dB A-B gap.
6. No history of a clotting disorder, and no use of anticoagulants in the past 10 days.

Exclusion criteria:

1. Traumatic tympanic membrane perforation involving >1 quadrant.
2. History of previous ear surgery.
3. Active middle ear cleft disease.
4. Dysfunctional eustachian tube.
5. Poorly pneumatized mastoid air cell system.
6. Pure tone audiogram with sensorineural hearing loss and ≥ 40 dB A-B gap.
7. Symptomatic deviated nasal septum and sinusitis (acute or chronic).
8. HBV, HCV and HIV Positive status.

Sample size:

Sample size was calculated using the formula:

$$N = 4PQ/L^2 \quad \text{where,}$$

P = proportion of patients with successful closure of TM following PRF myringoplasty

= 92% (taken from a study conducted by Kumar¹¹)

$$Q = 100 - P$$

L = Absolute allowable error of 8%

Therefore, N= 46

Hence, total sample size required for the study is 46 patients.

Study variables:

- Independent variables:
 - i. Age
 - ii. Gender
 - iii. Religion
 - iv. Cause of trauma
- Dependent variables:
 - i. Size of perforation
 - ii. Degree of hearing loss
 - iii. Eustachian tube status

Outcome Variables:

1. Graft uptake - yes or no
2. Post-operative Air Bone Gap (ABG) closure in decibel (dB)

Working definitions:

- Traumatic TM perforations often develop because of a slap injury, blast injury, accident, sporting injury, or instrumental injury.
- Mean time for spontaneous healing of traumatic perforations of TM is about 1 month.
- Myringoplasty is defined as the repair of tympanic membrane without exploring the middle ear.
- 50% Trichloroacetic Acid (TCA) has a property of chemical cautery and was used to freshen the margins of perforation.

- Platelet-rich Fibrin (PRF) is a second-generation thrombocyte product obtained by concentration of thrombocytes and cytokines within the fibrin network. Thrombocytes play an important role in hemostasis and wound healing. Growth factors, such as TGFb-1, EGF, PDGF, IGF-1, and VEGF, which are found in the alpha granules of thrombocytes, function in the healing stages.
- For preparation of PRF, 10 ml blood sample was withdrawn from each patient using a sterile plain vacutainer. The sample was then immediately centrifuged at 2400 rpm for 10 mins. Three layers were observed to have formed. The base layer was red blood cells, the top layer was non-cellular plasma and the middle layer was PRF coagulate. With sterile forceps, the PRF was removed from the tube and stripped from the adjacent red blood cell layer. With absorption of the PRF serum into a gauze pad, a membrane, rich in fibrin from the matrix and with high resistance, was obtained. The membrane was cut to size approximately 1.5-times larger than the perforation.
- Pure Tone Audiometry (PTA) is a useful tool to determine the degree and type of hearing loss. It was done before and 3 months after the procedure.
- Successful outcome: an intact, mobile tympanic membrane on otoendoscopic examination at the end of 1 month with reduction in AB gap on PTA at 3 months was considered as successful outcome.

Study tools:

1. A predesigned proforma with particulars of the participants, etiology of TM perforation, location (quadrant) involved, duration of perforation, PTA and ABG values (pre-operative and post-operative), graft status following PRF Myringoplasty (Annexure III).
2. Otoendoscope (Ø Karl Storz HOPKINS Telescope, 2.7 mm and 4 mm).
3. Pure Tone Audiogram.
4. Bench Top Centrifuge.
5. 50% Trichloroacetic acid (TCA).

Pre-procedural Evaluation:

The participants were fully explained about the study and informed written consent was taken. A detailed history and clinical examination was carried out before the procedure according to a defined proforma. A complete otorhinolaryngological (ENT) examination along with laboratory and radiological investigations (Complete hemogram, Hepatitis B & C status, HIV status, X Ray of bilateral mastoid) were done on OPD basis. Eustachian tube status and the middle ear mucosa were seen endoscopically. Pure tone audiometry was done for assessing the hearing loss. The patients were then posted for PRF myringoplasty.

