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Endoscopic closure of tympanic membrane perforations by platelet-richplasma laden cartilage with perichondrium

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***Abstract*---**Background: Myringoplasty surgery, also known as tympanic membrane repair, is performed to correct hearing loss brought on by TM perforation and to eliminate recurrent ear discharge. Platelets are the primary players in the process of tissue healing. They provide essential growth factors that stimulate fibroblasts to produce new blood vessels and lay down extracellular matrix. The study aim: Is to assess the efficacy of incorporating plateletrichplasma into tragal cartilage grafts with its perichondrium in order to speed healing and enhance the results of endoscopic transcanalmyringoplasty. Patients, and methods: Fifty people suffer from dry central TM perforation participated in this prospective case-control study. Under local anaesthesia, each of them had endoscopic transcanal myringoplasty by using tragal perichondrium grafts. 25 patients underwent myringoplasty surgery and also received platelet-richplasma (PRP) from the same patient in group A, compared to 25 patients in group B who underwent myringoplasty surgery but did not get PRP. Results: There were 25 patients in each group, and no statistically significant demographic differences existed between the two groups. A p-value of (0.01) indicates that there was a significant

difference between the plattelet-rich plasma group's (100%) and the non-plattelet-rich plasma group's (72%) graft absorption success rates. The plattelet_ rich plasma group significantly outperformed the non-plattelet_ rich plasma group in terms of time to graft absorption, with a p-value of (0.009). The revision rate was 0% in the plattelet-rich plasma group while it was 16% in the non-plattelet-rich plasma group. Conclusion: The results of our experiment show that plattelet-rich plasma is an inexpensive plattelet concentrate with enhanced growth factors. It boosted overall myringoplasty success rates, sped up tympanic membrane closure, inhibited graft migration, had no adverse effects, and prevented graft migration.

***Keywords*---**plattelet_rich plasma, tragalcartilage graft with its perichondrium, trans_canalmyringoplasty.

Introduction

Patients frequently visit ENT clinics due to tympanic membrane (TM) perforations (Dolhi N et al.,2022). Acute or chronic middle ear infections, object damage, blow, accident, sports injury, or a cut caused by the placement of a tympanostomy tube are all potential causes of eardrum perforation. (Spaw M. et al., 2022). Traumatic perforations of any size heal spontaneously in 88% of cases, while the remaining 14% develop and need treatment. Cholesteatoma, persistent otorrhea, and eventual hearing loss can develop if surgical treatment is delayed or avoided. To wit: (Shukla A et al.,2020)

Myringoplasty is the recommended surgical procedure for repairing a ruptured tympanic membrane. Several different grafting materials and myringoplasty procedures have been tried to heal the perforated tympanic membrane. Skin, fascia, cartilage, veins, fat, perichondrium, and duramater are only few of the grafting materials available. To wit: (Shivesh A et al., 2022).

Tympanic membrane perforation grafts made from the best graft material The ideal eardrum closure would mimic the tympanic membrane's conductive qualities, be readily available in adequate quantities, have a low metabolic rate at rest and a low rejection rate, have high tensile strength, and be conductive. As reported by (Gad H.A. et al., 2021). These requirements are met by the temporalis fascia. Because of its stiffness, immobility, and mechanical stability, cartilage is able to prevent the retracting of an organ. In addition to being well tolerated in the middle ear, its low metabolic rate makes it an attractive candidate for use in this location (Khalilullah S et al.,2016).

Tragal cartilage, made of collagen type II, has a physiology that parallels that of the tympanic membrane (Anand S et al.,2022). In order for the myringoplasty procedure to be successful, the graft must remain in place during the early phases of the healing process. According to research (Hasan MI et al., 2021), The growth factors found in plattelets encourage the formation of new blood vessels and extracellular matrix. Making plasma a vital fluid for maintaining and repairing cells and tissues presence of Nutrients, vitamins, hormones,

electrolytes, growth factors, and proteins (Nicolas J et al.,2020). Nowadays, tissue engineering and cellular therapy make substantial use of platelet-richplasma (PRP) (Liebig BE et al., 2020). Clinical studies have shown that the second-generation plattelet concentrate plattelet-rich plasma is critical for promoting wound healing and homeostasis in both soft-tissue and hard-tissue wounds. The results were published in 2017 (Qian Y. et al.

