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OUTCOMES OF DOUBLE DOOR TECHNIQUE IN TYMPANOPLASTY: A CASE SERIES

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ABSTRACT
The double door approach in tympanoplasty is a safe, successful, and adaptable way to repair the tympanic membrane. This study aims to evaluate the effectiveness and safety of a new double-door approach in tympanoplasty, addressing issues like optimal graft stability and improved functional results. The double-door technique aims to solve limitations of current surgical techniques and improve tympanic membrane repair results. A prospective case series of 13 patients underwent the procedure at Shyam Shah Medical College associated with Sanjay Gandhi Memorial Hospital, Rewa (M.P) for a duration of 12 months, demonstrating high graft uptake rates, hearing improvement, and minimal surgical complications. The study concludes that this novel method improves structural integrity, reduces recurrence rates, and improves functional outcomes.

KEY WORDS: Double door technique, swing door technique

INTRODUCTION
Tympanoplasty is a surgical procedure that repairs defects in the tympanic membrane restoring struc tural integrity and improving hearing performance.
It is a fundamental procedure in otologic surgery, frequently done on patients with chronic otitis me dia, traumatic perforations, or tympanic membrane atrophy.
Depending on the severity of the injury, tympanoplasty may additionally include middle ear disease s such as ossicular chain restoration. Tympanoplasty faces a number of difficulties, including graft stability, healing and integration, hearing improvement, perforation recurrence, anatomical and case-specific issues, and postsurgical sequelae. Delayed epithelialization, and graft displacement can all have an impact on results. Recurrent perforations are more prevalent in patients with large sized perforation. The double-door technique is a distinctive, dual-layer method that creates two flaps to sandwich the graft, reducing displacement and promoting stability. It offers enhanced mechanical support and a robust healing environment, utilizing both epithelial and mucosal layers. This technique is versatile and effective in complex cases, such as large or subtotal perforations and scarred or damaged tympanic membranes, making it an effective alternative to traditional methods.

Objective:

- Aim to evaluate the efficacy and safety of the double-door technique by analyzing the clinical outcomes, including graft uptake rates, hearing improvement, and complication profiles

MATERIALS AND METHOD

This study was a prospective case series involving **13 patients** who underwent tympanoplasty using the double-door technique. The cases were conducted at Shyam Shah Medical College and associated Sanjay Gandhi Memorial Hospital over a defined period of 12 months. Each patient underwent detailed ENT examination was evaluated preoperatively and postoperatively using pure-tone audiometry to assess outcomes, including graft uptake, hearing improvement, and complications.
Postoperative follow-ups were conducted at 1 month, 3 months, and 6 months to evaluate surgical success and functional outcomes. Data were collected through clinical examinations, audiometric tests, and patient feedback.

Inclusion Criteria

1. **Patients with age ranging from** 18–50 years.
2. **Patients with** large central perforations, subtotal perforation.
3. No active middle ear infection at the time of surgery.
4. **Hearing Loss:** Conductive hearing loss attributable to tympanic membrane perforation.
5. **Surgical Candidacy:** Patients eligible for tympanoplasty under local or general anesthesia.

Exclusion Criteria

1. Patients below 18 years of age and above 50 years of age.
2. Patients with small central perforation.
3. Presence of active chronic otitis media, cholesteatoma, or any ongoing middle ear infections at the time of surgery.
4. Patients with significant tympanosclerosis or adhesions.
5. Patients with ossicular chain disruption.
6. Patients with previous failed tympanoplasty.
7. Patients with anatomical abnormalities.
8. Patients with medical conditions: Systemic diseases or conditions (e.g., uncontrolled diabetes, immunocompromised states) that could increase the risk of surgical complications or impair postoperative healing.
9. Patients with Non-Candidacy for Anesthesia: Patients who were not candidates for general or local anesthesia due to medical reasons.

The swinging door technique, also known as the double door technique, is a surgical procedure used in tympanoplasty to repair perforation in the tympanic membrane.

- **Steps**

SURGICAL PROCEDURE

- The surgical procedures were carried out under local as well as undergeneral endotracheal anesthesia.
- Infiltration was given using 26 1 ½ needle and lignocaine and adrenaline in the ratio 1: 10,000 in the four walls of EAC , incisura terminalis, post auricular region and over supra-auricular region to harvest temporalis fascia graft.
- Using betadine and saline solution , ear-canal was cleaned.
- All patients were treated using the endaural technique, with the temporalis fascia excised for grafting.
- A curvilinear incision was made along the posterior canal skin, about 7 mm lateral to the annulus.
- A tympanomeatal flap was lifted from the posterior canal wall to the annulus, leaving the fibrous annulus intact at its bony sulcus.
- The flap was then sliced vertically at 9 o'clock, separating superior and inferior flaps.

