A Study on Ossicular Pathology in Chronic Suppurative Otitis Media

P S K Thangaraj¹, P Ramasundar¹, Heber Anandan²

¹Assistant Professor, Department of ENT, Government Theni Medical College, Theni, Tamil Nadu, India, ²Senior Clinical Scientist, Department of Clinical Research, Dr. Agarwal’s Healthcare Limited, Tirunelveli, Tamil Nadu, India

Abstract

Introduction: In developing countries, chronic suppurative otitis media (CSOM) accounted for 60-80% of middle ear disease. CSOM is a disease affecting, especially people with poor health, hygiene, and nutrition worldwide. Up to one-third of the population in developing countries has their quality of life affected by CSOM and its precursors. In children in developing countries CSOM is the most common cause of hearing impairment.

Aim: The aim is to study the long-term hearing stability in patients who undergoing ossicular reconstruction using auto- or homo-graft ossicles taken from CSOM.

Methods: Fifty cases of unsafe CSOM who underwent a modified radical mastoidectomy or radical mastoidectomy for their disease process were taken up for the study.

Results: Out of 50 patients, 34 were male and 16 were female prominent age group being 20-45, all the patient had ear discharge and hard of hearing. Removed ossicles are examined and found pathology from inflammatory cell infiltration to sequestrum formation, and long process of incus is most common to affect.

Conclusion: The long process of the incus is the most commonly eroded part of an ossicle in unsafe CSOM. Bone absorption is the most frequent pathological change and is usually observed where the granulation, inflammatory, or connective tissue with fibroblast is adjacent to the ossicle.

Key words: Cholesteatoma, Chronic suppurative otitis media, Ossicles

INTRODUCTION

Chronic suppurative otitis media (CSOM), a common condition in otorhinolaryngology, is characterized by chronic, intermittent, or persistent discharge through a perforated tympanic membrane. Poor living conditions, overcrowding, poor hygiene, and nutrition have been suggested as the basis for the widespread prevalence of CSOM in developing countries.¹ ²

Tubotympanic type of CSOM is called safe type because the rate of complication is very low and is usually not associated with cholesteatoma formation. Ossicular chain involvement is found in both safe and unsafe type of disease. In safe type, though the involvement of ossicular chain is less common, still significant numbers of patients are having hearing deterioration due to it. The tubotympanic types are mainly manifested with hearing loss, which may be due to perforation in the tympanic membrane or ossicular chain erosion/fixation. Mechanism of ossicular erosion in noncholesteatomatous middle ear disease is overproduction of cytokines tumor necrosis factor (TNF) alpha, interleukin-2 (IL-2), fibroblast growth factor, and platelet-derived growth factor, which promotes hypervascularization, osteoclast activation, and bone resorption causing ossicular damage.³

Management of CSOM has witnessed a profound change over the past 10 decades. Middle ear reconstruction is done after successful removal of the disease. For a successful ossicular reconstruction, an air-filled middle ear and a functioning eustachian tube are important prerequisites.
Grafts and biomaterials chosen for use in middle ear reconstruction should not induce a sustained foreign body reaction, neither should extrude or biodegrade.

**Aim**
The aim is to study the long-term hearing stability in patients who undergoing ossicular reconstruction using auto- or homo-graft ossicles taken from CSOM.

**MATERIALS AND METHODS**
This case series study was conducted in Department of ENT at Government Theni Medical College. A total of 55 cases of unsafe CSOM who underwent a modified radical mastoidectomy or radical mastoidectomy for their disease process were taken up for the study. All the ossicles were studied grossly under ×4 magnification while performing surgery. The ossicle in the cases where their chain was completely intact was not removed during surgery and hence was not studied histologically. Only 35 ossicles (24 incus, 11 malleus) were studied histologically. They were removed partially or completely as a part of the surgical procedure on such cases. The stapes was never removed or studied histologically. Whenever possible, biopsy was also taken from attic, aditus, antrum, and sinus tympani. The removed ossicle and biopsy materials were preserved in separate formalin containers. The ossicles were decalcified before sectioned.

**RESULTS**
Cholesteatoma and granulation tissue are the specific pathologies in atticoantral disease. Although cholesteatoma is invariably associated with granulation tissue, there may be only granulation tissue in active mucosal disease (Figure 1).

**Gross Pathology**
Erosion of the bone was most commonly seen in the long process of incus (54%) (Image 1). It was followed by erosion of handle of the malleus, body, and short process of the incus, in order of frequency. Whenever the stapes superstructure was eroded, the incus and malleus were markedly disrupted ossicular surface looked pitted under ×4 magnification in 5 incus and 2 malleus. Cholesteatoma was not always associated with ossicular disruption, and even in the absence of cholesteatoma, the ossicular disruption was present. Nearly 7% of cases with mainly cholesteatoma 90% with only granulations or chronic inflammation and 96% with both cholesteatoma and granulations or chronic inflammation in the middle ear cleft showed the evidence of bone destruction on gross examination in one or all the ossicles (Tables 1 and 2).