Aim of the work

The purpose of this research is to find out whether using tragal cartilage grafts infused with plattelet-rich plasma during endoscopic transcanalmyringoplasty improves healing and increases the success rate of myringoplasty.

Methods

Fifty people who have had dry central TM perforation were analysed in this prospective case-control study. Under local anaesthesia, all of them had endoscopic trans-canal (trans-perforation) myringoplasty procedures. Tools included cameras, cables, light sources, and video monitoring systems as well as tragal cartilage grafts with their associated perichondrium (9 cm in length and 2.7 mm in width) and 0° lenses.

Inclusion criteria

1. At least three months prior to surgery, patients suffer from tubotympanic type CSOM with dry central TM perforation.
2. Patients with 30 dB or below an air-bone gap (ABG) of to rule out ossicular disruption

Exclusion criteria

1. Cases had a central perforation that was actively discharged.
2. Those who have atticoantral illness
3. Patients who suspect the presence of ossiculardisconnection, and have an air-bone gap greater than 40 dB.
4. Perforation of the TM repeatedly

In group A, 25 patients had myringoplasty surgery and had plattelet-rich plasma from the same patient added to their blood. In group B, 25 patients also had myringoplasty surgery, but did not use plattelet-rich plasma.

Preoperative assessment

All of the patients had full physical exams, including otoscopy and microscopy to find out how big the hole was, as well as a thorough review of their medical history. The sizes of tympanic membrane perforations (TMP) are shown in the following table, which is based on the Saliba classification (**Saliba I et al., 2012**): "Small" means that the hole is less than 25% of the size of the TM. A "medium" is a hole that is between 25% and 50% of the TM's diameter. "Large" means that the diameter of the hole is more than 50% but less than 75% of the diameter of the TM. The sum goes around more than 75% of the diameter of the TMP.

All of the patients went through pure tone audiometry as part of an audiological exam, and the average (ABG) at speech frequencies of 500, 1000, and 2000 Hz was recorded. In order to check for conditions that may be harmful if platelet-richplasma was used during surgery, lab tests such a complete blood count, an erythrocyte sedimentation rate, and a coagulation profile were performed beforehand.

Operative technique

The endoscopic trans-canal (trans-perforation) myringoplasty every time was carried out using local anaesthesia, a tragal cartilage transplant with perichondrium was employed under local anaesthesia. Before surgery, we used the Saliba classification to divide TM perforations into four quadrants (small, moderate, , and large perforation). After making a 2 mm-long cut below the dome of the tragus in each case in the tragal skin, the tragal cartilage grafts and their coverings were carefully taken out. Then, the needle was used to sharpen the edge of the hole in the TM. The tragal cartilage graft with its perichondrium was put on the underside of the TM through the hole and adjusted under the handle of the malleus so that the tympanomeatal flap didn't have to be lifted. A piece of gelfoam was put into the middle ear to prevent the graft and its perichondrium from becoming medialized.

Before injecting gelfoam into the external auditory canal in (group A), a platelet-rich-plasma clot is administered to the TM remnant and the graft's lateral surface with its perichondrium (EAC). In (group B), platelet-rich-plasma was not employed; instead, gelfoam was applied to the side of the graft with its perichondrium and remaining TM in the EAC. This was accomplished prior to injecting gelfoam into the external auditory canal (EAC). Each group received an EAC pack for outdoor use. There was no post-aural incision, no lifting of the tympanomeatal flap, and no need for wound care after surgery, which can lead to keloid formation.

