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Original Research Article

Transient contralateral cochlear dysfunction following mastoidectomy: a prospective evaluation using distortion product otoacoustic emissions

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ABSTRACT

Background: Mastoidectomy remains an essential procedure for managing chronic suppurative otitis media, drilling forms an integral part of the surgery, the acoustic energy generated during drilling may influence cochlear function in the contralateral ear through bone-conducted transmission. Distortion product otoacoustic emissions (DPOAEs) serve as a sensitive indicator of outer hair cell integrity and can detect subtle postoperative auditory changes. This study aimed to evaluate contralateral cochlear function following mastoid drilling and to assess the reversibility of any alterations observed.

Methods: A prospective observational study was conducted on 30 patients with unilateral disease undergoing mastoidectomy for 18 months. Individuals with normal preoperative hearing in the non-operated ear were included. DPOAEs were recorded preoperatively and on postoperative day (POD) 1, POD 3, and POD 7 at frequencies ranging from 988 to 6000 Hz. Statistical analysis was performed using McNemar's and chi-square tests, with $p \leq 0.05$ considered significant.

Results: All patients demonstrated normal preoperative DPOAEs. A significant proportion exhibited absent responses on POD 1, followed by partial recovery on POD 3. Complete restoration of emissions across all frequencies was documented by POD 7, indicating a transient and reversible cochlear effect.

Conclusion: Mastoid drilling can temporarily alter contralateral cochlear function, likely due to acoustic and vibratory transmission, but these changes resolve within the early postoperative period. Incorporating DPOAE monitoring may improve perioperative evaluation and patient counselling, while future studies with larger cohorts may help clarify long-term implications.

Keywords: Mastoidectomy, DPOAE, Contralateral ear, Cochlear function, Postoperative monitoring

INTRODUCTION

Chronic otitis media (COM) continues to be a major cause of preventable hearing impairment worldwide, particularly developing countries where its prevalence can exceed 7–8% of the population.[1] Mastoidectomy remains a cornerstone in the surgical management of COM. While the procedure primarily aims to eradicate disease and restore a safe middle ear environment, concerns persist regarding the potential effects of high-speed mastoid drilling on the auditory function of the contralateral, clinically normal ear.[2]

High-speed otologic drills generate substantial noise, with intraoperative noise levels reported to exceed 100–120 dB SPL.[3] Although the operated ear is exposed directly to mechanical and acoustic trauma, the contralateral ear may also be vulnerable to drill-borne noise transmission due to minimal interaural skull attenuation.[4] Noise-induced cochlear changes can occur even at modest exposure levels, with outer hair cells

being the earliest and most sensitive structures affected.[5] These subtle cochlear alterations may not be detected on pure-tone audiometry but can be captured through otoacoustic emissions (OAEs), which provide an objective and highly sensitive measure of outer hair cell integrity.[6]

Given the widespread use of mastoid drills and the critical importance of safeguarding hearing in both ears, there is a need for systematic evaluation of contralateral cochlear function using reliable, non-invasive tools. Understanding whether drilling-related changes are transient or permanent has significant implications for operative technique, intraoperative protective strategies, and postoperative counselling.[7-9]

The present study was designed to measure the effect of mastoid drilling on contralateral ear hearing using OAE testing and to follow patients over time to determine whether any observed changes are transient or permanent. By providing objective data using a standardized protocol and serial assessments, this study aims to strengthen the evidence base for perioperative auditory risk in CSOM surgery and inform safer clinical practice.

METHODS

Study setting and design

This prospective observational study was conducted in the Department of Otorhinolaryngology at Guru Gobind Singh Medical College and Hospital (GGSMCH), Faridkot Punjab India. The study spanned 18 months from July 2023 to Dec 2024 following institutional ethics committee approval (Ethics Committee Re-Registration No. ECR/836/Inst/PB/2016/RR-25).

Study population

A total of 30 patients diagnosed with chronic suppurative otitis media (CSOM) in one ear and scheduled for mastoid surgery were recruited from the outpatient department. Eligibility was determined by history, clinical examination, and audiological assessment. Participants were between 18 and 70 years of age and were included only if the contralateral ear demonstrated normal otoscopic findings, pure-tone thresholds, and distortion product otoacoustic emissions (DPOAEs).

Patients were excluded if they had undergone previous mastoid surgery, had any abnormality or hearing impairment in the contralateral ear, had a history of occupational noise exposure, suffered from chronic systemic illnesses such as diabetes or hypertension, or reported the use of ototoxic medications. A non-probability convenience sampling strategy was adopted, and the first 30 individuals meeting eligibility criteria were enrolled.

