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# The styloid process in ossicular chain reconstruction
## (A pilot study)

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**Abstract**

Our pilot study reports twenty-six cases of resolved chronic otitis media in which the human, cadaveric styloid process was used as an ossicular graft material. A maximum follow-up of one year is presented in this paper. There was no extrusion or rejection of the styloid processes. Hearing improvement with a closure of the air-bone gap to within 10–15 dB. of the pre-operative bone conduction was found in most cases. So far the styloid process has proved to be an ideal ossicular graft though the long-term results are yet to be seen.

### Introduction

Since the advent of microsurgery, tympanoplasty has become a commonly performed operation, the aims of which are to remove the disease, to restore hearing function and to repair the tympanic membrane. Various human and synthetic materials have been utilised for ossicular chain reconstruction. Until now there has been no implant material which is better or more suitable than human autologous or homologous ossicles. This is especially so in terms of foreign body reaction and biocompatibility. We have laid down certain criteria for an ideal ossicular graft by which any ossicular material could be evaluated. These criteria are that it should be:

(1) Human autologous or homologous material.
(2) Easily available.
(3) Inexpensive.
(4) Biologically inert.
(5) None-toxic.
(6) Easy to mould.
(7) Easy to sterilise and store.
(8) Not extruded or absorbed.

Until now there have been no reports on the use of the styloid process in ossicular chain reconstruction. The present study was designed to evaluate its use.

### Material and Methods

We have studied twenty-six cases of resolved chronic otitis media with a central perforation or cholesteatoma in which the styloid process was used as an ossicular graft. The styloid processes were removed from fresh human temporal bones. The periosteum was stripped from the styloid process, and it was then stored in 70 per cent ethanol for a week. Prior to use, it was kept in a solution of oxytetracycline, and later irrigated with normal saline. Before being implanted, its biocompatibility was tested in experimental animals. It was implanted in a pouch in the neck of a white rat. The styloid process was compared histopathologically with an implanted homograft incus. It was found that the foreign body response to the styloid was similar to that of the homograft incus. In all 26 cases temporalis fascia was used as the graft material.

In all but one case the temporalis fascia graft took well. Hearing improvement, with a closure of the air-bone gap to within 10–15 dB. of the pre-operative bone conduction, was observed in most cases. Only one case was re-explored after 3 months as there was no hearing improvement. On exploration it was found that the ossicular graft had slipped from its place and mucosa had grown over the styloid process. Revision surgery after varying periods of time should reveal the ultimate fate of an implanted styloid process.

### Discussion

Various human and synthetic ossicular grafts have been used to date. The grafts used are cortical bone, autologous or homologous ossicles, cartilage, stainless steel wire, plastipore, proplast, ceramics and human teeth. Plastics and ceramics are not easily available in India and they are very expensive. Several authors, including Lang *et al.* (1986) and Palva and Makinen (1983), have reported foreign body reactions caused by plastic materials.

The styloid process is a long cylindrical cartilaginous bone, the normal length of which varies from 2.2 cm. to 4 cm. It develops from two parts:

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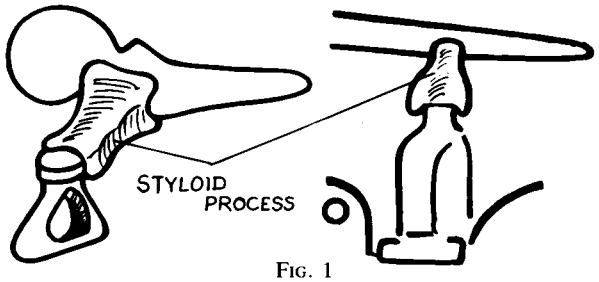



FIG. 1

Diagrams showing the malleus-stapes assemblies using the styloid process.

(1) The tympano-hyal part, which is embedded in temporal bone.
(2) The stylo-hyal part, which forms the main part of the styloid process.

These parts are united by cartilage which undergoes ossification often as late as middle age. A single styloid process can yield at least 4–5 ossicular grafts. The desired length of graft is cut and, after cleansing the graft in a tetracycline solution, the graft is gripped with artery forceps and shaped, using a diamond paste burr under the microscope. In all the 26 cases temporalis fascia was used as the graft. In the majority of cases a malleus-stapes assembly was performed (Fig. 1). The sculptured ossicular graft with notch and niche was placed in the middle ear so that continuity was restored between the malleus and the stapes, by fitting the graft over the malleus handle and the stapes head. In some cases continuity was maintained between the malleus handle and the stapes footplate when there was a diseased stapes superstructure. Shaping of the styloid process and its consequent interposition between the malleus and stapes is easier than with a homograft incus. The results in terms of hearing improvement have been found to be comparable with those of a homograft incus. So far, the styloid process has proved to be an ideal ossicular substitute. This has been a preliminary study of just one year; long-term results are awaited.

## Conclusion

Though the present pilot study of twenty-six cases using the styloid process as an ossicular material is of short duration and the series of cases is small, we hope to enlarge our case study and evaluate our patients on a long-term basis.

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