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Case Report

Stapes Crural Fracture without Perilymph Fistula by Q-Tip Injury

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We report a rare case where Q-tip induced mixed hearing loss without perilymph fistula and demonstrate the need for computed tomography imaging with three-dimensional reconstruction where fracture and dislocation of the stapes are suspected. A 28-year-old male experienced an accidental penetrating injury by a Q-tip in the right ear 6 years previously. Temporal bone computed tomography revealed a dislocation of the stapes and incus. A volume-rendered three-dimensional reconstruction revealed that the stapes was rotated 180° laterally toward the handle of the malleus. Exploratory tympanotomy revealed dislocation of the incus and superstructure of the stapes, with an intact tympanic membrane. The patient's hearing was successfully improved by ossiculoplasty (malleus-footplate assembly) using autologous incus. To differentiate stapes fracture with dislocation as the cause of traumatic conductive hearing loss, three-dimensional reconstruction of the temporal bone computed tomography is helpful before exploratory tympanotomy.

KEY WORDS: Stapes, crura, fracture, three-dimensional reconstruction, computed tomography (CT)

INTRODUCTION

Traumatic rupture of the tympanic membrane and ossicular chain dislocation results from either direct trauma, such as with an ear pick, or an indirect force with a blow to the head. Traumatic rupture of the tympanic membrane is often treated by conservative treatment using paper patch application. If the hearing loss persists after a healing process of several months, ossicular dislocation is suspected. Because the annular ligament firmly attaches the stapes to the oval window, stapediovestibular dislocation is an uncommon injury. A penetrating injury through the external auditory meatus by a Q-tip may cause the stapes to be dislocated from the oval window and depressed into the vestibule by internal dislocation. Fracture of the arch of the stapes occurs secondary to torsion. Fracture of the footplate mainly occurs secondary to a transverse fracture passing through the oval window. To date, three case reports of posterior crus fracture with perilymph fistula by head trauma have been reported [1-3]. However, a case involving both stapes crural fracture and dislocation by Q-tip injury, without perilymph fistula has not been reported, based on a Medline search conducted from 1970-2011. Here, we report the case of a Q-tip trauma inducing a crural fracture, without perilymph fistula.

CASE REPORT

A 24-year-old male was admitted to our department for persistent hearing loss of the right ear. History taking revealed that the patient had experienced a forceful right ear-penetrating injury by a Q-tip triggered by a companion 6 years previously. At that time, the patient experienced an immediate onset of severe earache, with hearing loss. Dizziness occurred 3 days after the trauma. At that time, the patient had visited a local clinic and was treated in a conservative manner using paper patch application. Presently, the patient visited our hospital complaining of persistent right ear hearing loss. Otomicroscopic examination revealed that both tympanic membranes appeared normal. A pure tone audiogram demonstrated mixed hearing loss, with an increase of the bone conduction threshold in the high frequencies (Figure 1a). High-resolution temporal bone computed tomography (CT) revealed well-developed pneumatic mastoid air cells. In axial view, incudomalleolar joint separation was found easily but dislocated superstructure of the stapes toward the handle of the malleus was revealed only in one slice (Figure 2a). The fractured stapes displayed a 180° rotation toward the handle of the malleus in a volume-rendered three-dimensional reconstruction CT (Figure 2b). Exploratory tympanotomy was performed. After elevation of the tympanomeatal flap, the aforementioned fractured stapes was confirmed (Figures 3a and 3b). After removal of the stapes superstructure, the dislocated incus was removed. The footplate was intact, without evidence of torn mucosa around the edge of the footplate. An L-shaped columella with the shaft at an 80-90° angle to the head of the autologous incus was drilled thin, as was the short process, so that they can be placed under the malleus handle. Malleus-footplate assembly was performed. The long process of the incus was firmly pressed over the footplate and supported by the application of fibrin glue instead of gelfoam. A pure tone audiogram performed 2 months after surgery revealed a remarkably improved condition, with closure of the air-bone gap (Figure 1b).

DISCUSSION

Penetrating trauma to the temporal bone or middle ear can range from a simple injury from a Q-tip to a life-threatening emergency due to a gunshot wound to the temporal bone. Any object used in the external canal can cause injury to the structures of the

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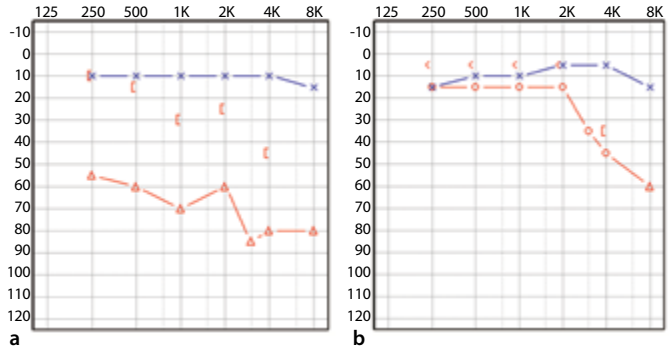

