

Platelet Rich Plasma Enriched Fat Myringoplasty: An Office Procedure for Repairing Small Tympanic Membrane Perforations

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Abstract: Fat myringoplasty is an easy and cost effective office procedure for repairing small tympanic membrane perforations. Platelet isolated from the blood forms a rich autologous source of growth factors. It enhances the healing and graft uptake of fat myringoplasty. A total of 50 patients participated in the study with ranging from 15-45 years. In this study, most common cause of perforation was due to COM (50%), followed by assault (35%), self cleaning (10%) and foreign body (5%). The graft take up rate in our study is 87.5% and a 12.5% failure rate. The air conduction thresholds reduced by 9.375 dB post-operatively.

Key words: Fat myringoplasty, Graft Uptake, Platelet Rich Plasma (PRP)

Date of Submission: 11-03-2019

Date of acceptance: 27-03-2019

I. Introduction

Myringoplasty is a reconstructive operation of the tympanic membrane performed to prevent recurrent ear discharge and improve hearing loss caused by tympanic membrane perforation.¹ From the 17th to 19th centuries; several attempts of closing tympanic membrane perforations using prosthetic materials were made. "Paper patch" technique was developed by Blake in 1887. The use of cauterizing agents to promote healing of tympanic membrane perforations was introduced by Roosa in 1876, where he used silver nitrate. The surgical repair of permanent tympanic membrane perforations was first attempted at the same time as the paper patch technique but did not produce adequate results until 1952, when Wullstein published a method of closing perforations with a split-thickness skin graft.² A year later, Zollner described his experiences with a similar graft.³ In 1958, Heermann began to use temporalis fascia. Tragal and auricular cartilage as well as perichondrium are other very commonly using grafting materials. The first attempt to use fat in perforation closure of tympanic membranes is attributed to Jordan C Ringerberg in 1962. This method of repair of small tympanic membrane perforations was confirmed by Sterkers in 1964 with the use of compressed abdominal fat.⁴

In the past years, there have been several attempts to use tissue adhesives in otorhinolaryngology.⁵ Also in recent years, some agents such as hyaluronic acid, pentoxifylline (Trental), and epidermal and fibroblast growth factors have been tried experimentally for healing of tympanic membrane (TM) perforations.⁶ Perforation closure occurs by epithelial proliferation and migration. Therefore, molecules, such as exogenous growth factors, that enhance regenerative processes could help to close TM perforations.⁷

Platelet isolated from the blood forms a rich autologous source of growth factors. When these platelets are concentrated and applied to the surgical site more predictable outcome can be expected. The rationale behind platelet rich plasma preparation for tympanic membrane perforation is to increase local concentration of growth factors.⁸ A platelet rich plasma (PRP) blood clot contains 95% of platelet, 4% of RBC's and 1% of WBC's.⁹

PRP-Fat myringoplasty would be an easy and cost effective procedure for small dry perforations without any complications. Thus in the present study we aimed to evaluate the effect of PRP enriched fat graft on the healing of TM perforations.

II. Materials and Methods

Study Design: Interventional study

Study Setup: In the Department of Otorhinolaryngology in collaboration with Department of Immunohaematology and Blood Transfusion, Regional Institute Of Medical Sciences, RIMS, Imphal, Manipur.

Study Duration: The procedure and Data collection was carried out since September 2016 to February 2018.

Sample Size: 40 patients

Inclusion Criteria:

1. Pars tensa small central perforations limited to one quadrant or occupying less than 30% of the total surface area of pars tensa of TM
2. Dry or non discharging ear for at least three weeks
3. Age between 15-45 years
4. Demonstrable conductive deafness not more than 40dB
5. Patients who are willing for surgery and consented to participate in the study procedure

Exclusion Criteria:

1. Central perforations involving more than one quadrant or occupying more than 30% of the total surface area of pars tensa
2. Marginal or attic perforations with cholesteatoma, otitis externa, uncontrolled Diabetes mellitus, ossicular fixation, ossicular discontinuity, sensorineural hearing loss, recurrent cases.
2. Age <15 years or >45 years
3. Patients whoever refuses to participate in study procedure

Operative Procedure:

