

# A Study Correlating the Site and Size of Tympanic Membrane Perforation with the Degree of Hearing Loss

Rakesh Sharma<sup>1</sup>, Sunil Kumar<sup>2</sup>

## ABSTRACT

**Introduction:** The commonest presenting symptom in ENT is a discharging ear. However there is always some degree of hearing loss associated. Therefore we endeavored to take up this study involving correlation of the degree of hearing impairment with the size and the site of perforation.

**Material and methods:** The study involved a total of 120 patients. The study was done at the department of ENT at GMC, Kathua, J and K. Only patients with safe chronic otitis media with a non discharging ear and conductive deafness were included.

**Results:** The 120 patients that were taken up for this study included 80 males and 40 females. Amongst these 82 patients belonged to the below poverty line (BPL). Low socioeconomic strata. There were 40 patients each belonging to 30-39 years, 40-49 years, 50-59 years age group. The various perforations included 30 small, 35 medium, 40 large, 15 subtotal perforations. Posteroinferior quadrant perforations showed maximum degree of hearing loss. Also larger the size of perforation, the greater was the degree of hearing impairment. The perforations involving the posteroinferior quadrant had a more pronounced hearing impairment compared to anteroinferior perforations. Study showed a greater hearing loss at lower frequencies.

**Conclusions:** Tympanic membrane defects result in varying degree of conductive deafness. The size of perforation does affect the degree of hearing loss. Lower frequencies are affected more than higher frequencies. Postero-inferior perforations cause more deafness than antero inferior perforations.

**Keywords:** Tympanic Membrane, Central Perforation, Degree of Hearing Loss, Conductive Deafness

## INTRODUCTION

Hearing is one of the vital senses that mankind possesses. Any compromise in hearing is bound to affect the quality of life and also the daily working of an individual. Still for some strange reasons most of the people who have a compromised hearing try to ignore and take due cognizance of the hearing impairment, not to talk of their seeking a medical consultation for the same. Strangely enough it is not the deafness that is the commonest symptom that brings the patient to an otorhinolaryngologist's clinic. Perhaps it is the fear of social embarrassment that dissuades the affected individuals from seeking a medical consultation unless it gets really bad.

While it is beyond doubt that one of the commonest presenting symptoms in an ENT outpatient department is a discharging ear. It's a daunting task to make the same patients accept that there is some degree of hearing loss that is involved too. At

least in our Indian set ups. The reason could be social taboos or the fact that most patients are not willing to accept that they have a compromised hearing. Or they take it too lightly until it gets severe.

Also once relieved of the ear discharge, the patients seldom turn up for follow up as the concomitant hearing loss does not bother them much. However we endeavored to take up this study involving correlation of the degree of hearing impairment with the size and the site of perforation in safe chronic otitis media.

The commonest presenting complaint of patients in ENT practice is a discharging ear. However the concomitant hearing impairment that almost invariably accompanies is often ignored and overlooked by the patients and is seldom a presenting complaint. Patients are usually bothered about their otorrhoea or otalgia. And once relieved they consider themselves cured of the ailment.

Many a times it is the associated complaints that bring the patient to the ENT outpatient department. And only on a detailed history taking and a thorough clinical examination it is discovered that the patient is having a hearing impairment which is due to a dry central perforation.

Sometimes it is the patients who come for routine general physical examination like in the case of driving license issuance and are completely oblivious of their ear pathology and associated hearing loss (or plead ignorance intentionally) that we discover and inform the patients of their issues (much to their disliking).

The deafness that the patients suffer from can be either conductive type or sensorineural type of deafness. The conductive deafness usually results from some hindrance in the biomechanics or the conductive mechanism of sound while as the sensorineural deafness occurs because of some defect in the inner ear or the neural pathways.

There are a wide variety of pathologies that result in conductive type of hearing impairment. Amongst the wide gamut of causes that result in conductive type of hearing loss a perforated tympanic membrane is one of the commonest

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causes. Depending upon the underlying pathology a perforation can be safe or unsafe. A safe perforation is seen in tubotympanic type of chronic suppurative otitis media while as an unsafe or a marginal perforation is seen in atticotympanic type of chronic suppurative otitis media. With the objective to try and establish a correlation if any between the site and size of the tympanic membrane perforation and the severity of the hearing impairment, we decided to take up this study at our institute.

