



Traumatic Incudomalleolar Joint Subluxation Repair

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ABSTRACT

INTRODUCTION: While conductive hearing loss secondary to trauma typically involved the incudostapedial, incudomalleolar dislocation can also occur. Previous described reconstructive options these include ossicular repositioning or interpositioning of the patients' own ossicular chain, partial or total prostheses, or more recently, with hydroxyapatite cement. Hydroxyapatite cement has been reported on several occasions for incudostapedial dislocation, but rarely for incudomalleolar dislocation. Here we report a patient with traumatic incudomalleolar joint (IMJ) separation which was successfully repaired using bone cement.

METHODS: A 15-year-old male patient who was involved in two motor vehicle accidents was referred to our Pediatric Otolaryngology department for a lifelong history of left sided hearing loss. Clinically, his otologic examination was unremarkable. Tuning forks confirmed the audiogram showing a normal right sided hearing threshold, and a moderate left sided conductive hearing loss. A computed tomography of the temporal bone demonstrated widening of the incudomalleolar joint. He had a standard transcanal tympanostomy with minimal atticotomy to expose the IMJ. The hydroxyapatite (HA) bone cement (OtoMimix®, Olympus) was used to bridge the gap between the subluxation. A 25 gauge angiocatheter aided in 2 small drop applications.

RESULTS: Follow up revealed not only subjective improvement, but also normalization of tuning forks and closure of his air bone gap.

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.

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INTRODUCTION

Motor vehicle collision, blast injuries, and falls can all lead to traumatic hearing loss. The hearing loss from these injuries can be conductive, sensorineural, or mixed in nature. 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.

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 [1]. Of the three middle ear bones, ossicular chain injury most commonly involves the incus, with incudostapedial joint separation being the most common [2, 3]. 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 [4].

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 Pediatric Otolaryngology department by his pediatrician with a lifelong history of left sided hearing loss (HL). He was involved in two significant motor vehicle accidents and has not had any prior otologic interventions or family history of HL.

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). A computed tomography of the temporal bone (CTTB) revealed widening of the IMJ space (figure 2)

He had a standard transcanal 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.

At his two months follow up, the external auditory canal was well healed. Weber tuning fork examination was midline and the Rinne's test revealed air conduction greater than bone conduction bilaterally. His audiogram improved to mild low frequency loss and complete closure at the high frequencies (figure 1B). The patient had a noticeable subjective appreciation for improved hearing.

