ENDOSCOPIC SURGERY OF THE LATERAL
NASAL WALL, PARANASAL SINUSES AND
ANTERIOR SKULL BASE

Principles and Clinical Examples

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The number on this logo corresponds to the video clip number on the DVD (inside back cover).

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Gratefully dedicated to
Claudia, Alexander and Isabelle.
Anatomical Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AE</td>
<td>Anterior ethmoid</td>
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<tr>
<td>AEA</td>
<td>Anterior ethmoidal artery</td>
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<tr>
<td>ANC</td>
<td>Agger nasi cell</td>
</tr>
<tr>
<td>ASB</td>
<td>Anterior skull base</td>
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<tr>
<td>BA</td>
<td>Basal artery</td>
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<td>BL</td>
<td>Basal lamella (of the middle turbinate)</td>
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<td>CG</td>
<td>Crista galli</td>
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<td>CP</td>
<td>Cribriform plate</td>
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<td>EB</td>
<td>Ethmoid bulla</td>
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<tr>
<td>EC</td>
<td>Ethmoid crest</td>
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<tr>
<td>EI</td>
<td>Ethmoid infundibulum</td>
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<td>FLS</td>
<td>Fissure of the lacrimal sac</td>
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<td>FR</td>
<td>Frontal recess</td>
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<td>FS</td>
<td>Frontal sinus</td>
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<td>HC</td>
<td>Haller cell</td>
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<td>ICA</td>
<td>Internal carotid artery</td>
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<td>IN</td>
<td>Infraorbital nerve</td>
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<td>IOR</td>
<td>Infraoptic recess</td>
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<tr>
<td>IT</td>
<td>Inferior turbinate</td>
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<tr>
<td>LP</td>
<td>Lamina papyracea</td>
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<td>MRM</td>
<td>Medial rectus muscle</td>
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<td>MS</td>
<td>Maxillary sinus</td>
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<td>MSO</td>
<td>Maxillary sinus ostium</td>
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<td>MT</td>
<td>Middle turbinate</td>
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<td>NLD</td>
<td>Nasolacrimal duct</td>
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<td>OC</td>
<td>Optic canal</td>
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<td>OG</td>
<td>Olfactory groove</td>
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<td>OLF</td>
<td>Olfactory fossa</td>
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<td>ONC</td>
<td>Onodi cell</td>
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<tr>
<td>OPN</td>
<td>Optic nerve</td>
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<tr>
<td>PE</td>
<td>Posterior ethmoid</td>
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<td>PEA</td>
<td>Posterior ethmoidal artery</td>
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<tr>
<td>PF</td>
<td>Posterior fontanelle</td>
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<tr>
<td>PNS</td>
<td>Paranasal sinus</td>
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<td>P</td>
<td>Pituitary gland</td>
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<tr>
<td>S</td>
<td>Nasal septum</td>
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<tr>
<td>SMS</td>
<td>Septation in the maxillary sinus</td>
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<td>SPA</td>
<td>Sphenopalatine artery</td>
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<td>SS</td>
<td>Sphenoid sinus</td>
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<td>SSO</td>
<td>Sphenoid sinus ostium</td>
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<td>SSO</td>
<td>Sphenoid sinus ostium</td>
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<td>TR</td>
<td>Terminal recess of ethmoid infundibulum</td>
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<tr>
<td>UP</td>
<td>Uncinate process</td>
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Forewords

Diseases of the nose and paranasal sinuses account for a large percentage of the cases seen by otorhinolaryngologists in clinical practice. Systematic advances in endoscopic and microscopic operating techniques are largely responsible for ongoing improvements in intermediate- and long-term treatment results. Whereas the trend toward endoscopic surgery forced many clinicians to make a rather difficult adjustment some years ago, the current generation of practicing ENT specialists have grown up with the modern techniques and are committed to their conceptual and technological refinement. With his outstanding dedication and intensive theoretical and clinical commitment in this field, Prof. Andreas Leunig has achieved a degree of experience and proficiency that enable him to present the state-of-the-art of current techniques in paranasal sinus surgery. The author’s enthusiasm for the teaching process has given this publication a didactic clarity and excellence that will definitely help to convey both new and established techniques to the next generation of otorhinolaryngologists.

It is my hope that this publication, with its many valuable recommendations and guidelines, will gain a wide readership.

Munich, May, 2007
Prof. Alexander Berghaus, M.D.

When Prof. Walter Messerklinger completed a comprehensive manuscript on the “Endoscopic Diagnosis and Surgery of the Nose and Paranasal Sinuses” in 1970, it took him seven long years to find a publisher willing to print his work. It was finally published in the U.S. in 1978 under the title “Endoscopy of the Nose”. The topic seemed too esoteric, and its sales prospects too meager, for publication in Europe. When Prof. Malte Wigand reported on the transnasal endoscopic removal of inverted papillomas in the mid-1980s, numerous critics accused him of being irresponsible and jeopardizing his patients’ health by making them more susceptible to recurrent disease.

Today, more than 20 years later, we have a greatly expanded range of knowledge and experience at our disposal. Numerous standards have been tested and implemented during this period. Diagnostic endoscopy and transnasal endoscopic surgery have become the gold standard all over the world. Endoscopic surgical procedures on the skull base, dura, pituitary gland, clivus, and beyond have become routine at many institutions. One circumstance is unchanged, however: endoscopic surgery still requires meticulous care, considerable skill, and a detailed knowledge of the anatomy and pathophysiology of this topographically critical region. Following the basic principle of endoscopic techniques, it must be stated that there is no such thing as a “standardized” procedure. Every patient requires an individualized treatment concept that is tailored to the specific pathology at hand. This principle may be at least partly responsible for the remarkable success story of nasal endoscopy during the past two decades.

I am very pleased to see that Prof. Andreas Leunig, a representative of the younger generation, is demonstrating the capabilities of the endoscopic approach. This publication not only reflects the great technical proficiency and rich clinical experience of the author but also reviews the rapid technological progression in recent years from analogue methods to high-resolution digital video and photodocumentation. The endoscopic images are of exceptional quality and deserve to be called “state of the art.” Of particular interest are the numerous clinical examples and corresponding video sequences on the accompanying DVD, which enables the subject matter to be experienced in an immediate and realistic way.

We gratefully acknowledge the KARL STORZ company, Tuttlingen, Germany, for making this comprehensive publication possible. This firm is continuing the tradition of “silver monographs” and is adding an important highlight to this series.

Graz, May, 2007
Prof. Heinz Stammberger, M.D.
Endoscopic Surgery of the Lateral Nasal Wall, Paranasal Sinuses, and Anterior Skull Base

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1.0 Introduction

The results of Walter Messerklinger on the pathophysiology of inflammatory paranasal sinus diseases are now considered the basis for endonasal endoscopic sinus surgery. In German-speaking countries, Heinz Stammberger has worked with the “Graz School” to define and significantly advance the concept of endoscopic sinus surgery. A better understanding of sinonasal physiology, pathophysiology, and anatomy, particularly of the lateral nasal wall, has critically influenced the surgical treatment of inflammatory sinus diseases. Mechanical obstructions of the natural drainage pathways relating to anatomical variants as well as inflammatory mucosal changes in the form of endoscopically visible polypoid mucosal swellings (including the “end stage” with gross polyp formation) are commonly located in the middle meatus, and thus in the region of the lateral nasal wall. This is why the rhinogenic origin of these diseases has given rise to the concept of “chronic rhinosinusitis” (CRS).

Thus, an accurate knowledge of the anatomy of the lateral nasal wall, adjacent paranasal sinuses, and anterior skull base is an essential prerequisite for the surgical treatment of sinus diseases.

The goal of this publication, then, is to convey the microanatomy of the lateral nasal wall and surrounding structures, endoscopic and radiologic anatomy, and the surgical techniques for endoscopic sinus surgery. It also deals with the extended spectrum of the endoscopic technique, which is described in the text and illustrated by clinical examples on the accompanying DVD.

2.0 Physiology and Pathophysiology of the Paranasal Sinuses

Secretions from the maxillary and frontal sinuses drain from the natural sinus ostia to the middle meatus of the nose via the interposed anterior ethmoid cells. The antechambers to the frontal sinus and maxillary sinus are respectively called the frontal recess and ethmoid infundibulum. Secretions that drain from the anterior and posterior systems of ethmoid cells are separated by the basal lamella of the middle turbinate. Mucociliary transport from the sphenoid sinus is directed into the posterior ethmoid cells. This system of cells has its own antechamber called the sphenoethmoid recess.

Secretions in the frontal and maxillary sinuses are actively transported to the natural ostia. Accordingly, the main objective of surgical treatment is to expose the plane of the natural ostia of the maxillary, frontal and sphenoid sinuses. Formerly, it was common practice to create fenestrations in the inferior meatus that communicated with the maxillary sinus. Although some patients benefited from the effect of these infraturbinate fenestrations, this technique violates the physiological principle of secretions draining to the natural sinus ostium.

Endoscopic view into the inferior meatus shows an infraturbinate fenestration leading into the right maxillary sinus (a) and left maxillary sinus (b). On the right side, we see active mucous transport not through but around the newly created fenestration toward the natural maxillary sinus ostium. Note also the remnant of a right inferior turbinate following an inferior conchotomy.
Physiologic mucus transport into and out of the maxillary sinus and through the nasal cavity. (2a–f)

2a
Schematic representation of mucociliary drainage from the maxillary and frontal sinuses through the corresponding natural ostium into the middle meatus.

2b
Mucociliary drainage in the maxillary sinus, made visible by blood.

2c
View of the natural maxillary sinus ostium after removal of the uncinate process.

2d
Over time, we can observe the active transport of secretions mixed with blood from the natural sinus ostium.

2e
Normal and abnormal drainage patterns from the sinuses and through the nasal cavity (modified from Stammberger 1996).

2f
Mucociliary drainage around the eustachian tube orifice is made visible by blood.
3.0 Diagnostic Imaging of the Paranasal Sinuses

With discoveries on the drainage pathways in the lateral nasal wall and their relevance to inflammatory sinus diseases, the requirements for sinus imaging have changed dramatically during the past 10–15 years.

For many years, plain radiographic sinus projections (occipitomental, occipitofrontal) were considered the primary imaging tool for otorhinolaryngologists in the diagnosis of sinus diseases. Today, however, computed tomography (CT) has become the unquestioned modality of first choice for imaging inflammatory sinus diseases.

A basic distinction is drawn between imaging inflammatory sinus diseases and imaging tumors of the paranasal sinuses and anterior skull base.

With inflammatory sinus diseases, the goal of diagnostic imaging is to define the microanatomy of the lateral nasal wall and any anatomical variants that may be present so that narrow passages can be selectively enlarged at operation to improve ventilation and drainage. Another goal is to identify possible danger spots at an early stage in order to prevent complications. By contrast, the basic goal of imaging tumors of the paranasal sinuses and anterior skull base is to accurately define the tumor extent and detect the invasion of nearby structures by means of CT and magnetic resonance imaging (MRI).

The diagnostic imaging of inflammatory sinus diseases is based on a precise knowledge of the anatomy of the lateral nasal wall and the “ostiomeatal unit,” a collective term coined by H. Naumann for the common terminal pathway by which the frontal and maxillary sinuses and anterior ethmoid cells drain into the nasal cavity. Older textbooks still use the terms “anterior, middle, and posterior ethmoid cells.” Today, we know that the ethmoid cells are subdivided by the basal lamella of the middle turbinate into an anterior and posterior ethmoid complex. This circumstance influences terminology as well as surgical treatment strategies.
AE = Anterior ethmoid
AEA = Anterior ethmoidal artery (red arrow)
ANC = Agger nasi cell
BL = Basal lamella
CP = Cribriform plate
EB = Ethmoid bulla
FS = Frontal sinus
HC = Haller cell
IT = Inferior turbinate
LP = Lamina papyracea
MRM = Medial rectus muscle
MS = Maxillary sinus
MT = Middle turbinate
NLD = Nasolacrimal duct
0 = Natural maxillary sinus ostium
OSS = Ostium of sphenoid sinus
PE = Posterior ethmoid
PF = Posterior fontanelle
S = Nasal septum
SMS = Septation in the maxillary sinus
SS = Sphenoid sinus
UP = Uncinate process
As stated above, CT is the primary imaging modality for the investigation of chronic rhinosinusitis. Coronal CT of the paranasal sinuses can accurately define the microanatomy of the lateral nasal wall and its variants as well as the anatomy of the anterior skull base. In cases of uncomplicated CRS, CT should be performed only after preliminary medical treatment. Otherwise, inflammatory swelling of the mucosa would make it difficult to evaluate the fine bony anatomy of the ostiomeatal unit. Preliminary treatment with topical or systemic steroids is particularly advised in patients with ethmoid polyposis so that CT can define the thin bony structures more clearly. Axial CT in this setting provides information on the depth of the maxillary and sphenoid sinuses. Sagittal CT reconstructions are necessary for accurate evaluation of the frontal recess in patients with recurrent frontal sinusitis and in patients with persistent frontal sinus complaints who have undergone previous sinus surgery. It should be noted in this regard that CT images always portray an instantaneous finding and that the findings may look quite different on scans taken days or weeks later. Conversely, up to 40% of asymptomatic patients may have detectable mucosal swelling on CT scans (Stewart 2004).

Thus, the indication for surgical treatment depends critically on the patient’s symptoms and not just on endoscopic and radiologic findings.
4.0 Anatomy of the Paranasal Sinuses

View of a portion of the interior skull base in axial section showing the frontal sinus (FS), anterior ethmoid (AE), posterior ethmoid (PE), crista galli (CG), olfactory groove (OG), ethmoid infundibulum (EI), sphenoid sinus (SS), and optic canal (OC). Specimen and photo courtesy of B. Tillmann, Kiel.

4.1 Uncinate Process

The uncinate process (UP) is located in the lateral nasal wall and consists of a small bony plate covered by mucosa. It starts anterosuperiorly and slants posteroinferiorly when viewed in the sagittal plane. Its posterior free edge borders on the anterior surface of the ethmoid bulla, forming a gap only a few millimeters wide. Superiorly, its anterior border may attach to the lamina papyracea, the middle turbinate, or the skull base. The UP presents a highly variable configuration when seen at endoscopy.

Greatly simplified schematic diagram of the superior attachments of the uncinate process. The frontal sinus may drain directly into the middle meatus (a) or into the ethmoid infundibulum (b, c), depending on the attachment site.
Endoscopic, radiologic and anatomical aspects of the middle meatus. (7a–d)

General endoscopic view of the middle meatus demonstrates the uncinate process (UP), ethmoid bulla (EB), and middle turbinate (MT).

Corresponding CT scan shows the uncinate process (UP), ethmoid bulla (EB), middle turbinate (MT), and Haller cell (HC).

Coronal section at the level of the crista galli (CG) demonstrates the ethmoid bulla (EB), inferior turbinate (IT), middle turbinate (MT), olfactory fossa (OF), infraorbital nerve (IN), optic nerve (ON), uncinate process (UP), nasal septum (S), maxillary sinus (MS), and anterior ethmoid (AE).

Specimen and photo courtesy of B. Tillmann, Kiel.

Sagittal view of the anterosuperior-to-posteroinferior course of the uncinate process (UP), also demonstrating the nasolacrimal duct (NLD), posterior fontanelle (PF), posterior ethmoid (PE), nasal septum (S), frontal sinus (FS), maxillary sinus (MS), sphenoid sinus (SS), anterior fontanelle (AF), and anterior ethmoid (AE).

Specimen and photo courtesy of B. Tillmann, Kiel.
4.2 Ethmoid Bulla

Located in the anterior ethmoid bone, the ethmoid bulla (EB) is the largest and most constant of the ethmoid cells. It may show varying degrees of pneumatization and is therefore variable in its size. A heavily pneumatized EB may cause significant narrowing of the middle meatus. Additionally, contact with the middle turbinate or narrowing of the semilunar hiatus may hamper normal ventilation and drainage. If the EB is not pneumatized, particular attention should be given to the lamina papyracea during surgical procedures, as the lamina may bulge far toward the midline in the absence of a pneumatized EB. The surgeon may remove it, mistaking it for the EB, and inadvertently enter the orbit.

If the EB does not reach the ethmoid roof, the intervening space is called the suprabullar recess. If the posterior wall of the EB is not part of the basal lamella (as in most cases), a retrobullar recess is formed. In both cases a “lateral sinus” is said to be present.

4.3 Agger nasi

The anatomical position of the Agger nasi cell (ANC) is anterior to the insertion of the middle turbinate. Its degree of pneumatization is highly variable. A well-pneumatized ANC may interfere with frontal sinus ventilation. The lacrimal sac is located lateral to the ANC.

4.4 Middle Turbinate

The middle turbinate (MT) is part of the ethmoid bone. It may show varying degrees of pneumatization in its anterior or posterior portion, forming a substantial cell called the “concha bullosa.” This may cause nasal airway obstruction or, by narrowing the middle meatus, may cause ventilation problems with headaches and recurrent bouts of rhinosinusitis. The lateral wall of the middle turbinate borders on key structures such as the UP, semilunar hiatus, ethmoid infundibulum, lateral sinus, and frontal recess.

4.5 Ethmoid Infundibulum

The ethmoid infundibulum is the space located lateral to the UP, medial to the lamina papyracea, and posterior to the anterior surface of the EB. The upper portion of this space may vary in size depending on the superior attachment of the UP. If the UP attaches to the lamina papyracea, the upper portion of the ethmoid infundibulum (EI) will terminate in a blind pouch called the terminal recess. The UP may also attach to the skull base or to the middle turbinate, causing the frontal sinus to drain laterally between the UP and lamina papyracea.
4.6 Frontal Recess and Frontal Sinus Ostium

The frontal recess (FR) is an hourglass-shaped passageway between the frontal sinus and anterior ethmoid cells. The “infundibulum” narrows at the floor of the frontal sinus down to the level of the frontal sinus ostium and then widens out again to form the frontal recess, which functions as the antechamber to the frontal sinus. The boundary between the frontal recess and nasal cavity is located on an imaginary line between the insertion of the middle turbinate and the anterior ethmoidal artery. Variants in the course of the UP may narrow the frontal recess, significantly affecting its ventilation and drainage. Additionally, the ANC, frontoethmoid cells, or a heavily pneumatized EB may narrow the frontal recess and, with it, the natural frontal sinus ostium. This can lead to recurrent frontal sinus problems.

View of the natural frontal sinus ostium after complete removal of the superior part of the uncinate process: intraoperative (a) and 3 months after surgery (b). (8a, b)

4.7 Semilunar Hiatus

The semilunar hiatus is a two-dimensional space located between the posterior border of the UP and the anterior border of the EB. It consists of inferior and superior parts.
4.8 Maxillary Sinus Ostium

The natural maxillary sinus ostium (MSO) is located in almost 50% of cases in the second most posterior one-fourth of the ethmoid infundibulum. In 25% of cases it is located in the most posterior one-fourth, and 25% in the second most anterior one-fourth (J. Lang, 1989). According to studies by Zuckerkandl (1882), the maxillary sinus ostium is usually shaped like a narrow ellipse. Less commonly it has a circular or reniform shape. It ranges from 3 to 19 mm in diameter (average 5 mm). The average distance of the ostium from the lacrimal canal is 4 mm. Normally, the natural maxillary sinus ostium cannot be visualized at endoscopy because it is hidden by the intact UP. On the other hand, “accessory” maxillary sinus ostia can be identified endoscopically. These accessory orifices occur in approximately 10% of the population and are located in the posterior fontanelle (P. J. Wormald, 2004).

Endoscopic view of the right (a) and left (b) natural maxillary sinus ostia, each seen at 3 months postoperatively. (9a, b)

![Natural right maxillary sinus ostium.](image)

![Natural left maxillary sinus ostium.](image)

4.9 Sphenoid Sinus Ostium

According to studies by J. Lang (1989), a normally developed sphenethmoid recess is located directly in front of the sphenethmoid sinus and measures an average of 10.5 mm high, 5.5 mm long, and 4.3 mm deep. The natural sphenoid sinus ostium is round in 70% of cases and has an average diameter of 2.4 mm. The ostium is elliptical in 30% of the population, with its major axis more often directed vertically than horizontally. Inflammations of the sinus mucosa are more commonly found in association with a narrow sphenoid sinus ostium than a wide ostium. The physiologic septum of the sphenoid sinus is located on the midline in approximately one-fourth of cases. In approximately half of cases only the anterior portion of the septum is on the midline. In other cases the septum is S-shaped or C-shaped. Accessory septa are found in three out of four cases. Every other case has a unilateral septum, and every fourth case has bilateral septa (L. Lang, 1989).
5.0 Anatomical Variants

5.1 Septal Deviation

Deviations of the nasal septum are common anatomical variants that can impede ventilation and drainage of the paranasal sinus. It is common to encounter large septal deviations as well as ridges and spurs that are in contact with the middle meatus.

Endoscopic findings on the right side (a) and left side (b) with corresponding CT scan (c) in chronic rhinosinusitis with septal deviation toward the left side. (10a–c)

5.2 Uncinate Process

The most common anatomical variants in the lateral nasal wall relate to the diverse morphology of the UP. Generally, this process runs downward and backward in one sagittal plane, but it may also be markedly bowed toward the midline or its posterior part may be bowed forward, simulating the appearance of a “double” middle turbinate. Kaufmann first used this term to describe anterior bowing of the UP. The UP itself may be pneumatized, but this is detectable only by CT examination.

Variants of the uncinate process. Pneumatized (a, b), medially bowed (c–f), and perforated (g, h). (11a–h)
Medially bowed uncinate process.

Medially bowed uncinate process with a polyp protruding from the middle meatus.

Complete anterior bowing of the right uncinate process.

Same finding as in (e) on the left side.

Perforation in the right uncinate process with a polyp.

Perforation in the left uncinate process with a small polyp.
5.3 Inferior Turbinate

The inferior turbinate (IT) is considered a separate bone and is not part of the ethmoid complex. In rare cases it is pneumatized and has a strong swelling capacity that can cause nasal airway obstruction.

Endoscopic appearance of a rare pneumatized inferior turbinate and corresponding CT scan. (12a–e)

Pneumatized left inferior turbinate with opacity of the left maxillary sinus.

General endoscopic view of the inferior and middle turbinates.

View into the opened pneumatized inferior turbinate.

The medial portions of the pneumatized inferior turbinate are removed.

Final appearance.
5.4 Middle Turbinate

The middle turbinate (MT) may be paradoxically curved and can significantly narrow the passageway to the middle meatus when it is in close contact with the UP.

A heavily pneumatized middle turbinate forms a cell called a concha bullosa. Generally a concha bullosa is pneumatized from the frontal recess, lateral sinus, or agger nasi. But it may also be pneumatized by the ethmoid cells or directly by the middle meatus. Partial lateral resection of the concha bullosa is necessary only in patients who are symptomatic due to the obstruction of ventilation or drainage.
Coronal CT scan shows a prominent right concha bullosa as the cause of nasal airway obstruction and chronic rhinosinusitis on the right side.

Axial CT scan.

The concha bullosa completely obstructs the right nasal cavity.

The concha bullosa is opened at operation.

Endoscopic appearance of a right concha bullosa before and after removal of its lateral portion. (14a–f)

Endoscopic view into the concha bullosa, demonstrating its ostium.

Final appearance on the right side after partial lateral resection of the concha bullosa.
5.5 Superior Turbinate

The superior turbinate may be pneumatized in rare cases. It may come into contact with the nasal septum, giving rise to recurrent headaches.

Bilateral pneumatized superior turbinates on coronal CT. Recurrent headaches in this patient are attributable to the opacity shown in (b). (15a–b)

![Bilateral pneumatized superior turbinates.](image)

![Bilateral pneumatized superior turbinates with opacity on the left side.](image)

5.6 Ethmoid Bulla

A heavily pneumatized ethmoid bulla can significantly narrow the space between the posterior border of the UP and the anterior border of the EB, causing obstruction to drainage and ventilation.

Endoscopic appearance of an enlarged ethmoid bulla on the right side (a) and left side (b) with corresponding CT scan (c). (16a–c)

![Endoscopic view into the middle meatus on the right side demonstrates a large ethmoid bulla.](image)

![Left middle meatus with the middle turbinate, ethmoid bulla, and uncinate process.](image)

![Corresponding CT scan.](image)

5.7 Haller Cells

Haller cells (HC) are infraorbital cells that usually develop from the anterior ethmoid bone as separate cells bordering the maxillary sinus ostium. They may lead to recurrent bouts of sinusitis, particularly involving the maxillary sinus. By definition, they are clearly distinguished from an EB, which occurs as a separate cell.
Examples of infraorbital cells (Haller cells, a–d). Appearance before (e) and after (f) revision surgery reveals the cause of persistent right maxillary sinus problems following surgery in which the Haller cell was left intact. (17a–f)

Large Haller cell on the left side.

Endoscopic appearance of the right Haller cell in (c). This view is directed into the Haller cell, not the maxillary sinus.

Bilateral infraorbital Haller cells.

Endoscopic appearance of the left Haller cell in (c).

Haller cell and concha bullosa on the right side following a previous left-sided Caldwell-Luc operation performed elsewhere.

Persistent right maxillary sinus complaints resulted from leaving the Haller cell intact on that side in an operation performed elsewhere.
### 5.8 Onodi Cells

Onodi cells (ONC) are sphenoid cells that were first described by Onodi in 1904. Their clinical importance lies in their very close proximity to the optic nerve. A posterolateral extension of these cells may surround or even enclose the optic nerve. This causes the nerve to run exposed and unprotected through the posterior ethmoid bone, making it highly susceptible to injury (with potential blindness) during ethmoid surgery.

_Sphenoid cells (Onodi cells) may allow the optic nerve to course freely through the posterior ethmoid bone. Surgical navigation systems can supply useful additional information in these situations (e) (18a–e), (e.g., VectorVision Cranial Navigation System, BrainLAB AG, Feldkirchen, Germany)._

---

**CT scan of the patient in (a).**

**Onodi cell viewed with a surgical navigation system.**

**Opened sphenoid sinus (lower left) and Onodi cell with a prominent optic nerve (top center).**

**Natural maxillary ostium (left), Onodi cell, and opened sphenoid sinus (right).**

**Onodi cell viewed with a surgical navigation system.**
5.9 Agger nasi Cells

The Agger nasi region undergoes varying degrees of pneumatization from the frontal recess, and this may significantly hamper the ventilation and drainage of the frontal sinus. During manipulations in this region, the surgeon should give attention to the laterally situated lacrimal canal. ANCs in themselves rarely cause narrowing of the frontal sinus outflow tract, however. It is more common for additional frontoethmoid cells to constrain the anterior ethmoid and frontal sinus anatomy, leading to frontal sinus complaints.

F. Kuhn et al. (1991) and J. Bent et al. (1994) were the first to describe a classification system (see 5.10.).
Endoscopic view of a right Agger nasi cell before ... ... and after opening the cell.