Postoperative evaluation

Once a month until the sixth month after surgery, then once a week for the first month, the perichondrium graft was examined. The clinical evaluation that followed surgery looked at TM healing, the existence of ear drainage or any granulation tissues, the emergence of problems, and improvements in subjective hearing. Three weeks to three months are needed for the TM perforation to heal. At the third and sixth months, PTA had finished a postoperative hearing assessment. The benchmark for hearing examination was the postoperative ABG. The typical PTA rise was also computed. In terms of hearing, was deemed successful a rise in ABG of 10 dB or greater at 6 months following surgery.

Statistical analysis

Data was entered into the computer and examined using IBM SPSS version 20.0 software. New York's Armonk is home to the IBM Corporation. Numbers and percentages were used to display the information about the categories. To compare two groups, a Chi-square test was performed. Fisher, on the other hand

> 20% of the cells had a projected count of less than 5, the exact correction test was used. When more than 20% of the cells had anticipated counts of less than 5, the Monte Carlo adjustment test was conducted.

The Shapiro-Wilk test to determine the normality of continuous data. Range (minimum and maximum), mean, standard deviation, and median were utilised to display quantitative data. A Two groups with quantitative variables that were evenly distributed were compared using the student t-test. To compare two sets of quantitative data that weren't evenly distributed, the Mann-Whitney test was applied. On the other hand, the t-test was utilised to compare two sets of quantitative data that were distributed similarly. The importance of the data was determined using the 5% level.

Result

25 cases included in each group with insignificant differences between both groups as regard demographic data table1

Table (1): Comparison between plattelet_ rich plasmagroup, andNo plattelet_ rich plasmagroup according to demographic data, and side of affection

	PLATTELET_ RICH PLASMA group (n= 25)	No PLATTELET_ RICH PLASMA group (n= 25)	Test of sig.	p
Age(years)				
Mean ± SD.	24.28 ± 4.37	24.36 ± 4.58	t=0.063	0.950
Median (Min. – Max.)	24.0 (19.0 – 32.0)	24.0 (18.0 – 32.0)		
Sex				
Male	11 (44.0%)	13 (52.0%)	χ^2=0.321	0.571
Female	14 (56.0%)	12 (48.0%)		
Side affected				
Right	17 (six8.0%)	14 (5six.0%)	χ^2=0.764	0.382
Left	8 (32.0%)	11 (44.0%)		

SD: Standard deviation
χ^2: Chi square testt: Student t-test
p: p value for comparison between the studied categories

As regard preoperative data there were insignificant differences between two groups as regard TM status , and preoperative air one gap as shown in table 2 , and fig 1,2

Table (2): Comparison between plattelet_ rich plasmagroup , and No plattelet_ rich plasmagroup according to Preoperative data

Preoperative data	PLATTELET_ RICH PLASMA group (n= 25)	No PLATTELET_ RICH PLASMA group (n= 25)	Test of sig.	p
T.M status				
Large central	13 (52.0%)	17 (68.0%)	χ^2=1.405	^{MC}p=

perforation				0.608
Medium sized perforation	8 (32.0%)	5 (20.0%)		
Subtotal perforation	4 (16.0%)	3 (12.0%)		
Air-bone gap				
Mean ± SD.	17.96 ± 2.86	18.23 ± 2.75	t=0.343	0.733
Median (Min. – Max.)	18.90 (14.30 – 21.50)	18.90 (14.20 – 22.60)		

