



Frontal sinus trephination for acute sinusitis

David M. Poetker, MD, MA,^{a,b} Todd A. Loehrl, MD,^{a,b} Robert J. Toohill, MD, FACS^a

From the ^aDivision of Rhinology and Sinus Surgery, Department of Otolaryngology and Communication Sciences, Medical College of Wisconsin, Milwaukee, Wisconsin; and

^bDivision of Otolaryngology, Department of Surgery, Zablocki VA Medical Center, Milwaukee, Wisconsin.

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Trephination of the frontal sinus has been used for more than a century to address acute infections of the frontal sinus. There are many levels at which the sinus can be entered. This article describes the options and indications for the various approaches to trephination of the frontal sinus.

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The concept of creating a small external opening into the frontal sinus for drainage of an acute infection has been entertained by clinicians for more than 250 years.¹ The location of the frontal sinus on the anterior bony area of the forehead lends itself to an external approach. The treating physician is obliged to control disease within the sinus because of its precarious position anatomically with the orbit and anterior cranial fossa.² Although the first published cases of trephination were reported in 1884,³ this technique, like many other sinus surgeries, was not widely performed until the midpoint of the twentieth century. Modern performances of trephination were reported by Hutchinson in 1939⁴ and during the next several decades, indications and techniques have been developed.

Indications

Broadly speaking, frontal sinus trephination can be used for 2 purposes. It is sometimes used concomitantly with functional endoscopic sinus surgery where an “above and below” or “2-sided approach” is used to guide the endoscopic approach to the nasofrontal recess and frontal sinus ostium.^{5,6}

Irrigation of the frontal sinus via the trephination while the surgeon observes endoscopically from below enhances visualization of the region and hence dissection. An endoscope may be inserted through the trephine to inspect the frontal sinus outflow and mucosal integrity. Any fluid in the frontal sinus should be removed by gentle nonbacteriostatic saline irrigation or aspiration, and sent for culture. If neoplastic disease is suspected in the frontal sinus, trephination allows access for a biopsy. A trephination may also be used to take down the wall(s) in a type 4 frontal cell, which cannot be reached from an endonasal approach. In these cases, a slightly larger trephine (which is not a problem cosmetically) is needed to insert both a small telescope and instrumentation into the frontal sinus to remove the bony lamellae.

The second indication for frontal sinus trephination is for acute frontal sinusitis refractory to appropriate medical management. The purpose of the trephination is to provide access for drainage or culture of infected frontal sinus material. In addition, trephination provides a portal to irrigate the sinus in the event of recurring mucopurulence. In some instances, an isolated refractory chronic frontal sinusitis may respond to trephination and an endoscopic procedure may be avoided. Even if an endoscopic procedure is required, it allows the region to be “cooled off” facilitating a more thorough dissection. The presence of intracranial spread of infection from an acute frontal sinusitis is a definite indication for trephination in conjunction with neurosurgical drainage procedures.⁷ Other complications of acute frontal sinusitis, such as orbital abscess, mucopyocele

Address reprint requests and correspondence: David M. Poetker, MD, MA, Division of Rhinology and Sinus Surgery, Department of Otolaryngology and Communication Sciences, Medical College of Wisconsin, Milwaukee, WI 53226.

E-mail address: dpoetker@mcw.edu.

or frontal bone osteomyelitis (Pott's puffy tumor) may benefit from early trephination.

Radiological evaluation

X-rays of the frontal sinus are an absolute necessity before a trephination procedure. They must indicate a fluid level or opacity and are used to guide the performance of the trephination. The conventional Caldwell and lateral views of the frontal will often give adequate information to perform a safe trephination. However, in present times computed tomography (CT) is readily available and provides information on all the paranasal sinuses when performed in the limited coronal technique. Standing alone these images may be sufficient if the clinician judges the depth of the computed slices properly. When performing the trephination, the height and depth of the frontal sinus must be appreciated. CT in the axial and sagittal views gives greater reassurance as to the dimensions of the frontal sinuses (Figure 1). In patients with difficult anatomy for any reason, computer-aided surgery may be considered.

