Research Article

INTERNATIONAL RESEARCH JOURNAL OF PHARMACY

www.irjponline.com

ISSN 2230-8407 [LINKING]

DISTORTION PRODUCT OTOACOUSTIC EMISSIONS AND PURE TONE AUDIOMETRY, THE EFFECT OF MASTOID DRILLING ON THE CONTRALATERAL HEALTHY EAR

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How to cite: Gangisetti KK. Distortion product otoacoustic emissions and pure tone audiometry, the effect of mastoid drilling on the contralateral healthy ear. International Research journal of Pharmacy. 2019; 10:5:243-246.

Doi: 10.7897/2230-8407.1005195

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ABSTRACT

Background: India has a high prevalence of chronic otitis media (COM), which affects around 5% of people worldwide. Although mastoidectomies are often essential for treating chronic otitis media, they require drilling, which may impair hearing in the contralateral ear.

Aim: The purpose of this study was to use distortion product otoacoustic emissions (DPOAEs) and pure tone audiometry to assess the effect of mastoid drilling on the contralateral healthy ear.

Methods: Ninety participants with a healthy contralateral ear and unilateral chronic otitis media were evaluated. Preoperative, 24-, 72-, and 7-day postoperative audiological evaluations were performed on all participants following mastoidectomy. The collected data was statistically examined in order to formulate the results.

Results: Mastoid drilling took an average of 53.6±17.4 minutes. The mean hearing threshold at 24 hours was 21.3±3.6 dB higher than the preoperative value, and recovery at day 7 was $p<0.001$ higher, according to pure tone audiometry. DPOAE revealed initial cochlear impairment in four participants at day seven ($p=0.004$) and in twelve subjects at 24 hours. Drilling time and audiological results did not significantly correlate.

Conclusion: regardless of the length of mastoid drilling, there are transient changes in the contralateral ear's hearing. These results highlight the necessity of precautionary measures to reduce the risk of hearing loss following surgery.

Keywords: mastoid drilling, mastoidectomy, hearing loss, DPOAEs, pure tone audiometry, and chronic otitis media

INTRODUCTION

With a high frequency of around 5%, chronic otitis media (COM) is a major issue for healthcare facilities in India, making it the country with the highest proportion of COM.

The number of mastoidectomies performed to treat chronic otitis media is rising as a result of ongoing medical developments. One These operations, however, require the drilling technique, which can be dangerous for both the operated ear and the contralateral ear. In most cases, the afflicted persons' only source of hearing function remains intact. These processes also produce a lot of noise.2

Understanding how exposure to surgical noise affects hearing is essential for both judicial usage and the best possible clinical results. Conventional evaluation techniques, such as pure tone audiometry (PTA), have been used to evaluate hearing impairments, however they may miss the minute impacts on the outer function of hair cells.3

Assessing transient changes in postoperative hearing following mastoidectomies can aid in determining the risk variables associated with mastoid drilling and advance knowledge on how to preserve hearing in patients having surgery for persistent otitis media. This knowledge is essential for evaluating clinical practice and managing chronic otitis media in

Indian patients in general. 4. The purpose of the current investigation was to use distortion product otoacoustic emissions (DPOAEs) and pure tone audiometry to assess the effect of mastoid drilling on the contralateral healthy ear.

MATERIALS AND METHODS

The goal of the current prospective institution-based investigation was to use distortion product otoacoustic emissions (DPOAEs) and pure tone audiometry to assess the effect of mastoid drilling on the contralateral healthy ear.

The research participants came from the Institute's ENT Department. Prior to their involvement in the study, all individuals gave their written and verbal informed consent. 90 participants who had to have mastoid drilling done as part of their treatment for unilateral chronic otitis media with the contralateral healthy ear were evaluated for the research. Subjects who did not volunteer to participate in the study, were recently using ototoxic medications such as diuretics, aminoglycosides, or chemotherapeutics, had psychiatric issues, or had just undergone ear surgery were excluded from the study.

