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Case Report

Management of infections complicating the orbitocranial approaches: Report of two cases and review of literature

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Abstract

Background: The orbitocranial approaches are now indispensible for treating lesions of the skull base, providing access to lesions in the anterior and middle cranial fossae, as well as the upper clivus and anterior brainstem. The management of infectious complications of the orbitocranial approaches, however, has evaded the literature.

Case Description: We present two cases of patients who underwent orbitocranial approach whose clinical course was complicated by wound infection and osteomyelitis. One patient was treated with antibiotics and then had a custom implant placed for cranioplasty. The other case was managed with removal of bone and wire-mesh cranioplasty.

Conclusion: Management of orbitocraniotomy infections can be difficult due to the complex geometry of the flap and to cosmetic considerations. Once the infection involves the bone, the bone can be replaced after cleaning or discarded and a cranioplasty performed. Cranioplasty can be performed with wire-mesh or a custom implant made by computer-assisted modeling.

Key Words: Cranioplasty, frontotemporal-orbitozygomatic, infection, orbitozygomatic

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INTRODUCTION

The frontotemporal-orbitozygomatic (FTOZ) approach, initially described by Pellerin *et al.*[28] and Hakuba *et al.*[19] is a modification of the pterional approach that utilizes removal of the supraorbital rim, zygomatic process, and superior and lateral orbital walls to increase exposure and working angle.[17,30] The full FTOZ approach and its variants[34] are now indispensible for treating lesions of the skull base, providing access to lesions in the anterior and middle cranial fossae, as well as the upper clivus and anterior brainstem.[1-3,12,19,20,23,27,28,35] These can be referred to as orbitocranial approaches.

Surgical technique is paramount in minimizing morbidity and optimizing the cosmetic outcome after such an extensive approach, although only a few reports focus on this.[5,14,34,35] Youssef *et al.* recently reported on the complications and functional outcomes associated with their series of patients undergoing the FTOZ approach.[34] The management of infectious complications of the orbitocranial approach, however, has evaded the literature. We report two patients who underwent orbitocranial approaches complicated by wound infection and osteomyelitis to illustrate potential management strategies.

CASE REPORTS

Case 1

A 58-year-old male was found to have a sellar/suprasellar mass that he refused to have treated for many years. He then presented to the emergency room (ER) with near blindness bilaterally, decreased level of consciousness, dilated right pupil, and left facial paresis. Imaging studies demonstrated a very large sellar/suprasellar mass with brainstem compression. The patient underwent right cranio-orbitozygomatic approach for subtotal resection of the mass. Pathology was consistent with craniopharyngioma. Several months later, the patient had recurrence of a tumor cyst and some re-growth of solid tumor, for which he underwent a second resection via the same approach. Six weeks later, the patient returned to clinic with right facial and forehead swelling with associated periorbital edema and drainage from the wound. The patient was taken to the operating room for washout and debridement of the wound. The infected bone flap was removed and the patient treated with a 6-week course of culture-specific intravenous antibiotics. The removed, infected bone flap was then imaged *ex vivo* using thin cut computed tomography (CT) to make a custom one piece FTOZ implant, which would be guaranteed to fit. Three months later, the patient underwent cranioplasty with the custom implant and tolerated the procedure well [Figure 1]. At 33-month follow-up, the patient is doing well and has had a good cosmetic outcome.

Case 2

A 32-year-old male suffered a seizure and was found to have a large fronto-parietal AVM with a flow-related anterior communicating artery aneurysm. The patient underwent left orbitopterional craniotomy for clipping of the aneurysm. He had a very large frontal sinus that was noted preoperatively. In surgery, this was cranialized. He did well in the initial postoperative period, however, 2 weeks later, he returned with swelling at the surgical site and fluctuance. Imaging studies demonstrated epidural fluid collection and possible bony involvement. The patient was taken to the operating room for washout. The bone flap was noted to be infected and was then used as a template to mold a piece of titanium mesh that was affixed to the skull to recreate the contours of the orbitopterional bone flap. The patient tolerated the procedure well and his postoperative course was uncomplicated. He underwent 6 weeks of culture-specific IV antibiotics. In follow-up, the patient has had an excellent cosmetic outcome [Figure 2] and is doing well at 21 months.

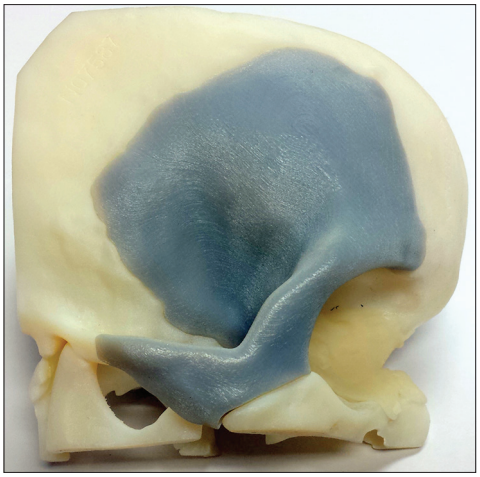

Figure 1: Custom implant made using computer-assisted modeling for patient 1

DISCUSSION

The orbitocranial approaches are a versatile and commonly used skull base approach that provides access to the anterior fossa, middle fossa, and posterior fossa anterior to the brainstem. The benefit of increased exposure and decreased brain retraction comes with the drawback of added morbidity and complication in a cosmetically sensitive area.[34] One such complication is infection involving the bone flap. In this report, we present two cases of patients who underwent an orbitocranial approach whose clinical course was complicated by wound infection and osteomyelitis. Management of this problem can be difficult due to the complex geometry of an orbitocranial flap and to cosmetic considerations.

