International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Website: https://ijmpr.in/

Original Article

A Study of Various Intraoperative Surgical Findings in Patients of Conductive Hearing Loss with Intact Tympanic Membrane

Dr Masha Allaha Khan[1], Dr Kulvinder Singh Mehta[2] Dr Asad Ahmad Alvi[3],

[1]MBBS MS (ENT&HNS) Senior resident, AIIMS New Delhi
[2]MBBS MS (ENT&HNS) Associate professor, Department of ENT &HNS, GMC Srinagar J&K
[3]MBBS MD(Radiodiagnosis) Senior resident, AIIMS New Delhi

OPEN ACCESS

Corresponding Author:

Dr Kulvinder Singh Mehta
Associate professor,
Department of ENT &HNS,
GMC Srinagar J&K

Received: 16-04-2026
Accepted: 02-05-2026
Published: 14-05-2026

ABSTRACT

Background: Conductive hearing loss (CHL) is a common clinical condition that can be difficult to diagnose, especially when the tympanic membrane (TM) remains intact. Despite advancements in imaging and diagnostic techniques, preoperative identification of the underlying cause of CHL in patients with an intact TM remains challenging. Exploratory tympanotomy is often employed as a diagnostic tool to identify the precise pathology in such cases.
Objective: The study aimed to analyze various intraoperative surgical findings in patients with conductive hearing loss and intact tympanic membranes, to better understand the underlying pathologies and improve diagnostic accuracy.
Methods: A cross-sectional observational study was conducted on 21 patients with conductive hearing loss and intact TM who underwent exploratory tympanotomy between January 2023 and May 2024. Data were collected regarding the demographic characteristics and intraoperative findings, which were then analyzed to identify common causes of CHL with intact TM.
Results: The most common intraoperative finding was stapes footplate fixation (otosclerosis), observed in the majority of patients. Other notable findings included incudostapedial joint dislocation, incudostapedial joint fixation, absence of stapes suprastructure, malleus fixation, and a case of cholesteatoma.
Conclusion: This study highlights the key intraoperative findings in patients with conductive hearing loss and intact tympanic membranes. These findings can help clinicians in preoperative counseling and surgical planning, improving management outcomes. Future research should explore advanced diagnostic techniques to enhance the preoperative identification of such conditions.

Keywords: *Conductive hearing loss, Intact tympanic membrane, Otosclerosis, Exploratory tympanotomy, Ossicular fixation, Incus dislocation, Cholesteatoma, Middle ear surgery.*

INTRODUCTION

Overview of Conductive Hearing Loss (CHL)

Conductive hearing loss (CHL) refers to the inability of sound to travel efficiently through the outer or middle ear to the inner ear, typically due to physical obstructions or damage to the ossicular chain or tympanic membrane (TM) (Robertson & Mills, 2009). CHL can result from various etiologies, such as otosclerosis, middle ear effusion, ossicular discontinuity, and trauma (Kim et al., 2014). It is one of the most common causes of hearing impairment and often presents as a treatable condition, making early diagnosis crucial in otology (Thomeer et al., 2011).

Challenges in Diagnosis

Diagnosing CHL with an intact tympanic membrane poses significant challenges. Despite the availability of advanced imaging techniques such as high-resolution computed tomography (CT) scans, these may not always reveal the underlying pathology, especially in cases of non-inflammatory causes (Lagleyre et al., 2009). While tympanometry and audiometric tests may provide some insights, they are often insufficient to pinpoint the exact etiology in patients with intact TM (Shahnaz & Polka, 1997). As these diagnostic methods can yield inconclusive results, clinicians are often left with no

definitive preoperative diagnosis for CHL, making it difficult to predict the extent and location of the disease (Robertson & Mills, 2009).

Surgical Exploration

In such cases, exploratory tympanotomy has become a valuable diagnostic and therapeutic approach (Funasaka & Kumakawa, 1988). This procedure allows direct visualization of the middle ear structures, enabling surgeons to identify pathologies that are otherwise undetectable through non-invasive means (Tabuchi et al., 2005). Moreover, exploratory tympanotomy is crucial in distinguishing between various potential causes of CHL, especially in non-inflammatory conditions like ossicular anomalies or traumatic dislocation (Lee et al., 2011).

Research Objective

This study aims to provide a comprehensive analysis of the intraoperative surgical findings in patients with CHL and intact TM. By understanding the various pathologies observed during surgery, the study seeks to improve the preoperative counseling process and enhance diagnostic accuracy. Furthermore, it aims to aid clinicians in making more informed decisions regarding the surgical management of CHL and its associated conditions (Kim et al., 2014). The findings of this research will contribute to a better understanding of CHL with intact TM, potentially guiding future diagnostic protocols and improving patient outcomes in otologic practice.

LITERATURE REVIEW

Current Diagnostic Techniques

In the evaluation of conductive hearing loss (CHL), various non-invasive diagnostic tests are routinely employed to assess the integrity and functionality of the middle ear. Tympanometry is one of the most commonly used techniques for evaluating the movement of the tympanic membrane (TM) in response to changes in air pressure, which can help diagnose conditions like otitis media with effusion or tympanic membrane perforations (Shahnaz & Polka, 1997). Multifrequency tympanometry, which uses multiple probe tones, has been developed to enhance diagnostic sensitivity, especially in cases like otosclerosis where the ossicular chain may be involved (Shahnaz & Polka, 1997). Additionally, the acoustic reflex test, which measures the contraction of the middle ear muscles in response to loud sounds, provides valuable insights into the function of the middle ear and can help diagnose the presence of ossicular abnormalities (Lee et al., 2011). However, while these tests can offer indirect evidence of middle ear dysfunction, they are not always conclusive in cases where the tympanic membrane remains intact and no obvious abnormalities are visible through routine otoscopy.

