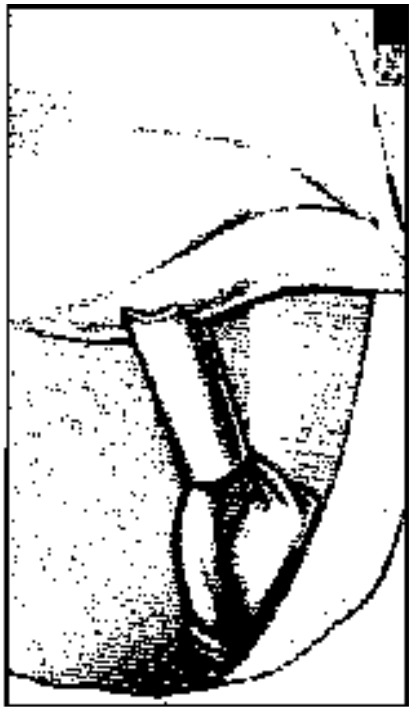


OSSICULAR RECONSTRUCTION USING HYDROXYLAPATITE STRUTS



INCUS STRUT



INCUS-STAPES STRUT

A Procedure Profile
by Jack M. Kartush, M.D.

Hydroxylapatite Prostheses

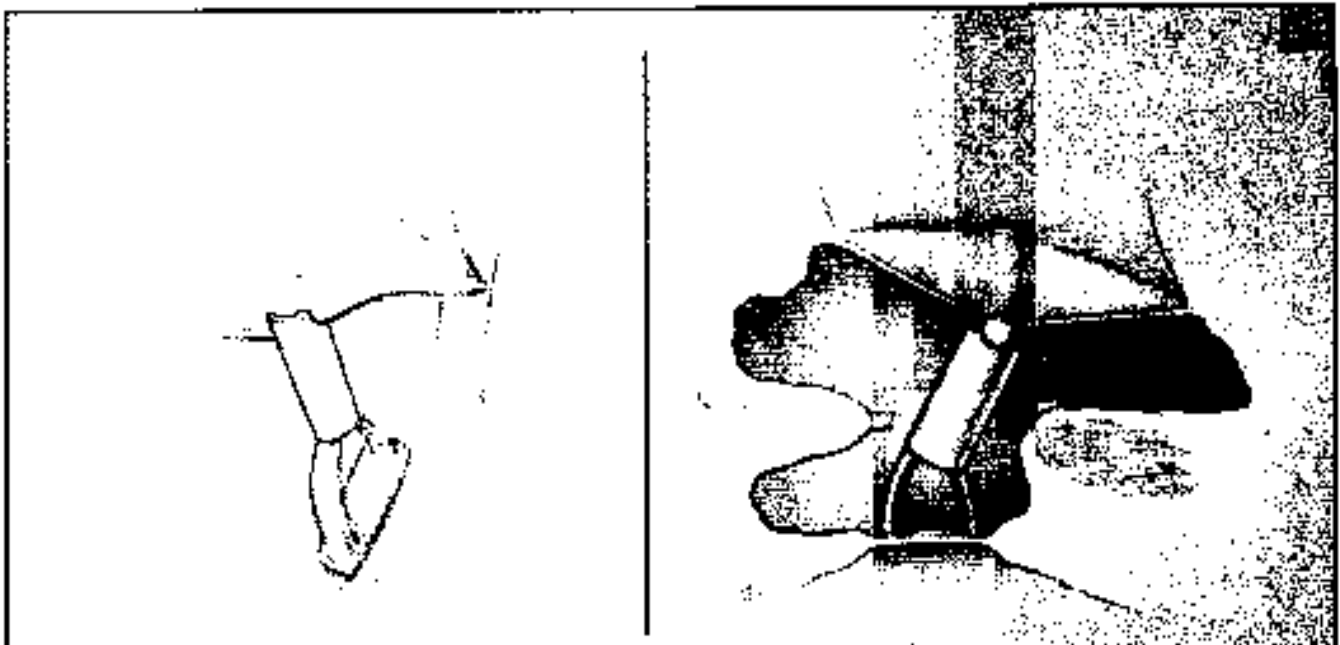
Hydroxylapatite (HA) has rapidly become accepted as an effective and well-tolerated material for ossicular chain reconstruction. During second-look **surgery** - microscopic examination demonstrates excellent biointegration with neovascularization of the implant. Unlike plastic and metal -, HA has demonstrated remarkable (although not absolute) tolerance in the face of acute infection or eustachian tube dysfunction (ETD). In patients with persistent ETD, a myringotomy tube can be safely placed near the HA prosthesis. To date, neither the perforation nor the myringotomy tube has led to infection or rejection of these implants.

Strut Design

For ossicular chain reconstruction, I use a simple strut design (*Figure 1*). Unlike the classic tack-shaped TORP® and PORP®, there is no platform cap to obstruct the surgeon's view of the medial aspect of the implant. Furthermore, the top heavy configuration of these prostheses may contribute to eventual displacement particularly with underlying ETD.