## MATERIAL AND METHODS

The study involved a total of 120 patients who walked into our ENT outpatient department between February 2020 and June 2020. The study was done at the department of ENT at GMC, Kathua, J and K.

This was a prospective study and only those patients who had a safe chronic otitis media with a non discharging ear were included in the study. Only patients with unilateral chronic otitis media having a dry central perforation were included in the study. Those having perforations in both the ears were excluded from the study. The reason being a likelihood of some coexisting pathology in the nasopharynx and or the nose and sinuses or even the throat.

This study was an observational study. An informed written consent was obtained from the patient. The ones who refused to sign the informed consent were excluded from the study. Prior to the taking up of this study a presentation was made before the institutional ethics committee and only once the committee cleared it, the study was taken up at the department of ENT, GMC Kathua, J and K, India.

A detailed history taking was done for all the patients. Those who were found to be suffering from systemic ailments like Diabetes mellitus, hypertension or other cardiovascular diseases, COAD were excluded from the study. Those with history of ototoxic drug intake like aspirin, NSAID's were also excluded from the study. The reason behind this was to minimize the influence of these ailments or drugs that could lead to alteration in the severity of deafness in the patients. Thereby affecting our study which was aimed at determining the effects of the site and size of dry central perforations on an individual's hearing abilities alone.

The patients were made to undergo a thorough ENT examination and audiometric hearing assessment (PTA). The patients that were included in our study were also sent for a bilateral radiograph of the mastoids (Schuller's view) in order to learn if the disease process had involved the mastoid air cell system or not.

We also made the patients go through diagnostic nasal endoscopies in order to rule in or rule out any nasal or sinus pathologies that could have a bearing upon the degree of hearing loss. This was done with the sole intention to minimize the chances of pathologies other than a dry central perforation contributing towards the conductive type of deafness, thereby affecting the degree and type of hearing loss. Patients with ear discharge, tympanosclerosis, middle ear granulations, mucosal edema and also the ones with adenoid hypertrophy, tonsillitis, DNS, sinonasal pathologies

were excluded from the study. Only patients with a patent eustachian tube and a conductive type of deafness were included in the study. Those with sensorineural type of deafness were excluded from the study. We intentionally took patients between the age group 30 to 59 years. The reason for this was to have better cooperation from the patient in terms of compliance, understanding and patience to go through the required formalities and investigations. Another reason why we excluded those over 59 years of age was to minimize other factors chipping in towards the hearing deficiency. Likewise children were excluded from the study. The reason being that the Eustachian tube of children is more horizontally placed and broader which can definitely affect the hearing in addition to the hearing loss being caused by the tympanic membrane perforations.

## RESULTS

The 120 patients that were taken up for this study included 80 males and 40 females. The reason here could be more than organic. It could be this lack of education and awareness amongst the female folk (graph-1). Also the fact that the women in this part of India are shy and hesitant when it comes to sharing medical problems. The reasons could be fear of rejection or sheer lack of literacy.

Most of the patients in our study were from a low socioeconomic background. This was on expected lines since the chronic suppurative otitis media is known to occur predominantly in patients from a poor socioeconomic background. Most of the patients belonged to the below poverty line (BPL) category which was confirmed by their ration cards and not just by their appearances.

There were only 38 Patients who did not belong to the BPL category and among these 21 patients had a history of traumatic perforations that had not healed and resulted in a permanent dry central perforation. Only 17 of these patients had a history of acute otitis media that had gone on to develop into a chronic suppurative otitis media.

In the present study amongst these patients there were 40 patients each belonging to 30-39 years, 40-49 years, 50-59 years age group (graph-2). We intentionally avoided including patients more than 59 years of age in order to avoid other factors influencing or contributing towards the hearing loss. Likewise children were excluded from the study. The reason being that the Eustachian tube of children is more horizontally placed and broader which can definitely affect the hearing in addition to the hearing loss being caused by the tympanic membrane perforations. The audiometric assessment (PTA) of the patients included in our study showed interesting results.

The various perforations that we examined in our study included 30 small, 35 medium, 40 large, 15 subtotal perforations. The criterion of classifying them was premised upon the total area of the ear drum that was lost. For the perforations with less than 25% surface area lost were labeled as small, 25-50% surface area lost as medium, more than 50% surface area lost as large perforations, and those

with more than 50% area lost along with a bare handle of malleus were labeled as subtotal perforations.