It was done as a day care surgery. Fat graft, about 2 times the size of the perforation was harvested from the posterior aspect of the lobule of the affected ear under local anaesthesia. Under aseptic condition the osteocartilaginous junction of the external ear canal was infiltrated with 2 ml of 2% lidocaine with 1:100,000 epinephrine divided at 4 different sites 3, 6, 9 and 12 O'clock positions. Using 0 degree endoscope the edges of the perforation were freshened with a sickle knife or with a Rosen needle and were removed with microforceps. The fat graft was introduced into the perforation and made to fit snugly like a dumbbell after filling the middle ear with gelfoam for support. The fat graft was overlaid with gelfoam in the external auditory canal. The canal was packed with antibiotic drops soaked pieces of gelatin sponge. Postoperatively, patients were followed up at 4 weeks for assessing healing of perforation. Evaluation of Air Conduction threshold was done by PTA and difference with preoperative AC threshold noted at 3 month.

Preparation of Platelet Rich Plasma¹³

Preparation of autologous platelet rich plasma will be done using a two stage centrifugation technique. Venous Blood (10 ml) will be collected using aseptic techniques in citrate dextrose vacutainer using a 10 cc syringe. The blood will be transported to the department of Immunohaematology and Blood Transfusion and centrifuged using a standard general purpose centrifuge. After the first soft spin of 700 RPMs for 20 minutes the blood gets separated into 3 layers.

- a. at the bottom of the tube, a pellet of erythrocytes and leukocytes which occupies 55% of the total
- b. At the surface a cell free plasma which is platelet poor and is known as platelet poor plasma which occupies 40% of the whole
- c. In between these two layers there is one layer where the concentration of platelets and fibrinogen is greatly increased. It comprises of only 5 % of the total volume and has a characteristic whitish buffy appearance and hence known as buffy coat. This layer is important for further processing.

This middle layer is then withdrawn carefully by inserting a sterile needle into the layers and is transferred to another plain vacutainer and spun a hard cycle for 15 minutes at 1750 (800G) rpm. The prepared platelet rich plasma is then mixed with an equal volume of calcium gluconate and applied over gelfoam.

Study Variables:

Data for the following variables will be collected:

Age and sex

Etiology of perforation

Location of perforation

Preoperative AC Threshold by PTA

Outcome variables:

Closure of Perforation

Post operative AC Threshold by PTA

Statistical Analysis:

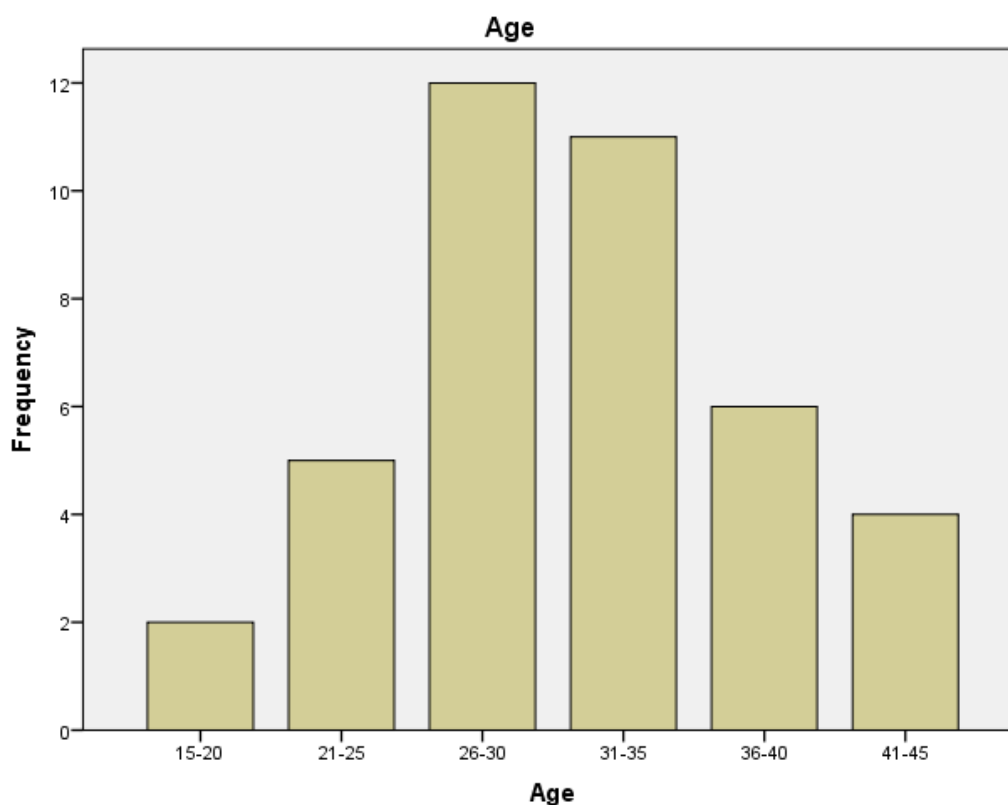
Data collected will be checked for completeness and consistency. Data will be entered in IBM SPSS Statistics 21 for Windows (IBM Corp. 1995,2012).Descriptive statistics like percentage & proportions will be used to present the data. Chi square will be used for significant testing. A p value of < 0.05 will be considered as significant.

