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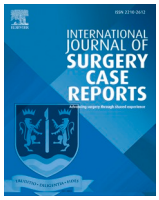

Case report

Successful surgical management of a complex temporal bone defect with brain contusion, meningocele, and CSF leak: A case report

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ABSTRACT

Introduction: Brain tissue can herniate through skull base defects, resulting in a condition known as Meningoencephalocele; it is always a surgical disease with many approaches (transmastoid, middle cranial fossa, and combined approach).

Case presentation: A 27-year-old male presented with right ear otorrhea, hearing loss, tinnitus, and headache. His medical history included a cranioplasty with a titanium mesh for repairing a skull fracture after head trauma and two episodes of meningitis with hospitalization. Physical examination revealed ear deformity and a pulsatile mass. Imaging studies confirmed a large tegmen tympani defect with meningocele and brain contusion. A transmastoid approach was used to repair the defect and address the CSF leak. Postoperatively, the patient's symptoms resolved, and hearing improved with no complications noted during follow-up.

Discussion: This article highlights the complexity and challenges involved in managing such a case, given the accompanying complications and symptoms; and the effectiveness of a well-planned surgical approach.

Conclusion: Prompt diagnosis of CSF otorrhea is crucial. Clinical examination, endoscopy, and imaging are essential to identify the defect. The optimal surgical approach is determined by the defect's size, location, and the patient's condition, in conjunction with the surgeon's expertise.

1. Introduction

Meningoencephaloceles (MECs) are a type of neural tube defect characterized by the herniation of encephalic tissue, covered by meninges, through a defect in the cranial base. These defects can result from a variety of etiologies, including traumatic injuries, otologic infections, surgical complications, and neoplasia, or may occur idiopathically [1]. Middle ear surgery and/or chronic otitis media are considered the key factors contributing to the occurrence of MECs; in 35 cases of brain herniation reported by Jackson et al. [2], 88.6 % of which were secondary to surgery and/or otologic infection. The incidence of encephalocele resulting from tegmen defects is rare in otorhinolaryngology practice and has been reduced through the application of broad-spectrum antibiotics and advancements in surgical techniques for otological procedures [3,4]. Despite the absence of a standardized surgical protocol, three procedures are generally acceptable: the transmastoid approach, the middle fossa approach, and a combination of both methodologies [4,5]. We present a challenging case of a tegmen tympani defect with meningocele, Cerebrospinal fluid (CSF) leak, and cerebral contusion successfully repaired via a transmastoid approach using an autologous bony graft. We advocate this surgical approach as an effective method for treating similar cases. This case report has been reported in accordance with the SCARE 2023 criteria [6].

2. Case presentation

A 27-year-old male presented to the hospital clinic complaining of right ear otorrhea (clear fluid), hearing loss, pulsating tinnitus, ear fullness and headache. The leakage was exacerbated by physical exertion. His medical history revealed a neurosurgery operation (cranioplasty using a titanium mesh) to repair a skull fracture after an accident (head trauma) 3 years ago, and two episodes of meningitis requiring hospitalization and antibiotic treatment during that period.

2.1. Physical examination and Investigations

Physical examination revealed a deformity of the right ear (auricular loss in the upper third of the auricle), a wide scar on the temporal scalp

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Fig. 1. Right ear deformity, and wide scar on temporal scalp with skin thinning.

associated with thinning of the skin, and a palpable metallic plate texture on temporal region (Fig. 1).

Otoscopy of the right ear (0 degree rigid lens, 3 mm diameter) revealed clear fluid leakage from the right external auditory canal along with bluish pulsating mass (meningocele) (Fig. 2).

Pure Tone Audiometry showed right conductive hearing loss with 40 dB air-bone gap (Fig. 3).

