A Roundtable Discussion: Advances in Endoscopic Sinus Surgery

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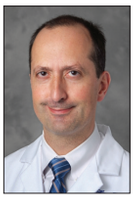

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Program Overview

This newsletter will explore minimally invasive surgical techniques under endoscopic guidance that are used to treat polyposis and other conditions such as chronic rhinosinusitis and benign sinonasal tumors as discussed in an educational roundtable with expert faculty in the fields of rhinology and otolaryngology.

Target Audience

This program is intended for otolaryngologists responsible for the care of patients requiring endoscopic sinus surgery.

Learning Objectives

After completion of this activity, the participant should be able to:

1. Compare the need for endoscopic versus standard sinus surgery in patients with rhinosinusitis
2. Distinguish between the benefits and limitations of newer instrumentation used to perform endoscopic sinus surgery
3. Explain the rationale for adopting new instrumentation for endoscopic sinus surgery
4. Describe clinical outcomes seen with endoscopic sinus surgery

Accreditation

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Introduction

A roundtable discussion recently took place with thought leaders in the fields of rhinology and otolaryngology who use powered instrumentation to perform endoscopic sinus surgery.

This report will summarize the content of that discussion and describe 3 surgical advances in endoscopic sinus surgery: the powered microdebrider, Coblation®, and image guidance.

Applications of Functional Endoscopic Sinus Surgery

Each year approximately 31 million Americans are diagnosed with chronic rhinosinusitis,[1] leading to roughly 500,000 surgical procedures of the paranasal sinuses[2] and direct annual health care costs of $5.8 billion.[3] Symptoms of the condition can be debilitating and lead patients to seek medical care to find relief. These symptoms include[4]:

- Mucopurulent drainage (anterior, posterior, or both)
- Nasal obstruction (congestion)
- Facial pain and pressure
- Decreased sense of smell
- Inflammation
- Purulent mucus or edema in the middle meatus or ethmoid region
- Polyps in the nasal cavity of the middle meatus

Treatment of chronic rhinosinusitis ranges from watchful waiting and observation to conservative medical approaches such as the use of topical and systemic antibiotics, oral and topical steroids, topical and systemic decongestants, antihistamines, mucolytics, and leukotriene modifiers.[4] Functional endoscopic sinus surgery is an alternative for patients when conservative treatment fails.

Since the introduction of endoscopy in the United States in 1985,[5] endoscopic sinus surgery techniques have evolved rapidly.[6] With advancements in instrumentation, endoscopic sinus surgery has emerged as a method to treat paranasal sinus disease refractory to medical treatment with minimal tissue trauma. In this application, the goal of endoscopic sinus surgery is to restore ventilation and mucociliary drainage while preserving as much healthy mucosa as possible.[7]

Another application of functional endoscopic sinus surgery is the removal of malignant sinonasal neoplasms and benign sinonasal tumors, such as juvenile nasopharyngeal angiofibromas (JNAs).

JNAs are highly vascular, benign head and neck tumors that are traditionally treated with embolization before resection using either open surgery or, when appropriate, an endoscopic technique.[8]

The introduction of instruments, such as the microdebrider, Coblation, and, more recently, image guidance for sinus surgery represents advances that enable surgeons to adapt and modify their surgical techniques to minimize complications without compromising patient outcomes (**Table 1**). Despite these advances in instrumentation and technology, complications in endoscopic sinus surgery still arise, albeit at a low rate for major complications.[9] One meta-analysis of complications of endoscopic sinus surgery—defined as a minimally invasive technique using an endoscope to restore nasociliary clearance of mucus, drainage, and aeration of sinuses—compared with other surgical treatment methods for the excision of nasal polyposis reported a range of overall complication rates from 0.3% to 22.4% (median 7.0%). Major complications ranged from 0% to 1.5% (median 0%), and minor complications ranged from 1.1% to 20.8%.[10] Results of other studies have estimated overall complication rates for endoscopic sinus surgery range from 2% to 17%.[11,12] However, the systematic collection and reporting of complication rates in endoscopic sinus surgery is highly variable due to the lack of an objective system for determining when a complication is considered minor or more significant.[6]

Table 1. Complications in Endoscopic Sinus Surgery[9]

Major Complications (Incidence range: 0% to 1.5%[10])
Cerebrospinal fluid leaks
Ocular injury
Orbital hemorrhage
Extraocular muscle injury
Intracranial injury
Minor Complications (Incidence range: 1.1% to 20.8%[10])
Epistaxis
Synechia
Antrostomy closure
Anosmia/hyposmia
Nasolacrimal duct injury
Periorbital emphysema
Pain

