Contemporary Study Of Ossiculoplasty

Essay

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Abstract

There is plenty of implant materials used for ossicular chain reconstruction. Some of these implants are of human origin like cartilage & ossicular bone grafts, others are made of synthetic materials like plastics, bioceramics & metals. They are in the PORP or TORP configuration.

Key words: ossicles, incus, PORP & TORP.

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List of Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
CORP-P	Partial Ceramic Ossicular Replacement Prosthesis
CORP-T	Total Ceramic Ossicular Replacement Prosthesis
CT	Computarized Tomography
dB	Decibel
HaH	Hydroxylapatite hybrid ossicular replacement prosthesis
HDPS	High Denisty Polyethylene sponge
HIV	Human Immunodeficiency Virus
IBP	Incus Bridge Prosthesis
MNP	Malleus Notch Prosthesis
PORP	Partial Ossicular Replacement Prosthesis
TORP	Total Ossicular Replacement Prosthesis
TTP	Titanium Prosthesis

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Aim of the study

To describe the criteria of different materials used for ossiculoplasty having the best acoustomechanical properties & the least rate of extrusion to get the best results of ossiculoplasty as regards to the patient ear condition & the surgeon `s experience. There is a plenty of prostheses for ossiculoplasty such as titanium implants, gold, stainless steel, ceramics, ossicular bone grafts & cartilage grafts. This comparative study will show the advantages & the disadvantages of each material & technique.

Introduction

Contemporary surgical techniques for treating various pathologies affecting the middle ear address not only eradication of the underlying disease process but also restoration of normal auditory function. Trauma, neoplasms, inflammatory processes and cholesteatomas can erode and alter normal middle ear components and relationships vital for the transmission of auditory energy to the inner ear. Over the last five decades, various ossiculoplasty techniques and prostheses have been studied and reported in the literature. Unfortunately, the multitude of reconstructive techniques attests to the fact that none of the currently available methods are ideal. Numerous combination of the graft position, ossicular interposion, cartilage and bone struts and various types of solid plastics and metal have been used.

Each technique is plagued with its own particular problems, including graft failure, implant extrusions, and persistent & recurrent conductive hearing loss.

There are two schools of thought among otologists with regard to reconstruction of the sound-conducting mechanism of the middle ear:

One group believe that the middle ear should not be violated by nonliving material and that only human autograft or homograft material-usually bone or cartilage-should be used in reconstructing the sound conducting mechanism of the middle ear.

The other group seeks to use the new biocompatible implant materials, developed in recent years by material scientists, to reconstruct the sound conducting mechanism of the middle ear (***Emmett, 1995***).

Aetiology of ossicular chain disruption:

Conductive hearing loss from ossicular chain abnormalities may result from either discontinuity or fixation of the ossicular chain. They may be eroded by a mass or inflammatory process, or they may be congenitally malformed. Any of these can prevent the transmission of sound to the inner ear.

In more than 80% of patients, the cause of ossicular damage (ie, discontinuity, fixation) is cholesteatoma or chronic suppurative otitis media. Trauma or congenital malformations account for most of the remaining causes of ossicular damage.

In order of frequency, discontinuity most commonly occurs because of an eroded incudostapedial joint (occurring in approximately 80% of patients with ossicular discontinuity), an absent incus, or an absent incus and stapes superstructure. Ossicular fixation, exclusive of otosclerosis, most commonly occurs from malleus head ankylosis or from ossicular tympanosclerosis.

The problems associated with ossicular chain reconstruction in chronic otitis media are quite different from those in patients with a dry, infection-free middle ear. Some of the problems associated with chronic otitis media include tympanic membrane perforation, eustachian tube dysfunction or cochlear deficits. These problems must also be considered to achieve optimal hearing (***Battista & Esquivel, 2005***).

Types of ossicular defects:

Various types of defects in the ossicular chain may exist. The most common is erosion of the incudostapedial joint with an intact, mobile malleus **(*Figure 1*)**.

Other types of defects may be present:

Malleus present, stapes present (M+S+)

Malleus present, stapes footplate present (M+S+)

Malleus and incus absent, stapes present (M-S+)

Malleus and incus absent, footplate present (M-S-) (***Kartush, 1994***).

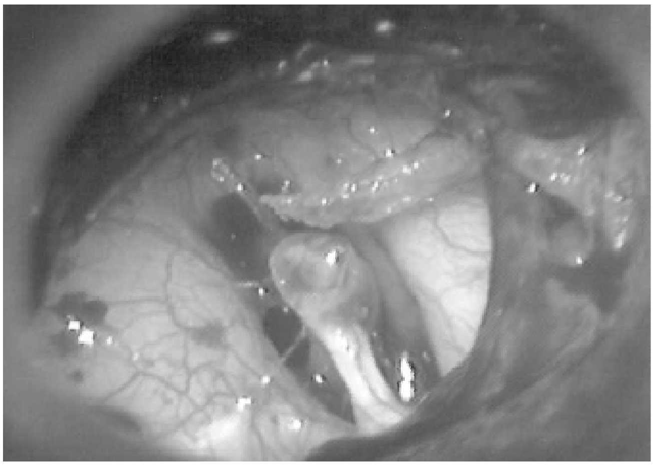

Figure (1): Eroded long process of Incus (***Sismanis, 2003***).