High-resolution Computed Tomography (CT) of the brain revealed

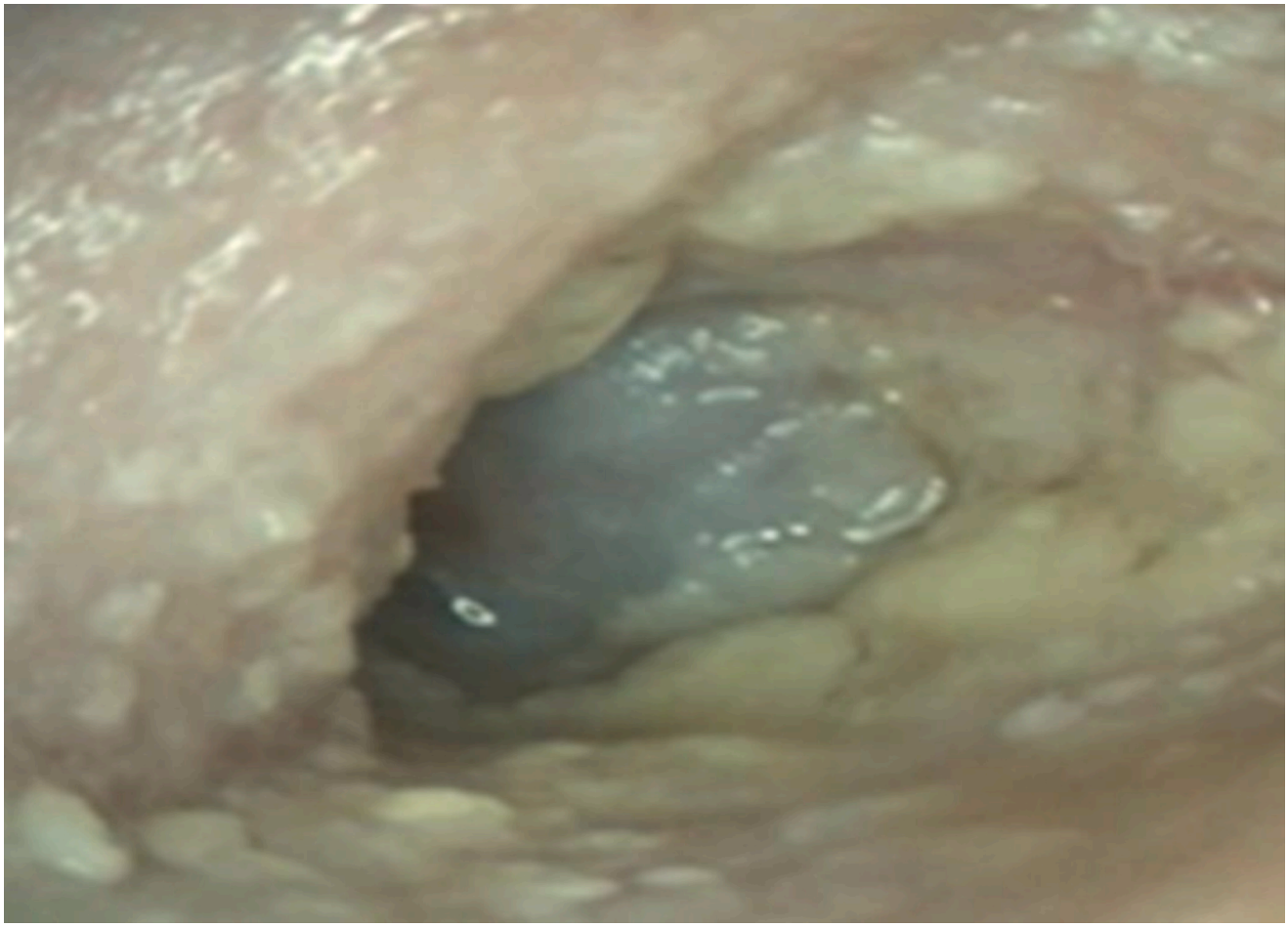

Fig. 2. Right ear otoscopy showing meningocele and Cerebrospinal fluid (CSF) leak.

brain contusions in the right temporal and parietal regions, a large cranial bone defect in the temporoparietal region, with a cranioplasty mesh overlying the defect and extending to the mastoid area, and a 1.3 cm bony dehiscence in the right tegmen tympani, with herniation from the middle cranial fossa into the middle ear cavity involving the auditory ossicles but without brain tissue involvement (Fig. 4).

Magnetic Resonance Imaging of the brain demonstrated a meningocele in the right temporal lobe, connected to the middle cranial fossa (Fig. 5).

Based on the diagnostic findings and with the patient's consent, the surgical decision was made to proceed with closing the defect and repairing the cerebrospinal fluid (CSF) leak via a transmastoid approach, due to the size of the tegmen tympani defect, the presence of a meningocele, and the partial absence of the dura in this region.

2.2. Surgical techniques and treatment

The patient was prepared for general anesthesia and injected with lidocaine and adrenaline 1/100000. Following hair removal and marking of the incision site (postauricular and along the scar from the previous surgical procedure), an incision was made with meticulous dissection of scar tissue and preservation of the flap. The titanium mesh was freed from underlying mastoid and cut to get the optimal surgical exposure (landmarks here: temporal line, mastoid tip and posterior wall of External Auditory Canal "EAC") (Fig. 6,B,C). The absence of bony temporal wall just superior to the temporal line was noted, and brain tissue was seen through the mesh (Fig. 6-D).