The Powered Microdebrider

Introduced to endoscopic sinus surgery in 1992, the microdebrider is an electrically powered tool that combines a small, hollow, rotating blade with continuous suction.[7] The microdebrider has no hemostatic capabilities, thus an adjunct device is required to stop bleeding. It features a blunt outer sheath that protects the blade and reduces the risk of inadvertent tissue trauma.[7] Originally designed for small-joint arthroplastic surgery, the microdebrider was later used for temporomandibular joint surgery and has been found useful for removing abnormal nasal and sinus mucosa and the thin bone of the ethmoid sinuses.[13]

Although direct comparisons of the microdebrider and other traditional methods of sinus surgery are few, the microdebrider is considered to offer advantages over traditional instrumentation, such as Blakesley instruments and rongeurs, including improved precision, better visualization, and less trauma to surrounding tissues.[14] Routinely used in many sinus surgeries, the microdebrider has also been used to treat the following nasal conditions in children and adults[14]:

- Enlarged/diseased adenoids (via the transnasal route)
- Obstructive scar tissue from failed repairs of choanal atresia
- Nasal papilloma
- Nasal polyps
- Obstructive adenoids extending into the nose

Although major complications with any endoscopic sinus surgery are rare,[10] complications with the microdebrider, when they do occur, can develop quickly.[5] In addition to the complications associated with endoscopic sinus surgery in general (**Table 1**), reports of other deleterious outcomes have emerged including injuries complicated by aspiration of adjacent structures, such as the dura, periorbita, and underlying brain, muscle, or fat tissue, as well as muscle injury to the medial rectus muscle.[5]

Coblation

Coblation technology enables rapid and controlled removal of tissue at relatively low temperatures (typically 40°–70°C) while maintaining the integrity of surrounding tissue or structures. It was approved by the US Food and Drug Administration in 2003 for ablation, resection, and coagulation of soft tissue and hemostasis of blood vessels in otorhinolaryngology surgery. The benefits of Coblation technology have led to its adoption in a wide range of surgical specialties, including arthroscopy, spine and neurosurgery, otolaryngology, urology, oncology, gynecology, and laparoscopy/general surgery.[15-21] Today we see a growing use of this technology in other otorhinolaryngological procedures including pediatric and adult turbinate resection, especially in relationship to sleep-apnea issues, as well as polypectomy, partial glossectomy, and uvulopalatopharyngoplasty.[23-25]

Practical Considerations to Adopting New Technologies in Sinus Surgery—What the Experts Think

Dr. Zacharek: We're talking about operating in a confined space within the paranasal cavity. The location of the orbit, skull base, carotid artery and optic nerve must be considered when utilizing any new technology.

Dr. Roth: We know the general concepts of endoscopic sinus surgery and the goals we're looking for. Obviously, we want to keep our high levels of outcome. We want endoscopic sinus surgery to be secure, direct, safe, and bloodless. Every time we have a new advance in technology, we want to keep a high level of outcome, but we want to continue to make the operations safer, easier, trainable, and more enjoyable for patients and physicians.

The microdebrider was a major advance when it came out in the '90s mainly for 2 reasons: one, it combined multiple functions within one tool. So it was a suction dissector. With a suction dissector, it's almost like you had a third hand. You didn't need to have a 2-handed technique when operating. Also because it was mucosal sparing, my outcomes were better and postoperative management was easier.

Comparing the Coblation device to a microdebrider, they both suction, they're both dissectors, but the Coblation device really has superior hemostasis. Even though I haven't compared it to other microdebrider devices, and there is one or more that does have a hemostatic component, I never found one that had the same hemostatic properties as the Coblator does. So now I have a third function on my device tool.

Coblation: Moving From Theory Into Practice—What the Experts Say

Dr. Zacharek: There is a need for prospective outcomes data in patients, in those patients with nasal polyposis and those patients with benign sinonasal tumors and potentially other malignancies. The patient selection honestly has yet to evolve where and how far we can take the technology.

Dr. Roth: Coblation does not change anything in the principles of physiology, the principles of sinus treatment, or medical therapy. It's a device that's being applied to current concepts in sinus surgery, but it's not really changing our general concept of sinus surgery.

Dr. Benninger: I've used Coblation very sparingly on the free margin of the vocal folds without any injury, but I haven't done any deep dissection on the free marginal vocal folds. I think it's probably relatively safe. I think there's still a little bit to do before I could say that it's justifiable to remove small benign lesions from the free margin of the vocal folds. The real question is, unlike in the sinuses where there's clearly an advantage in terms of bleeding, I'm not sure there's an advantage over microdissection in the larynx.

