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EXAMINING THE RELATIONSHIP BETWEEN CLINICAL AND AUDIOLOGICAL VARIABLES AND OSSICULAR CHAIN CONTINUITY IN PERSONS WITH CHRONIC OTITIS MEDIA

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ABSTRACT

Background: Myringoplasty is the recommended therapeutic option for people with COM (chronic otitis media) with tympanic membrane perforation. However, when ossicles are implicated, myringoplasty is combined with ossiculoplasty and referred to as tympanoplasty. Preoperative ossicular state assessment is critical in determining the type of tympanoplasty to be performed. Subjects with a short illness duration and a small air-bone gap have osseous chain continuity.

Aim: The current study sought to determine the link between preoperative audiological, clinical, and other variables and ossicular chain status.

Methods: The current study examined 200 people who had mucosal chronic otitis media (COM). All individuals had preoperative evaluation and diagnosis based on investigations and clinical examination. Operative findings were compared, and conclusions were developed.

Results: The study found that 30%, 28%, and 18% of participants experienced ear discharge for less than one year, one to five years, and six to ten years. Positive hearing loss was found in 80% of the research individuals. Correlating PTA (pure-tone average) with ossicular chain status yielded a statistically significant result (p=0.02). Ossicular chain defects were seen in 19.36% of patients, with the majority falling into the moderate category, followed by mild hearing loss in 31% and 24% of subjects, respectively.

Conclusion: According to the findings of this study, the majority of patients with severe hearing loss had ossicular chain discontinuity followed by profound hearing loss. The bulk of the individuals had moderate to severe conductive hearing loss on a pure-tone average. The likelihood of ossicular discontinuity increases as the air-bone gap widens.

Keywords: chronic otitis media, hearing loss, ossicular continuity, PTA, and tympanosclerosis

INTRODUCTION

Chronic otitis media (COM) is a clinical disease characterized by continuous or intermittent purulent discharge from a perforated TM (tympanic membrane), which may or may not be accompanied with cholesteatoma.

The most prevalent cause of recurring or chronic mucoid otorrhea, also known as active COM, is pathogen exposure via the Eustachian tube or external auditory canal. Ossicular chain discontinuity is identified intraoperatively; however, many

preoperative characteristics can aid in the prediction of ossicular erosion existence and may aid in subsequent ossicular reconstruction design.1

The ossicular state should be evaluated prior to surgery to determine the type of tympanoplasty and prosthesis necessary. Subjects with osseous chain continuity typically have a loss of less than 40 decibels in air conduction threshold on pure tone audiometry, no low-frequency loss, an air-bone gap of less than 25dB, no aural polyp, no myringosclerosis or tympanosclerosis, no granulation tissue, healthy middle ear mucosa, no cholesteatoma, and a shorter disease duration.2

Wullstein used the term tympanoplasty in 1953 to describe surgical treatments for reconstructing the middle ear hearing mechanism after it had been destroyed or impaired by chronic middle ear disease. In 1956, Wullstein detailed six different forms of tympanoplasty, ranging from tympanic membrane repair to ossicular chain building and lateral semicircular canal fenestration. Surgical treatment considerations include ossiculoplasty, graft sources (dura, perichondrium, cartilage graft, and temporalis fascia), and approach type (postaural, endaural, or parameter). No one technique is chosen for doing tympanoplasty.3

Pathologies that interact with the ossicular chain result in greater hearing loss severity. Complete ossicular chain disruption can result in roughly 60 decibels of hearing loss. Chronic middle ear inflammatory responses caused by cytokine overproduction are the most commonly acknowledged reason for ossicular erosion. Chronic otitis media is thus an inflammatory response with a faulty wound healing mechanism. This inflammatory process in the Middle War does more injury. The longer it persists, the closer it gets to the ossicular chain.4

Given the importance of understanding certain audiological and clinical factors as preoperative predictors of ossicular chain status, the current study sought to assess the relationship between preoperative audiological, clinical, and other factors and ossicular chain status in the mucosal type of chronic otitis media.

MATERIALS AND METHODS

The current cross-sectional prospective clinical investigation sought to determine the association between preoperative audiological, clinical, and other variables and the ossicular chain status in the mucosal type of chronic otitis media. The research subjects were members of the Institute's Department of ENT. All individuals provided verbal and written informed permission before participating in the study.

The study included both male and female participants with chronic otitis media. The study's inclusion criteria were participants who provided consent for study participation and follow-up, subjects aged 10 to 60 years, and subjects with a verified clinical diagnosis of mucosal type chronic suppurative otitis media.