All of the individuals' information was gathered during an interview and entered onto a pre-made, structured proforma that included sociodemographic and clinical history information. The next step was an otoscopic examination of both ears to make sure the contralateral ear was healthy and to confirm the diagnosis of chronic otitis media. Before surgery, standard blood tests were performed. A Bien-air micromotor drill was utilized for mastoid drilling, and the noise levels were recorded using a sound meter and the drilling duration was recorded using a stopwatch.

Following surgery, the participants were monitored for 24 hours, 72 hours, and 7 days. PTA and DPOAE were used to evaluate contralateral healthy ear hearing during follow-up visits. To evaluate any changes in emissions or thresholds, the outcomes of these audiological tests were documented.

ANOVA, chi-square test, student's t-test, Fisher's exact test, Mann Whitney U test, and SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk, NY, USA) were used to statistically evaluate the collected data from all subjects from healthy contralateral and affected ears. When the p-value was less than 0.05, the significance threshold was taken into account.

RESULTS

The goal of the current prospective institution-based investigation was to use distortion product otoacoustic emissions (DPOAEs) and pure tone audiometry to assess the effect of mastoid drilling on the contralateral healthy ear. Ninety participants with unilateral chronic otitis media and a healthy contralateral ear were evaluated for the research.

Preoperative, 24-, 72-, and 7-day postoperative audiological evaluations were performed on all participants following mastoidectomy. According to the demographic and illness characteristics of the research participants, the majority of them were between the ages of 18 and 39, with 55.6% (n=50) being between the ages of 18 and 39, followed by 37.8% (n=34), 4.4% (n=4), and 2.2% (n=2) being under the age of 18. The study included 35.6% (n=32) female participants and 66.4% (n=58) male participants.

According to the study findings, 48.9% (n=44) of the participants had chronic otitis media on their right side, whereas 51.1% (n=46) had it on their left. 53.3% (n=128) of the study participants had the right treated side, whereas 46.7% (n=112) had the left treated side. Regarding the surgical methods, 17.8% (n=16) of the study participants had atticotomy/attico-antrostomy, 11.1% (n=10) underwent modified radical mastoidectomy, and 71.1% (n=64) underwent cortical mastoidectomy (Table 1).

Preoperative DPOAE refer was observed in 0 patients prior to surgery, in 12 subjects 24 hours postoperatively, and in 4 subjects each at 72 hours and 7 days postoperatively for preoperative and postoperative audiometric results in the contralateral ear.

Ninety participants had DPOAE pass before surgery, 78 subjects had it 24 hours after surgery, and 86 subjects had it 72 hours and 7 days after surgery. With p=0.004, the difference was statistically significant. The mean pure tone audiometry was 18.4±2.4 dB before surgery, and it rose considerably to 21.3±3.6 dB at 24 and 20.4±3.4 dB after 72 hours. Healing was seen at 7 days, when it was 19.3±3.1 dB, with a p-value of less than 0.001 (Table 2).

Analysis of the relationship between study participants' distortion product otoacoustic emissions results and mastoid drilling revealed that there was no statistically significant correlation between PTA and mastoid drilling at 24 and 7 days after surgery, with correlation values of 0.071 and 0.077, respectively.

According to DPOAE, 12 participants had a refer result at 24 hours, but by the seventh day, that number had dropped to 4 subjects (p=0.004). Additionally, mastoid drilling time at every postoperative evaluation was significantly correlated with DPOAE results (Table 3).

DISCUSSION

Ninety participants with unilateral chronic otitis media and a healthy contralateral ear were evaluated in this study. Preoperative, 24-, 72-, and 7-day postoperative audiological evaluations were performed on all participants following mastoidectomy.

According to the demographic and illness characteristics of the research participants, the majority of them were between the ages of 18 and 39, with 55.6% (n=50) being between the ages of 18 and 39, followed by 37.8% (n=34), 4.4% (n=4), and 2.2% (n=2) being under the age of 18. The study included 35.6% (n=32) female participants and 66.4% (n=58) male participants. These statistics were similar to those from other research by Singh V et al. (2019) and Baskadem Yilmazer A et al. (2024), where the authors evaluated participants using demographic data similar to the current study. 48.9% (n=44) of the research participants had chronic otitis media on their right side, whereas 51.1% (n=46) had it on their left.