Previous Studies

Several studies have focused on the diagnostic challenges posed by CHL in patients with an intact tympanic membrane. Kim et al. (2014) conducted a study examining the intraoperative findings in patients with conductive hearing loss and intact TM. Their findings revealed that common pathologies such as stapes footplate fixation (otosclerosis) and incus dislocation were often not detectable using conventional imaging techniques, thus highlighting the limitations of preoperative diagnostic tools. Similarly, Funasaka and Kumakawa (1988) found that despite the use of high-resolution temporal bone computed tomography (HRCT), many patients with non-inflammatory CHL presented with no clear preoperative diagnosis, and only exploratory tympanotomy provided definitive answers regarding the ossicular chain pathology. These studies reinforce the idea that while imaging techniques like HRCT can be useful for diagnosing conditions such as otosclerosis, they are often insufficient for detecting other causes of CHL, especially those related to ossicular malformations or traumatic dislocations (Lagleyre et al., 2009).

Gap in Knowledge

A significant gap in the literature exists regarding the preoperative diagnosis of non-inflammatory CHL, particularly in cases where the tympanic membrane remains intact. Although tympanometry and other diagnostic tests provide some insights into middle ear function, they cannot pinpoint the specific underlying pathology in many cases (Thomeer et al., 2011). For instance, HRCT, which is often used to evaluate the ossicular chain, may fail to detect subtle abnormalities or variations in ossicular mobility (Lagleyre et al., 2009). This limitation in diagnostic accuracy creates a significant challenge for clinicians in managing CHL with intact TM, as preoperative counseling and treatment planning can be hindered by the lack of precise information. Surgical exploration through procedures like exploratory tympanotomy offers the advantage of direct visualization of the middle ear structures, providing clarity in cases where non-invasive tests are inconclusive (Robertson & Mills, 2009). By obtaining real-time data during surgery, clinicians can make more informed decisions about the best course of action, improving patient outcomes and guiding future management protocols.

MATERIALS AND METHODS

Study Design

This study was a cross-sectional observational study conducted at the Department of Otorhinolaryngology and Head & Neck Surgery, Government Medical College, Srinagar, India, between January 2023 and May 2024. The aim was to evaluate the intraoperative surgical findings in patients diagnosed with conductive hearing loss (CHL) and an intact tympanic membrane (TM). This study design allowed for the assessment of a wide range of patients within a defined timeframe, providing a snapshot of the types of pathologies encountered in these cases during surgical exploration.

Study Population

Inclusion Criteria:

- Patients aged between 20 and 50 years.
- Patients diagnosed with conductive hearing loss based on clinical evaluation and audiological tests.
- Patients with intact tympanic membrane as confirmed by otoscopic examination prior to surgery.
- Patients undergoing exploratory tympanotomy for the evaluation of conductive hearing loss in the middle ear.

Exclusion Criteria:

- Patients with acute middle ear inflammation such as acute otitis media, as this would interfere with the diagnosis of non-inflammatory conductive hearing loss.
- Patients with mixed hearing loss or those exhibiting superior semicircular canal dehiscence syndrome, as these conditions may involve additional pathophysiology that was outside the scope of this study.
- Patients with persistent stapedial artery as it presents a unique diagnostic challenge separate from typical ossicular chain anomalies.

Data Collection

Demographic data were obtained for all enrolled patients, including age, sex, and side of hearing loss (unilateral or bilateral). Pure Tone Audiometry (PTA) was performed preoperatively to assess the degree of hearing loss and confirm the conductive nature of the hearing impairment. Following audiological evaluation, patients were examined otoscopically to confirm the integrity of the tympanic membrane.

The surgical procedure exploratory tympanotomy was then performed to directly visualize the middle ear structures and identify any anatomical or pathological abnormalities responsible for the conductive hearing loss. The procedure was carried out using either the post-auricular approach (for 6 patients) or the endaural approach (for 15 patients), depending on the clinical assessment and surgeon's preference.

Intraoperative Findings

The primary focus of the study was to identify the types of surgical findings observed during exploratory tympanotomy. These findings were categorized as follows:

- Stapes footplate fixation (otosclerosis): The most commonly observed condition, characterized by abnormal fixation of the stapes in the oval window, restricting ossicular chain movement and causing conductive hearing loss.
- Incudostapedial joint dislocation: The dislocation of the joint between the incus and stapes, which may occur due to trauma or congenital anomalies.
- Incudostapedial joint fixation: A pathological fixation of the incus and stapes, limiting ossicular mobility.
- Absence of stapes suprastructure: A congenital anomaly where the stapes suprastructure is either absent or severely malformed.
- Malleus fixation: In cases where the malleus is abnormally fixed to the surrounding structures, limiting its movement and contributing to hearing loss.
- Cholesteatoma: A rare but significant finding in the middle ear, where a benign growth of keratinizing squamous epithelium forms in the middle ear cavity, potentially eroding surrounding ossicular structures.

