Disruptive Technology – How the Endoscope Transformed Rhinology

David W. Kennedy, M.D., FRCSI
Rhinology Professor, University of Pennsylvania
Disclosures

• Partnership
  – AcceptEnt (Instrumentation)

• Consultant
  – IntersectEnt
  – Sinuwave
  – Sinopsys
  – Fiagon
  – Neurent

• Royalties
  – Medtronic-Xomed
Sinus Surgery: Traditional Residency Teaching 1970’s

- Focus on Maxillary and Frontal sinuses (plane X-R)
- Open approaches
  - Caldwell-Luc
  - Frontal sinus osteoplasty
  - External or intranasal headlight ethmoidectomy
- Strip irreversibly diseased mucosa
- Failure typically because you did not get all the diseased mucosa
- Expect significant morbidity
Sinus X-Rays (up to the 1980’s)

- Standard imaging of the sinuses were plane sinus films
- 3 views
- Moderately good visualization of maxillary and frontal sinuses
- Worthless visualization of ethmoid and limited sphenoid information
In Rhinology, The Endoscope and Imaging Changed The Entire Thinking About Sinusitis

- Detailed visualization of mucociliary clearance
- Diagnostic nasal endoscopy enabled detailed visualization of the ostiomeatal complex (OMC)
- Polytomography of the sinuses, and soon after CT enabled detailed imaging of the OMC and ethmoid sinuses
- Concept of middle meatal antrostomy verified in rabbit studies
Historical Aspects of Nasal Endoscopy

- Hirschmann (1901) attempted endoscopic examination of the sinonasal cavity using a modified cystoscope.
- Reichert performed maxillary sinus manipulations with a 7mm endoscope through oroantral fistulas.
- 1925 Maltz promoted the use of nasal endoscopes for diagnostic evaluation of the sinonasal cavity and coined the term sinuscopy.
- Professor H.H. Hopkins developed rod optic system in 1960's (along with zoom camera lens and fiberoptic gastroscope)
Donald Proctor, M.D.

- Otolaryngologist but 1st Chair of Anesthesiology @ Hopkins
- Used endoscopic diagnosis
  “The ethmoid sinuses are usually the key to any problem involving infectious sinusitis. Infection generally begins there and persistent infection there is usually the reason for failure of therapy directed at any of the other paranasal sinuses.”

  Proctor, D. F. Lewis-Walters Practice of Surgery, 1966

- International expert on mucociliary clearance and nasal airflow
  – Advisor for my resident research project on mucociliary clearance
Ethmoidectomy in the 1970’s and 1980’s

- **External ethmoidectomy**
  - Unsightly scar, risk of diplopia
- **Intranasal ethmoidectomy**
  - Very controversial because of risks
  - Poor visualization with headlight and nasal speculum
  - “A dangerous procedure that should never be performed” Frank N Ritter, M.D.
- **Transantral ethmoidecomy**
Advocated microscopic ethmoidectomy in early 70’s

Presented Hopkins Grand Rounds
- Changed from JHH from headlight intranasal to microscopic ethmoidectomy
  - Improved lighting and visualization, but
    - Difficult to get binocular vision
    - Only see straight ahead
    - Orientation could be misleading
    - Intranasal ethmoidectomy remained controversial and risky
Book Review for Archives of Otolaryngology 1978

Walter Messerklinger

Endoscopy of the Nose

Book described the endoscopic findings of pathology but not endoscopic surgery.
Hopkins in Late 70’s and 80’s

- One of the 1st multidisciplinary skull base teams
- Close working relationship with neurosurgery, neuro-ophthalmology, neuroradiology
- Used endoscopes for photo-documentation of the ear
- Superb Department of Art as Applied to Medicine
- Edited a 3 part skull base journal special edition
Pituitary Surgery

- Published Hopkins Transphenoidal Technique and experience
- Was volunteered to present it at a sinus meeting in Europe

“In the field of observation, chance favors only the prepared mind” Louis Pasteur
April 20, 1984

Norman Silbertrust
Karl Storz Endoscopy America Inc.
10111 W. Jefferson Blvd.
Culver City, California 90230

Dear Mr. Silbertrust:

I recently gave some papers at a nasal sinus meeting in Europe, and while there, had the opportunity to listen to and talk with Dr. Walter Messerklinger and one of his associates Dr. Heinz Stammberger. As a result of their presentations and discussions, I became convinced that the techniques of endoscopic sinus surgery which Dr. Messerklinger has advocated and practices, are indeed techniques that will in the future will replace more conventional surgical approaches to sinus disease. I had previously had the opportunity to review Dr. Messerklinger's book on endoscopy of the nose, however, the book did not detail his surgical approaches and in the absence of this, his detailed diagnostic evaluation, described so well in the book, becomes somewhat superfluous and this I believe accounts for the fact that the publication has not been more widely popular in the United States.

