RHINOLOGY AND ALLERGY

CLINICAL REFERENCE GUIDE
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“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!
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
Rhinology Professor
Perelman School of Medicine
University of Pennsylvania
Brent A. Senior, MD, FACS, FARS, is Nat and Sheila Harris Professor of Otolaryngology and Neurosurgery at the University of North Carolina at Chapel Hill, where he also serves as vice chair of Clinical Affairs and chief of Rhinology, Allergy, and Endoscopic Skull Base Surgery. Dr. Senior has lectured and instructed in nearly 120 national and international rhinology courses and authored 120 articles and chapters in the field. In 2005, he coedited the very successful text *The Frontal Sinus*, now in its second edition. Dr. Senior’s passion for education has been honored with his receipt of the “Cottle Award” from the American Rhinologic Society, the highest award for education from that society. His humanitarian efforts garnered him a “Humanitarian of the Year” Award from the American Academy of Otolaryngology in 2005. He served as president of the American Rhinologic Society in 2010. He currently serves as associate editor of the International Forum of Allergy and Rhinology, president of the Christian Society of Otolaryngology, and president-elect of the International Rhinologic Society, and he sits on the Board of Directors of the American Academy of Otolaryngology/Head and Neck Surgery and the International Rhinologic Society.
Yvonne Chan, MD, FRCSC, MSc, HBSc, is an Assistant Professor and the Continuing Professional Development Director in the Department of Otolaryngology-Head & Neck Surgery at the University of Toronto. She is the division head of Otolaryngology at Trillium Health Partners. She is the vice chair of the Canadian Rhinology Working Group. At the Mississauga Academy of Medicine, she is the undergraduate medical lead for Otolaryngology. She finished her otolaryngology residency training at the University of Toronto and subsequently completed a rhinology fellowship at the Georgia Nasal and Sinus Institute. Dr. Chan obtained her medical degree and an MS degree in molecular biology also from the University of Toronto. Since 2015, she has been the coeditor of the world-renowned otolaryngology textbook, *K. J. Lee’s Essential Otolaryngology* (11th edition). Other texts that she has coedited include *Health Care Reform Through Practical Clinical Guidelines* and *Essential Paths to Life After Residency*. 
I would like to thank the many authors who participated in this project and contributed so admirably. I would also like to thank my mentors Drs. David Kennedy and Fred Kuhn without whose guidance and inspiration, rhinology may not have been my chosen field of study. And finally, I would like to thank my long-suffering wife, Dana, and my wonderful children for their interminable support despite long work-filled nights. You are amazing and you are loved! Sole Deo Gloria.

—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
Contributors

Waleed M. Abuzeid, MD
Assistant Professor
Director, Rhinology and Skull Base Surgery
Department of Otorhinolaryngology
Montefiore Medical Center
Albert Einstein College of Medicine
New York, New York
Chapter 38

Nithin D. Adappa, MD
Assistant Professor
Division of Rhinology and Skull Base Surgery
Department of Otorhinolaryngology–Head and Neck Surgery
University of Pennsylvania
Philadelphia, Pennsylvania
Chapter 2

Jay Agarwal, MD
Department of Otolaryngology–Head and Neck Surgery
New York Eye and Ear Infirmary of Mount Sinai
New York, New York
Chapter 25

Abdullah AlBader, MD, FRCSC
Rhinology–Endoscopic Skull Base Surgery Fellow
Department of Otolaryngology–Head and Neck Surgery
University of Miami
Miller School of Medicine
Miami, Florida
Chapter 27

Fuad M. Baroody, MD, FACS
Professor of Surgery
(Otolaryngology–Head and Neck Surgery) and Pediatrics
Director of Pediatric Otolaryngology
Residency Program Director
The University of Chicago Medicine
The Comer Children’s Hospital
Chicago, Illinois
Chapter 6

Pete S. Batra, MD, FACS
Stanton A. Friedberg, MD Chair in Otolaryngology
Professor and Chairman
Co-Director, Rush Center for Skull Base and Pituitary Surgery
Co-Director, Rush Sinus Program
Chicago, Illinois
Chapter 13

Elizabeth Bradford Bell, MD
Resident
Otolaryngology–Head and Neck Surgery
Emory University
Atlanta, Georgia
Chapter 7

Jason I. Blaichman, MD, CM, FRCPC
Clinical Instructor
Department of Radiology
University of British Columbia
Vancouver, Canada
Chapter 2 Illustrator
CONTRIBUTORS xix

