

## Autograft ossicle selection in cholesteatomatous ear disease: histopathological considerations

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### Abstract

In order to determine whether selection of autograft ossicles in cholesteatomatous ear disease should be based upon their appearance under the surgical operating microscope, we studied the histopathological features of 113 such ossicles. We attempted to correlate the extent of erosion of the ossicle, as noted under the surgical operating microscope, with their histopathological appearance. There were 60 mallei and 53 incudes. Seventy-nine ossicles were eroded and 34 were intact. The commonest abnormality noted was erosion of the long process of the incus (75 per cent). Both intact and eroded ossicles had similar histological features. There was no evidence of intra-ossicular cholesteatoma. The results suggest that the extent of erosion of these ossicles as seen under the surgical operating microscope should in no way prejudice their use as autografts when required.

**Key words:** Cholesteatoma; Ear ossicles; Histopathology

### Introduction

The use of autograft ossicles in middle ear reconstruction was first reported by Hall and Rytzner (1957). Several studies on the use of autologous ossicles in tympanoplasty followed (Hall and Rytzner, 1960; Kerr and Smyth, 1971; Lang *et al.*, 1986; Lang *et al.*, 1989; Wake *et al.*, 1992). One of the problems with the use of autograft ossicles in cholesteatomatous ear disease is that ossicular erosion due to the disease process itself limits its availability for reconstruction. Other problems have been noted too. Based on histological studies of ossicles from affected ears, some authors have described the presence of osteomyelitis (Hiranandani and Deshpande, 1971; Subotic and Femenic, 1991) and intraossicular mucous glands with the potential to undergo squamous metaplasia (Sade, 1972). These features would necessarily preclude the use of autograft ossicles in cholesteatomatous ears. However, others (Seifi and Fouad, 1992; Wake *et al.*, 1992) have not noted similar findings. Such conflicting reports prompted us to study histologically a series of ossicles from cholesteatomatous ears and also determine whether there is any correlation between the appearance of the ossicle under the surgical operating microscope and its histological appearance.

### Material and methods

One hundred and thirteen ossicles which were removed from the ears of 73 consecutive patients with cholesteatomatous ear disease as part of the

surgical procedure were studied. The anatomical site and extent of erosion of each ossicle was noted under the surgical operating microscope. The ossicles were stored in formalin to be subsequently sectioned. Approximately nine to 12 sections were made at three levels. The sections were then stained with haematoxylin and eosin and examined.

### Results

A total of 113 ossicles were removed from 73 patients. Sixty were mallei and 53 were incudes. Ossicular erosion was found to chiefly involve the incus (Table I), the long process being the commonest portion of the ossicle to be affected.

Eight histological features were noted. The most consistent histological features noted were the presence of periosteal thickening and fibrosis (Table II) (Figure 1). A layer of superficial granulation tissue (Figure 2) was present in more than half of the ossicles. Less than a third of ossicles showed surface cholesteatoma (Figure 3). This was characterized by a layer of keratinized squamous epithelium with no penetration into the deeper

TABLE I  
EXTENT OF OSSICULAR EROSION AS SEEN UNDER OPERATING MICROSCOPE

Ossicle	Intact	Eroded	Site of erosion
Malleus	31	29	Head/handle
Incus	3	40	Long process only
		10	Long process with body or short process

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TABLE II  
HISTOPATHOLOGICAL FEATURES OF OSSICLES

Feature studied	No.	(%)
Surface cholesteatoma	35	(31.6)
Inflammatory granulation tissue	73	(64.6)
Fibrosis	102	(90.3)
Periosteal thickening	103	(91.2)
Superficial inflammation within bone	93	(82.3)
Deep inflammation within bone	83	(73.5)
Mucous glands	—	—
Intraossicular cholesteatoma	—	—

layers. Other features noted were superficial and deep inflammation of the underlying bone. Superficial bony inflammation, characterized by the presence of chronic inflammatory cells with dilated vessels involving the superficial portion (less than half) of the thickness of the ossicle, was more commonly observed than deep bony inflammation (Figure 4), in which there was diffuse involvement of the entire ossicle. Three ossicles exhibited a perfectly normal appearance with no evidence of any inflammatory changes. Eight ossicles showed evidence of fibrosis and periosteal thickening alone. We compared the histological features of intact and eroded ossicles (Table III). Using the Chi squared test of proportions we found that there was no statistically significant difference between the two groups.

### Discussion

Ossiculoplasty using homografts is not favoured by some surgeons because of the risk of transmission of diseases like acquired immunodeficiency syndrome (AIDS) and Creutzfeldt-Jakob disease (Glasscock *et al.*, 1988). Although alloplasts enjoy popularity in many centres around the world, extrusion rates have been noted to be high (Mair *et al.*, 1989). Autografts are preferred in many instances because of easy availability, low cost of preparation, good sound conduction and biocompatibility. In cholesteatomatous ear disease, however, there is an element of concern regarding the presence of residual cholesteatoma in relationship to the ossicle.