Conflict Of Interest:

None

III. Results and Observations

Age Distribution:



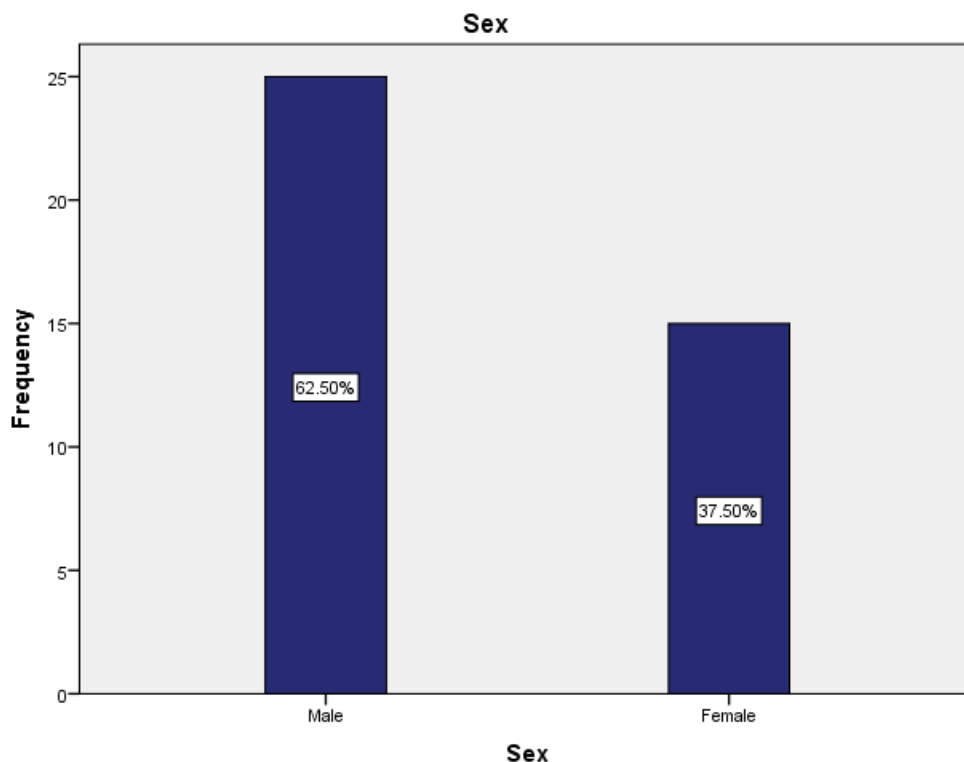
| | N | Mean | Std Deviation |
|-------------|----|------|---------------|
| Age (Years) | 40 | 29.1 | 6.029 |

A total of 50 patients participated in the study with ranging from 15-45 years. The mean age of the study population was 29.1 years with a standard deviation of 6.029 years. Majority of the patients 12(30%) cases belonged to the age group of 26-30 years .This was followed by 11 (27.5%) cases in the age group of 31-35 years.