MC: **Monte Carlo** FE**: Fisher Exact U: Mann Whitney test**

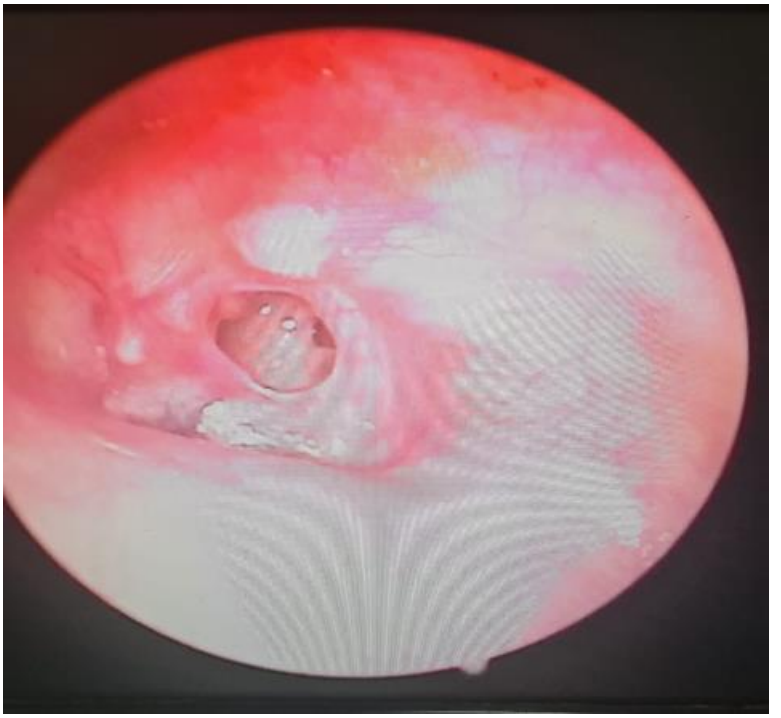

Figure1. Tympanic membrane perforation

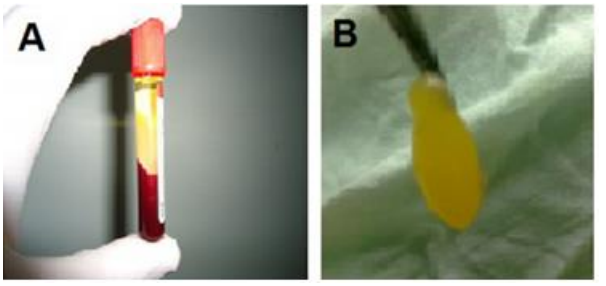

Figure 2. Preparation, insertion, and handling of platelet-rich plasma: The middle layer, which includes the platelet-rich plasma, was formed after the blood in (A) was divided into three layers. It would be simple to acquire platelet-richplasma (option B).

After operation, there was significant improvement in the plattelet_ rich plasma group vs non plattelet_ rich plasmagroup after 1 , andsix months as TM perforation healed in 84%, 100% after 1 , andsixmns respectively of cases in the plattelet_ rich plasma group vs 48%, 52% of cases in the non plattelet_ rich plasmagroup. p-value 0.007 Figure 3-5 shows healing , and graft uptake. Also, with regard to improvement in air bone gap, there was a significant decrease in the plattelet_ rich plasmagroup compared to the non-plattelet_ rich plasmagroup (p = 0.004).

As regards complications, no cases in the plattelet_ rich plasmagroup showed postoperative complications. On the other hand, 2 groups in the non-plattelet_ rich plasmagroup had complications as shown in table 3.

Table (3): Comparison between plattelet_ rich plasmagroup , andplattelet_ rich plasmagroup according to Post-operative

Post-operative	PLATTELET_ RICH PLASMA group (n= 25)	No PLATTELET_ RICH PLASMA group (n= 25)	Test of sig.	p
1 mn				
Healed	21 (84.0%)	12(48.0%)	χ^2=7.219*	0.007*
Perforated	4 (1six.0%)	13(52.0%)		
sixmn				
Healed	25 (100.0%)	18(72.0%)	χ^2=8.140*	FEp=0.010*
Perforated	0 (0.0%)	7(28.0%)		
Complications				
Infection	0 (0.0%)	2 (8.0%)	χ^2=2.083	FEp=0.490
Air-bone gap				
Mean ± SD.	12.41 ± 1.59	14.six2 ± 3.19		
Median (Min. – Max.)	12.40 (9.80 – 15.40)	13.70 (10.80 – 22.40)	t=3.098*	0.004*

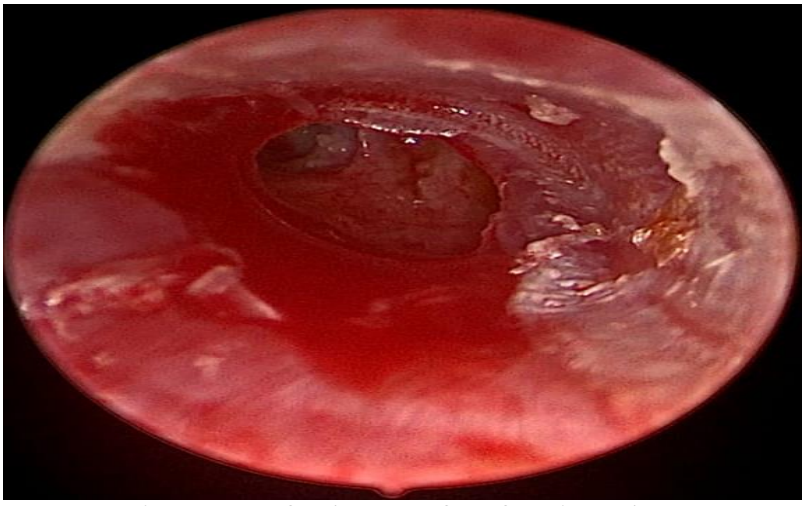

Figure 3. Refreshment of perforation edges

Figure 4. tragal **cartilage with its perichondrium**

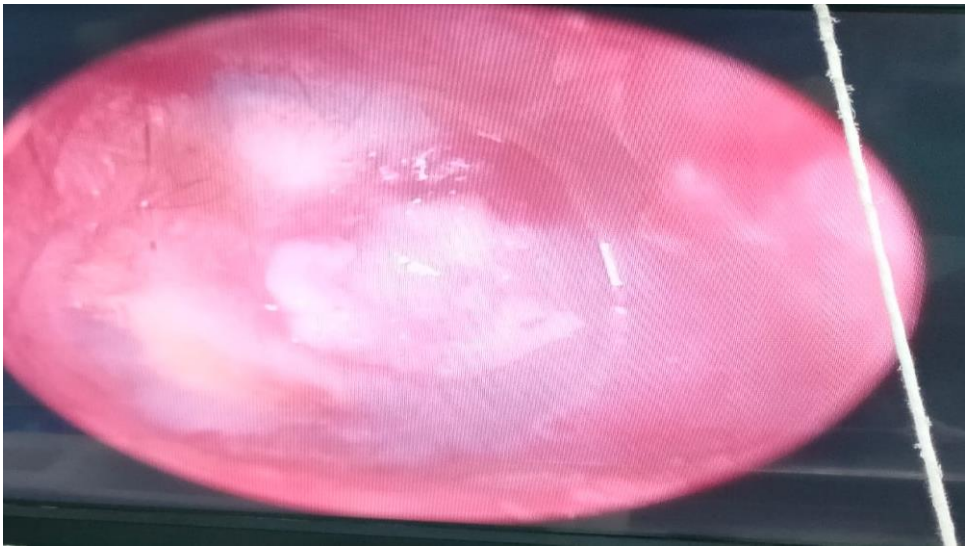

Figure5. Healed perforation

The plattelet_ rich plasmagroup had a 100% graft uptake success rate compared to the non-plattelet_ rich plasmagroup's 72%, p-value 0.01 suggesting a significant difference. p-value 0.009, the plattelet_ rich plasmagroup substantially outperformed the non-plattelet_ rich plasmagroup in terms of time to graft uptake. plattelet_ rich plasma group, the revision rate was 0%, but in the non-plattelet_ rich plasma group, it was 16%.

Table (4): Comparison between plattelet_ rich plasmagroup, and No plattelet_ rich plasmagroup according to Outcome

Outcome	PLATTELET_ RICH PLASMA group (n= 25)	No PLATTELET_ RICH PLASMA group (n= 25)	Test of sig.	p
Graft uptake				
No	0 (0.0%)	7(28.0%)	χ^2=8.140*	FEp=0.010*
Yes	25 (100.0%)	18(72.0%)		
Time to graft uptake\wk				
Mean ± SD.	4.48 ± 1.39	six.78 ± 3.3	U=129.50*	0.009*
Median (Min. – Max.)	4(3 – 8)	5(4 – 12)		
Revision case				
No	25 (100.0%)	21 (84.0%)	χ^2=4.348	FEp=0.110
Yes	0 (0.0%)	4 (16.0%)		

In comparison between changes in air bone gap in plattelet_ rich plasmagroup there was significant decrease in postoperative result from 17.96to 12.41, p-value <0.001 as shown in table4

Table (5): Pre- and post-operative comparison using the platelet-richplasma group's air-bone gap (n = 25)

Air-bone gap	Pre-operative	Post-operative	t	p
Mean ± SD.	17.96 ± 2.86	12.41 ± 1.59	7.515*	<0.001*
Median (Min. – Max.)	18.90 (14.30 – 21.50)	12.40 (9.80 – 15.40)		

In comparison between changes in air bone gap in non plattelet_ rich plasmagroup there was significant decrease in postoperative result from 17.9six to 12.41, p-value <0.001 as shown in table5

Table (6): Comparison of pre- and post-operative air-bone gaps in the non-platelet-richplasma group (n = 25)

Air-bone gap	Pre-operative	Post-operative	t	p
Mean ± SD.	18.23 ± 2.75	14.62 ± 3.19	6.359*	<0.001*
Median (Min. – Max.)	18.90 (14.20 – 22.60)	13.70 (10.80 – 22.40)		

Discussion

According to our findings, there were 25 instances in each group, and were matched regarding demographic. According preoperative data, there weren't any significant variations between the two groups' TM and air one gap conditions before to surgery.

After surgery, the plattelet-rich plasma group did much better than the non-plattelet-rich plasma group after one and six months. The TM perforation healed in 84% of cases in the plattelet-rich plasma group after one and six months, but only in 48% and 52% of cases in the non-plattelet-rich plasma group. p-value 0.007.

Through their research, Gopalakrishnan S. et al. found that platelet-richplasma with better growth factors is an inexpensive platelet concentrate. It speeds healing of the tympanic membrane after myringoplasty. In this study, 50 people with chronic middle ear infection and inactive mucosal disease were included. Out of these 50 people, 25 were put into the study group and 25 were put into the control group. When the study group did myringoplasty, platelet-richplasma was used, and the results were looked at. The results of the study showed that only one of the 25 people in the study group did not have a completely closed tympanic membrane. Five of the 25 control situations didn't work out. So, they came to the same conclusion as our study, which is that using platelet-richplasma speeds up graft absorption. (Gopalakrishnan S et al.,2014).

Our research is similar to that of Bajpai, who looked at two groups of 35 patients with tubotympanic type of chronic suppurative otitis media. In the first group, plattelet-rich plasma was used during the myringoplasty. In the second group, plattelet-rich plasma was not used. According to the study, 4 of the 35

participants in the experimental group and 8 of the 35 participants in the control group both had perforations that persisted following the procedure. Only 77.1 percent of the grafts in the control group were successful, compared to 88.57 percent in the case group. The patient had superior outcomes with a myringoplasty when platelet-richplasma was utilised. Only 27 of the 35 patients in the control group (77.1%) saw an improvement in their hearing of more than 10 dB, compared to 31 of the 35 patients (88.57%) in the case group.The case group's success rate (graft taking) was 100%, which was significantly greater than the control group's success rate (graft taking) of 81.25% (P = 0.02). Better hearing was reported by 21 (65.6%) of the case group participants and by 11 (34.4%) of the control group participants, although was statistically insignificant (P = 0.079). (10 dB). (Bajpai S.,2019).

In a study by Huang J. et al., the average rate of healing was 93.4% in the groups that were treated by platelet-richplasma and 78.6% in the control groups that just had regular surgery. Also, the OR (3.69) of healing showed that platelet-richplasma and autografts are better at treating perforations than traditional tympanoplasty or myringoplasty. But different autografts types could change the final success rate and make the study more diverse. Neither the main group nor any of its parts were different from each other. (Huang J et al.,2021).

This study's results show that platelet-richplasma is important for TM healing and that myringoplasty with platelet-richplasma is better than myringoplasty alone. This is because those who received platelet-richplasma had better outcomes in the granulation tissue region and vacuolization area due to their more developed arteries and greater proportion of normal adipocyte area.. (Aksoy MA et al.,2018).

Platelets are the most important parts of the coagulation system. They start to heal the wound and stop the bleeding. The high concentration of platelets in plattelet-rich plasma can be made to happen in order to make plattelet-rich plasma and release plattelet-derived growth factor for therapeutic purposes. Platelet-richplasma has plattelet-derived growth factor in the nonactivated platelets. However, because they are not released or in contact with the tissue, they are not useful. Before these growth factors can be released, the plattelets must first be made to move. Plattelet-derived growth factors are small molecules called peptides that help cells divide, move, move toward chemicals, and multiply. They are important to getting better.

The success rate for graft uptake was 100% in the platelet-richplasma group while it was just 72% in the non-platelet-richplasma group. A p-value of 0.01 indicates that this difference is significant. The platelet-richplasma group significantly outperformed the control group in terms of the time it took for the graft to take hold, with a p-value of 0.009. The rate of change was 0% in the group with many platelets whereas it was 16% in the group without many platelets. Erkilet et al. (2009) said that rat TM perforations can heal faster with platelet-rich plasma.

Fouad YA et al. (2018) found that the success rate for plattelet-rich plasma use was lower than ours (100%) and that this shows that the results for plattelet-rich

plasma myringoplasty were much worse than those for hyaluronic acid, according to Alhabib and Saliba's 2017 research. Because these were sad results, the study had to go on.

El-Anwar MW et al. (2018) say that the surgery increased the success rate of the underlying myringoplasty in a safe and effective way. Researchers found that combining platelet-richplasma with the sponge gels that are usually used to fix TM perforations sped up the time it took for the wound to heal completely and cut down on complications and morbidity. Fouad YA et al. did research that showed that platelet-richplasma had a much higher success rate than myringoplasty alone (2018).

Salaheldin AH et al. explain this by showing that platelet-richplasma is thought to help with healing and keep the edges of perforations from drying out. In a procedure called platelet-rich plasma-enhanced myringoplasty, the platelet-richplasma also helps the epithelial layer move in a circular motion over the temporary support of fat. This happens during the angiogenesis stage and right before adipogenesis. The fact that big TMP diameters have a high success rate shows that this relationship between platelet-richplasma and myringoplasty is good. (Salaheldin AH et al., 2012).

When compared to the group that didn't get platelet-rich plasma, the air-bone gap in the group that did get platelet-richplasma got much worse ($p = 0.004$). When compared to changes in the air-bone gap in the platelet-richplasma group, the postoperative results showed a significant drop from 17.96 to 12.41. The p-value for this change was 0.001. When compared to changes in air bone gap, the outcomes after surgery were significantly worse in the group that didn't get platelet-rich plasma. They went from 17.96 to 12.41, with a p-value of 0.001. When compared to the group that didn't get platelet-rich plasma, the air-bone gap in the group that did get platelet-richplasma got much worse ($p = 0.004$).

When compared to changes in the air-bone gap in the platelet-richplasma group, the postoperative results showed a significant drop from 17.96 to 12.41. The p-value for this change was 0.001. When compared to changes in air bone gap, the outcomes after surgery were significantly worse in the group that didn't get platelet-rich plasma. They went from 17.96 to 12.41, with a p-value of 0.001. After surgery, there were no issues in the group that received platelet-richplasma in terms of complications. However, there were issues in two of the groups with low platelet counts. According to research by El-Anwar MW et al., applying autologous platelet-richplasma to the skin during myringolpasty is risk-free, extremely successful, and problem-free.. Their findings support this. (El-Anwar MW et al.,2015)

Conclusion

The results of our research show that platelet-richplasma is an inexpensive platelet concentrate with better growth factors. It stopped the graft from moving, helped the tympanic membrane close faster during myringoplasty, increased the overall success rate of myringoplasty, and had no bad side effects.

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