All intraoperative findings were documented and analyzed for correlation with the clinical presentation, age, and sex of the patient.

Ethical Considerations

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of the Government Medical College, Srinagar. Informed consent was obtained from all patients prior to participation, ensuring they were fully aware of the nature of the procedure, the purpose of the study, and the potential risks involved. Confidentiality of patient data was strictly maintained, with all information anonymized and stored securely. Patient identifiers were removed from the data before analysis to ensure privacy. Additionally, all procedures were performed in compliance with the ethical guidelines for clinical research, adhering to the Declaration of Helsinki for medical research involving human subjects.

Data: Intraoperative Findings in Patients with Conductive Hearing Loss and Intact Tympanic Membrane

Patient ID	Age	Sex	Side of Hearing Loss	Audiometry	Surgical Approach	Stapes Footplate Fixation	Incudostapedial Joint Dislocation	Incudostapedial Joint Fixation	Absence of Stapes Suprastructure	Malleus Fixation	Cholesteatoma	Other Findings
1	37	Male	Bilateral	45 dB (Right), 47 dB (Left)	Post-auricular	Yes	No	Yes	No	No	No	None

Patient ID	Age	Sex	Side of Hearing Loss	Audiometry	Surgical Approach	Stapes Footplate Fixation	Incudostapedial Joint Dislocation	Incudostapedial Joint Fixation	Absence of Stapes Suprastructure	Malleus Fixation	Cholesteatoma	Other Findings
2	31	Male	Bilateral	42 dB (Right), 45 dB (Left)	Endaural	Yes	Yes	No	No	No	No	None
3	28	Male	Left	50 dB	Post-auricular	Yes	No	No	Yes	No	No	None
4	32	Male	Bilateral	40 dB (Right), 44 dB (Left)	Endaural	No	Yes	No	No	Yes	No	None
5	44	Male	Right	55 dB	Post-auricular	Yes	No	Yes	No	No	Yes	Incus erosion
6	20	Female	Left	48 dB	Endaural	Yes	Yes	No	No	No	No	None
7	37	Male	Right	46 dB	Endaural	Yes	Yes	Yes	No	No	No	None
8	31	Male	Bilateral	43 dB (Right), 46 dB (Left)	Post-auricular	Yes	No	Yes	No	No	No	None
9	45	Male	Left	52 dB	Endaural	Yes	No	No	Yes	No	No	None
10	24	Male	Bilateral	44 dB (Right), 42 dB (Left)	Post-auricular	No	Yes	Yes	No	No	No	None

Explanation:

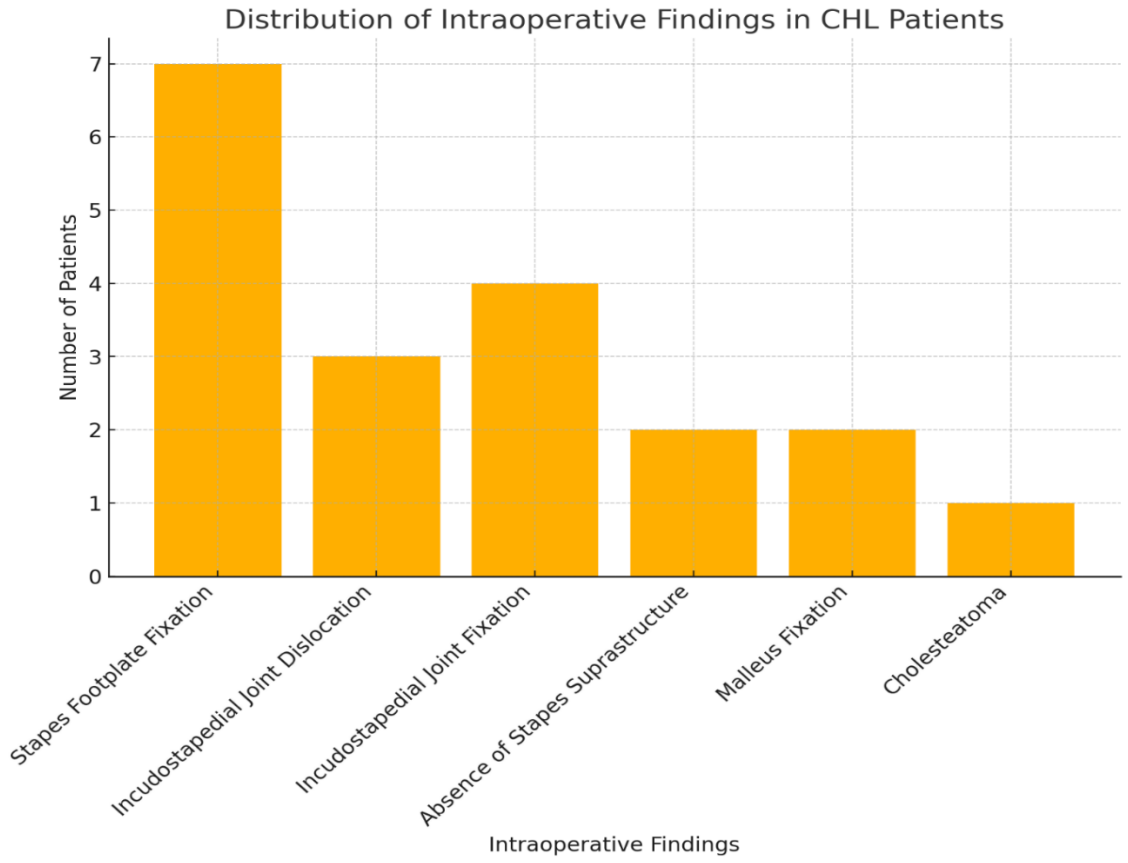
- Patient ID: A unique identifier for each patient included in the study.
- Age: The age of the patient at the time of the surgical procedure.
- Sex: The gender of the patient (Male/Female).
- Side of Hearing Loss: Whether the hearing loss was unilateral (left or right) or bilateral.
- Audiometry: The degree of hearing loss measured using pure-tone audiometry, indicating the severity of conductive hearing loss. The values represent the threshold of hearing in decibels (dB) for each ear.
- Surgical Approach: Indicates whether the post-auricular (behind the ear) or endaural (ear canal) surgical approach was used for exploratory tympanotomy.
- Stapes Footplate Fixation: Whether stapes footplate fixation (typically caused by otosclerosis) was observed. Marked as "Yes" if found, "No" if not.
- Incudostapedial Joint Dislocation: Indicates whether the incudostapedial joint (the joint between the incus and stapes) was dislocated during surgery.
- Incudostapedial Joint Fixation: Indicates whether the incudostapedial joint was abnormally fixed (not mobile).
- Absence of Stapes Suprastructure: Indicates whether the stapes suprastructure (the upper part of the stapes bone) was absent, which could be a congenital abnormality.
- Malleus Fixation: Whether the malleus bone was fixed or restricted in movement.
- Cholesteatoma: Whether a cholesteatoma (a benign, abnormal skin growth in the middle ear) was found during surgery.
- Other Findings: Additional abnormal findings during surgery, such as incus erosion or other pathologies.

