

Case Report

Development of posttraumatic frontal brain abscess in association with an orbital roof fracture and odontogenic abscess: A case report

Hael Abdulrazeq¹, Konrad Walek¹, Shailen Sampath¹, Elias Shaaya¹, Dardan Beqiri², Albert Woo², Prakash Sampath¹

Departments of ¹Neurosurgery and ²Plastic Surgery, Rhode Island Hospital, The Alpert Warren Medical School of Brown University Providence, United States.

E-mail: *Hael Abdulrazeq - hael.ashqar@gmail.com; Konrad Walek - konrad_walek@brown.edu; Shailen Sampath - praksampath@gmail.com; Elias Shaaya - elias_shaaya@brown.edu; Dardan Beqiri - d.beqiri77@gmail.com; Albert Woo - albert_woo@brown.edu; Prakash Sampath - psampath@lifespan.org



*Corresponding author:

Hael Abdulrazeq,
Department of Neurosurgery,
Rhode Island Hospital, The
Alpert Warren Medical
School of Brown University
Providence, United States.

hael.ashqar@gmail.com

Received : 04 September 2022

Accepted : 02 November 2022

Published : 18 November 2022

DOI

10.25259/SNI_813_2022

Quick Response Code:



ABSTRACT

Background: Brain abscess is a potentially fatal condition. Orbital fractures caused by penetrating injury may be associated with intracranial infection. Such complication associated with blunt trauma, orbital roof fractures, and odontogenic abscesses is exceedingly rare.

Case Description: We report the case of a 40-year-old transgender female with a frontal abscess presenting several weeks following a motor vehicle crash from which she suffered multiple facial fractures and an odontogenic abscess. On computed tomography scan, the patient had multiple right-sided facial fractures, including a medial orbital wall fracture and a right sphenoid fracture extending into the superior orbital roof. There was hemorrhage notable in the right frontal lobe. Communication with the ethmoid sinuses likely provided a conduit for bacterial spread through the orbit and into the intracranial and subdural spaces.

Conclusion: Skull base fractures that communicate with a sinus, whether it be frontal, ethmoid, or sphenoid may increase the risk of brain abscess, especially in patients who develop an odontogenic abscess. Surgical repair of the defect is essential, and treating patients prophylactically with antibiotics may be beneficial.

Keywords: Brain abscess, Odontogenic abscess, Orbital fracture, Trauma

INTRODUCTION

Brain abscesses are a rare but serious complication of focal intracerebral infection.^[3,8] The most common etiology of infection is direct or indirect inoculation through spread from the paranasal sinuses, middle ear, or teeth.^[1] Other causes include immunocompromise, head trauma, and postoperative complication of cranial surgery.^[3,8] Bacterial contamination of the intracranial space after penetrating brain injury or skull fractures is common, but the incidence of posttraumatic brain abscess is low; the typical route of spread is contamination from the sinuses, most commonly the frontal sinus.^[3,8] In the case of frontal sinus fractures, especially those that involve the anterior and posterior tables of the sinus, care must be taken to detect cerebrospinal fluid (CSF) leaks and to surgically repair the fracture and cranialize the sinus when indicated to prevent long-term complications such as infections or mucoceles.^[9]

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, transform, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

©2022 Published by Scientific Scholar on behalf of Surgical Neurology International

We present a case of a 40-year-old transgender female who suffered a right frontal abscess several weeks after a trauma that resulted in a number of complex right-sided injuries, including medial and superior orbital wall fractures. We discuss the surgical approach to treat this condition.

