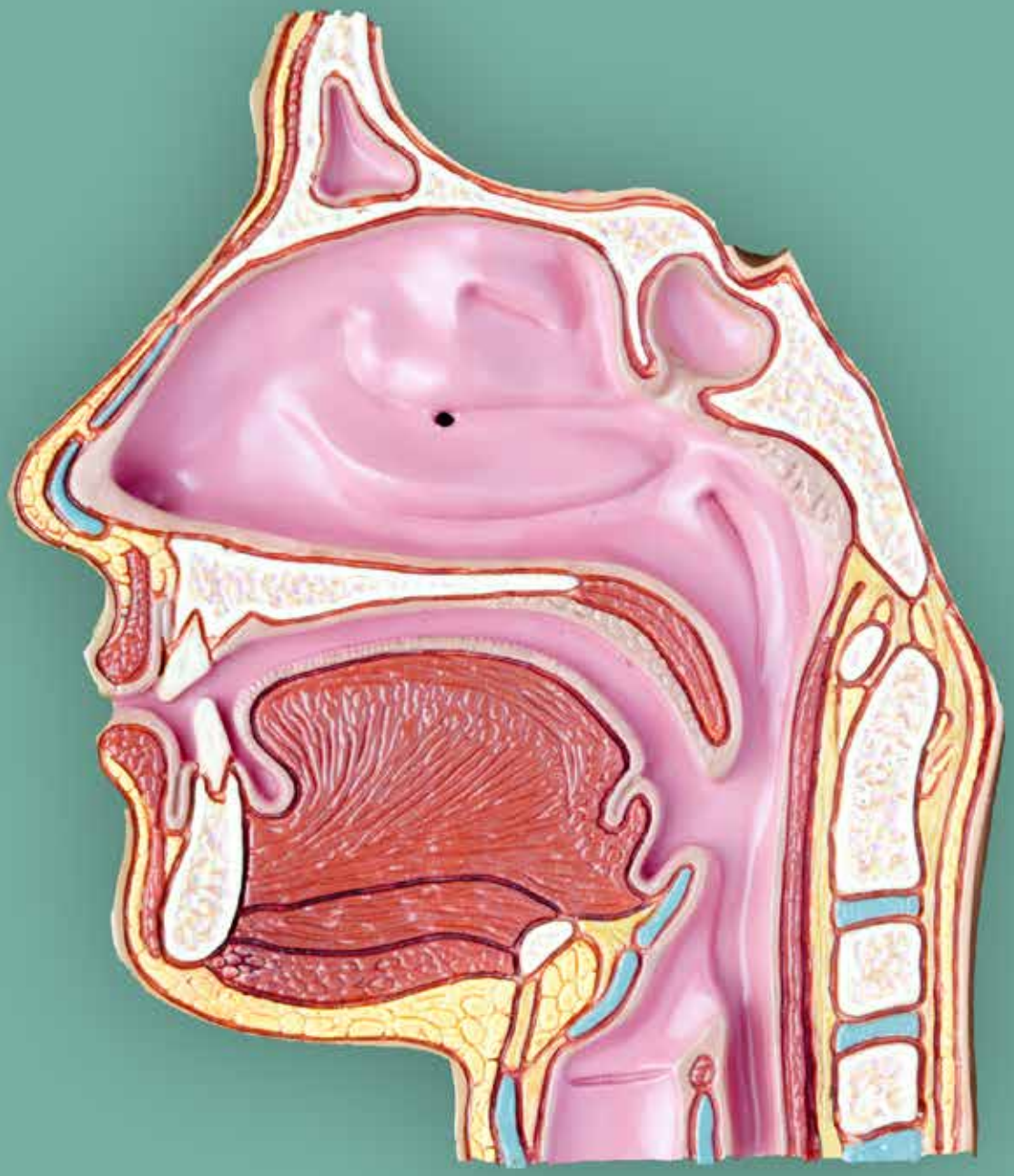

Functional Endoscopic Sinus Surgery with Image-Guided Navigation

Kendra G Ray, cst

Image-guided technology dates back to the mid-1900s, and surgically based, computer-navigated imaging systems were birthed in neurological surgeries long before otolaryngologists discovered the benefits of such a system for sinus surgery. Today image-guided surgery assists in confirming what the surgeon may already speculates and gives him or her a comprehensive map for surgical intervention.

