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Clinical Record

Reconstruction of the tensor tympani tendon

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Abstract

We describe a case in which reconstruction of the tendon of the tensor tympani muscle was necessary for the successful restoration of sound conduction.

The right ear of a nine-year-old boy was treated for cholesteatoma with staged surgery. During the first operation, the tendon was cut to ensure good visibility in the tympanic cavity. Post-operatively, maintenance of aeration of the middle ear required ventilation tubes at first and Valsalva manoeuvres later on. The position of the reconstructed tympanic membrane varied a great deal, moving between the medial wall of the tympanic cavity and extreme bulging. This made exact measurement of a columella for ossicular reconstruction impossible.

The preserved handle of the malleus was bound to the cochleariform process with ionomer cement, using a piece of surgical suture material as a substitute for the tendon. This arrangement prevented the tympanic membrane from undergoing excessive lateral movement after inflation and the ossicular chain was replaced with a successful ossiculoplasty with an autogenous bone 'drum to footplate' columella. The pre-operative 55.0 dB air–bone gap decreased immediately to 3.3 dB, widening after three years to 15.0 dB.

Key words: Tympanoplasty; Tensor Tympani; Auditory Ossicles; Glass Ionomer Cements

Introduction

While dissecting cholesteatoma from the middle ear, the head of the malleus and the incus (or its remnant) are often removed in order to clean out the areas hidden by them. The handle of the malleus can usually be preserved with the remnant of the tympanic membrane.

Cutting the tendon of the tensor tympani makes the anterior part of the tympanic membrane mobile and aids inspection of the anterior part of the middle ear. It is therefore often carried out even when not absolutely necessary. Experience gained from tympanoplasties is in accordance with the results of cadaver experiments performed by Asai *et al.*, i.e. cutting the tendon of the tensor tympani muscle does not affect sound conduction.[1]

When reconstructing the tympanic membrane and/or the ossicular chain, most otologists do not pay much attention to the tendon of the tensor tympani. Its presence or absence does not seem to affect the majority of patients, but in certain cases the function of the tendon (i.e. to maintain the proper position of the handle of the malleus and to control the excessive lateral movement of the attached tympanic membrane) may be necessary for successful restoration of sound conduction.

This paper describes such a case, the method of reconstruction of the tendon and the result.

Case report

In 1989, a nine-year-old boy presented with a right aural cholesteatoma. In the same year, he underwent the first stage of a planned, two-stage, combined-approach tympanoplasty. The cholesteatoma originated from a deep retraction pocket involving the posterior quadrant of the tympanic membrane, which was adherent to the medial wall of the tympanic cavity. The cholesteatoma had destroyed the long process of the incus and extended postero-superiorly, eroding the body of the incus and the head of the malleus. It filled the attic and the aditus ad antrum. The cholesteatoma was removed partly through the external auditory meatus and partly through the mastoidectomy. The posterior meatal wall was preserved. The head of the malleus and the body of the incus were removed and the tendon of the tensor tympani was divided. The handle of the malleus was preserved with the remnant of the tympanic membrane. The stapes was intact, but between it and the promontory cholesteatoma matrix was left intentionally because its removal would have jeopardized the inner-ear function in such an infected environment. Silastic sheeting was placed on the medial tympanic wall. The tympanic membrane was reconstructed with an underlaid fascia graft.

The ear healed well but the boy developed symptoms and signs of eustachian tube dysfunction on the operated side. The reconstructed tympanic membrane was retracted but adhesions to the medial wall of the middle ear were prevented by the Silastic sheeting. Ventilation of the middle ear was restored using a Shah grommet.

One year later, the planned second stage was performed. A small, residual cholesteatoma was found between the superstructure of the stapes and the promontory. Its removal was possible only after resection of the superstructure of the stapes. A third-stage operation was planned to recheck the ear.

At the third operation, in 1992, no residual cholesteatoma was found in the middle ear, so an ossicular reconstruction was carried out using an autologous bone graft

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to connect the tympanic membrane with the mobile footplate of the stapes. Because of the persistent eustachian tube dysfunction, a Shah grommet tube was inserted in the antero-superior quadrant of the tympanic membrane.