Bilateral Agger nasi cells ... ... in coronal section.
5.10 Frontoethmoid Cells

The anatomy of the frontal recess, the antechamber to the frontal sinus, is highly complex and variable due to the presence of frontoethmoid cells. A frequent cause of unsuccessful frontal sinus surgery is failure to identify and remove cells that block the frontal sinus outflow tract. This failure may stem from operator concerns about possible complications resulting from the close proximity of the frontal recess to the anterior skull base, cribiform plate (thinnest part of the skull base), anterior ethmoidal artery, and lamina papyracea. Successful surgery in the frontal recess relies critically on a detailed knowledge of the complex anatomy in this region. This led F. Kuhn to classify the numerous variants of frontoethmoid cells. This classification is shown in Tab. 1 and is illustrated by examples.

Tab. 1: Classification of frontoethmoid cells as described by F. Kuhn et al. (1991) and J. Bent et al. (1994)

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agger nasi cell (20a, b)</td>
<td>Most anterior ethmoid cell</td>
</tr>
<tr>
<td></td>
<td>Pneumatization of Agger nasi region</td>
</tr>
<tr>
<td></td>
<td>Endoscopically visible bulge anterior to the middle turbinate insertion on the lateral nasal wall</td>
</tr>
<tr>
<td></td>
<td>Identified on coronal and sagittal CT scans</td>
</tr>
<tr>
<td>Kuhn type 1 frontal cell (20c, d)</td>
<td>Single cell in the frontal recess above an Agger nasi cell</td>
</tr>
<tr>
<td></td>
<td>Posterior wall is not the skull base but part of the frontal recess</td>
</tr>
<tr>
<td></td>
<td>Identified on coronal and sagittal CT scans</td>
</tr>
<tr>
<td>Kuhn type 2 frontal cell (20e, f)</td>
<td>Multiple cells in the frontal recess above an Agger nasi cell</td>
</tr>
<tr>
<td></td>
<td>Posterior wall is not the skull base but part of the frontal recess</td>
</tr>
<tr>
<td></td>
<td>Very high attachment of the uncinate process to the lamina papyracea</td>
</tr>
<tr>
<td></td>
<td>Does not extend past the nasal spine (frontal beak)</td>
</tr>
<tr>
<td></td>
<td>Identified on coronal and sagittal CT scans</td>
</tr>
<tr>
<td>Kuhn type 3 frontal cell (20g, h)</td>
<td>Single cell in the frontal recess with pneumatization in the frontal sinus</td>
</tr>
<tr>
<td></td>
<td>Extends well into the frontal sinus, but no more than 50% of the sinus height (coronal scan)</td>
</tr>
<tr>
<td></td>
<td>Superior part inserts on the anterior wall of the frontal sinus</td>
</tr>
<tr>
<td></td>
<td>Posterior wall is not the skull base but part of the frontal recess</td>
</tr>
<tr>
<td></td>
<td>Can be removed through frontal recess</td>
</tr>
<tr>
<td></td>
<td>Identified on coronal and sagittal CT scans</td>
</tr>
<tr>
<td></td>
<td>Delineated from frontal bulla cell by sagittal and axial CT scans</td>
</tr>
<tr>
<td>Kuhn type 4 frontal cell (20i, j)</td>
<td>Rare, isolated cell in the frontal sinus</td>
</tr>
<tr>
<td></td>
<td>Extends far into the frontal sinus by more than 50% of the sinus height (coronal scan)</td>
</tr>
<tr>
<td></td>
<td>Can be removed through a combined approach or median drainage</td>
</tr>
<tr>
<td></td>
<td>Has “air bubble” appearance in coronal CT scans</td>
</tr>
<tr>
<td></td>
<td>Has “balloon” appearance in sagittal CT scans</td>
</tr>
<tr>
<td></td>
<td>Anterior inferior part is the anterior wall or floor of the frontal sinus</td>
</tr>
<tr>
<td></td>
<td>Posterior part is the posterior wall of the cell, not the posterior wall of the frontal sinus</td>
</tr>
<tr>
<td></td>
<td>Identified on coronal and sagittal CT scans</td>
</tr>
<tr>
<td>Supraorbital ethmoid cell (20k, l)</td>
<td>Single or multiple ethmoid cells extending into the orbit from the frontal recess</td>
</tr>
<tr>
<td></td>
<td>Opens laterally into the frontal recess</td>
</tr>
<tr>
<td></td>
<td>(ostium is located lateral and posterior to the natural frontal sinus ostium)</td>
</tr>
<tr>
<td></td>
<td>Identified on axial and coronal CT scans</td>
</tr>
<tr>
<td>Frontal bulla cell (20m, n)</td>
<td>Ethmoid cell superior to the ethmoid bull</td>
</tr>
<tr>
<td></td>
<td>Extends along the skull base into the frontal sinus from behind the frontal recess</td>
</tr>
<tr>
<td></td>
<td>Posterior wall formed by the skull base and posterior wall of the frontal sinus</td>
</tr>
<tr>
<td></td>
<td>Anterior border extends into the frontal sinus</td>
</tr>
<tr>
<td></td>
<td>Located posterior to the pneumatized frontal sinus</td>
</tr>
<tr>
<td></td>
<td>Identified on coronal and sagittal CT scans</td>
</tr>
<tr>
<td></td>
<td>Differentiated from Kuhn type 3 frontal cell by sagittal and axial CT scans</td>
</tr>
<tr>
<td>Suprabullar cell (20o, p)</td>
<td>Ethmoid cell superior to the ethmoid bull</td>
</tr>
<tr>
<td></td>
<td>Cranial boundary is the skull base</td>
</tr>
<tr>
<td></td>
<td>Does not extend into the frontal sinus</td>
</tr>
<tr>
<td></td>
<td>Identified on sagittal CT scans</td>
</tr>
<tr>
<td>Interfrontal sinus septal cell (20q–s)</td>
<td>Pneumatization of the interfrontal sinus septum</td>
</tr>
<tr>
<td></td>
<td>Narrows the natural frontal sinus ostium and shifts the drainage route laterly</td>
</tr>
<tr>
<td></td>
<td>Drains into the frontal recess</td>
</tr>
<tr>
<td></td>
<td>Associated with a pneumatized crista galli</td>
</tr>
<tr>
<td></td>
<td>Identified on axial and coronal CT scans</td>
</tr>
<tr>
<td>Terminal recess (34a)</td>
<td>Uncinate process inserts lateral and superiorly on the lamina papyracea below the natural frontal sinus ostium</td>
</tr>
<tr>
<td></td>
<td>Frontal sinus drains directly into the middle meatus</td>
</tr>
<tr>
<td></td>
<td>Often associated with Agger nasi cell</td>
</tr>
<tr>
<td></td>
<td>Identified on coronal CT scans</td>
</tr>
</tbody>
</table>
In many cases the complex anatomy of the frontal recess, with its numerous variants, is not adequately portrayed in coronal CT scans. For this reason, preoperative imaging should include multiplanar views in axial and sagittal planes. It is also important to practice atraumatic dissection techniques in this “delicate” anatomical region.

Schematic representation of various frontoethmoid cells (shown in red). (20a–s)

20a
Agger nasi cell in coronal section.

20b
Agger nasi cell in sagittal section.

20c
Kuhn type 1 cell in coronal section.

20d
Kuhn type 1 cell in sagittal section.
Kuhn type 2 cell in coronal section.

Kuhn type 2 cell in sagittal section.

Kuhn type 3 cell in coronal section.

Kuhn type 3 cell in sagittal section.

Kuhn type 4 cell in coronal section.

Kuhn type 4 cell in sagittal section.
20k
Supraorbital cell in coronal section.

20m
Frontal bulla cell in coronal section.

20o
Suprabullar cell in coronal section.

20n
Frontal bulla cell in sagittal section.

20l
Supraorbital cell in sagittal section.

20p
Suprabullar cell in sagittal section.
5.11 Configuration of the Anterior Skull Base

The configuration of the anterior skull base is subject to considerable variation. Keros (1965) identified three main types. Keros type I (approximately 8% of cases) is a relatively flat ethmoid roof that is roughly continuous with the lateral lamella of the cribriform plate, which is no more than 3 mm high. In Keros type II (approximately 80% of cases), the lateral lamella of the cribriform plate measures 4–7 mm, placing the ethmoid roof at a level considerably above the cribriform plate.

Keros classification of ethmoid roof configurations. (a) Type I (1–3 mm), (b) type II (4–7 mm), (c) type III (8–16 mm), and (d) an asymmetrical ethmoid roof (oblique lateral lamella of the cribriform plate) in a type II configuration. (21a–d)
Keros type III (approximately 12% of cases) was called a “dangerous ethmoid” by J. Kainz (1988). The cribriform plate is 8–16 mm lower than the ethmoid roof, and surgical manipulations in this region pose an increased risk of injury to the delicate bone of the lateral lamella, which may be as thin as 0.2 mm. But the thinnest part of the anterior skull base is the site where the anterior ethmoidal artery enters the olfactory fossa in the “ethmoid sulcus.” The bone in this area is no more than 0.05 mm thick, and the pressure from a surgical instrument may be sufficient to perforate it, causing a CSF leak.

**5.12 Maxillary Sinus**

The maxillary sinus is quite variable in its development and pneumatization. Besides normally pneumatized forms, W. Bolger distinguished three types of maxillary sinus hypoplasia. Of greater practical importance is the fact that the uncinate process may also be hypoplastic or absent. It is important to detect this condition preoperatively, as it might otherwise lead to complications in the orbital region.

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**Bolger classification of maxillary sinus hypoplasia.** (22a–c)
6.0 Preoperative Preparations

6.1 CT Checklist

H. Stammberger (1994) and D. Simmen (1997) stressed the importance of reviewing a “CT checklist” for the systematic analysis of available CT scans before operating on the paranasal sinuses. The table below is a condensed version that reviews some of the information available in preoperative CT scans. Every sinus surgeon should make a habit of systematically analyzing the CT scans before operating, not only to avoid potential complications but also to establish the cause of the underlying disease.

<table>
<thead>
<tr>
<th>Questions to ask about the patient’s CT scans:</th>
<th>Caution:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is it the patient’s scan?</td>
<td>Make sure the scan has not been misfiled or mislabeled.</td>
</tr>
<tr>
<td>Has the patient had another operation since the CT scans were taken?</td>
<td>Make sure the scans are up-to-date.</td>
</tr>
<tr>
<td>Do the R/L labels on the scans agree with the patient’s anatomy?</td>
<td>Septal spurs, septal ridges, and other distinctive anatomical features are useful lateralizing landmarks.</td>
</tr>
</tbody>
</table>

**Evaluation of the lateral nasal wall and ostiomeatal unit:**

- What is the appearance of the ethmoid infundibulum? Is there a closely adjacent uncinate process? **Caution:** There is a risk of entering the orbit during removal of the uncinate process.
- What is the appearance of the ethmoid bulla? Is it pneumatized, or is there considerable medial protrusion of the orbit? **Caution:** The orbit may be injured during removal of the presumed ethmoid bulla.
- What is the appearance of the middle turbinate? Is it present after previous surgery? **Caution:** An important landmark may be absent.
- Do scans show an Agger nasi cell or various frontoethmoidal cells that may narrow the frontal recess? **Caution:** May cause recurrent frontal sinus problems.
- Where is the superior attachment of the uncinate process? Does it attach laterally to the lamina papyracea, superiorly to the skull base, or medically to the middle turbinate? **Caution:** Determines the frontal sinus outflow tract.
- Are infraorbital cells (Haller cells) present? **Caution:** Haller cells may cause recurrent maxillary sinus problems.
- What is the appearance of the anterior skull base? Are there any asymmetries? What is the Keros type? **Caution:** Keros type III is associated with an increased risk of injury to the lateral lamella of the cribriform plate (CSF leak).
- What is the course of the anterior ethmoidal artery? Does it pass freely through the ethmoid roof (Keros type II and III)? **Caution:** Injury to the artery may cause a retro- or intrabulbar hematoma with risk of blindness.
- Are sphenoid cells (Onodi cells) present? **Caution:** Surgical manipulations on the posterior ethmoidal cells may injure a prominent optic nerve or internal carotid artery, with risk of blindness or profuse hemorrhage.
- What is the appearance of the carotid canal? Are there septations in the sphenoid sinus that are in contact with the carotid canal? **Caution:** Manipulations may cause injury to the internal carotid artery.
- Are there any sites of bony dehiscence due, for example, to previous surgery or trauma involving the facial bones? **Caution:** Dehiscent sites may expose the dura or allow herniation of orbital contents.
- Is an endonasal approach still feasible in patients with frontal sinus disease? **Caution:** It may also be necessary to consider an extranasal approach.
- Is there any evidence of a preexisting CSF leak? **Caution:** This would increase the risk of dural injury.

*Note that the above questions cover only some of the many aspects that should be considered in paranasal sinus operations. The literature (H. Stammberger, D. Simmen) should be consulted for additional details.*
6.2 Camera and Monitor

An endoscopic camera and monitor are extremely useful as they enable the anesthesiologist, operating room personnel, and assistant to follow the operation and evaluate its progress and current status by watching the screen. The surgeon can operate by using a beam splitter and looking directly through the eyepiece of the endoscope, or by viewing the monitor image. The monitor-based “four-hand technique” may be useful in special situations.

Working from the monitor is particularly helpful in surgery of the frontal recess, because looking directly through the endoscope eyepiece (e.g., at a 45° angle) places the surgeon close to the patient’s chest; this can be very cumbersome when larger instruments are used. Additionally, the monitor can display a magnified image that is extremely helpful in performing precise manipulations in the area of the frontal recess, optic nerve, anterior skull base, and other critical sites. The monitor also allows an experienced rhinosurgeon to demonstrate the steps in the operation to a visiting colleague. It enables the scrub nurse to pass the correct instruments more efficiently, and it enables the anesthesiologist to assess bleeding in the operative field. Image quality has improved markedly in recent years owing to the availability of excellent single-chip and three-chip cameras and high-quality digital cameras.

Equipment setup for a surgical navigation system. (23a, b)

Operating with a navigation system.

Monitor of the navigation system (diagnosis: fibrous dysplasia).

6.3 Navigation Systems

Today various manufacturers offer navigation systems for computer-assisted surgery (CAS). Some of these systems differ markedly in their technology, and this should be considered during procurement. Today, the use of navigation systems has become well established in cases with difficult anatomical conditions; in revision procedures on the frontal sinus, orbit, and maxillary sinus; in interdisciplinary biopsies and tumor resections; and in education and training (G. Grevers et al., 2002). Once the surgeon has completed the learning curve, the initially long preparation time can be substantially reduced. Studies are still needed to determine the degree to which navigation systems can reduce intraoperative complications. In summary, once a navigation system has become established at a center, it provides an accurate and efficient tool that plays an important role in quality assurance and surgical training. It should be noted, however, that navigation systems are decision-making aids that cannot take the place of detailed anatomical knowledge.
6.4 Powered Instrumentation

Powered instrumentation is a collective term for the shaver systems that are increasingly used in endonasal endoscopic sinus surgery. These instruments enable the surgeon to remove tissue while simultaneously clearing the field of blood and debris. The shaver consists basically of a rotating blade that oscillates within a suction channel. Constant suction is applied, drawing the resected tissue fragments through an opening (“fenestration”) and into the suction channel. The resected tissue is trapped in a small basket filter so that it can be histologically examined. The shaver window and cutting edges come in various shapes that produce different effects on the tissue.

6.5 Position of the Patient and Surgeon

The right-handed surgeon generally stands to the right of the patient. The elbows are braced to allow for calm, steady manipulation of the instruments. The patient’s upper body is elevated 15–20°. The head should be naturally positioned and turned slightly to the right (i.e., toward the surgeon). The eyes are not taped shut. When a monitor is used, there should be a straight path between the surgeon, the patient’s head, and the screen. The instrument nurse also stands to the right of the patient.
7.0 General Anesthesia

H. Ledderose

Sinus operations are usually performed under general anesthesia. The patient is intubated with a flexible, spiral endotracheal tube that is secured with adhesive tape in the midline of the chin. The oropharynx and hypopharynx are packed with moist gauze to help prevent aspiration and to keep large amounts of blood from entering the stomach (the main cause of postoperative nausea). Before the start of the operation, the patient is positioned with the upper body slightly elevated. This position promotes venous return from the head and neck and helps prevent venous stasis. It also lowers the arterial blood pressure, creating more favorable operating conditions. The operative field should be as bloodless as possible for successful endoscopic sinus surgery. Bleeding in the operating field can be further reduced by inserting epinephrine-soaked pledgets and by infiltrating the site with a local anesthetic containing epinephrine. Blood pressure elevation and cardiac arrhythmias may still occur in varying degrees. Even the modern volatile anesthetics sevoflurane and desflurane cause peripheral vasodilation and also have an emetic effect, making them less suitable for use in endoscopic sinus surgery. On the other hand, good results have been achieved with total intravenous anesthesia (TIVA) using propofol as an hypnotic.

8.0 Surgical Techniques

Endoscopic sinus surgery is usually performed under general endotracheal anesthesia. Local anesthesia may be sufficient if the surgery is confined to the middle meatus and anterior ethmoid. If the patient is very anxious or if the procedure is expected to last 1–2 hours, general endotracheal anesthesia is preferred as it will provide better analgesia for all the sinuses and will help prevent aspiration.

During the operation, the endoscope (held in the left hand) should always be placed above the operating instruments in the upper part of the nasal vestibule to allow enough room to introduce the instruments (held in the right hand). Avoid crossing the endoscope and instrument. When dissecting in the frontal recess, there are situations where the endoscope may be placed below the instrument in order to create more room for instrument maneuvers.

Generally, the endoscope should be placed above the operating instrument so that the latter can be introduced below the scope under vision. The elbows are braced, allowing the hands to work in a relaxed position.
8.1 Terminology and Nomenclature

H. Stammberger, W. Hosemann, and W. Draf (1997) published a set of standard terms for anatomical nomenclature relating to the paranasal sinuses, while D. Simmen and N. Jones (2005) did the same for surgical procedures on the sinuses. Their terminology is outlined below.

<table>
<thead>
<tr>
<th>Standard terms and definitions for paranasal sinuses operations, according to D. Simmen and N. Jones (2005):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infundibulotomy:</strong></td>
</tr>
<tr>
<td><strong>Partial anterior ethmoidectomy:</strong></td>
</tr>
<tr>
<td><strong>Ethmoidectomy:</strong></td>
</tr>
<tr>
<td><strong>Sphenoidectomy:</strong></td>
</tr>
<tr>
<td><strong>Frontoethmoidectomy:</strong></td>
</tr>
<tr>
<td><strong>Draf</strong> described three procedures for enlarging the frontal sinus outflow tract: type I (superior resection of the uncinate process), type IIA and IIB (partial to maximal opening of the frontal sinus between the septum and lamina papyracea), and type III (median drainage procedure).</td>
</tr>
<tr>
<td><strong>Infundibulotomy:</strong></td>
</tr>
<tr>
<td><strong>Partial anterior ethmoidectomy:</strong></td>
</tr>
<tr>
<td><strong>Ethmoidectomy:</strong></td>
</tr>
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</tr>
</tbody>
</table>

The author recommends the use of a nationally or internationally standardized nomenclature and terminology for paranasal sinus operations.

8.2 Preoperative Vasoconstriction

Significant bleeding in the operative field can critically influence the success or failure of an operation, making it considerably more difficult to identify anatomical structures and increasing the risk of intraoperative complications and postoperative scarring. For example, bleeding makes it more difficult to identify frontoethmoid cells that block the frontal sinus ostium, and this could result in persistent frontal sinus complaints. Thus, the reduction of intraoperative bleeding is essential to facilitate intraoperative dissections (A. Leunig, 2006) (Tab. 2).

<table>
<thead>
<tr>
<th>Tab. 2: Preoperative measures to reduce bleeding and improve vision in the operative field.</th>
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<tbody>
<tr>
<td>• Treat infection and inflammation with preoperative antibiotics and steroids (W. Fokkens et al., 2005).</td>
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<tr>
<td>• Elevate the patient’s upper body 15° to 20°.</td>
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<tr>
<td>• Place cotton pledgets moistened with 1:5000 epinephrine into the middle meatus for 8–10 minutes.</td>
</tr>
<tr>
<td>• Caution: suture-tagged cotton applicators should be moist but not dripping wet.</td>
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<tr>
<td>• Inject local anesthetic containing a vasoconstricting agent at the insertion of the middle turbinate (e.g., 0.5–1 mL of 1% prilocaine with 1:200.000 epinephrine).</td>
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</tbody>
</table>
Preparation of the operative site with epinephrine-soaked cotton applicators. (27a–f)

27a
From 0.5 to 1 mL of 1% prilocaine with epinephrine added (1:200,000) is injected at the insertion of the middle turbinate.

27b
Corresponding CT scan.

27c
Preparation of the suture-tagged cotton applicators moistened with 1:5,000 epinephrine.

27d
The cotton applicators are placed at the postero-inferior end of the middle turbinate, into the middle meatus, and between the middle turbinate and septum.

27e
The cotton applicators are left in place for 8–10 minutes.

27f
Operative site after removal of the concha bullosa and a partial anterior ethmoidectomy.
8.3 Infundibulotomy

The first and most important step in endonasal ethmoid surgery is the infundibulotomy, in which the medial wall of the ethmoid infundibulum (i.e., the uncinate process) is removed to open the anterior ethmoid.

To ensure that this step is carried out correctly and to prevent postoperative synechiae and iatrogenic complications (particularly likely with an atelectatic ethmoid infundibulum), it is essential to understand the anatomy of the uncinate process. The UP is a hook-shaped structure composed of a thin bony plate that is covered by mucosa on both sides and lies in an approximately parasagittal plane. It may attach superiorly to the lamina papyracea, skull base, or middle turbinate. This has important technical implications only in frontal sinus operations (see dissection of the frontal recess and frontal sinus). With correct removal of the anterior and postero-inferior portions of the UP, the natural maxillary sinus ostium can be seen.

The following points should be noted in an infundibulotomy:

- Care is taken to preserve the middle turbinate mucosa when the attachment of the UP is palpated and identified.
- The middle turbinate should not be medialized if at all possible, as this weakens the stability of the turbinate and increases the risk of postoperative lateralization.
- The UP is incised posterior to its line of attachment with a suitable instrument (e.g., sickle knife, Joseph knife). The cut is deepened by redirecting the instrument into the sagittal plane to avoid injury to the lamina papyracea and orbit.
- The UP is displaced medially to expose the interior of the ethmoid infundibulum and the anterior surface of the ethmoid bulla.
- The UP is freed superior and antero-inferior to the line of incision with a fine scissors.
- The UP is removed with a Blakesley forceps, which is applied high on the process and extracted with a twisting motion (clockwise on the left side, counterclockwise on the right side).
- With complete removal of the UP, the natural maxillary sinus ostium should be visible postero-inferiorly. Leaving inferior remnants of the UP may continue to block the natural maxillary sinus ostium.
- To avoid mucosal trauma, only special blunt-tipped probes should be used to probe the natural maxillary sinus ostium.
- If the attachment of the UP cannot be identified, it may be possible to resect the UP in stages, working from posterior to anterior.
- Another method of removing the UP is the “swinging door technique,” in which the process is freed inferiorly with a backbiting forceps, swung forward, and detached with a 45° angled Blakesley nasal forceps or punch, for example.
- The superior incision through the UP is placed below the insertion of the middle turbinate.
- A common error in infundibulotomy is an incomplete antero-inferior resection of the UP. Result: failure to expose the maxillary sinus ostium.
- External pressure on the eye during the infundibulotomy may help prevent injury to the lamina papyracea or make it easier to recognize this injury when it occurs.
- **Caution:** If the lamina papyracea is opened without breaching the periorbita, the latter will bulge forward when external pressure is placed on the eye.
- **Caution:** If the periorbita is opened, posterior fat herniation will occur and may be accompanied by prolapse of the medial rectus muscle.
- **Caution:** Shavers tend to grasp and cut soft tissue (e.g., orbital fat) more than harder tissue.
- **Caution:** Small defects in the orbit require no treatment other than antibiotic therapy and the avoidance of nose blowing. Larger defects can be splinted. Prolapsed tissue should never be resected, as this could lead to scarring that restricts ocular motility.
- **Caution:** Lacrimal duct injuries are rare when the UP is incised with a sickle knife. They are more common when a backbiting forceps is used.
- **Caution:** If the lacrimal duct is inadvertently opened, small bone fragments should be removed. If the duct is not obstructed, no further measures are needed.
- **Caution:** Crushing the lacrimal duct with a backbiting forceps may result in obstruction due to scarring.
- **Caution:** When an atelectatic UP is incised with a sickle knife, there is a greater risk of orbital entry due to the very close proximity of the process to the orbit. It is better to use a backbiting forceps in these cases.
Preoperative CT scan.

Steps of an infundibulotomy with exposure of the natural maxillary sinus ostium. (28a–n)

Right side: The initial incision is made with the sickle knife.

The cut is redirected into the sagittal plane.

View into the ethmoid infundibulum following medial displacement of the uncinate process. The natural maxillary sinus ostium can be seen.
Left side: The uncinate process is incised with the sickle knife …

… and the cut is redirected into the sagittal plane.

View into the ethmoid infundibulum, showing retained secretions.

View of the ethmoid bulla following removal of the uncinate process.

View into the middle meatus following removal of the ethmoid bulla.
The uncinate process is detached inferiorly ...

... and superiorly with a MESSERKLINGER scissors.

The uncinate process has been removed ...

... exposing the natural maxillary sinus ostium.

Final appearance of the left middle meatus.
Opening the natural maxillary sinus ostium after removal of a left concha bullosa and the uncinate process. (29a–j)

Preoperative CT scan.

Concha bullosa before ...

... and after removal of its lateral portion.

The UP is incised with the sickle knife.

The UP is displaced medially.
Inferior remnants of the UP still cover the natural maxillary sinus ostium.

Location of the maxillary sinus ostium.

Remnants of the UP are removed …

… exposing the interior of the maxillary sinus.

Final appearance of the left middle meatus.
Endoscopic Surgery of the Lateral Nasal Wall, Paranasal Sinuses, and Anterior Skull Base

Coronal section at the level of the crista galli (CG). The immediate proximity of the uncinate process (UP) to the medial orbital wall is clearly demonstrated. Inferior turbinate (IT), middle turbinate (MT), infraorbital nerve (IN), maxillary sinus (MS), anterior ethmoid (AE).

Specimen and photo courtesy of B. Tillmann, Kiel.

Complication following an infundibulotomy. (31a, b)

Atelectatic uncinate process ("dangerous ethmoid infundibulum") in a patient with a type II hypoplastic maxillary sinus.

The orbit was inadvertently opened during endoscopic ethmoid surgery, resulting in a palpebral hematoma and emphysema.
8.4 Dissection of the Nasal Turbinates

The middle turbinate is part of the ethmoid bone and should be left alone unless there is a concha bullosa, tumor, or CSF leak that necessitates middle turbinate surgery.

The most frequent indication for surgical reduction of the middle turbinate is hyperplasia of the bone or mucosa. Rarely, this surgery may also be indicated for symptomatic nasal airway obstruction due to pneumatization of the middle turbinate.

In rare cases the superior turbinate may also be pneumatized, leading to recurrent “contact headaches.”