CASE REPORT

This is a 40-year-old transgender female with no pertinent medical history who presented to the emergency room after a motor vehicle accident, in which she reported that she was a restrained driver, but was found ejected 25 feet from the crashed vehicle. She described subjective right eye visual loss but was found on ophthalmologic evaluation to have intact visual fields. She had computed tomography (CT) imaging as part of the trauma work up which revealed a right sided contusion, traumatic subarachnoid hemorrhage [Figure 1a], and right frontal and parafalcine subdural hematomas. The CT also revealed multiple facial fractures [Figure 1b], including comminution in all walls of the orbit, including superior, lateral, medial, and inferior orbital wall fractures with trace extraconal air medially and evidence of a retrobulbar hematoma of the right globe [Figure 1a]. There

were also bilateral nasal bone fractures, a comminuted right zygomaticomaxillary complex fracture, a right nasoethmoid fracture, comminuted right frontal and temporal skull fractures, as well as right sphenoid wing and cribriform plate fractures [Figure 1b]. In the emergency room, the ophthalmology service performed an urgent right lateral canthotomy to relieve globe pressure, and the nasal fracture underwent closed nasal reduction by the plastic surgery team. On neurological examination, the patient was Glasgow Coma Scale 13 for lethargy and confusion. There was no otorrhea or rhinorrhea noted on examination. The patient was admitted to the neurological critical care unit for observation.

On hospital day 7, she was noted to have a fever and elevated white blood cell count, as well as facial swelling. She then began having purulent drainage from the oral cavity and was diagnosed with an odontological abscess of tooth #2 and #5. Dental specialists performed an incision and drainage of a maxillary buccal vestibular abscess and placement of drains which were removed on postprocedure day 2. The patient was discharged on oral amoxicillin/clavulanic acid for 2 weeks. At this time, cultures were not sent for analysis.

The patient's mental status continued to improve, and she was discharged to a rehabilitation facility in stable condition on hospital day 15.

The patient returned 2 months after with 4 days of headaches and chills. Vital signs were stable, and the patient was neurologically intact. Laboratories revealed a normal white blood count, an elevated c-reactive protein level of 47 mg/dL (normal <1.0 mg/dL),^[10] and elevated erythrocyte sedimentation rate of 45 mm/h (normal ≤15 mm/h).^[12] CT of the brain showed a right frontal collection suspicious for an abscess, as well as a persistent orbital roof fracture. A magnetic resonance image (MRI) of the brain with contrast was obtained which demonstrated a right frontal heterogeneous collection with rim enhancement and central restricted diffusion highly suspicious for abscess [Figures 2a-c]. We hypothesize that the prior odontogenic abscess played a direct role as the infectious source for the development of the brain abscess, and the presence of the facial and orbital fractures facilitated the spread of the causative organisms.

Operative intervention

Given the imaging findings, the patient was taken emergently to the operating room as a joint procedure between the neurosurgery and plastic surgery teams for evacuation of abscess and skull base reconstruction. After general anesthesia was administered and the patient intubated, she was placed in supine position on a Mayfield head rest. A bicoronal incision was planned and the flap was reflected anteriorly for exposure, preserving a pericranial flap for reconstruction of the skull base. A right frontal craniotomy

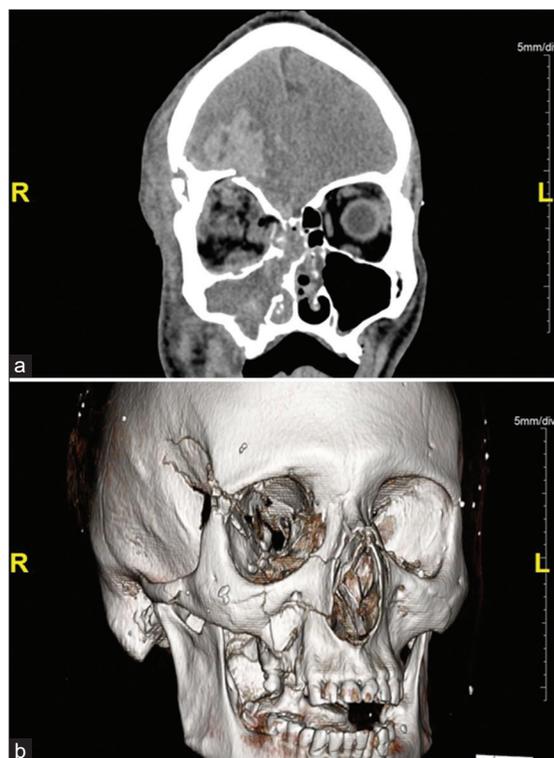


Figure 1: (a) Coronal view of computed tomography brain without contrast demonstrating a right frontal contusion with associated subarachnoid hemorrhage at the site of future abscess. (b) Three-dimensional reconstruction of computed tomography face which reveals the complex facial fractures as well as the right-sided orbital fractures.

