RHINOLOGY AND ALLERGY

CLINICAL REFERENCE GUIDE

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INTRODUCTION

"Surgery will not only develop new and previously impossible procedures, but all uncertain operations which depended on luck and approximation will become safe under the influence of direct vision, since the surgeon's hand will now be guided by his eyes."

—Philipp Bozzini, 1806

In 1806, Philipp Bozzini, a physician living in Germany developed what most historians acknowledge to be the first usable endoscope. Termed the "Lichtleiter," the device included a rudimentary self-contained lightsource allowing the user to peer into previously poorly seen orifices including the urethra, cervix, anus, mouth, *and nose*. With his quote above, now over two centuries later, Bozzini would undoubtedly be pleased to see how his invention has transformed the way we understand the nose, sinuses, and skull base, and how we perform surgery these structures to improve their function, eradicate tumors, and repair their defects.

This book is an attempt to distill the explosion of information about rhinology, allergy and skull base disorders that has occurred over the last 30 years since the modern endoscope was introduced to the rhinology community by the likes of Walter Messerklinger, Heinz Stammberger, and David Kennedy.

As a review book, it is ideal for residents in training, and those preparing for board and in-service training examinations as well as medical students looking for a "deeper dive" into the world of rhinology. However, it is also excellent for the practitioner who wants to get a succinct update on the latest, cutting-edge knowledge in rhinology, allergy, endoscopic skull base surgery. The information is authored by a collection of the "who's who" of modern rhinology, outstanding contributions that are dense and presented in bullet form and best digested slowly lest critical information be missed. In its 42 chapters, you will find all aspects of rhinology reviewed, including medical and surgical management of inflammatory and allergic disease of the nose, sinuses, and skull base, as well as a review of neoplasms, both benign and malignant.

We hope that you enjoy this book and we hope Dr. Bozzini would be proud!

FOREWORD

The field of knowledge within rhinology has expanded exponentially in recent years and the expectations for trainees within the field has ballooned accordingly. *Rhinology and Allergy: Clinical Reference Guide* is a succinct bullet pointed text edited by two internationally renowned rhinologists, with chapters authored by both rhinologists and allergists, each of whom are leaders in the field. The goal of the text is to provide a broad but brief reference text covering these subspecialties. The book is aimed at residents and fellows in training, especially those preparing for the boards, and the chapters provide all of the necessary information in a crisp format. It will also be of benefit to practitioners looking for a brief text to update their reference knowledge with comprehensive factual information within the field.

The text is divided into sections such as evaluation and diagnosis, sinonasal diseases, surgical management, allergy, and skull base surgery, with multiple brief chapters in each section. The incorporation of junior co-authors helps to ensure that the text includes the material most relevant for board preparation. In addition to providing comprehensive factual information, a number of the chapters are beautifully illustrated, providing excellent visual clarity to the bullet pointed notes.

Overall, this text provides an excellent review of the most salient current knowledge within the fields of rhinology, allergy and skull base surgery. As noted above, it lays out the important facts within each of the areas, providing the information necessary for a resident or fellow preparing for the Boards, or a practitioner needing to update his or her background knowledge. It is often not easy to keep the text in a book like this succinct and to the point, but the editors have done an excellent job in this book.

—David W. Kennedy, M.D., FACS, FRCSI
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—Brent A. Senior

I echo Dr. Senior's gratitude to all the authors who volunteered their time and expertise to help make this book possible. I would like to thank Dr. Senior for his guidance and tremendous input in shaping the contents of this monograph and his eagle eye in the editing process. I would like to thank my mentor Dr. Fred Kuhn for teaching me to "never stop looking and to never stop thinking about what you are looking at." I would also like to thank my mentor Dr. K. J. Lee for his support and belief in me. Last but not least, I would like to thank my family, especially my parents without their love and support, I would not be who I am today.

—Yvonne Chan

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CHAPTER

2

Sinonasal Development and Anatomy

Joseph S. Schwartz and Nithin D. Adappa

NASAL CAVITY

Nasal Embryology

Nasal Turbinates

- Arise in eighth week of gestation as ridges along lateral nasal wall
- **Maxilloturbinal**: arises inferiorly originating from maxillary process; gives rise to inferior turbinate
- **Ethmoturbinals**: arise superiorly from ethmoid bone; five arise with only four persisting throughout development
  1. First ethmoturbinal: ascending portion gives rise to agger nasi; descending portion gives rise to uncinate process; regresses during development
  2. Second ethmoturbinal: gives rise to middle turbinate
  3. Third ethmoturbinal: gives rise to superior turbinate
  4. Fourth and fifth ethmoturbinals: gives rise to supreme turbinate (when present)
- **Primary furrows**: form the recesses separating the ethmoturbinals; gives rise to meati
  1. First primary furrow: separates first and second ethmoturbinals; gives rise to middle meatus
  2. Second primary furrow: gives rise to superior meatus
  3. Third primary furrow: gives rise to supreme meatus

Nasal Anatomy

External Nasal Anatomy

Nasal Surface Landmarks

- **Nasion**: corresponds to nasofrontal suture
- **Radix**: nasal root; centered at nasion; extends inferiorly to the level of the lateral canthus and superiorly by equivalent distance
- **Rhinion**: corresponds to bony-cartilaginous junction along nasal dorsum
- **Supratip break**: a break in the nasal profile separating the nasal dorsum and lobule located immediately superior to the tip defining point
- **Supratip lobule**: portion of lobule located superior to tip-defining point
- **Tip-defining point**: two points located at the highest, medial and cephalic portion of the lateral crus; corresponds to light reflex externally

