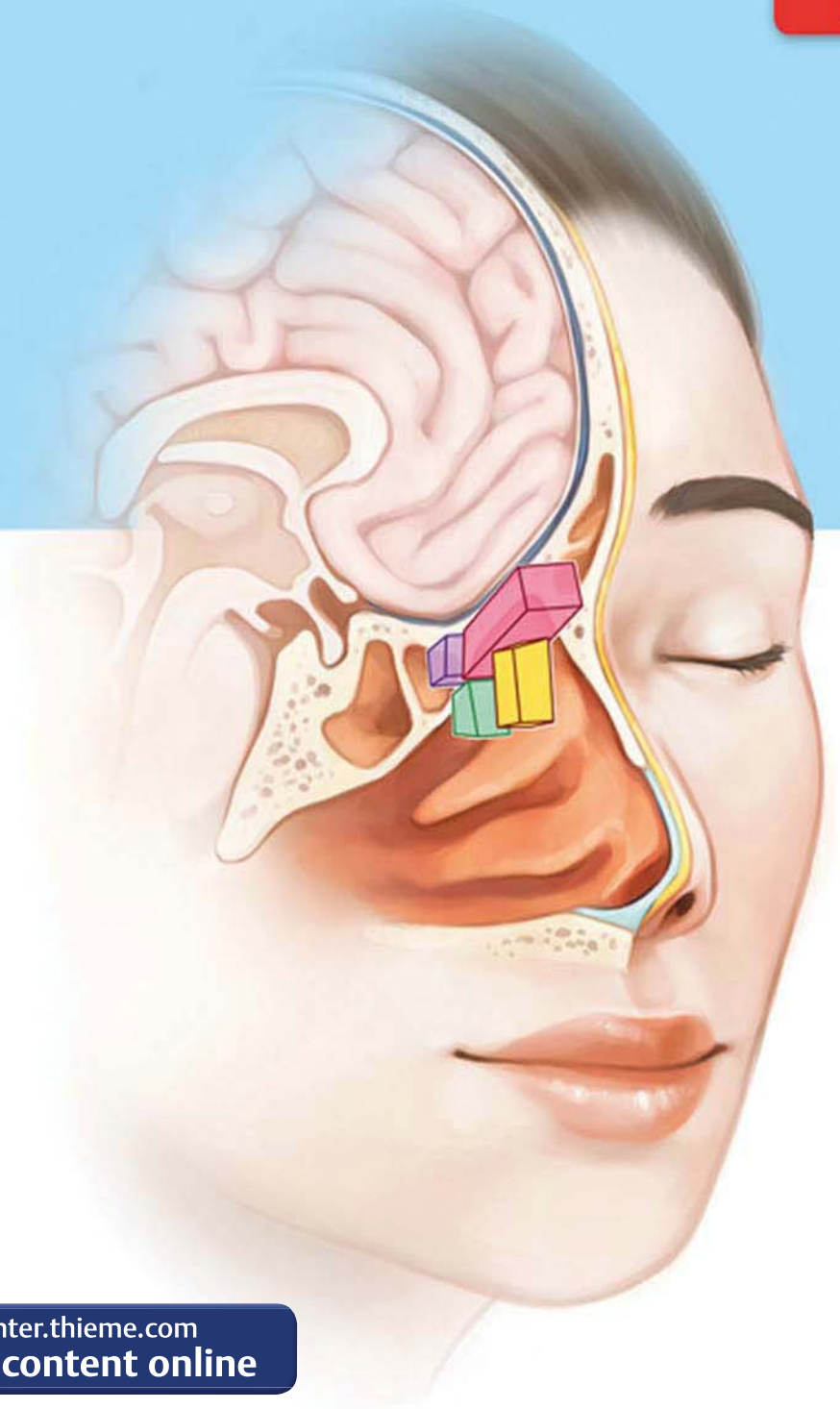
Endoscopic Sinus Surgery

Anatomy, Three-Dimensional Reconstruction, and Surgical Technique

Peter-John Wormald

Fourth Edition

plus videos



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Dedicated with love to Fiona, my wife, without whom this book would not have been possible, and to Nicholas and Sarah, my children who provide my inspiration.

