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Treatment of A Traumatic Incudomalleolar Joint Subluxation with Hydroxyapatite Bone Cement

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Abstract

Trauma-related hearing loss can be conductive, sensorineural, or mixed in nature. Alteration of any of the conductive mechanisms can result in a conductive hearing loss. Depending on the location and type of ossicular injury there several reconstructive options have been described. Hydroxyapetite cement has been reported on several occasions for incudostapedial dislocation, however, rarely/never for incudomalleolar dislocation. Here we report a patient with traumatic Incudomalleolar Joint (IMJ) separation which was successfully repaired using bone cement.

Case Description

A 15-year-old male patient was referred to our Paediatric Otolaryngology department by his paediatrician with a lifelong history of left sided hearing loss. He was involved in two motor vehicle accidents when he was younger. He had a moderate left sided conductive hearing loss. A computed tomography of the temporal bone demonstrated widening of the incudomalleolar joint.

He had a standard trans canal tympanostomy with minimal atticotomy to expose the IMJ. The hydroxyapatite (HA) bone cement (OtoMimix®, Olympus) was used to bridge the gap between the subluxation. At his two months follow up, objective and subjective reports confirmed the success of the surgery.

Conclusion

We have shown that bone cement can be a successful option for the primary repair of subluxed IMJ. Not only were we able to accomplish closure of the air-bone gap, but we still have a full armamentarium if future procedures are required.

Keywords: Hydroxyapatite; Incudomalleolar Joint; Displacement; Trauma.

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Introduction

Motor vehicle collision, blast injuries, and falls can all lead to traumatic hearing loss [1,2]. The hearing loss from these injures can be conductive, sensorineural, or mixed in nature [1]. Conductive Hearing Loss (CHL) can be secondary to tympanic membrane perforation, middle ear effusion or hemotympanum, or ossicular chain dysfunction, which can be diagnosed clinically with otoscopy and or audiologic evaluation [1,2].

Ossicular chain problems, such as dislocation, are more difficult to discern with simple testing and are often discovered after a process of elimination. If hemotympanum is the cause for the CHL, it

typically resolves in days to weeks. Tympanic membrane perforations can take longer to resolve, usually within two to three months, with resolution of the CHL once the perforation heals [1]. If the CHL is due to damaged ossicular chain, then it will persist with an air-bone gap of 30dB or greater [2].

Ossicular dislocations can be grouped into 5 different categories: incudostapedial joint separation, dislocation of the incus, dislocation of the malleoincudal complex, Incudomalleolar Joint (IMJ) separation, and stapediovestibular dislocation [3]. Of the three middle ear bones, ossicular chain injury most commonly involves the incus, with incudostapedial joint separation being the most common [1,4]. The stapes has both the annular ligament and the stapedial tendon; malleus has the tensor tympani tendon and and tympanic membrane for stabilization. The incus, in contrast, only has ligamental structures, the IMJ and incudostapedial joints suspending it in the proper position [5].

Depending on the location and type of ossicular injury there are several reconstructive options. These includes repositioning or interpositioning of the patients' own incus, partial or total prostheses, or with bone cement. Here we report a patient with traumatic IMJ separation which was successfully repaired using bone cement.

Case

A 15-year-old male patient was referred to our Paediatric Otolaryngology department by his paediatrician with a lifelong history of left sided HL. This was only recently received attention, prompted by the young man's schoolteacher. He denied any other otologic or vestibular symptoms. He has not had any prior otologic interventions or family history of HL. He was involved in two significant motor vehicle accidents when he was younger, one a rollover and the in the other a front to rear collision.

Clinically, his otologic examination was unremarkable. Weber tuning fork exam localised to the left and Rinne's test revealed equivocal air and bone conduction bilaterally. The audiogram showed a normal right sided hearing threshold, and a moderate left sided conductive HL (figure 1A).

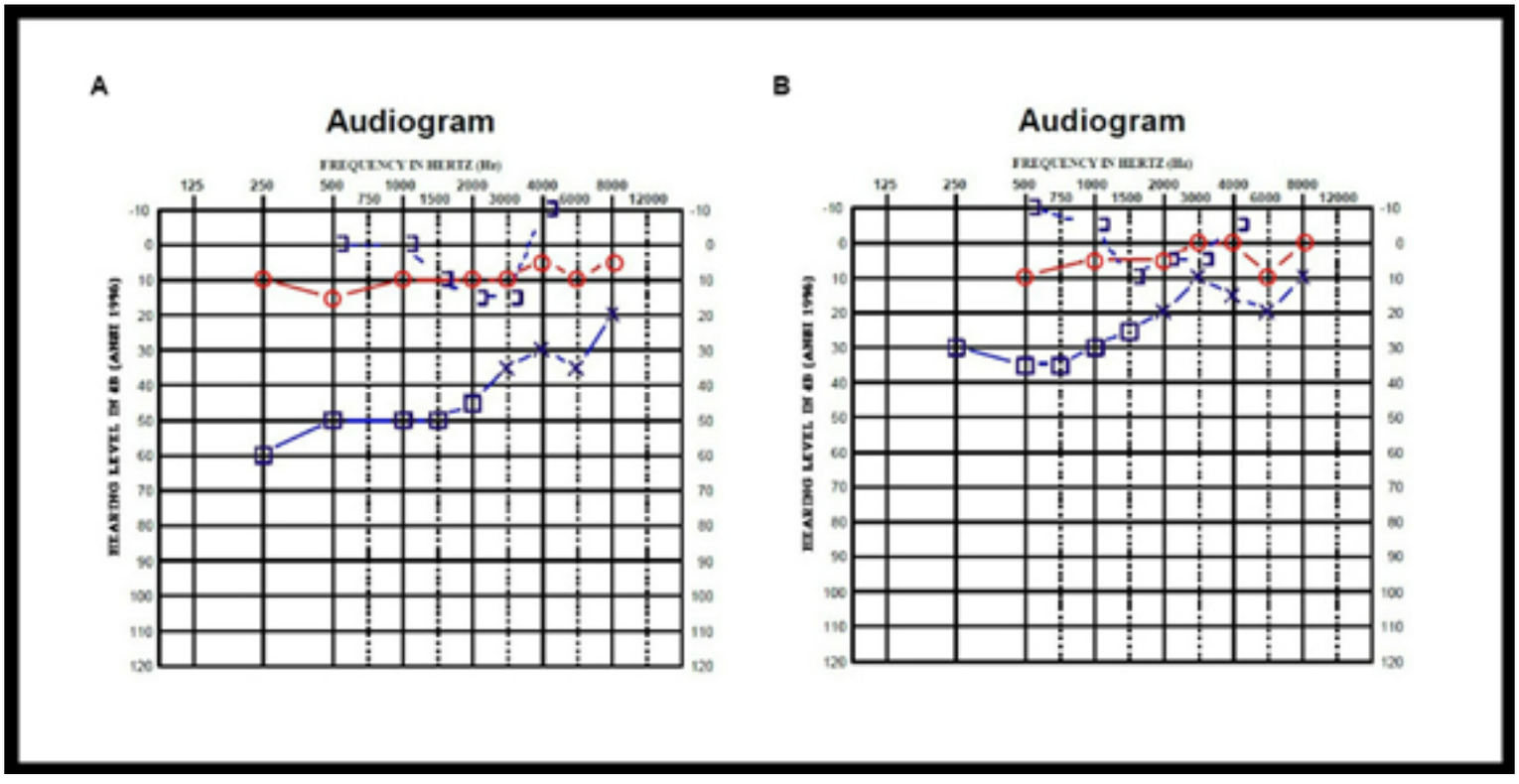

Figure 1: *(A) Pre-operative audiogram showing a moderated left sided conductive hearing loss; (B) Two months post-operative audiogram showing a mild left sided conductive hearing loss. Pre-operative ABG 37.5 and post-operative ABG was 25.*

A Computed Tomography of the Temporal Bone (CTTB) revealed widening of the IMJ space (figure 2). He had a standard trans canal tympanostomy with minimal atticotomy to expose the IMJ. There was subluxation of the malleus head with the incus surface exposed

(figure 3). Malleus head fixation was excluded with mobility on palpation. The round window reflex was absent when the malleus was palpated, though present with the palpation of the incudostapedial joint. The Hydroxyapatite (HA) cement (OtoMimix®, Olympus) was used to bridge the gap between the subluxed malleus and incus (figure 4). A piece of gelfoam was placed medial to the IMJ to prevent inadvertent application to the other middle ear structures. A 25-gauge angiocatheter was used to administer 2 controlled drops of hydroxyapatite.

Figure 2: *CT TB showing widening of the incudomalleolar joint space shown by the white arrow.*

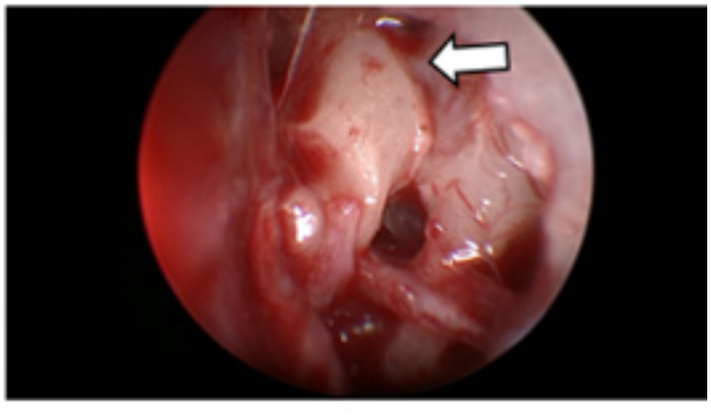

Figure 3a: *Intra-operative finding showing subluxation of the malleus head with the incudal articular surface exposed (single white arrow).*

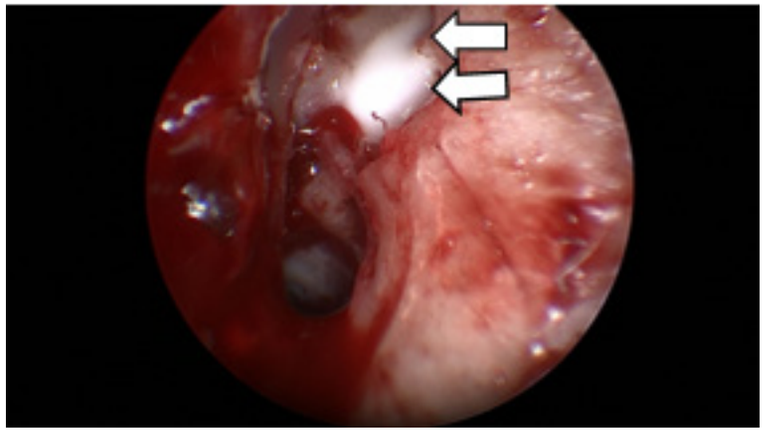

Figure 3b: *View following 2 applications of hydroxyapatite bone cement (OtoMimix®, Olympus) bridging the gap between the malleus and incus (double white arrows).*

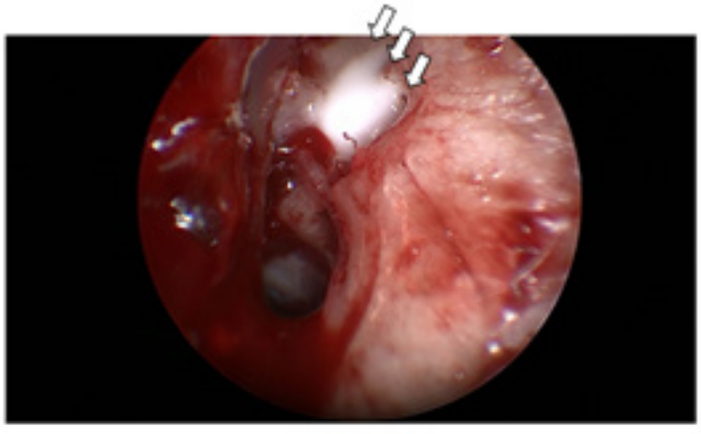

Figure 4: *Intra-operative finding showing hydroxyapatite bone cement (OtoMimix®, Olympus) bridging the gap between the malleus and incus (white arrows).*

At his two months follow up, the external auditory canal was well healed. Weber tuning fork examination was midline and the Rinne'stest revealed air conduction greater than bone conduction bilaterally. His audiogram improved to a mild left sided conductive HL (figure 1B) and the patient had a noticeable subjective appreciation for improved hearing.

Discussion

There are a variety of treatment options for IMJ dislocation. The options include observation, or surgical exploration with ossicular repositioning, cortical bone grafting, partial or total ossicular replacement with prosthesis [2]. HA bone cement has been used in increasing popularity of the last several decades to produce ossicular prostheses. It is a well-tolerated material for ossicular reconstruction and has been shown to be an osteoconductive material in animal studies [6,7]. Animal studies have demonstrated that at the implant-bone interface there is interdigitation between the two [8].

The other options considered were an incus interposition graft and a Partial Ossicular Replacement Prosthesis (PORP). The systematic review by Wegner et al. reported that bone cement does not underachieve in regards to hearing results after ossiculoplasty when compared to incus interposition and PORP [9].

Both the incus interposition graft and a PORP would have involved disarticulating the incudostapedial joint. Using the bone cement would not preclude either of these options in the future. PORP migration, while uncommon, has been reported to be responsible for half of the prosthesis failures requiring revision ossiculoplasty [10]. In addition, the per-patient cost effectiveness is roughly equal when comparing the costs of PORP and bone cement [9]. Bone cement allowed all the native ossicles to remain in place and did not exclude prosthesis use should this be required in the future.

Conclusion

We describe the first case of a subluxed IMJ treated successfully with application of the HA bone cement. Our stepwise thought process in intervention preserved surgical options if future intervention is necessary. A mild low frequency conductive loss persisted on audiometry, though subject improvement was perceptually noted. While the patient's air bone gap did not completely resolve, this was a major improvement four this patient and his quality of life drastically improved.

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