The incidence of postoperative wound infection after craniotomy has been reported to be 3–5%.[6,7,11,15,18,24] Up to one-third of these infections have been reported to result in osteomyelitis of the bone flap.[6,24,32] A devascularized bone flap is particularly susceptible to become involved in the infection. An osteoplastic bone flap, which retains blood supply to the bone flap, can minimize this complication. An osteoplastic orbitozygomatic craniotomy has been described.[5]

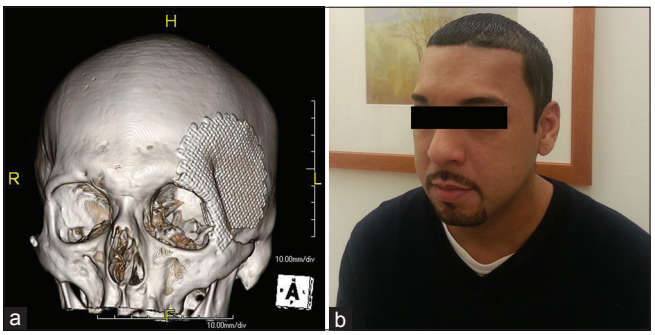

Figure 2: (a) 3D CT reconstruction demonstrating wire-mesh cranioplasty for patient 2. (b) Photograph demonstrating good cosmetic outcome at follow-up

Involvement of the bone can be identified based on imaging, but is usually determined by intraoperative findings. CT is the best, commonly used imaging modality, with osteopenia, erosion of the cortex, or lytic destruction being diagnostic. Radionuclide scanning as well as positron emission tomography (PET) scan has also been shown to be sensitive in detecting osteomyelitis.[8,33]

If the bone is thought to be involved, the wound is washed out and debrided, the devitalized bone flap removed traditionally,[9,22] and the wound closed. It is imperative to send cultures intraoperatively and to remove previously placed suture material and hemostatic agents. A cranioplasty can be done at the time of washout or in a delayed fashion, depending on the severity of the infection. Management for infections after the orbitocranial approach are more complicated due to the cosmetic nature of the affected area, thus, three management strategies can be employed when infection requires discarding the craniotomy flap.

Replacing devitalized bone after cleaning

While there have been many improvements in synthetic cranioplasty materials over the years, replacing the native bone flap is ideal when possible. Traditionally, the standard of care was to discard infected bone flaps, followed by a delayed cranioplasty.[4,9,22] However, several reports have established that it is possible to salvage infected bone flaps.[4,9,13] Bruce and Bruce reported scrubbing and soaking the bone flap in povidone-iodine solution. The flap was not autoclaved and foreign materials were avoided as much as possible. The patients were then treated with culture specific antibiotics for their infection. Two out of 13 patients could not have their flap salvaged; both underwent bifrontal approaches to the anterior skull base.[9] Delgado-Lopez *et al*. sterilized the bone flap using sterilizing solution or autoclaving and then placed subgaleal/epidural drains for noncontinuous irrigation with antibiotic solution.[13] All five of their patients achieved complete wound healing and resolution of infection. Auguste and McDermott reviewed 12 patients who had infected bone flaps that were replaced at the time of washout.[4] In their protocol, the bone flaps were scrubbed with povidone-iodine solution and then soaked in 1.5% hydrogen peroxide. Subgaleal and epidural drains were then used to set up a "wash-in, wash-out" antibiotic irrigation system, which was used for an average of 5 days. All but one their patients had resolution of the infection. These techniques have a higher failure rate in patients undergoing skull base approaches, but have the advantage of returning the patient's original bone flap.

Wire-mesh cranioplasty

Wire-mesh cranioplasty has been used successfully for a long time. Methylmethacrylate or cement can be used to augment the repair and further contour as necessary to achieve a good cosmetic result. Wire-mesh can be used to perform the cranioplasty at the time of washout,[25] provided the patient is on the appropriate culture-specific antibiotic regimen. Furthermore, the use of titanium, as opposed to stainless steel, further decreases the chance of development of biofilm or colonization after washout. For the patient in case 2, the infected flap was removed and used as a model to contour the titanium wire mesh to help optimize the cosmetic outcome. We did not place any bone cement to bolster the cranioplasty.

Reproducing original bone flap using custom implant

Custom implants are generally made using computer-assisted modeling, and can be made of polymethylmethacrylate (PMMA),[16] hydroxyapatite (HA),[31] carbon fiber reinforced polymer (CFRP),[29] poly ether-ether ketone (PEEK)[26] or titanium.[10,21,26] Compared with wire-mesh cranioplasty, they offer the advantages of being sturdier and not deformable. Additionally, they provide more reproducible cosmetic results since the implant is a copy of the patient's own anatomy. Usually, patients with skull defect have a custom implant made using mirroring, extrapolating the shape based on the contralateral side. For the patient in case 1, we obtained a thin-cut CT scan using the infected bone flap. This allowed us to create a custom implant that reproduced the discarded bone flap. The patient successfully underwent cranioplasty several months later after completing a culture-specific course of antibiotics.

CONCLUSION

The orbitocranial approaches are an important approach in treating lesions of the skull base by allowing less brain retraction. However, the management of infectious complications of orbitocranial approach has evaded the literature. We report two patients who underwent an orbitocranial approach complicated by wound infection and osteomyelitis. Once the infection involves the bone, the bone can be replaced after cleaning or discarded and a cranioplasty performed. Cranioplasty can be performed with wire-mesh or a custom implant made by computer-assisted modeling.

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