Middle Cranial Fossa Approach to Repair Tegmen Defects with Autologous or Alloplastic Grafts

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■ BACKGROUND: **Temporal bone tegmen defects may be associated with cerebrospinal fluid (CSF) otorrhea. Various techniques have been used for repair. We report our experience with skull base reconstruction for tegmen defects using either autologous or alloplastic grafts.**

■ METHODS: **A retrospective chart review was performed on patients with tegmen defects treated from 2007 to 2017 at the University of Missouri Hospital in Columbia, Missouri. Primary outcome measures were analyzed.**

■ RESULTS: **Thirty patients were treated (median age, 52 years; 83% female; median body mass index, 34.5; median follow-up, 8.5 months). Presenting symptoms included CSF leak (97%), hearing loss (53%), imbalance (13%), meningitis (10%), headache (3%), and tinnitus (3%). Most tegmen defects occurred spontaneously (80%), but cholesteatomas (10%), and trauma (10%) were also identified. Surgical approaches included middle fossa craniotomy (MFC) only in 83% of patients and combined MFC and mastoidectomy in 17%. Preoperative and postoperative audiograms were available for 16 patients (53%), showing objective improvement in 9 (56%). Fifteen patients were repaired with autologous bone graft (50%), 11 with an alloplastic graft (37%), and 4 with temporalis fascia only (13%). Recurrent CSF leak requiring reoperation occurred in 1 patient (3%). Four patients (13%) sustained a wound infection, and 3 (10%) had facial and/or petrosal nerve complications. The use of alloplastic grafts significantly shortened operative time (mean, 180 minutes for alloplastic vs. 208 minutes for autologous; $P = 0.03$).**

■ CONCLUSIONS: **CSF otorrhea due to tegmen defects can be repaired via an MFC using either an autologous or an alloplastic graft with equivalent outcomes and efficacy, although the use of an alloplastic graft can reduce operating time.**

INTRODUCTION

Temporal bone tegmen defects are often associated with cerebrospinal fluid (CSF) leakage into the mastoid and/or middle ear; temporal encephaloceles can also occur. Clinical manifestations may include conductive hearing loss, tinnitus, imbalance, aural fullness, and meningitis. Although tegmental defects often result from a spontaneous idiopathic process, traumatic injuries, infections, or neoplastic invasion of the skull base may play roles as well. In cases of spontaneous tegmental defects, several possible pathophysiological mechanisms have been postulated, including congenital defects in the floor of the middle fossa, increased intracranial pressure, and abnormal arachnoid granulation formation that cause pulsations of the dura, leading to gradual erosion of the bony tegmen.[1-3]

Tegmen defects are more common in obese female patients.[4] Given the rising incidence of spontaneous CSF leaks in association with the obesity epidemic,[5] further investigation of the natural history, presentation, and treatment of tegmen defects is warranted.

Three surgical approaches have generally been used to repair tegmental skull base defects: transmastoid, middle fossa craniotomy (MFC), and a combination of the 2 approaches.[6] Whereas

Key words
- CSF otorrhea
- Encephalocele
- Hearing loss
- Mastoidectomy
- Medpor
- Middle fossa craniotomy
- Tegmen defect

Abbreviations and Acronyms
BMI: Body mass index
CSF: Cerebrospinal fluid
CT: Computed tomography
MFC: Middle fossa craniotomy

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the transmastoid approach can be used for small defects, an MFC is preferred for multiple defects, defects larger than 1 cm, and anteriorly located lesions.[7] Others recommend a combined middle fossa and transmastoid approach for all patients for optimal results.[8]

Both autologous and alloplastic grafts have been used to repair tegmental defects. The Medpor porous polyethylene implant (Stryker, Kalamazoo, Michigan, USA) is an example of an allopathic synthetic graft. The Medpor's porous nature purportedly allows for rapid tissue ingrowth and eventual incorporation into bone, and the implant can be easily contoured and sized to the specific defect.

Here we review our experience with a middle fossa approach to repair tegmen defects, using either autologous or alloplastic grafts, and demonstrate that a middle fossa approach alone is usually sufficient to address the problem. We report advantages of using an allopathic graft in terms of reducing operative time. We also discuss the natural history and outcomes of the disease process with such treatment.

METHODS

Data Collection

This retrospective chart review study was approved by the University of Missouri Health Sciences Institutional Review Board (2009101) with waiver of consent. The senior author's clinical care database was queried from 2007 to 2017 for patients with a diagnosis of "tegmental defect" or who underwent "middle fossa craniotomy for reconstruction." Identified patient charts were reviewed for clinical data, including demographic information, presenting signs and symptoms, procedures, audiogram results, and clinical outcomes. Untoward events, including wound infection, unresolved CSF leak, and new cranial neuropathy, were defined as complications.