Technique/ Procedure:

- Under local anaesthesia and otoendoscopic guidance, the margins of the tympanic membrane perforation were chemically cauterized using a cotton-tipped applicator saturated with freshly prepared 50% trichloroacetic acid until a uniform 0.5 mm-wide white cauterized rim was achieved, while ensuring that the promontory is not scarred.
- An autologous platelet-rich fibrin (PRF) membrane, trimmed to approximately 1.5 times the size of the perforation, was carefully placed to occlude the perforation without the use of middle ear packing.
- The external auditory canal was subsequently packed with Gelfoam soaked in platelet-poor plasma.
- Finally, the external auditory canal was sealed with a cotton ball impregnated with an antibiotic-infused ointment.
- **Post-operative Advice:**
- A one-week course of broad-spectrum antibiotics, anti-histaminics, analgesics, and antioxidant therapy was prescribed.

- Patients were advised to avoid ear canal instrumentation, forceful coughing, sneezing, nose blowing, smoking, and alcohol consumption to prevent disruption of the healing process.
- As an office-based procedure, follow-up evaluations were scheduled at one week, four weeks, and the third month.

Post-procedural Evaluation:

Assessment for post procedural tympanic membrane status on otoendoscopy at the end of 1 month and hearing assessment (PTA) at the end of 3 months.

Statistical Analysis:

All the data were entered and analyzed using IBM SPSS version 26.0 (IBM Comp, Armonk, NY, USA). Descriptive statistics like mean, frequency and percentage were used for analysis. Statistical analysis was performed using the paired t-test to analyze the pre-operative and post-operative mean air bone gap closure and a p-value of <0.05 was considered significant.

Ethical issues:

Ethical approval was obtained from the Research Ethics Board, RIMS, Imphal (Ref. No. A/206/REB-Comm(SP)/RIMS/2015/1115/146/2023) before the beginning of the study. Informed written consent was obtained from the participants in the format annexed (Annexure I & II). Participation was completely voluntary and the right to refuse to participate in the study was respected. A unique code was assigned to each participant to maintain confidentiality. All the information collected were utilized only for the study purpose and not disclosed to anyone outside the research team.

Conflict of Interest

Nil

RESULTS

A total of 46 participants were included in this study, out of which 20 (43%) were males and 26 (57%) were females. The male: female ratio was 0.77:1. (Figure 1)

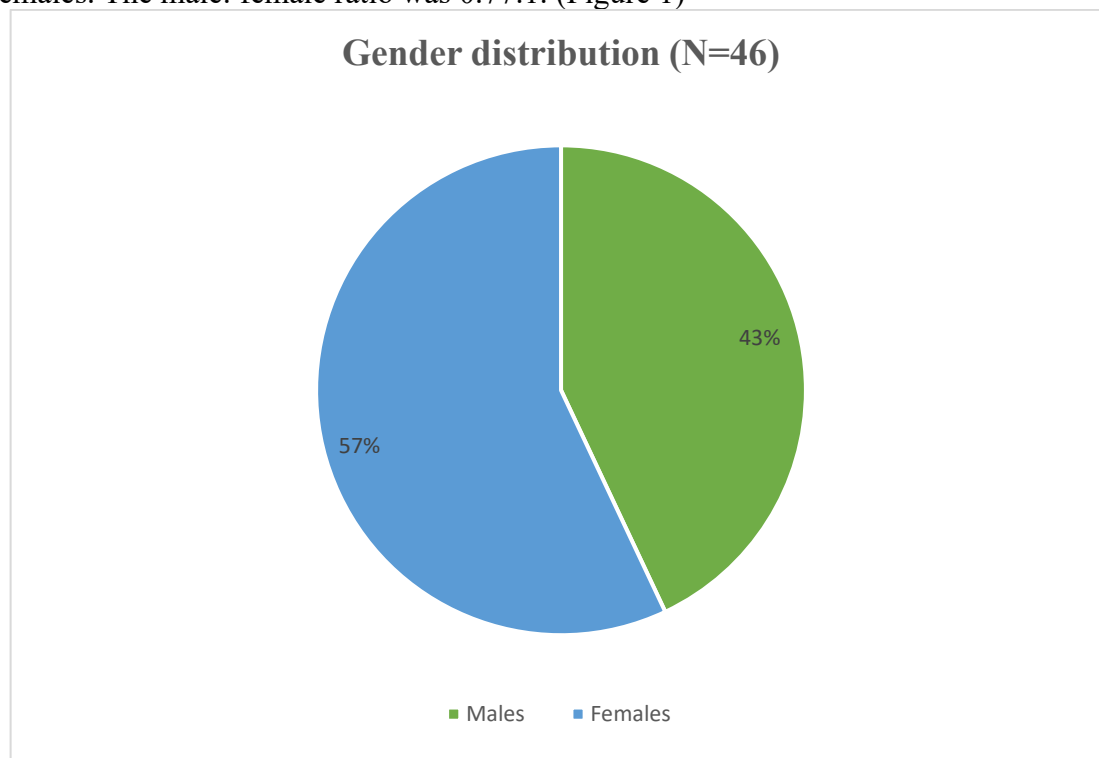


Figure 1: Pie chart showing the distribution of participants by gender (N=46)