This operation resulted in considerable improvement in hearing, which lasted for four months until the grommet fell out and the tympanic membrane once again became retracted. On examination, the membrane was relaxed and touched the medial wall of the tympanic cavity. After reinsertion of a Shah grommet, the tympanic membrane became tense, regaining its normal position, and the conductive component of the hearing loss almost disappeared (air–bone gap 10 dB). This series of events repeated itself three to four times a year but, after three years, the restoration of middle-ear ventilation did not result in restoration of hearing. After 1998, a wide air–bone gap, characteristic of a disrupted ossicular chain, appeared. Regular reinsertion of the ventilation tube was continued until 2000 when the patient, now 20 years old, became able to perform the Valsalva manoeuvre to reventilate his middle ear. After this, the position of the tympanic membrane changed significantly, bulging dramatically after the Valsalva manoeuvre.

The patient was keen to consider revision surgery to improve his hearing. A new ossicular reconstruction would be necessary, but it was clear that the dramatic movement of the tympanic membrane would make this impossible unless a reconstruction of the tendon of the tensor tympani was performed.

In June 2001, the right tympanic cavity was reopened. A bare bone surface was prepared with a diamond burr, both on the upper end of the malleus handle and on the cochleariform process. The bare surfaces were covered with a small amount of ionomer cement (Ketac Cem Glasionomerzement, ESPE, Seefeld, Germany). After setting, both ends of a 2 mm length of Dagrofil 4.0 surgical suture material were immersed in fluid ionomer cement and placed between the prepared surface of the malleus handle and that of the cochleariform process. After setting, the malleus handle became firmly bound to the medial wall but maintained its mobility. The handle of the malleus determined the exact position of the tympanic membrane (Figure 1).

An autogenous cortical bone columella was placed between the mobile footplate and the tympanic membrane. At the lateral end of the columella, an incision was made for the handle of the malleus. One side of the columella was covered with ionomer cement to prevent atrophy (Figure 2).

This operation resulted in considerable improvement in hearing; the pre-operative 55.0 dB air–bone gap (Figure 3a) was reduced to a post-operative measurement (taken in August 2001) of 3.3 dB.

The patient was not seen until May 2004, when he appeared for follow up after being personally telephoned. The upper-posterior quadrant of the right tympanic membrane was slightly retracted but, after Valsalva manoeuvre, the position of the tympanic membrane returned to normal. The air–bone gap was 15 dB (Figure 3b).