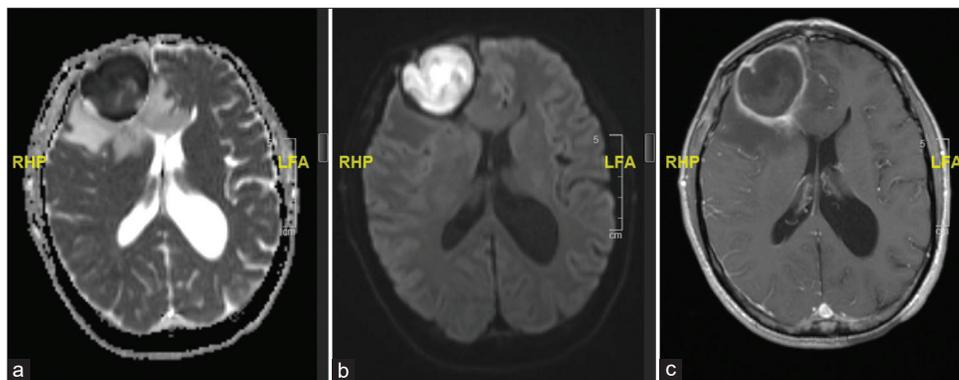


Figure 2: (a and b) Magnetic resonance image brain with diffusion sequences showing restricted diffusion of a right frontal collection, suspicious for abscess, as well as (c) T1 axial sequence with gadolinium (right) showing a right frontal rim enhancing collection.

was performed, which was close to midline and was extended anteriorly to the skull base. Given absence of a frontal sinus on the right side, the craniotomy was extended just above the orbital roof. After locating the abscess with intraoperative ultrasound, a U-shaped dural opening was performed. Using a combination of bipolar cautery and a 15-blade scalpel, corticectomy was extended until the abscess wall was identified. This was opened and copious purulent material was washed out. Attention was then shifted into developing the plane between the cortex and the abscess wall, which allowed for safe resection of what remained of the abscess wall.

At this point, it was noted that there was a dural defect under the abscess, which was overlying the orbital roof fracture and likely represented a conduit for bacterial spread [Figure 3a]. After copious irrigation and adequate hemostasis of the surgical cavity, the dural defect was closed in watertight fashion with interrupted 4-0 Nurolon sutures. The dura was dissected along the anterior skull base down to the orbital roof, which was noted to be irregular and elevated into the dura at the site of the prior fracture [Figure 3b]. An additional dural violation was noted near this which was repaired with a muscle graft as well. The displaced orbital roof segment was then dissected free and removed. Periorbital fat was encountered upon entering the orbit, and no abscess was visualized. The bony defect was then covered with the mobilized pericranial flap, which was stabilized posteriorly to the dura with sutures. The flap was then covered with synthetic dural sealant. The dural incision was then closed and the craniotomy flap plated [Figures 4a and b]. The remainder of the scalp closure was performed in standard technique.