The oldest participant in the study was 60 years of age and the youngest participant was 19 years of age. Out of the total participants, 16 (34.8%) participants belonged to the age group of 31-40 yrs,

Age group (years)	Frequency	Percentage (%)
≤20	4	8.7
21-30	13	28.3
31-40	16	34.8
>40	13	28.3
Total	46	100.0

Table 1 Distribution of the participants based on the age (N=46)

followed by 13 (28.3%) participants each in 21-30 yrs and >40 yrs age groups. Only 4 (8.7%) participants were 20 years or younger (Table 1).

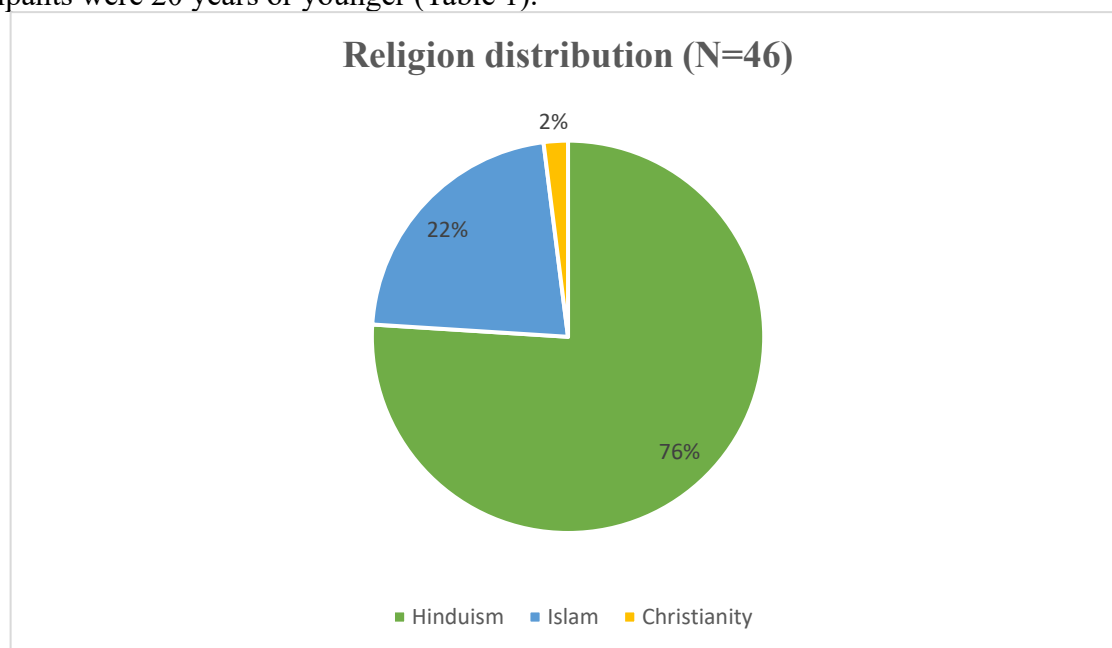


Figure 2: Pie chart depicting the distribution of participants by religion (N=46)

Among the 46 participants in the study, 35 (76%) participants were found to be Hindus, 10 (22%) participants were Muslims and only 1 (2%) participant was Christian. (Figure 2)

Table 2: Distribution of the participants based on the etiology (N=46)

Etiology	Frequency	Percentage (%)
Slap injury	23	50.0
Self-cleaning	17	37.0
Road Traffic Accidents (RTAs)	2	4.3
Foreign body	1	2.2
Blast injury	1	2.2
Sports injury	2	4.3
Total	46	100.0

In this study out of 46 participants with traumatic TM perforations, slap injury was the most common etiology in 23 (50%) participants, followed by self-cleaning in 17 (37%) participants, and 2 (4.3%) participants each by RTA and sports-related injury. Only 1 (2.2%) patient each sustained TM perforation by foreign body and blast injury. (Table 2)