The results of the present study show that although cholesteatoma may lie on the ossicular

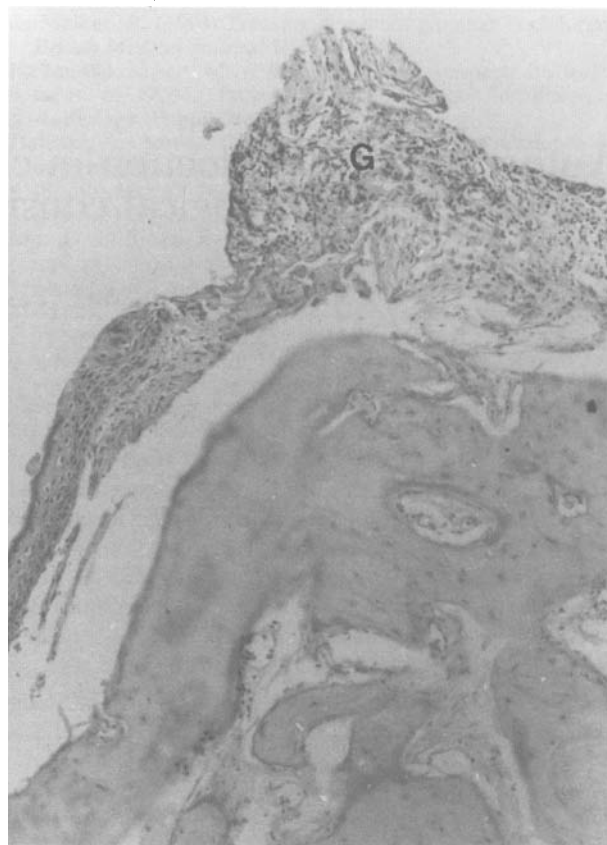


FIG. 2

Ossicle with inflammatory granulation tissue on the surface (G) (H & E;  $\times 90$ )

surface, there is no histopathological evidence of intraossicular cholesteatoma, even in the presence of gross ossicular destruction. This finding confirms the observations made by other authors (Glasscock, 1976; Seifi and Fouad, 1992; Wake *et al.*, 1992). Sade (1972) noted the presence of intra-ossicular mucous glands and suggested that squamous metaplasia of these elements could lead to intra-ossicular cholesteatoma. In the present study a careful search was made for any evidence of intra-ossicular squamous epithelium and mucous glands and none was found.

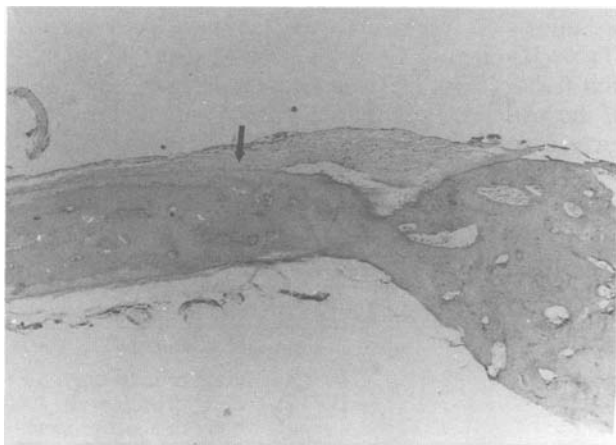


FIG. 1

Ossicle with thickened periosteum and fibrosis (arrow) (H & E;  $\times 40$ )

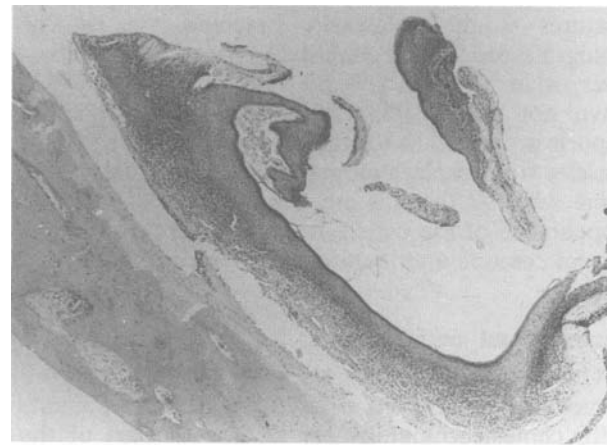


FIG. 3

Ossicle with cholesteatoma on the surface; note the keratinised squamous epithelium (H & E;  $\times 40$ )



FIG. 4

Ossicle exhibiting congested capillaries along with chronic inflammatory cells throughout the depth of the bone (H & E; × 40)