Postoperative course

Cultures obtained during the operative intervention resulted with *Streptococcus intermedius*, a β -hemolytic Gram-positive

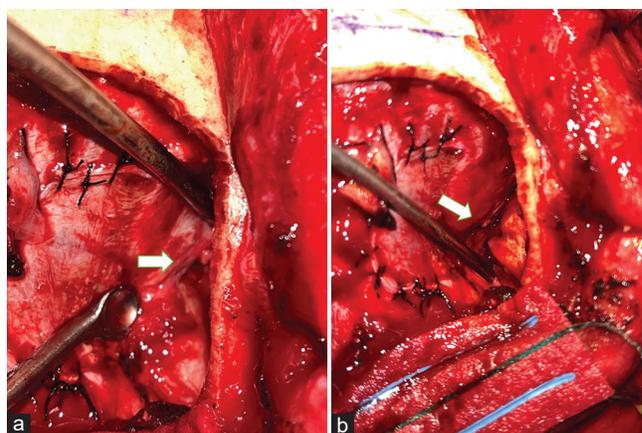


Figure 3: (a) Intraoperative picture showing dural tear (arrow) at the anterior skull base overlying the orbital roof fracture. (b) Intraoperative picture revealing a displaced fracture (arrow) of the right orbital roof.

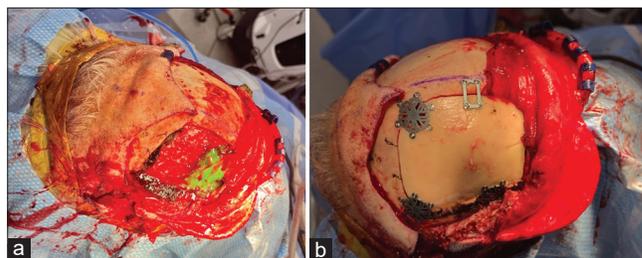


Figure 4: Intraoperative photographs. (a) Patient draped and supine after right frontal craniotomy and evacuation of abscess, status post dural closure with pericranium, and synthetic dural sealant. (b) Bone flap replaced with titanium plate fixation after drainage of abscess.

bacteria commonly found in the respiratory, gastrointestinal, genitourinary tracts, and a cause of dental abscesses.^[4] The patient was treated with intravenous ceftriaxone for a duration of 6 weeks. She was also started on levetiracetam

500 mg twice daily for 7 days for seizure prophylaxis. The patient underwent further infectious disease work up including human immunodeficiency virus serology which was negative. She was neurologically intact and discharged home on postoperative day 4. She remained well and was followed as an outpatient. An MRI of the brain with contrast at 3 months showed decreased vasogenic edema and a resolved intracranial abscess.

DISCUSSION

Orbital roof fractures place the overlying dura and frontal lobe at risk of further injury and complications. These include dural tear (such as in our case), CSF leak, cerebral contusion, subarachnoid hemorrhage, or subdural hematoma.^[5-7] In the case of transorbital penetrating injury, especially with skull base involvement, infection in an early or delayed fashion may occur up to 50% of cases in some reports.^[5,7] In these patients, the use of prophylactic is recommended, though no standard coverage or duration exists.^[13] In blunt traumatic injury associated with an anterior skull base defect, these injuries are at higher risk of causing an infection when a CSF leak develops.^[2] This was not present in the patient above. Periorbital wounds, especially those associated with orbital fractures, may also present with brain abscess if foreign bodies which may have gone undetected caused contamination of orbital contents. Although our patient has some facial abrasions at presentation, there were no foreign bodies detected on CT scan or on physical examination. One proposed mechanism for developing this infection could be the combination of the orbital roof fracture and the medial orbital wall fracture communicating with the ethmoid sinus, which provided a pathway for bacteria to travel from the sinus to the orbit, which communicated with the brain. Nose blowing may contribute to this, which might transfer bacteria under pressure into the brain from the nasal cavity. An alternative mechanism could be the possibility of hematologic spread from a dental abscess, which was also present at time of injury.

The causative organism in this case, *S. intermedius*, represents one of the most cultured class of organisms in brain abscesses and is typically treated with a course of intravenous ceftriaxone.^[4] These are typically found in the gastrointestinal tract and oropharynx. In addition, the patient had an odontogenic abscess requiring drainage, and the presence of this prior infection does place the patient at risk of intracranial abscess from hematogenous spread. The communication between the maxillary sinus and intracranial space due to the complex facial fractures as well as dural violation could increase the risk of sinogenic spread of the infection as well. *S. intermedius*, of interest, is also associated with dental infections.