Mastoidectomy was performed using a microscope and drill instruments to reach the antrum and expose the short process of the incus. A bony dehiscence in the mastoid tegmen was identified, with dura herniating through it. Bony thinning was observed in the area between the antrum and the middle cranial fossa, which made the transmastoid approach the preferred choice over the middle cranial fossa approach. After removing the posterior canal wall and the incus, the tegmen tympani was exposed, and the bony defect was observed extending anteriorly to involve the tegmen tympani. Meningocele herniation with

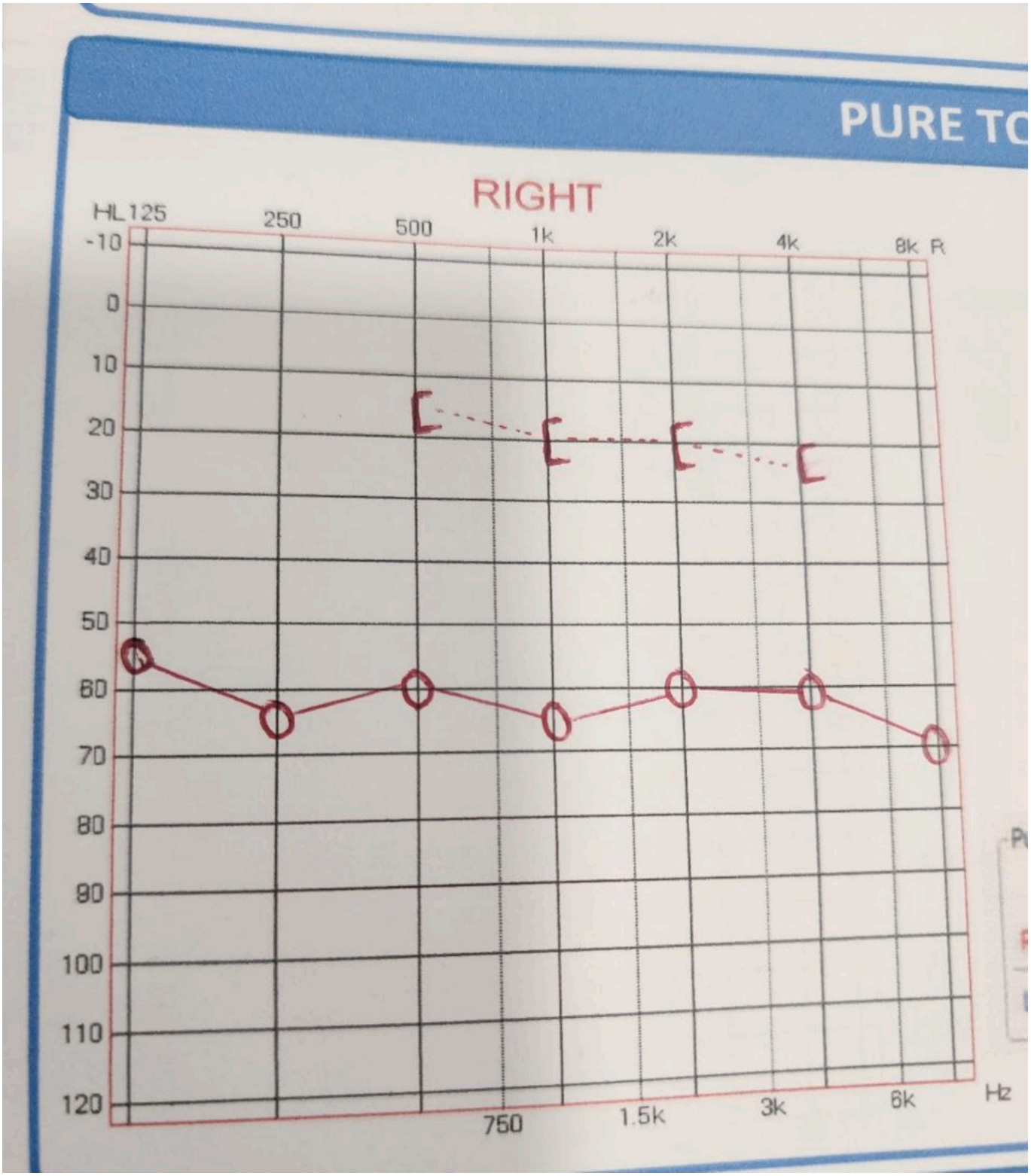

Fig. 3. Right ear Pure Tone Audiometry showing conductive hearing loss with 40 dB air-bone gap.