Dr. Ruiz: When we're talking about Coblation, we're not talking about a different procedure. We're still talking about functional endoscopic sinus surgery. We're talking about a tool or a device to get to that means. So there's really no difference in the preoperative or postoperative management of the patient.

As we all know for some patients, regrowth of the polyps may occur postsurgery, regardless of the technique or device used. Ideally we want to manage them medically, however, they may require revision surgery. In some of my patients with small recurrent polyps, not necessarily those who originally underwent Coblation, I have managed them in the office setting with Coblation.

Coblation differs from traditional electrocautery in that it uses plasma-based radiofrequency technology to vaporize tissue at temperatures of only 40° to 70°C. Unlike electrocautery, which uses temperatures in the range of 400° to 450°C[21,26], Coblation produces minimal thermal penetration, with minimal dissolution or burning of surrounding healthy tissue (**Table 2**).[27] Coblation applies a radiofrequency current to a conductive medium, predominantly saline, that excites the electrolytes and molecules in the solution to create a high density energy field (referred to as a localized plasma field) of sodium ions around the electrodes. The ions break down intercellular bonds in soft tissue and produce conditions capable of dissolving tissues. The presence of irrigating saline limits the amount of heat delivered to the surrounding tissues.[19,26]

This low-temperature approach may benefit patients in several ways by[21,28]:

- Limiting unnecessary prolonged exposure of tissue to high levels of power
- Reducing the risk of thermal collateral tissue damage
- Preserving tissue quality
- Minimizing pain during recovery

Coblation has been proven safe for otorhinolaryngology surgery, with minimal complications.[21,23,24]

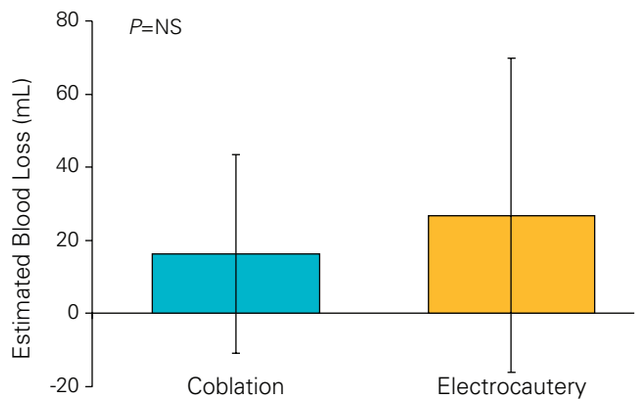
Intraoperative bleeding during otorhinolarygological procedures can be a concern for a number of reasons and should minimized as quickly as possible. Compared with traditional instrumentation such as cold dissection and more recently with electrocautery,

Table 2. A Comparison of Coblation and Conventional Electrocautery

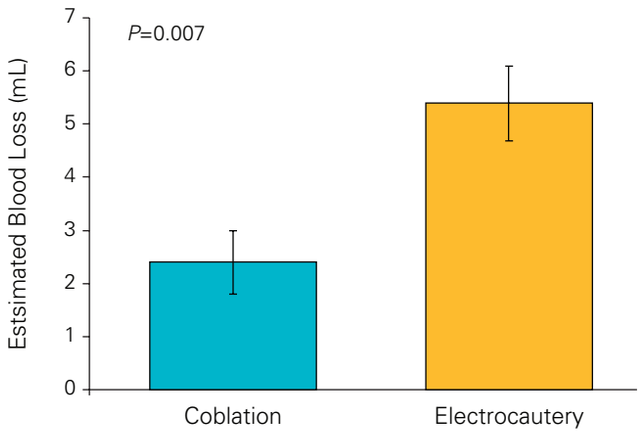
	Coblation Devices	Conventional Electrocautery Devices
Mechanism of action	Molecular dissociation: via a focused plasma field	Cellular rupture: via electricity arcing into the tissue
Temperatures	40°–70°C	>400°–600°C
Depth of penetration	Minimal	Deep
Collateral tissue damage	Minimal	Significant

Coblation has been associated with decreased estimated blood loss during pediatric and adult tonsillectomy,[29-34] adenoidectomy,[35] and in a recent pilot study, during endoscopic sinus surgery.[36] (**Figures A–C**)