Figure 1. a, b. Preoperative pure tone audiogram demonstrating mixed hearing loss with an increase of the bone conduction threshold in the high frequencies (a). Results of postoperative pure tone audiogram 2 months after surgery. Complete closure of the preoperative air-bone gap is evident (b)

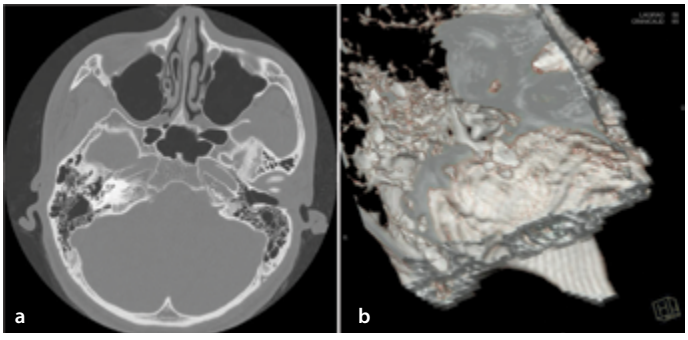

Figure 2. a, b. Results of temporal bone CT. Dislocated fractured stapes is suspected in the axial view (indicated by an arrow) (a). Three-dimensional volume-rendered reconstruction CT demonstrating the laterally rotated stapes toward the handle of the malleus (indicated by an arrow) (b)

CT: computed tomography

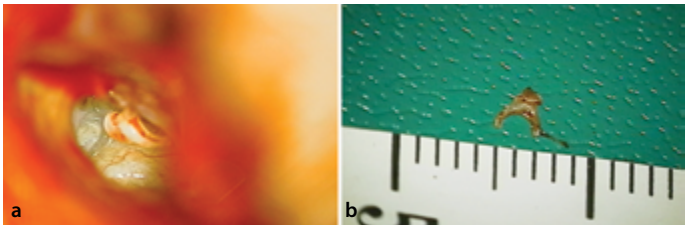

Figure 3. a, b. Elevation of the tympanomeatal flap confirms rotation of the fractured stapes by 180°, toward the handle of the malleus (indicated by an arrow) (a). Fractured superstructure of the stapes, with an elongated stapedial tendon (b)

temporal bone. Conductive hearing loss may be caused by middle ear haemorrhage or ossicular disruption. In most patients, middle ear bleeding and attendant hearing loss resolve in weeks. Reconstruction of the ossicular chain is considered if a patient has conductive hearing loss of more than 30 dB (mild to moderate) that persists 6 months after trauma [4]. About 20% of penetrating injuries result in fistulisation of the perilymphatic space, by either a subluxated stapes or a fractured footplate [5]. The repair may take the form of a graft of adipose or other tissue on the footplate, return of a dislocated stapes to its normal position, or removal of a fractured or dislocated stapes followed by oval window grafting [5]. Most trauma-related ossicular disruptions can be diagnosed by a temporal bone CT. Although axial CT scans can usually show fractures or joint separation, coronal or reformatted CT scans may help detect subtle laterally dislocated ossicles. In the present case, volume-rendered three-dimensional reconstructed images clearly revealed the 180° rotation of the fractured stapes to the handle of the malleus. This supports the previous findings that three-dimensional reconstruction of temporal bone CT is more diagnostically accurate than two-dimensional CT [6, 7].

In the present study, the fractured stapes dislocation was found concomitant with incudostapedial and incudomalleolar joint separation. Ears with loss of the stapes arch present the otologist with a greater reconstructive challenge than those in which the arch is intact. In the present case, both incus subluxation and crural fracture were found, and the incudomalleolar articulation was separated. However, there was no oval window fistula. Ossicular reconstruction was performed by malleus-footplate assembly using autologous incus. The interface between footplate and incus was fixed by fibrin glue, without use of gelfoam. We did not perform ossiculoplasty using total ossicular replacement prosthesis. Most ossicular reconstructions using a total ossicular replacement prosthesis require an interfaced cartilage beneath the tympanic membrane. The shape of the normal tympanic membrane is important, suggesting that prosthetic reconstruction to the malleus performs better than reconstruction of the tympanic membrane. Positioning of the malleus-footplate assembly and ossicular replacement prosthesis including autologous or homologous incus beneath the neck of the malleus may produce maximal force, whereas positioning beneath the manubrium of the malleus may produce the greatest displacement [8]. In the present case, postoperative pure tone audiogram revealed a completely closed air-bone gap.

Informed Consent: Informed consent is not as general rule in our hospital IRB.

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