Trephination technique

The frontal sinus is trephined by approaching it from 1 of 3 different levels (Figure 2). Each level of incision has its advantages and disadvantages, which are detailed in Table 1. The preferred anesthesia is general because the nature of drilling through bone may concern the patient. Local anesthesia with sedation may be performed in some situations. It is desirable to infiltrate the area where the skin incision is to be made with a mixture of lidocaine and epinephrine to decrease bleeding, which could complicate the performance of collecting fluid for microbiological analysis and endoscopic survey of the sinus. The skin incision regardless of the level of entrance need not be more than 2 cm in length. The incision is carried through the periosteum. A periosteal elevator is used to expose approximately 1 cm² of bone, above and below the incision. After the periosteum is elevated, penetration to the frontal sinus is best accomplished with a 4-mm rotating, cutting burr (Figure 3). Gentle pres-

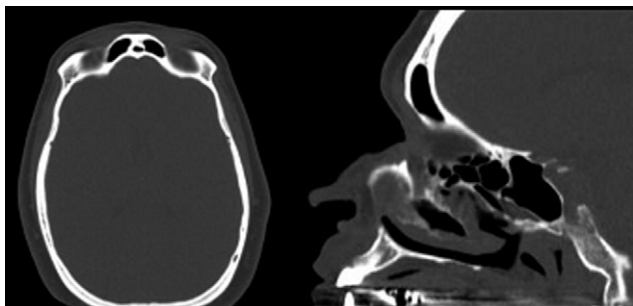


Figure 1 CT images in axial (left) and sagittal (right) planes. These are used to assess the anterior-to-posterior dimensions of the frontal sinus when planning for a trephination.

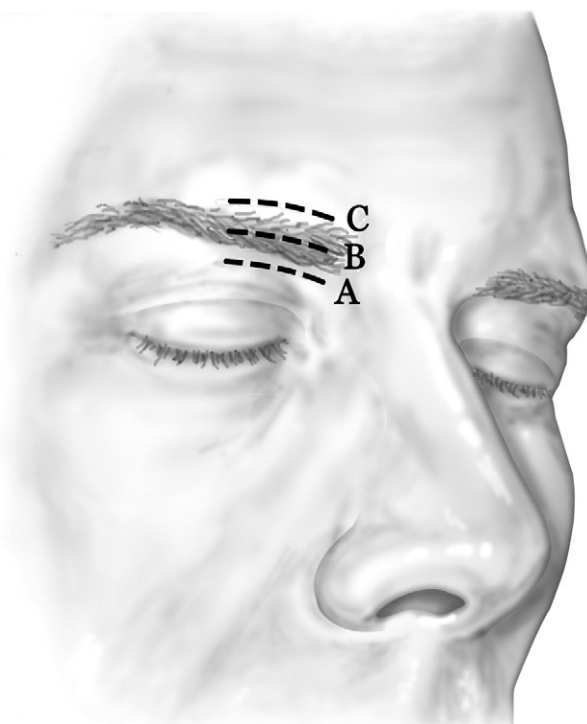


Figure 2 The 3 different sites at which to make the incision for a trephination. Site A is just inferior to the eyebrow, B is in the brow, and site C is superior to the eyebrow.

sure is placed on the bone, and the burr is rotated in a slight circular motion to allow for controlled penetration of the anterior table/floor. This allows for an anterior window of approximately 6-8 mm, with saucerized edges.

The most common approach involves an incision made in the superomedial aspect of the orbit immediately below the eyebrow and supraorbital rim (Figure 2A).⁸ The second approach is slightly higher through the medial aspect of the eyebrow (Figure 2B).⁹ The highest approach is above the eyebrow and directly through the anterior table of the frontal bone (Figure 2C).¹⁰ The term “mini-trephination” was coined after this approach with the development of special tools to perform such. A drill guide is placed through the incision biting into periosteum by rotation. Through this drill guide, a special rotating cutting burr mini-trephines the anterior table and will penetrate no further than 7 mm when

Table 1 Advantages and disadvantages of the various levels of frontal sinus trephination

	A. Below Eyebrow	B. Eyebrow	C. Above Eyebrow
Resultant scar	2	1	4
Adequacy of drainage	1	1	3
Endoscopic assessment	4	3	1
Safety of trephination	1	1	3
Nerve or vessel injury	2	2	1
Ease of biopsy	3	2	1
Bone infection	1	1	2

Scale is 1 (more advantageous) to 4 (less advantageous).

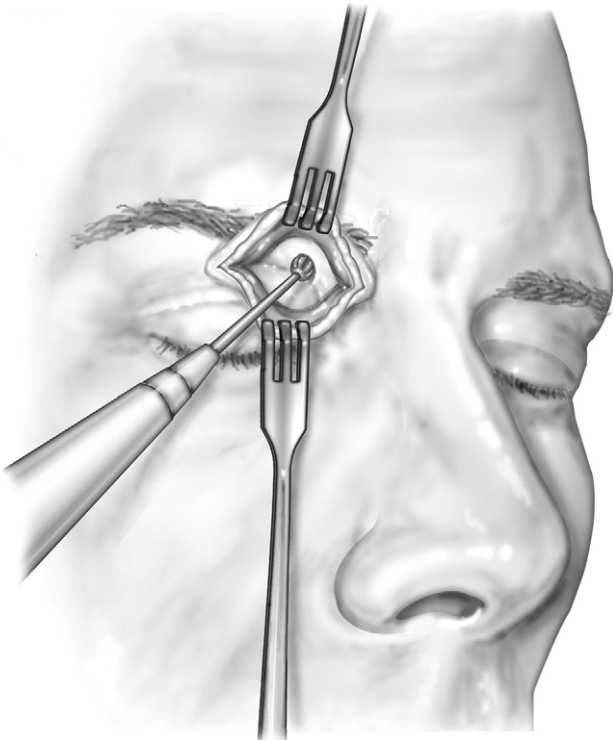


Figure 3 Technique for creating the trephination. The skin edges are retracted and a 4-mm cutting burr is used to drill through the bone.

fully engaged (Figure 4) to prevent penetration through the posterior table. However, in a report of 16 patients, one did have intracranial penetration with a resultant cerebrospinal fluid leak.¹⁰

When trephination is performed in acute frontal sinusitis a small amount of gentle saline irrigation will remove the fluid. One must be cautious with excessive irrigation especially when intracranial or orbital involvement is suspected. The size of the bony trephination need not be more than 6 mm in diameter but should be large enough to permit frontal sinus inspections with a small, angulated endoscope. A small soft drain, preferably silicone tubing, is placed into the sinus and sutured to the skin (Figure 5). Saline irriga-

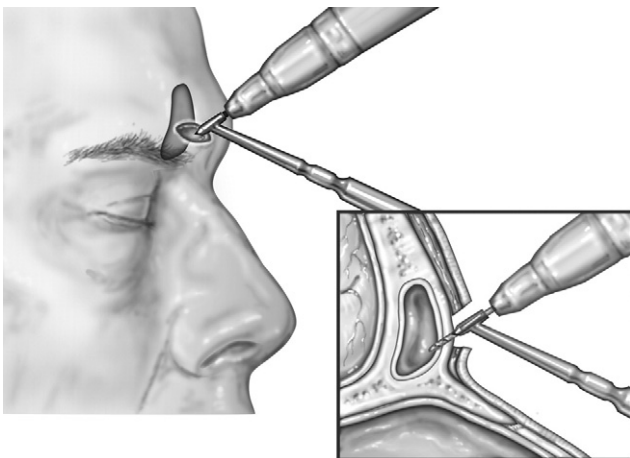


Figure 4 Mini-trephination.