53.3% (n=128) of the study participants had the right treated side, whereas 46.7% (n=112) had the left treated side. Regarding the surgical methods, 17.8% (n=16) of the study participants had atticotomy/attico-antrostomy, 11.1% (n=10) underwent modified radical mastoidectomy, and 71.1% (n=64) underwent cortical mastoidectomy. These results aligned with the findings of Waqas M et al. (2018) and Goyal A et al. (2013), where the authors' stated illness features for COM were similar to the findings of the current study.

According to the study's findings, preoperative DPOAE refer was recorded in no participants before surgery, in 12 individuals 24 hours after surgery, and in 4 subjects each after 72 hours and 7 days after surgery for both preoperative and postoperative audiometric outcomes in the contralateral ear. Ninety participants had DPOAE pass before surgery, 78 subjects had it 24 hours after surgery, and 86 subjects had it 72 hours and 7 days after surgery. With p=0.004, the difference was statistically significant.

The mean pure tone audiometry before surgery was 18.4±2.4 dB, and it dramatically rose to 21.3±3.6 dB at 24 and 20.4±3.4 dB after 72 hours. At 7 days, the p-value was less than 0.001, and the healing was 19.3±3.1 dB. These results were consistent with those of Baradaranfar MH et al. (2015) and Hiss MM et al. (2024), whose respective investigations likewise revealed preoperative and postoperative audiometric outcomes in the contralateral ear that were comparable to the current research.

At 24 hours and 7 days postoperatively, the correlation between PTA and mastoid drilling was statistically non-significant, with correlation values of 0.071 and 0.077, respectively, in relation to the evaluation of the association between distortion product otoacoustic emissions results and mastoid drilling in study subjects. According to DPOAE, 12 participants had a refer result at 24 hours, but by the seventh day, that number had dropped to 4 subjects (p=0.004).

Additionally, mastoid drilling time at any postoperative evaluation was significantly correlated with DPOAE outcomes. These findings were in line with those of Banakis Hartl RM et al.11 in 2017 and Jaiswal SK et al.12 in 2025, who found a similar correlation between distortion product otoacoustic emissions outcomes and mastoid drilling in their research.

CONCLUSION

Within its limitations, the present study concludes that there are temporary hearing alterations in contralateral ear after mastoid drilling irrespective of the duration of drilling. These findings focus on the need for protective strategies during surgery for mitigation of hearing risks.

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S. No	Characteristics	Number (n)	Percentage (%)
1.	**Age range (years)**		
a)	<18	2	2.2
b)	18-39	50	55.6
c)	40-59	34	37.8
d)	≥60	4	4.4
2.	**Gender**		
a)	Males	58	64.4
b)	Females	32	35.6
3.	**Chronic otitis media**		
a)	Right	44	48.9
b)	Left	46	51.1
4.	**Treated side**		
a)	Right	128	53.3
b)	Left	112	46.7
5.	**Surgical procedure**		
a)	Atticotomy/ attico-antrostomy	16	17.8
b)	Modified radical mastoidectomy	10	11.1
c)	Cortical mastoidectomy	64	71.1

Table 1: Demographic and disease characteristics in study subjects

S. No	Contralateral ear parameters	Preoperative	24h postop	72 h postop	7 days postop	p-value
1.	**DPOAE Refer (n)**	0	12	4	4	**0.004**
2.	**DPOAE Pass (n)**	90	78	86	86	
3.	**Mean PTA**	18.4±2.4	21.3±3.6	20.4±3.4	19.3±3.1	**<0.001**

Table 2: Preoperative and postoperative audiometric outcomes in contralateral ear

S. No	DPOAE pass/refer	t-test	p-value
1.	**Mastoid drilling time**		
a)	24h	-0.881	0.384
b)	72h	-1.075	0.286
c)	7 days	-1.075	0.286

Table 3: Association of distortion product otoacoustic emissions results and mastoid drilling in study subjects