Preface

This fourth edition of *Endoscopic Sinus Surgery* and its accompanying videos continue to refine and improve the concepts and illustrations of the third edition. With time, surgical techniques are refined and adjusted and these have been added to this edition. Each chapter has been thoroughly revised and although some have required minimal changes, others have undergone extensive revision and adjustment. A recent publication (Wormald PJ, et al. The International Frontal Sinus Anatomy Classification [IFAC] and Classification of the Extent of Endoscopic Frontal Sinus Surgery [EFSS]. *Int Forum Allergy Rhinol* 2016;6[7]:677–696) simplifying the terminology of the cells in the frontal recess (IFAC classification) has resulted in extensive revision of the frontal sinus chapters. This new classification of cells in the frontal recess is both simple and logical and we hope will be adopted as the new world standard for naming of these cells. In addition, there has long been a need for a new classification of the extent of surgery. There has been much confusion about previous classifications with different interpretations for the extent of surgery. The classification of the extent of frontal sinus surgery (EFSS) was also revised in the same publication and again is simple and logical and we hope will become accepted as the world standard for the grading for the extent of surgery. We acknowledge Rowan Valentine's contribution to this book with the high standard of dissection images he has provided. These images were obtained under the guidance of the late Albert L. Rhoton Jr. in the latter's laboratory in Gainesville, Florida. The images in this book reflect the high standard of excellence associated with Rowan's work. In this new edition, we continue to develop and refine surgical techniques. We have added the mega-antrostomy and prelacrimal approaches to the maxillary sinus and adjusted the use of anterior based pedicled flaps for the EFSS grade 6 (frontal drillout) procedure and refined many of the other surgical techniques presented.

This book differs from many others on anatomy and surgical techniques in that its scope is purely anatomical and operative. No attempt is made to cover the pathology or medical treatment of any of the conditions discussed—such information can be found in several excellent texts currently available. Many of the operative techniques presented in this book are novel but the results achieved with them have been carefully audited and published in peer-reviewed journals before they are presented here. It is hoped that the description of the relevant anatomy and surgical techniques in this text are sufficiently clear so that the reader will be able to apply them in his/her everyday practice. The concepts are presented with extensive use of illustrations, CT and MRI scans, and intraoperative and postoperative photographs. In addition, the accompanying videos illustrate the surgical techniques described in the text. This combination of text and videos should reinforce understanding of sinus anatomy and give the surgeon the confidence to tackle the many anatomical variations and technical challenges that may occur during endoscopic sinus and skull base surgery.

Acknowledgments

A book of this nature is an accumulation of all knowledge gleaned from many teachers over many years. However, I would like to single out the late Mike McDonogh as the teacher who had the greatest influence on my career as a rhinologist. Mike was an exceptional person who was highly innovative, and his humor, wit, and intelligence will be greatly missed. His ideas led to the development of the swing-door uncinectomy and the bath-plug closure of cerebrospinal leaks. I will remain forever indebted to him for his teaching, mentoring, and friendship.

Andrew van Hasselt deserves a special mention for his support over many years. In addition, I would like to thank the Australian ENT Society members for making me welcome in Australia and for their ongoing support of the development of academic ENT.

1 Setup and Ergonomics of Endoscopic Sinus Surgery

◆ Introduction

There has been a significant shift from external and headlight sinus surgery to endoscopic sinus surgery (ESS). This dramatic change was initiated by the pioneering studies of Messerklinger in which he demonstrated that each sinus has a predetermined mucociliary clearance pattern draining toward its natural ostium irrespective of additional openings that may have been created into the sinuses.[1] This philosophy of opening the natural ostium of the diseased sinus was then popularized by Stammberger[2] and Kennedy.[3] ESS is now accepted as the surgical management of choice for chronic sinusitis. In addition, as our knowledge of the anatomy of the sinuses has improved, other ancillary techniques such as endoscopic lacrimal surgery[4] and orbital decompression[5] have been developed. The development of specialized instruments has facilitated the endoscopic management of benign endonasal tumors[6,7] and more recently the endoscopic management of malignant tumors[8] of the nose, sinuses, and intracranial cavity. Endoscopic sinus surgery, ancillary nasal and sinus procedures, and, more recently, endoscopic transnasal intracranial surgery requires a broad range of specially designed endoscopic surgical instruments.