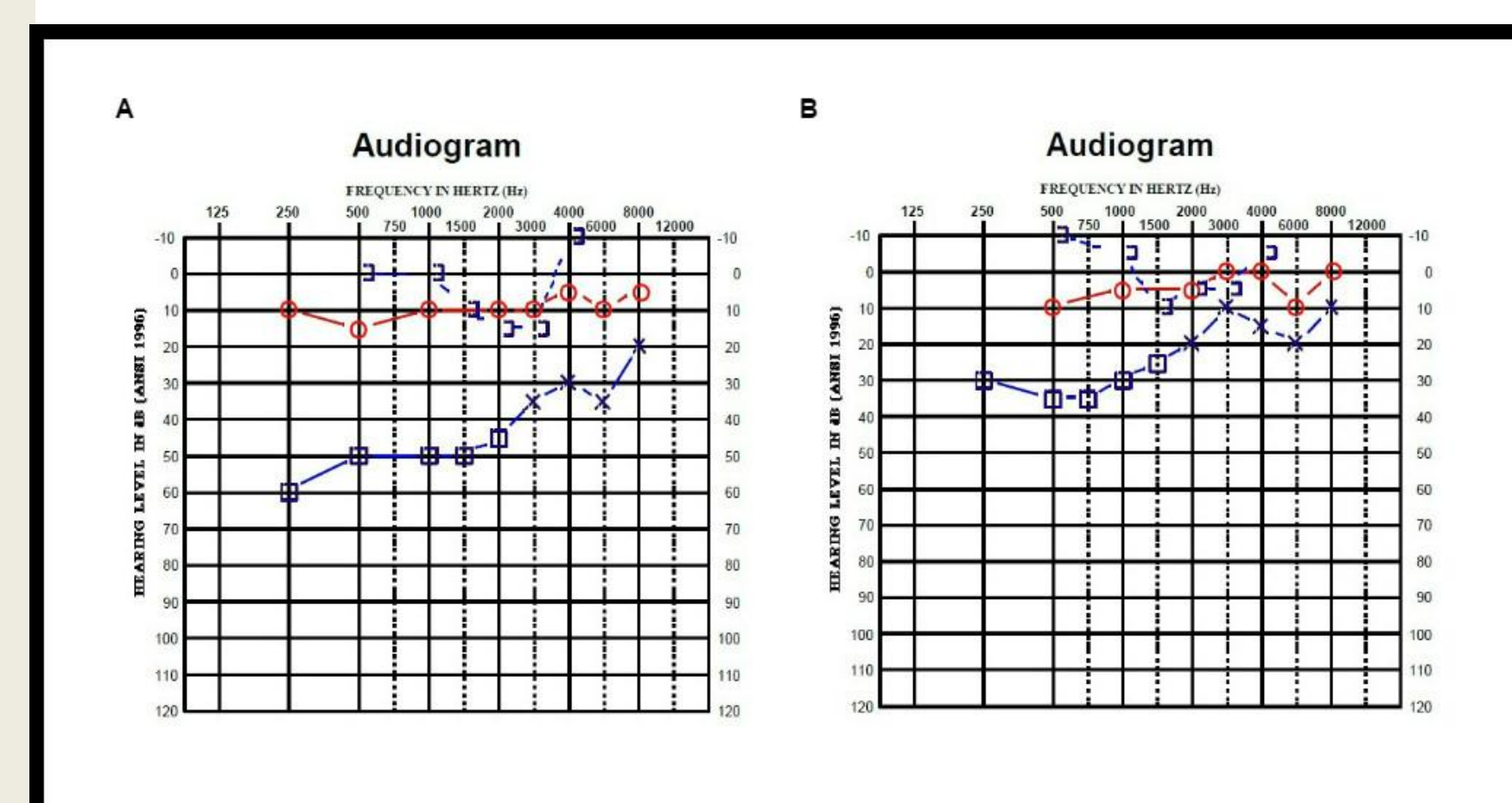


Figure 1: (A) Pre-operative audiogram showing a moderate left sided conductive hearing loss; (B) Two months post-operative audiogram showing a mild low frequency left sided conductive hearing loss.

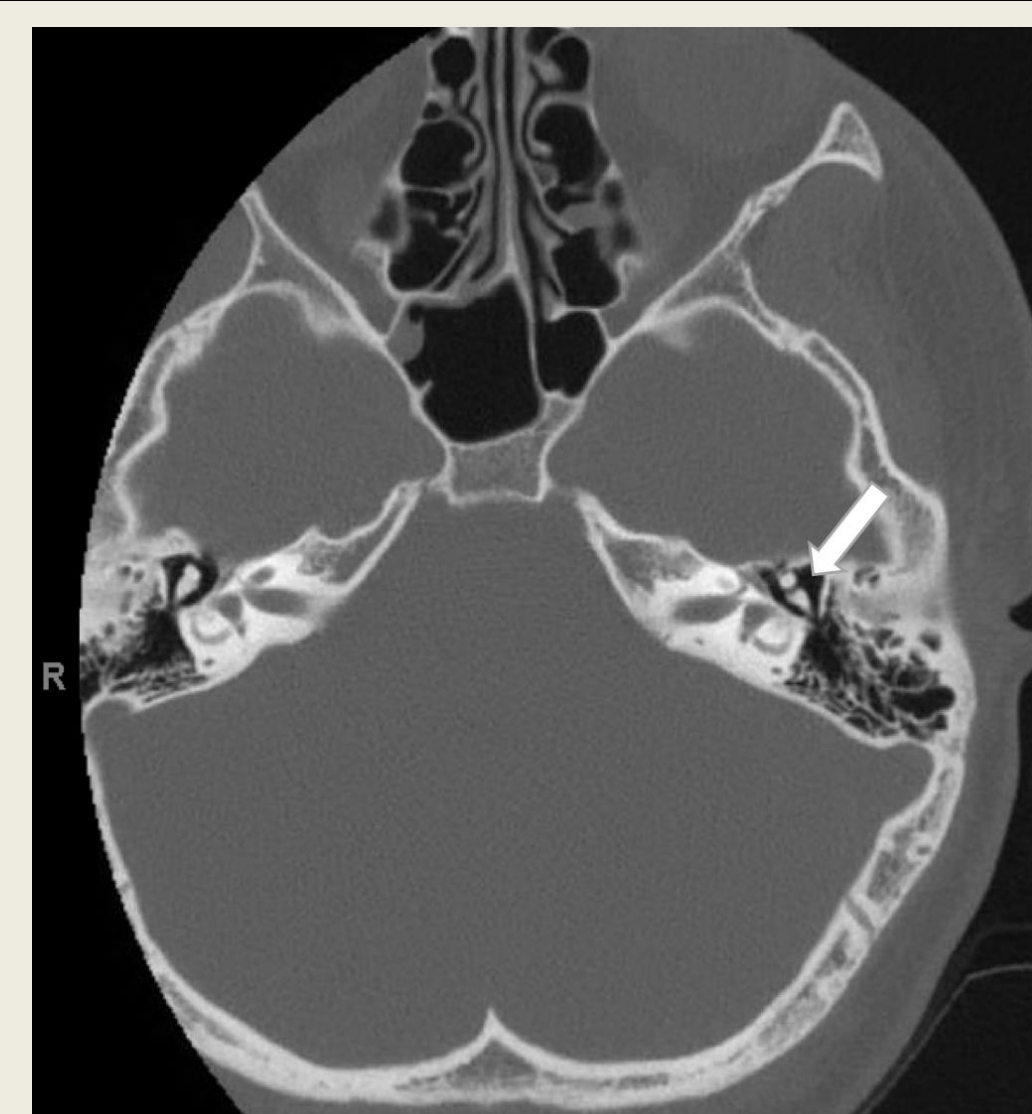


Figure 2: Figure 2: CT TB showing widening of the incudomalleolar joint space shown by the white arrow

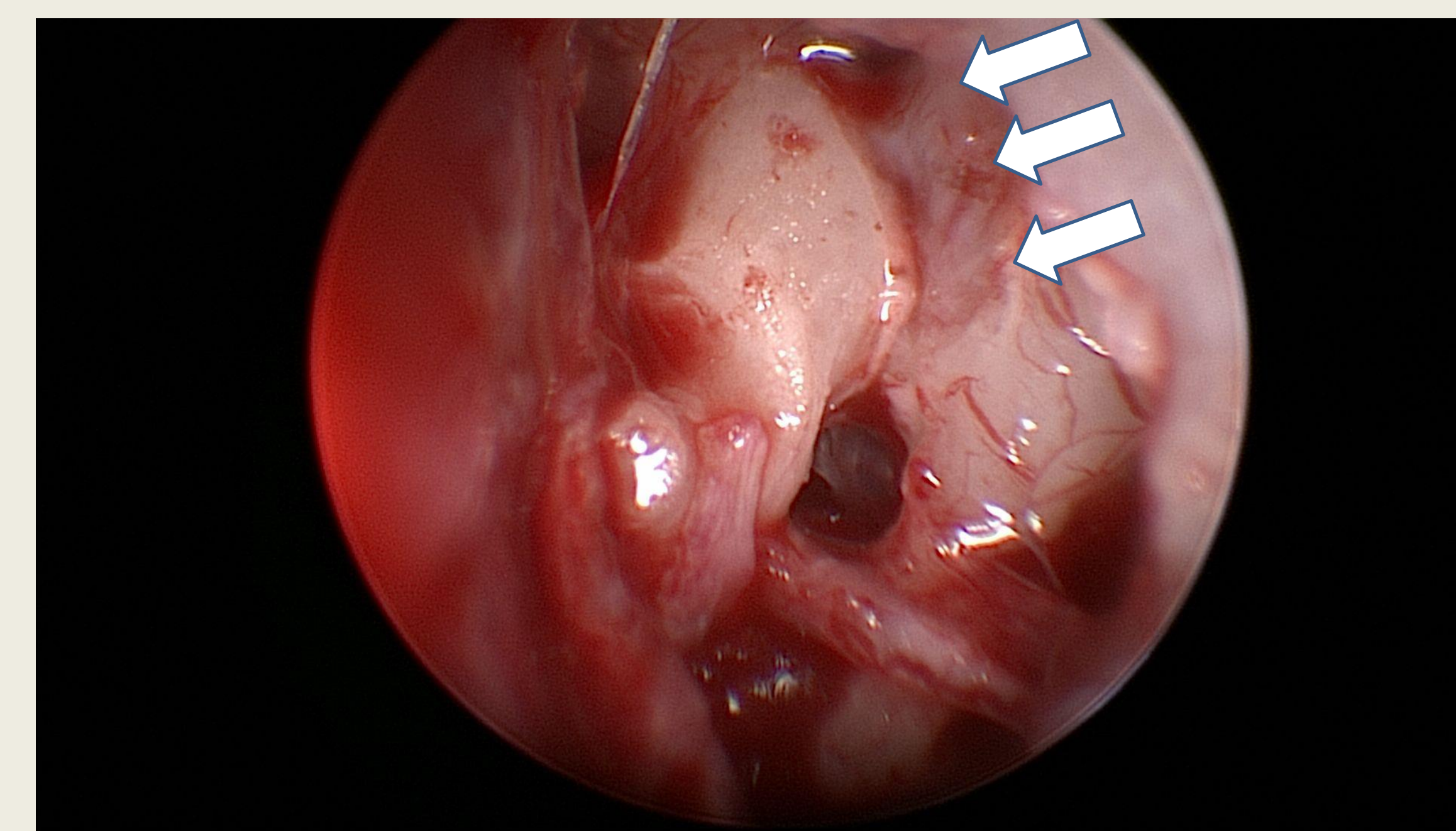


Figure 3: Intra-operative finding showing subluxation of the malleus head with the incudal articular surface exposed (white arrows). The Chorda tympani is intact as can be seen in the inferior portion of the image.