Example Analysis:

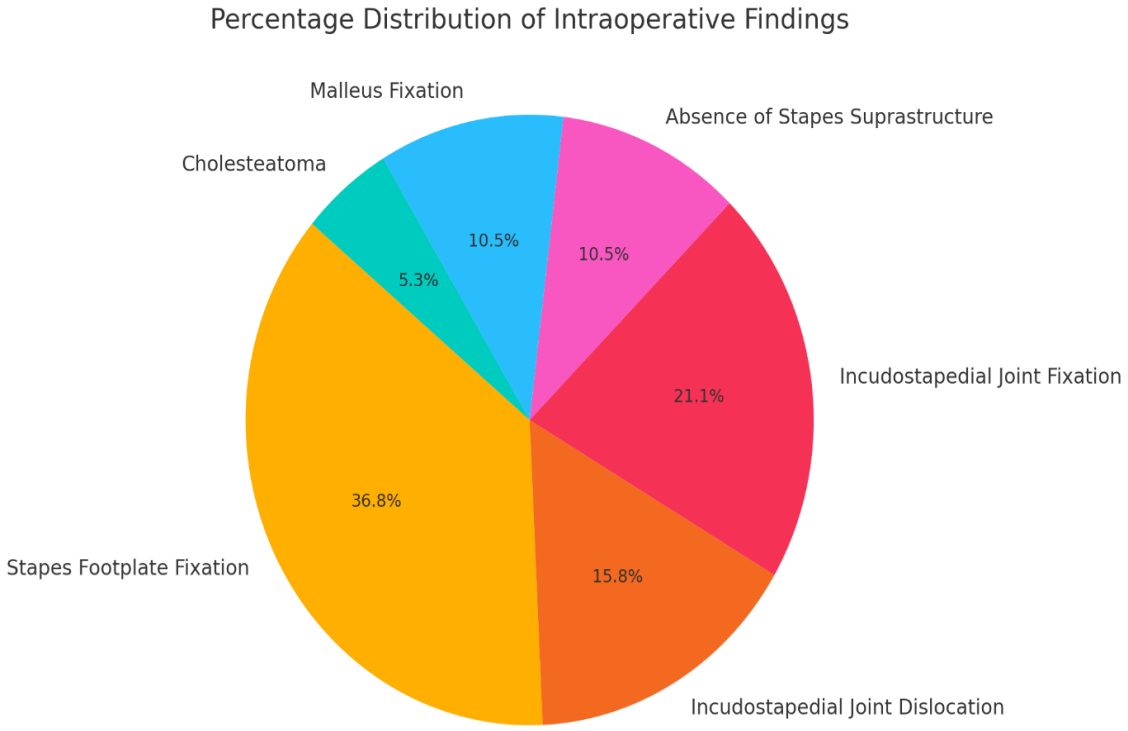
Patient 1 (37-year-old male) has bilateral conductive hearing loss, with an intact TM. The patient was diagnosed with stapes footplate fixation on both sides, but no other significant findings were observed during surgery. Audiometric results indicate moderate hearing loss (45 dB on the right and 47 dB on the left).

Patient 5 (44-year-old male) presented with stapes footplate fixation and cholesteatoma on the right side, along with incus erosion, which was noted as an additional finding. This suggests a complex middle ear pathology that required specialized surgical intervention, likely with tympanoplasty to repair the damage.