SEX DISTRIBUTION

Table 2: Sex distribution of patients:

| Sex | Frequency | Percentage (%) |
|--------|-----------|----------------|
| MALE | 25 | 62.5 |
| FEMALE | 15 | 37.5 |
| TOTAL | 40 | 100 |

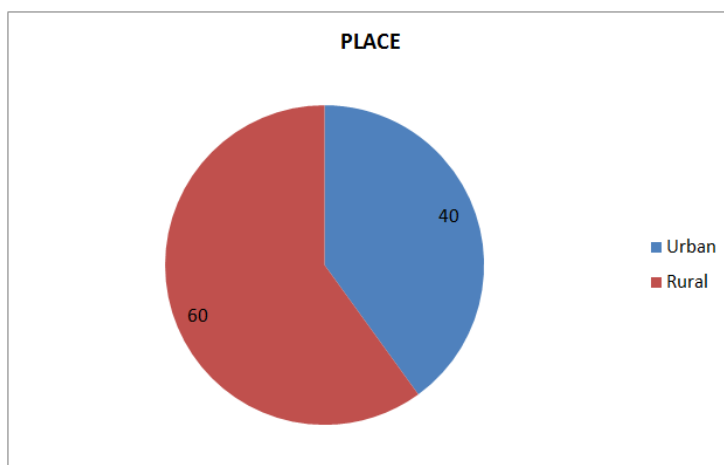


Out of the 40 patients, there were 25(62.5%) male patients and 15 (37.5%) female patients.

PLACE WISE DISTRIBUTION OF STUDY POPULATION

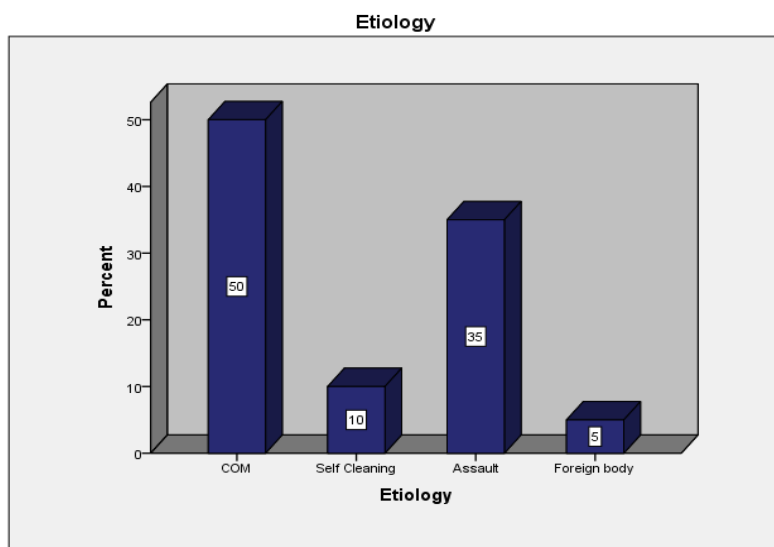
Table 5: Place wise distribution :

| Place | No.of patients | Percentage(%) |
|-------|----------------|---------------|
| URBAN | 16 | 40 |
| RURAL | 24 | 60 |



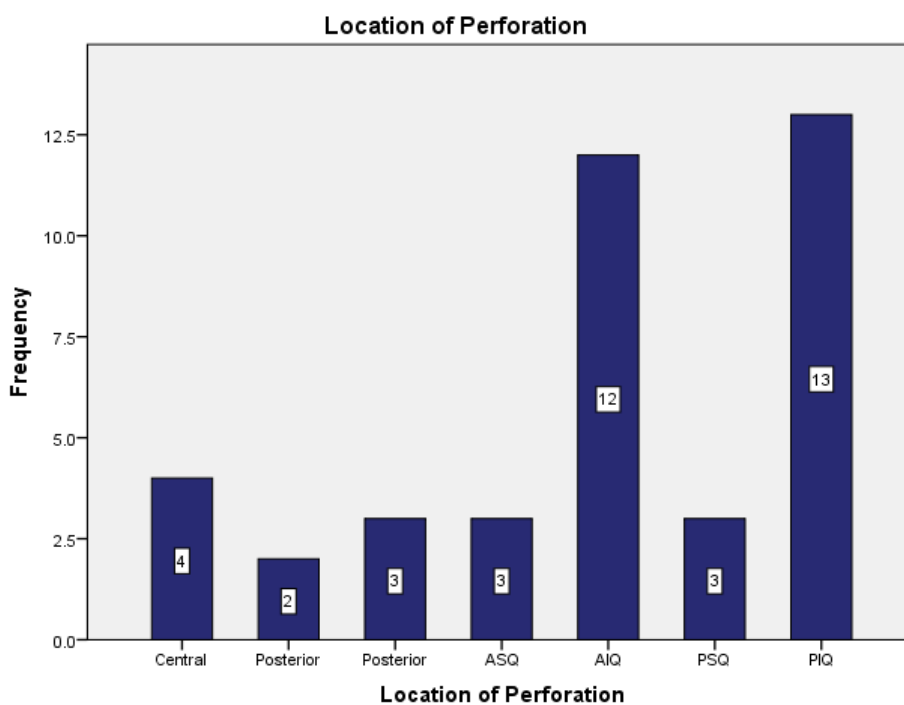
Distribution of Etiology of perforation:

| Etiology | Frequency | Percentage(%) |
|---------------|-----------|---------------|
| COM | 20 | 50 |
| Self Cleaning | 4 | 10 |
| Assault | 14 | 35 |
| FOREIGN BODY | 2 | 5 |
| Total | 40 | 100 |



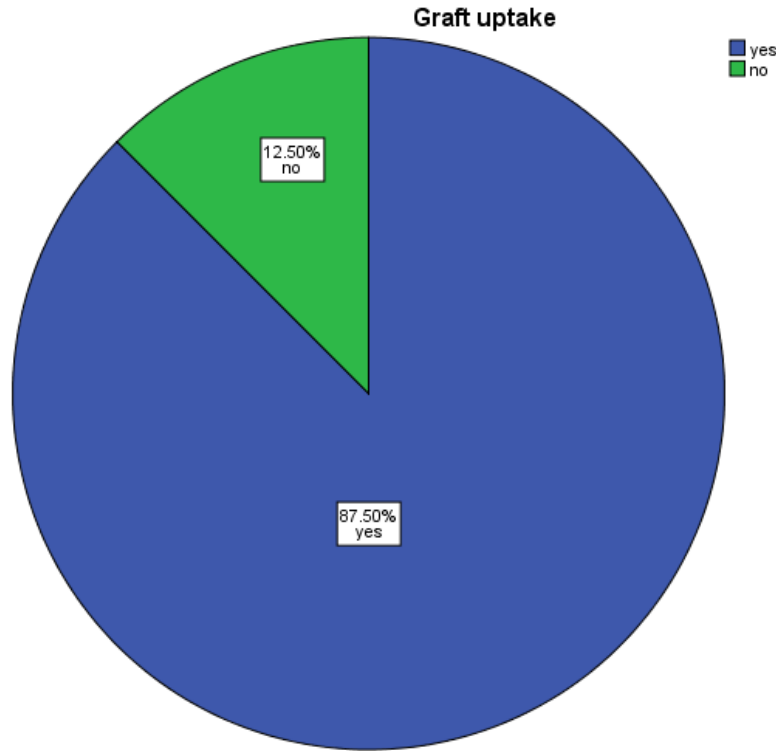
In this study, most common cause of perforation was due to COM (50%), followed by assault (35%), self cleaning (10%) and foreign body (5%).

| | | Frequency | Percent |
|-------------------------|-----------|-----------|---------|
| Location of Perforation | Central | 4 | 10.0 |
| | Posterior | 2 | 5.0 |
| | Posterior | 3 | 7.5 |
| | ASQ | 3 | 7.5 |
| | AIQ | 12 | 30.0 |
| | PSQ | 3 | 7.5 |
| | PIQ | 13 | 32.5 |
| | Total | 40 | 100.0 |



The distribution of the perforation location was as elaborated above in the table and chart, with the majority of the perforations in the inferior quadrants (antero-inferior and postero-inferior) and least number of perforations in the superior quadrants (antero-superior and postero-superior) and posterior quadrant.