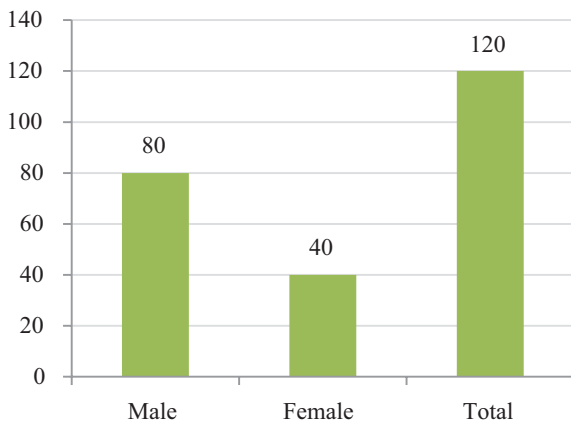
Amongst the small perforations, we had 10 perforations in the anterosuperior quadrant, 6 in the anteroinferior quadrant, 8 in the posterosuperior quadrant and 6 in the posteroinferior quadrant of the tympanic membrane (graph-3).

Among these different types of small central perforations, the ones located in the posteroinferior quadrant showed maximum degree of hearing loss. This was followed by the ones located in the posterosuperior quadrant. Between the anterosuperior and the anteroinferior small central perforations, it was the anteroinferior perforations that resulted in a lesser degree of hearing loss.

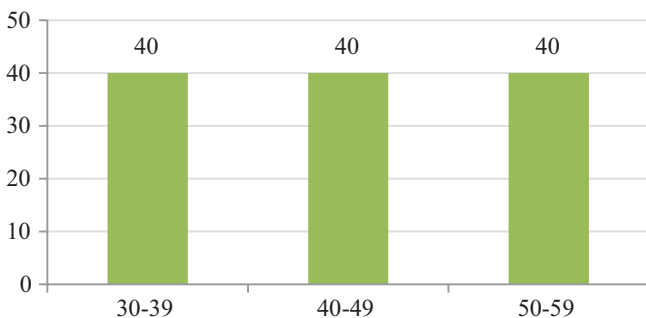
In the present study it was also noted that the larger the size of perforation, the greater was the degree of hearing impairment. Large and subtotal central perforations resulted in a greater degree of deafness in comparison to small and medium sized perforations.

In our study we also came to surmise that the site of the perforation also has a role to play in the determining the severity of hearing impairment. The perforations involving the posteroinferior quadrant had a more pronounced hearing impairment in comparison with the perforations in the anteroinferior quadrant. Likewise the perforations in the posterosuperior quadrant resulted in greater hearing loss when compared to the anterosuperior quadrant.

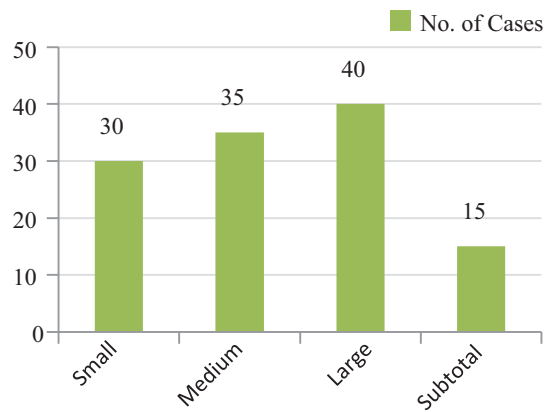
The severity of hearing loss was more in the lower frequencies as compared to higher frequencies. In our study it was noticed that the degree of hearing loss was greater at lower frequencies and lesser at higher frequencies, with the conductive deafness being maximum at 125 HZ and



Graph-1: Gender Profile



Graph-2: Age Groups



Graph-3: Types of Perforation

the lowest at 8000Hz. This pattern was observed in all the different types of dry central perforations including small, medium, large and subtotal perforations that we examined in our study.

In this study it was also observed that the hearing frequency that remained least affected by the tympanic membrane perforation was 2000Hz. The reason could be that this was the inherent vibrating frequency of the ear drum.