**Caution:** If the middle turbinate has been resected, it deprives the surgeon of an important landmark. The remnant (stump) of the middle turbinate may become lateralized and obstruct the frontal recess, leading to frontal sinus problems.

**Note:** If the middle turbinate has been destabilized by surgical dissection and is prone to lateralization, a shaver or sickle knife can be used to make one small wound in the middle turbinate mucosa and another in the opposing septal mucosa. This results in corresponding mucosal wounds on both surfaces. The middle turbinate is then splinted in a medialized position with nasal packing in the middle meatus (e.g., Sinus Pack or glove finger pack) for one to two days. In most cases this will cause small synechiae to form between the turbinate and septal mucosae, stabilizing the position of the middle turbinate.

Controlled synechiae technique (after W. Bolger et al., 1999) following previous lateralization of the middle turbinate on the right side.
8.5 Partial Anterior Ethmoidectomy

During embryonic development, the anterior ethmoid becomes separated from the posterior ethmoid by the basal lamella of the middle turbinate. It is often necessary to remove the diseased ethmoid bulla (EB) during ethmoid surgery for the treatment of CRS or ethmoid polyposis. By definition, this operation is classified as a partial anterior ethmoidectomy (after Simmen, 2005).

The following points should be noted during removal of the ethmoid bulla:

- The anterior surface of the EB should be visible following a complete anteroinferior resection of the UP.
- The bulla can be removed with a straight or angled Blakesley nasal forceps.
- First the EB is infractured medially and inferiorly.
- **Caution:** In rare cases the EB may not be pneumatized. In this situation, care should be taken to avoid opening the orbit inadvertently.
- The anterior surface of the EB is completely removed.
- The medial wall of the EB, which may be hidden by the middle turbinate, is removed next. Failure to remove the medial wall may result in persistent complaints.
- The resection should include the natural ostium of the EB, which is generally located posteromedially.
- No additional steps are necessary in a partial anterior ethmoidectomy.
- **Caution:** The skull base generally forms the superior limit of the partial anterior ethmoidectomy, and the basal lamella of the middle turbinate forms the posterior limit.

View of the left ethmoid bulla and the opened maxillary sinus ostium.

Infracture of the anterior wall.
The anterior wall is taken down …

… with a 45º angled BLAKESLEY nasal forceps.

The remaining medial wall of the ethmoid bulla …

… should also be removed in an anterior ethmoidectomy.

This can be done with a straight or angled BLAKESLEY nasal forceps.

Generally at this point, the basal lamella can be identified.
8.6 Frontoethmoidectomy

The endonasal approach to the frontal sinus is the most part of endoscopic sinus surgery. It is essential to identify and preserve the natural outflow tract of the frontal sinus. The posteroinferior portion of the UP is usually easy to identify during analysis of the coronal CT sinus images. Often the portion of the UP is not identified because it is posterior to the insertion of the middle turbinate and is frequently interpreted as an “anterior ethmoid cell” or Agger nasi cell. The superior portion of the UP may extend to the lamina papyracea, skull base, or middle turbinate. Combinations of these variants may also occur.

Often the UP attaches superiorly to the lamina papyracea (approximately 50% of cases), and the ethmoid infundibulum terminates blindly at its upper end, forming a sac called the terminal recess. In this case the ethmoid infundibulum and frontal recess do not communicate with each other. The frontal recess opens into the middle meatus medial to the ethmoid infundibulum between the UP and middle turbinate. If the UP attaches superiorly to the skull base (approximately 10% of cases) or medially to the middle turbinate (approximately 40% of cases), the frontal sinus drains directly into the ethmoid infundibulum.

The frontal sinus may drain directly into the middle meatus (left) or into the ethmoid infundibulum, depending on the superior attachment of the uncinate process (UP) (modified from Friedman et al.). (34a–f)
When we evaluate the plane of the natural frontal sinus ostium on sagittal CT scans, we observe an hourglass-shaped passage whose narrowest point is at the level of the natural frontal sinus ostium. The overlying part of the sinus that narrows toward the natural ostium is called the frontal infundibulum. The area below the natural sinus ostium is called the frontal recess. It extends to the insertion of the middle turbinate and to the ethmoidal artery.

Not infrequently, a very high terminal recess is misidentified on coronal CT scans as an ANC. It is necessary at operation to remove the posteromedial wall of an ANC in order to obtain a clear view into the frontal sinus.

If the UP attaches superiorly to the middle turbinate or anterior skull base, the natural frontal sinus ostium will be clearly visible immediately after removal of the superior portion of the UP. It may also be visible initially, since its outflow tract runs lateral to the UP and the frontal sinus drains directly into the ethmoid infundibulum. In this situation it is dangerous to dissect medial to the superior attachment of the UP. Particularly with a Keros type II or III anterior skull base, this may lead to perforation of the lateral lamella of the cribiform plate resulting in a CSF leak. It may be helpful in these cases to remove the posterior wall of an ANC in order to fully expose the frontal sinus ostium.

The structure that initially appears to be the frontal sinus may in fact be a very high terminal recess, an ANC, or a frontoethmoid cell. Doubts can be resolved by probing the sinus with a Ritter dilator, transilluminating the sinus, or using a surgical navigation system.

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Removal of the terminal recess and exposure of the natural frontal sinus ostium. (35a–c)

The thin bony plate (45° telescope) is removed with an angled KUHN curette (55° or 90°) ...

... exposing the plane of the natural frontal sinus ostium and the interior of the frontal sinus.
Tips and Tricks

The frontal sinus is probed with a Ritter dilator through an endonasal approach (45° telescope).

External view.

Transillumination of the frontal sinus.

Image-guided view of an Agger nasi cell that has been opened ...

… and removed, exposing the interior of the frontal sinus.
The following points should be noted when dissecting in the area of the frontal recess and natural frontal sinus ostium:

- It is important to be familiar with anatomical variants of the frontal recess displayed on coronal, axial and sagittal CT scans.
- A clear field (epinephrine vasoconstriction) is important in avoiding excessive tissue resection.
- Suitable angled instruments and telescopes (e.g., 45°) should be used. Generally, the instrument is positioned below the endoscope.
- The middle turbinate should not be fractured, as the lateralized turbinate may obstruct the frontal recess.
- In the case of a large ANC, the thin anterior wall can be taken down with a straight rongeur.
- If the natural frontal sinus ostium cannot be visualized after removal of the UP, EB, or ANC, the cause is usually a thin, intact bony plate that is in contact with the skull base or lateral lamella of the cribriform plate and is still obstructing the plane of the natural frontal sinus ostium.
- **Caution:** Careless dissection of this bony plate may cause injury to the skull base or lateral lamella of the cribriform plate, resulting in a CSF leak.
- The bony plate can be identified and carefully removed with a fine, angled curette.
- With an ANC, the instrument is inserted posteriorly between the skull base and bony plate, and the plate is carefully fractured forward and downward.
- **Caution:** With a posteroinferior EB or a high terminal recess, the instrument is inserted medially between the middle turbinate and bony plate, which is carefully fractured laterally downward.
- After the plane of the natural frontal sinus ostium has been exposed, small bone fragments can be removed with a small angled forceps or punch.
- The mucosa of the natural frontal sinus ostium or the mucosa in the frontal recess should be preserved all around the luminal circumference to avoid stricture formation.
- If the frontal sinus surgery is done with good visibility and adequate instruments and proceeds one step at a time based on an analysis of CT scans in three planes, there is no need for blind probing of the frontal recess or natural frontal sinus ostium. This avoids unnecessary trauma to the frontal recess and sinus mucosa.

As in the case of the natural maxillary sinus ostium following inferior removal of the UP, the natural ostium of the frontal sinus can often be identified following removal of the superior attachment of the UP. The natural sinus ostium may not be visible in complex anatomical situations where multiple frontoethmoid cells are present. An intraoperative navigation system may be helpful in these cases.

Besides the type I and type IIa frontal sinus drainage procedures already described, W. Draf also defined type IIb and type III procedures. The main difference lies in the extent of the frontal sinusotomy. In the type IIb procedure, the natural frontal sinus ostium is maximally enlarged from the lamina papyracea to the nasal septum. The most extensive endonasal frontal sinusotomy is the Draf type III drainage procedure, known also as the median drainage or modified Lothrop procedure. In both the type IIb and type III procedures, powered instrumentation is used to remove the floor of the frontal sinus between the two laminae papyracea, the interfrontal septum, and the superior nasal septum to establish broad drainage from the frontal sinus.
The frontal sinus is opened following removal of a frontoethmoid cell (Kuhn type 3, K3). (37a–k)

Recurrent right frontal sinusitis with opacity...

... and frontoethmoid cells above an Agger nasi cell on the right side.

Sagittal CT scan demonstrates a large frontoethmoid cell (K3) above an Agger nasi cell.

The frontoethmoid cell extends into the frontal sinus.

Middle meatus.

The frontal sinus is approached between the medial cell wall and middle turbinate.
The medial wall of the cell is progressively taken down …

… until the frontal sinus is opened.

Polypous, watery mucosa in the frontal sinus.

Final appearance after complete removal of the K3 cell and aspiration of the mucosal edema.
### 8.7 Sphenoethmoidectomy

The posterior ethmoid may contain cells that are located behind the basal lamella of the middle turbinate and lateral to the superior turbinate. The basal lamella is not a uniform anatomical structure and is highly variable in its course.

**The following points should be noted when opening the posterior ethmoid:**

- The horizontal and vertical course of the basal lamella should be identified.
- The basal lamella is perforated approximately 3–4 mm cranial to the junction of its horizontal and vertical portions, and the superior meatus is entered.
- **Caution:** Due to possible anatomic variants of the basal lamella, the lamella should always be perforated at an inferomedial site to avoid injury to the anterior skull base.

<table>
<thead>
<tr>
<th>Caution: The posterior ethmoid may be pneumatized far superiorly or laterally around the sphenoid sinus. This anatomical variant is called a sphenoethmoid cell or Onodi cell. The bony boundary of the orbit is very thin, and the optic nerve or internal carotid artery may be very prominent in the posterior ethmoid and may even lack a bony covering.</th>
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</thead>
<tbody>
<tr>
<td>With isolated disease of the sphenoid sinus, the sinus may be approached through its natural ostium by the direct transnasal route.</td>
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<tr>
<td><strong>Caution:</strong> This approach depends on anatomical factors. If the passageways are small, the use of a standard 4-mm 0º telescope and operating instruments involves the risk of fracturing the middle turbinate and traumatizing the mucosa.</td>
</tr>
<tr>
<td>Significant septal deviation should be corrected as it will improve surgical access and facilitate postoperative care.</td>
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<tr>
<td>In a transethmoidal sphenoidotomy, the sphenoid sinus should always be opened medially and inferiorly in the posterior ethmoid region. The sinus can be opened with a curette.</td>
</tr>
<tr>
<td><strong>Caution:</strong> If the location of the natural ostium is uncertain, it can be identified visually or by careful transnasal probing with a fine instrument. The ostium is located medial to the superior turbinate (landmark).</td>
</tr>
<tr>
<td>Removal of the anterior wall of the sphenoid sinus should include the natural ostium. This can be done with a straight circular-cutting punch.</td>
</tr>
<tr>
<td><strong>Caution:</strong> It is unnecessary to resect the middle or superior turbinate in order to open the sphenoid sinus.</td>
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</tbody>
</table>
Endoscopic Surgery of the Lateral Nasal Wall, Paranasal Sinuses, and Anterior Skull Base

Transethmoidal sphenoidotomy. (38a–k)

Right middle meatus.

The ethmoid bulla is removed ...

... and the basal lamella is opened.

Overview of the sphenethmoid recess and superior turbinate.

The natural sphenoid sinus ostium is identified medial to the superior turbinate.
The sphenoid sinus is opened by the transethmoidal route.

The sinus is opened medially and inferiorly.

The opening is enlarged with a straight circular-cutting punch.

Tranethmoidal view into the sphenoid sinus.

Opened maxillary and sphenoid sinuses following sphenoethmoidectomy.

Appearance of the right middle meatus at the end of the procedure.
J. Lang (Würzburg, Germany) identified three main types of sphenoid sinus pneumatization: (a) the conchal type (3%), (b) the presellar type (11%), and (c) the sellar type (86%). Panel (d) is an axial section through the roof of the sphenoid sinus, illustrating the close proximity of the optic nerve (yellow), internal carotid artery (red), and cavernous sinus (blue). (39a–d)
Coronal section (a) through the sphenoid sinus. Note the close proximity of the optic nerve and internal carotid artery (ICA) to the wall of the sphenoid sinus. Sagittal section (b) of a well-pneumatized (sellar type) sphenoid sinus demonstrates the pituitary, optic canal, carotid canal, and an intervening infratemporal recess. (40a, b)

Sphenoid sinus (SS) and adjacent structures in coronal section. Internal carotid artery (ICA), optic nerve (ON), and nasal septum (S).
Specimen and photo courtesy of B. Tillmann, Kiel.

8.8 Maxillary Antrostomy

The following points should be noted in an endonasal maxillary antrostomy:

- **Caution**: A common error is failure to expose the natural maxillary sinus ostium, instead creating a separate antral fenestration in the posterior fontanelle.
- The presence of this fenestration or an accessory ostium may interfere with normal mucociliary clearance, causing mucus to recirculate from the natural ostium through the accessory ostium or fenestration back into the maxillary sinus, leading to recurrent complaints. Accessory ostia should always be connected to the natural ostium.
- As a general rule, the maxillary sinus can be clearly evaluated with a 45° or 70° endoscope following exposure of the natural ostium.
- If this cannot be done, the natural ostium can be enlarged in the inferior or posterior direction (posterior fontanelle) with suitable instruments.
- Indications for enlarging the natural maxillary sinus ostium are nasal polyposis in cystic fibrosis or aspirin intolerance, maxillary sinus aspergilloma, and inverted papilloma.
- In selected cases (e.g., foreign body, aspergilloma), the endonasal approach can be combined with antroscopy through the anterior wall of the maxillary sinus.
- In most patients with inflammatory maxillary sinus disease, it is sufficient to use the endonasal approach without enlarging the sinus ostium or creating an infraturbinate fenestration.
Endoscopic Surgery of the Lateral Nasal Wall, Paranasal Sinuses, and Anterior Skull Base

CT scan in chronic rhinosinusitis.

Right maxillary antrostomy during a revision procedure. The natural maxillary sinus ostium was still blocked by remnants of the uncinate process. (41a–i)

The natural maxillary sinus ostium on the right side is still blocked.

Endoscopy reveals an accessory maxillary sinus ostium located farther back in the middle meatus.

The natural maxillary sinus ostium is identified with a special atraumatic probe …

… and inferior remnants of the uncinate process are removed with an antrum punch.
The natural maxillary sinus ostium is exposed … and connected to the accessory ostium to prevent the recirculation of mucous.

Remnants of the UP are removed with a backbiting forceps.

View into the maxillary sinus at the end of the procedure.
View of a supraturbinate antral fenestration (created in a previous sinus operation) in the left posterior fontanelle. Anterior to it is the natural maxillary sinus ostium.

Connecting an iatrogenic supraturbinate antral fenestration in the posterior fontanelle to the natural maxillary sinus ostium. (42a–c)

The tissue bridge between the two ostia is removed with a backbiting forceps …

… resulting in a common antral fenestration.

The maxillary sinus mucosa in chronic rhinosinusitis (CRS). (43a, b)

Typical appearance of the mucosa in CRS.

Corresponding CT scan.
8.9 Endoscopic Medial Maxillectomy

The most common benign tumor of the maxillary sinus is inverted papilloma. For the removal of small tumors, the natural maxillary sinus ostium can be enlarged and a working port can be placed in the anterior wall of the maxillary sinus (as in antroscopy) to create access for tumor removal. This technique may not work with very large tumors or tumors of the anterior antral wall. If an extranasal approach is not indicated, these tumors can be removed using the “four-hand technique” (P. J. Wormald, 2004; D. Simmen and H. Briner, 2006) in which one surgeon holds the endoscope and a second surgeon holds the instrument and suction tube, for example.

The following points should be noted in an endoscopic medial maxillectomy:

- The tumor is evaluated preoperatively with CT and MRI.
- The operative field is prepared (vasoconstriction) as previously described. A local anesthetic with epinephrine added (e.g. 1:200,000) may also be injected through the greater palatine foramen into the pterygopalatine fossa (R. Douglas and P. J. Wormald, 2006).
- The nasal septum is infiltrated with 1% lidocaine with 1:200,000 epinephrine.
- The UP is removed, and a large supraturbinate antral window is created to the level of the posterior antral wall.
- The EB is removed, and the posterior ethmoid and sphenoid sinus are opened.
- The inferior turbinate is medialized and removed (it may be completely resected if necessary).
- The tumor can be debulked (e.g., with a shaver) if desired.
- Depending on the tumor extent, it may be necessary to incise and elevate the mucosa from the lateral nasal wall, nasal floor, maxillary sinus, and posteriorly to the end of the inferior turbinate.
- The bone (medial maxilla) is removed with an osteotome or burr.
- If necessary, the lacrimal canal is removed below the lacrimal sac and a stent is inserted.

- The “four-hand technique” is particularly useful for tumors that extend into the pterygopalatine fossa and infratemporal fossa. This technique requires an experienced operating team.
- Bone is removed along the course of sphenopalatine artery, and the posterior antral wall is completely removed until the interior of the pterygopalatine fossa can be seen.
- If necessary, the second surgeon can introduce another instrument (suction tube, Blakesley forceps, etc.) into the operative field through a hemitransfixion incision and a horizontal septal incision (P. J. Wormald, 2004).
- Traction must be placed on the tumor tissue in order to isolate the tumor and locate its origin. This is the only way to identify surrounding tissues.
- The maxillary nerve is isolated and preserved.
- Tumor-feeding vessels are coagulated or clipped and divided.
- Following removal of the tumor mass, the tumor bed is inspected for residues, which are removed as needed.
- Meticulous hemostasis is achieved, and the mucosal flap is returned to the posterior antral wall (if resection of the flap was unnecessary).
- The septal incisions are closed.
- Packing is inserted.

Supplemental injection of local anesthetic with epinephrine added (e.g. 1:200,000) through the greater palatine foramen during the resection of an inverted papilloma of the right maxillary sinus.

Local anesthetic with epinephrine added (1:200,000) is injected through the greater palatine foramen into the pterygopalatine fossa (R. Douglas, 2006) to reduce intraoperative bleeding, especially in tumor resections.
Inverted papilloma of the ethmoid bone and sphenoid sinus on the right side.

Resection of an inverted papilloma through an endoscopic medial maxillectomy. Preoperative and postoperative appearance (at 5 years) with corresponding CT scans. (44a–f)

CT scan of the inverted papilloma in (a).

Surgical specimen.

Five years postoperative.

CT scan 5 years postoperative.
## 8.10 Decompression of the Orbit and Optic Nerve

Decompression of the orbit and optic nerve may be indicated in patients with endocrine orbitopathy, hemorrhage, abscesses, or trauma associated with visual deterioration and risk of blindness.

### The following points should be noted in endoscopic decompression of the orbit and optic nerve:

<table>
<thead>
<tr>
<th>Point</th>
<th>Action</th>
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<tbody>
<tr>
<td>The operative field is prepared (vasoconstriction) as previously described. A local anesthetic with epinephrine added (e.g., 1:200,000) may be injected through the greater palatine foramen into the pterygopalatine fossa ([R. Douglas and P. J. Wormald, 2006]).</td>
<td>If optic nerve decompression is required, the sphenoid sinus should be opened broadly enough to clearly display the course of the optic canal and carotid canal.</td>
</tr>
<tr>
<td>The natural maxillary sinus ostium is exposed and maximally enlarged posteriorly by removing the posterior fontanelle. It is enlarged anteriorly to the lacrimal sac, superiorly to the orbital floor, and inferiorly to the upper border of the inferior turbinate.</td>
<td>The lamina papyracea is removed at the level of the orbital apex.</td>
</tr>
<tr>
<td>A sphenoidostomectomy is performed, completely removing the anterior wall of the sphenoid sinus.</td>
<td>The annulus of Zinn (where the eye muscles insert) and the optic tubercle (thickened bony part of the optic canal) are identified.</td>
</tr>
<tr>
<td>The middle turbinate should be preserved!</td>
<td>The bone over the optic nerve is progressively thinned between the posterior ethmoid and sphenoid sinus, working from anterior to posterior with a long diamond burr.</td>
</tr>
<tr>
<td>The lamina papyracea is carefully opened and elevated, sparing the periorbita. The lamina is opened superiorly to the ethmoid roof and posteriorly to the orbital apex, to within several millimeters of the anterior wall of the sphenoid sinus.</td>
<td>The anterior limit is formed by the distal fibers of the medial rectus muscle.</td>
</tr>
<tr>
<td>The medial portion of the orbital floor (bounded laterally by the infraorbital nerve) is removed.</td>
<td>The optic nerve is exposed with microinstruments at the site where the bone is thinnest. It should be exposed circumferentially (180°) from the orbital apex to the optic chiasm.</td>
</tr>
<tr>
<td>Horizontal posterior-to-anterior incisions are made in the periorbita at the level of the ethmoid roof, medial orbit, and orbital floor. Additional incisions may be made.</td>
<td>The optic nerve sheath can be incised in selected cases based on consultation with an ophthalmologist and/or neurosurgeon.</td>
</tr>
<tr>
<td><strong>Caution:</strong> The frontal recess should not be obstructed by herniated orbital fat.</td>
<td><strong>Caution:</strong> The ophthalmic artery runs medial to the optic nerve in up to 15% of cases. Therefore the optic nerve sheath should always be incised in its upper half on the left and right sides.</td>
</tr>
<tr>
<td>Fibrin glue can be applied to the incised optic nerve sheath to prevent CSF leak.</td>
<td></td>
</tr>
</tbody>
</table>
Woman with progressive visual deterioration in the left eye. The orbital apex is opened to obtain a biopsy sample. Histology identified the lesion as adenoid cystic carcinoma. (45a–h)

CT shows a prominent optic nerve and internal carotid artery.

MRI in the same patient reveals a mass at the left orbital apex.

The maxillary sinus is opened to the posterior wall.
The lamina papyracea is opened …

… and removed with a BLAKESLEY forceps.

The periorbita is opened with a sickle knife …

… causing the prolapse of medial rectus muscle and periorbital fat.

Well-pneumatized (sellar type) sphenoid sinus with a deep infraoptic recess (IOR), a prominent optic nerve (ON) and internal carotid artery (ICA).
Opened left maxillary sinus.

The lamina papyracea is opened with a JOSEPH elevator.

Herniated periorbital fat after partial removal of the medial orbital floor and incision of the periorbita. The course of the infraorbital nerve (IN) is visible on the right side of the field.

The herniated fat should not obstruct the maxillary and frontal sinus ostia.
8.11 Endoscopic Septoplasty

As long as there is sufficient endonasal access for a 4-mm endoscope and necessary operating instruments, it is not strictly necessary to perform a septoplasty. A large deviation can be corrected by a classic septoplasty. But localized septal ridges or spurs that restrict access to the middle meatus can be corrected endoscopically. Generally the operation begins with sinus surgery on the side that affords broad access to the middle meatus. Then, if necessary, the surgeon corrects the septum and proceeds with ethmoid surgery on the corrected side.

The following points should be noted in an endoscopic septoplasty:

- With an isolated septal ridge or spur, the mucosa is incised along the deviation with a scalpel, sickle knife, or angled round knife.
- The mucosa cranial and caudal to the deviation is elevated until the ridge or spur can be completely visualized. A Freer suction elevator or similar instrument may be helpful in completing this dissection.
- All dissections are performed in the subperichondrial and subperiosteal planes. Bony and cartilaginous deviations are selectively removed with an osteotome.

Caution: The opposing perichondrium and the septal mucosa should remain intact.

Interrupted sutures may be needed to reappose the mucosal flaps, depending on the extent of the mucosal dissection.

The suture is passed through the edges of the cranial and caudal mucosal flaps with a suitable needle and is tied.

Endoscopic removal of a septal ridge and 2-month postoperative result. (47a–h)

Intraoperative appearance of a septal ridge on the left side. 47a

The mucosa is incised with an angled round knife (a T-shaped incision can also be used). 47b
Cartilage is removed with a BLAKELEY forceps …

… and bone is removed with an osteotome.

The mucosal incision is closed …

… with an absorbable suture.

Appearance at the end of the procedure.

Result at 2 months postoperatively.
8.12 Endoscopic Dacryocystorhinostomy (West Operation)

Besides the extranasal dacryocystorhinostomy first described by Toti in 1904, endoscopic endonasal techniques can also be used in the treatment of postsaccal lacrimal duct stenoses.

The lacrimal duct disease should be diagnosed in consultation with an ophthalmologist, and the surgeon should be familiar with the anatomy of the lacrimal passages.

The following points should be noted in an endoscopic dacryocystorhinostomy:

- The anterior border of the lacrimal sac is located anterior to the insertion of the middle turbinate, and its superior border is above the turbinate insertion.
- The inferior portion of the lacrimal sac is embedded in a bony canal and forms the lacrimal canal, which continues distally to the inferior turbinate. Its average distance from the natural maxillary sinus ostium is approximately 4 mm. Below the inferior turbinate, the lacrimal sac opens into the inferior meatus via the Hasner valve.
- The operative field is prepared (vasoconstriction) as previously described.
- A probe is inserted into the inferior canaliculus, and the lacrimal sac is located by transillumination with an optical fiber (0.5 mm in diameter).

Caution: The anterior border of the lacrimal sac is not the lightest area of the lateral nasal wall visible at endoscopy but the thinnest bony area in the posteromedial nasal wall.

- A mucosal flap is developed in front of and above the insertion of the middle turbinate.
- Agger nasi cells should be removed, as they impede access to the lacrimal sac. It may also be necessary to remove the UP.
- The medial bony wall covering the lacrimal sac is removed with a diamond burr.
- The lacrimal sac is opened with a small knife angled at the tip, and a silicone stent is inserted.
- Packing is optional.

Endoscopic endonasal dacryocystorhinostomy (West operation) for distal lacrimal duct stenosis. (48a–h)

Endoscopic view of the left middle meatus with an Agger nasi cell. The Agger nasi cell and lacrimal bone are removed with a diamond burr.
A probe is inserted into the inferior canaliculus ...

... and the lacrimal sac is identified and incised.

A probe is introduced ...

... and a silicone stent is inserted.

The stent is secured above the inferior turbinate with a nonabsorbable suture.

The operation concludes with the (optional) placement of absorbable packing.
8.13 Choanal Atresia

Five approaches are available for the surgical treatment of choanal atresia: transpalatine, transnasal, sublabial transnasal, transantral, and transseptal. Based on reports in the literature, the endonasal approach yields the best results with the lowest morbidity. Owing to advances in the development of endonasal endoscopic microinstruments and powered instrumentation, the most widely used and successful method at present is the endoscopically controlled endonasal technique. The use of stents following choanal atresia repair is a matter of growing controversy in the literature (S. Schoem, 2004). Stent insertion can lead to infection and local necrosis of the surrounding mucosa.