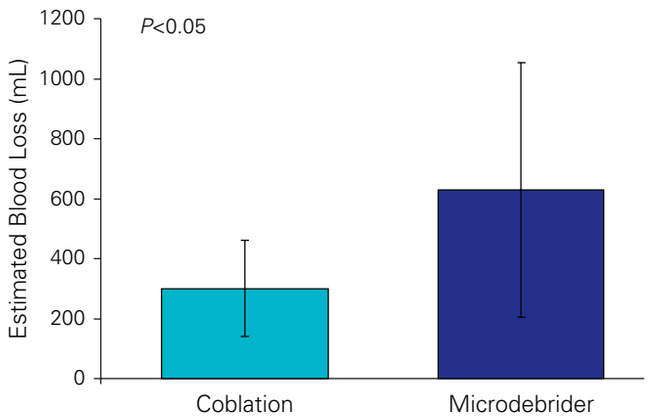
A. Estimated blood loss in pediatric tonsillectomy[33]



B. Estimated blood loss in adult tonsillectomy[34]



C. Estimated blood loss in adult endoscopic sinus surgery[36]



Outcomes of Coblation-Assisted Sinus Surgery— What the Experts See

Dr. Zacharek: We've been involved with animal studies including a rabbit and sheep study. Additionally, there's accumulation of some evidence from others who have used the Coblation wand in patients. We used the Coblation technology in an animal model to determine how the Coblation energy affects normal healthy tissue. We also wanted to determine how Coblation affects mucosa as dependent on the time or length of time of the energy applied to the mucosa. Our conclusions are that the Coblator may be safe in the paranasal sinuses. As to the physics and effects of Coblation energy on the periorbita and rectus muscles, further study is necessary.

Dr. Benninger: We've done 2 animal studies and a third has recently been completed in sheep. One was a dog study looking at the safety of Coblation on dog larynges and then we did another study looking at the safety in relationship to the paranasal sinuses in rabbits and, more recently, we looked at the impact of Coblation in paranasal sinuses in sheep.

One of the things we noticed in the rabbit study was a clear demarcation of the zone of injury. In addition, we had no bleeding. After surgery, the rabbits were responsive, we did not have to give them postoperative pain medications, they didn't have any nasal obstruction, they had no change in gross acuity of their vision or loss of extraocular motion or any propulsion or retrusion of the eye.

Currently, [in humans] I'm using Coblation not on the free margin of the vocal fold because I don't use the laser on the free margin of the vocal fold anyway, but I am using it for papilloma in the supraglottic structures. It's much more rapid than using a microdebrider because you don't have any bleeding.

Dr. Ruiz: We conducted a pilot study [in humans] comparing estimated blood loss using Coblation-assisted sinus surgery with traditional microdebrider technique in patients with nasal polyposis undergoing endoscopic sinus surgery. The important thing is that we've actually found statistically significant less blood loss comparing the Coblation-assisted polypectomy versus microdebrider alone or traditional polypectomy.

Continued on next page

Outcomes of Coblation-Assisted Sinus Surgery—What the Experts See (con't.)

The other thing that was interesting was that there was no difference in the overall surgical time. The difference in actual surgical time, even when comparing similar staging systems, was not statistically significant. Not only do you have an overall estimated blood loss that is less, but you also have less blood loss per minute of surgical time, which makes sense if you combine the idea of estimated blood loss overall being less and surgical time being the same. But typically with polyps compared with any other sinus surgery, you'll have an increase in blood loss per minute of surgical time.

Dr. Roth: I began using the Coblator for bipolar suction cautery as opposed to monopolar for the treatment of epistaxis to decrease the potential risk of surgical fire. I already had extensive experience with the device for tonsillectomies. Then I started using Coblation for resecting polyps during endoscopic sinus surgery and for additional bipolar cautery when needed. I expanded my indications for Coblation to disease states that I suspected would be associated with increased vascularity such as cystic fibrosis and inverted papilloma. Now I use the Coblator regularly during endoscopic sinus surgery. I've never had a major complication using Coblation for endoscopic sinus surgery although the potential for complications is as real as any device applied to sinus surgery.