Sengkang Health and Singapore General Hospital
Bukit Merah, Singapore
Chapter 37

Wirach Chitsuthipakorn, MD
Consultant, Rhinologist
Department of Otolaryngology
Sawan Pracharak Hospital
Nakhon Sawan, Thailand
Chapter 15

Garret W. Choby, MD
Assistant Professor
Rhinology and Endoscopic Skull Base Surgery
Department of Otorhinolaryngology–Head and Neck Surgery
Mayo Clinic School of Medicine
Rochester, Minnesota
Chapter 11

Martin J. Citardi, MD
Professor and Chair
Department of Otorhinolaryngology–Head and Neck Surgery
McGovern Medical School
University of Texas Health Science Center at Houston
Houston, Texas
Chapter 21

Patrick Colley, MD
Assistant Professor
Rhinology and Skull Base Surgery
Department of Otolaryngology–Head and Neck Surgery
Icahn School of Medicine at Mount Sinai
New York, New York
Chapter 17

Greg E. Davis, MD, MPH
Director of Rhinology and Endoscopic Skull Base

Associate Professor
Department of Otolaryngology–Head and Neck Surgery
University of Washington
Seattle, Washington
Chapter 22

Anthony G. Del Signore, MD, PharmD
Assistant Professor
Director of Rhinology and Endoscopic Skull Base Surgery
Mount Sinai Beth Israel
Department of Otolaryngology–Head and Neck Surgery
New York, New York
Chapter 25

Jaron Densky, MD
Department of Otolaryngology–Head and Neck Surgery
Ohio State University
Columbus, Ohio
Chapter 40

Richard Douglas, MD, FRACS, FRACP
Associate Professor
Department of Surgery
The University of Auckland
Auckland, New Zealand
Chapter 9

Charles S. Ebert, Jr., MD, MPH, FACS, FAAOA
Associate Professor
University of North Carolina
Department of Otolaryngology–Head and Neck Surgery
Division of Rhinology, Allergy, and Endoscopic Skull Base Surgery
Chapel Hill, North Carolina
Chapters 17 and 39
Ashleigh A. Halderman, MD  
Assistant Professor  
Rhinology and Skull Base Surgery  
Department of Otolaryngology–Head and Neck Surgery  
UT Southwestern  
Dallas, Texas  
Chapter 12

Andrea M. Hebert, MD, MPH  
Assistant Professor  
Department of Otorhinolaryngology–Head and Neck Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland  
Chapter 33

Sarah E. Hodge, MD  
Department of Otolaryngology–Head and Neck Surgery  
University of North Carolina at Chapel Hill  
Chapel Hill, North Carolina  
Chapter 39

Wayne D. Hsueh, MD  
Resident Physician  
Department of Otorhinolaryngology–Head and Neck Surgery  
Montefiore Medical Center  
Albert Einstein College of Medicine  
Bronx, New York  
Chapter 36

Kevin Hur, MD  
Caruso Department of Otolaryngology–Head and Neck Surgery  
Keck School of Medicine  
University of Southern California  
Los Angeles, California  
Chapter 4

Arif Janjua, MD, FRCSC  
Clinical Assistant Professor  
Rhinology, Endoscopic Sinus and Skull Base Surgery  
Division of Otolaryngology–Head and Neck Surgery  
Vancouver General Hospital and St. Paul’s Hospital  
University of British Columbia  
Vancouver, Canada  
Chapter 23

Aimee A. Kennedy, MD  
Section of Otolaryngology–Head and Neck Surgery  
University of Chicago Medicine and Biological Sciences  
Chicago, Illinois  
Chapter 6

Robert Kern, MD  
Professor of Otolaryngology  
Northwestern University Feinberg School of Medicine  
Chicago, Illinois  
Chapter 34

Suat Kilic, BA  
Rutgers New Jersey Medical School  
Department of Otolaryngology–Head and Neck Surgery  
Newark, New Jersey  
Chapter 36

Esther Kim, MD  
Assistant Professor  
Department of Otolaryngology–Head and Neck Surgery  
Walter Reed National Military Medical Center  
Bethesda, Maryland  
Chapter 29
Houston, Texas  
*Chapter 21*

**Kristian I. Macdonald, MD, MSc, FRCSC**  
Assistant Professor  
Department of Otolaryngology–Head and Neck Surgery  
University of Ottawa  
Ottawa, Canada  
*Chapter 3*