Informed consent

The purpose and procedures of the study were explained to each participant in their native language. Only those who provided written informed consent were included. Participants were assured of confidentiality and informed of their right to withdraw at any point without affecting their clinical care.

Data collection tools and preoperative assessment

Data were recorded using a structured proforma capturing demographic information, detailed otologic history, clinical findings, and audiological investigations. All patients underwent otoscopic evaluation, routine haematological tests, pure-tone audiometry (PTA), and DPOAE testing prior to surgery.

PTA was conducted in a sound-treated room using the PIANO INVENTIS audiometer. Hearing thresholds at 500, 1000, and 2000 Hz were obtained, and the pure-tone average was calculated. DPOAEs were measured using the Neurosoft OAE system (Medlife Technologies). Two primary tones (f1 and f2) with a fixed frequency ratio (f2/f1=1.22) were presented at levels of L1=65 dB SPL and L2=55 dB SPL. DPOAE responses were recorded at f2 frequencies of 988, 1481, 2222, 2963, 4444, and 6000 Hz. Responses were categorised as PASS if emissions were present and REFER if absent.

Only patients with intact preoperative DPOAEs in the contralateral ear were included in the final analysis.

Surgical procedure

All surgeries were performed under standard aseptic conditions. Patients were positioned with the diseased ear uppermost, followed by infiltration of the postauricular region and external auditory canal using 2% lignocaine with adrenaline. A postauricular incision was made 0.5–1 cm behind the groove, and temporalis fascia grafts of appropriate size were harvested.

After freshening the perforation margins and elevating the tympanomeatal flap, mastoid drilling was initiated. Large cutting burrs were used for initial bone removal, followed by progressively smaller cutting or diamond burrs when working near critical structures including the facial nerve canal, lateral semicircular canal, tegmen plate, sigmoid sinus, and digastric ridge. Mastoidectomy—either canal-wall-up or canal-wall-down—was performed based on disease extent, followed by the required type of tympanoplasty.

The average duration of surgery ranged from 45 to 90 minutes. Haemostasis was secured, and mastoid dressing was applied. Postoperatively, all patients received antibiotics, analgesics, and antihistamines for one week.

Postoperative OAE assessment

The contralateral ear was reassessed using DPOAEs on postoperative day 1, day 3, and day 7. (Recorded DPOAE amplitudes were compared with preoperative baselines. In this cohort, all patients demonstrated complete return of DPOAE values to preoperative levels by day 7.

Data management and statistical analysis

All data were compiled in Microsoft Excel and analysed using IBM SPSS Statistics version 20. Descriptive statistics included means, medians, and standard deviations for quantitative variables, and frequency distributions for categorical variables. Comparisons between preoperative and postoperative DPOAE results were performed using the chi-square test and McNemar's test as appropriate. A p value ≤0.05 was considered statistically significant, and all analyses were two-tailed.

Ethical considerations

Ethical approval was obtained from the Institutional Ethics Committee of GGSMCH, Faridkot (Ethics Committee Re-Registration No. ECR/836/Inst/PB/2016/RR-25). Written informed consent was secured from all participants. Confidentiality and anonymity of patient data were strictly maintained throughout the study.

RESULTS

In the present cohort of 30 patients with CSOM undergoing mastoid surgery, ear discharge was the most frequently reported symptom. A total of 28 patients (93.3%) presented with active otorrhoea, a distribution that was statistically significant (χ^2=22.533, p=0.0001). Vertigo was reported by 6 patients (20.0%), while the remaining 24 patients (80.0%) denied any vestibular symptoms (χ^2=10.8, p=0.001). Tinnitus was documented in 5 patients (16.7%), and the association was statistically significant (χ^2=13.333, p=0.0001). These findings underline that although otorrhoea remains the predominant presenting feature in CSOM, vestibular and auditory secondary symptoms are also observed in a minority of patients.

The severity of preoperative hearing impairment varied across individuals. Moderate hearing loss constituted the largest category, affecting 15 patients (50.0%), followed by mild loss in 9 patients (30.0%). Six patients (20.0%) exhibited moderately severe deficits, while no participants demonstrated severe or profound hearing loss. The mean pure-tone average was 47.17 dB (SD 8.69), reflecting a moderate level of auditory dysfunction overall. The chi-square analysis (χ^2 = 4.2, p=0.122) indicated that the differences in distribution were not statistically significant. Among the diagnostic categories, inactive mucosal disease (IM COM) was most prevalent, observed in 17 patients (56.7%). (IS COM) in 7 patients (23.3%), and active squamosal disease (AS COM) in 5 patients (16.7%). Only 1 patient (3.3%) presented with active mucosal disease (AM COM).