The beginning of image-related diagnosis and treatment began roughly 100 years ago when X-rays were discovered. Although surgery came years before the X-ray, this new development gave doctors an anatomy map of the diseased portion so he or she could what they were about to cut into to. As technology evolved, so did the operating room, thus bringing together computers, electromagnetic/infrared systems, CT scans and the knowledge of the surgeon forming state of the art patient care.

Today's computer image-guided surgery system works by correlating a map of the patient's anatomy using a CT or MRI scan of the patient with a steri-static performing head registry and subsequently integrating the instruments used in the surgery. The instruments then operate like a GPS reflecting their placement as images seen on the computer monitor showing exactly where the surgeon is working.

There are essentially two types of image-guided systems. One is called an infrared system which uses LEDs or reflectors that must be seen or read by the computer in order to track the surgery. The second

LEARNING OBJECTIVES

- Eearn about the history of image-guided technology in surgery
- Examine the anatomy of the nasal cavity
- Explore the potential complications of functional endoscopic sinus surgery
- List the equipment and instruments needed for this procedure
- Review the steps of FESS

type is an electromagnetic system that employs a magnetic field to register reference points on the patient. Although the electromagnetic system does not need to be seen by the computer to track the surgery, it requires wires and a large amount of metal in the magnetic field that can cause a skewed reading.

The purpose of image-guided technology in Functional Endoscopic Sinus Surgery (FESS) is to clarify complex anatomy in select cases. Although this technology is at the discretion of the surgeon and facility, it is typically used for sphenoid, frontal and posterior ethmoid surgeries. Candidates for FESS using image-guided systems generally are patients with previous surgeries that may need revision, or those with any distorted anatomy due to abnormal anatomical landmarks, polyps, benign or malignant neoplasms or CSF leaking.

DIAGNOSIS

Diagnosis of a patient for potential sinus surgery begins with an examination of the ear, nose and throat to determine what is causing the pathology. Depending on the relationship to allergy, infection or obstruction, X-rays, blood or allergy tests may be required as well as a CT scan. Sinus surgery, although safe, generally is the last resort and performed when maximal medical therapy has failed, typically when the patient has chronic sinusitis. After the diagnosis but before surgery, CT images are taken and downloaded into the IGS where the patient's CT scan is displayed onto a monitor in axial, sagittal and coronal positions. These views give the surgeon the capabilities to create a surgical trajectory in the same way an astronaut or pilot would create a flight plan. Today's state-of-the-art technology allows precision within 2mm and is intended as an aid during surgical procedures to locate anatomical structures that may otherwise be skewed. Furthermore, the system tracks the placement of instruments in real-time projecting the image on the monitor, thus showing the surgeon exactly where the instruments are located in the sinus cavity.

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PREOPERATIVE FIELD AND SET UP

The equipment used is dependent on a surgeon's and facilities' preference. In this case preparation of such a surgery requires the following equipment, supplies and instruments needed to facilitate a thorough and inclusive surgery.

SURGICAL PREPARATION

Following a routine timeout initiated by the circulating nurse, the patient is placed under anesthesia. A tracker is strapped to the forehead of the patient where the IGS registers the instruments. A mobile emitter is attached to the OR bed pointing directly at the patient's nose at 15 to 25cm in distance to insure trackers are inside the electromagnetic field to record placement and display viewing on the monitor. No skin prep is necessary as the nasal area is considered clean contaminated.