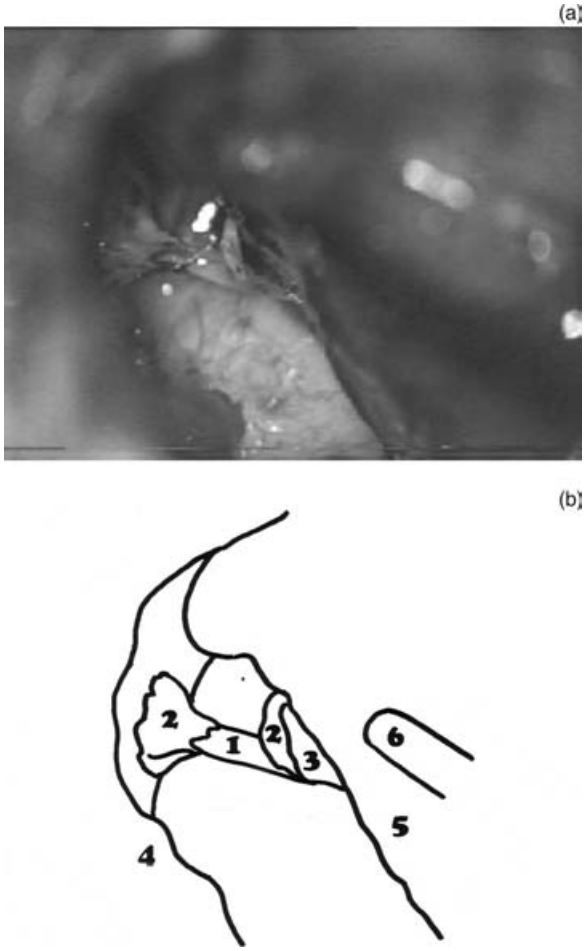

FIG. 1

(a) Operative view of the reconstructed tendon of the tensor tympani, right ear. (b) Operative sketch of this view. 1 = piece of surgical suture material in the position of the tendon; 2 = spots of ionomer cement on the cochleariform process and on the handle of the malleus; 3 = upper end of the malleus handle; 4 = bony tympanic ring; 5 = anteriorly reflected tympanic membrane; 6 = tip of the suction tube.

Discussion

Having gained considerable experience, ear surgeons performing tympanoplasties can reach a level at which they can produce a cured ear and closed tympanic cavity with great certainty. It is more difficult to eliminate or reduce a conductive hearing loss in the long term. Permanent eustachian tube dysfunction and technical nuances may affect sound conduction even if it was restored successfully for a relatively long period of time post-operatively.[2,3]

It is recommended that as many as possible of the original sound-conducting structures be preserved during the curative phase of tympanoplasty, as this is likely to result in a better long term improvement in hearing.

This case illustrates the fact that the usually neglected function of the tensor tympani may be necessary for optimal results in special cases. It is rather surprising that, in our experience, this is the only case in which lack of the tensor tympani tendon posed a problem, as it has been divided in many previous cases. It seems likely that in earlier cases adhesions developed between the cochleariform process and the handle of the malleus. In this special case, however, the Silastic sheeting prevented adhesions not only between the medial wall of the tympanic cavity and the graft but between the upper end of the handle of the malleus as well. It is advisable to keep in mind this possibility when tailoring the Silastic sheeting after cutting the tendon.

Reconstruction of the tendon became possible by using ionomer cement. Ionomer cement was first developed by Wilson;[4] Hehl *et al.*[5] first used this material for ossicular reconstruction, followed by others. Ionomer cement has been used for bridging over small defects of the long process of the incus and for reconstructing an absent long

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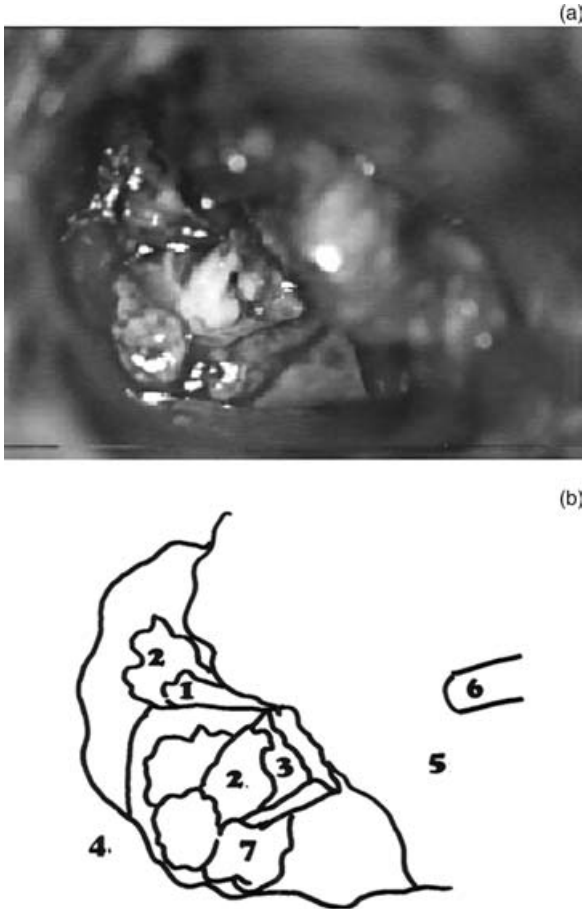