The contralateral ear demonstrated generally preserved hearing thresholds. Air-conduction PTA values showed a mean of 12.30 dB (SD 2.78), with a median of 12.50 dB and an interquartile range (IQR) of 10.00–14.00 dB. Bone-conduction PTA exhibited a mean of 7.83 dB (SD 2.80), with a median of 8.50 dB and an IQR of 6.00–10.00 dB. The air–bone gap remained minimal, with a mean of 4.50 dB (SD 1.50). The distribution of values, including narrow IQRs and modest ranges, confirmed that hearing in the contralateral ear was largely within normal limits preoperatively. This provided a suitable baseline for assessing potential postoperative changes associated with mastoid drilling.

Table 1: distribution of patients depicting various clinical features of the patients.

Clinical Features	Category	No. of patients	(%) age	Chi-Square	P value
Ear Discharge	Present	28	93.3	22.533	0.0001
	Absent	2	6.7	—	—
	Total	30	100.0	—	—
Vertigo	Present	6	20.0	10.8	0.001
	Absent	24	80.0	—	—
	Total	30	100.0	—	—
Tinnitus	Present	5	16.7	13.333	0.0001
	Absent	25	83.3	—	—
	Total	30	100.0	—	—

Table 2: patients distribution based on severity of hearing loss.

Hearing loss (db)	No. of patients	Percentage	Chi-square	P value
Mild	9	30.0%		
Moderate	15	50.0%		
Moderately Severe	6	20.0%		
Severe	0	0.0%	4.2	0.122
Profound	0	0.0%		
Total	30	100.0%		
Mean	47.17			
SD	8.69			

Table 3: patients distribution based on diagnosis.

Diagnosis	No. Of patients	Percentage	Chi-Square	P value
AM COM	1	3.3%		
AS COM	5	16.7%		
IM COM	17	56.7%		
IS COM	7	23.3%	18.533	0.0001
Total	30	100.0%		

Table 4: patients distribution based on preoperative PTA of contralateral ear.

Preoperative PTA	Preop AC PTA (dB)	Preop BC PTA (dB)	Preop AB Gap Normal Ear
N	30	30	30
Mean	12.30	7.83	4.50
Standard deviation	2.78	2.80	1.50
Median	12.50	8.50	4.50
Quartile-I	10.00	6.00	4.00
Quartile-III	14.00	10.00	6.00
Minimum	7.00	4.00	2.00
Maximum	18.00	12.00	7.00

A progressive improvement in otoacoustic emission (OAE) responses was observed across the postoperative period.

Low-frequency responses (988 Hz, 1481 Hz)

At 988 Hz, 88.2% of patients achieved a "pass" result on POD 1, increasing to 94.1% on POD 3, and reaching 100% by POD 7. A similar pattern was noted at 1481 Hz, with pass rates improving from 82.4% (POD 1) to 88.2% (POD 3), and ultimately 100% on POD 7. This consistent enhancement suggests that the contralateral cochlea exhibits early recovery from transient postoperative effects of mastoid drilling.

High-frequency responses (2222–6000 Hz)

High-frequency emissions displayed a more delayed but definitive recovery trajectory. At 2222 Hz, only 35.3% of patients passed on POD 1, rising to 64.7% by POD 3, and achieving 100% by POD 7. At 2963 Hz, 4444 Hz, and 6000 Hz, none of the patients elicited passing OAEs on POD 1. However, by POD 3, pass rates increased to 47.1%, 35.3%, and 17.6%, respectively. By POD 7, all patients demonstrated normal OAE responses across all high-frequency ranges (100%). These findings collectively indicate that mastoid drilling produces a transient suppression of high-frequency cochlear emissions in the contralateral ear, with complete recovery typically achieved within one week.

Table 5: Distribution of hearing loss at different frequencies on POD1, POD3, POD7.