Among the total participants, 22 (47.8%) participants had a posteroinferior quadrant perforation, followed by 15 (32.6%) participants with anteroinferior quadrant perforation, 9 (19.6%) participants with posterosuperior quadrant perforation. No participant in the study presented with an anterosuperior quadrant perforation. (Table 3)

Etiology	Frequency	Percentage (%)
Anterosuperior	0	0
Anteroinferior	15	32.6
Posterosuperior	9	19.6
Posteroinferior	22	47.8
Total	46	100.0

Table 3: Distribution of the participants based on the location of perforation (N=46)

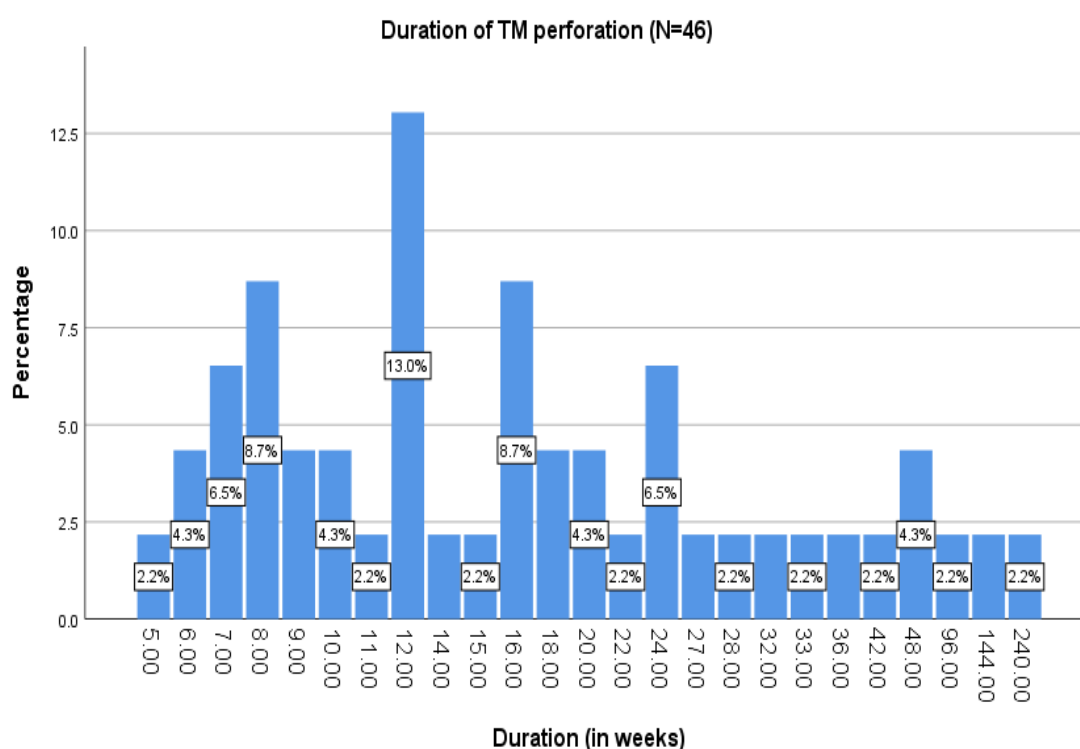


Figure 3: Bar chart showing the distribution of participants by duration of TM perforation (N=46)

In the present study, the participants presented with variable duration of TM perforation as shown in the bar diagram depicted above. The minimum duration observed in the study was 5 weeks and the maximum duration was 240 weeks. (Figure 3)

Table 4: Table showing Pre-operative PTA and ABG values (N=46)

	Pre-operative PTA	Pre-operative ABG
N	46	46
Mean (dB)	30.77	9.86
Standard Deviation	2.49	2.07

Pure Tone Audiometry (PTA) was done for all 46 participants before the procedure in the present study. All 46 patients presented with mild conductive hearing loss (<40 dB HL). The pre-operative

mean PTA value was found to be 30.77 dB, whereas the mean pre-operative ABG value was found to be 9.86 dB. (Table 4)

	Post-operative PTA	Post-operative ABG
N	46	46
Mean (dB)	21.67	4.46
Standard Deviation	4.84	2.77

Table 5: Table showing graft uptake of PRF myringoplasty (N=46)