As I mention, I am convinced that endoscopic sinus surgery will probably revolutionize current surgical approaches in the future. Although I am primarily an otologist-neurootologist, I have a significant interest in sinus surgery particularly as it relates to both general otolaryngology and to eustachian tube function. As Director of the Resident Training Program at The Johns Hopkins Hospital, I also have responsibility for postgraduate education of otolaryngology residents.

Sincerely yours,

[Signature]

[Address]

[City, State ZIP Code]
Moving Forwards

- Obtained instrumentation
  - Started using endoscopic instrumentation with microscope
  - Visited Draf, Wiegand, Baum and Messerklinger
  - Developed some experience
  - Submitted a paper (which became two)

Functional Endoscopic Sinus Surgery

Theory and Diagnostic Evaluation

David W. Kennedy, MD; S. James Zinreich, MD; Arthur E. Rosenbaum, MD; Michael E. Johns, MD

- The keys to functional endoscopic sinus surgery are an understanding of the underlying mechanisms of paranasal sinus disease and the ability to diagnose the causes accurately. Previously unrecognized causes of recurrent acute sinusitis endoscopically both by the inferior meatal and canine fossa routes, and noted the diagnostic limitations of relying solely on radiographic information. Although iso-

Functional Endoscopic Sinus Surgery

Technique

David W. Kennedy, MD

- The purpose of functional endoscopic sinus surgery is to reestablish ventilation and mucociliary clearance of the sinuses. This goal is achieved primarily by the endoscopic removal of disease from the anterolateral wall of the maxillary sinus for some time, although the area cannot be adequately visualized on routine sinus roentgenograms and on conventional anterior rhinoscopy to provide an alternative to surgi-

- fungal sinus drainage of fronti...
Held the First Ever Endoscopic Sinus Surgery Course June 1985

Invited Heinz Stammberger as course co-director.
For many years, two courses/year at Hopkins and always a waiting list

$365 including 2 laboratory fresh frozen specimen dissections and a dinner cruise on the tall ship ‘Pride of Baltimore’!
Middle Meatal Antrostomy

- Hilding, based upon his mucociliary clearance experiments recommended that the opening be made as far away from the natural ostium as possible.
- 1949 Wilkerson reopened the issue of middle meatal antrostomy ‘with some trepidation’.
- Inferior meatal antrostomy became the standard for maxillary sinus disease (with or without Caldwell-Luc).
Imperative to Demonstrate Safety and Efficacy of Middle Meatal Antrostomy

- Evaluated mucociliary clearance and middle meatal antrostomy in rabbits
- Published clinical paper as a Laryngoscope supplement
I am against his technocratic evangelism in proseletising for magnification in area where surgeons who are skilled in conventional instrumentation have found readily visualizable without magnification.

If as he as other nasal astronomers assert …morbidity is thus reduced by confining surgery to an area of pathology … is a presumptuous banality” (Friedman, W. Laryngoscope, 96-10: 1171, 1986)
Controversial Talks

- Invited as an assistant professor at Hopkins to address the College of Physicians in Philadelphia
- Gave what I thought was an okay talk, answered a couple of questions
- Following dinner opened up to additional questions
  Totally pilloried for espousing endoscopic concepts
Sinus Surgery Course in Birmingham, England

- Zinreich and I presented our early work on endoscopic sinus surgery and CT imaging of the sinuses
- Discussed middle meatal antrostomy
- Presented our early work on endoscopically decompressing mucoceles

“This just proves that you don’t understand the pathology of mucoceles” Valerie Lund FRCS
Frank Ritter came to Hopkins to see what I was doing (remember “intranasal ethmoidectomy is a dangerous procedure that should never be performed”)

Spent a day in the OR

December 4, 1983

To David,

Many thanks for a wonderful day.