Frequency		Post op Days					
		POD 1		POD 3		POD 7	
		N	%	N	%	N	%
988 Hz	Pass	15	88.2%	16	94.1%	17	100.0%
	Refer	2	11.8%	1	5.9%	0	0.0%
1481 Hz	Pass	14	82.4%	15	88.2%	17	100.0%
	Refer	3	17.6%	2	11.8%	0	0.0%
2222 Hz	Pass	6	35.3%	11	64.7%	17	100.0%
	Refer	11	64.7%	6	35.3%	0	0.0%
2963 Hz	Pass	0	0.0%	8	47.1%	17	100.0%
	Refer	17	100.0%	9	52.9%	0	0.0%
4444 Hz	Pass	0	0.0%	6	35.3%	17	100.0%
	Refer	17	100.0%	11	64.7%	0	0.0%
6000 Hz	Pass	0	0.0%	3	17.6%	17	100.0%
	Refer	17	100.0%	14	82.4%	0	0.0%

Table 6: Assessment of the patient on the basis of preoperative and post-operative status of the patient

Assessment Time	Result	No. of Patients	Percentage (%)	P value
Pre-operative	Pass	30	100.0	0.0001 (vs POD 1)
	Refer	0	0.0	
	Total	30	100.0	
Post-operative Day 1 (POD1)	Pass	13	43.3	
	Refer	17	56.7	
	Total	30	100.0	
Post-operative Day 3 (POD 3)	Pass	21	70.0	0.004 (vs POD 3)
	Refer	9	30.0	
	Total	30	100.0	
Post-operative Day 7 (POD 7)	Pass	30	100.0	>0.05 (vs POD 7)
	Refer	0	0.0	
	Total	30	100.0	

Table 7: Assessment of patient preoperative and post operative on day 7 with respect to frequency

Frequency (Hz)	Preoperative Pass (%)	POD 7 Pass (%)	POD 7 Refer (%)	p-value (POD7)
988 Hz	30 (100%)	30 (100%)	0 (0%)	>0.05
1481 Hz	30 (100%)	30 (100%)	0 (0%)	>0.05
2222 Hz	30 (100%)	30 (100%)	0 (0%)	>0.05
2963 Hz	30 (100%)	30 (100%)	0 (0%)	>0.05
4444 Hz	30 (100%)	30 (100%)	0 (0%)	>0.05
6000 Hz	30 (100%)	30 (100%)	0 (0%)	>0.05

All patients demonstrated normal otoacoustic emission (OAE) responses in the preoperative evaluation, with a 100% pass rate. However, a marked decline was observed on the first postoperative day (POD 1), where only 13 patients (43.3%) achieved a passing result, while 17 patients (56.7%) were categorized as "refer." This postoperative deterioration was statistically significant when compared with the preoperative status ($p = 0.0001$), reflecting an immediate postoperative suppression of cochlear responses likely attributable to drill-induced acoustic and vibratory stimuli.

By POD 3, a notable improvement was observed, with 21 patients (70.0%) demonstrating a pass result, and the

comparison with early postoperative outcomes remained statistically significant (p = 0.004). Complete recovery was observed by POD 7, with all 30 patients (100%) regaining normal OAE responses. The lack of statistical significance at this time point (p > 0.05) indicates full restoration of contralateral cochlear function, suggesting that the postoperative changes were transient and reversible.

Frequency-wise analysis demonstrated that all patients (100%) achieved normal OAE responses at every tested frequency during the preoperative evaluation. By POD 7, this complete recovery pattern persisted across all tested frequencies-988 Hz, 1481 Hz, 2222 Hz, 2963 Hz, 4444 Hz, and 6000 Hz-with a consistent 100% pass rate. No patient demonstrated a "refer" response at any frequency.
The absence of statistically significant differences across all frequency comparisons ($p > 0.05$ for each frequency) reinforces the observation that any early high-frequency vulnerability noted during the immediate postoperative period resolved entirely by one week. These findings confirm that mastoid drilling, although temporarily impacting high-frequency cochlear emissions, does not result in sustained functional impairment of the contralateral ear.

DISCUSSION

COM defined as persistent inflammation of the mucoperiosteal lining of middle ear cleft is one of the common conditions in otolaryngology. COM in its natural course can induce conductive and sensorineural hearing loss and if not treated efficiently can end up in intracranial as well as extracranial complications.

Mastoidectomy remains the mainstay treatment in COM. It demands the use of highly magnifying operative microscope, high speed electric or pneumatic drills, various types and sizes of burrs and suction irrigation system.

Drilling forms a major part of the surgical procedure, during which the acoustic trauma and vibration generated by drill reach operated ear through 3 routes, mainly by injury to the membranous labyrinth, secondly due to the contact of drill with ossicles and lastly due to drilling noise being transmitted through the bone.