No correlation was found in the present study between the degree of ossicular erosion as seen under the operating microscope and its histopathological appearance. Comparing intact and eroded ossicles with respect to all the histopathological features studied (Tables IV and V), we found that there was no significant difference between the two groups. This was true of both malleus and incus. Thus, a fairly normal looking uneroded ossicle showed histopathological features of extensive inflammation within the bone, while an ossicle with gross destruction showed a comparatively lesser degree of inflammation histologically. Subotic and Femenic (1991) studying intact incudes in patients with attic cholesteatoma found osteitis or osteomyelitis in 67.5 per cent. Features such as osteomyelitis with sequestrum formation which have been noted by some authors (Hiranandani and Deshpande, 1971; Subotic and Femenic, 1991) were not observed in any of the specimens examined.

The incus is the ossicle which is most prone to erosion in chronic ear disease. It is also the ossicle which is most frequently available for ossicular reconstruction. An entirely intact incus is rarely encountered in surgery for cholesteatoma, the commonest abnormality being erosion of the long process. In this study the frequency of this pathology was 75 per cent.

A successful functional result following autograft ossiculoplasty is dependent upon a multitude of factors. While most reports concerning autograft ossiculoplasty concentrate on the long-term viability of these ossicles (Lang *et al.*, 1986; Lang *et al.*, 1989; Wake *et al.*, 1992), few elaborate on the method of selection of the viable ossicle. The present study shows that rejecting an ossicle for reconstruction on the premise that there may be intraossicular cholesteatoma is inappropriate. There may be surface cholesteatoma which, as demonstrated elsewhere (Seifi and Fouad, 1992), can be removed by drilling with a burr prior to use for reconstruction.

TABLE III

COMPARISON OF HISTOPATHOLOGICAL FEATURES IN INTACT AND ERODED OSSICLES

Histopathological features	Operative findings		p value
	Eroded (n = 79)	Intact (n = 34)	
Surface cholesteatoma	24	11	0.99
Inflammatory granulation tissue	47	26	1.00
Fibrosis	71	31	0.89
Periosteal thickening	71	32	0.71
Superficial inflammation	66	27	0.79
Deep inflammation	58	25	1.00

The results show that there is no statistically significant difference between the histopathological features of intact and eroded ossicles

Further, there is no correlation between the degree of ossicular erosion and the presence of histologically evident inflammatory changes.

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**References**

Glasscock, M. E. (1976) Ossicular chain reconstruction. *Laryngoscope* **86**: 211-221.

Glasscock, M. E., Jackson, C. J., Knox, G. W. (1988) Can acquired immunodeficiency syndrome and Creutzfeldt-Jakob disease be transmitted via otologic homografts? *Archives of Otolaryngology - Head and Neck Surgery* **114**: 1252.

Hall, A., Rytzner, C. (1957) Stapedectomy and autotransplantation of ossicles. *Acta Otolaryngologica* **47**: 318-324.

Hall, A., Rytzner, C. (1960) Viability of autotransplanted ossicles. *Acta Otolaryngologica* **158**: (Suppl) 335.

Hiranandani, L. H., Deshpande, C. K. (1971) Infections of the middle ear cleft. In *Histopathological Study of the Middle Ear Cleft and Its Clinical Applications*. (Hiranandani, L. H., Deshpande, C. K., eds.), Butterworths, London, pp 6-36.

Kerr, A. G., Smyth, G. D. L. (1971) The fate of transplanted ossicles. *Journal of Laryngology and Otology* **85**: 337-347.

Lang, J., Kerr, A. G., Smyth, G. D. L. (1986) Long-term viability of transplanted ossicles. *Journal of Laryngology and Otology* **103**: 741-747.

Lang, J., Kerr, A. G., Smyth, G. D. L. (1989) Transplanted ossicles after two decades. *Journal of Laryngology and Otology* **103**: 471-472.

Mair, I. W., Pedersen, S., Laukli, E. (1989) Audiometric results of TORP and PORP middle ear reconstruction. *Annals of Otology, Rhinology and Laryngology* **98**: 429-433.

Sade, J. (1972) Epithelial invasion of intraossicular spaces. *Journal of Laryngology and Otology* **86**: 15-21.

Seifi, A. E., Fouad, B. (1992) Autograft ossiculoplasty in cholesteatoma. *ORL* **54**, 324-327.

Subotic, R., Femenic, B. (1991) Histological changes of incus with cholesteatoma in the attic. *Acta Otolaryngologica* **111**: 358-361.

Wake, M., Robinson, J. M., Sheehan, A. L., Bazerbach, S., Codling, B. W. (1992) The histology of 'stored' autologous ossicles. *Journal of Laryngology and Otology* **106**: 17-20.

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