Incidence and Clinical Significance of Frontal Sinus or Orbital Entry during Pterional (Frontotemporal) Craniotomy

Rita S. Patel, David M. Yousem, Joseph A. Maldjian, and Eric L. Zager

BACKGROUND AND PURPOSE: Frontal sinus entry, orbital entry, or both may occur during pterional craniotomy for microsurgical clipping of aneurysms. We sought to determine the incidence and clinical significance of these findings on postoperative CT scans.

METHODS: Eighty-two postoperative CT scans of the head obtained from 81 patients (64 women, 17 men; age range, 25-80 years) were retrospectively reviewed over a 1-year period. These scans were reviewed independently by two blinded neuroradiologists for the presence and degree of orbit and frontal sinus entry that may have occurred during craniotomy. Clinical charts, operative notes, and discussions with the patients' neurosurgeons were reviewed to determine the clinical management and significance of these findings.

RESULTS: Of the total 82 craniotomies reviewed, 77 (94%) had been performed via the pterional approach (43 right, 34 left). Twenty-three (30%) of these 77 studies revealed some evidence of penetration into the orbit or frontal sinus (orbit=65.2% [15/23]; frontal sinus=30.4% [7/23]; both=4.4% [1/23]). Only five of 16 patients with radiographic orbital penetration had evidence of involvement of intraorbital contents (ie, thickened lateral rectus, fat herniation, intraorbital air). Chart review revealed no complication or change in management. Of the seven patients with frontal sinus entry, three had mucosal exenteration and packing with antibiotic-coated gelfoam. No delayed complications (ie, persistent fever, mucocele, cerebrospinal fluid leak, air leak, or meningitis) were identified (follow-up period, 18-29 months).

CONCLUSION: Frontal sinus or orbital entry is not uncommon after pterional craniotomy, but the incidence of immediate complications is rare.
formed on GE HiSpeed Advantage scanners (Milwaukee, WI) using 3-mm axial scans through the posterior fossa and 10-
mm axial images to the vertex of the head. The studies were 
evaluated in both soft-tissue and bone windows. They were 
independently reviewed by two neuroradiologists for presence 
and degree of orbit and frontal sinus involvement. If any wall 
of the sinus or orbit showed discontinuity through its thickness, 
the case was considered positive. Disagreements were decided 
by a consensus reading. In addition to the review of postop-
erative scans, the clinical charts, operative notes, and office 
follow-up notes were analyzed. The range of follow-up was 
18 to 29 months (mean, 22 months) measured from surgical 
date to the most recent office visit after the date of discharge. 
Follow-up evaluation relied solely on office visit notes, as head 
imaging was not performed after the date of hospital discharge 
on any patient except the subject who had a second operation. 
The neurosurgical staff was also consulted to clarify questions 
regarding operative procedure and subsequent complications. 
We were specifically interested in the occurrence of compli-
cations such as cerebrospinal fluid rhinorrhea, excessive orbital 
swelling, visual compromise, extraocular palsy, air leaks, mu-
coceles, chronic sinusitis, or other infection.

Results
A total of 82 postoperative CT scans of the head 
were reviewed. Seventy-seven or 93% of the an-
eurysm clippings were performed via pterional 
approach. Forty-three pterional craniotomies were 
performed on the right and 34 on the left. Five of 
the patients who did not have a pterional craniot-
omy underwent either frontal- or suboccipital-appro-
ach craniotomies. By consensus of the two re-
viewing neuroradiologists, 23 (30%) of the 77 
pterional craniotomies demonstrated radiographic 
penetration into the orbit or frontal sinus. Fifteen 
of the 23 studies showed involvement of the orbit, 
whereas seven showed showed some involvement 
of the frontal sinus. One CT scan showed involvement 
of both the frontal sinus and orbit. Five of 
the 16 patients who demonstrated penetration into 
the orbit showed more extensive involvement of 
infraorbital contents, including a thickened lateral 
rectus, fat herniation, or the presence of intraorbital 
air (Fig 1).

Review of the operative notes and clinical charts 
revealed that one patient who demonstrated intraor-
bital involvement had considerable postoperative 
periorbital swelling, which prompted an ophthalm-
ologic consult. The examination did not reveal 
any significant visual impairment or orbital injury. 
The periorbital swelling subsequently subsided 
without any sequela during the postoperative 
course and was normal by the time of the follow-
up office visit. Orbital entry did not result in any 
other reported complications or change in overall 
postoperative management. However, three of 
the seven patients with frontal sinus entry did undergo 
mucosal exenteration and packing with antibiotic-
coated gelfoam at the time of the craniotomy clo-
sure. One of these three patients also underwent 
placement of a vascularized pericranial graft (5). 
None of these patients have thus far developed 
complications such as mucoceles, air, or CSF leaks 
(6, 7).

Discussion
Frontal Sinus Entry
Neurosurgeons review preoperative CT scans to 
assess the osseous anatomy of patients, including 
the amount of pneumatization of the frontal sinus. 
By doing so, the neurosurgeon may be able to 
preserve for possible inadvertent entry into structures 
such as the frontal sinus. Management options for 
inadvertent frontal sinus entry are controversial 
among neurosurgeons and otolaryngologists. 
Both surgical specialties agree that if the frontal 
sinus is entered but the mucosa is not violated, no 
treatment is required. However, if the frontal sinus 
mucosa is violated, treatment is varied depending 
on the preference of the individual surgeon. During 
craniotomy closure, some neurosurgeons prefer to-
tal mucosal exenteration, irrigation, packing with 
antibiotic-soaked gelfoam, and placement of a peri-
cranial graft over the entrance to the frontal sinus.
Fig 2. Sinus entry. A and B. These axial CT images filmed in bone windows are from a 55-year-old with an anterior communicating artery aneurysm who had extensive pneumatization of the frontal sinus and thick calvarium. Owing to frontal sinus entry during a right pterional craniotomy, the patient required frontal sinus mucosal exenteration with antibiotic-laden gelfoam (arrows) placed in the sinus. A pericranial graft over the entrance of the frontal sinus was also required.

Possible complications related to orbital entry include orbital hematomas or damage to the extraocular muscles, affecting ocular movement. As with endoscopic sinus surgery, complications of orbital hematomas can lead to optic nerve ischemia or increase in orbital pressure or both, causing injury to the nerve and visual loss. Injury to the superior ophthalmic vein or the ophthalmic artery is rare, as the muscular capsule may serve as a relative barrier to intracranial entry.

Although no major complications were identified in our series, a prospective study with longer clinical and imaging follow-up may be useful to identify a subset of patients at increased risk of developing complications. Although clinical evaluation of patients will be most accurate in assessing long-term complications, mucoceles (with an expanded sinus) and CSF leaks (intrathecal contrast dye studies showing flow into the nose) should be easily distinguishable from the effects of mucosal exenteration.

Conclusion

Frontal sinus and orbital entry of a pterional craniotomy are common but rarely cause significant complications in patients with microsurgical clipping of aneurysms.

References