Drill induced noise trauma can unavoidably reach the contralateral ear due to minimal interaural attenuation of skull, levels of which are expected to be around 100 db. Noise generated by diamond burr varies considerably from cutting burrs, with mean levels of 5-11 dB lower than of cutting ones.

Acoustic trauma generated during surgery has potential to cause sensorineural hearing loss in contralateral ear, which could be the only hearing ear in many cases.

OHCs in the cochlea are the initial and predominant site of damage by noise trauma. Otoacoustic emissions (OAEs) are produced by function of outer hair cells of cochlea and are first to get affected after the acoustic insult. Distortion Product OAEs (DPOAEs), a type of OAEs is better objective test for OHC function, can be conveniently recorded, relatively stable and unaffected by behavioural responses, are more reliable at 4khz which is most affected frequency in noise trauma.

When an ear is affected to noise, due to activation of medial olivocochlear bundle system, OAEs are suppressed not only in that ear but also in contralateral ear.[10,11] Noise level at which DPOAEs amplitude began to decrease is estimated to be around 50db SPL, which is far lower than noise received by contralateral ear during mastoid surgery.[12] This further supports taking DPOAEs as a rational test to assess the hearing loss of opposite normal ear after mastoid surgery.

In our study of 30 participants, while comparing the hearing of contralateral normal ear of patient preoperatively and on postoperative day 1 using DPOAES, (56.7%) patients had postoperative changes interpreted as REFER while other 13 patients (43.3%) with intact DPOAEs were interpreted as PASS, suggesting greater auditory impairment in immediate postoperative period following surgery which can be explained as a consequence of increased permeability of blood vessels of stria vascularis and subsequent injury to Organ of Corti following vibrations produced by drilling.[13]

Current study finds similarity to study conducted by Meena et al. who observed 6 (15%) out of 40 patients after mastoidectomy had changes on DPOAEs at postoperative Day1.[14]

Comparable observations were seen by Singh V et al. where 8 (12.9%) out of 62 patients had absent DPOAES at POD 1.[15]

This study additionally, aligns with study by Shenoy V et al. 56 where 45 (91.8%) out of 49 patients, Latheef et al.58 in which 45 (90%) out of 50 patients had reduced DPOAEs and Karatas et al.51 where 22 i.e (100%) of the patients had altered DPOAEs on postoperative Day 1.

In our study, on comparing the hearing preoperatively with POD3, we observed 21 (70%) patients had passed the test while the other 9 were still labelled as REFER. However, no. of patients passing the test comparatively improved from the POD1 indicating significant auditory function recovery (p=0.04), pertaining to resolution of transient factors such as intraoperative trauma effects and acoustic overstimulation.[16]

Studies by Meena et al. also observed significant postoperative difference in 5 (12.5 %) patients out of 40 on day 3 from preoperative findings. She further noticed improvement in 1 patient from day 1 suggesting recovery.[14]

Current Study slightly differs from study by Latheef et al., including 50 patients where he could conclude significant postoperative changes in 45 patients (90%) on consecutive postoperative day 1 and 2, but all patients (100%) reverted back to preoperative values on POD3 suggesting complete improvement.[17]

In present study, on POD7 we detected that all of our 30 patients had passed that test (100%) pointing to complete recovery of cochlear function suggesting no permanent damage due to outer hair cells had occurred, i.e there is only physiological disruption of OHC following noise induced by drilling which is reversible and can be held responsible for temporary changes on DPOAEs.[18]

With all our patients, showing complete recovery on day 7, further points that drill induced hearing loss is a temporary threshold shift (TTS) which is eventually reversible.

Study by Singh V et al where 30 patients had absent DPOAEs in immediate postoperative period ,10 patients recovering within 1 hr after surgery ,12 patients regained DPOAEs by day 1, whereas remaining 8 fully regained DPOAEs by Day 7 pointing to complete recovery.[15]

Current study resonates with studies executed by Shenoy et al. where 45 patients post mastoidectomy after having significant postoperative changes on DPOAEs on day 1, completely recovered (100%) on Day 7.[19]

This is in contrast to study conducted by Neeraj S. et al, in which on following up 58 patients 1 week after surgery, author noticed 41 patients (71%) had REFER DPOAEs by day 7, and on further follow ups till 12 weeks , all patients had recovered DPOAEs except 1 patient still having REFER DPOAEs at 12 week 55, recommends evidently transient nature of the hearing loss , however persistent deficit in some patients highlights the different susceptibility of certain individuals or groups to noise induced trauma to cochlea.[18]

In our study on comparing the hearing of opposite normal ear on 6 frequencies on DPOAEs at POD 1 with preoperative observations, we observed most affected frequency were 2222 Hz, 2963Hz ,4000Hz and 6000 Hz and these changes held statistical significance while low frequency 988 and 1481 Hz remained unaffected recommending that hearing loss following acoustic trauma by drill particularly occurs at higher frequencies which can be related to the sensitivity of senotopical regions in the cochlea to the drilling 19, while lower frequency gets protected due to their anatomical and physiological resilience to noise.