Per the preference of the surgeon, the patient will be injected with 1% lidocaine epinephrine injection into the septum, turbinates and any polyps. The nasal cavity will be packed with pledgets soaked in 0.25% bupivacaine hydrochloride and epinephrine 1:1000 mixed 50/50. Ten minutes will need to pass to ensure the epinephrine will be effective in vasoconstriction. During this time, the surgical tech will drape three towels in triangulation across the patient's mouth and alongside each ear exposing the nose, eyes and forehead area. A split sheet drape will be placed on the patient and all suction, the camera, straight shot cords and IGS equipment will be put in place.

SURGICAL INTERVENTION

To begin the procedure, the surgeon will use the IGS tracing instrument to register the patient tracker with the instru-

ments. The transmitter and CT images of the patient will be synchronized with the patient and projected onto the computer monitor. All pledgets will be removed from the nasal area and placed in the bupivacaine/EPI emesis basin.

Many times septoplasty and bilateral turbinate reduction will be performed in conjunction with endoscopic sinus surgery due to a deviated septum and enlarged turbinates which cause obstruction. A #15 blade will be used to incise the septum followed by a Cottle knife to elevate the lining of the septum. The surgical technologist will provide suction using a Frazier suction tip. The surgeon will then take a swivel knife, Jensen Middleton forceps and Takahashi or Farris Smith forceps to remove any deformed cartilage from the septum. A camera will be employed to examine the middle meatus identifying the uncinate process, which is located along the wall of the maxillary sinus articulating with the ethmoid process. Sometimes, the uncinate will be removed with a microdebrider or trimmed using a 45-degree up-biting through-cut forceps to open a pathway to the ethmoid sinus or ethmoid bulla as well as to provide easier access to the maxillary sinus. In this case, a bilateral middle meatal antrostomy, BMMA, is performed by first probing the area with an ostium seeker to find the natural sinus ostia of the maxillary sinus. A back biter forceps, Stammberger forceps or straight through-cuts will be placed in the sinus ostia and tissue will be removed to enlarge the opening. According to Dr Brennan Wood, Medical Director of Northeast Georgia Otolaryngology, "This connects the sinuses allowing them to communicate thus providing better drainage."