- The TM remnant was detached from the malleus handle and almost completely removed to provide a new rim for the graft .
- Superiorly and inferiorly based swing-door flaps were rotated anteriorly, which permits good view of the entire tympanum and thus facilitates the removal of the pathologic tissues in the middle ear as well as fascia grafting.
- A laterally based anterior meatal flap was lifted, preserving the anterior annulus . After trimming the dried fascia to the appropriate size,
- The fascia graft was put across the anterior fibrous annulus and lateral to the malleus handle, then stretched up the posterior canal wall.
- Specifically, the superior section of the temporalis fascia was tucked underneath the malleus, secured by a semicircular thin piece of cartilage, bringing the the superior convex part anteriorly and posteriorly concave limbs over the malleus in a fascia-handle-fascia sandwich.
- All canal flaps were reposited above the fascia graft
- The anterior tympano- meatal angle was first packed with numerous tiny pieces of antibiotic-soaked abgel to attach the fascia-flap combination to the annulus and canal wall while also preventing blunting.
- The fascia and flap were secured in the canal using larger abgel pieces .
- Mastoid dressing was done.

After 7 days of i.v antibiotic course, patients were discharged

OBSERVATION

GENDER Distribution for 13 Patients

Gender	**Number of Patients**	Percentage
Male	**7**	53.8%
Female	**6**	46.2%
Total	**13**	100%

The gender distribution for the 13 patients includes a total of 7 male patients, accounting for 53.8% of the study population**,** and a total of 6 female patients participated, representing 46.2% of the study population.

AGE Distribution for 13 Patients

Age Range (Years)	**Number of Patients**	**Percentage**
18–25	0	0
26–35	4	30.8
36–45	5	38.5
46–50	4	30.8
Total	13	100%

The table shows the distribution of **13** patients undergoing tympanoplasty based on their age, with no patients in this age group of **18-25 years**, **4 patients** in the age group **26-35 years** contributing **30.8%, 5 patients** in the age group **36-45 years** contributing **38.5%,** and **4 patients** in the age group **46-50 years** making **4%** of the total populatio**n**

Degree of Hearing Loss (WHO)	**Number of Patients**	**Percentage**
Mild (21–35 dB)	2	15.4%
Moderate (36–50 dB)	8	61.5%
Moderately Severe (51–65 dB)	3	23.1%
Severe (66–80 dB)	0	0%
Profound (>80 dB)	0	0%
Total	13	100%

In this study, 8 patients (61.5%) have moderate hearing loss (36–50 dB), 3 patients (23.1%) have moderately severe hearing loss (51–65 dB), and 2 patients (15.4%) have mild hearing loss (21–35 dB). There are no patients with severe (66–80 dB) or profound (>80 dB) hearing loss.

Patient ID	Age (Years)	Gender	Hearing Threshold (dB)	AB Gap (dB)	Degree of Hearing Loss (WHO)	Perforation Type	Graft Material Used
P001	28	Female	30 dB	25 dB	Mild	Large Central	Temporalis Fascia
P002	38	Male	32 dB	33 dB	Mild	Large Central	Temporalis Fascia
P003	32	Male	38 dB	28 dB	Moderate	Subtotal	Temporalis Fascia
P004	37	male	40 dB	30 dB	Moderate	Subtotal	Temporalis Fascia
P005	30	Female	47 dB	32 dB	Moderate	Large Central	Temporalis Fascia
P006	40	Female	39 dB	34 dB	Moderate	Subtotal	Temporalis Fascia
P007	45	Female	45 dB	30 dB	Moderate	Large Central	Temporalis Fascia
P008	50	Female	49 dB	28 dB	Moderate	Subtotal	Temporalis Fascia
P009	37	Male	40 dB	27 dB	Moderate	Subtotal	Temporalis Fascia
P010	46	Male	36 dB	31 dB	Moderate	Subtotal	Temporalis Fascia
P011	29	Female	57 dB	29 dB	Moderately Severe	Large Central	Temporalis Fascia
P012	40	Male	59 dB	33 dB	Moderately Severe	Large Central	Temporalis Fascia
P013	50	Male	55 dB	40 dB	Moderately Severe	Subtotal	Temporalis Fascia

Average Hearing Threshold: Approximately 43.38 dB (ranging from 30 dB to 59 dB).**Average AB Gap**: Approximately 32.46 dB (ranging from 25 dB to 40 dB).**Mild Hearing Loss**: 2 patients (15.38%).**Moderate Hearing Loss**: 8 patients (61.54%).**Moderately Severe Hearing Loss**: 3 patients (23.08%). Subtotal Perforation: 7 patients (53.85%).Large Central Perforation: 6 patients (46.15%) T**emporalis Fascia**: 13 patients (100%).

