

# Does Image-Guided Surgery Reduce Complications?



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## KEYWORDS

- Sinusitis • Endoscopic sinus surgery • Cerebrospinal fluid leak
- computer-aided surgery • Orbital injury • Surgical navigation
- Image-guided surgery

## KEY POINTS

- Routine use of image-guided surgery in functional endoscopic sinus surgery has not been definitively found to decrease risk of major complications.
- There seem to be significant benefits on the surgeon psyche that may translate into a decreased likelihood for adverse outcomes.
- Current recommendations for image-guided surgery use have been proposed (American Academy of Otolaryngology—Head and Neck Surgery) and endorsed by specialty societies (American Rhinologic Society); these general recommendations should be coupled with surgeon comfort/experience to determine if image-guided surgery is indicated on a case-by-case basis.
- Current literature does not support the routine use of image-guided surgery in endoscopic sinus surgery to minimize medicolegal liability.

## INTRODUCTION

Rhinosinusitis is a highly prevalent disorder with significant detrimental effects on quality of life<sup>1,2</sup> and often, unfortunately, does not completely improve with medical therapies. In these instances, endoscopic sinus surgery (ESS) is offered to patients. An estimated 350,000 sinus surgeries are performed annually in the United States, and this number seems to be increasing.<sup>3</sup> In fact, more than one-third of patients with chronic rhinosinusitis will undergo surgery within 6 months of their diagnosis.<sup>4</sup> Fortunately, complications from ESS are rare, with an estimated occurrence of less than 1% for major complications such as intracranial penetration, orbital injury, and massive hemorrhage.<sup>5,6</sup> Minor complications occur more frequently and are variably

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**Abbreviations**

ESS Endoscopic sinus surgery  
IGS Image guided surgery

defined. ESS may also be used to assist in approaches to more complicated disorders of the orbit and skull base, an application that is also gaining in popularity. Again, complications in these types of surgeries are also fortunately rare but can be devastating.

Simultaneously, image-guided surgery (IGS) has become popularized as an adjunct in many surgical procedures and is being used more often in ESS.<sup>7</sup> IGS is most often used by surgeons to help facilitate anatomic understanding during surgery, offering the ability to discriminate fine anatomic detail in multiple planes in real time. It has been hypothesized that the use of IGS in ESS would help the surgeon more reliably identify the anatomic boundaries of the dissection and, as a result, would be associated with a significantly lower complication rate. Unfortunately, the literature has not sufficiently shown this association, likely because of several factors. However, there are many compelling reasons to selectively use this technology, including the potential for a reduction in intraoperative complications. This review discusses the application of IGS in ESS to understand its current impact on intraoperative complications and critically understand available evidence supporting its use.

**CURRENT TECHNOLOGY AND USE**

IGS technology has improved dramatically over the last few decades, with smaller and more mobile platforms, quick setup time, and user-friendly interfaces. All of these features likely have contributed to its widespread acceptance and increased utilization. However, one of the most important factors in the prevention of complications may be the degree of accuracy obtained during registration. It is recognized that a reasonable target error in the 1.5- to 2.0-mm range is expected.<sup>8</sup> As such, it is imperative that this technology never be solely relied on to make intraoperative decisions—IGS should be used only to confirm or validate anatomic suspicion or help the surgeon reorient when visualization is suboptimal or anatomy is not straightforward (**Figs. 1–3**). This use would be in contradistinction to using the technology as a purely navigational tool. If IGS is relied on over anatomic knowledge or surgical experience, and registration is not 100% accurate, the surgeon may mistakenly have the confidence to make a maneuver along the orbit or skull base that may actually lead to a complication (see **Fig. 1**). In this hypothetical scenario, one could imagine that the use of IGS may actually unfavorably impact complication rates, as its use may confer a false sense of confidence leading to more aggressive dissection in risky areas. In fact, one published study reported trainees using IGS seemed to trust the navigation system more than 90% of the time and demonstrated a significantly increased willingness to take risks when using the navigation system.<sup>9</sup>

When is IGS used? Expert opinion and clinical experience suggest that it is not necessary to use IGS in a routine fashion, but rather to consider its use in cases outlined by the American Academy of Otolaryngology—Head and Neck Surgery (AAO-HNS) published guidelines (**Box 1**).<sup>10</sup> A recent survey of members of the American Rhinologic Society in 2010 found that 95% of respondents had access to IGS. Interestingly, and perhaps not surprisingly, this percentage represented a significant increase in utilization as reported in a similar survey published in 2005.<sup>7</sup> However, these are data from a subspecialty society survey with a 27% response rate, so these numbers may represent a select population of surgeons and practice patterns. An ambulatory surgery database review from

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