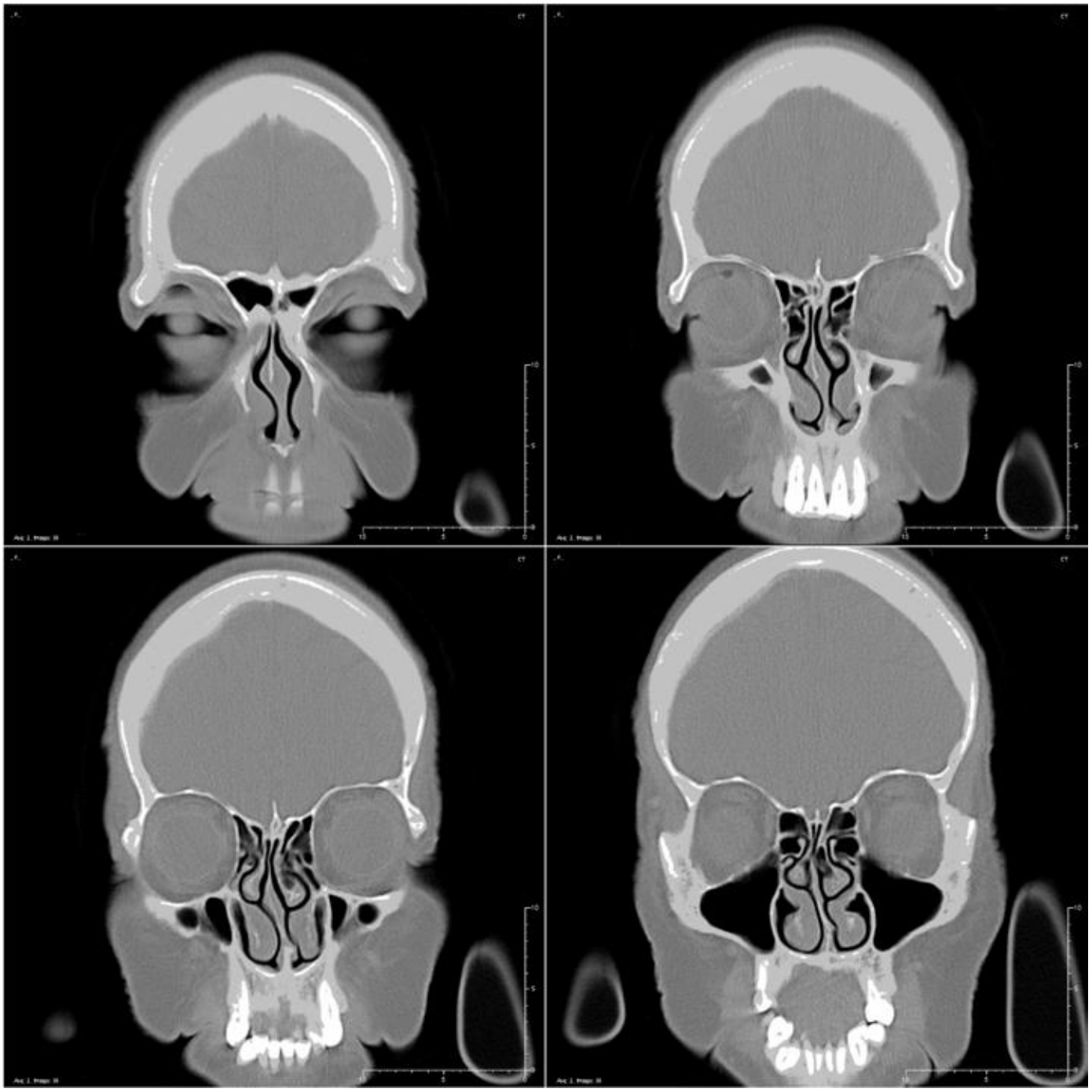
It is common that without this method, sinus surgery may fail. After a typical BMMA is performed, the lateral boundary of the sinus will be determined and the ethmoid sinus will be examined. Many times, however, once the uncinate has been removed, the surgeon has a clear pathway to the ethmoid for examination of any polyps or diseased portion of the sinus. This type of progression of treatment is strictly based on surgeon preference and type of case. From here an ethmoidectomy, sphenoidectomy and frontal sinusotomy may be performed. Using the IGS integrated with the microdebrider, the location of the instrument is registered on the monitor in relation to the patient's anatomy. This provides the surgeon with valuable information including the location of the eyes, skull base and optic nerve. In regard to the frontal sinus the introduction of a balloon to dilate the sinus may be used in lieu of a sinusotomy.

Research studies conducted by Ron Van Tuyl, MD, of Piedmont Hospital have shown that the hybrid method using both the balloon system coupled with the microdebrider provides better post-operative results than either system alone. Polyps also may be removed using the microdebrider or up-biting Blakesley forceps. A standby long bi-polar forceps or a suction Bovie may be used for any excessive bleeding.

When the turbinates of the nasal cavity are swollen, the surgeon will incise the middle turbinate using a #15 blade and employ a special microdebrider blade to create scaring on the inside of the middle turbinate and along the septum. A Freer elevator or Boise elevator will be employed to press the middle turbinate against the septum. The goal will be to encourage the turbinate to heal to the septum in a manner called Bolgerization. Some ENT surgeons use