Graft Uptake	Frequency	Percentage (%)
Yes	40	87.0
No	6	13.0
Total	46	100.0

Otoendoscopic examination was done in all 46 participants at the one-month follow up visit. The above shows that the PRF graft was found to be intact in 40 out of the 46 participants. This translates to a success rate of 87% for this PRF myringoplasty technique in the repair of small, non-healing traumatic TM perforations. (Table 5)

Table 6: Table showing post-operative PTA and ABG correction (N=46)

Pure Tone Audiometry (PTA) was repeated for all 46 participants at the three-month follow up visit after the procedure. The post-operative mean PTA value as shown in the above table was found to be 21.67 dB, whereas the mean post-operative ABG value was found to be 4.46 dB. (Table 6)

Table 7: Comparison of Preoperative and Postoperative PTA Scores: Paired t-Test Analysis (N=46)

Variable	Mean	Standard Error	Standard Deviation	95% CI	P-value	T-test
Pre-op PTA	30.76587	0.3664402	2.485319	30.02782, 31.50392	< 0.0001	12.1315
Post-op PTA	21.66522	0.7128918	4.835067	20.22938, 23.10106		
Difference	9.100652	0.7501677	5.087885	7.589737, 10.61157		

In the present study, the mean difference between the pre-operative PTA value and post-operative PTA value was 9.100652, and this difference is statistically significant ($p < 0.0001$). Since the mean of pre-operative PTA is 30.76587 and the mean of post-operative PTA is 21.66522, the results show that there is a significant decrease in the values from the pre-operative PTA to the post-operative PTA. The 95% confidence interval for the mean difference (7.589737 to 10.61157) does not include 0, further supporting the conclusion that the difference is significant. The large t-statistic (12.1315) and extremely small p-value (<0.0001) provide strong evidence against the null hypothesis, suggesting that the observed difference is not due to random chance. (Table 7).

Table 8: Comparison of Preoperative and Postoperative ABG Scores: Paired t-Test Analysis (N=46)

Variable	Mean	Standard Error	Standard Deviation	95% CI	P-value	T-test
Pre-op ABG	9.86413	0.3057132	2.073448	9.248393, 10.47987	< 0.0001	11.6466
Post-op ABG	4.451087	0.4078502	2.766174	3.629635, 5.272539		
Difference	5.413043	0.4647747	3.152256	4.476939, 6.349148		

The mean difference between the pre-operative ABG value and the post-operative ABG value in the present study is 5.413043, and this difference is statistically significant ($p < 0.0001$). Since the mean of pre-operative ABG is 9.86413 and the mean of post-operative ABG is 4.451087, the results suggest that there is a significant decrease in the values from the pre-operative ABG to the post-operative ABG. The 95% confidence interval for the mean difference (4.476939 to 6.349148) does not include 0, further supporting the conclusion that the difference is significant. The large t-statistic (11.6466) and extremely small p-value (0.00001) provide strong evidence against the null hypothesis, suggesting that the observed difference is not due to random chance. (Table 8)

DISCUSSION

Non-healing tympanic membrane perforations typically necessitate tympanoplasty for definitive closure. One alternative graft for tympanoplasty is autologous Platelet Rich Fibrin (PRF), a second-generation platelet concentrate that releases various growth factors from α -granules, promoting tissue repair and accelerating wound healing¹⁵. Platelet-rich fibrin (PRF) was first developed in France by Choukroun et al³⁹ for applications in oral and maxillofacial surgery. Today, it is widely utilized by dental surgeons and in jaw surgeries. Research has also explored its potential in tympanic membrane repair.

This prospective study on the efficacy of PRF myringoplasty, brought forwards the significant potential of PRF as a method for repairing non-healing traumatic tympanic membrane perforations. Out of 46 participants who underwent PRF myringoplasty in this study, successful closure of the tympanic membrane was seen in 40 (87%) of the participants while non-closure was observed only in 6 (13%) cases.

In the present study, 26 (57%) of the study population were females and 20 (43%) were males with a male to female ratio of 0.77:1. This finding correlates with the gender distribution seen in a study by Gür et al⁸ with females comprising of 18 (60%) patients of the study population and 12 (40%) patients being males. However, this is in contrast to a study by Sogebi et al⁹ who reported a male predominance (60.4%). Similarly, Kumar¹¹ reported a gender distribution of 15 (60%) males and 10 (40%) females in his study. Carniol et al⁴⁰ also reported a male preponderance in their study where out of the 949 patients evaluated, 568 (59.8%) were males and 381 (40.2%) were females, resulting in a male to female ratio of 1.49:1.