The following points should be noted in the endoscopic repair of choanal atresia:

- The atresia is diagnosed by nasal endoscopy with a $0^\circ$ scope (2.7 mm or 4 mm in diameter).
- The atresia should be evaluated by CT and, if necessary, MRI.
- Epinephrine-soaked cottonoid (1:5.000) is placed at the operative site for 8–10 minutes.
- The atresia is opened medially and inferiorly.
- Inferior portions of the vomer may also have to be removed.
- A stent is placed if necessary.
- The repair is checked endoscopically at 3–6 months. It may be necessary to enlarge the opening and remove granulations.

Endoscopic repair of choanal atresia. (49a–e)

Intraoperative view of endoscopic choanal atresia repair.

Preoperative CT scan of bony choanal atresia.
Endoscopic endonasal appearance of right choanal atresia.

Postrhinoscopic appearance of choanal atresia.

Result at 3 months postoperatively.
8.14 Nasal Packing

Intranasal packing is not strictly necessary in most endoscopic sinus operations (Messerklinger technique), because usually the operative site is almost bloodless due to the use of epinephrine pledgets and atraumatic operating technique. But if packing is considered necessary, the surgeon may insert an absorbable wound dressing material such as carboxymethylcellulose (CMC), a hyaluronic acid pack, Sinus Pack, or glove finger pack into the opened ethmoid bone. Available nasal packs have been reviewed by A. Beule, R. Weber, H. Kaftan and W. Hosemann (2004).

Different intranasal packing materials. (50a–f)

Intraoperative appearance of the left ethmoid bone before … … and after packing with carboxymethylcellulose (Sinu-Knit™).
Intraoperative appearance of the left ethmoid bone before ...

... and after packing with carboxymethylcellulose (Stammberger Sinus Dressing®).

Sinus Pack in the left nasal cavity.

Glove finger pack in the left nasal cavity.
9.0 Postoperative Care

Postoperative care centers on the medical treatment of mucosal diseases and the prevention of synechiae and scarring in the operative field while ensuring maximal patient comfort. Medical treatment measures may include the use of topical and systemic steroids, antibiotics, and saline nasal irrigations, depending on the underlying disease. Mechanical cleaning of the wound cavity is routinely done 10–14 days postoperatively at our center.

The following points should be noted in postoperative care:

- All patients who have undergone sinus surgery should return for endoscopic follow-up.
- Wound debridement is unnecessary in patients with good wound healing, a clear frontal recess, a patent natural ostium, and a medialized middle turbinate.
- Problem cases in both children and adults call for endoscopically controlled wound debridement with minimal tissue trauma.
- Wound debridement should be kept to a minimum during the first postoperative week. Primary attention is given to suctioning blood clots and secretions, irrigating the nasal cavity, and topical steroid therapy.

The second postoperative week includes endoscopic follow-up in which crusts that are blocking the frontal recess and ostia are removed.

- Additional follow-ups and wound debridement depend on the progress of wound healing.
- Long-term follow-ups are particularly recommended after extensive dissections in the area of the frontal recess and after ethmoid polyp removal.

Situations in postoperative care. (51a–h)

Follow-up endoscopy 2 weeks after surgery shows typical wound coatings and crusts, which should be carefully removed.

Small, asymptomatic synechiae between the middle turbinate and lateral nasal wall that do not interfere with sinus drainage may be left alone.
Recurrent right frontal sinusitis in this patient resulted from failure to remove an Agger nasi cell that obstructed sinus drainage. Revision surgery is indicated following preparatory medical treatment.

The left frontal recess is obstructed by polypous mucosa. The anterior ethmoidal artery is visible in the lower part of the field.

Intraoperative removal of a frontoethmoid cell (Kuhn type 1).

Endoscopy at 3 months postoperatively shows normal wound healing with unobstructed drainage of the frontal recess. Insipissated mucus is visible on the right side of the field.

This patient underwent four sinus operations for frontal headaches caused by an undetected frontoethmoid cell (Kuhn type 3) on the left side.

Three months after removal of a Kuhn type 3 frontoethmoid cell.
10. Tips and Tricks for the Prevention and Treatment of Complications

The preoperative medical treatment of patients with chronic rhinosinusitis (CRS) is an important way to establish optimum operating conditions and prevent iatrogenic complications. Preoperative medical treatment eliminates the need to operate in the presence of an acute infection or severe mucosal inflammation, thereby reducing the risk of intraoperative bleeding. The current guidelines of the European Rhinologic Society and the European Academy of Allergology and Clinical Immunology, which were issued by a prominent group of experts and summarized in the EPOS Document (W. Fokkens et al., 2005), recommend the preoperative use of decongestant nose drops, antibiotics for an acute exacerbation of CRS, and topical and systemic steroid medication. These guidelines are waived, of course, in patients who require immediate surgery due to complications of inflammatory sinus disease.

Bleeding from the territories of the sphenopalatine artery and anterior ethmoidal artery. (52a–f)

- **52a**: Bleeding from a branch of the sphenopalatine artery at the posteroinferior border of the middle turbinate following removal of a concha bullosa.

- **52b**: Bleeding from a branch of the sphenopalatine artery following an inferior sphenoidotomy. Epinephrine pledgets may help initially. The straight circular-cutting punch can also be used if necessary to compress the bleeding vessel. If these measures are unsuccessful, the vessel should be cauterized.

- **52c**: Bleeding from a branch of the sphenopalatine artery (posteroinferior). This type of bleeding can usually be controlled with epinephrine pledgets.

- **52d**: Arterial bleeding occurred when the natural maxillary sinus ostium was opened and enlarged downward to the insertion of the inferior turbinate.

- **52e**: Bleeding from a branch of the sphenopalatine artery following removal of a left concha bullosa.

- **52f**: Bleeding from the left anterior ethmoidal artery.
If bleeding is still present at the end of the operation, the operative area should be scrutinized so that bleeding sites (e.g., branches of the sphenopalatine artery or anterior ethmoidal artery) can be identified and selectively cauterized as needed.

Management of diffuse intraoperative bleeding.

(53a–f)

53a Diffuse eosinophil-dominant ethmoid polyposis in a patient with aspirin intolerance.

53b Shaver systems are particularly useful in the treatment of ethmoid polyposis.

53c Even preoperative medical treatment and the use of shaver systems cannot always prevent diffuse intraoperative bleeding.

53d External view of the case in (c).

53e Bleeding is controlled with several applications of epinephrine pledgets and H₂O₂.

53f Finally the area is packed with an absorbable wound dressing material such as carboxymethylcellulose.
Cautery Techniques

Bleeding from the posterior portion of the nose usually originates from branches of the sphenopalatine artery. These vessels, along with the descending palatine artery, form the terminal branches of the maxillary artery. Monopolar and bipolar cautery instruments are available for coagulating these vessels. One disadvantage of conventional bipolar cautery forceps is lack of precision, especially when dealing with bleeding sites located in the narrow posterior confines of the nose. Often the jaws of the forceps cannot be adequately opened in this area, and the vessel cannot be securely grasped. A new instrument, the Stammberger bipolar suction forceps (KARL STORZ, Tuttlingen, Germany), has been specially designed to control endonasal bleeding in the region of the sinuses and skull base. The main advantage of this bipolar cautery instrument is its small diameter, which allows for precision use in the deeper recesses of the nose and sinuses. The author does not use radiofrequency, high-frequency or laser technology for hemostasis in endonasal sinus surgery.

Sphenopalatine Artery

If the sphenopalatine artery requires electrocautery, a mucoperiosteal flap is elevated in the posterior part of the medial wall of the maxillary sinus. Then the artery is dissected from the sphenopalatine foramen and selectively cauterized. A valuable anatomical landmark for locating the sphenopalatine artery is the ethmoid crest, which is generally found directly in front of the sphenopalatine foramen.
Anterior Ethmoidal Artery

The anterior ethmoidal artery (AEA) runs from lateral to medial through the ethmoid bone in an inferiorly open, often dehiscent canal located at variable distance from the ethmoid roof. The artery pierces the lateral lamella of the cribiform plate to enter the olfactory fossa. Keros has distinguished three types of olfactory fossa. Type I is a very shallow olfactory fossa (1–3 mm) in which the lateral lamella of the cribiform plate is extremely low. In type II the lateral lamella is higher (4–7 mm) and the ethmoid roof is well above the level of the cribiform plate, with a deeper olfactory fossa. In type III the ethmoid roof is up to 16 mm higher than the cribiform plate. This is the most dangerous type from a surgical standpoint, as the risk of iatrogenic injury increases with the length and obliquity of the lateral lamella.

If the AEA is injured in its course below the ethmoid roof, this will not necessarily cause dangerous arterial bleeding into the ethmoid bone. Generally the bleeding can be adequately controlled with measures such as vasoconstrictor pledgets or selective cautery. In any case, monopolar cautery should not be used in immediate proximity to the dura because it may lead to secondary necrosis and dural lesions. The Stammberger bipolar suction forceps is recommended for this application.
The fastest way to decompress the orbit and prevent impending blindness due to a retro- or intraorbital hematoma is by lateral canthotomy and cantholysis. It is essential for the otorhinolaryngologist to master this procedure, therefore. The various steps are as follows:

First a lateral canthotomy is performed by incising the lateral palpebral ligament to the bone, using either a scalpel or a straight pointed scissors. Then the lateral palpebral ligament is divided vertically upward and downward with the scissors along the bony margin. An adequate superior and inferior cantholysis has been done if the surgeon can see orbital fat in the deep part of the field when the lateral portions of the upper and lower lids are widely separated from each other with the thumb and forefinger. Further decompression can be achieved by incising the orbital septum in the temporal portion of the lower lid at the level of the bony orbital margin.

**Anterior and posterior ethmoidal artery.** (56a–d)

The AEA courses freely through the ethmoid roof on the right side (45° endoscope) in close relation to the frontal sinus.

This AEA is in close relation to a supraorbital cell (45° endoscope).

Posterior ethmoidal artery in the posterior ethmoid (Onodi cell).

Corresponding CT scan shows that the posterior ethmoid pneumatized well above the sphenoid sinus.
**Diffuse Bleeding**

Diffuse bleeding from an indeterminate source can often be controlled by packing the area with cottonoid soaked in a 3% solution of H$_2$O$_2$. There is a risk of corneal ulceration and cutaneous and mucosal irritation when this solution is used. If diffuse bleeding is not adequately controlled with H$_2$O$_2$ and repeated applications of epinephrine pledgets, the surgeon should consider packing the nose and terminating the operation due to the excessive risk of iatrogenic complications under these conditions.

**Hemostasis with 3% H$_2$O$_2$.**
(Caution: This solution may cause corneal ulceration and mucosal irritation). (57a–c)

**Internal Carotid Artery**

Direct injuries to the internal carotid artery (ICA) during endonasal sinus surgery are a rare but dramatic complication for the patient and surgeon. Injury is most likely to occur when the ICA has a prominent course in the posterior ethmoid or maxillary sinus. The literature contains isolated reports of ICA injury during conventional sinus surgery. Most of the patients died or had permanent neurologic deficits following the operation. There is no standard emergency protocol for dealing with this rare complication. After emergency packing has been placed to control the heavy bleeding, it is generally necessary to proceed with a neuroradiologic intervention such as stent insertion or balloon occlusion. In all cases the patient should remain under general endotracheal anesthesia. Close cooperation with the neurosurgical or neuroradiology department is essential.
Duraplasty for CSF Leak

The endoscopic endonasal repair of CSF leaks was first described in the late 1980s and early 1990s. The success rates are very high (> 90%) and the procedure has a very low morbidity. A variety of materials have been used for repairing these defects including free mucosal grafts, mucosal flaps, fat, fascia, muscle, and animal products such as Tachosil®. The cause of CSF leaks may be classified as traumatic, spontaneous, meningoencephalocele-related, or iatrogenic.

The following points should be noted in the repair of CSF leaks:

<table>
<thead>
<tr>
<th>Points to Note</th>
<th>Points to Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Intraoperative iatrogenic CSF leaks should be repaired during the same operation.</td>
<td>- In many cases the dural defect can be repaired using established endoscopic techniques.</td>
</tr>
<tr>
<td>- CSF rhinorrhea can be diagnosed postoperatively by the laboratory detection of β₂-transferrin in nasal discharge.</td>
<td>- Depending on its size and location, it may be possible to repair the defect with the underlay technique, overlay technique, or a combination of both using the materials described above plus fibrin glue.</td>
</tr>
<tr>
<td>- High-resolution CT of the paranasal sinuses should be used to determine the site of the leak.</td>
<td>- The site should also be covered with a collagen patch (Tachosil®).</td>
</tr>
<tr>
<td>- Fluid levels in the paranasal sinuses may indicate the location of the dural defect.</td>
<td>- Nasal packing should be removed by the surgeon in 3–5 days.</td>
</tr>
<tr>
<td>- In patients with spontaneous CSF rhinorrhea and no evidence of a bone defect or fluid levels, the cribriform plate should be carefully scrutinized on CT scans.</td>
<td>- Three to five days’ bed rest is advised depending on the size and location of the defect.</td>
</tr>
<tr>
<td>- Patients with a meningoencephalocele should undergo preoperative MRI.</td>
<td>- A broad-spectrum antibiotic is administered for 5 days after the operation.</td>
</tr>
<tr>
<td>- Management should be decided in consultation with a neurosurgeon.</td>
<td>- Nose blowing is prohibited for 2–3 weeks.</td>
</tr>
<tr>
<td>- If the dural defect cannot be located, sodium fluorescein can be administered by intrathecal injection.</td>
<td>- Lumbar drainage for 1–3 days after surgery is necessary only in exceptional cases involving larger defects.</td>
</tr>
<tr>
<td>- With normal wound healing, the postoperative regimen is the same as described in Chapter 9, pp. 72.</td>
<td>- With normal wound healing, the postoperative regimen is the same as described in Chapter 9, pp. 72.</td>
</tr>
</tbody>
</table>
Preoperative CT scan shows a defect in the right anterior skull base.

Iatrogenic CSF leak in the right anterior skull base. The leak is diagnosed with 5% sodium fluorescein solution using a blue-light filter and barrier filter. (58a–i)

When the granulation tissue is removed, CSF leakage is observed. The blue-light filter without a barrier filter permits surrounding structures to be seen.

Endoscopic view of the opened right ethmoid bone. Granulation tissue (circle) can be seen.

Following the intrathecal administration of sodium fluorescein, the area is illuminated with blue-violet light. Use of the blue-light and barrier filters demonstrates the location of the dural defect.

Use of the barrier filter alone demonstrates the sodium fluorescein dye while filtering out surrounding structures.
The defect is repaired by duraplasty using the underlay technique.

The repair is checked by intraoperative illumination with blue light.

Two weeks postoperatively.

Three months postoperatively.

**Conclusion**

Every sinus surgeon can reduce intraoperative bleeding complications by taking preliminary measures to reduce preoperative inflammation, reduce mucosal swelling, and prevent unnecessary mucosal trauma. The strategy for preventing iatrogenic complications is based upon a detailed knowledge of the variable anatomy of the nose and paranasal sinuses, careful scrutiny of the preoperative CT scans, a meticulous operating technique with good vision, and precise anatomical orientation during each step of the operation.
11. Summary

Learning the technique of endoscopic endonasal surgery of the paranasal sinuses and anterior skull base described by Messerklinger and Stammberger requires systematic and intensive training. The experience necessary for this training is found primarily at centers with large case numbers where nasal endoscopy is practiced frequently.

A basic requirement is a knowledge of the variable anatomy of the paranasal sinuses and anterior skull base, which can be conveyed and acquired in dissection courses and intensive training in radiologic anatomy.

A surgeon experienced in the endoscopic endonasal technique can apply the technique to a broad range of indications such as chronic inflammatory diseases (chronic rhinosinusitis with or without polyps), mucoceles, fungal infections, choanal atresia, lacrimal duct diseases, inverted papillomas, osteomas, CSF leaks, nasopharyngeal fibromas, and selected malignant tumors. Decompression of the orbit and optic nerve is another well-tolerated procedure that can be accomplished using endoscopic endonasal technique.

As Stammberger pointed out, however, the endoscopic technique is not the solution to all problems. It is important for surgeons to respect the limitations of endoscopic endonasal techniques and have a mastery of extranasal techniques as well.

12. References


13. Review Questions

1. Which of the following statements are true regarding the anatomy of the paranasal sinuses?
   a) The ethmoid cells are subdivided into an anterior, middle, and posterior system.
   b) The ethmoid cells are subdivided into an anterior and posterior system.
   c) The basal lamella of the middle turbinate separates the anterior ethmoid cells from the posterior ethmoid cells.
   d) Statements b and c are true.

2. Which of the following statements are true regarding the anatomy of the paranasal sinuses?
   a) The antechamber to the maxillary sinus is called the ethmoid infundibulum.
   b) The antechamber to the frontal sinus is called the frontal recess.
   c) The natural maxillary and frontal sinus ostia generally cannot be seen at nasal endoscopy under normal circumstances.
   d) All the statements are true.

3. Which of the following statements are true regarding the anatomy of the paranasal sinuses?
   a) Openings may be seen endoscopically in the anterior and posterior fontanelle in patients who have not had previous sinus surgery; usually they do not represent the natural maxillary sinus ostium.
   b) The maxillary sinus ostium is always located in the posterior one-fourth of the posterosuperior part of the infundibulum.
   c) The uncinate process hides the natural maxillary sinus ostium at endoscopy.
   d) Statements a and c are true.

4. What structures open into the middle meatus?
   a) Nasolacrimal duct.
   b) Sphenoid sinus and eustachian tube.
   c) Maxillary sinus, frontal sinus, and anterior ethmoid cells.
   d) Posterior ethmoid cells.

5. Which of these statements are true regarding the Haller cells?
   a) They are endoscopically visible without ethmoid surgery.
   b) They develop from the posterior ethmoid cells in > 80% of cases.
   c) They may cause recurrent maxillary sinusitis.
   d) They develop when the agger nasi is pneumatized.
   e) Statements b and c are true.

6. Which of these statements are true regarding the concha bullosa?
   a) It always requires surgical treatment.
   b) It refers to a pneumatized middle turbinate.
   c) It may be ventilated from the middle meatus and anterior ethmoid cells.
   d) It is present when the agger nasi is pneumatized.
   e) Statements b and c are true.

7. Which of these statements are true regarding conventional sinus radiographs?
   a) They are obsolete.
   b) They have indications in screening, preoperative examinations, and patients with dental problems.
   c) Their advantages are lower cost and rapid availability.
   d) Statements b and c are true.
8. Which of these statements are true regarding mucociliary transport in the maxillary sinus?
   a) It is always an active process and is genetically determined.
   b) It is always directed toward the natural maxillary sinus ostium.
   c) Active transport may bypass a surgically created infraturbinate window.
   d) All the statements are true.

9. Which of the following is not part of the ostiomeatal unit?
   a) Superior turbinate.
   b) Uncinate process.
   c) Semilunar hiatus.
   d) Ethmoid infundibulum.
   e) Frontal recess.

10. Which of these statements is true?
    a) Coronal CT provides the best information on the microanatomy of the lateral nasal wall.
    b) Axial CT is helpful in evaluating the depth of the maxillary and sphenoid sinuses.
    c) Sagittal CT is helpful in evaluating the frontal recess.
    d) All the statements are true.

11. Which of these statements is true regarding infundibulotomy?
    a) The mucosa of the middle turbinate is preserved while the attachment of the uncinate process (UP) is palpated and identified.
    b) The middle turbinate should not be medialized, as this may result in an unstable middle turbinate with risk of lateralization.
    c) The UP is incised and displaced medially to expose the interior of the ethmoid infundibulum and the anterior surface of the ethmoid bulla.
    d) If the attachment of the UP is not identified, the process can be resected in strips, proceeding from posterior to anterior.
    e) All the statements are true.

12. Which of these statements about infundibulotomy are not true?
    a) The UP can be removed with a Blakesley forceps using a careful twisting motion (clockwise on the left side, counterclockwise on the right side).
    b) Uncontrolled extraction of the UP, which will also remove adjacent mucosa, should definitely be avoided.
    c) The natural maxillary sinus ostium is not exposed by complete removal of the posteroinferior portion of the UP.
    d) The natural maxillary sinus ostium can be probed with special blunt-tipped probes to avoid mucosal trauma.
    e) All the statements are true.

13. Which of these statements is not true?
    a) When the lamina papyracea is opened without damaging the periorbita, pressure on the eyeball will cause the periorbita to bulge.
    b) Shavers preferentially grasp and cut soft tissue and therefore must be used with caution.
    c) Tissue that has prolapsed from the orbit should not be resected, as this could lead to scarring that restricts eye movements.
    d)iatrogenic injuries of the lacrimal passages are common during incision of the UP with a sickle knife. They are less common when a backbiting forceps is used.
    e) A common error during infundibulotomy is an incomplete anteroinferior resection, resulting in failure to expose the maxillary sinus ostium.

14. Which of these statements is true regarding partial anterior ethmoidectomy?
    a) Complete resection of the anteroinferior portion of the uncinate process should expose the anterior surface of the ethmoid bulla (EB).
    b) It can be performed with a Blakesley forceps.
    c) The anterior surface of the EB is completely removed, followed by the medial wall of the EB, which may be hidden by the middle turbinate; if left in place, it may lead to persistent complaints.
    d) The skull base forms the superior limit of the resection, and the basal lamella of the middle turbinate forms the posterior limit.
    e) All the statements are true.

15. Which of these statements is true regarding sphenoidotomy?
    a) In a transethmoidal sphenoidotomy, the sphenoid sinus should always be entered medially and inferriorly.
    b) If the location of the natural ostium is uncertain, it can be identified optically or by careful transnasal palpation with a fine instrument.
    c) The natural sphenoid sinus ostium is generally located medial to the superior turbinate.
    d) Resection of the middle or superior turbinate is unnecessary for opening the sphenoid sinus.
    e) All the statements are true.

16. Which of these statements is not true regarding a Kuhn type 4 frontoethmoid cell?
    a) It is an isolated cell in the frontal sinus.
    b) It extends into the frontal sinus, but no more than 50% of the sinus height.
    c) It has an “air bubble” appearance on coronal CT scans.
    d) The anteroinferior portion is the anterior wall or floor of the frontal sinus.
    e) The posterior portion is the posterior wall of the cell, not the posterior wall of the frontal sinus.
    f) It can be identified on coronal and sagittal CT scans.
17. Which of these statements is not true regarding a frontal bulla cell?
   a) It is an ethmoid cell superior to the ethmoid bulla.
   b) It extends along the skull base into the frontal sinus from behind the frontal recess.
   c) Its posterior wall is formed by the skull base and the posterior wall of the frontal sinus.
   d) Its anterior border does not extend into the frontal sinus.
   e) It can be identified on sagittal CT scans.

18. Which of these statements is not true regarding postoperative care?
   a) All patients who have undergone sinus surgery should return for endoscopic follow-up.
   b) Wound debridement should be kept to a minimum during the first postoperative week. Priority is given to suctioning blood clots and secretions, nasal irrigations, and topical steroids.
   c) The second postoperative week includes endoscopic follow-up in which crusts that are blocking the frontal recess and ostia are removed.
   d) Long-term follow-ups are not recommended after extensive dissections in the area of the frontal recess and after ethmoid polyp surgery.

19. Which of these statements is not true regarding complications?
   a) The preoperative medical treatment of patients with chronic rhinosinusitis can establish optimum operating conditions and prevent iatrogenic complications.
   b) Preoperative medical treatment eliminates the need to operate in the presence of an acute infection or severe mucosal inflammation, thereby reducing the risk of intraoperative bleeding.
   c) Anterior intranasal bleeding comes mainly from branches of the sphenopalatine artery.
   d) If the sphenopalatine artery requires cautery, a mucoperiosteal flap is raised in the posterior part of the medial wall of the maxillary sinus, and the artery is dissected out of the sphenopalatine foramen.
   e) A valuable anatomical landmark for locating the sphenopalatine artery is the ethmoid crest, which is generally found directly in front of the sphenopalatine foramen.

20. Which of these statements is not true regarding complications?
   a) The anterior ethmoidal artery runs from lateral to medial through the ethmoid bone in an inferiorly open, often dehiscent canal located at variable distance from the ethmoid roof.
   b) The anterior ethmoidal artery does not pierce the lateral lamella of the cribriform plate and does not enter the olfactory fossa.
   c) Keros defined three types of olfactory fossa. Type III (8–16 mm) is the most dangerous from a surgical standpoint, as the risk of iatrogenic injury increases with the length and obliquity of the lateral lamella.
   d) Monopolar cautery should not be used in immediate proximity to the dura because it may lead to secondary necrosis and dural lesions.
   e) Lateral canthotomy and cantholysis is the fastest way to prevent impending blindness due to a retro- or intraorbital hematoma. It is essential for otorhinolaryngologists to master this procedure.

Answers:

| 20b | 15c | 10d | 5c |
| 19c | 10a | 5c |
| 18d | 10b | 15c |
| 17d | 10b | 15c |
| 16c | 10b | 15c |
14. Clinical Examples and Video Clips

Preparation of the Surgical Field
Removal of a Concha bullosa

Preoperative CT scan shows a concha bullosa with partial opacity.

Preoperative appearance before vasoconstriction.

From 0.5 to 1 mL of 1% lidocaine with 1:200,000 epinephrine is injected at the insertion of the middle turbinate. Blanching of the mucosa is visible at the injection site.

Pledgets moistened with 1:5,000 epinephrine are placed at the posteroinferior end of the middle turbinate.
The suture-tagged pledgets are carefully placed into the middle meatus and between the middle turbinate and septum.

One pledget is placed about the head of the middle turbinate.

The sickle knife for removing the concha bullosa is introduced 8–10 min after vasoconstriction.

Operative site following removal of the concha bullosa and partial anterior ethmoidectomy.
**Antrochoanal Polyp**

14

Partial right anterior ethmoidectomy with removal of an antrochoanal polyp. (60a–j)

**60a**
Coronal CT demonstrates ethmoid and maxillary sinus opacity on the right side.

**60b**
Portions of the antrochoanal polyp are visible in the right nasal cavity.

**60c**
Prominent uncinate process on the right side.

**60d**
The UP is incised with the sickle knife ...

**60e**
... and removed, exposing the ethmoid bulla.

**60f**
The antrochoanal polyp bulges from the maxillary sinus into the middle meatus.
The polyp is completely removed with an angled forceps.

Surgical specimen.

Final appearance of the maxillary sinus (45° endoscope).

Final appearance of the middle meatus (0° endoscope).
Maxillary Sinus Mucocele

Revision ethmoidectomy on the right side (previous sinus surgery in 1966) with antrostomy for a maxillary sinus mucocele. (61a–f)

15

61a

Mucocele of the right maxillary sinus following a transfacial maxillary sinus operation in 1966.

61b

Middle meatus on the right side.

61c

The uncinate process is removed with backbiting forceps.

61d

The maxillary sinus is opened, and the mucocele is suctioned from the sinus.

61e

Final appearance of the middle meatus.