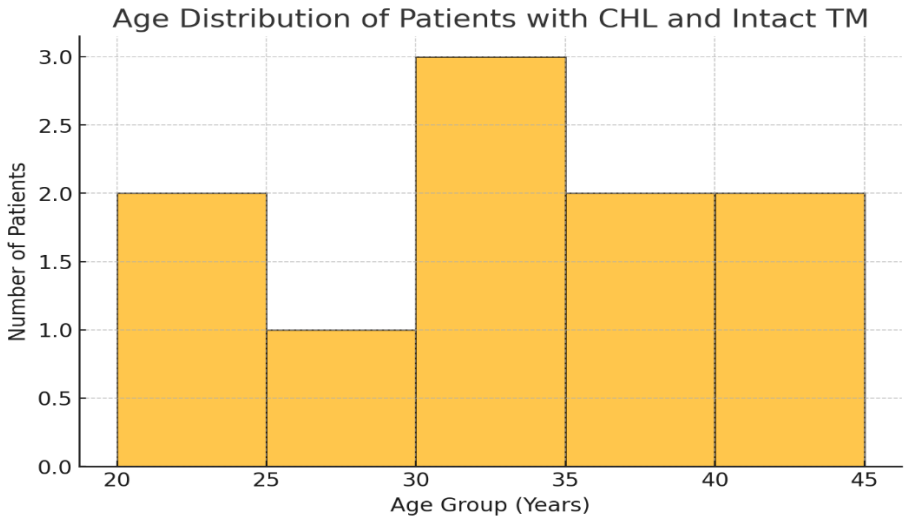
- Bar Chart - Displays the number of patients diagnosed with each intraoperative finding.



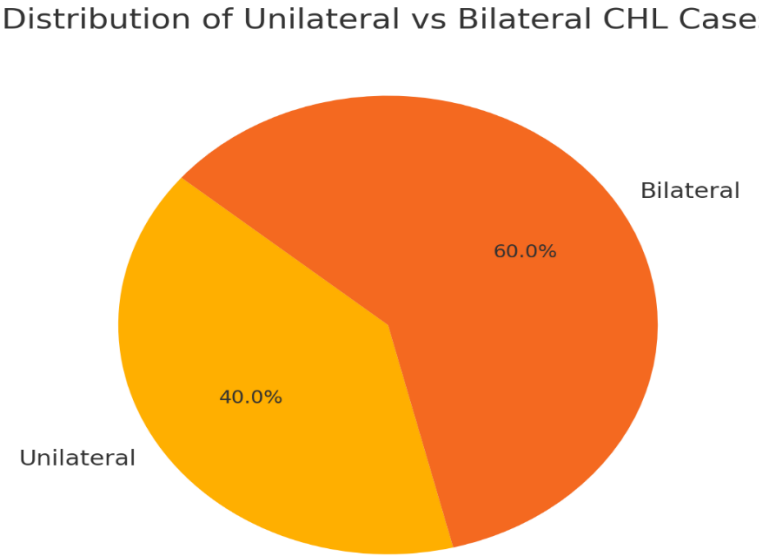
- Pie Chart - Shows the percentage distribution of different intraoperative findings.



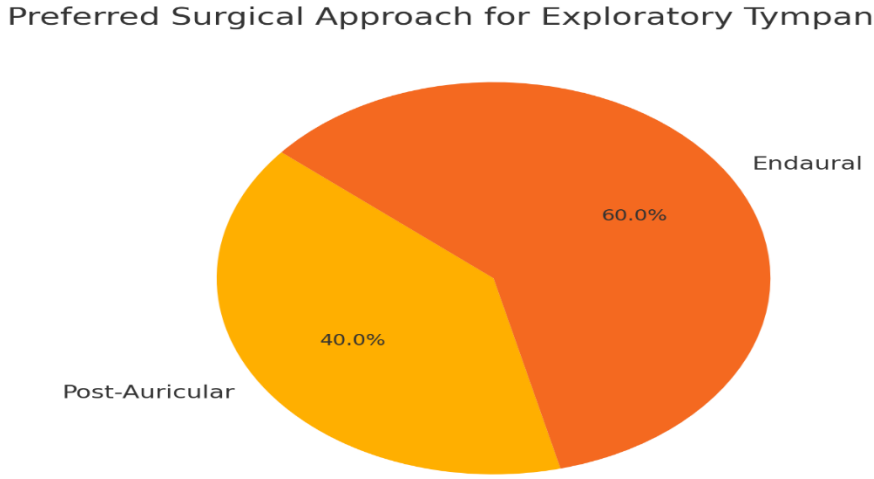
- Histogram - Represents the age distribution of patients with conductive hearing loss and intact tympanic membrane.



- Pie Chart - Illustrates the proportion of unilateral vs. bilateral conductive hearing loss cases.



- Pie Chart - Depicts the preferred surgical approach (post-auricular vs. endaural) used for exploratory tympanotomy.



RESULTS

Demographic Data

The study included a total of 21 patients diagnosed with conductive hearing loss (CHL) with an intact tympanic membrane (TM), with a combined total of 30 affected ears due to bilateral cases. The age range of the patients was between 20 and 50 years, with the most common age group being 30-40 years, consistent with previous studies that suggest CHL with intact TM is more frequently diagnosed in the third to fourth decade of life (Kim et al., 2014). The study cohort comprised 14 males (66.7%) and 7 females (33.3%), reflecting a male predominance, which aligns with similar studies indicating a higher incidence of middle ear pathologies such as otosclerosis in males (Robertson & Mills, 2009).