FIG. 2

(a) Operative view of the reconstructed tendon of the tensor tympani and the autogenous bone 'drum to footplate' columella, right ear. One side of the columella is covered with ionomer cement except for its medial tip and its lateral end touching the tympanic membrane. (b) Operative sketch of this view. 1 = piece of surgical suture material in the position of the tensor tympani tendon; 2 = spots of ionomer cement on the cochleariform process and on one side of the bone columella; 3 = lateral end of the columella touching the tympanic membrane; 4 = bony tympanic ring; 5 = anteriorly reflected tympanic membrane; 6 = tip of suction tube; 7 = small fascia grafts around the medial end of the columella, ensuring its central position in the oval window niche.

process of the incus,[6–12] whole incus[13,14] and handle of the malleus.[14] Malleo-incudal discontinuities and post-stapedectomy erosions of the long process have also been thus repaired.[6,10,14]

The technique described required only small quantities of ionomer cement applied onto ossicular structures; the possible toxic effect of the material, noted when applied in great quantity and in immediate contact with body fluids,[15] could therefore be disregarded.

Ionomer cement is a versatile tool for ossicular reconstruction in well selected cases, and it is likely that novel solutions to unusual problems such as this one will be developed in the future.

Conclusion

We report a case of reconstruction of the tensor tympani tendon in order to achieve good sound transmission. Dividing the tendon of the tensor tympani muscle in tympanoplasties does not generally influence sound conduction either in clinical practice or in cadaver experiments.

This is the first case to highlight the importance of the usually neglected function of the tensor tympani tendon, which may be necessary for optimal results in special cases. It is also the first reported case to carry out the reconstruction using suture material and ionomer cement.

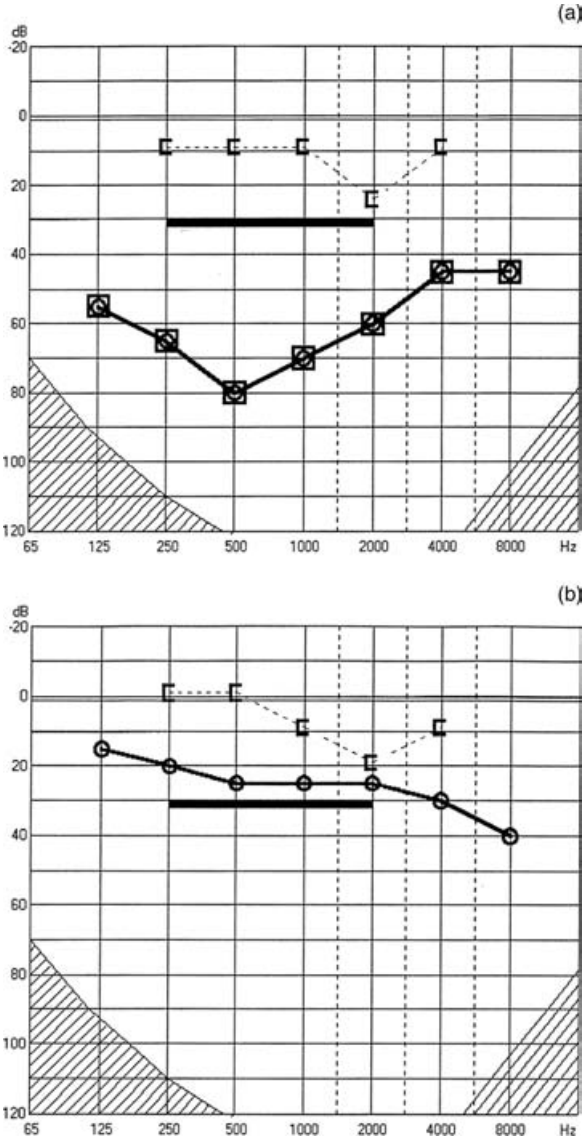

FIG. 3

(a) Pre-operative audiogram (June 2001). (b) Post-operative audiogram (May 2004, i.e. three years post-operatively); note changes in bone conduction.

- **This case report describes the use of ionomer cement to reconstruct the tensor tympani tendon, following staged surgery for treatment of cholesteatoma**
- **Prior division of the tensor tympani tendon resulted in a variable malleolar position, making ossicular reconstruction difficult**
- **Tensor tympani reconstruction stabilized the malleus, facilitating successful ossicular reconstruction**

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