The study excluded participants with a history of trauma, ENT concerns requiring surgery, incomplete follow-up, unwillingness to participate, age <10 or >60, and squamosal type of COM. Following the research subjects' final inclusion, preoperative assessments and diagnoses were established based on clinical examinations and laboratory investigations, which were then compared to the operational results. The characteristics reported for all participants were the individuals' domicile, gender, and age. The following characteristics were used to determine response variables: intraoperative ossicular chain status, middle ear mucosa, cholesteatoma, tympanosclerosis or myringosclerosis, presence of granulation, and disease duration.

The audiologist used an audiometer in the soundproof room to calculate the pure tone average (PTA). The pure-tome average was calculated using the Modified Hughson-Westlake technique. The average of 500, 1000, and 2000 was deemed PTA 1, whereas the average of 2000, 4000, and 8000 was selected as PTA 2. For the management plan, audiological, radiological, and clinical results were documented in all participants with mucosal chronic otitis media. This was followed by tympanoplasty done on all individuals by a single surgeon with expertise in the field. All participants received normal postoperative care. Subjects were released after their condition had stabilized.

The collected data were statistically analyzed using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk, NY, USA) for descriptive measures, one-way ANOVA (analysis of variance), and the chi-square test. The data were presented in the form of mean and standard deviation, as well as frequency and percentage. A p-value < 0.05 was considered statistically significant.

RESULTS

The current cross-sectional prospective clinical study aims to examine the association between preoperative audiological, clinical, and other parameters regarding the ossicular chain status in the mucosal type of chronic otitis media. The current investigation included 200 participants with mucosal chronic otitis media (COM). The mean age of research participants was

28.27 years, ranging from 10 to 60 years. The bulk of individuals (39%) were between the ages of 10 and 20, followed by 26%, 14%, 13%, and 8% from the ages of 21 to 30, 31 to 40, 41 to 50, and 51 to 60. The majority of individuals experienced unilateral or bilateral ear discharge (68% and 32%, respectively). 7% of respondents reported foul-smelling discharge. Based on symptoms, 9% and 71% of research respondents had fluctuating hearing loss, whereas 80% had non-fluctuating hearing loss. The discharge duration was <1. 30% (n=60), 28% (n=56), 18% (n=36), 10% (n=20), 10% (n=20), 2% (n=4), and 2% (n=4) research volunteers were aged 1-5, 6-10, 11-15, 16-20, 21-25, and 26-30 years, respectively (Table 1).

The average air-bone gap in study subjects was 31-40 dB, with 30% (n=60) having an air-bone gap of 21-30 dB, 26% (n=52) having an air-bone gap of 11-20 dB, 9% (n=18) having an air-bone gap of 1-10 dB, and 7% (n=14) having an air-bone gap of 41-50 dB. Table 2 shows that 1% (n=2) of research respondents had the lowest average air-bone gap of 51-60 dB.

It was discovered that PTA 1 category normal patients had discontinuous and unbroken ossicular chains in 9.09% (n=2) and 90.91% (n=20) of the subjects, respectively. PTA1 moderate was seen in 48 patients, with 4.17% (n=2) and 95.83% (n=46) having discontinuous and entire ossicular chains, respectively. Moderate PTA1 was found in 62 patients, with 19.36% (n=12) and 80.64% (n=50) having discontinuous and entire ossicular chains, respectively. Moderately severe PTA1 was seen in 38 patients with discontinuous and intact ossicular chains in 31.58% (n=12) and 68.42% (n=26) of the research subjects, respectively. Severe PTA1 was seen in 20 patients, with 50% (n=10) having discontinuous or entire ossicular chains.

Profound PTA1 was observed in ten participants with discontinuous and intact ossicular chains, in 40% (n=4) and 60% (n=6) of the research subjects, respectively. The connection was statistically significant (p=0.02). The study found that PTA2 category normal patients had discontinuous and unbroken ossicular chains in 8.69% (n=4) and 91.31% (n=42) of the subjects, respectively. PTA2 mild was found in 46 patients, with 4.34% (n=2) and 95.66% (n=44) having discontinuous and entire ossicular chains, respectively. Moderate PTA2 was seen in 52 patients, with 23.07% (n=12) and 76.93% (n=40) having discontinuous and entire ossicular chains, respectively.

Moderately severe PTA2 was seen in 38 patients, with discontinuous and intact ossicular chains in 46.15% (n=12) and 53.85% (n=14) of the research subjects, respectively. Severe PTA2 was detected in 16 patients, with discontinuous and intact ossicular chains in 37.50% (n=6) and 62.50% (n=10), respectively. Profound PTA1 was seen in 14 participants with discontinuous and intact ossicular chains, with 42.85% (n=6) and 57.15% (n=8), respectively. This link was statistically significant, with p=0.01 (see Table 4).