Patient ID	Age (Years)	Gender	Surgical Complications	Graft Success	Air-Bone Gap Improvement (dB)	Postoperative Infections
P001	28	Female	Minor bleeding	Yes	14 dB	None
P002	38	Male	None	Yes	15 dB	None
P003	32	Male	None	Yes	18 dB	None
P004	37	male	Minor bleeding	Yes	18 dB	None
P005	30	Female	None	Yes	18 dB	None
P006	40	Female	None	Yes	16 dB	None
P007	45	Female	None	Pin point Perforation	18 dB	None
P008	50	Female	None	Yes	13 dB	None
P009	37	Male	None	Yes	18 dB	None
P010	46	Male	None	Yes	20 dB	None
P011	29	Female	Minor bleeding	Yes	16 dB	None
P012	40	Male	Mild hematoma	Yes	18 dB	None
P013	50	Male	None	Yes	18 dB	None

No complications: 9 patients (69.23%).Minor/Mild bleeding: 3 patients (23.08%).Mild hematoma: 1 patient (7.69%).Successful graft uptake: 12 patients (92.31%). Pinpoint perforation: 1 patient (7.69%).Air-Bone Gap Improvement ranges between 13 dB to 20 dB,Mean. No infections reported: 13 patients (100%)

Patient ID	Age (Years)	Gender	Hearing Threshold (dB)	Preoperative AB Gap (dB)	Postoperative AB Gap (dB)	Air-Bone Gap Improvement (dB)	Speech Discrimination Score (%)	Postoperative PTA (dB)
P001	28	Female	30 dB	25 dB	**11dB**	14 dB	92%	**19dB**
P002	38	Male	32 dB	33 dB	**18dB**	15 dB	85%	**23dB**
P003	32	Male	38 dB	28 dB	**10dB**	18 dB	88%	**28dB**
P004	37	Male	40 dB	30 dB	**12dB**	18 dB	84%	**26dB**
P005	30	Female	47 dB	32 dB	**14dB**	18 dB	80%	**29dB**
P006	40	Female	39 dB	34 dB	**18dB**	16 dB	86%	**30dN**
P007	45	Female	45 dB	30 dB	**12dB**	18 dB	82%	**27dB**
P008	50	Female	49 dB	28 dB	**15dB**	13 dB	79%	**29dB**
P009	37	Male	40 dB	27 dB	**9dB**	18 dB	90%	**26dB**
P010	46	Male	36 dB	31 dB	**11dB**	20 dB	91%	**25dB**
P011	29	Female	57 dB	29 dB	**13dB**	16 dB	75%	**32dB**
P012	40	Male	59 dB	33 dB	**15dB**	18 dB	70%	**34dB**
P013	50	Male	55 dB	40 dB	**22dB**	18 dB	68%	**35dB**

Average hearing threshold was 43.38 dB, indicating substantial hearing loss across the population. Pre-operative AB Gap ranges between 25 dB to 40 dB, Post operative AB Gap ranges between 9dB to 22 dB;patients showed improvements between 13 dB and 22 dB. Speech Discrimination Score (SDS) ranged from **68% to 92%** .Postoperative PTA: Ranged from **19 dB to 35 dB**, indicating a significant improvement in hearing thresholds. Postoperative Hearing Threshold improved to an average of 27.6 dB