◆ Instruments

Disclaimer

A number of instruments that are presented in this book are manufactured and sold by Medtronic ENT and Integra. Those that are identified by an * have been designed by the author and a royalty is received from the sale of these instruments. There are no undeclared financial incentives associated with any of the instruments discussed that do not bear the identifying *.

A complete list of endoscopic sinus surgery instruments used by the author is presented in **Table 1.1**. If the instrument is produced by a number of companies, no manufacturer is named. If a particular instrument is produced by only one company, then the manufacturer is named. The following instruments are important for basic sinus surgery:

- Small rotating backbiting forceps
- Sickle knife
- Small (2.5-mm) straight and 45-degree upturned Blakesley forceps
- Small (2.5-mm) straight and 45-degree upturned through-biting (cutting) Blakesley forceps
- Endoscopic scissors
- Double right-angled ball probe
- Forceps 45- and 90-degree giraffe cup, 45- and 90-degree through-biting giraffe forceps
- Hajek Koeffler forward-biting punch
- Suction Freer's elevator
- Curettes (straight, 45-degree, and 90-degree curette)
- Malleable suction Freer's elevator* (Integra, Plainsboro, NJ)
- Malleable suction curette* (Integra)
- Malleable frontal sinus probe* (Integra)

Powered Microdebriders

Powered microdebriders now form an essential part of the instrumentation required to perform ESS and skull base surgery. These instruments allow the surgeon to remove blood from the operating field with the gate open and then with considerable precision the tissue can be cut by the rotating inner blade of the microdebrider. This precision cutting of mucosa minimizes the potential for stripping of the mucosa and helps to achieve maximum mucosal preservation which should improve postoperative healing and consequently the results of the surgery. These instruments are very effective at removing tissue and if placed in the wrong area, such as the orbit, can create significant damage to the orbital contents in a

Table 1.1 Full list of operating instruments and equipment

Instruments
Jacobson angled 7-inch needle holder
6-inch fine needle holder
Small Luc forceps
Angled Heyman turbinectomy scissors
Tilley Henkel forceps
Tilley packing forceps
Mosquito curved artery clips
Backhaus towel clips
Sponge holder
McIndoe forceps
Adson toothed OR Adson Brown forceps
Adson plain OR tungsten tip forceps
Suture scissors
Iris curved scissors
No. 7 scalpel blade handle
Freer's dissector
Frazier 9 French gauge sucker and stilette
Frazier 10 French gauge sucker and stilette
Dental syringe
Heath's mallet
Small Killian's speculum
Medium Killian's speculum
Large Killian's speculum

Sinoscopy instruments
Medium straight Blakesley forceps
Medium upturned Blakesley forceps
Blakesley forceps straight through cut
Blakesley forceps upturned through cut
Right ostrum punch downcut
Left ostrum punch downcut
Sinus short sucker
Sinus long sucker
Sickle knife
Freer's dissector
Double-ended probe
Kuhn Bolger frontal ostium seeker
Kuhn Bolger frontal sinus curette 55 degrees
Antrum curette
90-degree curette
Sucker Freer's and stiletto
Rotating microbite backbiter
Hajek Koffler sphenoid punch upcut forward

Special instruments
Sinoscopy scissors – straight
Sinoscopy scissors – curved left
Sinoscopy scissors – curved right
Kuhn Bolger giraffe forceps horizontal
Kuhn Bolger giraffe forceps vertical
Kuhn Bolger forceps 60 degrees
Kuhn Bolger forceps 90 degrees
Kuhn Bolger forceps 90 degrees right angled
Kuhn Bolger forceps 90 degrees left angled
Ligature clip carrier