The Strut prostheses are - placed beneath the malleus which minimizes the possibility of extrusion and locks them in place without the need for gelfoam to support their position.

Although the malleus and stapes are never directly aligned, their offset is usually small enough to allow a direct - connection with excellent hearing results. We have found **Strut** - reconstructions to be satisfactory when the Malleus-Stapes (M-S) angle is less than **-60°**; this accounts for over 90% of reconstructions. If the M-S angle is greater than **-60°**, I - use **either a TORP/PORP or place a cartilage cap over a Strut.**



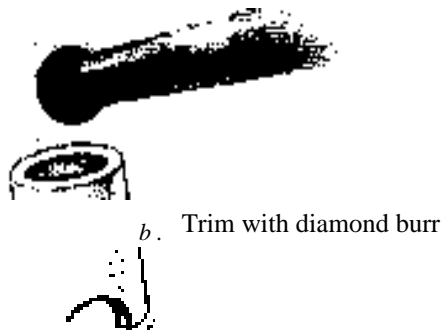
Kartush Incus Strut

Figure /

Incus Replacement Strut

The incus replacement prosthesis consists of a hollow tube with a lateral **notch** - . A "medium" or **"short"** length is satisfactory for most middle ears although slight shortening using a drill with a small diamond burr (*Figure 2*) is often necessary.

Turning the drill down to half-speed will minimize breakage of the Strut. Following sizing, the Strut is washed with saline to clean off any talc that may have adhered from the surgeon's gloves.



Kartush Incus Strut

Figure 2

The surgeon places the implant on a curved needle with the **notch** - side up. This allows the surgeon to precisely place the tip of the needle on the stapes capitulum. The prosthesis is then slid off the needle directly on to the stapes using a 20 gauge suction tip (*Figure 3A and B*). A 2 mm right-angled hook is then used to lift the malleus while the Strut is advanced beneath it.

If the middle ear is particularly shallow or if the malleus appears hypomobile, **-the tensor tympani can be stretched or cut to allow lateral mobilization of the malleus.** This - will significantly ease insertion of the Strut and should be performed without hesitation if - manipulations are creating undue pressure on the stapes. **I prefer to stretch rather than cut the tendon if the malleus head has been removed in order to maintain stability of the manubrium.** The size of the prosthesis, of course, must also be appropriate. Attempting to insert too large a prosthesis may cause undue labyrinthine trauma and may prevent adequate excursion of the reconstructed ossicular chain. Once the tensor tympani has been cut, greater leeway in sizing will be obtained. Note that if the initial Strut has been significantly shortened, it may be too short following malleus mobilization and will require replacement. **- When the M-S angle is marginal, creating a notch on the bottom of the Strut which overlies the anterior stapes crura helps improve seating of the prosthesis (Figure 4). Also, if the stapes tendon remains, a posterior notch can be created to accommodate it.**

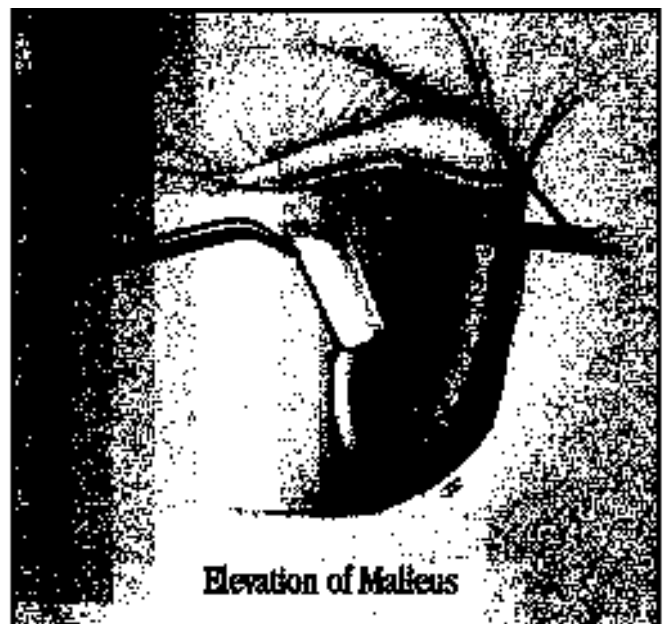
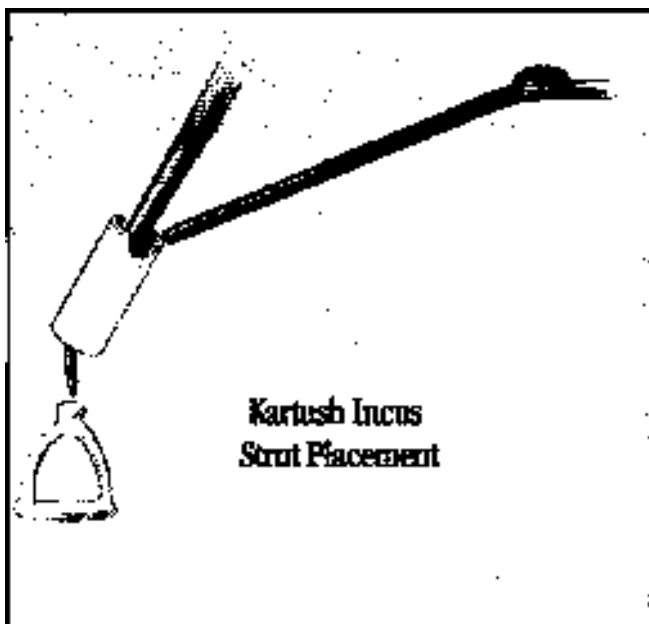