Graft Uptake

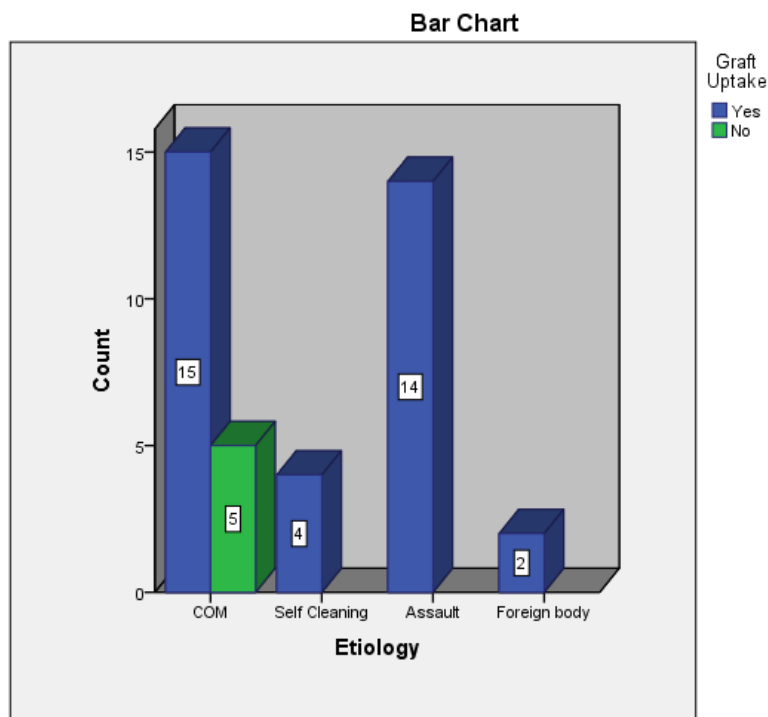


| Graft Uptake | Frequency | Percent |
|--------------|-----------|---------|
| Yes | 35 | 87.5 |
| No | 5 | 12.5 |
| Total | 40 | 100.0 |

Of the 40 patients operated graft was found to be intact in 35 of the 40 patients. This translates to a success percentage of 87.5% in terms of graft uptake, and a 12.5% failure rate.

Etiology * Graft Uptake Crosstabulation

| Count | | Graft Uptake | | Total |
|----------|---------------|--------------|----|-------|
| | | Yes | No | |
| Etiology | COM | 15 | 5 | 20 |
| | Self Cleaning | 4 | 0 | 4 |
| | Assault | 14 | 0 | 14 |
| | Foreign body | 2 | 0 | 2 |
| Total | | 35 | 5 | 40 |



Pre and Post operative Air Conduction Threshold(Paired Students T test)

| Variables | N | Mean | Std Deviation | P value |
|-------------------------------|----|--------|---------------|---------|
| Preoperative AC Threshold(db) | 40 | 35.475 | 2.353 | <0.001 |
| Post operative AC threshold | 40 | 26.10 | 2.146 | |

Pure Tone Audiometry was done for all 40 patients pre- and 3 months post-operatively. Air Conduction, Bone Conduction thresholds and Air-Bone-Gap was calculated each time for all patients. The average pre-operative Air Conduction threshold was 35.475 dB with a standard deviation of 2.353 dB. The Average Air conduction threshold after the procedure was 26.10 dB with a standard deviation of 2.146 dB. The Student’s ‘t’ test for paired samples was applied to these values and p value arrived at which was found to be less than 0.05 and hence significant. This disproves the Null Hypothesis that there is no significant difference in the Air conduction thresholds of the patients pre- and post-operatively. Since this surgery addresses only the conductive component of hearing and the sensorineural component is left untouched, there was absolutely no difference in the bone conduction thresholds of the patients pre and post-operatively.

Air Bone Gap – pre and post - operative (by applying Student’s ‘t’ test)

| Variables | N | Mean | Std Deviation | P value |
|---------------------------|----|-------|---------------|---------|
| PTA(Preoperative ABG) db | 40 | 21.25 | 5.158 | <0.001 |
| PTA(Postoperative ABG) db | 40 | 13.10 | 4.511 | |

The Air Bone Gap is calculated as an average of the difference in the Air and Bone conduction thresholds at 500, 1000 and 2000 Hertz. This was calculated for all 40 patients in the study. The mean air bone gap pre-operatively was 21.25 dB with a standard deviation of 5.158 dB while the mean air bone gap post-operatively, was 13.10 dB with a standard deviation of 4.511 dB. The difference between the mean pre- and post-operative air bone gap is 8.15 dB. The Student’s ‘t’ test for paired samples was applied to these values and p value was calculated which was found to be less than 0.05. This is significant which disproves the Null Hypothesis that there is no significant difference in the air bone gap pre and post-operatively.