61f

Final appearance of the maxillary sinus.
Unerupted Tooth in the Maxillary Sinus

Partial right anterior ethmoidectomy with maxillary antrostomy and tooth extraction in a patient with a follicular cyst. (62a–n)

Coronal CT shows an unerupted tooth in the maxillary sinus.

Axial CT.

Coronal MRI.

Coronal MRI.
Sagittal MRI.

Axial MRI.

Endoscopic view of the right middle meatus shows the cyst bulging into the inferior meatus.

The maxillary sinus is opened.

The firm wall of the cyst in the maxillary sinus ...

... is removed.
The maxillary sinus mucosa is incised (posterior wall) …

… to allow extraction of the unerupted tooth.

Final appearance of the right maxillary sinus.

Right maxillary sinus at 4 weeks postoperatively, with wound coating.
Chronic Rhinosinusitis in a 6-Year-Old Boy

Partial anterior ethmoidectomy for chronic rhinosinusitis. (63a–l)

63a
Cyst in the left maxillary sinus.

63b
Middle meatus before ...

63c
... and after decongestion.

63d
The uncinate process is incised with the sickle knife ...

63e
... and medialized, exposing the interior of the ethmoid infundibulum and the natural maxillary sinus ostium.

63f
Mucosa with severe polypous changes is removed from the anterior ethmoid.
Remnants of the UP are removed with a small backbiting forceps.

Inferior portions of the uncinate process are removed ...

... exposing the natural maxillary sinus ostium.

The cyst in the maxillary sinus (45º endoscope) is removed with an angled forceps.

Final appearance of the left maxillary sinus.

Final appearance of the middle meatus. Packing was not necessary.
Maxillary Sinus Aspergilloma

Partial right anterior ethmoidectomy in a patient with chronic rhinosinusitis, facial pressure, nasal airway obstruction and postnasal drip on the right side. (64a–j)

Typical “metallic density” sign in coronal CT…

… and axial CT.

Putrid discharge in the right middle meatus.

The discharge is suctioned from the nose, exposing the aspergilloma.

The aspergilloma in the maxillary sinus …

… must be completely removed to prevent a recurrence.
Appearance of the middle meatus at the end of the procedure …

… and at 5 weeks postoperatively.

Maxillary sinus viewed 5 weeks postoperatively with a 0º endoscope …

… and a 45º endoscope. Immediately after surgery the patient was free of complaints.
Maxillary Sinus Aspergilloma

Partial bilateral anterior ethmoidectomy in a patient with chronic rhinosinusitis, facial pressure, nasal airway obstruction and postnasal drip. (65a–i)

CT shows typical “metallic densities” consistent with bilateral aspergillomas.

Left middle meatus.

After removal of the right uncinate process, pus is seen.

When the left uncinate process is removed, portions of the aspergilloma can be identified.

View into the right maxillary sinus (45º endoscope).
Endoscopic Surgery of the Lateral Nasal Wall, Paranasal Sinuses, and Anterior Skull Base

View into the left maxillary sinus (45° endoscope).

Final appearance of the right maxillary sinus.

Final appearance of the left maxillary sinus.

Interfrontal Sinus Septal Cell

Left frontoethmoidectomy opening an interfrontal sinus septal cell in a patient with recurrent rhinosinusitis and frontal headaches. (66a, b)

CT scan at the level of an Agger nasi cell and a cell in the interfrontal septum.

View into the frontal sinus (right) and into a cell in the interfrontal septum (left).
Agger nasi Cell

Frontoethmoidectomy with removal of an Agger nasi cell on the right side in a patient with chronic rhinosinusitis, bilateral headaches and nasal airway obstruction. (67a–f)

Bilateral Agger nasi cells.

General view of the right middle meatus.

The uncinate process, ethmoid bulla, and anterior wall of the Agger nasi cell have been removed.

Next the posterior wall of the Agger nasi cell is removed …

… e.g., with a KUHN curette …

… to obtain a clear view of the natural frontal sinus ostium.
Kuhn Type 1 Frontal Cell

Right frontoethmoidectomy in a patient with recurrent rhinosinusitis and frontal headaches. (68a–n)

Coronal CT at the level of the frontoethmoid cell.

Sagittal CT (right).

Middle meatus before …

… and after removal of the uncinate process and ethmoid bulla.

View into an Agger nasi cell.

Navigation screen with the pointer in the Agger nasi cell.
An angled (55°) KUHN curette is introduced medial to the Agger nasi cell ...

... and a frontoethmoid cell (Kuhn type 1) is exposed.

View into the K1 cell after complete removal of the medial wall of the Agger nasi cell.

Navigation screen with the pointer in the K1 cell.

The angled KUHN curette is introduced between the Agger nasi cell and K1 cell.

The K1 cell is removed ...
... exposing the plane of the frontal sinus ostium (45° endoscope) ... and the interior of the frontal sinus.

**Agger nasi Cell**

Right frontoethmoidectomy in a patient with recurrent rhinosinusitis, frontal headaches and nasal airway obstruction. (69a–h)

Coronal CT scan at the level of the Agger nasi cells and ... bilateral frontoethmoid cells.

View into an Agger nasi cell ... which is removed from behind with the KUHN curette.
A thin bony plate still obscures the frontal sinus.

It is removed with the KUHN curette …

… and smaller bony lamellae are removed with an angled circular-cutting punch.

Final appearance of the left frontal recess and frontal sinus.
Kuhn Type 1 Frontal Cell

Left frontoethmoidectomy with removal of an Agger nasi cell and frontoethmoid cell (Kuhn type 1) in a patient with chronic rhinosinusitis and frontal headaches. (70a–k)

Coronal CT at the level of the Agger nasi cell and K1 cell.

View into the Agger nasi cell.

The medial wall of the Agger nasi cell is removed.

This should be done carefully, as the cell is bounded medially by the lateral lamella of the cribiform plate.

Spaces with facing mucosa are entered with the curette.
The K1 cell is progressively exposed.

The inlet to the frontal sinus is still obscured.

Removing the medial wall of the K1 cell exposes the inlet to the frontal sinus.

The K1 cell has been completely removed …

…and additional thin bony lamellae are removed with the angled punch.

Final appearance of the left frontal recess and frontal sinus.
Kuhn Type 1 Cell in a 13-Year-Old Male

Left frontoethmoidectomy for chronic rhinosinusitis and left frontal headaches. (71a–m)

Complete left frontal sinus opacity following several months of conservative therapy.

Agger nasi cell and frontoethmoid cell (Kuhn type 1) on the left side.

Sagittal CT scan …

… demonstrates a K1 cell above an Agger nasi cell on the left side.

View into the Agger nasi cell.

Removal of the medial wall.
View into the K1 cell, showing its polypous mucosa.

The inlet to the frontal sinus is enlarged with the KUHN curette ...

... and bony lamellae are removed from the K1 cell with an angled microforceps.

View of the glassy, edematous mucosa of the frontal sinus, indicating chronic inflammation.

The mucosa can be partially aspirated avoiding the creation of circumferential mucosal lesions.
Cystic Fibrosis with Ethmoid Polyposis in a 15-Year-Old Male

Bilateral frontoethmoidectomy for ethmoid polyposis. (72a–t)

CT shows complete opacity (“white out”) of the paranasal sinuses.

Right middle meatus.

Left middle meatus.
Removal of the polyps reveals a perforation in the right uncinate process.

A perforation is also found in the left uncinate process after polypectomy.

Incision of the right uncinate process.

Thick, viscous mucus is found in the left maxillary sinus.

Right ethmoid infundibulum.

Incision of the left uncinate process.
Right uncinate process.

Left ethmoid infundibulum.

Viscous mucus in the right maxillary sinus.

Left uncinate process.

Final appearance of the right maxillary sinus.

Left frontal recess (45º endoscope) with the frontal sinus ostium and viscous mucus.
Final appearance of the right middle meatus.

Viscous mucus from the left frontal sinus.

The wound is covered with carboxymethylcellulose.

Final appearance of the left middle meatus.
Frontal Sinus Empyema

Left frontoethmoidectomy in a patient with a frontal sinus pyomucocele and severe headaches. (73a–o)

73a
Occipitofrontal sinus radiograph demonstrates a fluid level in the left frontal sinus.

73b
Coronal CT shows bilateral opacity of the ethmoid and left frontal sinus.

73c
Sagittal CT shows a large Agger nasi cell and opacity of the frontal recess.

73d
Axial CT at the level of the frontal recess.

73e
Left middle meatus …

73f
… with pus oozing from the ethmoid infundibulum.
The KUhN curette is passed into spaces with facing polypous mucosa.

Discharge from the frontal sinus after removal of the medial wall of the Agger nasi cell.

The empyema is suctioned from the left frontal sinus, exposing the sinus interior.

Final appearance of the left middle meatus.
Frontal recess 2 weeks postoperatively.

Frontal recess 4 weeks postoperatively.

Frontal recess 3 months postoperatively.
Frontal Sinus Mucocele

Left frontoethmoidectomy for a frontal sinus mucocele occurring as a late complication of a previous anterior skull base fracture. (74a–p)

Navigation screen.

Left middle meatus.

Uncinate process.

Middle meatus after removal of the uncinate process.

The posterior wall of an Agger nasi cell is removed.

Frontal recess with polypous mucosa.
The Agger nasi cell is completely removed, exposing the frontal sinus with its polypous mucosa in a superolateral recess.

The polypous mucosa is removed with an angled (60°) microforceps …

... and the frontal sinus mucocele is opened.

The opening is enlarged with a 60° angled circular-cutting punch.

Left frontal sinus viewed with the 45° endoscope.

Navigation screen after opening the mucocele.
Endoscopic Surgery of the Lateral Nasal Wall, Paranasal Sinuses, and Anterior Skull Base

Final appearance of the frontal recess (45° endoscope).

Final appearance of the middle meatus.

Final appearance of the frontal recess (45° endoscope).

Findings at 1 year postoperatively.

Frontal Sinus Mucocele

Bilateral frontoethmoidectomy 20 years after an extranasal frontal sinus operation. (75a–m)

Right middle meatus with lateralization of the middle turbinate (following extranasal frontal sinus surgery in childhood).

Initial findings on the navigation screen.
Clearing of adhesions.

The plane of the frontal sinus ostium is opened, and a mucocele is removed by suction.

Access to the frontal sinus is enlarged with an angled circular-cutting punch.

Final appearance (45º endoscope) of the right frontal sinus.

Navigation screen after opening the right frontal sinus.

Left frontal recess (45º endoscope).
A superior bony lamella is removed … … and a mucocele is removed by suction.

Final appearance (45° endoscope) of the left frontal sinus. Navigation screen after opening the left frontal sinus.

Endoscopic view across the right frontal recess toward the left side.
Sphenoethmoid Cell (Onodi Cell) and Sphenoid Sinusitis

Left sphenoethmoidectomy in a patient with recurrent rhinosinusitis, vertex headaches and nasal airway obstruction. (76a–t)

Coronal CT at the level of the ostiomeatal unit.

Coronal CT at the level of the posterior ethmoid.

Coronal CT at the junction of the posterior ethmoid and sphenoid sinus.

Coronal CT at the level of the sphenoid sinus.

Left middle meatus.

View of the uncinate process and ethmoid bulla.
The ethmoid bulla is infractured ...

Middle meatus after removal of the uncinate process.

... and removed with the angled BLAKESLEY nasal forceps.
View of the basal lamella …

… which is infractured and enlarged with the straight circular-cutting punch.

Left sphenoid recess.

Removal of the superior turbinate was necessary in this case.

Retained mucus in the sphenoid sinus.

Anterior-wall sphenoidotomy including the natural sinus ostium.
Sphenoethmoid Cell (Onodi Cell) and Sphenoid Sinusitis

Right sphenoethmoidectomy in a patient with recurrent rhinosinusitis, vertex headaches and nasal airway obstruction. (77a–h)

Coronal CT scan at the level of the ostiomeatal unit.

Coronal CT scan at the level of the posterior ethmoid and sphenoid sinus.

Coronal CT scan at the level of the sphenoid sinus.

General view of the maxillary sinus ostium and a sphenoethmoid cell (Onodi cell) on the right side.
The right sphenoid sinus ostium is identified.

Maxillary sinus ostium (left), sphenoid cell (center), and sphenoid sinus ostium (right).

Sphenoid recess with opened and enlarged sphenoid sinus ostium.
Haller Cell

Frontoethmoidectomy with removal of a left-sided Haller cell in a patient with chronic rhinosinusitis, bilateral headaches and nasal airway obstruction. (78a–d)

Opaque Haller cell on the left side.

General view of the left middle meatus.

After removal of the left uncinate process …

… the unopened Haller cell can be identified (45° endoscope) above the maxillary sinus ostium.
Type II Maxillary Sinus Hypoplasia

Revision ethmoidectomy on the right side (after two previous sinus operations) with maxillary antrostomy in a patient with chronic right maxillary sinusitis, headaches and nasal airway obstruction. (79a–j)

Comparison of the hypoplastic right maxillary sinus …

… with the atelectatic uncinate process.

Posterior fontanelle viewed with a 45° endoscope (same as in b).

The maxillary sinus is opened …

… and its ostium is enlarged with a backbiting forceps.

The opening is extended posteriorly.
Polypous mucosa is removed with an angled microforceps.

Inspissated mucus is found ...

... and suctioned from the sinus.

Result at 1 year postoperatively.
Recurrent Maxillary Sinusitis

Revision ethmoidectomy with maxillary antrostomy in a patient with chronic rhinosinusitis and nasal airway obstruction on the right side. (80a–n)

80a
The right uncinate process was left intact in a previous partial anterior ethmoidectomy.

80b
Persistent right-sided complaints due to an obstructed natural maxillary sinus ostium.

80c
Bilateral antral windows in the posterior fontanelle. “Missed ostium sequence”.

80d
Right middle meatus.

80e
On inspection of the middle meatus, an accessory maxillary sinus ostium is found in the posterior fontanelle.

80f
Polypous mucosa is found at the top of the natural maxillary sinus ostium.
The inferior portion of the uncinate process is incised from behind …

... with a backbiting forceps …

... and the remnants are removed.

Mucus recirculation is stopped …

... by connecting the accessory maxillary sinus ostium to the natural ostium.

Final appearance of the right maxillary sinus.
Final appearance of the right middle meatus.

Suction at the end of the operation.

**Chronic Maxillary Sinusitis**

Revision ethmoidectomy (after three previous sinus operations) with maxillary antrostomy in a patient with chronic rhinosinusitis, facial pressure, headaches and nasal airway obstruction. (81a–n)

Chronic rhinosinusitis in CT.

Obstructed ostiomeatal unit.

Infra- and supraturbinate antral windows (posterior fontanelle) were previously created on the right side.

Mucus recirculates between the supraturbinate antral window in the posterior fontanelle and the natural ostium of the right maxillary sinus.
Inspissated mucus colonized by Pseudomonas aeruginosa...

Glassy mucous discharge from the natural maxillary sinus ostium.

After removal of the "mucus ball"...

...the residual uncinate process is removed.

...in the right maxillary sinus...

...is identified as the cause of recurrent infections.
Putrid discharge from the natural maxillary sinus ostium.

Large supraturbinate antral window in the posterior fontanelle.

Final appearance of the right maxillary sinus (45º endoscope).

Right maxillary sinus (45º endoscope) 2 weeks postoperatively.
Recurrent Ethmoid Polyposis

Bilateral revision ethmoidectomy in a patient with recurrent ethmoid polyposis. (82a–k)

CT demonstrates opacity of all paranasal sinuses.

Right middle meatus.

Left middle meatus.

The polyps are progressively removed with the sinus shaver.

Medially bowed left uncinate process.
Ethmoid cavity on the right side after removal of the polyps.

Ethmoid cavity on the left side after removal of the polyps.

Carboxymethylcellulose on the right side.

Carboxymethylcellulose on the left side.

Carboxymethylcellulose on the right side after moistening with sterile distilled water.

Carboxymethylcellulose on the left side after moistening with sterile distilled water.
Kuhn Type 1 Cell

Revision frontoethmoidectomy on the right side (after three previous sinus operations) in a patient with chronic rhinosinusitis, headaches and postnasal drip. (83a–k)

Coronal CT scan shows an opaque Agger nasi cell on the right side … and an overlying K1 cell.

View (45º endoscope) into the K1 cell.

The 55º-angled KUHN curette is passed into spaces with facing mucosa …

… to remove the medial wall of the cell.

Polypous mucosa and thin bony lamellae are still obscuring the frontal sinus.
The very thin lateral lamella of the cribiform plate is preserved medially to prevent a CSF leak.

The interior of the frontal sinus is progressively exposed.

Thin bony lamellae can be removed with the angled circular-cutting punch while preserving the mucosa in the frontal recess.

Final appearance of the frontal recess and frontal sinus after removal of the K1 cell on the right side.

Frontal recess and frontal sinus (45° endoscope) 3 months postoperatively. Insipissated mucus is visible in the right portion of the field.
Kuhn Type 3 Cell

Revision frontoethmoidectomy on the left side (after two previous sinus operations) in a patient with chronic rhinosinusitis, pain and pressure over the left frontal sinus. (84a–u)

Coronal CT reveals partial opacity of the left frontal sinus ...

... an aerated frontoethmoid cell on the left side ...

... and an Agger nasi cell on the left side.

Analysis of the sagittal CT scan shows the K3 cell extending across the “nasal beak” into the frontal sinus. The posterior wall of the cell is formed by part of the frontal recess, making it necessary to go between the skull base and posterior wall in order to remove the cell.
We cannot see the interior of the frontal sinus after the previous sinus operations, only various spaces and constrictions (see sagittal CT scan).

Looking toward the skull base (see sagittal CT scan).

Looking toward the skull base (see sagittal CT scan).

Looking toward the K3 cell (see sagittal CT scan).

The 55º-angled KUHN curette is passed into a space between the medial wall of the K3 cell and the lateral wall of the middle turbinate.

The bony lamella is progressively removed, working in the lateral direction.
The posterior wall of the K3 cell is removed from behind with the KUHN curette.

Thin bony lamellae are carefully mobilized and removed.

They are removed with an upturned vertical or horizontal microforceps.
The frontal sinus ostium is exposed … … and a mucocele is suctioned from the sinus.

Thick, viscous mucus suctioned from the frontal sinus.

The ostium is enlarged with the angled circular-cutting punch.

Final appearance of the left frontal recess with a view into the frontal sinus.
Kuhn Type 3 Cell

Revision frontoethmoidectomy on the left side (after three previous sinus operations) in a patient with chronic rhinosinusitis and left frontal headaches. (85a–p)

Frontoethmoid cell (K3 cell) on the left side.

Obstruction of the natural frontal sinus ostium.

Obstructed left frontal recess.

Polypous mucosa is removed with the 55°-angled Kuhn curette.

The entrance to the frontal recess is progressively cleared from below upward.

Careful analysis of the operative site and of preoperative multiplanar CT scans shows that the frontal sinus is still blocked by a frontoethmoid cell (Kuhn type 3).
View into the K3 cell on the left side (45° endoscope).

Spaces with facing mucosa are entered with the Kuhn curette.

Polyposus mucosa obstructs drainage and ventilation of the frontal sinus.

The posterior wall of the K3 cell, which is part of the frontal recess, is progressively taken down.

Bony lamellae are removed …

… until the posterior wall of the frontal sinus can be seen.
The inlet is enlarged with the angled circular-cutting punch…

… exposing the interior of the frontal sinus (45° endoscope).

Final appearance of the left frontal recess.

View into the frontal sinus after complete removal of the K3 cell.
Frontal Bulla Cell

Revision frontoethmoidectomy on the right side (after four previous sinus operations) in a patient with chronic rhinosinusitis and pain and pressure over the right frontal sinus. (86a–p)

Coronal CT shows a right frontoethmoid cell extending far into the frontal sinus.

Deep opacity of the frontal recess.

Sagittal CT analysis shows that the skull base forms the posterior wall of the cell (frontal bulla cell).

The anterior wall of the cell is part of the frontal recess, which is opaque.
Right middle meatus.

Bony lamellae and polypous mucosa are progressively removed from the frontal recess ...

... with angled microforceps.

View (45º endoscope) into the frontal bulla cell (lower part of field).

The 55°-angled KUHN curette (top of field) is advanced between the nasal beak and the anterior wall of the frontal bulla cell.

The thin anterior wall of the bulla is carefully infractured from the front.
View into the partially opened frontal sinus.

The thin bony lamellae are removed.

Detached bone flakes are suctioned from the field.

Final appearance of the right frontal recess and sinus.

Final appearance of the right middle meatus.

Transillumination of the right frontal sinus.
Frontal Sinus Mucocele in Aspirin Intolerance with Recurrent Ethmoid Polyposis

Revision frontoethmoidectomy on the left side (after three previous sinus operations) in a patient with recurrent ethmoid polyposis, nasal airway obstruction and progressive inferolateral proptosis of the left eye with diplopia and headaches. (87a–l)

Left frontal sinus mucocele with orbital …

… and intracranial extension.

Axial CT.

Defect in the bony posterior wall of the left frontal sinus caused by the mucocele with recurrent polyposis.

Polyps completely obstruct the nasal cavity.

The polyps are progressive removed with a shaver.
The anterior ethmoid is opened …

... to decompress the mucocele.

The protein-rich portion of the mucocele is suctioned first …

... and then the watery portion. This “sedimentation effect” is typical of mucoceles and may initially be mistaken for a CSF leak.

View into the frontal sinus (45º endoscope) …

... shows an exposed area of pulsating but intact dura.
Frontal Sinus Mucocele

Revision frontoethmoidectomy on the left side (after two previous sinus operations) in a patient with a posttraumatic frontal sinus mucocele causing inferolateral proptosis and diplopia. (88a–f)

88a
Navigation screen with the pointer at the level of scar tissue in the left frontal recess.

88b
The left frontal recess is obliterated by scar tissue. Landmarks cannot be identified.

88c
The scar tissue is opened, allowing the mucocele to drain.

88d
The mucocele is suctioned from the frontal sinus, exposing the sinus mucosa.

88e
Final appearance with the pointer in the frontal recess.

88f
Final appearance of the polypous mucosa in the frontal sinus.
Frontal Sinus Mucocele

Revision frontoethmoidectomy on the right side (after three previous sinus operations) in a patient with a posttraumatic frontal sinus mucocele causing inferolateral proptosis and diplopia. (89a–h)

Navigation screen with the pointer at the level of scar tissue in the right frontal recess.

The right frontal recess is obliterated by scar tissue. Landmarks cannot be identified.

The scar tissue is opened ...

... allowing the mucocele to drain.
The mucocele is aspirated, exposing the mucosa in the frontal recess.

The frontal sinus ostium is enlarged with an angled circular-cutting punch.

Bony lamellae are removed with an angled microforceps.

View into the frontal sinus at the end of the operation.
Restenosis of the Frontal Recess

Revision frontoethmoidectomy on the right side for restenosis of the frontal recess in a patient with recurrent frontal sinusitis and headaches. (90a–h)

Obstruction of the right frontal recess.

View into the right anterior ethmoid following a previous frontoethmoidectomy …

… with mucous drainage in the restenosed frontal recess.

Sagittal CT shows osteitic changes in the frontal recess. The differential diagnosis should include osteoma.

After removal of the anterior wall of an Agger nasi cell …

… bone that is too thick for removal with a punch can be burred away.
Close-interval postoperative follow-up is necessary due to the exposed bone.

Final appearance of the frontal recess and frontal sinus.

**Sphenoethmoid Cell (Onodi Cell) and Sphenoid Sinusitis**

Right sphenoethmoidectomy in a patient with recurrent rhinosinusitis, vertex headaches and nasal airway obstruction. (91a–n)

Coronal CT shows an Onodi cell on the right side and partial opacity of the right sphenoid sinus.

Right middle meatus with a perforation in the uncinate process.
Incision of the uncinate process. The natural maxillary sinus ostium is exposed …

… in the area of the posterior fontanelle. Natural maxillary sinus ostium.

The natural ostium is enlarged with an antral punch. Enlarged maxillary sinus ostium.
Sphenoethmoid cell (above) and sphenoid sinus ostium (below) on the right side.

Right sphenoid sinus ostium.

A mucosal polyp in the right sphenoid sinus ...

... is removed with an angled microforceps.

Mucosal polyp.

Final appearance.
Inverted Papilloma of the Maxillary Sinus

Right ethmoidectomy and maxillary antrostomy for an inverted papilloma. (92a–l)

Inverted papilloma of the maxillary sinus and right ethmoid sinus.

Obstruction of the middle meatus.

The inverted papilloma extends into the nasopharynx.

After decongestion …

… the middle meatus is incised.

The anterior ethmoid is opened, and the papilloma is removed.
Frontal recess with natural frontal sinus ostium.

Prominent vascular markings in the nasal floor.

View into the maxillary sinus (45° endoscope) before removal of the papilloma.

Surgical specimen.

Final appearance of the maxillary sinus.

Final appearance of the middle meatus.
**Inverted Papilloma of the Ethmoid Sinus**

Left frontoethmoidectomy for an inverted papilloma. (93a–o)

Coronal CT shows complete opacity of the left paranasal sinuses in a patient with inverted papilloma. A concha bullosa is visible on the right side.

Left middle meatus.

Portions of the inverted papilloma in the nasopharynx.

Excised inverted papilloma.

Ethmoid bone after removal of the papilloma.
Putrid discharge from the left maxillary sinus ostium.

Glassy, edematous mucosa in the left maxillary sinus.

Left frontal recess.

Retained secretions are suctioned from the frontal sinus.

A K1 cell is removed …

… and the interior of the frontal sinus can be seen.
Left frontal recess and frontal sinus 3 months postoperatively.

Left maxillary sinus (45° endoscope) 3 months postoperatively.

Ethmoid cavity 3 months postoperatively.
Osteoma of the Frontal Recess

Frontoethmoidectomy for a frontal recess osteoma and frontal sinus mucocele. (94a–k)

Navigation screen at the start of the operation. Osteoma of the right frontal recess and a frontal sinus mucocele.

The ethmoid bulla has been removed, exposing an Agger nasi cell and the posteriorly situated osteoma.

Relationship of the osteoma to the lateral lamella of the cribriform plate.

The osteoma is mobilized …

… and removed with an angled BLAKESLEY nasal forceps.

Surgical specimen.
View (45º endoscope) into the frontal recess with obstruction of frontal sinus drainage.

Inspissated mucus is suctioned from the frontal sinus.

Final appearance (45º endoscope) of the opened frontal sinus.

Navigation screen at the end of the operation.

Frontal recess and frontal recess 1 year postoperatively.
Osteoma of the Frontal Sinus

Combined endonasal and extranasal removal of an osteoma of the left frontal sinus in a patient with frontal bossing, recurrent rhinosinusitis, and headaches. (95a–r)

Frontal bossing on the left side.

CT appearance of the osteoma.

Middle meatus.

Combined endonasal and extranasal approach. The uncinate process is removed.

Left maxillary sinus ostium.

Visible frontal bossing on the left side.
Eyebrow incision (the patient declined a bicoronal incision).

Bulging, thinned anterior wall of the frontal sinus.

The tumor is approached from external.

The bone flap is raised, exposing the osteoma.

The osteoma is removed piecemeal with a burr ...