In terms of intraoperative results in research patients, the Incudo-stapedial joint was intact in 79% (n=158) of them and discontinuous in 21% (n=42). Table 5 shows that ossicular chain continuity was intact in 84% (n=168) of research individuals and discontinuous in 16% (n=32). In terms of the correlation of Tympanosclerosis/myringosclerosis and granulation to ossicular chain status in study subjects, granulation tissue was present in 43.47% (n=40) subjects with discontinuity and 56.52% (n=52) subjects with intact chain, while it was absent in 1.85% (n=2) subjects with discontinuity and 98.14% (n=106) subjects with intact ossicular chains. The difference was statistically significant (p = 0.000).

Tympanosclerosis/myringosclerosis was found in 73.68% (n=28) of participants with a discontinuous ossicular chain and 26.32% (n=10) in subjects with a complete ossicular chain. Tympanosclerosis/ myringosclerosis did not occur in 8.64% (n=14) of participants with discontinuous ossicular chains or 93.65% (n=148) of those with intact ossicular chains. This difference was statistically significant at p=0.000 (Table 6).

DISCUSSION

The current investigation included 200 participants with mucosal chronic otitis media (COM). The mean age of research participants was 28.27 years, ranging from 10 to 60 years. The bulk of participants were between the ages of 10 and 20, accounting for 39%, followed by 26%, 14%, 13%, and 8% from the ages of 21 to 30, 31-40, 41-50, and 51 to 60.

The majority of individuals experienced unilateral or bilateral ear discharge (68% and 32%, respectively). 7% of respondents reported foul-smelling discharge. Based on symptoms, 9% and 71% of research respondents had fluctuating hearing loss, whereas 80% had non-fluctuating hearing loss. The discharge duration was <1. 30% (n=60), 28% (n=56), 18% (n=36), 10% (n=20), 10% (n=20), 2% (n=4), and 2% (n=4) of the study respondents were aged 1-5, 6-10, 11-15, 16-20, 21-25, and 26-30 years old. These recordings were comparable to those of Harkare VV et al5 in 2020 and Bayat A et al6 in 2019, who tested participants with COM and demographic and illness characteristics similar to the current research.

The study results showed that when assessing the air-bone gap average in study subjects, the majority of the study subjects showed an air-bone gap average of 31-40 dB, with 30% (n=60) subjects followed by 27% (n=54) subjects with an air-bone

gap of 21-30 dB, 26% (n=52) subjects with an air-bone gap of 11-20 dB, 9% (n=18) subjects with an air-bone gap of 1-10 dB, and 7% (n=14) subjects with an air-bone gap of 41-50 dB. The average air-bone gap was 51-60 dB, as seen in 1% (n=2) of research participants. These findings were comparable with those of Carrillo MD7 in 2006 and Varshney S et al8 in 2010, who found an air-bone gap average similar to the current research in their separate investigations.

In terms of the relationship between PTA 1 and ossicular chain status in research participants, PTA1 category normal people had discontinuous and unbroken ossicular chains in 9.09% (n=2) and 90.91% (n=20) of cases, respectively. PTA1 moderate was seen in 48 patients, with 4.17% (n=2) and 95.83% (n=46) having discontinuous and entire ossicular chains, respectively. Moderate PTA1 was found in 62 patients, with 19.36% (n=12) and 80.64% (n=50) having discontinuous and entire ossicular chains, respectively. Moderately severe PTA1 was seen in 38 patients with discontinuous and intact ossicular chains in 31.58% (n=12) and 68.42% (n=26) of the research subjects, respectively. Severe PTA1 was seen in 20 patients, with 50% (n=10) having discontinuous or entire ossicular chains.

Profound PTA1 was observed in ten participants with discontinuous and intact ossicular chains, in 40% (n=4) and 60% (n=6) of the research subjects, respectively. The connection was statistically significant (p=0.02). These findings were consistent with the findings of Thangaraj PS et al9 in 2017 and Singh BR et al10 in 2018, who found a substantial association of PTA 1 to ossicular chain status, which matched the results of the current investigation.

In terms of the association between PTA2 and ossicular chain status in research participants, PTA2 category normal people had discontinuous and intact ossicular chains in 8.69% (n=4) and 91.31% (n=42) of the cases, respectively. PTA2 mild was found in 46 patients, with 4.34% (n=2) and 95.66% (n=44) having discontinuous and entire ossicular chains, respectively. Moderate PTA2 was seen in 52 patients, with 23.07% (n=12) and 76.93% (n=40) having discontinuous and entire ossicular chains, respectively. Moderately severe PTA2 was seen in 38 patients, with discontinuous and intact ossicular chains in 46.15% (n=12) and 53.85% (n=14) of the research subjects, respectively. Severe PTA2 was detected in 16 patients, with discontinuous and intact ossicular chains in 37.50% (n=6) and 62.50% (n=10), respectively. Profound PTA1 was seen in 14 participants with discontinuous and intact ossicular chains, with 42.85% (n=6) and 57.15% (n=8), respectively. The connection was statistically significant (p=0.01).