- **Infratip lobule**: portion of lobule located inferior to tip-defining point and superior to infratip break
- **Infratip break**: lobule-columella junction
- **Nasal sill**: nostril rim located between columella and alar facial attachment

Nasal Musculature

- Elevators: function to shorten nose and dilate nostrils
  1. Procerus
  2. Levator labii superioris alaeque nasi
  3. Anomalous nasi
- Depressors: function to lengthen nose and dilate nostrils
  1. Depressor septi
  2. Alar nasalis
- Compressors: function to lengthen nose and constrict nostrils
  1. Compressor narium minor
  2. Transverse nasalis

Subcutaneous Layers of the Nose

- Best remembered using the phrase "**S**ubcutaneous **F**at **D**ee**P**"
  1. S = **S**uperficial fatty layer (connected to dermis)
  2. F = **F**ibromuscular layer (nasal SMAS)
  3. D = **D**eep fatty layers (contains neurovascular system)
  4. P = **P**eriosteum/Perichondrium
     - Optimal plane of dissection is located between D and P as it is avascular and heals with minimal fibrosis.

Nasal Tip Support

- Major tip supports
  1. Medial and lateral crura
  2. Attachment of medial crura to caudal edge of quadrangular cartilage
  3. Attachment of upper lateral cartilage to lower lateral cartilage ("scroll area")
- Minor tip supports
  1. Skin-soft tissue envelope (attachment of lower lateral cartilage to overlying skin and musculature)
  2. Sesamoid complex (located between lateral crura and pyriform aperture)
  3. Interdomal ligament (located between lower lateral cartilages)
  4. Anterior nasal spine
  5. Cartilaginous septal dorsum
  6. Membranous nasal septum

Nasal Bony Anatomy

- Comprised of two nasal bones fused in the midline to form a pyramidal shape
- Thicker superiorly than inferiorly
- Attachments of nasal bones:
  1. Superiorly: nasal process of frontal bone
  2. Laterally: frontal process of maxilla
- Pyriform aperture = Bony opening into the nasal cavity bounded as described below:
  1. Superiorly: caudal margin of nasal bones
  2. Inferiorly: alveolar process of maxilla
  3. Laterally: frontal process of maxilla
  4. Medially: nasal septum

Nasal Cartilages

- **Upper lateral cartilage (ULC)**: fuses superiorly with the nasal bones; articulates inferiorly with the cephalic margin of the LLC, most often forming an interlocking scroll; thickens medially where it becomes continuous with the quadrangular cartilage of the septum, forming the cartilaginous portion of the nasal dorsum
- **Lower lateral cartilage (LLC)**: provides the shape of the nasal tip; composed of medial and lateral crura
- **Sesamoid cartilages**: small cartilages located lateral to the lateral crus

Nasal Septum

- Comprised of both bony and cartilaginous components; lined by either a mucoperiosteal or mucoperichondrial layer.
  1. Cartilage components = Quadrangular cartilage
  2. Bony components = Perpendicular plate of ethmoid, vomer, crest of the maxillary bone, crest of the palatine bone; minor contributions from crest of sphenoid bone and nasal spine of frontal bone
- **Membranous (mobile) septum**: cartilage deficient membrane adjoining the columella to the caudal septum; site of hemitransfixion/transfixion incision
- **Keystone area**: corresponds to convergence of caudal margin of nasal bone, perpendicular plate of ethmoid, and cephalic margin of ULC and cartilaginous septum; failure to preserve this region can result in nasal collapse
- **Vomeronasal organ** (VNO or Jacobsen's organ): auxiliary olfactory organ involved in the perception of pheromones in mammals; in humans, function is controversial as it largely regresses in utero; identified as a groove in the anterior-inferior nasal septum

Nasal Cavity

Nasal Vestibule

- Serves as the entrance to the nasal cavity
- Lined by hair bearing skin, sebaceous and sweat glands
- Boundaries include nasal septum medially, LLC superiorly and laterally, and alveolar process of maxilla inferiorly
- Posteriorly bounded by the limen nasi (limen vestibule), formed by the caudal margin of the ULC; this coincides with the transition from the skin of the nasal vestibule to the mucosal surface (pseudostratified ciliated columnar epithelium) of the nasal cavity

Nasal Valves

- Important contributors to nasal airway resistance
- Regions at greatest potential for collapse resulting in nasal airway obstruction
  1. **Internal nasal valve**: bounded by nasal septum, caudal edge of ULC, anterior face of inferior turbinate; normally forms 10°–15° nasal valve angle; narrowest cross-sectional area of the nasal cavity and site of greatest nasal airflow resistance; normally does not undergo any change in dimension during inspiration
  2. **External nasal valve**: bounded by nasal ala laterally, nasal septum and columella medially; situated caudal to internal nasal valve; normally dilates during inspiration

Lateral Nasal Wall

- Bony contributions to the lateral nasal wall from anterior to posterior include:
  1. Frontal process of maxilla
  2. Lacrimal bone
  3. Medial maxillary wall inferiorly, lamina papyracea (LP) superiorly
  4. Perpendicular plate of the palatine bone
  5. Medial pterygoid plate of the sphenoid bone
     – Latter two structures make up the sphenopalatine foramen.
- **Lamella of the lateral nasal wall**: five lamella from anterior to posterior
  1. First lamella = uncinate process
  2. Second lamella = ethmoid bulla (EB)
  3. Third lamella = basal lamella of middle turbinate
  4. Fourth lamella = basal lamella of superior turbinate
  5. Fifth lamella = basal lamella of supreme turbinate (when present)