IV. Discussion

Age

The mean age of the study population was 29.1 years. Trauma as the cause of perforation was more in the younger age range from 15 to 25 years (8 out of the 9 traumatic perforations), while chronic otitis media dominated in the older age range of 25 – 40 years. Literature strongly recommends the use of the technique in the pediatric population as a day-care procedure under local anaesthesia for the closure of small-sized perforations^{3,8,16,19,52}. However, this study was restricted to the adult population as this is the first study of its kind here.

Gender

25 male and 15 female patients had been enrolled in this during the study period and satisfied the inclusion criteria for this study. The gender of the patient did not affect the outcome of the technique in any significant way.

SIZE OF THE PERFORATION: ^{10,11,12,13}

There is a general consensus in literature, that smaller the size of the perforation, better suited it is for fat graft myringoplasty with higher closure rates. A small sized perforation is taken as one that is less than 30% of the total surface area of the pars tensa. Thus perforations less than <25% are chosen for this study. Studies by Sarker MZ and others in 2011, Bertoli GA and others in 2007, Khan and others in 2012, Konstantidinis and others in 2009 and 2013 agree with this generalisation.

LOCATION OF THE PERFORATION:

Majority of the perforations were in the inferior quadrants (antero-inferior 30% and postero-inferior 32.5%) and least number of perforations in the superior quadrants (antero-superior and postero-superior) and posterior quadrant.

ETIOLOGY OF PERFORATION

It can be seen from the results section under this heading, that 100% closure was attained with traumatic perforations while the success rate with perforations due to chronic otitis media was only 75%. The usual nature of the traumatic perforation to be small-sized makes them ideal candidates for this technique of myringoplasty.

ANALYSIS OF THE AUDIOLOGICAL GAIN:

The air conduction thresholds reduced by 9.375 dB post-operatively. The p value calculated by applying Student's paired t test for the pre and post operative air conduction thresholds was also significant This proves that the surgery has helped to improve the hearing level of the patient.

In a study on fat graft Myringoplasty with PRP conducted by Ahmed R¹⁵ et al there was significant postoperative improvement in the mean air bone gap [p = 0.0016].

Another study conducted by Sharma D¹⁶ et al concluded that ABG <10 dB at 500 hz postoperatively improved to 82% in case group and control group the improvement in ABG <10 dB at 500 hz was 38%. The results were statistically significant with p value.

Graft Uptake

The graft take up rate in our study is 87.5% and a 12.5% failure rate which is comparable with the reference studies. In our study among 40 cases that underwent fat myringoplasty with use of platelet rich plasma, 35 had complete tympanic membrane closure and only 5 failures has been noticed.

A study done by Kaddour H S in 1992 recommends that fat graft myringoplasty can be done as a day - care procedure under local anaesthesia (EMLA cream). In this study, there was a 80% closure rate with 11dB hearing gain. As per this particular study, this procedure is indicated for perforations less than 30% of pars tensa.¹⁷

According to Maria Luisa Navarrete Alvaro¹⁷ use of platelet rich plasma during myringoplasty had a satisfactory result.

A study was conducted by Mehmet Habesoglu M.D¹⁸ in 2011 among 32 patients with acute tympanic membrane perforations. He concluded that use of platelet rich plasma accelerated the tympanic membrane closure.

El-Anwar MW¹⁹ et al conducted a prospective study to assess the effectiveness of a platelet-rich plasma hourglass graft in the repair of small tympanic membrane perforations as an office-based procedure on 25 patients. Successful perforation repair was achieved in 21 of the 25 ears (84%).

Aksoy MA²⁰ et al investigated the use of autologous platelet-rich plasma (PRP) to improve the success rate of fat graft Myringoplasty

Ahmed R et al conducted a study on Myringoplasty of central tympanic membrane perforation with a fat graft from the ear lobule and platelet rich plasma in Zagazig University, Egypt on 20 patients. Successful TM perforation repair was achieved in 36 ears [85.7%].

V. Conclusion

Fat graft Myringoplasty with Platelet rich plasma is a cheap and cost effective office procedure. Growth factors present in PRP accelerates the graft uptake following Myringoplasty and prevents graft migration. Thus it improves the overall success rate of Myringoplasty without any noticeable complications.

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Dr Nicola C Lyngdoh. "Platelet Rich Plasma Enriched Fat Myringoplasty: An Office Procedure for Repairing Small Tympanic Membrane Perforations." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 3, 2019, pp 30-38.