Wormald Sucker Bipolar* Integra
Wormald's suction bipolar forceps – straight*
Wormald's suction bipolar forceps – upturned*
Sterilization case
Bipolar cable

Medtronic ENT frontal trephine set
Medtronic frontal trephine set
Drill guide
Drill pin
Irrigation cannula (reusable; keep six in stock)
Sterilizing tray

Wormald's Malleable Frontal Sinus Instruments* Integra
Wormald malleable frontal sinus probe
Wormald malleable frontal sinus suction
Wormald malleable elevator blunt
Wormald malleable frontal sinus curette
Sterilization tray

Wormald Dacryocystorhinostomy Set* Integra
Sickle knife
Spear knife
Lusk microbite forceps

Wormald MicroFrance Anterior Skull Base and Pituitary Instrument Set* Integra
5-mm fine scissors: left, right, and straight
5-mm fine scissors: up
8-mm fine scissors: left, right, and straight
8-mm fine scissors: up
1-mm forceps straight and 45 degrees
Malleable probe straight
Malleable probe right-angled hook
Malleable suction dissector
Malleable suction
Malleable suction cage
Malleable small and large 45-degree ring curettes
Malleable small and large 90-degree ring curettes
Bending tool

MicroFrance Medtronic Hemorrhage Control Set* Integra
Clamp straight rotatable
Clamp curved small
Clamp curved long
Clamp 45-degree straight
Clamp 45-degree curved small
Clamp 45-degree curved long
Clip-applying forceps rotatable straight
Clip-applying forceps rotatable 45 degrees
Needle holder rotatable

Equipment

Camera system
STORZ HD digital camera SPIES
0-degree endoscope (4 × 11 mm Hopkins)
30-degree endoscope
45-degree endoscope
70-degree endoscope

Lens washer
Medtronic Endoscrub II

Consumables
0-degree Endoscrub II sheath
30-degree Endoscrub sheath

Microdebrider
Medtronic IPC (integrated power console)
M5 handpiece
Midas Rex Stylus handpiece
Skull base burs

Solutions

Topical
Cocaine solution (10% – 2 mL)
Adrenaline (1:1000 × 1 mL)
Normal saline (0.9 × 3 mL)

*Instruments identified by an asterisk were designed by the author.

very short space of time.[9,10] Due to its soft consistency, orbital fat can be sucked into the blade opening and cut by the rotating inner blade at a frightening rate. If the surgeon is unaware of having penetrated the orbital periosteum with microdebrider, significant damage can occur within a few seconds. There are numerous case reports in the literature in which powered microdebriders have caused inadvertent injury to the orbital contents and to the medial rectus muscle.[9,10]

The blade is used in oscillate mode for the majority of the surgery. Most of the instruments have a default setting that will allow the blade to oscillate at 3000 or 5000 revolutions per minute. The foot pedal will also usually have a switch to allow the surgeon to select either variable or full speed when the pedal is depressed. Variable mode allows the surgeon to slow the speed whereas full speed will result in the blade turning at 3000 or 5000 rpm immediately as the pedal is depressed. It is important to understand that the speed at which the blade turns determines the amount of tissue that is cut. The higher the speed the less time the port is open and the less tissue is able to be sucked into the blade before the turning blade cuts the tissue. Conversely, the slower the speed the more tissue is sucked in and the more aggressively the blade cuts. **Fig. 1.1a** shows the blade in open mode and **Fig. 1.1b** shows tissue being sucked into the port of the blade before rotation of the blade cuts the tissue.

In forward and reverse mode the revolutions may vary from 3000 to 12,000 rpm and consequently the blade is open for only a very short period of time. Tissue cutting in this mode is thus severely limited. Forward mode is usually used for the various bur attachments that can be used in place of the blade. However, forward mode can also be used for very gently shaving bony septations on the lamina papyracea or skull base. This needs to be done with absolute knowledge of the anatomy and great care as inadvertent penetration of either structure can be disastrous. When this is done, the septations are brushed with the rotating blade without any use of pressure.