Sogebi et al⁹ reported an age range between 8 and 71 years, with the age group 21-30 years having the highest frequency (total of 35.8%). In a cross sectional study by Carniol et al⁴⁰, most injuries occurred in patients 18 years or younger, representing 602 of 949 cases (63.4%) followed by 223 (23.5%) cases in the 19-36 years age group. In a study by A. T. FH et al⁴¹, most of the patients fell under the 20-30 years age group (46.7%). Puttamadaiah et al⁴² reported 33 (37.5%) cases in the age group of 21-30 years, followed by 27 (30.68%) cases in the age group of 31-40 years, 20 (22.72%) cases in the age group of 41-50 years and 8 (9.09%) cases in the age group of 15-20 years.

In the current study, the most common age group observed was 31-40 years with 16 (34.8%) of the participants, followed by 13 (28.3%) participants each in the 21-30 years and over 40 years age groups. Only 4 (8.7%) participants were 20 years old or younger. The age range of participants in this study spanned from 19 to 60 years.

Slap injury was observed to be the most common etiology in the present study, affecting 23 (50%) participants, followed by self-cleaning in 17 (37%) participants. 2 (4.3%) participants each had tympanic membrane perforation due to road traffic accidents (RTAs) and sports-related injuries, while 1 (2.2%) case each resulted from a foreign body and blast injury. On a similar note, Gür et al⁸ reported slap injury as the most common etiology comprising of 47 (78.3%) of the cases, followed by 8 (13.3%) cases of sports injury. Similar observations were made by Kumar¹¹ where slap injury was again the etiological factor in 15 (60%) of the cases, followed next by road traffic accidents (12%). The finding in this present study is further supported by a study conducted by Puttamadaiah et al⁴² who also reported slapping as the most common mode of injury in 50 (56.8%) cases out of 88 study participants, followed by 21 (23.86%) cases resulting from direct trauma from earbuds, 11 (12.5%) cases from assault and 2 cases (2.27%) from RTAs. In a retrospective study conducted by Sagiv et al⁴³, it was similarly observed that most patients suffered from traumatic TM perforations caused by assault (50%) followed by Q-tip injury (40%).

This is in contrast to a study by Carniol et al⁴⁰ who reported the most common mechanism of traumatic TM perforation presenting to the Emergency Department as foreign body instrumentation (61.2%). A study by A. T. FH et al⁴¹ reported the common causes of perforation to be accidental trauma (46.7%) followed by assault (40%). Variations observed in the etiology of traumatic TM perforations may indicate cultural and behavioural differences across different populations.

In this study, 22 (47.8%) participants presented with a tympanic membrane perforation in the posteroinferior quadrant, followed by 15 (32.6%) cases in the anteroinferior quadrant while the remaining 9 (19.6%) participants presented with a perforation in the posterosuperior quadrant. To add further strength to our results, in a study by A. T. FH et al⁴¹, the posteroinferior quadrant was also reported to be the most commonly affected site (50%), followed by the anteroinferior quadrant (16.7%) and posterosuperior quadrant (6.70%). No anterosuperior quadrant was singly involved in their study; its involvement occurred together with adjacent quadrants.

This distribution can be attributed to the anatomical orientation of the tympanic membrane, which lies obliquely at a 55° angle within the medial end of the external auditory canal. Consequently, the posterior part of the TM is more laterally positioned than the anterior part, making it more susceptible to direct impact during assaults or other forms of trauma. This anatomical positioning likely explains the higher incidence of posteroinferior quadrant involvement. In contrast, the posterosuperior quadrant was less frequently affected, possibly due to the protective effect of the external auditory canal wall.

Similar observations were made in the study by Puttamadaiah et al⁴² where posteroinferior quadrant was the most commonly involved single quadrant in 35.22% patients, followed by anteroinferior quadrant consisting of 19.3% patients and posterosuperior quadrant in 4.5% patients. However, anterosuperior quadrant was involved in 3.4% patients. A study by Sarojamma et al⁴⁴ also reported posteroinferior quadrant to be affected most commonly (58%) followed by the anteroinferior quadrant (38%). The findings in this study are, therefore, consistent with the findings reported in the existing literature.