**Luis Macias-Valle, MD**  
Rhinology and Endoscopic Skull Base Surgery Fellow  
Department of Otolaryngology–Head and Neck Surgery  
The Queen Elizabeth Hospital  
The University of Adelaide  
South Australia, Australia  
*Chapter 26*

**Edward D. McCoul, MD, MPH**  
Associate Professor  
Department of Otorhinolaryngology  
Ochsner Clinic Foundation  
New Orleans, Louisiana  
*Chapter 10*

**Craig Miller, MD**  
Resident Physician  
Department of Otolaryngology–Head and Neck Surgery  
University of Washington  
Seattle, Washington  
*Chapter 22*

**Eric Monteiro, MD, MSc, FRCSC**  
Assistant Professor  
Sinai Health System  
University of Toronto  
Toronto, Canada  
*Chapter 20*

**Taha A. Mur, MD**  
Resident  
Otolaryngology–Head and Neck Surgery  
Boston Medical Center  
Boston, Massachusetts  
*Chapter 31*

**Sean Mutchnick, MD**  
Resident Physician  
Department of Otolaryngology–Head and Neck Surgery  
Wayne State University School of Medicine  
Detroit, Michigan  
*Chapter 35*

**Javier Ospina, MD**  
Fellowship in Rhinology and Skull Base Surgery  
University of British Columbia  
Otolaryngologist  
Javeriana University  
Vancouver, Canada  
*Chapter 23*

**Sanjay R. Parikh, MD, FACS**  
Professor of Otolaryngology–Head and Neck Surgery  
University of Washington  
Medical Director, Bellevue Clinic and Surgery Center  
Seattle Children’s Hospital  
Seattle, Washington  
*Chapter 18*

**Zara M. Patel, MD**  
Assistant Professor  
Rhinology–Endoscopic Skull Base Surgery  
Department of Otolaryngology–Head and Neck Surgery  
Stanford University School of Medicine  
Stanford, California  
*Chapter 11*
Anju T. Peters, MD  
Director of Clinical Research  
Division of Allergy-Immunology  
Professor of Medicine  
Feinberg School of Medicine  
Northwestern University  
Chicago, Illinois  
Chapter 34

Michael Pfisterer, MD  
Rhinology, Sinus and Skull Base  
Fellow  
Department of Otolaryngology–Head and Neck Surgery  
Rutgers New Jersey Medical School  
Newark, New Jersey  
Chapter 36

Steven D. Pletcher, MD  
Associate Professor  
Department of Otolaryngology–Head and Neck Surgery  
University of California, San Francisco  
San Francisco, California  
Chapter 14

David M. Poetker, MD, MA  
Associate Professor  
Zablocki VAMC, Division of Surgery  
Department of Otolaryngology  
Medical College of Wisconsin  
Milwaukee, Wisconsin  
Chapter 8

Daniel M. Prevedello, MD, FACS  
Professor  
Department of Neurological Surgery  
ENT–Head and Neck Surgery Department  
The Ohio State University  
Columbus, Ohio  
Chapter 40

Alkis James Psaltis, MBBS(hons), PhD, FRACS  
Associate Professor  
Department of Surgery  
University of Adelaide  
Head of Department, Otolaryngology–Head and Neck Surgery  
Queen Elizabeth Hospital  
South Australia, Australia  
Chapter 26

Christopher R. Roxbury, MD  
Resident  
Department of Otolaryngology–Head and Neck Surgery  
Johns Hopkins University  
Baltimore, Maryland  
Chapter 32

Luke Rudmik, MD, MSC, FRCSC  
Department of Surgery  
Division of Otolaryngology  
University of Calgary  
Calgary, Canada  
Chapter 16

Joseph S. Schwartz, MD, FRCS  
Assistant Professor  
Rhinology and Skull Base Surgery  
Department of Otolaryngology–Head and Neck Surgery  
Jewish General Hospital  
McGill University Health Center  
Montreal, Canada  
Chapter 2

Brent A. Senior, MD, FACS, FARS  
Professor of Otolaryngology/Neurosurgery  
Vice Chairman for Clinical Affairs
Chief, Division of Rhinology, Allergy, and Endoscopic Skull Base Surgery
Department of Otolaryngology–Head & Neck Surgery
University of North Carolina School of Medicine
Chapel Hill, North Carolina

Jasper Shen, MD
Academic Rhinology Fellow
Department of Otolaryngology–Head and Neck Surgery
Northwestern Medicine
Chicago, Illinois
Chapter 4