Endoscopic High-Speed Drills

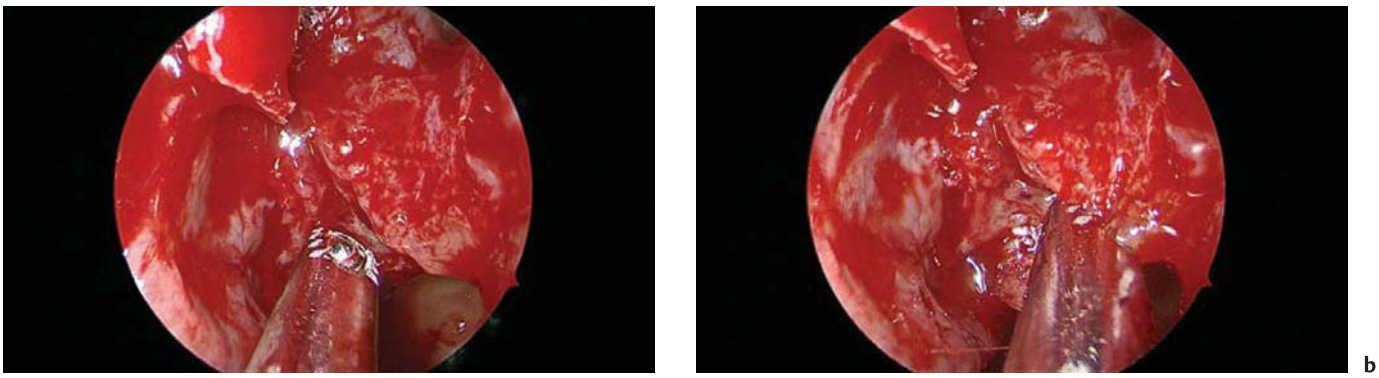
Medtronic ENT (Minneapolis, MN) has a microdebrider base box that takes both a microdebrider handpiece with power range up to 30,000 rpm and all standard microdebrider blades and burs. The new burs designed to be run at 30,000 rpm come in a variety of angles as well as cutting or diamond options. This high-speed bur is very efficient at removing large amounts of bone quickly and has resulted in much shorter operating times for procedures requiring bone removal. A caution must be added that the efficiency of these burs and the high speed at which they function may contribute added risk to the surgery as quick bone removal may result in breach of the skull base and intracranial penetration or orbital penetration. Experience and care is required when using the high-speed burs. In addition, this base box also takes an electronic endoscopic high-speed drill (Stylus) with curved irrigated diamond and cutting burs with power range up to 60,000 rpm. The surgeon can switch between the standard hand piece with drill (M5) and the high-speed electric drill by simply touching the button on the foot pedal. This high-speed electric drill, although irrigated, does not have in-built suction like a normal microdebrider drill and therefore is more suitable in a two-surgeon setup where the second surgeon can provide suction during drilling.

Endoscope Cleaners

A large number of companies manufacture endoscope cleaners or scrubbers. These are designed to wash the lens of the endoscope should it become obscured with blood. If the surgical field is bloody, the endoscope cleaner keeps the scope lens clear of blood and allows the operation to proceed without the need to remove the endoscope from the nose and manually clean it. The endoscope cleaner speeds up the operation and improves the safety of the surgery by maintaining visibility and decreasing the surgeon's frustration level by allowing the surgery to progress more rapidly.

Cameras and Monitors

Surgery was originally performed by the surgeon looking through the eye piece of the endoscope but this traditional technique is seldom used anymore. Currently, most surgeons connect a video camera to the endoscope which enables the surgeon to operate using the view on the monitor. A significant advantage of operating from the monitor is the ergonomic advantage this affords the surgeon as he or she can sit or stand next to the patient and not have to bend either their back or neck to obtain a view of the nasal cavity. This is especially valuable if the frontal recess is being operated upon as the surgeon viewing the procedure through the eyepiece



a b

Fig. 1.1 (**a**) The blade open and (**b**) with tissue being sucked into the blade prior to rotation of the inner blade and severing of the tissue.