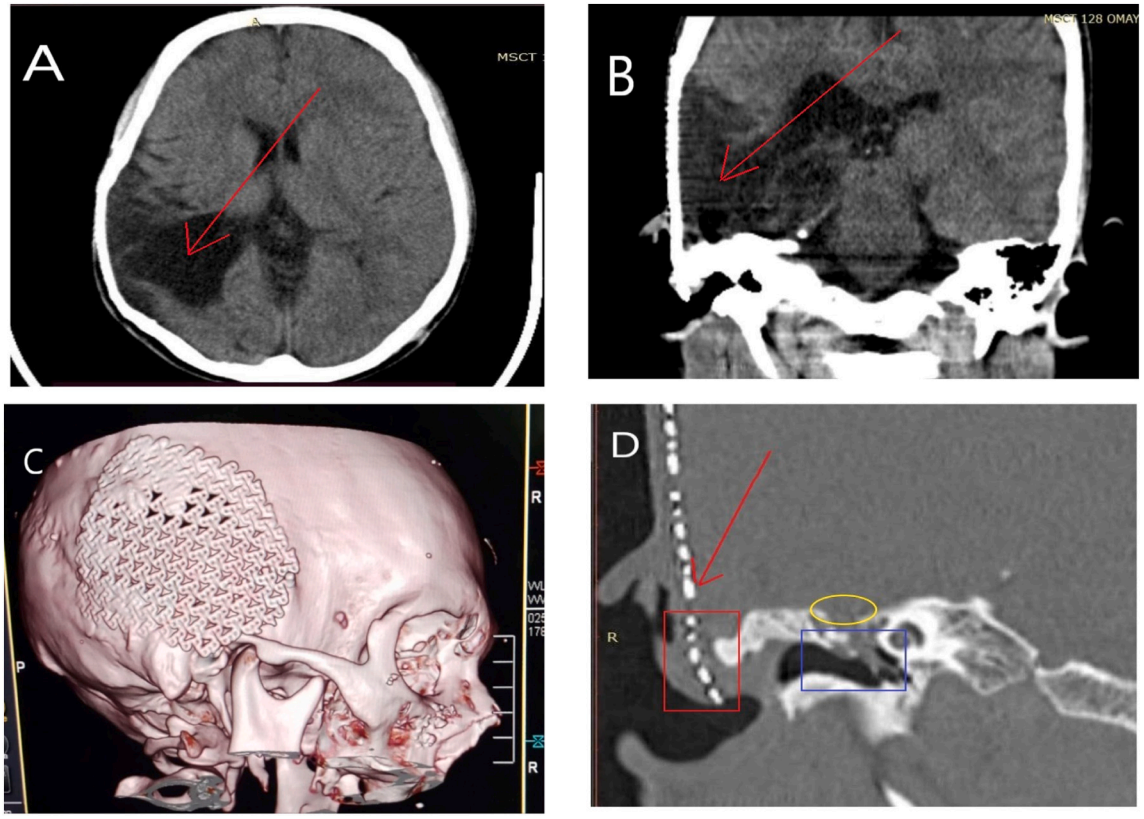

Fig. 4. Fig. 4-A. Brain contusion in CT (cross-sectional slice). **Fig. 4-B.** Brain contusion in CT (coronal slice). **Fig. 4-C.** Three-dimensional micro-computed tomography (3D-MCT) showing cranioplasty mesh. **Fig. 4-D.** Red arrow; the cranioplasty mesh that covers the parietal bone defect, red rectangle; the cranioplasty mesh that covers the work area in the mastoid, yellow circle; tegmen defect, blue rectangle; meningocele herniation with pathological tissues and CSF in the middle ear. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

dura tearing and CSF leakage was noted (Fig. 7). Pathological tissue in the middle ear and mastoid mucosa was removed, and the meningocele was repaired using bipolar cauterization (Fig. 7-B). The margins of the bone defect were prepared using a drill. An autologous bony graft from the mastoid cortex was measured, harvested, and placed in an underlay fashion (Fig. 7-D). A cartilaginous graft from the concha was used as a supporting layer over the bony graft (Fig. 7-C). A piece of the temporalis muscle with fascia was also used as an additional layer (Fig. 7-E). The area was then covered with bony dust (from drilling), and biological glue was applied until the defect was closed and the CSF leak was stopped (Fig. 7-F).

The middle ear was packed with gelfoam, the incision was closed in three layers, and a dressing was applied. Augmentin 1000 mg was administered intravenously every 12 h for three days during the patient's hospital stay, followed by oral administration for four days post-discharge.