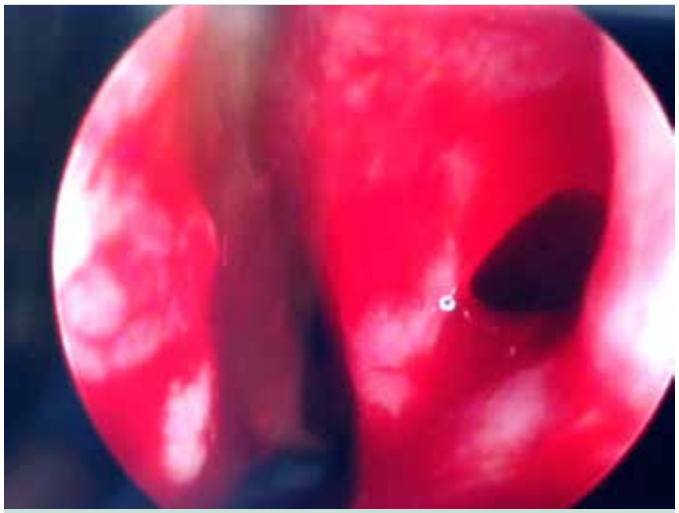
EQUIPMENT & INSTRUMENTS
System monitor and emitter
Camera, lens, monitor and light source
Straight shot microdebrider system with tracking blade system
On stand-by: hydrodebrider system and electrosurgical unit
Nasal tray and sinus tray
System monitor and emitter
Patient tracker
Instrument tracker
Electromagnetic balloon system

SUPPLIES
Basic ENT Pack
Doyle splints, nasal packing, packing gel, hemostatic powder or propel stents
Medications: Bupivacaine hydrochloride- and epinephrine-soaked pledgets, lidocaine epinephrine injection
Suture
Saline and sterile water
System monitor and emitter
Patient tracker
Instrument tracker
Electromagnetic balloon system

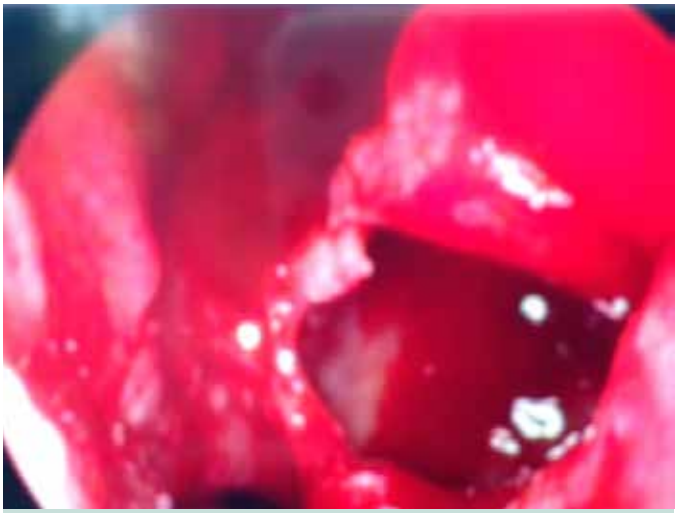


polypropylene suture to stitch the turbinates to the septum, which assists in keeping them in place. This form of a submucous resection serves as an invasive way of shrinking the turbinates without affecting the anatomy. Ultimately, it allows more space for air flow. Once the ethmoid sinuses have been debrided, the surgeon will ensure that there is no lateralization of the middle turbinates obstructing the ethmoids. Lawerence Robinson, MD, recommends the employment of an absorbable mesh that releases anti-inflammatory properties during a six-week period and used in lieu of suture.

With regard to treating the inferior turbinates, Michael Callahan, MD, suggests performing a submucous resection on the inferior turbinates by removing the front third of the turbinate with through-cut forceps and a suction Bovie. A bioresorbable nasal packing is placed. Using a



Before MMA



After MMA

Coblator wand to resect the submucous is another method of treating the turbinate to help prevent scaring.

Throughout the surgery irrigation and suction will be ready and available as needed while bupivacaine hydrochloride and epinephrine-soaked pledgets will be packed to maintain hemostasis. Kennedy packs, along with a packing gel, may be used to serve as a stent while the sinuses heal. A hemostatic powder may be used to control bleeding.