It may be noted that in the present study, no participants presented with an anterosuperior quadrant perforation. This may be due to several anatomical and protective factors. The oblique anatomical position of the tympanic membrane within the external auditory canal makes the posterior part more exposed and lateral, making it the first point of impact during trauma. The anterosuperior quadrant, being more medial and recessed, is naturally shielded from direct blows. Also, the external auditory canal's anterior wall offers protection to the anterosuperior quadrant. Additionally, the presence of the temporomandibular joint (TMJ) in front of the external auditory canal acts as a barrier, further reducing the likelihood of trauma to this region. Moreover, most common causes of trauma, such as slap injuries, falls, or self-cleaning mishaps, typically deliver force in a posterior or inferior direction. As a result, the force tends to impact the more exposed posteroinferior and anteroinferior quadrants rather than the anterosuperior quadrant. The anterosuperior quadrant is also structurally reinforced by the handle of malleus, which is firmly attached to the TM. This added support makes it less prone to rupture compared to the more vulnerable inferior quadrants.

Among the 46 patients who underwent PRF myringoplasty in this study, successful tympanic membrane closure was achieved in 40 (87%) participants, while non-closure occurred in 6 (13%) participants. In a comparative study by Gür et al⁸ in which a platelet-rich fibrin membrane was used to repair traumatic tympanic membrane perforations, successful closure was achieved in 28 perforations (93%). By day 10, complete TM closure was observed in 24 patients (80%) in the PRF group and 16 patients (53%) in the paper patch group. This finding demonstrated that PRF appears to achieve more rapid healing due to the growth factors it contains, in addition to its function as a scaffold for migration with a strong elastic structure. A study by Kumar¹¹ also reported a success rate of traumatic tympanic membrane closure using PRF in the repair of traumatic TM perforations to be 92%. This is in contrast to the study conducted by Habesoglu et al¹⁵ in which they found the rate of ear drum closure to be 64.3%. However, they found that PRF application in acute traumatic TM perforations resulted in significantly improved healing rates and faster recovery compared to spontaneous healing.

Shukla et al¹⁶ reported a successful outcome of 85.4% using PRF membrane as a graft material in combination with surgical refreshing of the perforation margins for the repair of chronic tympanic membrane perforations of various sizes. Various other studies in literature which used PRF either as a graft or an adjunct to conventional myringoplasty showed a wide variation in the successful graft uptake, ranging from 60-100%¹⁸⁻³⁸. Thus, the present study of 46 cases that underwent platelet rich fibrin myringoplasty, in which the graft take rate was observed to be 87 %, correlates with the quoted literature.

The pre-operative PTA values were recorded before the procedure and it was observed that all of the forty-six participants presented with mild conductive hearing loss (<40dB HL). Similarly, a study conducted by Puttamadaiah et al⁴² observed that majority (61.36%) of the study population presented with hearing loss between 26–40 dB. This finding is comparable to the study by Sarojamma et al⁴⁴ wherein majority of the patients (62%) presented with conductive hearing loss in the range of 26-35 dB, 22% with ≤ 25 dB and only 8% of patients presented with ≥ 36 dB hearing loss. On the contrary, A. T. FH et al⁴¹ observed minimal hearing loss (15-25 dB) in 15 patients (50%) and normal values in rest of the 15 patients (50%).

In the current study, the pre-operative mean PTA value was found to be 30.77 dB. The post-operative PTA was taken 3 months after the procedure, and the post-operative mean PTA value was observed to be 21.67 dB. Thus, the hearing gain in the present study was 9.1 dB. Additionally, the mean pre-operative ABG value observed in this study was 9.86 dB, while the mean post-operative ABG value was found to be 4.45 dB. Hence, the corrected mean air-bone gap in the present study was 5.41 dB. Statistical significance was determined using the paired t-test to establish the successful closure and correction of the mean air-bone gap in the present study. The resulting findings documented that there is a significant decrease in the post-operative values of both the PTA and ABG values which is statistically significant ($p < 0.0001$). These findings suggest that autologous PRF membrane could be a favourable and cost-effective graft material for the repair of traumatic tympanic membrane perforations.

Platelet-rich fibrin (PRF) offers several advantages, including its simple preparation and autologous nature, which minimizes the risk of immunogenic reactions, disease transmission, and graft failure. Since autologous PRF can be prepared repeatedly, it provides an abundant supply of graft material for multiple procedures or surgeries, even in conventional myringoplasty where temporalis fascia grafting has failed. PRF is cost-effective and can be performed as an outpatient procedure^{11,31}. PRF myringoplasty requires no incisions, resulting in minimal patient morbidity, making it a suitable first-line treatment for traumatic tympanic membrane perforation before considering more invasive tympanoplasty procedures. Additionally, PRF releases growth factors for an extended period- up to seven days or more- while its slow fibrin matrix polymerization and remodeling help sustain these growth factors and other critical cells, enhancing the healing process⁴⁵.

The current study's strengths were that it was prospective in design and that it was an investigation of a novel and promising subject.

Limitations of study

There are several limitations to consider when interpreting the results of the study:

- The study had a limited sample size, reducing the generalizability of results and making it harder to draw definitive conclusions.
- Currently, there is no universally accepted protocol for PRF preparation (centrifugation speed, duration, and handling techniques) which may affect the consistency and reproducibility of results.
- The study had a short follow-up period, making it difficult to assess the long-term outcomes of PRF applications.
- The study was done in a single centre, which therefore, may have limited generalizability and may have been prone to selection or measurement bias.

Future Directives:

- Standardized protocols need to be developed for consistent PRF preparation and application protocols for uniform outcomes.
- Similar studies with larger study population, larger TM perforations and longer study duration is suggested for more representative and promising results.
- The potential of PRF combined with other biomaterials or regenerative therapies should be explored to enhance healing outcomes.
- PRF applications need to be further explored to treat other middle ear conditions and to improve outcomes in revision surgeries.

CONCLUSION

The study of the use of platelet-rich fibrin (PRF) in the treatment of small, non-healing traumatic tympanic membrane (TM) perforations in RIMS Imphal demonstrated an innovative and promising technique that facilitates rapid and effective healing of the TM while utilizing autogenous material. This study showed a closure rate of 87% for small traumatic tympanic membrane perforations treated with this technique, with improved audiological outcomes.

This study established that PRF myringoplasty is an effective, feasible and affordable alternative for the treatment of traumatic TM perforations. The procedure's simplicity, combined with its ability to enhance healing and improve hearing outcomes, makes it particularly well-suited for office-based settings.

To our knowledge, this study is one of the first of its kind to be conducted among the North-Eastern states of India and can be useful further as a reference for future policymaking towards repair of traumatic TM perforations.

SUMMARY

A prospective study was conducted in the Department of Otorhinolaryngology, in collaboration with the Department of Transfusion Medicine, Regional Institute of Medical Sciences, Imphal for two calendar years w.e.f. April 2023 to March 2025 to evaluate the clinical efficacy of PRF Myringoplasty in the repair of small, non-healing traumatic tympanic membrane (TM) perforations and to determine the success rate of closure and correction of the mean air bone gap (ABG).

The study included a total of 46 participants recruited from OPD and Casualty who presented with small, non-healing TM perforations based on inclusion and exclusion criteria. All 46 patients were evaluated clinically, followed by laboratory and radiological investigations. Pure tone audiometry (PTA) was carried out preoperatively to assess the hearing loss and ABG. After obtaining informed written consent, patients were scheduled for PRF myringoplasty. Graft uptake was assessed at one month by oto-endoscopic examination. Post-operative PTA was performed at the three-month follow-up to measure the hearing improvement and the mean air-bone gap (ABG).

The age of the participants in the study ranged from 19-60 years of age, consisting of 26 (57%) females and 20 (43%) males. Slap injury was observed to be the most common etiology in 23 (50%) participants followed by self-cleaning in 17 (37%) participants. 22 (47.8%) patients presented with

posteroinferior quadrant perforations, followed by 15 (32.6%) patients with anteroinferior quadrant perforations and 9 (19.6%) patients with posterosuperior quadrant perforations. All the participants presented with mild conductive hearing loss (<40 dB HL).

The closure of TM perforations with correction of mean air-bone gap in the study by this technique was observed to be 40 (87%). Moreover, the study showed a hearing gain of 9.1 dB, with the mean PTA improving from 30.77 dB pre-operatively to 21.67 dB post-operatively. The mean ABG improved by 5.41 dB, decreasing from 9.86 dB to 4.45 dB after the procedure. The results showed statistically significant ($p < 0.0001$) findings in the closure and correction of the mean air bone gap after the procedure.

Autologous PRF myringoplasty can hence be suggested as a time- and cost-effective, office-based procedure for treating traumatic tympanic membrane perforations

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