2.3. Follow up after 6 months

Symptoms resolved and hearing improved; the air-bone gap reduced from 40 dB to approximately 15 dB, with no complications occurred (Fig. 8).

3. Discussion

Although the repair of tegmen tympani defects, meningoceles, and cerebrospinal fluid (CSF) leaks has been well-documented in the medical literature, this case gains its significance and rarity from the complication associated with it (brain contusion with dural absence, the titanium mesh covering the surgical field, surgical site scar, skin thinning, and the risk of non-healing of the wound) and the approach used for defect repairing; usually three different surgical approaches are used: middle fossa approach, transmastoid approach and combination of both [4,5], most authors in medical literature consider the middle fossa approach is the best for large tegmen defects that are over 1 cm (like our case), and

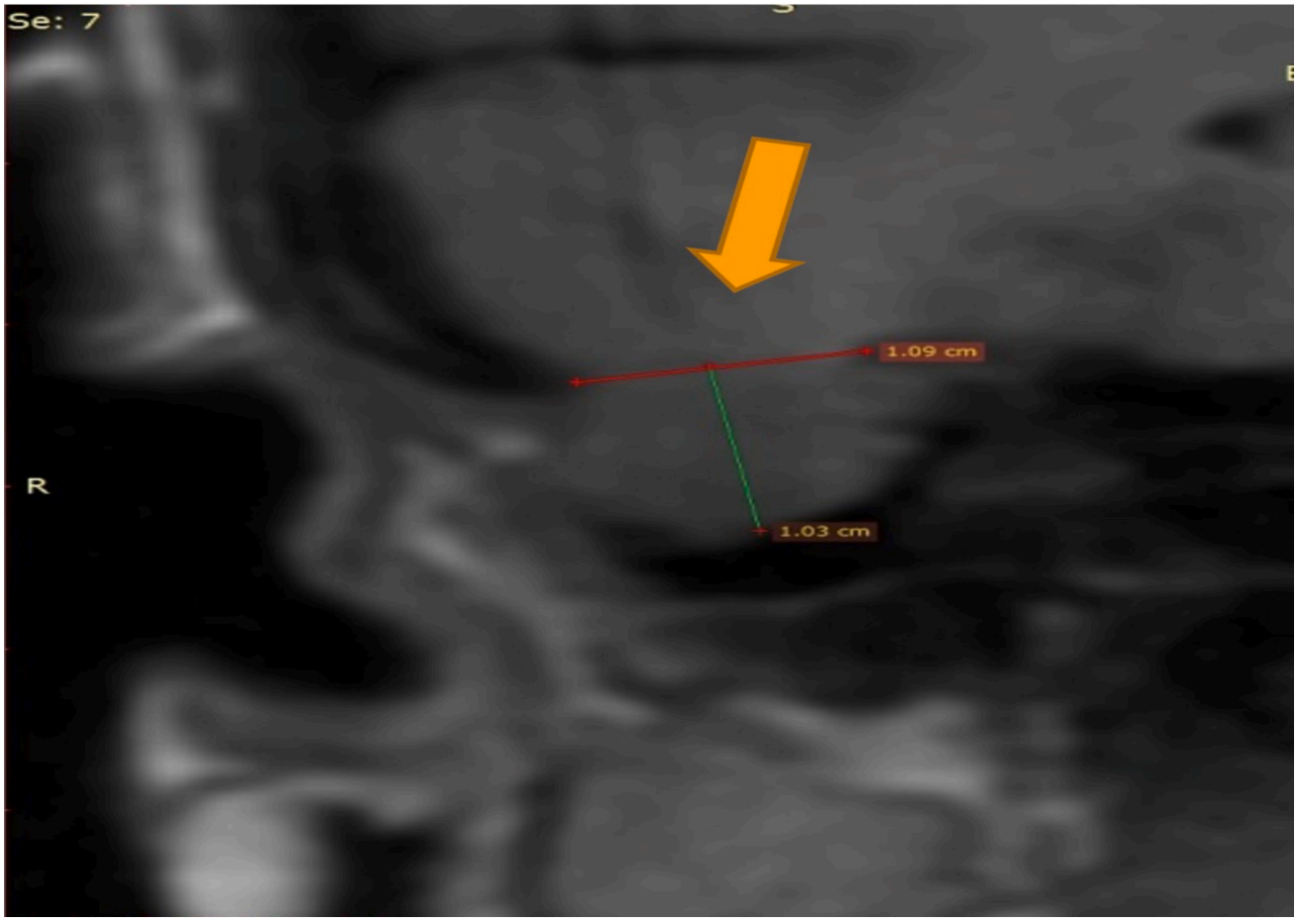

Fig. 5. MRI showing the meningocele (coronal view).