The surgeon will close the incision at the septum using a 5-0 plain cut fast absorbing suture. Doyle splints may be placed in the septum to re-approximate the septal flaps while healing.

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POST OP AND RECOVERY

Post-operative procedures in the PACU consist of monitoring the patient for any pain, bleeding or breathing difficulties as well as checking vital signs. All information, intervention and patient outcome will be documented along with discharge instructions. Most patients are discharged within an hour of the procedure. Typically, patients will be seen for a follow up by the ENT in five days. Any temporary packing that is not absorbable will be removed at that time to keep from any infection developing.

CONTRAINDICATIONS OR POTENTIAL COMPLICATIONS

Potential complications of functional endoscopic sinus surgery using an image-guided system may include any medical condition that may contraindicate the sinus surgery itself. Complications that are specific to this procedure include intracranial injury or CFS leaking, potential damage to the orbital tissue, orbital hematoma, an impaired sense of taste and smell or scar obstruction.

Middle turbinate

Many practices that have its own ambulatory surgery center maintain policy criteria as a guideline to these surgeries. It is recommended that surgery centers properly screen their patients for the eligibility of these Medicare regulations. Any FESS surgery in an ambulatory setting would not be recommended in which a patient would be categorized as a class 4 by anesthesia criteria. Furthermore, any surgery taking place in an ambulatory setting requiring general anesthesia must follow these criteria.

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ABOUT THE AUTHOR

Kendra Ray, CST, earned her Bachelor of Science degree from Carson-Newman University in Jefferson City, Tennessee, in 1989. After raising a family she completed a certification in surgical technology from Lanier Technical College in Gainesville, Georgia. She is currently employed by Piedmont Mountainside Hospital serving the Northern Atlanta Metropolitan area and Limestone Surgery Center in Gainesville serving Northeast Georgia Otolaryngology.

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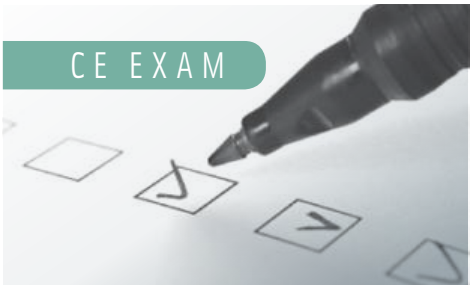

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1. Image-guided technology dates back to the mid-_____.
a. 1600s
b. 1700s
c. 1800s
d. 1900s

2. Typically, patients will be seen for follow up within ____ days.
a. 2
b. 5
c. 6
d. 10

3. Due to a deviated septum, what other procedure is performed in conjunction with endoscopic surgery?
a. Septoplasty
b. Nasal Valve Surgery
c. Rhinoplasty
d. Balloon sinusplasty

4. A____ will be used to incise the septum.
a. #10 knife
b. #15 blade
c. #3 handle
d. #12 blade

5. After the surgeon removes any deformed cartilage from the septum, a camera will be employed to examine the _____.
a. Maxillary sinus wall
b. Turbinates
c. Ethmoid sinus
d. Middle meatus

6. Complications that are specific to this procedure include:
a. Intracranial injury
b. Damage to the orbital tissue
c. Infection
d. A and b

7. Today's state-of-the-art-technology allows surgeons to be precise within ____.
a. 0.5 mm
b. 1 mm
c. 2 mm
d. 3 mm

8. A surgeon will use a special microdebrider blade to create scaring on the inside of the _____ and along the septum.
a. Nasal cavity
b. Inferior turbinate
c. Middle turbinate
d. Septum

9. The surgeon will close the incision at the septum using a ____ plain cut fast absorbing suture.
a. 5-0
b. 4-0
c. 3-0
d. 2-0

10. The nasal area is considered _____.
a. Contaminated
b. Clean
c. Clean contaminated
d. None of the above

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