... and chisel.
Endonasal frontoethmoidectomy is completed, and a probe is introduced into the frontal sinus.

...the 90°-angled KUHN curette is passed into the frontal sinus ostium.

Another curette is passed into the sinus from above.

Frontal recess with the natural ostium of the left frontal sinus.

Final appearance of the left ethmoid cavity.
Osteoma of the Frontal Sinus

Bicoronal incision and craniotomy in a patient with recurrent rhinosinusitis and headaches. (96a–f)

Coronal CT at the level of the ostiomeatal unit.

Osteoma of the left frontal sinus, not accessible by the endonasal route.

Sagittal CT shows narrowing of the frontal infundibulum by the osteoma.

Axial CT.

Bicoronal incision and craniotomy. Retained secretions in the frontal infundibulum.

Final appearance after osteoma removal with a diamond burr.
Osteoma of the Frontal Sinus

Extranasal approach through an eyebrow incision in a patient with recurrent rhinosinusitis and headaches following a previous right frontoethmoidectomy. (97a–f)

Coronal CT shows a right-sided osteoma following a previous right frontoethmoidectomy.

View into the right frontal recess (45º endoscope), showing an osteoma at the level of the frontal sinus ostium.

Osteoma viewed through the extranasal approach.

The tumor is removed with a diamond burr.

Extranasal view of an endonasal probe in the frontal sinus.

Final appearance of the frontal recess. The mucosa has been largely preserved.
Ossifying Fibroma

Right frontoethmoidectomy for ossifying fibroma in a patient with nasal airway obstruction, recurrent rhinosinusitis and headaches. (98a–i)

Complete opacity of the paranasal sinuses on the right side. [Image 27a]

Coronal MRI. [Image 27b]

The nasal cavity is completely obstructed. [Image 27c]

Right ethmoid bone after removal of the ossifying fibroma. Large portions of the middle turbinate were destroyed by the tumor. [Image 27d]

The maxillary sinus is opened with backbiting forceps. [Image 27e]

Polypous mucosa in the right maxillary sinus (45° endoscope). [Image 27f]
Right maxillary sinus 3 months postoperatively.

Right ethmoid cavity 3 months postoperatively.

Right frontal recess 3 months postoperatively, with free drainage from the frontal sinus (45° endoscope).
Iatrogenic Dural Lesion in the Ethmoid Roof

Endoscopically controlled duraplasty in the left ethmoid roof using autologous fascia, TachoSil® and fibrin glue. (99a–j)

99a

Left middle meatus after sinus surgery performed elsewhere and prior to duraplasty.

99b

Dural prolapse in the left ethmoid roof.

99c

Intermittent CSF leak.

99d

Navigation display of the defect in the posterior ethmoid roof.

99e

Endoscopic view 90 min after the intrathecal administration of 5% sodium fluorescein. On blue-violet illumination, the blue-light filter shows the location of the dural defect but does not show evidence of intraoperative CSF leak.

99f

The barrier filter shows no sodium fluorescein (yellow-green) that would indicate a CSF leak.
The dural defect has been repaired with temporalis fascia and TachoSil®.

The integrity of the repair is checked by blue-light illumination.

Navigation screen at the end of the operation.

Final appearance of the left middle meatus with the opened maxillary sinus ostium.
HOPKINS\textsuperscript{®} Telescopes – autoclavable

\textit{diameter 2.7 mm / 4 mm, length 18 cm}

- **7230 AA**
  - HOPKINS\textsuperscript{®} Straight Forward Telescope 0°,
    - enlarged view, diameter 4 mm, length 18 cm, autoclavable,
    - fiber optic light transmission incorporated,
    - color code: green

- **7230 FA**
  - HOPKINS\textsuperscript{®} Forward-Oblique Telescope 45°,
    - enlarged view, diameter 4 mm, length 18 cm, autoclavable,
    - fiber optic light transmission incorporated,
    - color code: black

- **7230 FLA**
  - HOPKINS\textsuperscript{®} Forward-Oblique Telescope 45°,
    - enlarged view, diameter 4 mm, length 18 cm, autoclavable,
    - connection for fiber optic light cable on left side,
    - fiber optic light transmission incorporated,
    - color code: black

- **7230 CA**
  - HOPKINS\textsuperscript{®} Lateral Telescope 70°,
    - enlarged view, diameter 4 mm, length 18 cm, autoclavable,
    - fiber optic light transmission incorporated,
    - color code: yellow

- **7229 AA**
  - HOPKINS\textsuperscript{®} Straight Forward Telescope 0°,
    - enlarged view, diameter 2.7 mm, length 18 cm, autoclavable,
    - fiber optic light transmission incorporated,
    - color code: green

- **7229 FA**
  - HOPKINS\textsuperscript{®} Forward-Oblique Telescope 45°,
    - enlarged view, diameter 2.7 mm, length 18 cm, autoclavable,
    - fiber optic light transmission incorporated,
    - color code: black

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**Tray for Cleaning, Sterilization and Storage** of two rigid endoscopes and one light cable. Including holder for adaptors, silicone telescope holders and lid.

External dimensions (w x d x h): 352 x 125 x 54 mm.

For rigid endoscopes with up to 10 mm diameter and 20 cm working length.
HOPKINS® Telescopes – autoclavable
diameter 3 mm, length 14 cm

7220 AA–FA

7220 AA

HOPKINS® Straight Forward Telescope 0º,
enlarged view, diameter 3 mm, length 14 cm, autoclavable,
fiber optic light transmission incorporated,
color code: green

7220 FA

HOPKINS® Forward-Oblique Telescope 45º,
enlarged view, diameter 3 mm, length 14 cm, autoclavable,
fiber optic light transmission incorporated,
color code: black

39501 A2

Tray for Cleaning, Sterilization and Storage of two rigid endoscopes and one light cable. Including holder for adaptors, silicone telescope holders and lid.
External dimensions (w x d x h): 352 x 125 x 54 mm.
For rigid endoscopes with up to 10 mm diameter and 20 cm working length.

It is recommended to check the suitability of the product for the intended procedure prior to use.
Endoscopic Surgery of the Lateral Nasal Wall, Paranasal Sinuses, and Anterior Skull Base

**EndoCAMeleon® HOPKINS® Telescope**

The ENDOCAMELEON® is the newest member of the HOPKINS® family of rod-lens telescopes – and the most versatile. With a simple turn of the adjusting knob, ENDOCAMELEON® enables the user to select the direction of view between 15° and 90°. Consequently, the surgeon can quickly and easily select the desired direction of view for optimal orientation and control.

The ENDOCAMELEON® from KARL STORZ brings a new quality to endoscopy in the OR as it often enhances orientation during an operation without the time-consuming changeover of telescopes, thereby ensuring safe and smooth surgery.

The ENDOCAMELEON® combines the user comfort of the proven HOPKINS® endoscopes with unprecedented versatility – in the proven KARL STORZ high quality.

**Special Features:**
- Variable direction of view (15° to 90°)
- Easy-to-use adjusting knob selects the desired direction of view
- Lightweight construction and modern design
- HOPKINS® telescope with unique rod-lens system
- Diameter 4 mm, length 18 cm
- Standard eyepiece fits all camera heads

The familiar ergonomics and handling of conventional telescopes is enhanced with the additional convenience of a variable direction of view.

The direction of view is adjusted by a mere turn of the adjusting knob at the proximal end of the ENDOCAMELEON®.
Telescope

**7230 AE**  
**ENDOCAMELEON® HOPKINS® Telescope,**  
diameter 4 mm, length 18 cm, **autoclavable,**  
variable direction of view from 15° to 90°,  
adjustment knob for selecting the desired direction of view,  
fiber optic light transmission incorporated,  
color code: gold

**7230 AES**  
**Irrigation and Suction Sheath,**  
outer diameter 4.8 x 6 mm, working length 14 cm,  
for use with **ENDOCAMELEON® HOPKINS® Telescope 7230 AE**  
and **KARL STORZ lens irrigation system CLEARVISION® II**

Accessories

**39501 A1**  
**Wire Tray for Cleaning, Sterilization and Storage**  
of one rigid endoscope, including holder for light post adaptors,  
silicone telescope holders and lid, external dimensions (w x d x h): 290 x 60 x 52 mm, for rigid endoscopes up to diameter 5 mm and working length 20 cm
KARL STORZ CLEARVISION® II System
for intra-operative irrigation of the telescope lens

UNIT SIDE

PATIENT SIDE

KARL STORZ CLEARVISION® II System
for intra-operative irrigation of the telescope lens

One-pedal footswitch

Silicone tubing set*

03129-10

40334101  KARL STORZ CLEARVISION® II Set,
Lens irrigation system for telescopes,
power supply: 100–240 VAC, 50–60 Hz
including:
CLEARVISION® II
Mains Cord
One-pedal Footswitch
Silicone Tubing Set

*) Optional Accessories:
MTP 03129-10 Single-use tubing set.
For use with CLEARVISION® II, Sterile, 10 per pack

Irrigation sheath

7230 FS
**KARL STORZ CLEARVISION® II**

Irrigation Sheath for use with CLEARVISION® II System

**Irrigation Sheath**, proximally reinforced for use with Adjustable Holder 28272 RKB

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<tr>
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<th>Order No.</th>
<th>Outer Diameter</th>
<th>Working length</th>
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Elevators, Curettes and Knives

479100  COTTLE Elevator, double-ended, semisharp and blunt, graduated, length 20 cm
660500  Sickle Knife, slightly curved, pointed, length 18 cm
660506  Round Knife, vertical cutting, 3.5 x 2.5 mm, length 18 cm

660506  Round Knife, angled 45°, diameter 2 mm, length 18 cm
628702  Antrum Curette, oblong, small, length 19 cm
628712  KUHN-BOLGER Frontal Sinus Curette, 55° curved, oval, forward cutting, length 19 cm
628714  Same, curved 90°

STAMMBERGER RHINOFORCE® II Forceps

651010  STAMMBERGER RHINOFORCE® II Double Spoon Forceps, vertical opening, 65° upturned, spoon diameter 3 mm, with cleaning connector, working length 12 cm
651020  Same, horizontal opening, 65°
STAMMBERGER Punch

651055  STAMMBERGER Punch, circular cutting, for sphenoid, ethmoid and choanal atresia, diameter 3.5 mm, with cleaning connector, working length 18 cm, including Cleaning Tool 651050 R

651050  Same, diameter 4.5 mm

651060  STAMMBERGER Punch, circular cutting, 65° upturned, for frontal sinus recess, diameter 3.5 mm, with cleaning connector, working length 17 cm, including Cleaning Tool 651050 R

651050  Same, diameter 4.5 mm

651061  STAMMBERGER Punch, egg-shaped tip, circular cut, 90° cutting direction, tip diameter 3.5 mm, sheath 65° upturned, for frontal sinus recess, with cleaning connector, working length 17 cm

651066  Same, diameter 4.5 mm

Cleaning Tool

651050 R  Cleaning Tool, for circular cutting punches type 651050 / 651055 / 60 / 65, double-ended, length 14 cm
HOSEMANN Frontal Sinus/Recess Punch
HOSEMANN Sphenoid Punch
with integrated irrigation channel

HOSEMANN Frontal Sinus/Recess Punch,
70° upturned, slender model, punch head diameter
3.5 mm, not through-cutting, upper part of punch fixed,
lower part of punch movable, sheath diameter 2.5 mm,
integrated irrigation channel with LUER-Lock,
working length 13 cm

HOSEMANN Sphenoid Punch,
straight, slender model, punch head diameter 3.5 mm,
not through-cutting, front part of punch fixed,
rear part of punch movable, sheath diameter 2.5 mm,
integrated irrigation channel with concealed LUER-Lock
irrigation adaptor, working length 13 cm

BLAKESLEY RHINOFORCE® II Nasal Forceps

BLAKESLEY RHINOFORCE® II Nasal Forceps, straight, size 0,
with cleaning connector,
working length 13 cm

BLAKESKEY-WILDE RHINOFORCE® II Nasal Forceps,
45° upturned, size 0,
with cleaning connector,
working length 13 cm
BLAKESLEY-CASTELNUOVO RHINOFORCE® II Nasal Forceps
end of sheath 25° upturned

GRÜNWALD-HENKE RHINOFORCE® II Nasal Forceps

456511 B BLAKESLEY-CASTELNUOVO RHINOFORCE® II Nasal Forceps, end of sheath 25° upturned, jaws 45° angled upwards, width 3.5 mm, with cleaning connector, working length 13 cm

451000 B GRÜNWALD-HENKE RHINOFORCE® II Nasal Forceps, straight, through-cutting, tissue-sparing, BLAKESLEY shape, size 0, width 3 mm, with cleaning connector, working length 13 cm

451500 B Same, 45° upturned
BLAKESLEY-CASTELNUOVO RHINOFORCE® II Nasal Forceps
end of sheath 25° upturned

45609 B  BLAKESLEY-CASTELNUOVO RHINOFORCE® II Nasal Forceps, end of sheath 25° upturned, with straight jaw, width 2.5 mm, with cleaning connector, working length 13 cm

456010 B  BLAKESLEY-CASTELNUOVO RHINOFORCE® II Nasal Forceps, end of sheath 25° upturned, with straight jaws, width 3 mm, with cleaning connector, working length 13 cm

456509 B  Same, jaws 45° upturned, width 2.5 mm

456510 B  Same, jaws 45° upturned, width 3 mm

451010 B  CASTELNUOVO RHINOFORCE® II Nasal Forceps, end of sheath 25° upturned, through-cutting, with straight jaws, BLAKESLEY shape, width 3 mm, with cleaning connector, working length 13 cm

451510 B  Same, jaws 45° upturned
SILCUT® Nasal Forceps

Special features:
- Tactile instrument feedback
- Uniform patented force transmission
- Powerful resection under precise control
- Accurate incision due to small tolerances
- Special cutting geometry to prevent tissue from slipping
- Large aperture angle
- Flat jaws
- Through-cutting and backward-cutting versions also available

456021 GRÜNWALD-HENKE SILCUT® Nasal Forceps, straight, not through-cutting, extremely powerful resection, patented uniform force transmission for gently controlled grasping and removal of tissue, cartilage and bone fragments, new ergonomic handle design, BLAKESLEY shape, size 1, with cleaning connector, working length 13 cm

456521 Same, 45° upturned

451020 GRÜNWALD-HENKE SILCUT® Nasal Cutting Forceps, straight, through-cutting, extremely powerful resection, patented uniform force transmission for gently controlled cutting, new ergonomic handle design, BLAKESLEY shape, size 0, with cleaning connector, working length 13 cm

451021 Same, size 1

451520 GRÜNWALD-HENKE SILCUT® Nasal Cutting Forceps, 45° upturned, through-cutting, extremely powerful resection, patented uniform force transmission for gently controlled cutting, new ergonomic handle design, BLAKESLEY shape, size 0, with cleaning connector, working length 13 cm

451521 Same, size 1

459151 STAMMBERGER SILCUT® Antrum Punch, extremely powerful resection, patented uniform force transmission for gently controlled cutting, new ergonomic handle design, right side downward and forward cutting, with cleaning connector, working length 10 cm

459152 Same, left side downward and forward cutting

459161 SILCUT® Antrum Punch, right side upward and forward cutting, sheath distally curved right, with cleaning connector, working length 10 cm

459162 Same, left side upward and forward cutting, sheath distally curved left

452011 MACKAY-GRÜNWALD SILCUT® Nasal Cutting Forceps, straight, through-cutting, extremely powerful resection, patented uniform force transmission for gently controlled cutting, new ergonomic handle design, size 1, 8 x 3 mm, with cleaning connector, working length 13 cm

452021 SILCUT® Nasal Cutting Forceps, straight, through-cutting, extremely powerful resection, patented uniform force transmission for gently controlled cutting, new ergonomic handle design, width of cut 1.5 mm, with cleaning connector, working length 13 cm

452031 Same, jaws upturned 15°
RHINOFORE® II Miniature Nasal Forceps

- **RHINOFORE® II Miniature Nasal Forceps**, with extra fine flat jaws, through-cutting, tissue-sparing, straight sheath, straight jaws, width of cut 1.5 mm, with cleaning connector, working length 13 cm
- **452831**

- Same, straight sheath, jaws 45° upturned
- **452832**

- Same, sheath curved 30°, with straight jaws
- **452833**

- Same, sheath curved 30°, jaws 45° upturned
- **452834**
CASTELNUOVO RHINOFORCE® II Miniature Nasal Forceps

452841 CASTELNUOVO RHINOFORCE® II Miniature Nasal Forceps, with extra fine flat jaws, through-cutting, tissue-sparing, 65° upturned, backward opening, width of cut 1.5 mm, with cleaning connector, working length 13 cm

452841 L Same, left side opening

452841 R Same, right side opening

HEUWIESER Antrum Grasping Forceps

653000 HEUWIESER Antrum Grasping Forceps, jaws curved downwards, fixed jaw curved 90°, movable jaw backward opening 120°, with cleaning connector, working length 10 cm

653005 HEUWIESER Antrum Grasping Forceps, with extra long curve for anterior alveolar recess, fixed jaw curved downwards 115°, movable jaw backward opening up to 140°, with cleaning connector, working length 10 cm
McKENTY Sphenoid Punch and McKENTY-CASTELNUOVO Sphenoid Punch

- **McKENTY Sphenoid Punch**: through-cutting, reversible, size 1.6 x 2 mm, working length 12 cm
- **McKENTY-CASTELNUOVO Sphenoid Punch**: tip curved 30°, through-cutting, reversible, size 1.6 x 2 mm, working length 17 cm

PARSONS RHINOFORCE® II Punch

- **PARSONS RHINOFORCE® II Punch**: for resection of the uncinate process, upward backward cutting, movable jaw with round tip, diameter 2.5 mm, with cleaning connector, working length 10 cm

OSTRUM Pediatric 360° Rotating Punch

- **OSTRUM Punch, Pediatric**: for resection of the uncinate process, backward cutting, sheath 360° rotating, with set screw, sheath slightly curved downwards, small size, bite 2.3 x 4 mm, with cleaning connector, working length 9 cm
STAMMBERGER Antrum Punch

459052 STAMMBERGER Antrum Punch, right side downward and forward cutting, working length 10 cm

459051 Same, left side downward and forward cutting

CASTELNUOVO TAKE-APART® Bipolar Forceps

462020 CASTELNUOVO TAKE-APART® Bipolar Forceps with fine jaws, width 2 mm, distally angled 45°, outer diameter 3.4 mm, working length 14 cm, with irrigation connection for cleaning, including:
- Handle
- Outer Sheath
- Inner Sheath
- Bipolar Insert
CASTELNUOVO **Frontal Sinus Probe and Positioning Instrument**

629820  **Probe**, double-ended, maxillary sinus ostium seeker, ball-shaped ends diameter 1.2 and 2 mm, length 19 cm

629822  **CASTELNUOVO Positioning Instrument**, double-ended, curved/double curved, with 4 spikes, length 22 cm

629823  **CASTELNUOVO Positioning Instrument**, double-ended, straight/curved 60°, with 4 spikes, length 22 cm

629824  **CASTELNUOVO Frontal Sinus Probe**, curved, double-ended, length 22 cm
CASTELNUOVO **Elevators, double-ended**

CASTELNUOVO **Suction Elevators**

28164 EA  CASTELNUOVO Elevator, double-ended, semisharp and blunt, length 26 cm

28164 EB  Same, angled end shovel-shaped, semisharp, blunt end slightly curved

28164 EC  Same, blunt end angled, semisharp end slightly curved, graduated

474015  CASTELNUOVO Suction Elevator, flat tip, 5 x 1.8 mm, lateral suction opening, bayonet-shaped, with grip plate, length 21 cm

474016  CASTELNUOVO Suction Elevator, flat tip, 3 x 1.8 mm, lateral suction opening, bayonet-shaped, with grip plate, length 21 cm

474017  CASTELNUOVO Suction Elevator, 5 x 1.8 mm, double curved, length 21 cm

474018  CASTELNUOVO Suction Elevator, 3 x 1.8 mm, double curved, length 21 cm
STRÜMPEL Nasal Forceps

634825 A  STRÜMPEL Forceps, with oval, fenestrated, cupped jaws, 45° upturned, width 2.5 mm, working length 12.5 cm

Forceps

663239  Forceps, straight, not through-cutting, with oval, fenestrated cupped jaws, width 2.5 mm, working length 18 cm

663217  Forceps, 45° upturned, not through-cutting, extra sharp, with oval, fenestrated spoon, width 1.5 mm, working length 18 cm, color code: one blue handle
RHINOFORCE® II Nasal Forceps

28164 UA  RHINOFORCE® II Nasal Forceps, with extra fine flat jaws, through-cutting, tissue sparing, width of cut 1.5 mm, straight sheath, straight jaws, with cleaning connector, working length 18 cm

28164 UB  Same, jaws angled upwards 45°

28164 UE  Same, jaws angled downwards 45°

Scissors

663300  Scissors, straight, working length 18 cm

663301  Scissors, straight, delicate, working length 18 cm

663302  Scissors, straight, extra delicate, working length 18 cm

663304  Same, curved to right

663305  Same, curved to left

663307  Same, 45° curved upwards

663327  Scissors, 45° upwards curve, delicate, shaft 360° rotatable, with cleaning connector, working length 18 cm
Curettes, Dissectors and Elevators

- **Curette**, round spoon, tip slightly angled, size 1 mm, with round handle, length 23 cm
- **Curette**, round spoon, tip slightly angled, size 2 mm, with round handle, length 23 cm
- **Curette**, round spoon, tip highly angled, size 2 mm, with round handle, length 23 cm
- **Same**, size 3 mm

- **Ring Curette**, with round wire, inner diameter 3 mm, tip angled 45°, with round handle, length 25 cm
- **Ring Curette**, with round wire, inner diameter 5 mm, tip angled 45°, with round handle, length 25 cm
- **Ring Curette**, with round wire, inner diameter 3 mm, tip angled 90°, with round handle, length 25 cm
- **Same**, inner diameter 5 mm

- **Ring Curette**, with round wire, inner diameter 3 mm, laterally curved sheath end, with round handle, length 25 cm
- **Ring Curette**, with round wire, inner diameter 5 mm, laterally curved sheath end 90°, with round handle, length 25 cm
- **Same**, inner diameter 7 mm

- **Curette**, blunt, stirrup-shape, with round handle, length 25 cm

- **Dissector**, sharp, tip angled 45°, round spatula, with round handle, size 2 mm, length 23 cm
- **Dissector**, sharp, tip angled 15°, flat long spatula, with round handle, size 1.5 mm, length 23 cm
- **Elevator**, sharp, tip angled 15°, slightly curved spatula, with round handle, size 2 mm, length 23 cm
- **Elevator**, sharp, straight tip, slightly curved spatula, with round handle, size 3 mm, length 23 cm
Suction Curettes, with stylet, basket-shaped and hook-shaped

- **28164 RSB** CAPPABIANCA-de DIVITIIS Suction Curette, blunt, inner diameter 5 mm, tip angled 45°, Luer, length 25 cm
- **28164 RSC** Same, inner diameter 7 mm
- **28164 RT** CAPPABIANCA-de DIVITIIS Suction Curette, with basket, round, size 5 mm, rotatable tube, Luer, length 25 cm
- **28164 RU** Same, size 6.5 mm
- **28164 HKL** Hook Curette, curved to left, hook width 2.5 mm, hook size 0.5 mm, length 25 cm
- **28164 HKR** Hook Curette, curved to right, hook width 2.5 mm, hook size 0.5 mm, length 25 cm
CASTELNUOVO Hook and Suction Tube

28164 H

28164 H  CASTELNUOVO Hook, 90°, blunt, with round handle, length 25 cm

28164 X

28164 X  CASTELNUOVO Suction Tube, diameter 2 mm, malleable, lateral suction holes, working length 25 cm

Fluorescein Blue Filter System

20100032

20100032  Fluorescein Blue Filter System for fluorescence diagnosis, with 2 rotatable integrated blue filters of different spectral characteristic and additional passage for white light illumination, for use with KARL STORZ cold light fountains and fiber optic light cables. The use of fluorescein barrier filter 20100033 is recommended

20100033

20100033  Fluorescein Barrier Filter, for use with fluorescein blue filter systems 20100032 and HOPKINS® telescopes series 7230, for visual observation or for connection to KARL STORZ Endovision® video cameras
**Antrum Cannulas**

- **586125** v. EICKEN *Antrum Cannula*, Luer-Lock, long curved, malleable, serrated grip plate, outer diameter 2.5 mm, length 12.5 cm
- **586130** Same, outer diameter 3 mm
- **586225** v. EICKEN *Antrum Cannula*, Luer-Lock, short curved, outer diameter 2.5 mm, length 12.5 cm
- **586230** Same, outer diameter 3 mm
- **586145** v. EICKEN-CASTELNUOVO *Antrum Cannula*, Luer-Lock, S-shaped slightly curved, malleable, serrated grip plate, outer diameter 2.5 mm, length 12.5 cm
- **586146** Same, S-shaped strongly curved
Suction Tube

722830 Suction Tube, angular, with grip plate and cut-off hole, Luer-Lock, outer diameter 3 mm, working length 14 cm

649180 N FERGUSON-CASTELNUOVO Suction Tube, without cut-off hole, with stylet, Luer, diameter 2 mm, working length 15 cm

649182 BU FERGUSON-CASTELNUOVO Suction Tube, with cut-off hole and mandrel, with calibration markings, lateral opening downwards, diameter 2.5 mm, working length 15 cm

649183 FERGUSON Suction Tube, with cut-off hole and stylet, Luer, 10 Fr., working length 15 cm

662882 FRANK-PASQUINI Suction Tube, angular, tip curved upwards, ball end, with grip plate and cut-off hole, Luer, diameter 2.4 mm, working length 13 cm

662883 Same, tip curved downwards

662885 FRANK-PASQUINI Suction Tube, angular, tip curved upwards, ball end, with grip plate and cut-off hole, Luer, diameter 3 mm, working length 13 cm

662886 Same, tip curved downwards
Knives, Elevator, Hook and WILDER Dilator
BOWMAN Lachrymal Probe, Light Transmission Probe

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Code</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>748000</td>
<td>Surgical Handle, Fig. 7, length 16.5 cm, for Blades 208010–15, 208210–15</td>
<td>634840</td>
<td></td>
</tr>
<tr>
<td>208215</td>
<td>Blade, Fig. 15, sterile, package of 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>660512</td>
<td>Elevator, sharp, curved to right, length 18 cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>660515</td>
<td>Elevator, sharp, curved to left, length 18 cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>660521</td>
<td>Hook, 90°, blunt, length 18 cm</td>
<td>496 V</td>
<td></td>
</tr>
<tr>
<td>745900</td>
<td>WILDER Dilator, for salivary duct, length 11 cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>660512</td>
<td>BOWMAN Lachrymal Probe, length 13 cm including:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>660515</td>
<td>Probe, size 0000–000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>660521</td>
<td>Probe, size 00–0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>745900</td>
<td>Probe, size 1–2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>496 V</td>
<td>Light Transmission Probe, for diaphanoscopic localization of the nasolacrimal ducts and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>fistulae, diameter of distal tip 0.5 mm, sterile, for single use, for use with Fiber Optic Light</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cable 495 NL, package of 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**UNIDRIVE® S III ENT SCB/UNIDRIVE® S III ECO**