the transmastoid approach for defects smaller than 1 cm [7–9]. The middle fossa approach allows access to the entire region with exposure of the tegmen and safe closure of multiple defects through comprehensive visualization of the area [10]. Additionally, this procedure does not result in hearing impairment. However, it carries a significant risk of complications and should only be performed by experienced surgeons. On the other hand, Giddings and Brackmann [11] argue that a middle fossa craniotomy has low morbidity and provides excellent exposure of the tegmen. As a result, there is a tendency to initially choose transmastoid repair, with the understanding that selecting a less invasive approach initially may necessitate a more complex second procedure, such as a craniotomy [12]. Many neurosurgeons and neurotologists believe that the best outcomes for correcting bone defects in the tegmen are achieved through the middle fossa approach [13]. However, mastoid tegmen thinning and partial absence of the dura in this area made the transmastoid approach preferable to the middle fossa approach in our case. Usually the temporalis muscle fascia and cartilage can be used independently for repair, or the defect can be reinforced with additional materials such as bone, muscle, and fibrin glue [2]; in this case we used the technique described by Diab et al. [14], which provides a reliable closure of bone defects measuring 10 mm or larger preventing the recurrence of cerebrospinal fluid (CSF) leakage and the herniation of membranes and brain tissue into the mastoid and tympanic spaces. The use of postoperative lumbar drainage is debated due to the potential risks of complications, including meningitis, headaches, and catheter blockage [12]. As a result, it was not performed on the patient, especially since there was no clear reason to justify its use. After surgical procedure, complications like CSF leak, epileptic seizures, transient