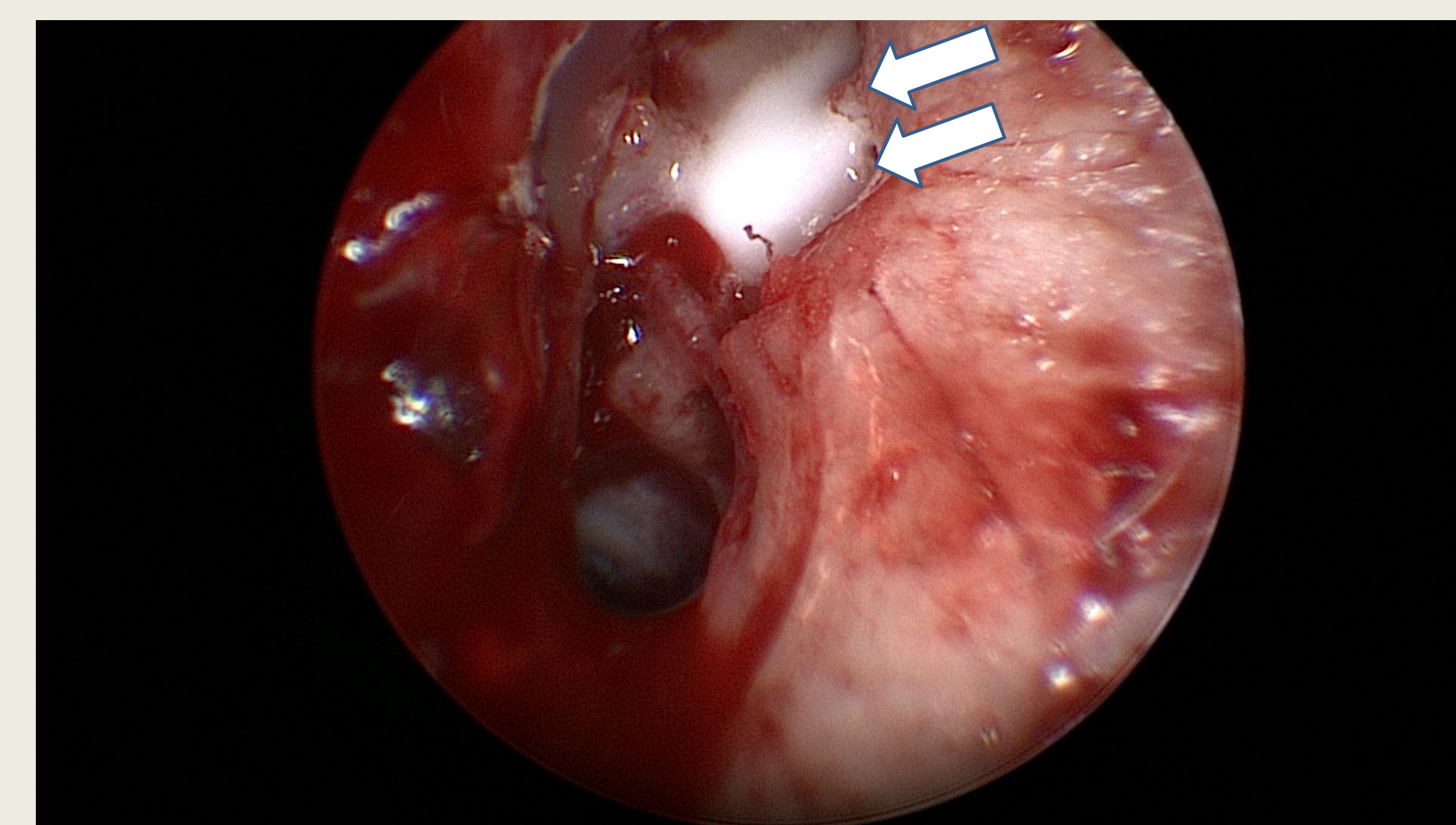


Figure 4: View following 2 applications of hydroxyapatite bone cement (OtoMimix®, Olympus) bridging the gap between the malleus and incus (white arrows)

DISCUSSION

There are a variety of treatment options for IMJ dislocation. HA bone cement has been used in increasing popularity of the last several decades for the production of ossicular prostheses. It is a well-tolerated material for ossicular reconstruction and has been shown to be an osteoconductive material in animal studies [5, 6]. Animal studies have demonstrated that at the implant-bone interface there is interdigitation between the two [7].

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 [8].

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 [9]. In addition, the per-patient cost effectiveness is roughly equal when comparing the costs of PORP and bone cement [8]. Bone cement allowed all the native ossicles to remain in place and did not exclude prosthesis use should this be required in the future.

CONCLUSIONS

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 for this patient and his quality of life drastically improved.

REFERENCES

- Stephan, A.L. and J.E. Isaacson, *Incudomalleolar joint separation*. Am J Otol, 2000. **21**(2): p. 284-5.
- Meriot, P., et al., *CT appearances of ossicular injuries*. Radiographics, 1997. **17**(6): p. 1445-54.
- Yetiser, S., et al., *Traumatic ossicular dislocations: etiology and management*. Am J Otolaryngol, 2008. **29**(1): p. 31-6.
- Kim, J.H., E.J. Lee, and E.J. Son, *Traumatic incus dislocation into the external auditory canal*. Otol Neurotol, 2013. **34**(4): p. e28-9.
- Goebel, J.A. and A. Jacob, *Use of Mimix hydroxyapatite bone cement for difficult ossicular reconstruction*. Otolaryngol Head Neck Surg, 2005. **132**(5): p. 727-34.
- Kalcioglu, M.T., et al., *Evaluation on shear bond strength of different glass ionomer and hydroxy apatite cements used in ossiculoplasty*. Balkan Med J, 2015. **32**(1): p. 23-9.
- Hoffmann, K.K., J.J. Kuhn, and B. Strasnick, *Bone cements as adjuvant techniques for ossicular chain reconstruction*. Otol Neurotol, 2003. **24**(1): p. 24-8.
- Wegner, I., et al., *Systematic review of the use of bone cement in ossicular chain reconstruction and revision stapes surgery*. Laryngoscope, 2015. **125**(1): p. 227-33.
- Geyer, G. and J. Helms, *Ionomer-based bone substitute in otologic surgery*. Eur Arch Otorhinolaryngol, 1993. **250**(5): p. 253-6.