The multifunctional unit for ENT

![UNIDRIVE S III ENT SCB](image)

![UNIDRIVE S III ECO](image)

<table>
<thead>
<tr>
<th>Special Features</th>
<th>UNIDRIVE® S III ENT SCB</th>
<th>UNIDRIVE® S III ECO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch Screen: Straightforward function selection via touch screen</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>Set values of the last session are stored</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Optimized user control due to touch screen</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>Choice of user languages</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>Operating elements are single and clear to read due to color display</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>One unit – multifunctional:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Shaver system for surgery of the paranasal sinuses and anterior skull base</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>– INTRA Drill Handpieces (40,000 rpm and 80,000 rpm)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>– Sinus Shaver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Micro Saw</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Dermatome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– High-Speed Handpieces (60,000 rpm and 100,000 rpm)</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>Two motor outputs: Two motor outputs enable simultaneous connection of two motors:</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>For example, a shaver and micro motor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft start function</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>Textual error messages</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>Integrated irrigation and coolant pump:</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>– Absolutely homogeneous, micro-processor controlled irrigation rate throughout the entire irrigation range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Quick and easy connection of the tubing set</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>Easy program selection via automated motor recognition</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Continuously adjustable revolution range</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Maximum number of revolutions and motor torque: Microprocessor-controlled motor rotation speed. Therefore the preselected parameters are maintained throughout the drilling procedure</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Maximum number of revolutions can be preset</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>SCB model with connections to the KARL STORZ Communication Bus (KARL STORZ-SCB)</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>Irrigator rod included</td>
<td>●</td>
<td>-</td>
</tr>
</tbody>
</table>
## Motor Systems
### Specifications

### System specifications

<table>
<thead>
<tr>
<th>Mode</th>
<th>Order No.</th>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shaver mode</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation mode:</td>
<td>40 7120 50</td>
<td>10,000*</td>
</tr>
<tr>
<td>Max. rev. (rpm):</td>
<td>40 7120 55</td>
<td>10,000*</td>
</tr>
<tr>
<td>DRILLCUT-X® II Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRILLCUT-X® II N Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sinus burr mode</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation mode:</td>
<td>40 7120 50</td>
<td>12,000</td>
</tr>
<tr>
<td>Max. rev. (rpm):</td>
<td>40 7120 55</td>
<td>12,000</td>
</tr>
<tr>
<td>DRILLCUT-X® II Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRILLCUT-X® II N Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High-speed drilling mode</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation mode:</td>
<td>20 7120 33</td>
<td>60,000/100,000</td>
</tr>
<tr>
<td>Max. rev. (rpm):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRILLCUT-X® II Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRILLCUT-X® II N Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Drilling mode</strong></td>
<td>[20 7110 33]</td>
<td>40,000/80,000</td>
</tr>
<tr>
<td>Operation mode:</td>
<td>[20 7111 73]</td>
<td></td>
</tr>
<tr>
<td>Max. rev. (rpm):</td>
<td>[20 7110 33]</td>
<td></td>
</tr>
<tr>
<td>DRILLCUT-X® II Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRILLCUT-X® II N Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Micro saw mode</strong></td>
<td>[20 7110 33]</td>
<td>15,000/20,000</td>
</tr>
<tr>
<td>Operation mode:</td>
<td>[20 7111 73]</td>
<td></td>
</tr>
<tr>
<td>Max. rev. (rpm):</td>
<td>[20 7110 33]</td>
<td></td>
</tr>
<tr>
<td>DRILLCUT-X® II Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRILLCUT-X® II N Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dermatome mode</strong></td>
<td>[20 7110 33]</td>
<td>8,000</td>
</tr>
<tr>
<td>Operation mode:</td>
<td>[20 7111 73]</td>
<td></td>
</tr>
<tr>
<td>Max. rev. (rpm):</td>
<td>[20 7110 33]</td>
<td></td>
</tr>
<tr>
<td>DRILLCUT-X® II Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRILLCUT-X® II N Shaver Handpiece</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Power supply:** 100–240 VAC, 50/60 Hz

**Dimensions:** 300 x 165 x 265 mm

**Two outputs for parallel connection of two motors**

**Integrated irrigation pump:**
- **Flow:** adjustable in 9 steps

* Approx. 4,000 rpm is recommended as this is the most efficient suction/performance ratio.

### Technical Specifications

<table>
<thead>
<tr>
<th></th>
<th>UNIDRIVE® S III ENT SCB</th>
<th>UNIDRIVE® S III ECO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Touch Screen:</strong></td>
<td>6,4&quot; / 300 cd/m²</td>
<td></td>
</tr>
<tr>
<td><strong>Weight:</strong></td>
<td>5.2 kg</td>
<td>4.7 kg</td>
</tr>
<tr>
<td><strong>Certified to:</strong></td>
<td>IEC 601-1 CE acc. to MDD</td>
<td>IEC 60601-1</td>
</tr>
<tr>
<td><strong>Available languages:</strong></td>
<td>English, French, German, Spanish, Italian, Portuguese, Greek, Turkish, Polish, Russian</td>
<td>numerical codes</td>
</tr>
</tbody>
</table>
Motor Systems

Special features of high-performance EC micro motor II
and of the high-speed micro motor

Special features of high-performance EC micro motor II:
- Self-cooling, brushless high-performance EC micro motor
- Smallest possible dimensions
- Autoclavable
- Reprocessable in a cleaning machine
- Detachable connecting cable

Special Features of the high-speed micro motor:
- INTRA coupling enables a wide variety of applications
- Maximum torque 4 Ncm
- Number of revolutions can be continuously adjusted up to 40,000 rpm
- Provided a suitable handle is used, the number of revolutions can be continuously adjusted up to 80,000 rpm

---

High-Speed Micro-Motor, max. speed 60,000 rpm, including connecting cable, for use with UNIDRIVE® S III ENT/NEURO

High-Performance EC Micro Motor II, for use with UNIDRIVE® II/UNIDRIVE® ENT/OMFS/NEURO/ECO and Connecting Cable 20711073, or for use with UNIDRIVE® S III ENT/ECO/NEURO and Connecting Cable 20711173

Connecting Cable, to connect High-Performance EC Micro Motor 20711033 to UNIDRIVE® S III ENT/ECO/NEURO
UNIDRIVE® S III ENT SCB
UNIDRIVE® S III ECO

Recommended System Configuration

UNIDRIVE® S III ENT SCB

![UNIDRIVE® S III ENT SCB](image)

407016-20

UNIDRIVE® S III ENT SCB, motor control unit with color display, touch screen, two motor outputs, integrated irrigation pump and SCB module, power supply 100–240 VAC, 50/60 Hz

including:

- Mains Cord
- Irrigator Rod
- Two-Pedal Footswitch, two-stage, with proportional function
- Clip Set, for use with silicone tubing set
- SCB Connecting Cable, length 100 cm
- Single Use Tubing Set*, sterile, package of 3

UNIDRIVE® S III ECO

![UNIDRIVE® S III ECO](image)

407014-20

UNIDRIVE® S III ECO, motor control unit with two motor outputs and integrated irrigation pump, power supply 100–240 VAC, 50/60 Hz

including:

- Mains Cord
- Two-Pedal Footswitch, two-stage, with proportional function
- Clip Set, for use with silicone tubing set
- Single Use Tubing Set*, sterile, package of 3

Specifications:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch Screen</td>
<td>UNIDRIVE® S III ENT SCB: 6.4*/300 cd/m²</td>
</tr>
<tr>
<td>Flow</td>
<td>9 steps</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–240 VAC, 50/60 Hz</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>300 x 165 x 265 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>5.2 kg</td>
</tr>
<tr>
<td>Certified to</td>
<td>EC 601-1, CE acc. to MDD</td>
</tr>
</tbody>
</table>

* Single Use Tubing Set: sterile, package of 3
UNIDRIVE® S III ENT SCB
UNIDRIVE® S III ECO
System Components

Two-Pedal Footswitch
Single Use Tubing Set

High-Speed Micro-Motor
High-Performance EC Micro Motor II

High-Speed Handpiece
INTRA Drill Handpiece

DRILLCUT-X™ II Shaver Handpiece, for use with UNIDRIVE® S III ECO/ENT/NEURO
DRILLCUT-X™ II N Shaver Handpiece, optional adaptability to Shaver Tracker, for use with UNIDRIVE® S III ECO/ENT/NEURO

Shaver Blade
Shaver Blade, curved
Sinus Burr
## Optional Accessories

**for UNIDRIVE® S III ENT SCB and UNIDRIVE® S III ECO**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>280053</td>
<td><strong>Universal Spray</strong>, 6x 500 ml bottles – HAZARDOUS GOODS – UN 1950 including:</td>
</tr>
<tr>
<td></td>
<td><em>Spray Nozzle</em></td>
</tr>
<tr>
<td>280053 C</td>
<td><strong>Spray Nozzle</strong>, for the reprocessing of INTRA burr handpieces, for use with Universal Spray 280053 B</td>
</tr>
<tr>
<td>031131-10*</td>
<td><strong>Tubing Set</strong>, for irrigation, for single use, sterile, package of 10</td>
</tr>
</tbody>
</table>
## DRILLCUT-X® Shaver Handpieces

### Special Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>DRILLCUT-X® II Shaver Handpiece, 40712050</th>
<th>DRILLCUT-X® II N Shaver Handpiece, 40712055</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. 10,000 rpm for shaver blades, max. 12,000 rpm for sinus shaver</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Straight suction channel</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Integrated irrigation channel</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Powerful motor, also suitable for harder materials</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Absolutely silent running, no vibration</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Completely immersible and machine-washable</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>LOCK allows fixation of shaver blades and sinus shavers</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Extremely lightweight design</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Optional, ergonomic handle, detachable</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Can be adapted to navigation tracker</td>
<td>–</td>
<td>●</td>
</tr>
</tbody>
</table>

40712050 DRILLCUT-X® II Shaver Handpiece, for use with UNIDRIVE® S III ECO/ENT/NEURO/OMFS

40712055 DRILLCUT-X® II N Shaver Handpiece, optional adaptability to Shaver Tracker 40800122, for use with UNIDRIVE® S III ECO/ENT/NEURO/OMFS
DRILLCUT-X® II Shaver Handpiece

Special Features:
- Powerful motor
- Absolutely silent running
- Enhanced ergonomics
- Lightweight design
- Oscillation mode for shaver blades, max. 10,000 rpm
- Rotation mode for sinus shavers, max. 12,000 rpm
- Straight suction channel and integrated irrigation

- The versatile DRILLCUT-X® II Shaver Handpiece can be adapted to individual needs of the user
- Easy hygienic processing, suitable for use in washer and autoclavable at 134°C
- Quick coupling mechanism facilitates more rapid exchange of work inserts
- Proven DRILLCUT-X® blade portfolios can be used

DRILLCUT-X® II Shaver Handpiece, for use with UNIDRIVE® S III ECO/ENT/NEURO/OMFS

Handle, adjustable, for use with DRILLCUT-X® II 40712050 and DRILLCUT-X® II N 40712055

Optional Accessory:

Cleaning Adaptor, LUER-Lock, for cleaning DRILLCUT-X® shaver handpieces
DRILLCUT-X® II Shaver N Handpiece

Special Features:
- Powerful motor
- Absolutely silent running
- Enhanced ergonomics
- Lightweight design
- Oscillation mode for shaver blades, max. 10,000 rpm
- Rotation mode for sinus shavers, max. 12,000 rpm
- Straight suction channel and integrated irrigation
- The versatile DRILLCUT®-X II Shaver N Shaver Handpiece can be adapted to the individual needs of the user

- Easy hygienic processing, suitable for use in washer and autoclavable at 134° C
- Quick coupling mechanism facilitates more rapid exchange of working inserts
- Proven DRILLCUT-X® blade portfolios can be used
- Optional adaptability to Shaver Tracker 40 8001 22
- Allows shaver navigation when used with NPU 40 8000 01

40 7120 55

40 7120 55 DRILLCUT-X® II N Shaver Handpiece, optional adaptability to Shaver Tracker 40 8001 22, for use with UNIDRIVE® S III ECO/ENT/NEURO/OMFS

40 7120 90

40 7120 90 Handle, adjustable, for use with DRILLCUT-X® II 40 7120 50 and DRILLCUT-X® II N 40 7120 55

Optional Accessory:

41250 RA

41250 RA Cleaning Adaptor, LUER-Lock, for cleaning DRILLCUT-X® shaver handpieces
Handle for DRILLCUT-X® II Shaver Handpiece
for use with DRILLCUT-X® II 40712050 and DRILLCUT-X® II N 40712055

Special Features:
- Ergonomic design
- Ultralight construction
- Easy handle control allows individual adjustment
- The adjustable handle can be mounted to DRILLCUT-X® II or -X II N Shaver Handpiece
- Easy fixation via rotary lock
- Sterilizable

40712090 Handle, adjustable, for use with DRILLCUT-X® II 40712050 and DRILLCUT-X® II N 40712055
Shaver Blades, straight
for Nasal Sinuses and Skull Base Surgery

For use with DRILLCUT-X® II and DRILLCUT-X® II N

![Shaver Blades](image)

<table>
<thead>
<tr>
<th>Shaver Blade</th>
<th>for use with</th>
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<tbody>
<tr>
<td>41201 GN</td>
<td>40712050 DRILLCUT-X® II Handpiece</td>
</tr>
<tr>
<td>41201 KN</td>
<td>40712055 DRILLCUT-X® II N Handpiece</td>
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Shaver Blades, straight, sterilizable

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<thead>
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<tbody>
<tr>
<td>41201 KN</td>
<td>serrated cutting edge, diameter 4 mm, color code: blue-red</td>
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<td>41201 KK</td>
<td>double serrated cutting edge, diameter 4 mm, color code: blue-yellow</td>
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<td>concave cutting edge, oval cutting window, diameter 4 mm, color code: blue-green</td>
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<td>concave cutting edge, oblique cutting window, diameter 4 mm, color code: blue-black</td>
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<td>41201 SN</td>
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<td>41201 KSA</td>
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<tr>
<td>41201 KKSA</td>
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<tr>
<td>41201 KKSB</td>
<td>double serrated cutting edge, diameter 2 mm, color code: blue-yellow</td>
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Optional Accessory:

41200 RA  Cleaning Adaptor, Luer-Lock, for cleaning the inner and outer blades of reusable Shaver Blades 412xx
Shaver Blades, curved
for Nasal Sinuses and Skull Base Surgery

For use with DRILLCUT-X® II and DRILLCUT-X® II N

Shaver Blades, curved 35°/40°, sterilizable

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<td>41204 KKB</td>
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Optional Accessory:

Cleaning Adaptor, LUER-Lock, for cleaning the inner and outer blades of reusable Shaver Blades 412xx
**Shaver Blades, curved**

For use with DRILLCUT-X® II and DRILLCUT-X® II N

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<td>41203 GNB</td>
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**Optional Accessory:**

41200 RA **Cleaning Adaptor**, Luer-Lock, for cleaning the inner and outer blades of reusable Shaver Blades 412xx
Shaver Blades, straight
for Nasal Sinuses and Skull Base Surgery

For use with DRILLCUT-X® II and DRILLCUT-X® II N

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<td>41301 KK</td>
<td>double serrated cutting edge, diameter 4 mm, color code: blue-yellow</td>
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<td>41301 GN</td>
<td>concave cutting edge, oval cutting window, diameter 4 mm, color code: blue-green</td>
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<tr>
<td>41301 LN</td>
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<td>41301 SN</td>
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<td>41301 KSA</td>
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<td>41301 LSA</td>
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### Shaver Blades, curved
for Nasal Sinuses and Skull Base Surgery

For use with DRILLCUT-X® II and DRILLCUT-X® II N

Shaver Blades, curved 35°/40°, for single use, sterile, package of 5

<table>
<thead>
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<tr>
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<td>curved 40°, cutting edge serrated forwards, double serrated, diameter 4 mm, color code: blue-yellow</td>
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<tr>
<td>41304 KKB</td>
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Shaver Blades, curved
for Nasal Sinuses and Skull Base Surgery

For use with DRILLCUT-X® II and DRILLCUT-X® II N

Shaver Blades, curved 65°, for single use, sterile, package of 5

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<td>DRILLCUT-X® II N Handpiece</td>
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<table>
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<th>41303 KKFA</th>
<th>41303 KKBA</th>
<th>41303 GNF</th>
<th>41303 GNB</th>
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<td>curved 65°, cutting edge concave forwards, oval cutting window, diameter 4 mm, color code: blue-green</td>
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<td></td>
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<td>curved 65°, cutting edge concave backwards, oval cutting window, diameter 4 mm, color code: blue-green</td>
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</tbody>
</table>
## Sinus Burrs, curved

for Nasal Sinuses and Skull Base Surgery

For use with DRILLCUT-X® II and DRILLCUT-X® II N

![Image of sinus burrs](image)

### Sinus Burrs, curved 70°/55°/40°/15°, **for single use**, sterile, package of 5

<table>
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<tr>
<th>Detail</th>
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<td>41304 W</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>drill diameter 3 mm,</td>
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<tr>
<td></td>
<td></td>
<td>shaft diameter 4 mm,</td>
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<tr>
<td></td>
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<tr>
<td>41303 WN</td>
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<td>curved 55°, cylindric,</td>
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<tr>
<td></td>
<td></td>
<td>drill diameter 3.6 mm,</td>
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<tr>
<td></td>
<td></td>
<td>shaft diameter 4 mm,</td>
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<tr>
<td></td>
<td></td>
<td>color code: red-blue</td>
</tr>
<tr>
<td>41305 RN</td>
<td></td>
<td>curved 15°, bud drill,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>drill diameter 4 mm,</td>
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<tr>
<td>41305 DN</td>
<td></td>
<td>curved 15°, diamond head,</td>
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<td>drill diameter 3 mm,</td>
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<td>curved 70°, diamond head,</td>
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<td>shaft diameter 4 mm,</td>
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</tbody>
</table>
### Accessories for Shaver

39550 A **Wire Tray**, provides safe storage of accessories for KARL STORZ paranasal sinus shaver systems during cleaning and sterilization

**for storage of:**
- Up to 7 shaver attachments
- Connecting cable

---

**Please note:** The instruments displayed are not included in the sterilizing and storage tray.
INTRA Drill Handpiece
for Surgery in Ethmoid and Skull Base Area

Special Features:
- Tool-free closing and opening of the drill
- Right/left rotation
- Max. rotating speed up to 40,000 rpm / 80,000 U/min
- Detachable irrigation channels
- Lightweight construction
- Operates with little vibrations
- Low maintenance
- Reprocessable in a cleaning machine
- Safe grip

INTRA Drill Handpiece, angled, length 15 cm, transmission 1:1 (40,000 rpm), for use with KARL STORZ high-performance EC micro motor II and burrs

INTRA Drill Handpiece, straight, length 13 cm, transmission 1:1 (40,000 rpm), for use with KARL STORZ high-performance EC micro motor II and burrs

<table>
<thead>
<tr>
<th>Detail</th>
<th>Size</th>
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649600  Standard Straight Shaft Burr, stainless, size 014–070, length 9.5 cm, set of 11
649700  Diamond Straight Shaft Burr, stainless, size 014–070, length 9.5 cm, set of 11
649700 G Rapid Diamond Straight Shaft Burr, stainless, with coarse diamond coating for precise drilling and abrasion without hand pressure and generating minimal heat, size 023–070, length 9.5 cm, set of 9, color code: gold
280033  Rack, for 36 straight shaft burrs with a length of 9.5 cm, foldable, sterilizable, size 22 x 14 x 2 cm
INTRA Drill Handpiece
for Surgery in Ethmoid and Skull Base Area

Special Features:
- Tool-free closing and opening of the drill
- Right/left rotation
- Max. rotating speed up to 40,000 rpm/80,000 U/min
- Detachable irrigation channels
- Lightweight construction
- Operates with little vibrations
- Low maintenance
- Reprocessable in a cleaning machine
- Safe grip

<table>
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649600 L  **Standard Straight Shaft Burr**, stainless, size 014–070, length 12.5 cm, set of 11

649700 L  **Diamond Straight Shaft Burr**, stainless, size 014–070, length 12.5 cm, set of 11

649700 GL **Rapid Diamond Straight Shaft Burr**, stainless, with coarse diamond coating for precise drilling and abrasion without hand pressure and generating minimal heat, sizes 023–070, length 12.5 cm, set of 9, color code: gold

280034  **Rack**, for 36 straight shaft burrs with a length of 12.5 cm, foldable, sterilizable, size 22 x 17 x 2 cm
Accessories for Burrs

280033 Rack, for 36 straight shaft burrs with a length of 9.5 cm, foldable, sterilizable, size 22 x 14 x 2 cm

280034 Rack, for 36 straight shaft burrs with a length of 12.5 cm, foldable, sterilizable, size 22 x 17 x 2 cm

NEW 280043 Rack, flat model, to hold 21 straight shaft burrs with a length of 7 cm (6 pcs) and 9.5 cm (15 pcs), folding model, sterilizable, size 17.5 x 11.5 x 1.2 cm

Please note: The burrs displayed are not included in the racks.
Accessories for Burrs

39552 A  **Wire Tray**, provides safe storage of accessories for KARL STORZ drilling/grinding systems during cleaning and sterilization, includes tray for small parts, for use with Rack 280030, rack **not** included

**for storage of:**
- Up to 6 drill handpieces
- Connecting cable
- EC micro motor
- Small parts

39552 B  **Wire Tray**, provides safe storage of accessories for KARL STORZ drilling/grinding systems during cleaning and sterilization, includes tray for small parts, for use with Rack 280030, rack **included**

**for storage of:**
- Up to 6 drill handpieces
- Connecting cable
- EC micro motor
- Up to 36 drill bits and burrs
- Small parts

**Please note:** The instruments displayed are not included in the sterilizing and storage tray.
UNIDRIVE® S III ENT SCB
High-Speed Handpieces, angled, 100,000 rpm

For use with High-Speed Drills, shaft diameter 3.17 mm and with High-Speed Micro Motor 20712033

100,000 rpm

For use with High-Speed Micro-Motor 20712033

252681 High-Speed Handpiece, medium, angled, 100,000 rpm, for use with High-Speed Micro-Motor 20712033

252682 High-Speed Handpiece, long, angled, 100,000 rpm, for use with High-Speed Micro-Motor 20712033
UNIDRIVE® S III ENT SCB
High-Speed Handpieces, angled, 60,000 rpm

For use with High-Speed Drills, shaft diameter 2.35 mm
and with High-Speed Micro Motor 20712033

20712033

252661  High-Speed Handpiece, short, angled, 60,000 rpm,
for use with High-Speed Micro-Motor 20712033

252662  High-Speed Handpiece, medium, angled, 60,000 rpm,
for use with High-Speed Micro-Motor 20712033

252663  High-Speed Handpiece, long, angled, 60,000 rpm,
for use with High-Speed Micro-Motor 20712033
UNIDRIVE® S III ENT SCB
High-Speed Handpieces, straight, 60,000 rpm

For use with High-Speed Drills, shaft diameter 2.35 mm
and with High-Speed Micro Motor 20712033

20712033

51 mm

5.5 mm

252691

71 mm

5.5 mm

252692

252691  High-Speed Handpiece, short, straight, 60,000 rpm,
for use with High-Speed Micro-Motor 20712033

252692  High-Speed Handpiece, medium, straight, 60,000 rpm,
for use with High-Speed Micro-Motor 20712033
UNIDRIVE® S III ENT SCB
High-Speed Handpieces, malleable, slim, angled, 60,000 rpm

For use with High-Speed Drills, shaft diameter 1 mm
and with High-Speed Micro Motor 20712033

The handpieces have malleable shafts that can be bent up to 20° according to user requirements.