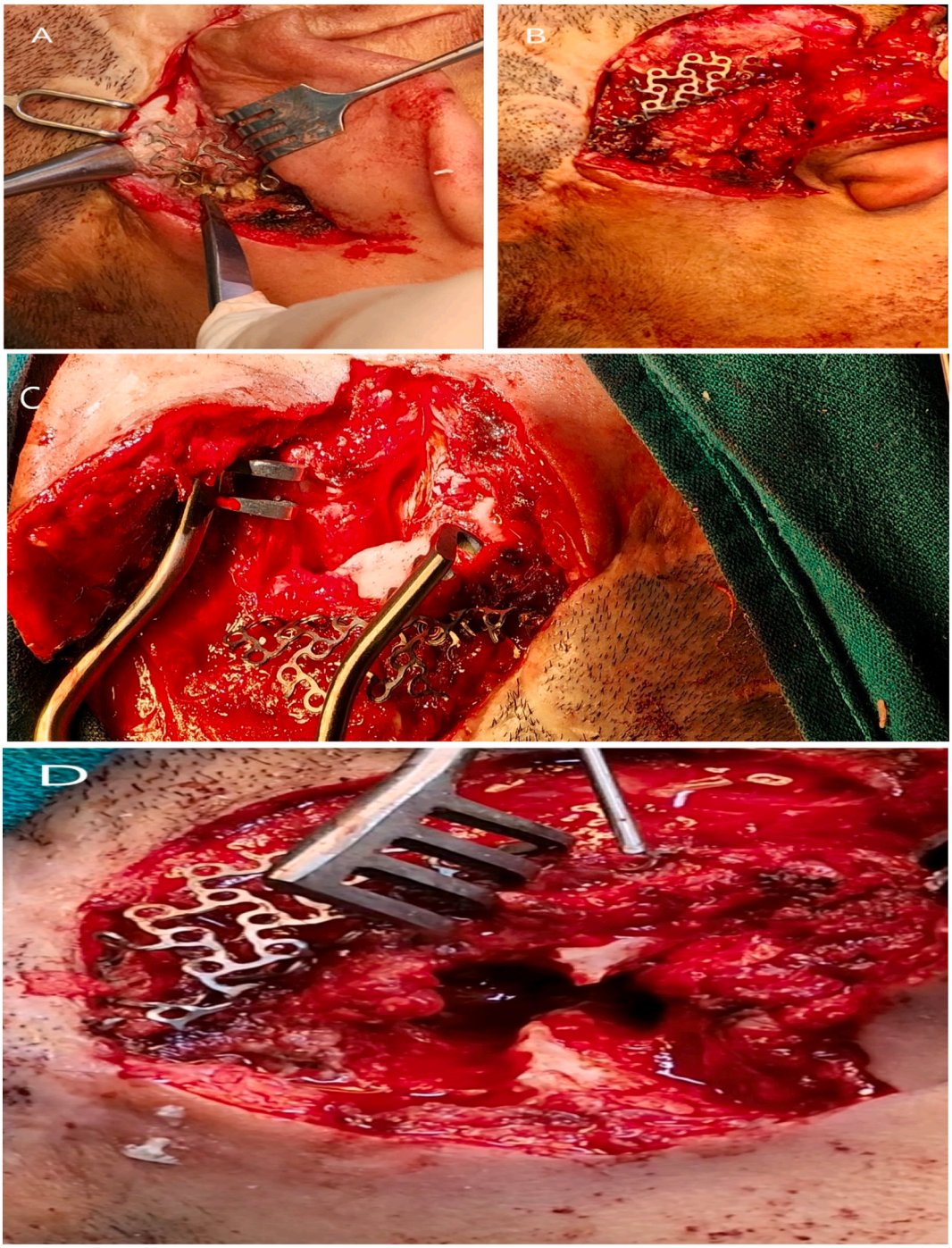

Fig. 6. **Fig. 6-A.** The appearance of the mesh immediately after the incision. **Fig. 6-B,C.** Moving the mesh above the work area. **Fig. 6-D.** Absence of meninges above the work area and the metal indicator points to the brain contusion.

ischemic attacks or strokes, sensorineural hearing loss, and sepsis can occur [2]. Nonetheless, none of these issues were noted in our case during either the early or late follow-up assessments.

4. Conclusion

Any case of CSF otorrhea must be thoroughly evaluated by clinical examination with endoscopy and high resolution radiologic imaging to