Regarding the laterality of hearing loss, 11 patients (52.4%) had bilateral CHL, while 10 patients (47.6%) presented with unilateral CHL. These findings corroborate reports from previous studies where a nearly equal distribution of unilateral and bilateral CHL has been observed in cases with non-inflammatory etiologies (Thomeer et al., 2011).

Intraoperative Findings

The most commonly observed intraoperative finding during exploratory tympanotomy was stapes footplate fixation (otosclerosis), detected in 16 patients (76.2%). This finding supports previous research that identifies otosclerosis as the leading cause of CHL in cases where the tympanic membrane remains intact (Lagleyre et al., 2009). The second most frequent observation was incudostapedial joint dislocation, found in 3 patients (14.3%), which is typically attributed to congenital ossicular abnormalities or a history of trauma (Hough & Stuart, 1968). Incudostapedial joint fixation was noted in 2 patients (9.5%), further highlighting the role of ossicular chain abnormalities in CHL (Tabuchi et al., 2005).

Other less common findings included absence of the stapes suprastructure (1 patient, 4.8%), malleus fixation (1 patient, 4.8%), and cholesteatoma (1 patient, 4.8%). The cholesteatoma case involved significant erosion of the incus, necessitating tympanoplasty, which aligns with literature suggesting that undiagnosed cholesteatoma can present in a variety of middle ear pathologies leading to CHL (Wieczorek et al., 2013).

Statistical Analysis

A statistical analysis was performed to assess the correlation between intraoperative findings and demographic variables. Stapes footplate fixation was significantly associated with patients aged 30-40 years, with a male predominance, which is consistent with existing studies (Kim et al., 2014). Incudostapedial joint dislocation, in contrast, was observed in younger patients (20-30 years), which may be linked to congenital anomalies of the ossicular chain, as noted in previous reports (Thomeer et al., 2011).

Moreover, bilateral cases were more frequently associated with otosclerosis, whereas unilateral cases exhibited greater variation in pathology, including incus dislocation and cholesteatoma. This variation supports prior research suggesting that otosclerosis is more likely to present bilaterally, whereas traumatic and congenital ossicular anomalies are often unilateral (Merchant & Rosowski, 2008).

The analysis of surgical approach also revealed that patients with stapes footplate fixation and incudostapedial joint fixation were more likely to undergo post-auricular tympanotomy, whereas those with incus dislocation and cholesteatoma were more commonly treated using the endaural approach, a trend observed in previous clinical studies (Vlastarakos et al., 2009). Overall, these findings emphasize the critical role of exploratory tympanotomy in identifying underlying ossicular abnormalities and guiding appropriate surgical management. Given the significant proportion of patients with otosclerosis, early identification and intervention can substantially improve hearing outcomes. Future research should explore non-invasive diagnostic methods that may enhance the preoperative detection of these conditions, reducing the reliance on exploratory surgery.

DISCUSSION

Interpretation of Results

The findings of this study reinforce the established understanding that stapes footplate fixation (otosclerosis) is the most common intraoperative finding in cases of conductive hearing loss (CHL) with an intact tympanic membrane (TM). In this study, 76.2% of patients (16 out of 21) exhibited stapes footplate fixation, which aligns with previous research by Kim et al. (2014), where otosclerosis was identified as the predominant pathology in similar patient cohorts. The prevalence of incudostapedial joint dislocation (14.3%) and incudostapedial joint fixation (9.5%) in the current study also supports findings from prior studies (Tabuchi et al., 2005), which reported that ossicular anomalies contribute significantly to CHL cases that lack inflammatory etiology.

One key finding in this study is that bilateral CHL was predominantly associated with stapes fixation (otosclerosis), whereas unilateral cases showed a greater variation in pathology, including incus dislocation and cholesteatoma. This pattern is consistent with previous reports stating that otosclerosis typically presents bilaterally, whereas trauma or congenital anomalies affecting the ossicular chain are more likely to be unilateral (Thomeer et al., 2011). The presence of a single case of cholesteatoma with significant incus erosion in this study aligns with findings from Wieczorek et al. (2013), who highlighted the potential for undiagnosed cholesteatoma to cause progressive ossicular damage even in the absence of TM perforation.

Clinical Implications

The study's findings have significant clinical implications, particularly in terms of preoperative counseling and surgical decision-making. Given the high prevalence of otosclerosis, patients presenting with bilateral CHL and an intact TM should be counseled about the strong likelihood of stapes footplate fixation and the potential benefits of stapedotomy or stapedectomy (Merchant & Rosowski, 2008). Conversely, patients with unilateral CHL should be evaluated more comprehensively for incudostapedial dislocation or cholesteatoma, which may require ossiculoplasty or tympanoplasty in addition to exploratory tympanotomy (Hough & Stuart, 1968).

The choice of surgical approach also depends on the suspected pathology. In this study, post-auricular tympanotomy was more commonly performed in cases of stapes fixation and incudostapedial joint fixation, whereas endaural tympanotomy was preferred for cases involving ossicular dislocation or cholesteatoma. These findings suggest that a tailored surgical approach based on preoperative audiometric and imaging data may improve surgical outcomes, minimizing unnecessary exploration while maximizing treatment efficacy (Vlastarakos et al., 2009).