These findings were consistent with the findings of Ghosh NC et al11 in 2020 and Karimi-Yazdi A et al12 in 2011, who found a substantial association between PTA2 and the ossicular chain, identical to the results reported by the authors in their respective investigations. In the examination of intraoperative results in study individuals, the Incudo-stapedial joint discontinuity was intact in 79% (n=158) of the subjects and discontinuous in 21% (n=42). In participants, ossicular chain continuity was intact in 84% (n=168) of research subjects and discontinuous in 16% (n=32).

These findings were supported by earlier investigations by Rasheed RA et al13 in 2019 and Gupta A et al14 in 2021, who reported results for incudo-stapedial joint discontinuity and ossicular chain continuity that were equivalent to the current research. The study also found that when Tympanosclerosis/ myringosclerosis and granulation were correlated to ossicular chain status in study subjects, granulation tissue was present in 43.47% (n=40) subjects with discontinuity and 56.52% (n=52) subjects with intact chain, while it was absent in 1.85% (n=2) subjects with discontinuity and 98.14% (n=106) subjects with ossicular chain intact. The difference was statistically significant (p = 0.000).

Tympanosclerosis/myringosclerosis was found in 73.68% (n=28) of participants with a discontinuous ossicular chain and 26.32% (n=10) in subjects with a complete ossicular chain. Tympanosclerosis/ myringosclerosis did not occur in 8.64% (n=14) of participants with discontinuous ossicular chains or 93.65% (n=148) of those with intact ossicular chains. The difference was statistically significant (p=0.000). These findings were consistent with the findings of Balasubramanian C et al15 in 2017 and Orji FT et al16 in 2016, who found a link between tympanosclerosis/ myringosclerosis and granulation to ossicular chain status similar to the current investigation.

CONCLUSIONS

Considering its limitations, the present study concludes that ossicular chain discontinuity followed by profound hearing loss is seen in the majority of subjects with severe hearing loss. The majority of the subjects present moderate to moderately severe conductive hearing loss on a pure-tone average. With the increase in the air-bone gap, an increase is seen in the possibility of ossicular discontinuity.

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TABLES

Discharge duration (years)	Number (n=200)	Percentage (%)
<1	60	30
1-5	56	28
6-10	36	18
11-15	20	10
16-20	20	10
21-25	4	2
26-30	4	2
Total	200	100

Table 1: Duration of ear discharge in study subjects

Air-bone gap average (dB)	Number (n=200)	Percentage (%)

1-10	18	9
11-20	52	26
21-30	54	27
31-40	60	30
41-50	14	7
51-60	2	1
Total	200	100

Table 2: Assessment of Air-bone gap average (dB) in study subjects

PTA 1 category	**Ossicular chain status**				**Total n (%)**
	Discontinuity		**Intact**		
	n=42	**%**	**n=158**	**%**	
N (normal)	2	9.09	20	90.91	22 (100)
M (mild)	2	4.17	46	95.83	48 (100)
MD (moderate)	12	19.36	50	80.64	62 (100)
MS (moderately severe)	12	31.58	26	68.42	38 (100)
S (severe)	10	50	10	50	20 (100)
P (profound)	4	40	6	60	10 (100)
Total	42		158		100%
p-value	**0.02**				

Table 3: Correlation of PTA 1 to ossicular chain status

PTA 2 category	**Ossicular chain status**				**Total n (%)**
	Discontinuity		**Intact**		
	n=42	**%**	**n=158**	**%**	
N (normal)	4	8.69	42	91.31	46 (100)
M (mild)	2	4.34	44	95.66	46 (100)
MD (moderate)	12	23.07	40	76.93	52 (100)
MS (moderately severe)	12	46.15	14	53.85	26 (100)
S (severe)	6	37.50	10	62.50	16 (100)
P (profound)	6	42.85	8	57.15	14 (100)
Total	42		158		100%
p-value	**0.01**				

Table 4: Correlation of PTA 2 to ossicular chain status

	Intact		**Discontinue**		**Total**
	n	**%**	**n**	**%**	
Incudostapedial joint discontinuity	158	79	42	21	100
Ossicular chain continuity	168	84	32	16	100

Table 5: Analysis of intraoperative findings in study subjects

Parameter	**Tympanosclerosis/myringosclerosis and granulation**				**Total n (%)**	**p-value**
	Discontinuity		**Intact**			
	n	**%**	**n**	**%**		
Granulation						
Present	40	43.47	52	56.52	92 (100)	**0.000**
Absent	2	1.85	106	98.14	108 (100)	
Total	42	100	158	79	200 (100)	
Tympanosclerosis/myringosclerosis						
Present	28	73.68	10	26.32	38 (100)	**0.000**
Absent	14	8.64	148	93.65	162 (100)	
Total	42		158	79	100	

Table 6: Correlation of Tympanosclerosis/myringosclerosis and granulation to ossicular chain status in study subjects