Gratefully,

Frank
Near Misses

- December 24\textsuperscript{th} 1985 child admitted with periorbital abscess
- Asked by another faculty if I would like to try (the 1\textsuperscript{st}) endoscopic decompression of an orbital abscess
- Saw the patient and was concerned that he slight neck rigidity
- Recommended LP
Near Miss

• LP positive, patient underwent external ethmoidectomy, ID Consult, IV antibiotics
• Developed subdural empyema, multiple intracranial abscesses despite aggressive medical and surgical management
• Child passed away at 3 weeks
• Family insisted on an outside autopsy rather than Hopkins
• **Given the ongoing debate about endoscopic sinus surgery, what would have happened if I had done FESS on this patient?**
Also Received Interesting Offers

- Investors asked me to set up a for profit teaching lab in the central US
- Limit courses to this site(s)
- Make “millions”
- Similar model utilized by early laparoscopic surgeons
Only Limited Technology Available

When cameras introduced they utilized tube technology and were big and very heavy.

Rigid sidearms required special skills on the part of the surgeon and the observer!!
Through cutting instrumentation developed from arthroscopic instruments
Computer Image Guided Surgery

- Started work with Jim Zinreich in 1989 with rigid arm
- Endoscopic sinus surgery ideal candidate
- Rigid bony framework
- Very variable anatomy
- Critical anatomic relationship
- Chair of radiology at Penn suggested the potential use of digitizers (then used for making ship propellers)
Early Electro-Magnetic Device  c. 1989

Errors from dental fillings, OR tables, instruments etc.
Early Intranasal Laser Applicators for KTP Laser

Straight ahead and rotatable tip applictors (modified ventriculoscope)
Lasers (KTP, Holmium) introduced to reduce bleeding but caused collateral heat damage.
EndoScrub Originally Developed for Pulsed Lasers

- Initially developed by Rebeiz and Shapshay
- Improved visualization and operative time
- Enabled new techniques (e.g. endoscopic septoplasty)
- Significantly facilitated adoption of the endoscope by neurosurgeons
Microdebrider Introduction

- Introduced by Setliff and Parsons
  - Orthopedic cartilage device
  - Slow
  - Design revolutionized by Xomed
  - Dramatic impact on surgical technique
Received a call from an ophthalmologist – a colleague’s wife had undergone endoscopic sinus surgery in Oklahoma and woke up bilaterally blind.
Hint: If the endoscope eyepiece rests against the nose, the tip is probably no longer in the sinuses!!
Surgeon in Orlando Televised a FESS

- One week later, I get a call from the local news “How often do patients go blind from endoscopic sinus surgery”
- Patient had a unilateral visual loss and they were broadcasting the case on the news that evening
- Surgeon had to leave town, could not get insurance to do surgery for several years
Surgery was (and is) Overutilized

- Patient with prior history of several sinus surgeries
- Primary complaint headache
CT Prior to 1st Surgery Obtained

Pristine Sinuses!!!
Traumatic CSF Leak Closure

- Patient underwent a revision FESS and septoplasty
- Primary complaint headache
- Transferred to Penn on day of surgery
- Angiogram showed anterior cerebral artery spasm
Extension to Orbital Decompression

- Worked with Neil Miller at Hopkins and introduced concept of endoscopic decompression
- Presented at the ISIAN in Tokyo in 1997 and published in 1990
Evolution of Endoscopic Skull Base surgery

– Endoscopic oncologic surgery (initiated 1989)

– Endoscopic pituitary surgery (initiated Hopkins 1990, but Penn pituitary surgeons not interested)

  • Published by Jankowski, R (1992)
Improvements in Anesthesia have Reduced Bleeding and Enabled More Meticulous Surgery

- Originally all done under local anesthesia with sedation and headphone music
- Improved safety of general anesthesia
- Total intravenous anesthesia
- Pre-operative treatment with oral Steroids
- Controlled hypotension
- Changes in local anesthesia injection sites
- Topical 1:1000 epinephrine
1912 and a Century Later

• Moser: “…… in practice ethmoidectomy has proven one of the easiest ways to kill a man”

• Today - in practice ethmoidectomy can be one of the easiest ways to create long term debilitating health problems for a patient

• Too many sinus surgery and balloon interventions performed (£€$$ )
Lessons Learned Regarding Introduction of New Techniques

- Disruptive change not popular with established physicians
- Introduction eased if it can demonstrate and fundamentally change understanding of a disease
- Supportive Chair essential in academic practice
- Adoption is significantly easier if reimbursement favorable - but may lead to overuse
- Credentialling and training needs to be carefully managed (e.g. TORS)
- Was much easier 35 years ago!!
Lessons Regarding Endoscopic Skull Base

• Not all tumors can or should just have an endoscopic approach (even all inverting papillomas)
• Skull base tumors require a dedicated skull base team
• Oncologic principles must not be compromised
• But all learned in medical school does not remain true (e.g. en-bloc resection, tumor approach)