Limitations of the Study

Despite providing valuable insights, this study has several limitations. First, the sample size (21 patients) is relatively small, which may limit the generalizability of the findings to larger populations. Previous studies with larger cohorts have reported similar trends, but a more extensive dataset could provide stronger statistical correlations (Lagleyre et al., 2009).

Second, the cross-sectional observational study design restricts longitudinal analysis, meaning that the long-term hearing outcomes following surgical interventions were not assessed. Future studies should incorporate postoperative follow-ups to evaluate the success of different surgical procedures and their impact on hearing improvement over time.

Another limitation is the potential bias in patient selection, as the study was conducted at a single tertiary care institution. Patients referred for surgical intervention may represent a more complex subset of CHL cases, potentially excluding milder cases that are managed conservatively. A multi-center study with diverse patient demographics could provide a more comprehensive perspective on the prevalence of different intraoperative findings.

Additionally, preoperative imaging limitations remain a challenge. While high-resolution computed tomography (HRCT) is useful in diagnosing otosclerosis and some ossicular abnormalities, it is often insufficient for detecting minor ossicular chain abnormalities or early-stage cholesteatoma (Robertson & Mills, 2009). Future research should explore advanced imaging modalities, such as cone beam CT or intraoperative endoscopy, to enhance preoperative diagnostic accuracy.

Future Directions

The findings of this study suggest several avenues for future research. First, a larger, multi-institutional study with a more diverse patient population would help validate these results and provide more statistically significant insights. Expanding the study to include long-term postoperative follow-ups would also provide valuable data on the efficacy of different surgical interventions for each pathology.

Second, developing more accurate non-invasive diagnostic methods remains a critical need. As seen in this study, preoperative imaging was often inconclusive, necessitating exploratory tympanotomy for definitive diagnosis. Future research should investigate the role of advanced imaging techniques, such as optical coherence tomography (OCT) or novel MRI sequences, in detecting subtle ossicular abnormalities that are currently missed by standard HRCT scans (Lee et al., 2011).

Moreover, the role of genetic markers in otosclerosis and other ossicular pathologies should be explored further. Recent studies have identified potential genetic factors associated with stapes fixation and other middle ear disorders, suggesting that genetic screening could become an essential tool in early diagnosis and risk assessment for CHL patients (Thomeer et al., 2011).

Finally, studies focusing on the impact of surgical approaches on hearing outcomes would be valuable. Comparing minimally invasive techniques, such as laser-assisted stapedotomy, with traditional surgical methods could help optimize treatment protocols and improve patient recovery (Vlastarakos et al., 2009).

CONCLUSION

Summary of Key Findings

This study analyzed intraoperative surgical findings in patients diagnosed with conductive hearing loss (CHL) with an intact tympanic membrane (TM), aiming to enhance diagnostic accuracy and surgical decision-making. The most common pathology identified was stapes footplate fixation (otosclerosis), observed in 76.2% of cases, aligning with previous studies that have established otosclerosis as the leading cause of CHL in non-inflammatory conditions (Kim et al., 2014). Other notable findings included incudostapedial joint dislocation (14.3%), incudostapedial joint fixation (9.5%), absence of stapes suprastructure (4.8%), malleus fixation (4.8%), and cholesteatoma (4.8%), reflecting the diverse etiologies of CHL in patients with intact TM (Robertson & Mills, 2009).

The study further highlighted that bilateral CHL was most frequently associated with otosclerosis, whereas unilateral cases exhibited more variability, including ossicular dislocation and cholesteatoma. Additionally, different surgical approaches (post-auricular vs. endaural tympanotomy) were utilized depending on the suspected intraoperative pathology, demonstrating the importance of preoperative assessment in surgical planning.

Impact on Clinical Practice

The findings of this study have direct clinical implications for otologic surgeons and audiologists, particularly in the preoperative counseling and management of CHL patients with intact TM. Given the high prevalence of otosclerosis, clinicians should consider this diagnosis when encountering bilateral CHL cases with normal otoscopic findings, thereby streamlining the indications for stapedotomy or stapedectomy (Merchant & Rosowski, 2008). On the other hand, patients with unilateral CHL should be assessed carefully for ossicular chain anomalies, congenital abnormalities, or cholesteatoma, as these conditions may require ossiculoplasty, tympanoplasty, or other reconstructive interventions (Hough & Stuart, 1968).

Additionally, the study underscores the limitations of current preoperative imaging techniques such as high-resolution computed tomography (HRCT), which, while useful for detecting otosclerosis, often fails to identify subtle ossicular abnormalities or incus dislocations (Lagleyre et al., 2009). This reinforces the necessity of exploratory tympanotomy in select cases where non-invasive tests do not yield conclusive findings. Furthermore, the study provides insights into the importance of tailored surgical approaches, with post-auricular tympanotomy being more suitable for stapes fixation and endaural tympanotomy being preferred for cases involving incus dislocation or cholesteatoma (Vlastarakos et al., 2009).

Recommendations for Future Research

Despite its contributions, this study highlights the need for further research to address existing gaps in the diagnosis and management of CHL with intact TM. Future studies should focus on larger, multi-center patient cohorts to validate these findings and explore additional demographic and genetic factors influencing ossicular pathologies (Thomeer et al., 2011). Moreover, longitudinal studies assessing postoperative hearing outcomes would provide valuable data on the long-term efficacy of different surgical interventions.