Surgical Technique

Our standard surgical procedure includes an MFC to perform a skull base reconstruction of the tegmen defect. We frequently place a lumbar drain to minimize retraction after anesthesia induction and before final surgical positioning. The patient is positioned supine with an ipsilateral shoulder roll and the head rotated to the contralateral side. Mayfield cranial fixation is used. Before skin incision, a prophylactic antibiotic, mannitol 25 g, Lasix 20 mg, and Keppra 1 g are routinely administered. The patient is hyperventilated to a pCO_2 goal of 28—32 mm Hg. A horseshoe incision is fashioned approximately 1 cm anterior to the tragus, curving slightly anteriorly and superiorly approximately 3—4 cm above the pinna and then posteriorly and inferiorly toward the mastoid tip. The temporalis muscle is elevated inferiorly with care to clearly expose the zygoma and to avoid traction or direct trauma to the frontalis branch of the facial nerve. The anterior limb of the temporalis incision is made more anterior relative to the skin incision to ensure that the craniotomy can be extended as inferiorly and anteriorly as possible. Four burr holes are placed to achieve a 4-cm superior-to-inferior × 5-cm anterior-to-posterior bone flap, with the anterior inferior burr hole as anterior and inferior as possible relative to the posterior root of the zygoma.

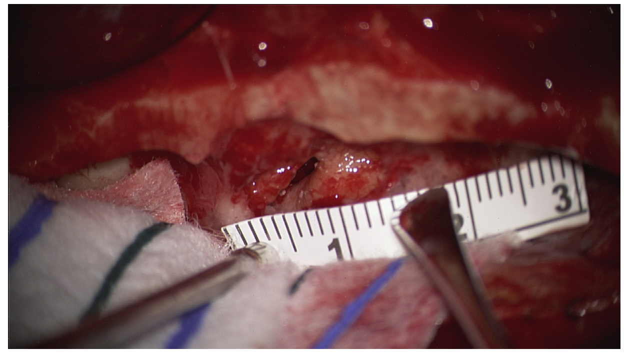

Figure 1. Intraoperative image of the middle fossa floor showing a tegmen defect measuring approximately 10 mm. The lateral semicircular canal, malleus, and incus can be identified through the defect.

Following the craniotomy, a combination of Leksell rongeur and high-speed burr is used to drill the squamous temporal bone flush to the floor of the middle cranial fossa. The lumbar drain is then opened and drained, usually approximately 60—100 mL, until the brain is appropriately relaxed. Via extradural dissection with care to avoid durotomy, the brain is elevated using gentle traction. Without or with microscopic visualization, the dura is carefully mobilized away from the middle fossa floor, in a posterior-to-anterior direction to avoid avulsing the greater superficial petrosal nerve.[7] Dural elevation is centered over the tegmen tympani, identifying the following key landmarks: middle meningeal artery anteriorly, greater superficial petrosal nerve medially, and arcuate eminence posteriorly.[7] The dissection is carried out medially beyond the medial edge of the defect to visualize intact dura (Figure 1).

Encephaloceles herniating through the dura are coagulated and amputated until the attachment recedes behind the dural margin. If possible, any dural defect is closed primarily. If primary closure cannot be performed, a synthetic dural patch (bovine pericardium or DuraMatrix (Stryker) or harvested temporalis fascia is secured from anterior to posterior along the inferior temporal dura. This patch is reflected over the native dura inferiorly along the skull base to cover the durotomy sites and then tucked medially under the temporal dura (Figure 2). A piece of Gelfoam packed medially helps maintain the graft position.

Any portion of the encephalocele protruding through the tegmental defect into the mastoid or middle ear is carefully microscopically dissected to avoid injury to the ossicular chain. A 0.6- to 1.0-mm-thick Medpor sheet implant is then carved to span the defect. A slightly larger piece of DuraMatrix is also trimmed. The Medpor and DuraMatrix are secured together using a 4-0 nylon stitch (Figure 3). This construction is placed over the defect to span the exposed temporal floor, with the DuraMatrix in direct contact with the tegmen defect. A sealant such as Tisseel (Baxter International, Deerfield, Illinois, USA) is then applied as medially as possible. The temporal lobe is released to fall back to its usual position, and the lumbar drain is closed. Ventilation is reduced to normalize pCO_2. The bone flap is secured back into place, and skin closure is performed in a standard fashion.