**DISCUSSION**

Hearing is one of the vital functions of human ear. A compromised hearing adversely affects the day to day working and quality of life of the affected individual. Any defect in the conduction of the sound waves up to the inner ear invariably results in a conductive type of deafness. From the external ear right up to the oval window any pathology is likely to result in a conductive type of hearing loss. Any pathology that effects the cochlea and the neural auditory pathways is likely to result is a sensorineural hearing loss.

Mawson<sup>2</sup> in his study had also noted that impairment of the auditory function depended upon the position of the perforation with respect to the four quadrants of the tympanic membrane. Thorburn<sup>6</sup> had also stated that hearing impairment tends to be lesser with an anterior perforation but greater with a posterior extension due to loss of sound protection of the round window. Bianca et al.<sup>3</sup> and Malik et al<sup>4</sup> in their studies had also concluded that that deafness was greater in perforations situated in the posterior quadrants in comparison to the central perforations and anterior perforations. Matsuda et al<sup>5</sup> in their works had observed that the hearing impairment was the least with the anteroinferior perforations.

A perforated ear drum remains one of the commonest causes of conductive type of hearing loss. There are a plethora of factors that come into play when we try and analyze the reasons of deafness in a perforated ear drum. The compromised biomechanics of hearing is most certainly at fault which results in conductive type of hearing loss. Whether it is the reduced transformer ratio which is due to the lost surface area of the tympanic membrane.Or the jeopardized ossicular lever mechanism as a result of accompanying ossicular erosion. Or for that matter an infringement in the phase difference between the oval and round window as a result of

ear drum perforations. This is especially encountered in the case of posteroinferior perforations resulting in an exposed round window.

All these factors are a direct sequel of the chronic otitis media that results in a perforated ear drum.

The results that we inferred from our study with regards to the site of the tympanic membrane perforation having an effect on the severity of hearing loss, these were quite in line with the findings of Simpson et al<sup>6</sup> who had concluded that small perforations produced less hearing loss than large perforations. Our study is also in sync with Thorburn<sup>7</sup> who had concluded that anterior perforations produced lesser hearing loss as compared to posterior perforations.

In our study we also figured that the hearing loss due to all perforations showed maximum loss at lower frequencies and gradually decreasing as we progressed towards higher frequencies. It being lowest at 8000Hz. Similar results were reported by Simpson et al.<sup>6</sup> Similar results were observed in the study by Bhusal et al.<sup>8</sup> Likewise the findings in the research works by Bigelow et al., on rodents, yielded similar results.

We in our study also concluded that the perforations that were closer to the handle of malleus they resulted in a greater degree of deafness when compared to the ones that were located at the periphery. Similar findings were reported by Anthony and Harrison.<sup>9</sup>

We in our study also came to the conclusion that the severity of deafness also increased with increase in the size of ear drum perforation. Ahmad and Ramani<sup>10</sup> also concluded an increased hearing loss at the lower frequencies. The degree of hearing loss in their study was also found to be increasing with the size of the perforation. The findings of an increased hearing loss with an increase in the size of perforation were again quite in line with the findings reported by Payne and Githler<sup>11</sup>, Wever and Lawrence.<sup>12</sup> Similar observations were also reported by Bordley and Hardy.<sup>13</sup>

## CONCLUSION

Ear drum perforations invariably lead to a varying degree of hearing impairment. The hearing loss due to tympanic membrane perforation is usually a conductive type of deafness. Any sensorineural component is likely to be because of accompanying complication of the chronic otitis media that has affected the inner ear or the auditory pathway. Or it could even be because of a coexisting disease process that has affected the cochlea or the neural pathways. The lost surface area of the tympanic membrane does affect the severity of hearing loss. The greater the percentage of the surface area of the tympanic membrane that is lost, more severe is the degree of deafness. Lower frequencies are affected more than higher frequencies in conductive deafness due to simple perforations. The conductive deafness is more pronounced in perforations that involve or are in proximity to the malleus handle than those away from it. Amongst the perforations located in the inferior quadrants of the tympanic membrane, the ones located in the posteroinferior quadrant cause greater degree of deafness than the anteroinferior

quadrant perforations. The perforations in the posteroinferior quadrant cause a higher degree of deafness than the ones located in the anterosuperior quadrant.

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