The Use of Titanium Mesh for Middle Fossa Skull Base Reconstruction: Presentation of Cases and Review of the Literature

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Abstract:

Middle fossa skull base reconstruction following removal of encephaloceles or skull base tumors is complex. The reconstruction must be rigid to prevent herniation of intracranial contents into the middle ear yet must conform to the varied anatomy of the middle fossa floor. Split calvarial grafts are commonly used, but these are not pliable, can be difficult to contour to the appropriate size and shape, and cannot be rigidly fixed to avoid migration. This study describes a novel method of reconstruction using an orbital floor titanium mesh plate. *Methods and Measures*: Clinical case series. Outcomes measured were successful hearing preservation with no air-bone gap, absence of cerebrospinal fluid leak, stability of the plate and absence of infection. *Results:* All patients were successfully reconstructed with a titanium mesh plate. There was no conductive hearing loss from herniation of intracranial contents through the tegmen. None of the plates migrated nor were rejected or became infected. There were no CSF leaks. *Conclusions:* Titanium mesh plate reconstruction of the floor of the middle cranial fossa is a useful reconstructive tool for the skull base surgeon. The plates are malleable, can be easily sized for the defect, and can be rigidly fixed to avoid displacement.

Background:

The causes of middle fossa encephelocele have been well documented and include chronic otitis media, temporal bone trauma, congenital defect, neoplasm (1–5), and most commonly prior mastoid surgery. (3,4,6). Often middle fossa encephelocele is associated with aural fullness, hearing loss, and CSF otorrohea, and timely diagnosis is critical to identify and treat CSF otorrhea to avoid potentially devastating meningitis.

The diagnosis of brain herniation is facilitated by combined imaging CT and MRI. CT provides bony anatomy detail that will identify tegmen defects and soft tissue herniation. MRI provides improved soft tissue imaging permitting the differentiation between recurrent mastoid disease and brain herniation.(7)

Repair is accomplished through a middle cranial fossa approach, a transmastoid approach, or a combination thereof. Using autologous fascia, cartilage, or bone, the floor of the middle fossa can be patched and repaired. (8) The traditional methods of repairing middle fossa defects employ both bone and soft tissue grafts from extra-temporal sites in a multilayer closure. The need for a rigid base to support the overlying brain has made split calvarial bone the graft of choice. Given the disadvantages of donor site morbidity, suboptimal contouring, and increased operative time, we present a novel approach for repairing large middle fossa cranial base defects with titanium mesh.

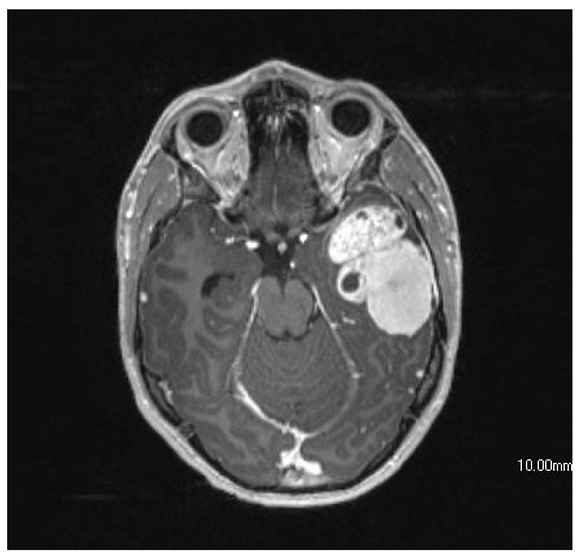
Closure	Advantages	Disadvantages
Split Calvarial Bone	•Autologous graft •"Gold Standard" •Potential osseointegration	•Donor site morbidity •Increased OR time •Suboptimal contour •Lack of rigid fixation
Ti Mesh	•Immunologically inert •No donor site morbidity •Easily contoured •Shortened OR time	•Foreign body rxn •Risk of infection •Graft extrusion •Radiographic scatter

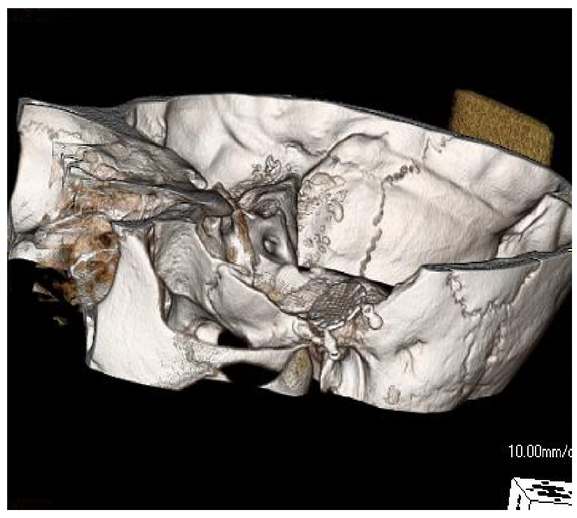
Technique:

In each case a middle cranial fossa approach was employed alone or in combination with transmastoid exposure. A sandwich of soft tissue, titanium mesh, and soft tissue overlay was employed to cover the middle fossa defect. Soft tissue repair consisted of autologous fascia or muscle, or acellular dermal matrix (AlloDerm, Life Cell Corp.) The composite graft was secured using self-tapping titanium screws. Post operative imaging was employed to confirm results.

