

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.

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www.ijss-sn.com

Month of Submission : 04-2017
Month of Peer Review : 05-2017
Month of Acceptance : 06-2017
Month of Publishing : 06-2017

Corresponding Author: Heber Anandan, No. 10, South By-pass Road, Vannarpettai, Tirunelveli - 627 003, Tamil Nadu, India.
Phone: +91-9894067910. E-mail: clinicalresearch@dragarwal.com

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 atticotympanic 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 1: Gross ossicular finding in 50 unsafe CSOM cases

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

CSOM: Chronic suppurative otitis media

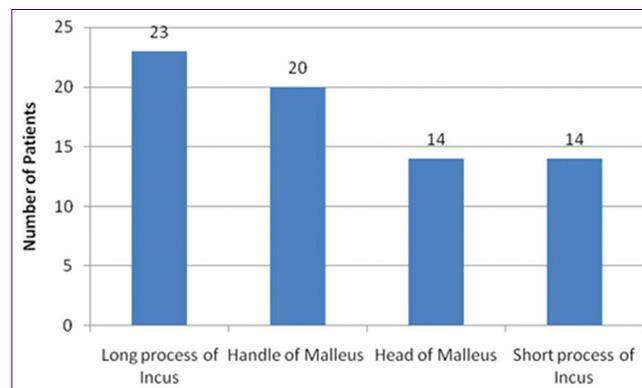


Figure 1: Distribution of ossicular defects



Image 1: Long process of incus and handle of malleus

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%).⁴

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.⁵⁻⁷

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^a and prostaglandins, to the hypothesis of bone absorption by biochemical action, exclusively played by collagenolytic enzymes.⁸⁻¹⁰

CONCLUSION

The long process of the incus is the most commonly eroded part of an ossicle in unsafe CSOM, followed by

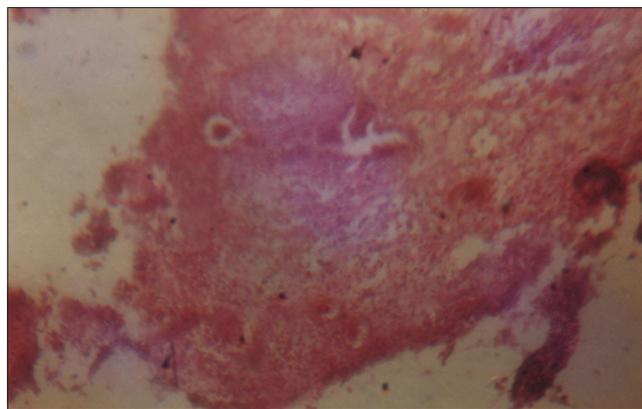


Image 2: Photomicrograph of eroded ossicles

Table 2: Incidence and nature of bone changes in 35 ossicles studied histopathologically

Findings	Number (%)
Normal bone	2 (6)
Change in bone spaces	
Congestion of blood vessels	18 (4)
Infiltration by inflammatory cells	25 (71)
Epithelium in bone spaces	0 (4)
Granulation tissue	28 (58)
Necrosis	1 (2)
Vascular thrombosis	1 (2)
Fibrous tissue	1 (6)
Bone formation	
Lamellar and intra membrane	12 (25)
Bone destruction	
Absorption	32 (84)
Sequestrum formation	4 (12)
Sclerotic bone fractures	9 (25)

Table 3: Incidence and nature of the changes in mucosa covering the 35 ossicles

Parameter	Mucosal changes	Number (%)
Epithelial	Stratified squamous	11 (25.0)
	Keratinized stratified squamous	4 (11.52)
	Columnar	3 (7.68)
	Cuboidal	-
	Ciliated	-
Subepithelial	Epithelium not seen	24 (5.7)
	Congestion	8 (19.2)
	Granulation tissue, chronic or acute inflammatory cells	15 (38.4)
	Cystic dilated gland	1 (5.76)
	Cholesterin granuloma	-
	Tubercular granuloma	-
	Fibroblast proliferation	7 (21.12)

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 may not be as beneficial in producing the long-term results.

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How to cite this article: Thangaraj PSK, Ramasundar P, Anandan H. A Study on Ossicular Pathology in Chronic Suppurative Otitis Media. Int J Sci Stud 2017;5(3):223-226.

Source of Support: Nil, **Conflict of Interest:** None declared.