**Histopathology**
Totally, 2 out of the 35 ossicles studied histopathologically looked intact on gross examination under ×4 magnification. They were, however, studied histopathologically while they were removed completely or partially as a part of the surgical procedure because the ossicular chain in these cases was not intact one of the two ossicles showed bone changes.

<table>
<thead>
<tr>
<th>Ossicle</th>
<th>Gross finding under ×4 magnification</th>
<th>Number of ossicles (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incus</td>
<td>Intact</td>
<td>5 (16)</td>
</tr>
<tr>
<td></td>
<td>Pitted</td>
<td>5 (16)</td>
</tr>
<tr>
<td></td>
<td>Body eroded</td>
<td>5 (12)</td>
</tr>
<tr>
<td></td>
<td>Long process eroded</td>
<td>23 (54)</td>
</tr>
<tr>
<td></td>
<td>Short process eroded</td>
<td>14 (32)</td>
</tr>
<tr>
<td></td>
<td>Incus completely eroded</td>
<td>7 (18)</td>
</tr>
<tr>
<td>Malleus</td>
<td>Intact</td>
<td>8 (20)</td>
</tr>
<tr>
<td></td>
<td>Pitted</td>
<td>2 (4)</td>
</tr>
<tr>
<td></td>
<td>Handled eroded</td>
<td>20 (44)</td>
</tr>
<tr>
<td></td>
<td>Head eroded</td>
<td>14 (24)</td>
</tr>
<tr>
<td></td>
<td>Malleus completely eroded</td>
<td>2 (4)</td>
</tr>
<tr>
<td>Stapes</td>
<td>Intact</td>
<td>8 (16)</td>
</tr>
<tr>
<td></td>
<td>Head eroded</td>
<td>4 (8)</td>
</tr>
<tr>
<td></td>
<td>Crura eroded</td>
<td>4 (8)</td>
</tr>
<tr>
<td></td>
<td>Not seen</td>
<td>30 (60)</td>
</tr>
</tbody>
</table>

CSOM: Chronic suppurative otitis media

![Distribution of ossicular defects](image1.png)

![Long process of incus and handle of malleus](image2.png)
on histological study. All the ossicles which looked pitted on gross examination showed bone changes. Only one ossicle was absolutely normal histologically. Bone absorption was the most common histopathological change and was found in 84% ossicles (Image 2). It was followed by infiltration by inflammatory cells in the bone spaces. Keratinized stratified squamous epithelium was seen in the mucosal covering of 4 (12%) ossicles. Proliferation of fibroblast was present just adjacent to the surface in 7 (19%) ossicles. In 12% ossicles, there was evidence of sequestrum. New bone formation was observed in 20% ossicles (Tables 2 and 3).

**DISCUSSION**

Subtotal perforations were the most common type recorded in our series. These may be due to aggressive and recurrent middle ear disease due to inadequate and improper medical therapy, lack of awareness about aural hygiene and unavoidable delays in scheduling surgery. Some of the perforations had only a small remnant of tympanic membrane and can be called total perforation.

Subtotal perforations are associated with defective handle of the malleus and long process of the incus while the posterior perforation mostly involves the long process of the incus. In Austin’s series, the most common ossicular defect was absence of long process of the incus (59.2%), followed by loss of the incus and superstructure of stapes (23.2%) and necrosis of the incus, superstructure of the stapes and malleus. The malleus was markedly affected along with incus. Granulation tissue exhibits their impact equivocally with cholesteatoma (8.2%).

Cholesteatoma has the property of bone erosion. A number of theories have been propounded explaining the mechanism of bone erosion by cholesteatoma such as pressure, bacterial, enzymatic, hyperemic, chemical, and immunological theories. Site of cholesteatoma has an influence on the pattern of ossicular damage.

Ferlito et al. suggested that the destructive property of cholesteatomas - the bone erosion is caused by the production of collagenase by the components of squamous and fibrous epithelial tissues. It is not properly demonstrated yet whether mineralized bone can be absorbed by collagenase. Other agents were incorporated, such as TNF, IL-1 and prostaglandins, to the hypothesis of bone absorption by biochemical action, exclusively played by collagenolytic enzymes.

**CONCLUSION**

The long process of the incus is the most commonly eroded part of an ossicle in unsafe CSOM, followed by handle and head of the malleus. Bone absorption is the most frequent pathological change and is usually observed where the granulation, inflammatory, or connective tissue with fibroblast is adjacent to the ossicle. The high incidence of bone changes seen in the ossicles in unsafe CSOM suggests that their retention during mastoid surgery...
surgery may not be as beneficial in producing the long-term results.

REFERENCES


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