Bone flap infection

- Wet-adhesive and antibacterial PAH-TPP coacervates with self-mineralizing capability for cranial flap fixation
- Bedside Sonographic Ventricular Monitoring Through a Sonolucent Cranial Implant for Weaning of External Ventricular Drain After Aneurysmal Subarachnoid Hemorrhage
- Immediate titanium mesh cranioplasty after debridement of post-craniotomy infection
- Application of dental pulp stem cell-conditioned medium combined with deep cryopreservation of autologous cranial flaps
- Craniectomy Combined with Rapid Internal Decompression in Massive Cerebral Infarction : Surgical Technique and Outcomes
- Immediate and Long-Term Outcomes of Autologous and Alloplastic Cranioplasty in Pediatric Population
- Cranioplasty Approaches and Outcomes in Low-Middle Income Countries: A Systematic Review
- One-piece bifrontal basal craniotomy with pericranial flap for frontal sinus management: How I Do It

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Craniotomy is a common neurosurgery used to treat intracranial pathologies. Nearly 5% of the 14 million craniotomies performed worldwide each year become infected, most often with Staphylococcus aureus (S. aureus), which forms a biofilm on the surface of the resected bone segment to establish a chronic infection that is recalcitrant to antibiotics and immune-mediated clearance [1)].

Diagnosis

Imaging studies: Imaging tests are essential to visualize the bone flap and surrounding structures. The most common imaging techniques used include:

X-ray: X-rays can reveal changes in the bone, such as bone loss, destruction, or signs of osteomyelitis (bone infection). CT scan (computed tomography): CT scans provide detailed cross-sectional images of the bone flap and surrounding tissues, helping to identify abnormalities and signs of infection.

MRI (magnetic resonance imaging): MRI is particularly useful in detecting soft tissue infections, such as abscesses or deep-seated infections around the bone flap. Aspiration or biopsy: In some cases, a sample of fluid or tissue from the affected area may be collected for laboratory analysis. This can help identify the specific bacteria causing the infection and determine the most appropriate antibiotic treatment.

Other diagnostic procedures: Depending on the clinical scenario, additional tests may be performed, such as bone scans or PET scans, to evaluate the extent of infection or to rule out other possible conditions.

Treatment

When complicated by infection, craniotomy bone flaps are commonly removed, discarded, and delayed cranioplasty is performed. This treatment paradigm is costly, carries the risks associated with additional surgery, and may cause cosmetic deformities.

Auguste et al. retrospectively reviewed the medical records for 12 patients with bone flap infections following craniotomy who received treatment with the wash-in, wash-out indwelling antibiotic irrigation system. Infected flaps were removed and scrubbed with povidone-iodine solution and soaked in 1.5% hydrogen peroxide while the wound was debrided. The bone flaps were returned to the skull and the irrigation system was installed. Antibiotic medication was infused through the system for a mean of 5 days. Intravenous antibiotic therapy was continued for 2 weeks and oral antibiotics for 3 months postoperatively. Wound checks were performed at clinic follow-up visits, and there was a mean follow-up period of 13 months. Eleven of the 12 patients who had undergone placement of the bone flap irrigation system experienced complete resolution of the infection. In five patients there was involvement of the nasal sinus cavities, and in four there was a history of radiation treatment. In the one patient whose infection recurred, there was both involvement of the nasal sinuses and a history of extensive radiation treatment.

Infected bone flaps can be salvaged, thus avoiding the cost, risk, and possible disfigurement associated with flap removal and delayed cranioplasty. Although prior radiation treatment and involvement of the nasal sinuses may interfere with wound healing and clearance of the infection, these factors should not preclude the use of irrigation with antibiotic agents for bone flap salvage [2)].

Case series

O'Donnell et al. retrospectively reviewed data on clinical samples sent for culture from patients with suspected BFI. They also accessed information recorded prospectively from national and local databases for evidence of BFI or related conditions based on terms used in surgical operative notes or discharge summaries and documented monomicrobial and polymicrobial infections related to craniotomy sites.

Between January 2016 and December 2020, they we documented 63 patients with a mean age of 45 years (16-80). Craniectomy for infection of the skull was the most common terminology used to describe BFI in the coding used in a national database, 40/63 (63%), but other terms were used. A malignant neoplasm was the most common underlying condition necessitating craniectomy in 28/63 (44%) cases. Specimens submitted for microbiological investigation included 48/63 (76%) bone flaps, 38/63 (60%) fluid/pus, and 29/63 (46%) tissue. Fifty-eight (92%) patients had at least one culture-positive specimen; 32 (55%) were monomicrobial and 26 (45%) were polymicrobial. Gram positive bacteria predominated and Staphylococcus aureus was the most common.

Greater clarity on how to define BFI is required to enable better classification and the carrying out of appropriate surveillance. This will inform preventative strategies and more effective patient management [3)].

1)
Van Roy Z, Kielian T. Tumor necrosis factor regulates leukocyte recruitment but not bacterial persistence during Staphylococcus aureus craniotomy infection. J Neuroinflammation. 2024 Jul 23;21(1):179. doi: 10.1186/s12974-024-03174-9. PMID: 39044282; PMCID: PMC11264501.

2)
Auguste KI, McDermott MW. Salvage of infected craniotomy bone flaps with the wash-in, wash-out indwelling antibiotic irrigation system. Technical note and case series of 12 patients. J Neurosurg. 2006 Oct;105(4):640-4. PubMed PMID: 17044572.
3)
O'Donnell S, Creedon M, Walsh J, Dinesh B, O'Brien DP, MacNally S, Humphreys H. Bone flap infections after craniotomy: a review of 63 cases and the implications for definitions, classification and surveillance methodologies. J Hosp Infect. 2023 Jun;136:14-19. doi: 10.1016/j.jhin.2023.03.019. Epub 2023 Mar 31. PMID: 37004785.