Image-Guided Endoscopic Sinus Surgery

Initially developed for use in neurosurgery, image guidance is a significant advance now being applied to endoscopic sinus surgery. Image guidance during endoscopic sinus surgery provides a real-time correlation between the operative field and preoperative imaging.[37]

Image-guided endoscopic sinus surgery incorporates a preoperative imaging data set, often a computerized tomographic slice, that is uploaded to a workstation. The data set is then correlated with the position of the instrument in the surgical field during actual surgery. This allows the surgeon to identify anatomic landmarks and monitor the position of surgical tools during surgery.[37] The use of such navigation systems has increased the safety of sinus surgery when performed near vital structures, significantly reducing the risk for iatrogenic trauma.[38]

The American Academy of Otolaryngology–Head and Neck Surgery (AAO-HNS) advocates the intraoperative use of image-guided surgery in appropriately selected cases to assist the surgeon in clarifying complex anatomy during sinus and skull base surgeries.[39] The AAO-HNS identifies the following situations for which image guidance may be useful:

- Revision sinus surgery
- Distorted sinus anatomy of development, postoperative, or traumatic origin
- Extensive sinonasal polyposis
- Pathology involving the frontal, posterior ethmoid, and sphenoid sinuses
- Disease abutting the skull base, orbit, optic nerve, or carotid artery
- Cerebrospinal fluid leaks or conditions where a skull base defect exists
- Benign and malignant sinonasal neoplasms

Summary

Recent advances in instrumentation and technology have enabled surgeons to perform endoscopic sinus surgery with few complications while preserving healthy mucosa. The microdebrider, Coblation technology, and image-guided surgery represent 3 recent surgical advancements for the treatment of patients with sinus disease. Additional prospective clinical trials are needed to more fully examine the advantages of these new approaches to sinus surgery compared with other traditional techniques.

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A Round-table Discussion: Advances in Endoscopic Sinus Surgery

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Test Questions

Pre-Test Assessment: Prior to your participation what was your knowledge of ***Advances in Endoscopic Sinus Surgery*** on a scale of 1 to 5, with 1 the lowest and 5 the highest. **1 2 3 4 5**

CME Test Questions

1. Which of the following conditions is considered a major complication following endoscopic sinus surgery?
   A. Epistaxis
   B. Intracranial injury
   C. Nasolacrimal duct injury
   D. Pain
   E. Periorbital emphysema
2. The microdebrider:
   A. Both dissects and suctions
   B. Has variable speeds
   C. Removes nasal and sinus mucosa and thin bone
   D. Rotates or oscillates
   E. All of the above
3. The ENT applications of Coblation include:
   A. Excision of false vocal fold papillomas
   B. Partial glossectomy
   C. Polypectomy
   D. Removal of sinonasal tumors
   E. All of the above

4. Image-guided endoscopic sinus surgery:
   A. Enables the surgeon to identify anatomical landmarks and monitor the position of surgical tools during surgery
   B. Is not approved for use by the AAO-HNS
   C. Results in longer operative times
   D. Results in more surgery-related complications
   E. All of the above

5. In pilot studies, patients with polyposis treated with Coblation compared with those treated with the microdebrider demonstrated:
   A. Increased blood loss per minute of surgical time
   B. Increased incidence of major complications
   C. Increased operative times
   D. Statistically significant decreased blood loss overall
   E. None of the above

Course Evaluation:

Please evaluate the effectiveness of this activity by circling your choice on a scale of 1 to 5, with 1 the lowest and 5 the highest.

How well did this activity meet the educational objectives of enabling participants to do the following:

Compare the need for endoscopic versus standard sinus surgery in patients with rhinosinusitis	1	2	3	4	5
Distinguish between the benefits and limitations of newer instrumentation used to perform endoscopic sinus surgery	1	2	3	4	5
Explain the rationale for adopting new instrumentation for endoscopic sinus surgery	1	2	3	4	5
Describe clinical outcomes seen with endoscopic sinus surgery	1	2	3	4	5
How do you rate the overall quality of the activity?	1	2	3	4	5
How do you rate the educational content of the activity?	1	2	3	4	5

Was the presented information fair, objective, balanced, and free of bias in the discussion of any commercial product or service? ____Yes ____No

If not, please describe: _____

_____

Suggested topics for future activities: _____

_____

Suggested authors for future activities: _____

_____

After participation in this activity, have you decided to change one or more aspects of the treatment of your patients? ____Yes ____No

If yes, what changes will you make:

_____

If no, why? _____

_____

Would you be willing to participate in postactivity follow-up surveys? ____Yes ____No

Would you be willing to participate in a phone, e-mail, or in-person discussion exploring ways to improve our CME activities? ____Yes ____No

The EOCME thanks you for participation in this CME activity. All information provided improves the scope and purpose of our programs and your patient's care.

Automatic scoring and remediation of wrong answers. In order to receive credit all participants must pass 70% of the questions.

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A Round-table Discussion: Advances in Endoscopic Sinus Surgery