Patient ID	Follow-Up at 1 Week	Follow-Up at 1 Month	Follow-Up at 3 Months	Follow-Up at 6 Months	Patient Satisfaction	Postoperative Issues
P001	Graft intact, no infection	Graft stable, no complaints	Graft well-healed, no hearing issues	Graft stable, good hearing improvement	Very Satisfied	None
P002	Graft intact, mild discomfort	Graft stable, slight hearing improvement	Graft intact, slight hearing improvement	Good graft integration, hearing improved	Satisfied	Mild discomfort at first week
P003	Graft intact, no infection	Graft stable, slight discomfort	Graft well-healed, mild hearing improvement	Hearing improved, stable graft	Very Satisfied	Mild discomfort
P004	Graft intact, mild discomfort	Graft stable, mild hearing improvement	Hearing stable, slight discomfort	Hearing improvement observed	Satisfied	Mild discomfort
P005	Graft intact, mild discomfort	Graft stable, hearing improvement	Graft intact, good hearing improvement	Hearing improvement sustained	Very Satisfied	Mild discomfort
P006	Graft intact, no infection	Graft stable, mild discomfort	Mild hearing improvement, stable graft	Hearing improved, stable graft	Satisfied	Mild discomfort
P007	Graft ? intact, slight discomfort	Pinpoint perforation discomfort	Graft intact, hearing improvement	Stable hearing, stable graft	Satisfied	Mild discomfort
P008	Graft intact, slight discomfort	Graft stable, hearing improvement	Hearing improved, stable graft	Graft stable, hearing improved	Very Satisfied	Mild discomfort
P009	Graft intact, no infection	Graft stable, mild hearing improvement	Hearing improvement stable	Graft intact, good hearing	Very Satisfied	No issues
P010	Graft intact, no infection	Graft stable, slight discomfort	Hearing improved, stable graft	Hearing improvement sustained	Very Satisfied	Mild discomfort
P011	Graft intact, slight discomfort	Graft stable, mild discomfort	Good graft stability, mild hearing improvement	Hearing stable, no issues	Satisfied	Mild discomfort
P012	Graft intact, no infection	Graft stable, mild hearing improvement	Graft intact, mild hearing improvement	Graft stable, hearing improved	Satisfied	Mild discomfort
P013	Graft intact, mild discomfort	Graft stable, mild discomfort	Hearing improvement, stable graft	Stable hearing, good graft	Satisfied	Mild discomfort

Graft Status: At 1-week- 12 out of 13 grafts intact, no infections. At 1-month: All grafts stable except for one pinpoint perforation.At 3 and 6 months: All grafts intact and well-healed. **Hearing Improvement**:Mild improvement noted by 1 month, progressing to good hearing improvement by 6 months in all cases. **Postoperative Issues**:Mild discomfort was the most common issue, resolving in all patients over time.No cases of infection, major bleeding, or graft failure occurred. **Patient Satisfaction**:61.5% (8/13) of patients were "Very Satisfied."38.5% (5/13) were "Satisfied," primarily due to mild discomfort.

RESULTS

1. The study population exhibits a near-balanced distribution of genders, with 7 male patients (53.8%) and 6 female patients (46.2%). While males make up a slightly higher percentage, the difference is marginal.
2. **18–25 Years (0%)**: No patients in this group suggest a lower prevalence of conditions requiring tympanoplasty in younger individuals. **26–35 Years (30.8%)**, **36–45 Years (38.5%)**, and **46–50 Years (30.8%)**: The majority of patients are middle-aged adults, indicating tympanoplasty is most commonly performed in this demographic.
3. **Mild (21–35 dB)**: 2 patients (15.4%) fall into the mild hearing loss category, indicating a relatively lower prevalence of mild hearing loss among the study population. **Moderate (36–50 dB)**: 8 patients (61.5%) have moderate hearing loss, which is the most common degree of hearing loss in this group. **Moderately Severe (51–65 dB)**: 3 patients (23.1%) fall into this category, highlighting a moderate representation of moderately severe hearing loss. **Severe (66–80 dB)** and **Profound (>80 dB)**: No patients in these categories, suggesting that severe and profound hearing loss are not prevalent among this sample of tympanoplasty patients.
4. The average hearing threshold is around 43.38 dB, suggesting moderate hearing loss across the cohort. The AB gap averages 32.46 dB, reflecting a moderate degree of conductive hearing loss in this group of patients.
5. There is a slight majority of patients with subtotal perforations (53.85%) compared to large central perforations (46.15%). No patients have marginal perforations.
6. All patients in this study have undergone tympanoplasty using temporalis fascia as the graft material.
7. The majority of patients (69.23%) experienced no surgical complications. Minor or mild bleeding occurred in 23.08% of patients, and one patient (7.69%) developed a mild hematoma. These complications were mild and manageable, indicating overall safe procedures.
8. The success rate of graft uptake was high at 92.31%. One patient (7.69%) experienced a pinpoint perforation, indicating a small failure rate but overall excellent outcomes.
9. The mean AB Gap Improvement was approximately 17.07 dB, reflecting substantial hearing improvement for most patients. This improvement supports the effectiveness of the tympanoplasty procedure.
10. The average preoperative hearing threshold was 43.38 decibels, showing significant hearing loss throughout the population.
11. All patients had Preoperative AB Gaps larger than 20 dB, with values ranging from 25 to 40 dB, suggesting moderate to severe conductive hearing loss.
12. All patients had Postoperative AB Gap reduction, ranging from 9 dB to 22 dB, with the majority obtaining values below 20 dB.
13. Patients demonstrated AB Gap improvements ranging from 13 to 22 decibels, with consistent results.
14. Postoperative Speech Discrimination Score (SDS) increased from 68% to 92%, indicating improved speech perception.
15. Postoperative PTA was19 dB to 35 dB, showing a considerable improvement in hearing thresholds.
16. Grafts were intact in most patients at all follow-up intervals except for a pinpoint perforation in one case (P007).
17. Mild discomfort was common during the early postoperative period.
18. Hearing improvement was observed progressively, with good stability at 6 months.
19. No significant infections or major complications were noted.

