Emergent skull-base mesh cranioplasty for large defects using titanium implants in severe head trauma: a case report of difficult craniofacial separation

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Introduction

Large defects of the anterior / central skull base are a niche pathology that infrequently occurs in the setting of traumatic head injuries, more specifically high impact motor vehicle accidents and self-inflicted gun shot wounds to the head.

Case Description

This 37-year-old otherwise healthy male presented to our level 1 trauma center in 2012 after a self-inflicted gunshot wound to the face and head. He had an entrance wound in the submental region, resulting in extensive comminuted facial fractures (involving the mandible, mid face, and anterior skull base). Initial CT scan demonstrated a shattered mandible, palatal defect with associated comminuted midface fractures, and anterior skull base defect involving frontal sinus, cribiform plate and orbital roof. CT scan of the head showed an 11 cm subdural hematoma with midline shift and uncal herniation, for which he had an emergent craniotomy and evacuation of subdural hematoma. His ICP drain was removed over the next few days, but he developed massive CSF rhinorrhea as a result of his cranial base defect.

On day 10, he underwent an anterior skull base reconstruction using titanium mesh cranioplasty. Patient tolerated the procedure well, but recovery was complicated by development of cerebritis and brain abscess in the frontal lobe. He improved with drainage of the abscess and antibiotic treatment without improvement in cognitive function.

Figure 1. Initial presentation. A. Bullet fragment in frontal bone and B, subdural hematoma with midline shift. C. CT facial bones demonstrating shattered midface and mandible and D violation anterior cranial base with disruption of orifice and displaced orbita gall.

Repeat CT after one month revealed persistent pneumocephalus in communication with the air space of the nasal and oral cavities. Exam under anesthesia demonstrated a 2.5 cm irregular palatal defect leading from the oral cavity to the nasal cavity. A tract leading to the left frontal sinus where the mesh titanium plate was exposed without soft tissue covering was seen. A stage 2 reconstruction was performed with composite flap repair with free cartilage/bone/mucosa 2 months later. One month later, a flexible nasal endoscopy demonstrated a viable graft in place and a CT scan demonstrated resolution of previous pneumocephalus. After an enduring craniofacial separation was achieved, the otorhinolaryngology team then repaired the extensively comminuted facial fractures based on CT-guided design of reconstruction plates for his midface fractures. In collaboration with oromaxillofacial surgery, nonviable portions of mucosa and underlying dentition, maxilla, and palate were removed. The resulting palatal defect was occluded with a temporary acrylic obturator. A dental prosthesis was fashioned to obdurate the palatal defect and bridge the maxilla.

Figure 2. Brain abscess developed during initial hospitalization

Figure 3. A and B. Six weeks after initial mesh skull base reconstruction a defect is apparent in the reconstruction resulting in oral nasal cranial communication with pneumocephalus. C, D, E. Intraoperative images three months after presentation with endoscopic visualization of mesh plate from mouth and nose

Discussion

Cranioplasty is required in craniaral trauma patients with large basal defects, for physiologic restoration of neurovascular structures, cosmesis, and prevention of CSF leak. A number of materials can be used to reconstruct cranial defects, and choice should be guided by consideration of biocompatibility, MR- and CT-compatibility, malleability and ease of surgical manipulation, optimal structure, weight, and stress-bearing capability, and finally cost. In the setting of acute trauma, however, the choice of material is narrowed by time-sensitive conditions that necessitate efficient decision-making, surgical planning, and operative action. Titanium-mesh is ideal and allows for easy surgical manipulation and contouring to the cranial defect, increasing the accuracy of graft reconstruction and reducing the surgical morbidity and mortality.

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