Whether the patient had a CSF leak that was undetected and led to increased risk of intracranial infection, which

is unknown. The odontogenic abscess also represents a source of spread especially through a hematogenous route, though this is exceedingly rare and is usually a diagnosis of exclusion.^[1,11] However, the location of brain abscess near a traumatic fracture with dural violation raises suspicion for association of this orbital fracture caused by blunt trauma with intracranial abscess. A careful review of a patient's history and risk factors is necessary to determine the source of infection and adequate treatment, whether the infection be traumatic, iatrogenic, or otherwise.

CONCLUSION

Intracranial abscess is a rare and potentially fatal condition. Patients with complex facial fractures and those who present with orbital fractures after blunt trauma are at risk, even in the absence of clear evidence of CSF leak. Neurosurgeons should identify scenarios when there is communication with a sinus, whether it be frontal, ethmoid, or sphenoid. Patients must be cautious about nose blowing to prevent injection of bacteria under pressure into the brain. Beyond this, the question is raised whether such patients should be prophylactically treated with antibiotics, especially considering presence of other infections such as dental abscesses.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Akashi M, Tanaka K, Kusumoto J, Furudoi S, Hosoda K, Komori T. Brain abscess potentially resulting from odontogenic focus: Report of three cases and a literature review. *J Maxillofac Oral Surg* 2017;16:58-64.
2. Becker SS, Russel PT. Intracranial abscess after anterior skull base defect: Does pneumocephalus play a role? *Rhinology* 2009;47:287-92.
3. Bodilsen J, Dalager-Pedersen M, van de Beek D, Brouwer MC, Nielsen H. Incidence and mortality of brain abscess in Denmark: A nationwide population-based study. *Clin Microbiol Infect* 2020;26:95-100.
4. Darlow CA, McGlashan N, Kerr R, Oakley S, Pretorius P, Jones N, *et al.* Microbial aetiology of brain abscess in a UK cohort: Prominent role of *Streptococcus intermedius*. *J Infect* 2020;80:623-9.
5. De Villiers JC, Sevel D. Intracranial complications of

- transorbital stab wounds. *Br J Ophthalmol* 1975;59:52-6.
6. Ecklund JM, Mauer PK, Ellenbogen RG. Cerebral abscess after presumed superficial periorbital wound. *Mil Med* 1999;164:444-5.
 7. Maruya J, Yamamoto K, Wakai M, Kaneko U. Brain abscess following transorbital penetrating injury due to bamboo fragments-case report. *Neurol Med Chir (Tokyo)* 2002;42:143-6.
 8. Mathisen GE, Johnson JP. Brain abscess. *Clin Infect Dis* 1997;25:763-79; quiz 780-1.
 9. Metzinger SE, Guerra AB, Garcia RE. Frontal sinus fractures: Management guidelines. *Facial Plast Surg* 2005;21:199-206.
 10. Nehring SM, Goyal A, Patel BC. C Reactive protein. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2022.
 11. Pereira AJ, Tavares AT, Prates M, Ribeiro N, Fonseca L, Marques MD, *et al.* Brain abscess: A rare clinical case with oral etiology. *Case Rep Infect Dis* 2022;2022:5140259.
 12. Tishkowski K, Gupta V. Erythrocyte sedimentation rate. In: StatPearls. Treasure Island: StatPearls Publishing; 2022.
 13. Zhang D, Chen J, Han K, Yu M, Hou L. Management of penetrating skull base injury: A single institutional experience and review of the literature. *Biomed Res Int* 2017;2017:2838167.

How to cite this article: Abdulrazeq H, Walek K, Sampath S, Shaaya E, Beqiri D, Woo A, *et al.* Development of posttraumatic frontal brain abscess in association with an orbital roof fracture and odontogenic abscess: A case report. *Surg Neurol Int* 2022;13:539.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Journal or its management. The information contained in this article should not be considered to be medical advice; patients should consult their own physicians for advice as to their specific medical needs.