Patient selection for ossiculoplasty:

The clinical presentation of patients who would benefit from ossiculoplasty is quite variable. The goal of ossicular chain reconstruction is better hearing, most typically for conversational speech. Ossiculoplasty is used to improve or to maintain the conductive portion of hearing loss. The aim of ossiculoplasty is not to close the air-bone gap per se but to improve the patient's overall hearing (improve the air conduction score).

A patient's perceived hearing improvement is best when the hearing level of the poorer-hearing ear is raised to a level close to that of the better-hearing ear. Small improvements in hearing are more likely to be appreciated by patients with bilateral hearing loss.

The goal of functional reconstruction is to obtain a permenant restoration of hearing with neither conductive nor sensorineural hearing loss (***Graham & Goldsmith, 1999***).

***Contraindications of ossiculoplasty*:**

Relatively few contraindications to ossiculoplasty exist. Acute infection of the ear is the only true contraindication (***Graham & Goldsmith, 1999***).

Acute infection would most likely result in poor healing, prosthesis extrusion or both. Relative contraindications include: persistent middle ear mucosal disease, tympanic membrane perforation and repeated unsuccessful use of the same or similar prostheses (***Battista & Esquivel, 2005***).

Causes of failure in ossiculoplasty:

Successful restoration of hearing in tympanoplasty requires more than the insertion of a link in the ossicular chain. Chronic inflammation, bone destruction, poor aeration of the middle ear and mastoid and alterations of normal anatomy by either the disease process or the surgical procedure all exert influence over the functional result. The disease process, the surgical approach, the method of reconstruction and the biochemical properties of the prosthesis, each of these factors may cause failure (***Austin, 1982***).

Anatomy

A thorough knowledge of the anatomy of the ear ossicles and the middle ear space is necessary prior to performing ossiculoplasty **(Figure 2)**.

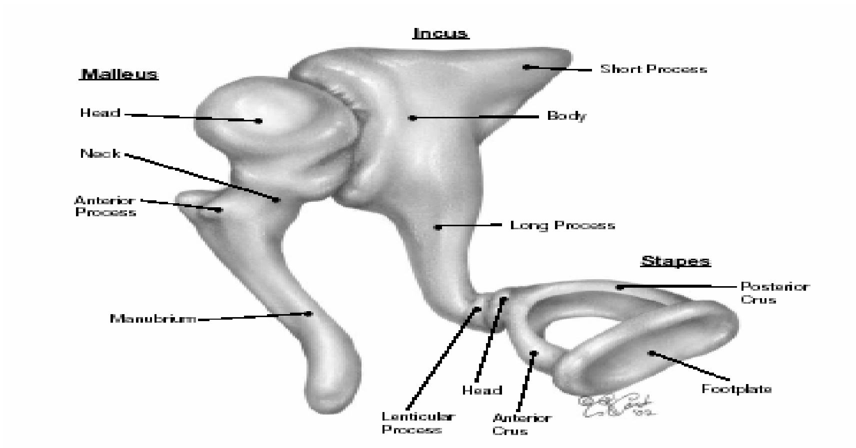

Figure (2): The ossicular chain, medial aspect (***Gulya, 2003***).

The malleus:

The malleus (hammer), the largest of the three ossicles, comprises a head, neck and three processes arising from below the neck. The overall length of the malleus ranges from 7.5 to 9.0 mm. The head lies in the epitympanum and has on its posteromedial surface an elongated saddle-shaped, cartilage covered facet for articulation with the incus.

This surface is constricted near its middle and the smaller inferior portion of the joint surface lies nearly at right angles to the superior portion. This projecting lower part is the cog, or spur, of the malleus. Below the neck of the malleus, the bones broadens and gives rise to the following: the anterior process from which a slender anterior ligament arises to insert into the petrotympanic fissure; the lareral process which receives the anterior and posterior malleolar folds from the tympanic annulus; and the handle.

The handle runs downwards, medially and slightly backwards between the mucosal and fibrous layers of the tympanic membrane. On the deep, medial surface of the handle, near its upper end, is a small projection into which the tendon of the tensor tympani muscle inserts. Additional support for the malleus comes from the superior ligament which runs from the head to the tegmen tympani (***Austin, 1996***).

The incus:

The incus articulates with the malleus and has a body and two processes. The body lies in the epitympanum and has a cartilage-covered facet corresponding to that on the malleus. The short process projects backwards from the body to lie in the fossa incudis to which it is attached by a short ligament. The long process descends into the mesotympanum behind and medial to the handle of the malleus, and at its tip is a small medially directed lenticular process which articulates with the stapes (***Bojrab & Wiet, 1990***).

The stapes:

The stapes consists of a head, neck, two crura (limbs) and a base or footplate. The head points laterally and has a small cartilage-covered depression for articulation with the lenticular process of the incus. The stapedius tendon inserts into the posterior part of the neck and upper portion of the posterior crus. The two crura arise from the broader lower part of the neck and the anterior crus is thinner and less curved than the posterior one. Both are hollowed out on their concave surfaces. The two crura join the footplate which usually has a convex superior margin, an almost straight inferior margin and a curved anterior and posterior ends. The average dimensions of the footplate are 3 mm long and 1.4 mm wide and it lies in the fenestra vestibule where it is attached to the bony margins of the labyrinthine capsule by the annular ligament. The long axis of the footplate is almost horizontal, with its posterior end being slightly lower than the anterior (***Wright, 1997***).