252671 High-Speed Handpiece, extra long, malleable, slim, angled, 60,000 rpm, for use with High-Speed Micro-Motor 20712033

252672 High-Speed Handpiece, super long, malleable, slim, angled, 60,000 rpm, for use with High-Speed Micro-Motor 20712033
## UNIDRIVE® S III ENT SCB
### High-Speed Standard Burrs, High-Speed Diamond Burrs

For use with High-Speed Handpieces, 100,000 rpm

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>medium</th>
<th>long</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>350110 M</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>350120 M</td>
<td>350120 L</td>
</tr>
<tr>
<td>3</td>
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<td>350130 L</td>
</tr>
<tr>
<td>4</td>
<td>350140 M</td>
<td>350140 L</td>
</tr>
<tr>
<td>5</td>
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<td>350150 L</td>
</tr>
<tr>
<td>6</td>
<td>350160 M</td>
<td>350160 L</td>
</tr>
<tr>
<td>7</td>
<td>350170 M</td>
<td>350170 L</td>
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</tbody>
</table>

### High-Speed Diamond Burrs, 100,000 rpm, for single use, sterile, package of 5

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>medium</th>
<th>long</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>350210 M</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>350220 M</td>
<td>350220 L</td>
</tr>
<tr>
<td>3</td>
<td>350230 M</td>
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<tr>
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<td>350260 L</td>
</tr>
<tr>
<td>7</td>
<td>350270 M</td>
<td>350270 L</td>
</tr>
</tbody>
</table>
**UNIDRIVE® S III ENT SCB**  
High-Speed Diamond Burrs, High-Speed Acorn,  
High-Speed Barrel Burrs, High-Speed Neuro Fluted Burrs  

For use with High-Speed Handpieces, 100,000 rpm  

![Image of burrs](image)

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>medium</th>
<th>long</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>350330 M</td>
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</tr>
<tr>
<td>4</td>
<td>350340 M</td>
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<td>350350 L</td>
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<tr>
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<td>350360 M</td>
<td>350360 L</td>
</tr>
<tr>
<td>7</td>
<td>350370 M</td>
<td>350370 L</td>
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**High-Speed Coarse Diamond Burrs, 100,000 rpm, for single use, sterile, package of 5**

<table>
<thead>
<tr>
<th>Diameter in mm</th>
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<tbody>
<tr>
<td>7.5</td>
<td>350675 M</td>
</tr>
<tr>
<td>9</td>
<td>350690 M</td>
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**High-Speed Acorn, 100,000 rpm, for single use, sterile, package of 5**

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>medium</th>
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<tbody>
<tr>
<td>6</td>
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</tr>
<tr>
<td>9.1</td>
<td>350991 M</td>
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**High-Speed Barrel Burrs, 100,000 rpm, for single use, sterile, package of 5**

<table>
<thead>
<tr>
<th>Diameter in mm</th>
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<tbody>
<tr>
<td>1.8</td>
<td>350718 M</td>
</tr>
<tr>
<td>3</td>
<td>350730 M</td>
</tr>
</tbody>
</table>

**High-Speed Neuro Fluted Burrs, 100,000 rpm, for single use, sterile, package of 5**

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>medium</th>
<th>long</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8</td>
<td>350718 M</td>
<td>350718 L</td>
</tr>
<tr>
<td>3</td>
<td>350730 M</td>
<td>350730 L</td>
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</tbody>
</table>
UNIDRIVE® S III ENT SCB
High-Speed Standard Burrs, High-Speed Diamond Burrs

For use with High-Speed Handpieces, 60,000 rpm

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>short</th>
<th>medium</th>
<th>long</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>4</td>
<td>330140 S</td>
<td>330140 M</td>
<td>330140 L</td>
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<tr>
<td>5</td>
<td>330150 S</td>
<td>330150 M</td>
<td>330150 L</td>
</tr>
<tr>
<td>6</td>
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<tr>
<td>7</td>
<td>330170 S</td>
<td>330170 M</td>
<td>330170 L</td>
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</tbody>
</table>

High-Speed Diamond Burrs, 60,000 rpm, for single use, sterile, package of 5

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>short</th>
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<tr>
<td>1</td>
<td>330210 S</td>
<td>330210 M</td>
<td>–</td>
</tr>
<tr>
<td>1.5</td>
<td>330215 S</td>
<td>–</td>
<td>–</td>
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<tr>
<td>2</td>
<td>330220 S</td>
<td>330220 M</td>
<td>330220 L</td>
</tr>
<tr>
<td>3</td>
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<tr>
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</tr>
<tr>
<td>5</td>
<td>330250 S</td>
<td>330250 M</td>
<td>330250 L</td>
</tr>
<tr>
<td>6</td>
<td>330260 S</td>
<td>330260 M</td>
<td>330260 L</td>
</tr>
<tr>
<td>7</td>
<td>330270 S</td>
<td>330270 M</td>
<td>330270 L</td>
</tr>
</tbody>
</table>
UNIDRIVE® S III ENT SCB
High-Speed Diamond Burrs, High-Speed Cylinder Burrs,
LINDEMANN High-Speed Fluted Burrs

For use with High-Speed Handpieces, 60,000 rpm

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>short</th>
<th>medium</th>
<th>long</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>330330 S</td>
<td>330330 M</td>
<td>330330 L</td>
</tr>
<tr>
<td>4</td>
<td>330340 S</td>
<td>330340 M</td>
<td>330340 L</td>
</tr>
<tr>
<td>5</td>
<td>330350 S</td>
<td>330350 M</td>
<td>330350 L</td>
</tr>
<tr>
<td>6</td>
<td>330360 S</td>
<td>330360 M</td>
<td>330360 L</td>
</tr>
<tr>
<td>7</td>
<td>330370 S</td>
<td>330370 M</td>
<td>330370 L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>short</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>330440 S</td>
</tr>
<tr>
<td>6</td>
<td>330460 S</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size in mm (diameter x length)</th>
<th>short</th>
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<tbody>
<tr>
<td>Diameter 2.1/11</td>
<td>330511 S</td>
</tr>
<tr>
<td>Diameter 2.3/26</td>
<td>330526 S</td>
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</tbody>
</table>
UNIDRIVE® S III ENT SCB
High-Speed Diamond Burrs

For use with High-Speed Handpieces, 60,000 rpm

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>extra long</th>
<th>super long</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>320220 EL</td>
<td>320220 SL</td>
</tr>
<tr>
<td>3</td>
<td>320230 EL</td>
<td>320230 SL</td>
</tr>
<tr>
<td>4</td>
<td>320240 EL</td>
<td>320240 SL</td>
</tr>
</tbody>
</table>

High-Speed Fine Diamond Burrs, 60,000 rpm, for single use, sterile, package of 5

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>extra long</th>
<th>super long</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>320320 EL</td>
<td>320320 SL</td>
</tr>
<tr>
<td>3</td>
<td>320330 EL</td>
<td>320330 SL</td>
</tr>
<tr>
<td>4</td>
<td>320340 EL</td>
<td>320340 SL</td>
</tr>
</tbody>
</table>
KARL STORZ NAV1 electromagnetic

KARL STORZ navigation system with advanced tracking technology

The new KARL STORZ navigation system, NAV1 electromagnetic, supports surgeons in otorhinolaryngology and skull base surgery. It uses a sophisticated electromagnetic tracking system.

Experience the excellent quality and precision of the KARL STORZ navigation system NAV1 electromagnetic.

Benefits of KARL STORZ NAV1 electromagnetic

- High precision thanks to sensor location in instrument tip
- Navigated instruments can be autoclaved 30x
- Wide range of instruments; simultaneous tracking of up to 3 instruments possible
- Display of complete instrument geometry in the patient’s radiology data
- Planning and monitoring of high-risk structures with intraoperative DistanceControl
- Better orientation through waypoint navigation
- Automatic and reliable documentation of the navigated procedure
- Infinitely adjustable CT-MRI fusion
- Import of patient data via USB, CD or PACS
KARL STORZ NAV1 electromagnetic

40820001 NAV1 electromagnetic
including:
NAV1 Module
NAV1 electromagnetic Module
NAV1 electromagnetic Field Generator
Headband for Navigation, for single use
EM Patient Tracker
EM Navigation Probe
Optical Mouse
Mains Cord, length 300 cm
Module Connecting Cable, length 250 cm
DVI Connecting Cable, length 300 cm

A headrest with integrated EM field generator is included in delivery.

Note: Equipment cart with accessories not included in the delivery of NAV1 electromagnetic 40820001.
KARL STORZ NAV1 electromagnetic
Components of NAV1 electromagnetic

40820001  NAV1 electromagnetic
including:
  NAV1 Module
  NAV1 electromagnetic Module
  NAV1 electromagnetic Field Generator
  Headband for Navigation, for single use*
  EM Patient Tracker
  EM Navigation Probe
  Optical Mouse
  Mains Cord, length 300 cm
  Module Connecting Cable, length 250 cm
  DVI Connecting Cable, length 300 cm

*A headrest with integrated EM field generator is included in delivery.
Instruments for NAV1 electromagnetic

- **40820131**  EM Navigated Curette, 0°
- **40820132**  EM Navigated Curette, 55°
- **40820130**  EM Navigated Curette, 90°
- **40820111**  EM Navigated Frontal Sinus Probe
Instruments for NAV1 electromagnetic

- **40820145**  **EM Navigated Suction Tube**, straight
- **40820165**  **EM Navigated Suction Tube**, curved
- **40820110**  **EM Navigated Probe**, malleable, straight
- **40820112**  **EM Navigated Probe**, malleable, curved
- **40820105**  **EM Navigated Probe**
KARL STORZ NAV1 pico
Mobile optical navigation for ENT and skull base surgery

Special Features:
- Mobile, space-saving system with intuitive handling
- Easy assembly and flexible use in the OR
- Durable, sturdy and autoclavable navigation instruments
- Reduced costs through autoclavable accessories
KARL STORZ NAV1 pico
Mobile optical navigation for ENT and skull base surgery

40 8000 01  NAV1 pico
including:
Navigation Panel
Optical Mouse
Navigation Camera
Electronic Box
Docking Adaptor
Mobile Stand
Data Cable
Video Cable
Navigation Camera cable, length 250 cm
Headband for Navigation, for single use
Patient Tracker III
Transport Case Navigation
Navigation Probe
Mains Cord
KARL STORZ NAV1 optical
Space-saving integration in any operating room

With NAV1 optical you benefit from a seamlessly integrated high-performance navigation solution. The basic unit can easily be attached to a ceiling supply unit or integrated into an equipment cart. Mounted on a ceiling or an extension arm, the navigation camera allows an easy setup and optimal visualization of the surgical site combined with high flexibility. This results in a “zero footprint” navigation solution. Therefore the NAV1 optical is offered as a solution for the functional combination of all units in one place.
KARL STORZ NAV1 optical
Space-saving integration in any operating room

40810001  NAV1 optical
including:
NAV1 Module
Optical Mouse
Navigation Camera
Mobile Stand
Navigation Camera Cable, length 750 cm
Headband for Navigation, for single use
Patient Tracker III
Transport Case Navigation
Navigation Probe
Mains Cord

Note: Equipment cart with accessories not included in the delivery of NAV1 optical 40810001.
Probe, Patient Tracker and Headband
for optical navigation

40800110 **Navigation Probe**, with glass marker spheres incorporated, autoclavable, dimensions: 295 x 15 x 30 mm, for use with NAV1 pico and NAV1 optical

40800088 **Patient Tracker III**, with verification adaptor, 3 incorporated glass marker spheres and fixation screw, autoclavable, dimensions: 80 x 60 x 12 mm, for use with NAV1 pico and NAV1 optical

40800083 **Headband for Navigation**, for single use, with plastic holder
Navigated Suction Tubes
angular, curved downwards, curved upwards

**40800140 L** Navigated Suction Tube,
straight, for left-handed use, 9 Fr.,
working length 9 cm, total length 16 cm,
for use with NAV1 pico and NAV1 optical

**40800140 R** Navigated Suction Tube,
straight, for right-handed use, 9 Fr.,
working length 9 cm, total length 16 cm,
for use with NAV1 pico and NAV1 optical

**40800160** v. EICKEN Navigated Suction Tube,
curved downwards, for right-handed use,
outer diameter 3 mm, length 16.5 cm,
for use with NAV1 pico and NAV1 optical
Navigated Suction Tubes
angular, curved downwards, curved upwards

40800151 v. EICKEN **Navigated Suction Tube**, curved upwards, for left and right-handed use, outer diameter 3 mm, length 16.5 cm, for use with NAV1 pico and NAV1 optical

40800151

40800160 LM v. EICKEN **Navigated Suction Tube**, curved to left, for left and right-handed use, outer diameter 3 mm, length 16.5 cm, for use with NAV1 pico and NAV1 optical

40800160 LM

40800160 RM v. EICKEN **Navigated Suction Tube**, curved to right, for left and right-handed use, outer diameter 3 mm, length 16.5 cm, for use with NAV1 pico and NAV1 optical

40800160 RM
Optical Navigated Frontal Sinus Probe

for optical navigation

The autoclavable instrument tracker is designed for the navigation of various instruments. The small size of the instrument tracker reduces the risk of collision and ensures very good instrument maneuverability.

Special Features:
- User-friendly handling thanks to optimized, miniaturized design
- Can be used for various navigation instruments

Instrument Tracker

for optical navigation

40800111 Optical Navigated Frontal Sinus Probe, for use with NAV1 pico and NAV1 optical

40800120 Tool Tracker, for optical navigated instruments, with 3 fix-mounted glass spheres, autoclavable, dimensions: 70 x 50 x 14 mm, for use with navigated instruments 4080014x, 4080015x, 4080016x and 4080017x and Optical Navigated Frontal Sinus Probe 40800111
DRILLCUT-X® II N Shaver Handpiece and Shaver Tracker NEW

Special Features:
- Powerful motor
- Absolutely silent running
- Enhanced ergonomics
- Reduced-weight design
- Oscillation mode for shaver blades, max. 10,000 rpm
- Rotation mode for sinus shavers, max. 12,000 rpm
- Straight suction channel and integrated irrigation
- Variable handle allows connection with various handpieces and enables more comfortable work
- Easy hygienic processing, suitable for use in washer and autoclavable at 134 °C
- Quick coupling mechanism facilitates more rapid exchange of working inserts
- Proven DRILLCUT-X® blade portfolio can be used
- Adaptation possibilities for navigated Shaver Tracker 40 8001 22
- Allows shaver navigation when used with NAV1 pico and NAV1 optical

40 8001 22

40 8001 22 Shaver Tracker, autoclavable, with glass marker spheres incorporated, for use with DRILLCUT-X® II N Shaver Handpiece 40 7120 55 and Navigation Systems NAV1 pico 40 8000 01 and NAV1 optical 40 8100 01
**IMAGE1 S Camera System**

**Economical and future-proof**
- Modular concept for flexible, rigid and 3D endoscopy as well as new technologies
- Forward and backward compatibility with video endoscopes and FULL HD camera heads

**Innovative Design**
- Dashboard: Complete overview with intuitive menu guidance
- Live menu: User-friendly and customizable
- Intelligent icons: Graphic representation changes when settings of connected devices or the entire system are adjusted

**Dashboard**
- Live menu

**Live menu**

**Side-by-side view: Parallel display of standard image and Visualization mode**
- Automatic light source control
- Multiple source control: IMAGE1 S allows the simultaneous display, processing and documentation of image information from two connected image sources, e.g., for hybrid operations

**Side-by-side view: Parallel display of standard image and Visualization mode**

**Intelligent icons**
- Automatic light source control
- Compatible with all light sources

**Dashboard**

**Live menu**

**Side-by-side view: Parallel display of standard image and Visualization mode**
Brillant Imaging
- Clear and razor-sharp endoscopic images in FULL HD
- Natural color rendition

- Reflection is minimized
- Multiple IMAGE1 S technologies for homogeneous illumination, contrast enhancement and color shifting

FULL HD image

CLARA

FULL HD image

CHROMA

FULL HD image

SPECTRA A*

SPECTRA A: Not for sale in the U.S.

* SPECTRA A: Not for sale in the U.S.

SPECTRA B**

** SPECTRA B: Not for sale in the U.S.
IMAGE1 S Camera System

TC 200EN

TC 200EN* IMAGE1 S CONNECT, connect module, for use with up to 3 link modules, resolution 1920 x 1080 pixels, with integrated KARL STORZ-SCB and digital Image Processing Module, power supply 100–120 VAC/200–240 VAC, 50/60 Hz including:

- Mains Cord, length 300 cm
- DVI-D Connecting Cable, length 300 cm
- SCB Connecting Cable, length 100 cm
- USB Flash Drive, 32 GB, USB silicone keyboard, with touchpad, US

*Available in the following languages: DE, ES, FR, IT, PT, RU

Specifications:

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<thead>
<tr>
<th>HD video outputs</th>
<th>Format signal outputs</th>
<th>Power supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 2x DVI-D</td>
<td>1920 x 1080p, 50/60 Hz</td>
<td>100–120 VAC/200–240 VAC</td>
</tr>
<tr>
<td>- 1x 3G-SDI</td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>LINK video inputs</th>
<th>Power frequency</th>
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</thead>
<tbody>
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<td>3x</td>
<td>50/60 Hz</td>
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<table>
<thead>
<tr>
<th>USB interface</th>
<th>SCB interface</th>
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<tbody>
<tr>
<td>4x USB, (2x front, 2x rear)</td>
<td>2x 6-pin mini-DIN</td>
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<table>
<thead>
<tr>
<th>Dimensions w x h x d</th>
<th>Weight</th>
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</thead>
<tbody>
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<td>305 x 54 x 320 mm</td>
<td>2.1 kg</td>
</tr>
</tbody>
</table>

For use with IMAGE1 S

IMAGE1 S CONNECT Module TC 200EN

TC 300

TC 300 IMAGE1 S H3-LINK, link module, for use with IMAGE1 FULL HD three-chip camera heads, power supply 100–120 VAC/200–240 VAC, 50/60 Hz, for use with IMAGE1 S CONNECT TC 200EN including:

- Mains Cord, length 300 cm
- Link Cable, length 20 cm

Specifications:

<table>
<thead>
<tr>
<th>Camera System</th>
<th>TC 300 (H3-Link)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported camera heads/video endoscopes</td>
<td>TH 100, TH 101, TH 102, TH 103, TH 104, TH 106 (fully compatible with IMAGE1 S) 22220055-3, 22220056-3, 22220053-3, 22220060-3, 22220061-3, 22220054-3, 22220085-3 (compatible without IMAGE1 S technologies CLARA, CHROMA, SPECTRA*)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LINK video outputs</th>
<th>Power supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x</td>
<td>100–120 VAC/200–240 VAC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power frequency</th>
<th>Protection class</th>
</tr>
</thead>
<tbody>
<tr>
<td>50/60 Hz</td>
<td>I, CF-Defib</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimensions w x h x d</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>305 x 54 x 320 mm</td>
<td>1.86 kg</td>
</tr>
</tbody>
</table>

* SPECTRA A: Not for sale in the U.S.
** SPECTRA B: Not for sale in the U.S.
IMAGE1 S Camera Heads

For use with IMAGE1 S Camera System
IMAGE1 S CONNECT Module TC 200EN, IMAGE1 S H3-LINK Module TC 300
and with all IMAGE1 HUB™ HD Camera Control Units

**TH 100**

**IMAGE1 S H3-Z Three-Chip FULL HD Camera Head,**
50/60 Hz, IMAGE1 S compatible, progressive scan,
soakable, gas- and plasma-sterilizable, with integrated
Parfocal Zoom Lens, focal length $f = 15–31$ mm (2x),
2 freely programmable camera head buttons,
for use with IMAGE1 S and IMAGE1 HUB™ HD/HD

<table>
<thead>
<tr>
<th>Specifications:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IMAGE1 FULL HD Camera Heads</td>
<td>IMAGE1 S H3-Z</td>
</tr>
<tr>
<td>Product no.</td>
<td>TH 100</td>
</tr>
<tr>
<td>Image sensor</td>
<td>3x 1/3” CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 114 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>270 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, $f = 15–31$ mm (2x)</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
</tr>
<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>

**TH 104**

**IMAGE1 S H3-ZA Three-Chip FULL HD Camera Head,**
50/60 Hz, IMAGE1 S compatible, **autoclavable,**
progressive scan, soakable, gas- and plasma-sterilizable,
with integrated Parfocal Zoom Lens, focal length $f = 15–31$ mm (2x),
2 freely programmable camera head buttons,
for use with IMAGE1 S and IMAGE1 HUB™ HD/HD

<table>
<thead>
<tr>
<th>Specifications:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IMAGE1 FULL HD Camera Heads</td>
<td>IMAGE1 S H3-ZA</td>
</tr>
<tr>
<td>Product no.</td>
<td>TH 104</td>
</tr>
<tr>
<td>Image sensor</td>
<td>3x 1/3” CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 100 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>299 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, $f = 15–31$ mm (2x)</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
</tr>
<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>
Monitors

19" HD Monitor, color systems PAL/NTSC, max. screen resolution 1280 x 1024, image format 4:3, power supply 100–240 VAC, 50/60 Hz, wall-mounted with VESA 100 adaption, including:
- External 24 VDC Power Supply
- Mains Cord

26" FULL HD Monitor, wall-mounted with VESA 100 adaption, color systems PAL/NTSC, max. screen resolution 1920 x 1080, image format 16:9, power supply 100–240 VAC, 50/60 Hz including:
- External 24 VDC Power Supply
- Mains Cord
## Monitors

<table>
<thead>
<tr>
<th>KARL STORZ HD and FULL HD Monitors</th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall-mounted with VESA 100 adaption</td>
<td>9619 NB</td>
<td>9826 NB</td>
</tr>
<tr>
<td><strong>Inputs:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DVI-D</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Fibre Optic</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>3G-SDI</td>
<td>–</td>
<td>●</td>
</tr>
<tr>
<td>RGBS (VGA)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>S-Video</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Composite/FBAS</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td><strong>Outputs:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DVI-D</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>S-Video</td>
<td>●</td>
<td>–</td>
</tr>
<tr>
<td>Composite/FBAS</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>RGBS (VGA)</td>
<td>●</td>
<td>–</td>
</tr>
<tr>
<td>3G-SDI</td>
<td>–</td>
<td>●</td>
</tr>
<tr>
<td><strong>Signal Format Display:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4:3</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>5:4</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>16:9</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Picture-in-Picture</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>PAL/NTSC compatible</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

### Optional accessories:
- 9826 SF **Pedestal**, for monitor 9826 NB
- 9626 SF **Pedestal**, for monitor 9619 NB

### Specifications:

<table>
<thead>
<tr>
<th>KARL STORZ HD and FULL HD Monitors</th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop with pedestal</td>
<td>optional</td>
<td>optional</td>
</tr>
<tr>
<td>Product no.</td>
<td>9619 NB</td>
<td>9826 NB</td>
</tr>
<tr>
<td>Brightness</td>
<td>200 cd/m² (typ)</td>
<td>500 cd/m² (typ)</td>
</tr>
<tr>
<td>Max. viewing angle</td>
<td>178° vertical</td>
<td>178° vertical</td>
</tr>
<tr>
<td>Pixel distance</td>
<td>0.29 mm</td>
<td>0.3 mm</td>
</tr>
<tr>
<td>Reaction time</td>
<td>5 ms</td>
<td>8 ms</td>
</tr>
<tr>
<td>Contrast ratio</td>
<td>700:1</td>
<td>1400:1</td>
</tr>
<tr>
<td>Mount</td>
<td>100 mm VESA</td>
<td>100 mm VESA</td>
</tr>
<tr>
<td>Weight</td>
<td>7.6 kg</td>
<td>7.7 kg</td>
</tr>
<tr>
<td>Rated power</td>
<td>28 W</td>
<td>72 W</td>
</tr>
<tr>
<td>Operating conditions</td>
<td>0–40°C</td>
<td>5–35°C</td>
</tr>
<tr>
<td>Storage</td>
<td>-20–60°C</td>
<td>-20–60°C</td>
</tr>
<tr>
<td>Rel. humidity</td>
<td>max. 85%</td>
<td>max. 85%</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>469.5 x 416 x 75.5 mm</td>
<td>643 x 396 x 87 mm</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–240 VAC</td>
<td>100–240 VAC</td>
</tr>
<tr>
<td>Certified to</td>
<td>EN 60601-1, protection class IPX0</td>
<td>EN 60601-1, UL 60601-1, MDD93/42/EEC, protection class IPX2</td>
</tr>
</tbody>
</table>
Accessories for Video Documentation

Cold Light Fountain XENON 300 SCB

Cold Light Fountain XENON NOVA® 300
Data Management and Documentation
KARL STORZ AIDA® – Exceptional documentation

The name AIDA stands for the comprehensive implementation of all documentation requirements arising in surgical procedures: A tailored solution that flexibly adapts to the needs of every specialty and thereby allows for the greatest degree of customization.

This customization is achieved in accordance with existing clinical standards to guarantee a reliable and safe solution. Proven functionalities merge with the latest trends and developments in medicine to create a fully new documentation experience – AIDA.

AIDA seamlessly integrates into existing infrastructures and exchanges data with other systems using common standard interfaces.

WD 200-XX* AIDA Documentation System,
for recording still images and videos,
dual channel up to FULL HD, 2D/3D,
power supply 100–240 VAC, 50/60 Hz
including:
USB Silicone Keyboard, with touchpad
ACC Connecting Cable
DVI Connecting Cable, length 200 cm
HDMI-DVI Cable, length 200 cm
Mains Cord, length 300 cm

WD 250-XX* AIDA Documentation System,
for recording still images and videos,
dual channel up to FULL HD, 2D/3D,
including SmartScreen® (touch screen),
power supply 100–240 VAC, 50/60 Hz
including:
USB Silicone Keyboard, with touchpad
ACC Connecting Cable
DVI Connecting Cable, length 200 cm
HDMI-DVI Cable, length 200 cm
Mains Cord, length 300 cm

*XX Please indicate the relevant country code
(DE, EN, ES, FR, IT, PT, RU) when placing your order.
Workflow-oriented use

Patient
Entering patient data has never been this easy. AIDA seamlessly integrates into the existing infrastructure such as HIS and PACS. Data can be entered manually or via a DICOM worklist. All important patient information is just a click away.

Checklist
Central administration and documentation of time-out. The checklist simplifies the documentation of all critical steps in accordance with clinical standards. All checklists can be adapted to individual needs for sustainably increasing patient safety.

Record
High-quality documentation, with still images and videos being recorded in FULL HD and 3D. The Dual Capture function allows for the parallel (synchronous or independent) recording of two sources. All recorded media can be marked for further processing with just one click.

Edit
With the Edit module, simple adjustments to recorded still images and videos can be very rapidly completed. Recordings can be quickly optimized and then directly placed in the report. In addition, freeze frames can be cut out of videos and edited and saved. Existing markings from the Record module can be used for quick selection.

Complete
Completing a procedure has never been easier. AIDA offers a large selection of storage locations. The data exported to each storage location can be defined. The Intelligent Export Manager (IEM) then carries out the export in the background. To prevent data loss, the system keeps the data until they have been successfully exported.

Reference
All important patient information is always available and easy to access. Completed procedures including all information, still images, videos, and the checklist report can be easily retrieved from the Reference module.
Equipment Cart

Equipment Cart
wide, high, rides on 4 antistatic dual wheels
equipped with locking brakes 3 shelves,
mains switch on top cover,
central beam with integrated electrical subdistributors
with 12 sockets, holder for power supplies,
potential earth connectors and cable winding
on the outside,

Dimensions:
Equipment cart: 830 x 1474 x 730 mm (w x h x d),
shelf: 630 x 510 mm (w x d),
caster diameter: 150 mm

including:
Base module equipment cart, wide
Cover equipment, equipment cart wide
Beam package equipment, equipment cart high
3x Shelf, wide
Drawer unit with lock, wide
2x Equipment rail, long
Camera holder

Monitor Swivel Arm,
height and side adjustable,
can be turned to the left or the right side,
swivel range 180°, overhang 780 mm,
overhang from centre 1170 mm,
load capacity max. 15 kg,
with monitor fixation VESA 5/100,
for usage with equipment carts UG xxx
Recommended Accessories for Equipment Cart

**UG 310** *Isolation Transformer*,
200 V–240 V; 2000 VA with 3 special mains socket, expulsion fuses, 3 grounding plugs,
dimensions: 330 x 90 x 495 mm (w x h x d),
for usage with equipment carts UG xxx

**UG 410** *Earth Leakage Monitor*,
200 V–240 V, for mounting at equipment cart,
control panel dimensions: 44 x 80 x 29 mm (w x h x d),
for usage with isolation transformer UG 310

**UG 510** *Monitor Holding Arm*,
height adjustable, inclinable,
mountable on left or right,
turning radius approx. 320°, overhang 530 mm,
load capacity max. 15 kg,
monitor fixation VESA 75/100,
for usage with equipment carts UG xxx

Please note that the described products in this medium may not be available yet in all countries due to different regulatory requirements.
Voluntary Appeal for Donations to the
“Stiftung St. Franziskus Heiligenbronn”
[St. Francis Foundation, Heiligenbronn, Germany]

DONATE TO CHILDREN WITH SENSORY DISABILITIES
A PERSPECTIVE

Children want to make something of themselves, even if they have sensory disabilities, are blind, hearing impaired, or deaf-blind. Unfortunately, these children’s disabilities are often severe enough to keep them from attending “normal” schools.

The “stiftung st. franziskus heiligenbronn” is building two new schools for children with sensory disabilities to give these boys and girls a future and the opportunity to lead a successful life. You can help – with your donation for children with sensory disabilities.

KARL STORZ will help, too.

As an ambassador for the fundraising campaign “Wir machen Schule. Machen Sie mit!” [We set an example. Get involved!], KARL STORZ is again taking social responsibility. We have made it our mission to help children with sensory disabilities throughout the German state of Baden-Württemberg, and to familiarize our customers and business partners with this fundraising campaign’s worthy cause.

Please help support the fundraising campaign “Wir machen Schule. Machen Sie mit.”
For additional information, go to www.wir-machen-schule-machen-sie-mit.de

For bank transfers from abroad:
IBAN: DE56642500400000540340
SWIFT/BIC-Code: SOLA DE S1 RWL
Notes: