

Utility of Image-Guidance in Frontal Sinus Surgery



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KEYWORDS

• Frontal sinus • Frontal • Sinusitis • Rhinosinusitis • Image guidance • Navigation

KEY POINTS

- Image guidance is a surgical tool that is widely accepted by endoscopic surgeons and used in most frontal sinus surgeries.
- The use of image guidance can help identify critical structures and distorted anatomic landmarks, increasing the surgeon's confidence and ability to perform a more complete dissection.
- Image-guided placement of limited external frontal sinusotomy allows access to and management of frontal sinus disease that is beyond the endoscopic reach while avoiding the need for an osteoplastic flap.

BACKGROUND ON IMAGE GUIDANCE IN ENDOSCOPIC SINUS SURGERY

The use of image-guided surgery (IGS) in endoscopic sinus surgery (ESS) has expanded during the last 2 decades. A 2010 survey of American Rhinologic Society members¹ suggests that more surgeons have access to IGS and are using this technology in a greater percentage of cases compared with a similar survey conducted in 2005.² With respect to frontal sinus procedures, 71% of respondents thought there was a relative or absolute indication for its use in primary frontal sinus exploration, 96% in revision frontal sinus exploration, and 98% in modified Lothrop

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procedures.¹ Although it is well known that IGS is not a substitute for sound anatomic knowledge and clinical decision-making,³ it may help minimize the risk of injury by verifying the location of vital structures surrounding the paranasal sinuses and assist in a more complete clearance of disease. Logically, this would translate into fewer surgical complications and improved patient outcomes, the former of which was a conclusion of a recent meta-analysis of surgical cohorts with and without IGS in sinus surgery.⁴

Complication rates for ESS have been reported to range from 0.36% to 3.1%.⁵⁻⁷ Although all aspects of ESS can present challenges, surgery of the frontal sinus is the most technically demanding. The complex and varied anatomy, acute nasofrontal angle, and proximity to critical structures, such as the olfactory fossa, skull base, vascular structures (anterior ethmoid artery), and orbit contribute to the technical difficulty of frontal recess surgery. In addition, distorted anatomy from chronically inflamed mucosa and absent anatomic landmarks from prior surgery only add to the potential risk. However, IGS has uses well beyond simply avoiding complications. It can facilitate identifying the appropriate location for an external frontal trephine (or minitrephine), mapping an osteoplastic flap, or defining the extent of nasofrontal beak exposure before Draf III sinusotomy. Some procedures, such as an image-guided external biopsy of lateral frontal sinus disease, depend entirely on the IGS technology.

Image-guidance systems typically used in ESS can be either optically based or electromagnetic-based, and consist of a computer workstation, tracking system, and specially designed navigation instruments (**Fig. 1**). The patient's image-guidance compatible computed tomography (CT) scan, usually an axial noncontrast CT with 1 mm or thinner cuts, is loaded into the system either by CD-ROM or over a broadband network preoperatively. Once the image guidance is registered to the patient, intraoperative localization of a given navigation instrument is displayed in real time on the patient's preoperative CT in axial,

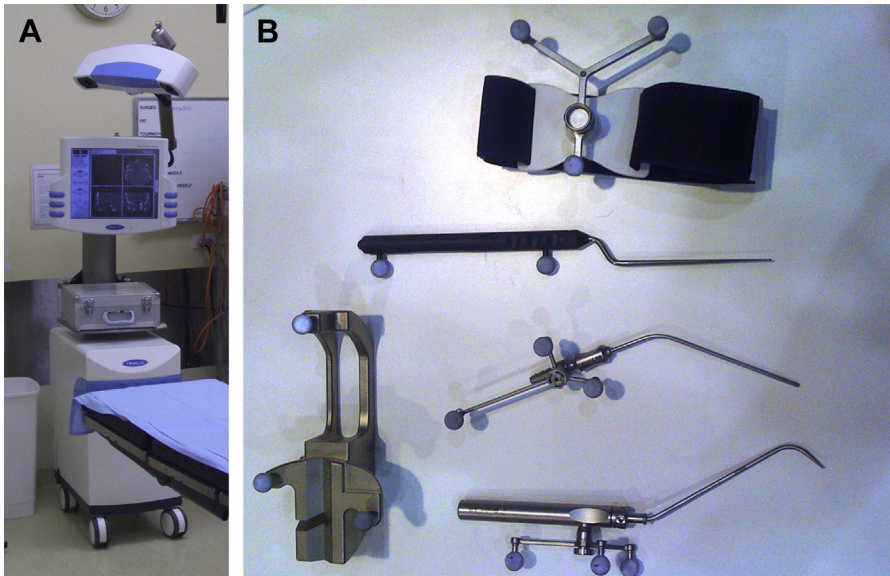


Fig. 1. Standard image guidance system used in ESS (A) with associated instrumentation (B).

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