DISCUSSION

The gender distribution indicates that the conclusions drawn from the study can be generalized to both genders, providing a comprehensive understanding of the surgical outcomes and patient satisfaction across male and female populations**.** According to a study by Kim AS et.al 1 Males and

females have a similar prevalence at 2.3% (95% CI, 1.6%-3.0%) among males and 2.0% (95% CI, 1.4%-2.6%) among females. Similar results were found by Kvestad et.al2.
The mean age of the patients is μ=38.6 years, and the standard deviation is σ=7.27 years.The age distribution reflects that tympanoplasty is most common among middle-aged adults (26–50 years). Younger individuals (18–25 years) are either less affected by the conditions requiring tympanoplasty or underrepresented in the sample. The near-equal representation of patients across the 26–35, 36–45, and 46–50 age groups highlights the broad age-related applicability of tympanoplasty within the adult population. The study by C. Ankit et.al 3found that the average patient age was 25.87+12.29 years, with most (39.4%) aged 21-30 years, followed by 31-40 years (36.3%). Age did not vary across gender. Whereas, M.M.Baig4 found mean age of the patients was 29+14.26 years.
In this study, the majority of patients (61.5%) have moderate hearing loss (36–50 dB), followed by moderately severe hearing loss (23.1%). Mild hearing loss affects 15.4% of patients, with no cases of severe or profound hearing loss. Dawood MR et.al5 found 60 dB was the maximal conductive hearing loss.
The average hearing threshold is 43.38 decibels, showing substantial hearing loss throughout the population. The average preoperative air conduction (AC) in the study by **Gupta et.al6** was found to be 46.6 dB which is comparable to this study. The average AB gap is 32.46 decibels, indicating that this group of patients has moderate conductive hearing loss which is comparable to the average ABG closure within 0-30 dB was seen in 33 (82%) of the cases by Gupta et.al.
Intraoperative bleeding is minimal , significant bleeding during the procedure is uncommon but can occur, particularly in patients with bleeding disorders or those on anticoagulant therapy.

Shim et al.793.2% using three-point fix tympanoplasty **Schwaber8** graft uptake was 95% using a modified swinging door underlay approach; **Schraff et** al.994.5% using window shade tympanoplasty; **Peng and Lalwani10** 96% using hammock tympanoplasty.
Preoperative AB Gap was ranging from 25-40dB, indicating moderate to moderately severe and severe conductive hearing loss. The postoperative AB gap was reduced to less than 18 dB in most patients, with an average of 13.15 dB, indicating effective sound conduction repair, indicating significant hearing improvement for the majority of individuals which is comparable to Park SY et.al where preoperative AB Gap was more than 20 dB and postoperative air-bone gap was closed to ≤20 dB in 86.9%. 11
In this study , speech discrimination score increased from 68% to 92%, an average of **83.3%**, demonstrating enhanced auditory perception which is comparable with Boron et.al depicting where speech comprehension increased from 72.9% (pre-operative) to 95.2%12
The study found that 12 out of 13 grafts were intact at 1 week, stable at 1 month, and well-healed at 3 and 6 months. Hearing improvement was noted by 1 month, and postoperative issues resolved over time.A study published in the Journal of Clinical and Experimental Otorhinolaryngology 13found that endoscopic ear surgery (EES) can be a good alternative to microscopic ear surgery (MES) in terms of graft success rates and hearing outcomes in patients undergoing tympanoplasty or myringoplasty.

CONCLUSION

The double-door technique approach for tympanoplasty produced good results, with a high graft success rate and considerable improvement in hearing characteristics, as measured by postoperative air-bone gap closure and speech discrimination scores. Surgical complications were modest, primarily involving minor bleeding or pain, and were treated conservatively with no long-term repercussions. In most cases, postoperative wound healing went smoothly, and no infections were noted.

This approach resulted in consistent patient satisfaction, with the majority reporting significant hearing improvement and durable graft integration during follow-ups. The data support the double-door technique as a dependable strategy to tympanic membrane perforation, with equivalent or superior results to standard procedures.

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