Figure 3A

Kartush Incus Stapes Strut Figure 5

Incus-Stapes Replacement

The incus-stapes - prosthesis consists of a solid shaft with a lateral **notch** - (*Figure 5*). Thus, sizing can be quickly accomplished using malleus-type scissors (*Figure 6*). - The implant is washed with saline. It is then passed into the middle ear by placing a 20 gauge suction tip onto the body of the prosthesis while the surgeon's thumb covers the control hole (*Figure 7*). The force of the vacuum holds the Strut in place until the control hole is uncovered while a one millimeter right-angled hook assists in positioning the implant over the stapes footplate and just posterior to the malleus. Perichondrium or fascia is placed over the oval window if the footplate is absent. A 2 mm right-angled hook is then used to lift the malleus while the Strut is advanced beneath it. Mobilization of the malleus, as described above, should be performed if needed.



Trim with malleus scissors

Kartush Incus-Stapes Strut
Figure 6

Absent Malleus



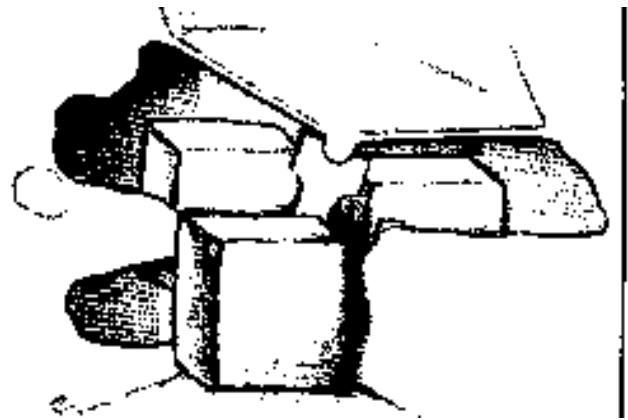
Kartush Incus-Stapes
Strut Placement

Figure 7

- When the malleus was absent, I initially used an HA prosthesis shaped in a typical TORP or PORP design beneath the tympanic membrane or graft. As noted above, however, tack-shaped prostheses have a number of limitations. If the malleus is absent or the M-S angle is greater than 60 degrees, the incus strut can be combined with a cartilage cap (Figure 8).

Intact Canal Mastoidectomy

Prior to the availability of HA, I had abandoned reconstructing the ossicular chain during the first phase of intact canal wall mastoidectomy due to the relatively high chance of infection and extrusion of plastic prostheses. With the superior tolerance of HA, I now routinely reconstruct the ossicular chain during the first surgery. The self-locking nature of the Strut design increases the probability that the implant will remain in good position despite the anticipated fluid and pressure changes which occur following tympanomastoidectomy. Furthermore, the Strut, in combination with the cartilage blocks, helps maintain a ventilated middle ear.



Cartilage Block Technique

Fig 9

Cartilage Blocks

ETD can be a major source of short and long term tympanoplasty failure. Although a number of surgeons have used cartilage during tympanoplasty, it has usually been used in thin sheets (with or without pedicled perichondrium) to reduce the chance of attic or posterior tympanic membrane retraction. In recent years, I have used thick block~s of cartilage with attached perichondrium within the middle ear and attic to obviate the displacement of thin cartilage sheets (Figure 9). This technique can be employed with or without ossicular chain reconstruction regardless of whether a lateral or medial tympanoplasty technique is used.

A widely opened facial recess and epitympanum provide an excellent means of assuring proper implant placement following return of the tympanomeatal flap. I routinely obtain this transmastoid exposure for revision of transcanal ossicular chain reconstructions.

Should recurrent or persistent cholesteatoma be identified near the stapes during a second-look procedure, I do not hesitate to remove the prosthesis to improve exposure and reduce the possibility of mechanical trauma to the cochlea. Since I began routine use of the laser during tympanomastoidectomy, however, the incidence of persistent cholesteatoma has been dramatically reduced. The laser can also be used to vaporize the shaft of the HA Strut. In so doing, it can be easily extracted with minimal mechanical trauma to the ossicular chain.

A videotape demonstrating these techniques is available upon request.