Studies have further demonstrated that temporal bone vibration cause hearing loss at higher frequencies than lower ones.[20]

This firmly aligns with previous studies by Baradarnafar et al. and Shenoy V et al, which also established statistically, significant postoperative changes on DPOAEs at 2000 Hz and above frequencies on POD1.[19,21]

Study by Ozdamar et al. could find significant changes only on one frequency i.e 4000 hz (p=0.05) out of 5 tested frequency, whereas all the 4 frequencies below 4kHz could not make up to significance on Day 1.

On comparing the hearing frequency affected on DPOAEs on Day 3 with preoperative findings, didn‟t demonstrates any alterations below 2000 Hz. Although significant differences existed on 2000, 2963 and 4000, 6000 Hz but hearing at preceding three frequency were significantly improving indicating hearing had started to begun at these frequencies but no recovery was noticed at 6kHz.This can be explained as recovery of hearing following acoustic trauma due to drilling, usually begins at lower frequencies.

Ozdamar et al. also showed significant differences at 4KHz in his study after 72 hrs after surgery and study by Agrawal N also proved significant differences at 4kHz as well as 6kHz, 3 days post-surgery.[22,23]

This slightly matches with study by Baradarnafar et al. 54 where 72 hrs post-surgery, only two frequencies held significant difference i.e 4kHz and 6kHz value while 2kHz and 8 kHz lacked significance recommending improvement at these frequencies.

On considering the frequency affected on day 7 with preoperative data, no significant differences were noticed at any of tested six frequencies (988,1481,2222,2963,4444,6000Hz) therefore assuring changes at all the 6 frequencies had returned back to their preoperative levels, thus recommending hearing threshold changes seen postoperatively at different frequencies are eventually reversible.

Current study greatly corroborates with study by Shenoy V et al 56 which also ascertained, no significant alteration at any of his four tested frequency (2000,3000,4000,5000Hz) post seven days after surgery pointing full recovery of hearing.

This however partly aligns with study of Aggarwal N.23 where two (2000,6000Hz) out of four tested frequency lacked significance while the other two (1khz and 4 khz) still held significant differences at day 7, implying incomplete return to baseline levels.

Overall, the present study reinforces the evidence that mastoid drilling results in a predictable pattern of temporary OHC dysfunction in the contralateral ear, with early high-frequency impairment that subsequently resolves. These findings underscore the importance of minimizing unnecessary acoustic trauma during surgery

by optimizing drill speed, minimizing drilling time, and using protective surgical techniques. Moreover, OAE monitoring, non-invasive and highly sensitive, may serve as a valuable adjunct for perioperative assessment of cochlear integrity in patients undergoing mastoid surgery.

Limitations

Despite the statistical significance of our findings, the relatively small sample size of 30 patients limits the generalizability of the results. Larger, multicentric studies with diverse populations are needed extend these observations.

This study didn‟t take consider total drilling time, the size and type of each burr employed and drilling time for each burr, which could have deepens our understanding of possible impact of total drilling time, various burr and their usage duration on hearing outcome after surgery.

Moreover, incorporating auditory brainstem responses (ABR) in future studies could great insights into neural pathway integrity and distinguish between cochlear and retro cochlear effects of mastoid drilling noise.

CONCLUSION

This study offers meaningful contributions by employing a prospective design, uniform surgical technique, and standardized audiological assessment using DPOAEs across multiple postoperative intervals. These methodological strengths enhance the accuracy of detecting subtle cochlear changes and provide clinically relevant insight into the transient auditory effects of mastoid drilling.

However, the study's relatively small cohort, single-institution setting, and short follow-up period limit the broader applicability of its findings. Potential inter-operator variability and the absence of long-term audiometric evaluation further constrain interpretation. Future multicentric research with larger samples and extended follow-up is essential to comprehensively delineate long-term auditory outcomes and validate these observations.

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