

IMAGE-GUIDED SURGERY

Kevin C. Welch, MD

INTRODUCTION

Rhinologists perform procedures with the aid of telescopes and cameras to magnify and illuminate the nasal and sinus tissue. Surrounding the sinuses are organs that are vital to a person's health and well being. The most important structures surrounding the sinuses are the eyes, the tear ducts, the optic nerves, the brain, and carotid arteries. While years of training, knowledge of anatomy, and skill are vital to an understanding of anatomy, a tool known as image-guidance allows surgeons to know almost precisely where any given structure is within the nose and sinuses at any given point during surgery.

IMAGE-GUIDANCE "SCIENCE"

The term "image-guidance" refers to the use of a probe, which is generally placed within the nose, that is tracked by a machine as that probe moves through the nose and sinuses. A computer, which is either physically or remotely attached to that probe, provides the surgeon with a map of the nose and sinuses. This map is provided by a CAT scan or and MRI, which is performed prior to your surgery. This CAT scan or MRI is commonly referred to as a "image-guidance scan."

In some respects, image-guidance is similar to a GPS system, constantly calculating the position of the probe within a patient's nose and sinuses and displaying that location on a "3-dimensional" layout of the sinuses provided by the patient's own CAT scan or MRI. Unlike GPS systems in your car, image-guidance tools don't tell surgeons where they can go, rather, it gives them a very precise knowledge of where they are.

There are two types of image-guidance systems commonly used today. Both systems perform the same functions; however, the technology they use to provide the information to the surgeon is very different. In all cases, a device is attached to the patient. This device is known as a head frame, a mask, or



Infrared (Optical) Systems: These systems use infrared sensors in combination with light-emitting diodes or passive reflectors that are fixed to the patients head (e.g., via a headband strap or sticker) and fixed to a handheld probe. Both the headband and the instrument must be simultaneously "seen" by the computer in order to track where the surgeon's instrument is within the sinuses.

Electromagnetic Systems: These systems employ electromagnetic field arrays that use as reference points a device attached to the patient's head (a plastic mask with metallic beads or headband) and a wired instrument that the surgeon uses within the nose and sinuses. Unlike optical systems, electromagnetic systems do not have to be "seen" by the computer. Unlike optical systems, excess metal within the electromagnetic field can cause inaccuracies.



IMAGE-GUIDANCE IN ACTION

Image-guided systems are used for a number of surgeries. The following is a list of some surgeries that might benefit from image-guided surgery

- Primary sinus surgery
- Revision sinus surgery
- Sinus surgery when polyps are present
- The removal of sinus tumors
- CSF (brain fluid) leaks
- Optic nerve decompression
- Surgery on the pituitary gland



ADVANTAGES

The advantages of such systems are obvious: they can help surgeons know the precise anatomy of each patient's nose and sinuses and help identify important landmarks during surgery.

DISADVANTAGES

All patients must undergo a CAT scan or an MRI in order to use image-guided surgery. For some, this can mean an extra dose of radiation or for patients who are claustrophobic, time spent in a long tube (MRI only). Additionally, these computer systems can be susceptible to human error in use.

CONCLUSIONS

Image-guided surgery has been a tremendous advance in the field of endoscopic sinus and tumor surgery. The overwhelming consensus is that image-guidance makes some surgical procedures safer and more complete. You will have to discuss with your surgeon whether you would be a candidate for image-guided surgery during your surgical procedure, as not all endoscopic procedures require this technology.



Revised 7/2011
©American Rhinologic Society