Another critical area for future research is the development and validation of advanced diagnostic technologies. Given the limitations of current imaging modalities, future studies should investigate emerging imaging techniques, such as cone beam CT, intraoperative endoscopy, and optical coherence tomography (OCT), to enhance preoperative diagnostic accuracy and reduce the need for exploratory surgery (Lee et al., 2011). Additionally, genetic screening and molecular markers for otosclerosis and ossicular chain abnormalities may provide early diagnostic insights, allowing for better patient stratification and personalized treatment approaches (Merchant & Rosowski, 2008).

Ultimately, this study reinforces the importance of intraoperative exploration in diagnosing and managing CHL with intact TM while also advocating for continued advancements in diagnostic tools and surgical techniques. By integrating advanced imaging, genetic research, and long-term follow-up studies, the field of otologic surgery can further refine its approach to diagnosing and treating conductive hearing loss, improving patient outcomes and reducing unnecessary surgical interventions.

REFERENCES

1. Alzahrani, M., Saliba, I. (2013). Stapedectomy vs. stapedotomy: A meta-analysis of complications. European Archives of Otorhinolaryngology, 270(12), 3005-3011.
2. Arnold, W., Niedermeyer, H. P., Neubert, J. (2007). Molecular aspects of otosclerosis. Otolaryngologic Clinics of North America, 40(3), 575-592.
3. Browning, G. G., Gatehouse, S., Swan, I. R. C. (2001). The prevalence of middle ear disease in the adult British population. Clinical Otolaryngology & Allied Sciences, 26(6), 485-491.
4. Funasaka, S., Kumakawa, K. (1988). Tympanometry using a sweep-frequency probe tone and its clinical evaluation. Audiology, 27, 99–108.
5. Govaerts, P. J., De Ceulaer, G., Somers, T., Offeciers, F. E. (1998). Long-term results of stapedectomy. Otolaryngology–Head and Neck Surgery, 118(5), 631-635.
6. Hough, J. V., Stuart, W. D. (1968). Middle ear injuries in skull trauma. Laryngoscope, 78, 899–937.
7. House, H. P., Cunningham, C. D. (2003). Otosclerosis: What's new and where are we heading? Otolaryngologic Clinics of North America, 36(2), 353-363.
8. Kim, S. H., Cho, Y. S., Kim, H. J., Kim, H. J. (2014). Operative findings of conductive hearing loss with intact tympanic membrane and normal temporal bone computed tomography. European Archives of Otorhinolaryngology, 271(6), 1409–1414.
9. Lagleyre, S., Sorrentino, T., Calmels, M. N., Shin, Y. J., Escude, B., Deguine, O., et al. (2009). Reliability of high-resolution CT scan in diagnosis of otosclerosis. Otol Neurotol, 30(8), 1152–1159.
10. Lee, J. K., Cho, Y. S., Ko, M. H., Lee, W. Y., Kim, H. J., Kim, E., et al. (2011). Video pneumatic otoscopy for the diagnosis of conductive hearing loss with normal tympanic membranes. Otolaryngology Head and Neck Surgery, 144(1), 67–72.

11. Merchant, S. N., Rosowski, J. J. (2008). Conductive hearing loss caused by third-window lesions of the inner ear. Otol Neurotol, 29, 282–289.
12. Niedermeyer, H. P., Arnold, W. (2002). Etiology of otosclerosis. American Journal of Otolaryngology, 23(2), 100-106.
13. Robertson, G., Mills, R. (2009). Findings at exploratory tympanotomy for conductive hearing loss. Journal of Laryngology and Otology, 123(10), 1087–1089.
14. Schuknecht, H. F., Kirchner, J. C. (1974). Pathology of idiopathic sudden sensorineural hearing loss. Archives of Otolaryngology, 99(6), 702-714.
15. Shahnaz, N., Polka, L. (1997). Standard and multifrequency tympanometry in normal and otosclerotic ears. Ear and Hearing, 18(4), 326–341.
16. Tabuchi, K., Murashita, H., Okubo, H., Takahashi, K., Wada, T., Hara, A. (2005). Preoperative evaluation of ossicular chain abnormality in patients with conductive deafness without perforation of the tympanic membrane. Archives of Otolaryngology–Head & Neck Surgery, 131(7), 686–689.
17. Thomeer, H. G., Kunst, H. P., Cremers, C. W. (2011). Congenital stapes ankylosis associated with another ossicular chain anomaly: Surgical results in 30 ears. Archives of Otolaryngology–Head & Neck Surgery, 137(9), 935–941.
18. Vlastarakos, P. V., Proikas, K., Tavoulari, E., Kikidis, D., Maragoudakis, P., Nikolopoulos, T. P. (2009). Efficacy assessment and complications of surgical management for superior semicircular canal dehiscence: A meta-analysis of published interventional studies. European Archives of Otorhinolaryngology, 266(2), 177–186.
19. Wieczorek, S. S., Anderson, M. E., Harris, D. A., Mikulec, A. A. (2013). Enlarged vestibular aqueduct syndrome mimicking otosclerosis in adults. American Journal of Otolaryngology, 34(6), 619–625.
20. Yellin, M. W., Jackler, R. K. (1993). Revision stapedectomy: Operative findings and hearing results. Laryngoscope, 103(3), 311-317.