Kristine A. Smith, MD, FRCSC
Department of Surgery
Division of Otolaryngology
University of Calgary
Calgary, Canada
Chapter 16

Peter K. Smith, MBBS, BMedSci, FRACP, PhD
Professor
Clinical Medicine
Griffith University
Queensland, Australia
Chapter 30

Kornkiat Snidvongs, MD, PhD
Faculty of Medicine
Department of Otolaryngology
Chulalongkorn University
Bangkok, Thailand
Chapter 15

Maheep Sohal, MD
Resident
Division of Otolaryngology
University of Connecticut
Storrs, Connecticut
Chapter 5

Satyan Belur Sreenath, MD
Department of Otolaryngology–Head and Neck Surgery
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina
Chapter 39

Jeffrey D. Suh, MD
Associate Professor
Department of Head and Neck Surgery
University of California, Los Angeles School of Medicine
Los Angeles, California
Chapter 41

Peter F. Svider, MD
Resident Physician
Department of Otolaryngology–Head and Neck Surgery
Wayne State University School of Medicine
Detroit, Michigan
Chapter 35

Abtin Tabaee, MD
Associate Professor
Department of Otolaryngology
Weill Cornell Medicine
New York Presbyterian Hospital
New York, New York
Chapter 10

Bobby A. Tajudeen, MD
Assistant Professor
Co-Director, Rush Sinus Program
Director, Otorhinolaryngology Research
Department of Otorhinolaryngology–Head and Neck Surgery
Rush University Medical Center
Chicago, Illinois
Chapter 13
Marc A. Tewfik, MDCM, MSc, FRCSC
Assistant Professor of Otolaryngology–Head and Neck Surgery
McGill University Health Centre
Sir Mortimer B. Davis–Jewish General Hospital
Montreal, Canada
Chapter 37

Brian D. Thorp, MD
Assistant Professor
Department of Otolaryngology–Head and Neck Surgery
University of North Carolina–Chapel Hill
Chapel Hill, North Carolina
Chapter 39

Elina Toskala, MD, PhD, MBA
Professor
Chief of Otolaryngology–Head and Neck Surgery
Director of Allergy
Temple Head and Neck Institute
Temple University
Philadelphia, Pennsylvania
Chapter 31

Thomas G. Townes, MD
Resident Physician
Otolaryngology–Head and Neck Surgery
Walter Reed National Military Medical Center
Rockville, Maryland
Chapter 29

Gordon F.Z. Tsang, MD, FRCSC
Otology/Neurotology Fellow
University Health Network
Department of Otolaryngology–Head and Neck Surgery
University of Toronto

Toronto, Canada
Chapter 1

Julian A. Vellucci, MD
Department of Surgery, Head and Neck Surgery
Madigan Army Medical Center
Tacoma, Washington
Chapter 18

Kevin Welch, MD
Associate Professor of Otolaryngology
Northwestern University
Feinberg School of Medicine
Chicago, Illinois
Chapter 42

Sarah K. Wise, MD, MSCR
Associate Professor
Director of Otolaryngic Allergy
Department of Otolaryngology–Head and Neck Surgery
Emory University
Atlanta, Georgia
Chapter 7

Bozena B. Wrobel, MD
Director, USC Rhinology and Endoscopic Skull Base Surgery
USC Caruso Department of Otolaryngology–Head and Neck Surgery
University of Southern California
Los Angeles, California
Chapter 4

Tary Yin, MBChB, BMedSc(Hons)
University of Auckland
Auckland, New Zealand
Chapter 9

Jonathan Yip, MD
Resident
Department of Otolaryngology–Head and Neck Surgery
University of Toronto
Toronto, Canada

Chapter 20

Adam M. Zanation, MD, FACS
Harold C. Pillsbury
   Distinguished Professor
Vice Chairman for Academic Affairs
Director of Practice Development
Associate Professor of Otolaryngology and Neurosurgery

University of North Carolina
School of Medicine
Chapel Hill, North Carolina

Chapter 39

Zhong Zheng, MD
Department of Otolaryngology–Head and Neck Surgery
New York Eye and Ear Infirmary of Mount Sinai
New York, New York

Chapter 25
CHAPTER 2

Sinonasal Development and Anatomy

Joseph S. Schwartz and Nithin D. Adappa

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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 “Subcutaneous Fat DeeP”
  1. S = Superficial fatty layer (connected to dermis)
  2. F = Fibromuscular layer (nasal SMAS)
  3. D = Deep fatty layers (contains neurovascular system)
  4. P = Periosteum/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)