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A COMPARATIVE ANALYSIS OF OUTCOMES OF MYRINGOPLASTY WITH AND WITHOUT PLATELET RICH PLASMA (PRP)

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Abstract

Background:
Chronic suppurative otitis media (CSOM) with tympanic membrane perforation often requires surgical intervention, with myringoplasty being the standard procedure. However, graft uptake and hearing outcomes vary. Platelet-rich plasma (PRP), rich in growth factors, has been proposed to enhance tissue healing. This study aimed to evaluate the effect of PRP on graft uptake and hearing outcomes following myringoplasty. **Methods:**
A prospective comparative study was conducted on 90 patients (18–50 years) with inactive mucosal CSOM and central tympanic membrane perforation. Patients were randomly allocated into two groups: Group A (n=45), undergoing myringoplasty with autologous PRP, and Group B (n=45), undergoing myringoplasty without PRP. All surgeries were performed using the underlay technique with temporalis fascia graft. Postoperative outcomes were assessed in terms of graft uptake (at 4 weeks and 3 months), residual perforation, ear discharge, and hearing improvement using pure tone audiometry (PTA) at 6 months. **Results:**
Graft uptake was significantly higher in Group A at both 4 weeks (95.6% vs. 82.2%, p=0.044) and 3 months (97.8% vs. 86.7%, p=0.045). Residual perforation and postoperative ear discharge showed no significant difference between the groups. Both groups demonstrated significant hearing improvement postoperatively; however, A–B gap improvement was greater in Group A (13.24 ± 1.26 dB) compared to Group B (12.31 ± 2.26 dB) (p=0.018). **Conclusion:**
The use of autologous PRP during myringoplasty enhances graft uptake and provides slightly better hearing improvement compared to conventional myringoplasty. PRP is a simple and effective adjunct for improving surgical outcomes in tympanic membrane repair.

Keywords: Myringoplasty, Platelet-Rich Plasma (PRP)**,** Chronic Suppurative Otitis Media (CSOM)**,** Tympanic Membrane Perforation**,** Otologic Surgery

Introduction

The ear represents the most important warning sensor of the body, from the evolutionary standpoint, a function which it combines with its fundamental role in social communication. Ear is an accurate, reliable and powerful instrument of perception. The sense of hearing is our most important biological source of information, next to the sense of sight. The importance of the hearing sense for the social life of man was aptly described by Immanuel Kant: 'Blindness separates people from things. Deafness separates people from people' [1-5].

Both convention and convenience have separated the ear into its three parts – external, middle and internal – for descriptive purposes [6-8]. Tympanic membrane is a membranous structure, which separates the middle ear from the external ear. It comprises of two parts: Pars tensa and Pars flaccida.

Chronic suppurative otitis media (CSOM), is characterized by repeated or prolonged episodes of acute otitis media lasting for more than 12 weeks, that can further lead to damage to the tympanic membrane, resulting in a non-healing perforation [9]. The symptoms of CSOM are ear discharge that comes into the external ear canal through the tympanic membrane perforation and hearing loss.

Tympanic membrane (TM) perforation represents a common problem in otology clinics. Acute perforations tend to heal spontaneously, but when the disease shows a chronic progression, surgery is usually necessary.

Tympanoplasty with autografts (e.g., temporalis fascia) is the standard surgical treatment for tympanic membrane perforation. The success rate of graft take-up after myringoplasty varies widely, ranging from 70% to 90%. Therefore, there remains a necessity to search for novel methods to improve the healing of the tympanic membrane after myringoplasty to improve the surgical outcomes. However, an ideal repair material has yet to be identified because of various limitations.

Platelet-rich plasma (PRP) is an autologous blood derived biomaterial that was first introduced in 1984 by Assoian. In comparison to the normal human platelet concentration, PRP is enriched with a 2-to-6-fold concentration of platelets. Multiple growth factors and various bioactive proteins are stored in α-granules of platelets [10-12]. Growth factors are present in higher concentration than in whole blood; and hence, PRP has been used to enhance the healing response across quite a few specialties, and it is also being used in traumatic injuries.

PRP provides a simple, minimally invasive and easily preparable method to get a high concentration of autologous growth factors, which can then be easily introduced into the surgical site while performing the surgical procedure.

Aims & Objectives

To evaluate the results of myringoplasty with the use of autologous PRP in terms of graft uptake and hearing.

Objectives

1) Primary objective - To compare, graft uptake following myringoplasty with and without PRP.
2) Secondary objective - To compare functional hearing outcome using Pure Tone Audiometry (PTA) with and without PRP.

Material and Methods

This study is a prospective comparative study and was conducted over a period of one year at Department of Otorhinolaryngology, Bhagat Phool Singh Government Medical College for Women, Sonepat, Haryana after Institution Ethical Committee approval. The study included 90 patients of inactive mucosal CSOM with central perforation in the age group of 18-50 years for whom myringoplasty will be performed from May 2022 to May 2023.

Inclusion criteria

- Age between 18 – 50 years.
- Patients with inactive mucosal chronic suppurative otitis media (CSOM)
- Central TM perforation.
- Patients with conductive hearing loss.

Exclusion criteria

- Age < 18 and > 50 years
- Patients with squamosal chronic suppurative otitis media (CSOM).
- Patients with sensorineural or mixed hearing loss on audiometry.
- Patients with active nose and throat infection.
- Patients with uncontrolled systemic illness

Simple random sampling with comparison random numbering table was used. Sample size calculation is based upon, proportions of two groups. Taking proportions of audiological improvement and graft uptake in case group and in control group, at 95 % confidence interval, the minimum required sample size is 90; 45 in each group.

Preparation of autologous platelet-rich plasma

5 ml of blood was withdrawn from a peripheral vein of the patient using a 16 or 18 G syringe in operation theatre on the day of surgery. Then centrifugation is carried out immediately, at 3200 rpm for a total of 12 minutes, which divided the blood into three layers [13]. The top layer consisted of platelet-poor plasma, the middle layer comprised of about 1.5 ml of PRP as well as a buffy coat of white blood cells, and the bottom layer consisted of red blood cells (RBCs). The layer of PRP was easily extractable at the time of use.

All patients fulfilling the inclusion criteria were subjected to detailed history taking, thorough ENT examination and pure tone audiometric evaluation. Patients were randomly divided into two groups, with 45 patients in each group. The case group comprised of patients undergoing myringoplasty with the use of autologous PRP, while the control Included patients undergoing myringoplasty without the use of autologous PRP. Myringoplasty was performed using underlay technique under local anaesthesia. Post auricular approach was used for access and a temporalis fascia graft was used to repair the TM defect. Once the graft was placed over the TM remnant, this extracted PRP then be placed over the lateral aspect of the newly grafted TM. EAC then be packed with gel foam and medicated ear wick. Patient was discharged two days after surgery. All the patients in this study were assessed with respect to postoperative graft uptake at 4 weeks and 3 months and with respect to, improvement in hearing at 3 months and 6 months respectively.

The study was conducted on 90 patients of age group 18 - 50 years of either sex who presented with symptoms of ear discharge and reduced hearing in the ENT OPD after considering inclusion and exclusion criteria.

The study was conducted among patients in the age group of 18 – 50 years. 31 - 40 years of age. The remaining 15.55 % were 41 years and above. In both the groups, majority of the patients were 30 years and below.

The study comprised of 50 males and 40 females. Using Chi Square test, no statistical significance could be attributed to the greater number of males.

Among the 90 patients selected for the study, 69 patients had symptoms involving their right ear. Left ear was involved in 30 patients. Only 9 patients had bilateral disease, which contributes only 10 percentage of the total patients enrolled for the study.

While considering symptoms, all the 90 patients had complaints of ear discharge. 91.11 % of the subjects had reduced hearing along with ear discharge, while it was absent in the remaining 8.88 % of patients. This data was statistically insignificant, as p value was 0.266.

The following symptoms and complaints were compared:

- Ear discharge (POD 28 & at 3rd month)
- Residual perforation (on POD 28 & at 3rd month)
- Graft uptake (on POD 28 & at 3rd month)
- Graft displacement (on POD 28 & at 3rd month)
- A-B gap improvement/ PTA improvement (at 6th month)
- Comparison of ear discharge on POD 28

Result

Table Legends

		Myringoplasty with PRP		Myringoplasty without PRP		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
GRAFT UPTAKE (POD 28)	No	2	4.4%	8	17.8%	10	4.05	0.044
	Yes	43	95.6%	37	82.2%	80		

Table 1: Comparison of graft uptake on postoperative day 28 between Group A [myringoplasty with platelet-rich plasma (PRP)] and Group B [myringoplasty without PRP]. The number and percentage of cases showing graft uptake are presented. Statistical significance was evaluated using the Chi-square test.

		Myringoplasty h PRP		Myringoplasty without PRP		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
GRAFT UPTAKE AT 3rd MONTH	No	1	2.2%	6	13.3%	7	3.997	0.045
	Yes	44	97.8%	39	86.7%	83		

Table 2: Comparison of graft uptake at 3 months between Group A (myringoplasty with platelet-rich plasma [PRP]) and Group B (myringoplasty without PRP). The number and percentage of

cases showing graft uptake are presented, and statistical significance was evaluated using the Chi-square test.

	Myringoplasty with PRP		Myringoplasty without PRP		Z	p-value
	Mean	SD	Mean	SD		
PRE OP PTA (dB)	31.44	3.16	30.56	3.12	1.342	0.183

Figure 3: Comparison of preoperative air-bone (A-B) gap between Group A (myringoplasty with platelet-rich plasma [PRP]) and Group B (myringoplasty without PRP). The mean A-B gap was 31.44 ± 3.16 dB in Group A and 30.56 ± 3.12 dB in Group B, with no statistically significant difference (p = 0.183).

	Myringoplasty with PRP		Myringoplasty without PRP		Z	p-value
	Mean	SD	Mean	SD		
POST OP PTA (dB) (AT 6 MONTH)	18.20	3.14	18.24	3.54	-0.063	0.950

Table 4: Comparison of postoperative pure tone audiometry (PTA) air conduction thresholds (in dB) at 6 months between Group A (myringoplasty with platelet-rich plasma [PRP]) and Group B (myringoplasty without PRP). Data are presented as mean ± standard deviation (SD), and statistical significance was evaluated using the Z-test.

	Myringoplasty with PRP		Myringoplasty without PRP		Z	p-value
	Mean	SD	Mean	SD		
PTA IMPROVEMENT (dB)	13.24	1.26	12.31	2.26	2.414	0.018

Table 5: Comparison of pure tone audiometry (PTA) improvement (in dB) between Group A (myringoplasty with platelet-rich plasma [PRP]) and Group B (myringoplasty without PRP). Data are presented as mean ± standard deviation (SD), and statistical significance was evaluated using the Z-test.

Figure Legends

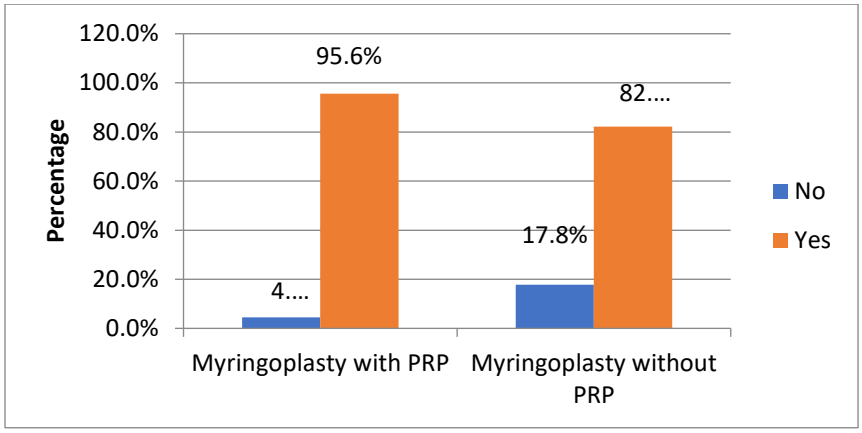

Figure 1: Percentage distribution of graft uptake on postoperative day 28 between Group A (myringoplasty with platelet-rich plasma [PRP]) and Group B (myringoplasty without PRP). Graft uptake was higher in Group A (95.6%) compared to Group B (82.2%).

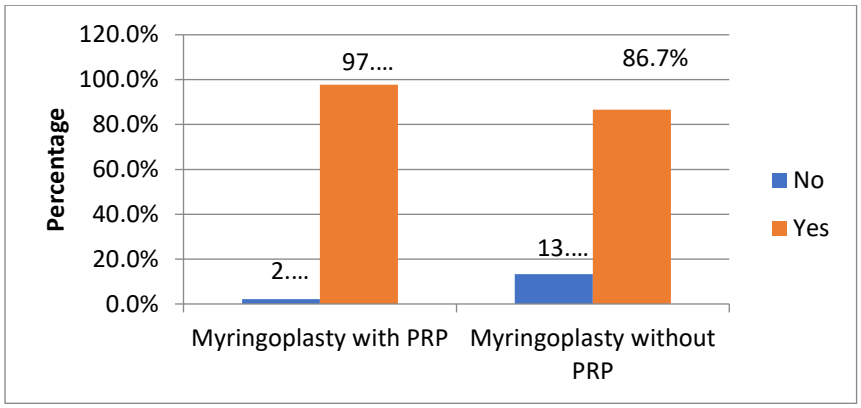

Figure 2: Percentage distribution of graft uptake at 3 months between Group A (myringoplasty with platelet-rich plasma [PRP]) and Group B (myringoplasty without PRP). Graft uptake was higher in Group A (97.8%) compared to Group B (86.7%).

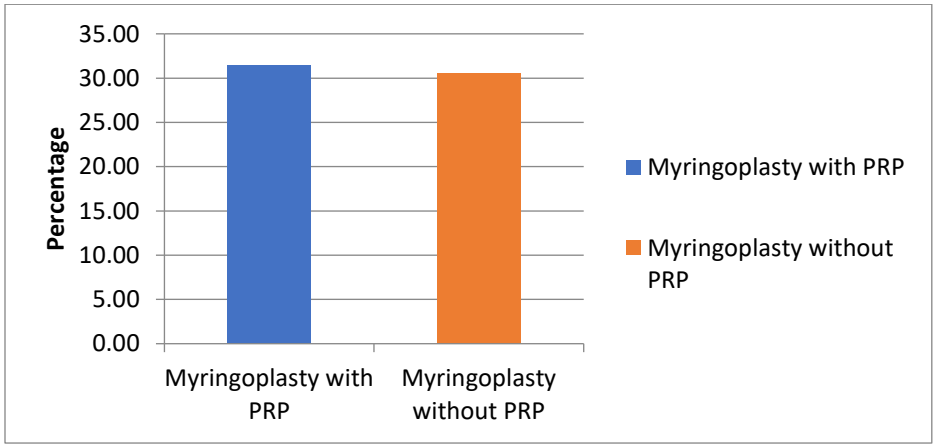

Figure 3: Comparison of preoperative air-bone (A-B) gap between Group A (myringoplasty with platelet-rich plasma [PRP]) and Group B (myringoplasty without PRP). The mean preoperative A-

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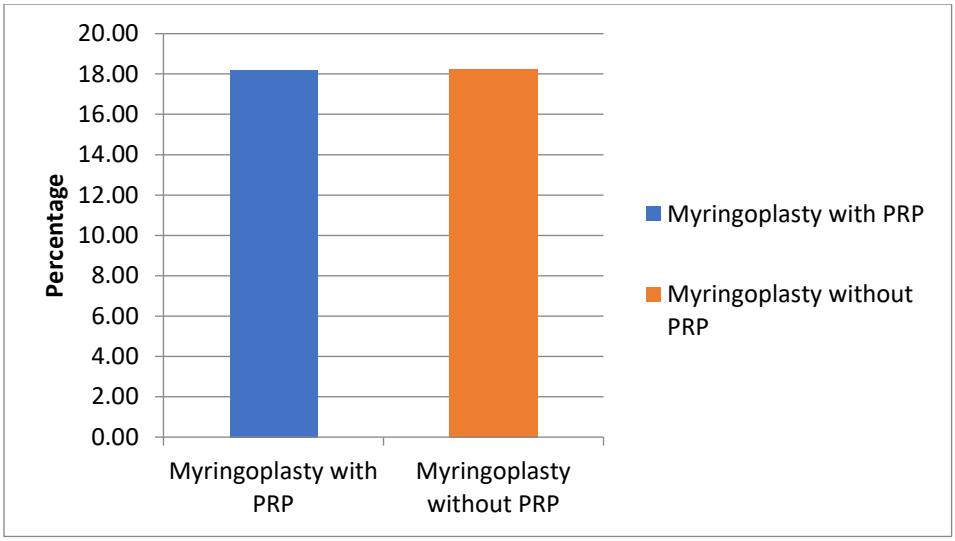

Figure 4: Comparison of postoperative pure tone audiometry (PTA) air conduction thresholds at 6 months between Group A (myringoplasty with platelet-rich plasma [PRP]) and Group B (myringoplasty without PRP). The mean PTA was 18.20 ± 3.14 dB in Group A and 18.24 ± 3.54 dB in Group B, showing no statistically significant difference (p = 0.950).

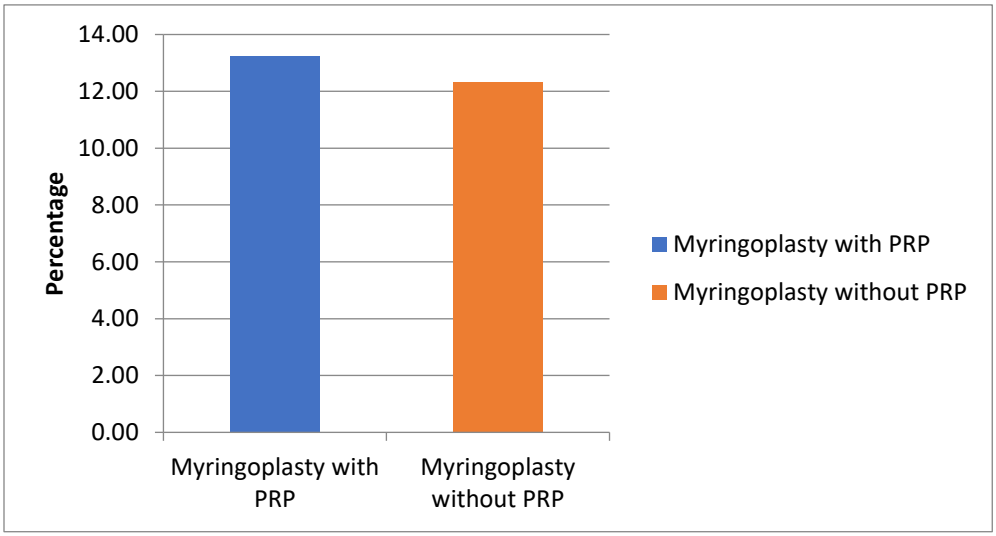

Figure 5: Comparison of pure tone audiometry (PTA) improvement between Group A (myringoplasty with platelet-rich plasma [PRP]) and Group B (myringoplasty without PRP). The mean PTA improvement was 13.24 ± 1.26 dB in Group A and 12.31 ± 2.26 dB in Group B, showing a statistically significant difference (p = 0.018).

COMPARISON OF EAR DISCHARGE AT POD 28

With respect to ear discharge on Post op day 28, 93.3% of patients in Group A had dry ears and 84.4% of patients in Group B had dry ears. It revealed increased dry ears in Group A compared to Group B. But this data was statistically insignificant since p value was 0.18 (p>0.05).

COMPARISON OF EAR DISCHARGE AT 3rd MONTH (POST OP)

With respect to ear discharge, at 3 month (Post OP), Group A (97.8 %) showed dry ears and Group B (91.1 %) also had dry ears. Chi square test analysis of this data revealed increased dry ears among patients of Group A. But this was statistically insignificant, as p value was 0.167.

RESIDUAL PERFORATION ON POD 28

With respect to the residual perforation on 28th post op day, majority of the patients in Group A (95.6 %) did not have any residual perforation while Group B showed more number (13. 3%) of residual perforation. Chi square analysis of this data (value = 2.195), revealed no statistical significance, as p value was 0.138.

RESIDUAL PERFORATION AT 3RD MONTH

With respect to the residual perforation at 3 months (post op), only one patient (2.2 %) in Group A had residual perforation, while 5 patients (11.1 %) in Group B had residual perforation. Chi square analysis of this data (value 2.857) revealed no statistical significance, since p value was 0.203.(p value > 0.05).

GRAFT UPTAKE ON POD 28

With respect to the graft uptake on Post op day 28, Group A showed 95.6 % uptake, while only 82.2 % of patients in Group B showed graft uptake. Chi square value was 4.05 and p value was 0.044, which came out to be statistically significant as p value < 0.05 [Table 1, Figure 1].

GRAFT UPTAKE AT 3rd MONTH

With respect to the graft uptake at 3rd month, Group A showed 97.8 % uptake while only 86.7% of patients in Group B had successful graft uptake. Chi square value was 3.997 and p value noted to be 0.045, which was < 0.05, and the data came out to be statistically significant [Table 2, Figure 2].

GRAFT DISPLACEMENT ON POD 28 AND AT 3rd MONTH

With respect to graft displacement at 28th Post op day and at 3rd month, both groups showed no displacement.

PRE-OPERATIVE A-B GAP

With respect to pre op A-B gap, Group A had a mean A-B gap of 31.44 ± 3.16 and Group B had a mean A-B gap of 30.56 ± 3.12. This data was statistically insignificant as p value was 0.183 [Table 3, Figure 3].

POST-OPERATIVE A-B GAP AT 6TH MONTH

With respect to A-B gap at 6th month post operatively, among Group A and Group B, mean A-B gap was found to be 18.20 ± 3.14 in Group A and 18.24 ± 3.54 in Group B, which was statistically insignificant as p value was 0.950 [Table 4, Figure 4].

A-B GAP IMPROVEMENT/ PTA IMPROVEMENT

With respect to A-B gap improvement, Group A showed mean improvement of 13.24 ± 1.26 while Group B showed mean A-B gap improvement of 12.31 ± 2.26. This data was statistically significant, as p value was 0.018 (p value < 0.05) [Table 5, Figure 5].

Discussion

Chronic suppurative otitis media is a chronic infection of the middle ear and the mastoid cavity, which usually presents with purulent otorrhoea for more than six weeks, otalgia or hearing loss. The global burden of chronic suppurative otitis media is estimated to be around 65 to 300 million patients, 60% of which experience significant hearing loss. The prevalence of chronic suppurative otitis media is higher in developing countries and 6% of the Indian population suffers from chronic ear disease [14-20]

Perforations of the tympanic membrane are found in majority of such cases, necessitating tympanoplasty as an established procedure. Tympanoplasty using a temporalis fascia graft is the mainstay surgical approach for the management of tympanic membrane perforation due to chronic otitis media, where the aim is to create a dry and non-infected environment in the ear, repair the perforated membrane, eradicate infection, and restore the hearing loss [21-24].

In our study out of the 90 patients who underwent surgery, 50 were males (55.55 percent) and 40 were (44.44 percent) were Females. Both the PRP and Non PRP groups had male predominance in this study, similar to a study conducted by Yadav et al., where 24 out of 40 patients were males [25]. This data was statistically insignificant.

The analysis of age distribution revealed no statistically significant difference between the study and the control groups. The age of patients ranged from 18- 55 years. The mean age of the study participants in the control group was 32.22 ± 7.89, and the mean age of the study participants in the PRP group was 31 ± 7.54. Maximum study participants were under 30 years of age, in both PRP and Non PRP groups.

In a study conducted by Vignesh et al [26], the mean age of the study participants in the control group was 30.84 ± 8.86, and the mean age of the study participants in the PRP group was 29 ± 8.57.In this study most of the subjects were under 30 years of age, which is in accordance with our study.

In a study conducted by Nair et al., majority of the patients recruited were young, with 55.7% of the patients in the 18–30 years age group, similar to our study [27].

About 93.3 percent (81 patients) of people in the study population had unilateral ear disease whereas remaining 6.7 percent (9 patients) had bilateral disease. In PRP group, 39 patients had unilateral disease and 6 patients had bilateral disease. In controls 42 patients had unilateral disease whereas only 3 patients had bilateral disease. Among the unilateral disease in controls 29 patients had left ear disease whereas 13 patients had right ear disease. Among PRP group, 31 patients had left ear disease and 8 patients had right ear disease. Thus, in the present study majority of the patients had unilateral disease, with right ear predominance. This was in accordance with the study done by Taneja et al. [28], where left ear was predominantly involved, in a ratio of 1.3:1. All these data were statistically insignificant.

The present study showed that nearly 95.6 % (43) had graft uptake at POD 28 in the PRP group, which is higher than the control group, which had only 82.2 % graft uptake. This was statistically significant. Similarly, at 3 months, the graft uptake was higher among the PRP group (97.8 %) than the control group (86.7 %) which was statistically significant.

The result of the present study on graft uptake is in accordance with the study done by Yadav SPS et al. [25] which showed that after the 3-month period the graft uptake was 95% and 85% in the PRP and control groups respectively, which was statistically significant.

A Randomized Controlled Trial (RCT) conducted by Anwar et.al [13] in 2020, on 70 patients, who were having tympanic membrane perforation caused by, chronic suppurative otitis media or CSOM, of tubotympanic type, for whom myringoplasty was performed, with and without PRP. Graft uptake in the case group was 88.57% and graft uptake in the control group was 77.1%. Study concluded that result was better in cases that underwent myringoplasty with PRP.

A study done by El-Anwar et al. [29] to assess the topical use of autologous PRP to improve success rate of myringoplasty, which was carried out on 64 patients with large dry central tympanic membrane perforations, showed better graft uptake in cases (100%) compared to control (81.25%) and it was statistically significant. Infection rate in control group was found to be significantly higher than in case group.

The present study thus in accordance with other studies showed that the addition of platelet-rich plasma resulted in higher graft uptake than the graft alone group and revealed that PRP would be important in the success rate of the myringoplasty procedure. The reason for the graft failure could be due to recurrent upper respiratory tract infections, eustachian tube dysfunction, and poor compliance of instructions to be followed in the post-operative period including general hygiene by the patient.

The present study showed that the percentage of closure at POD 28 and 3rd month was higher among the PRP group than the control group which was statistically significant.

In our study, out of 45 cases (PRP group), 43 showed complete closure with 2 failed closures at POD 28. In control group, there were 6 failures among 45 cases. Follow up at 3 months, showed failed closure only in one case, among 45, in PRP group. In Non PRP group, there were 39 patients with successful closure, 6 patients had failed closure, at 3 month follow up. Our study therefore reveals that use of autologous platelet concentrate accelerates tympanic membrane closure. This result is accordance with various other studies conducted by other authors.

A study done by Sankaranarayanan G et al. [30] stated that the closure in the PRP group was 72% whereas in the control group it was only 40% at the end of the 1st month. At the end of the 3rd month, the closure was 96% and 80% in the PRP group and the control group respectively, which matches the present study findings.

Fouad et al. [10] conducted a retrospective study in 2018, on 69 patients with medium sized central TM perforations. In 21 patients, PRP was used with the FGM; and in 23 patients, HA was used with the FGM; while in 25 patients, pure FGM was performed without adding an enhancing material. Successful TM perforation repair was achieved in 18 ears (85.7) with using PRP with FGM and in 20 ears (87%) with using HA with FGM and in 15 ears (60%) with pure FGM. Study proved that successful closure of the tympanic membrane in the PRP group was 85.7%, higher than that in the pure myringoplasty group.

With respect to Air-Bone gap improvement, PRP group showed mean improvement of 13.24 while Non PRP group showed mean improvement of 12.31. When statistically analyzed, p value was 0.018, which was statistically significant, which was comparable with some of the reference studies.

This was in accordance with the study conducted by Yadav SPS et al [25]. In this study, the mean pre-operative air–bone gap was 26.94 dB, while the mean post-operative gap was 13.79 dB, giving a mean gain of 13.15 dB. The chi-square test value was 8.27, with 3 degrees of freedom.

The p-value was 0.04 for the gain in hearing threshold (air–bone gap gain) between both groups, which was statistically significant.

Conclusion

The present study concludes that the usage of platelet rich plasma in the conventional myringoplasty technique has improved the success rate of graft uptake. The addition of PRP has also revealed better audiological outcome in terms of air-bone gap closure in the pure-tone audiogram (PTA).

Underlay myringoplasty using platelet-rich plasma is a simple, safe, quick and economical procedure conducted under local anaesthesia. Platelet-rich plasma acts as an immediate surgical haemostatic agent that is biocompatible, safe and effective. When autologous platelet rich plasma is used, it hastens the epithelialisation over the graft leading to faster graft uptake.

The reduced postoperative infection rate in the platelet-rich plasma aided myringoplasty group may suggest the antimicrobial effect of platelet-rich plasma.

Usage of platelet rich plasma has no side effects like transmitting HIV, Hepatis B and other blood borne diseases as it is taken from patients own blood.

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Compliance with Ethical Standards

Conflict of Interest: All the authors declare that they have no conflict of interest.

Consent: Appropriate informed and written consent was obtained for the treatment and publishing of photographs in the journal.

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