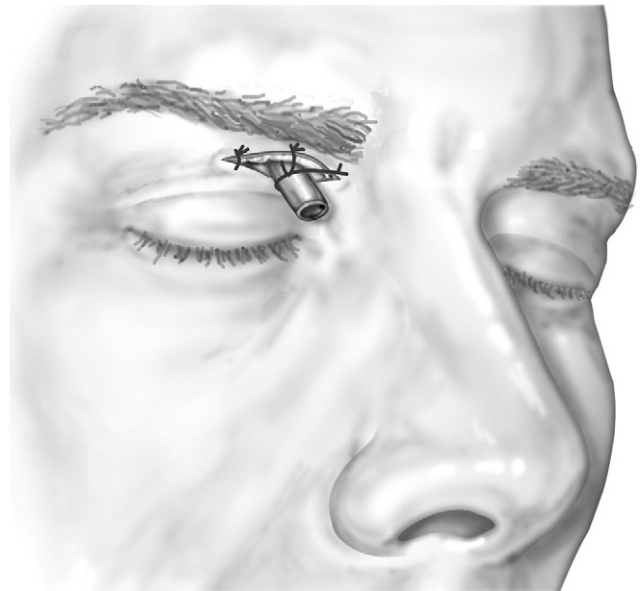


Figure 5 A stent may be left in place to facilitate irrigation of the frontal sinus.

tions via this drain may be necessary until natural drainage through the nasofrontal ostium occurs. Usually the drain can be removed in 3–5 days.

Complications

The unavoidable complication after a frontal sinus trephination is scar at the incision site. Depending on the site of the incision, this may be well camouflaged with the eyebrow. Most incisions are approximately 1 cm in length and heal very well even if below the eyebrow. A second complication, of which patients must be made aware, is numbness or paresthesias of the forehead and vertex. The supratrochlear nerve exits the skull in the region of the trephination site. Although damage to the nerve is very unpredictable, many patients complain of at least some paresthesias. This may be temporary or permanent. As described previously, even with a mini-trephination, there exists the risk of cerebrospinal fluid leak.

Discussion

Often, acute frontal sinusitis will clear spontaneously. The treatment involves use of decongestant nasal sprays, systemic decongestants, and antibiotics. If there is middle meatus purulence on initial endoscopic evaluation, a culture will give guidance as to antibiotic choice, otherwise high dose oral antibiotics are appropriate. If the sinusitis is refractory to initial treatment (ie, persistent pain, continued x-ray opacification, or evidence of intracranial or orbital involvement) intravenous antibiotics may be required. At this point, trephination can be considered to irrigate or aspirate the sinus and obtain culture material.

It is believed that when trephination is performed for acute frontal sinusitis it is preferable to use the below eyebrow incision (Figure 2A). The resultant scar is minimal and there is very adequate dependant drainage as the trephination is directed through the anterior-inferior aspect of the sinus. In addition this route best avoids posterior table penetration. Finally, because the bone of the floor is cancellous, not marrow containing, the chances of developing osteomyelitis are less, in contrast to incisions made through the anterior table, as that bone is marrow containing. The eyebrow incision will leave the least noticeable scar however the bone penetration is very thick at the supraorbital ridge. If endoscopic inspection or biopsy of the frontal sinus is contemplated, the above the eyebrow incision (Figure 2C) may be preferable. When the various incisions are made they should be medial and near the midline to avoid injury to supratrochlear and supraorbital nerves and vessels. If the resident in training or otolaryngologist has not had experience with trephination they should attend a cadaver sinus training course and practice the various approaches. Given the anatomic/developmental variability of the frontal sinus,¹¹ careful preoperative planning is required to prevent inadvertent penetration of the intracranial cavity.

In conclusion, the need for frontal sinus trephination is relatively uncommon. However, there is a need for the otolaryngologist-head and neck surgeon to be familiar with the indications and technique because frontal sinusitis demands immediate medical and sometimes surgical attention.

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