Case 1:

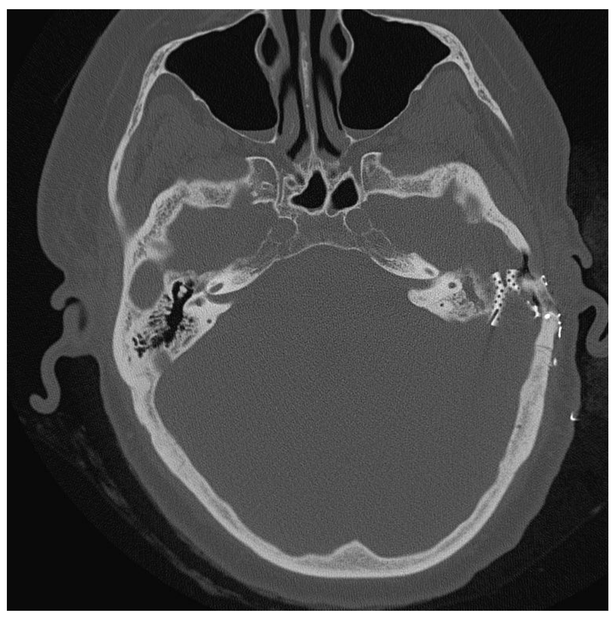
16 year-old male presented with progressive worsening headaches. Workup including an MRI and CT revealed large enhancing mass in the middle fossa, eroding the squamous portion of the temporal bone and skull base. Surgical resection proceeded via a middle fossa approach. Reconstruction consisted of a three-layer approach, including a base layer of AlloDerm. The titanium plate was then overlaid for support and covered by fibrin glue and a final layer of AlloDerm. The plate was secured with self-tapping / self-drilling screws to the lateral skull base at the zygomatic root and mastoid cortex. The patient has done well post operatively at 6 months and is without conductive hearing loss or CSF leak. Pathology revealed chondrosarcoma. *(Upper images demonstrate axial and coronal T1 MRI with gadolinium showing chondrosarcoma. 3D Images below demonstrate middle fossa defect and reconstruction using orbital floor Ti plate.)*

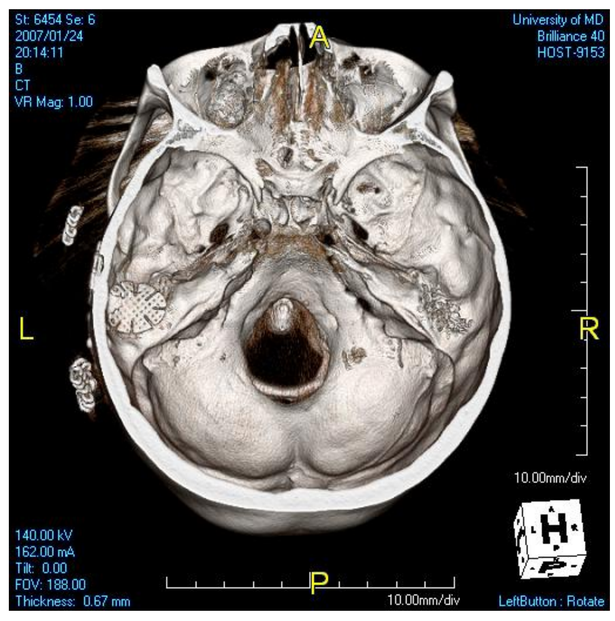




Case 2:

50 year-old female presented with a 3 month history of left sided otorrhea. The patient demonstrated a conductive hearing loss and was found to have a middle ear effusion. A tympanostomy tube was placed and the middle ear fluid tested positive for beta-2 transferrin. CT scan demonstrated a soft tissue mass in the epitympanum. Surgical resection proceeded via transmastoid approach and revealed herniated brain filling the medial portion of the mastoid antrum and entire epitympanum. A middle fossa approach was employed to close the skull base defect. Temporalis fascia was placed over the middle fossa defect. A titanium mesh orbital floor plate was secured to the skull base followed by temporalis muscle to plug the dural defect. The patient has done well without conductive hearing loss or CSF otorrhea. *(Images demonstrate axial CT with Ti reconstruction plate and corresponding 3D image.)*





Conclusion:

Titanium mesh can serve as a successful, stable scaffold for the repair of middle fossa defects and resulting encephalocele. The use of a maleable, inert support mesh can obviate the need for autologous bone grafting and associated donor site morbidity. Multilayer closure with titanium mesh and autologous soft tissue grafting may be explored for repair of CSF otorrhea arising from tegmen defects.

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