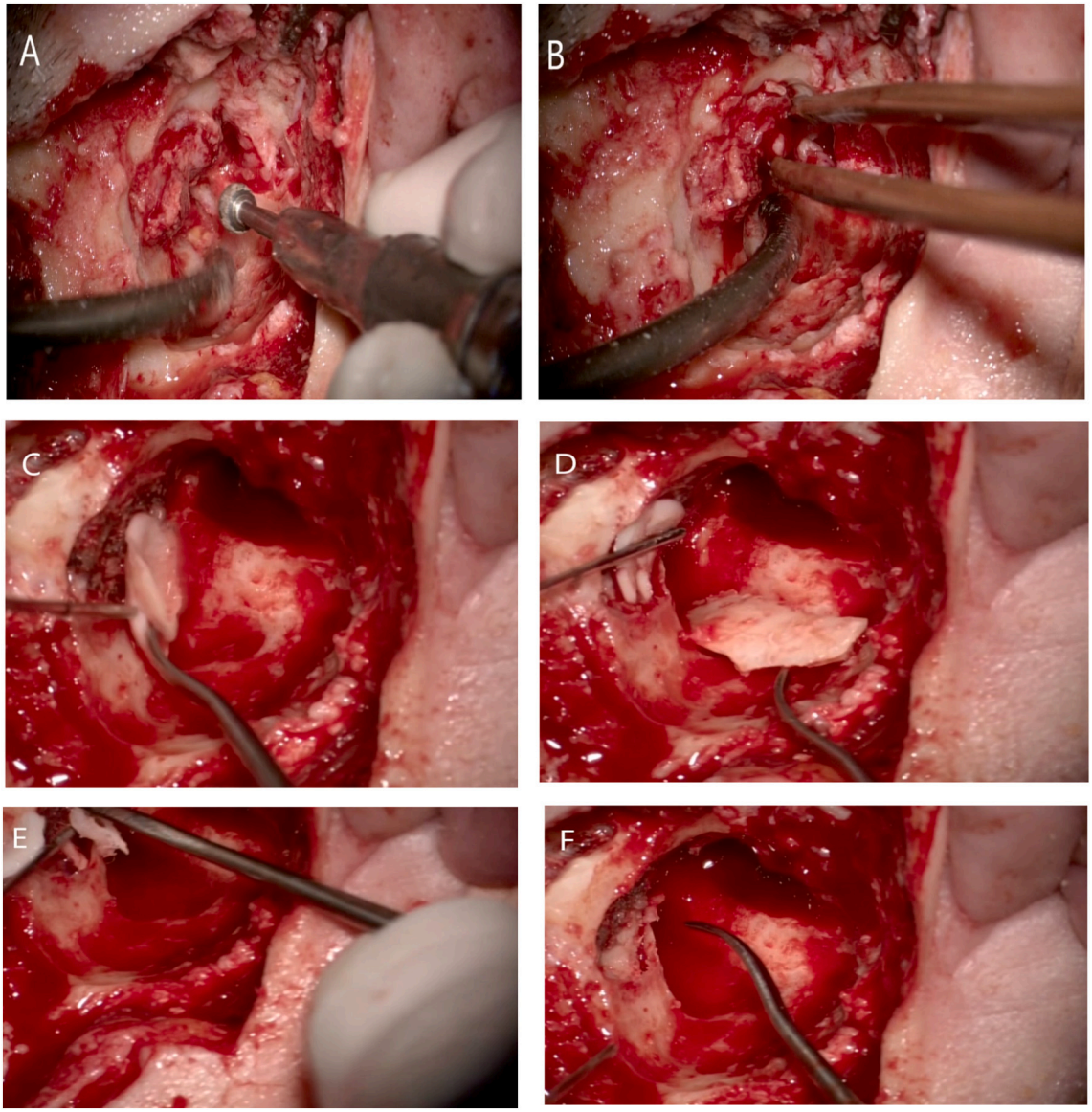

Fig. 7. **Fig. 7-A.** Defining the edges of the hernia. **Fig. 7-B.** Cauterization the meningocele and its removal. **Fig. 7-C.** Closure of the defect with a cartilaginous graft from concha. **Fig. 7-D.** Closure of the defect with a bony graft from mastoid cortex. **Fig. 7-E.** Closure of the defect with the fascia of temporalis muscle. **Fig. 7-F.** Complete closure of the defect with 4 layers (Bony layer from mastoid cortex, cartilage layer from concha, bony dust (from drilling) with biological glue, fascia layer of the temporalis muscle) without CSF leak.

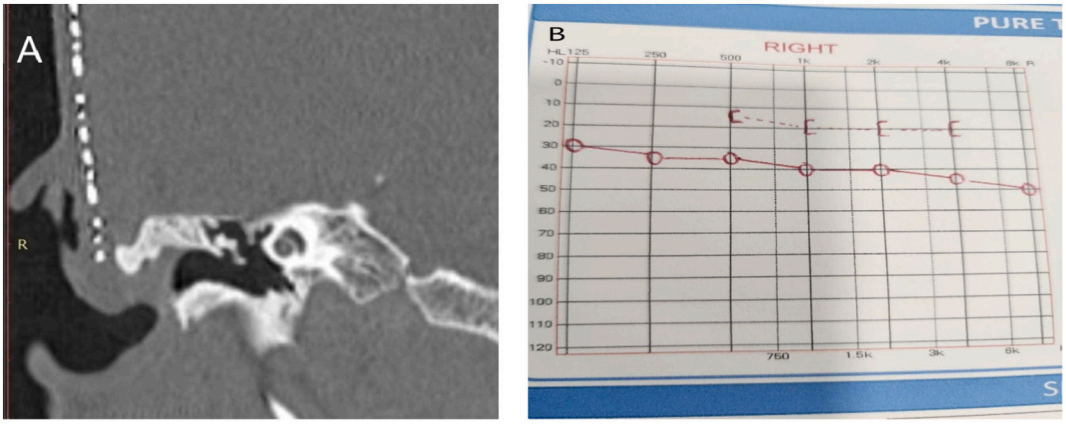

Fig. 8. Follow up 6 months after surgery. Fig. 8**-A.** CT of the brain showing removal of the covering mesh in the work area, closure of tegmen defect, removal of the meningocele and pathological tissue. Fig. 8**-B.** Right ear Pure Tone Audiometry showing the reduced air-bone gap which was 40 dB before surgery.

detect the defect site, size and obtain a good surgical plan while minimizing the risk of further complications. Any defect larger than 1 cm must be repaired as soon as possible with approach determined by various factors and each case presents its own unique complexities.

5. Methods

The work has been reported in line with the SCARE 2023 criteria.

Consent for publication

Ethics approval was not applicable for this study, as our institution's IRB committee does not mandate approval for reporting individual cases or case series.

Ethical approval

Ethics approval was not applicable for this study, as our institution's IRB committee at Yusuf al-Azma Hospital does not mandate approval for reporting individual cases or case series.

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Author contribution

Dr. Bilal Hasan: provided medical treatment, wrote and revised the manuscript, and made grammar and spelling language editing

Dr. Mohammad Jourieh: provided medical treatment, and wrote the manuscript.

Dr. Jafar Hamdan: wrote the manuscript.

Guarantor

Dr. Bilal Hasan.

Declaration of competing interest

There were no conflicts of interest.

Data availability

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

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