OTOLARYNGOLOGY
HEAD and NECK SURGERY

CLINICAL REFERENCE GUIDE

Seventh Edition

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PREFACE TO THE SEVENTH EDITION

Not sure how one is supposed to define precisely when a midlife crisis begins. I'm not saying I'm going to live past 108, but it sure feels like it. And these editions . . . my God . . . enough with these editions. As far as I can tell, there's no real reason to plan anything long-term anymore. Honestly with AI and Neurolink today how is knowledge going to be distributed tomorrow anyway? Through letters in a book? I doubt it. I'm thinking the robots take over in another 10 years and we'll have to redefine life from carbon-based to silicon/lithium biochemistry. Relationships will be technosexual. I mean that'll be the new banner of woke-theists. Human relationships will be like vinyl. You may appreciate the nostalgia of it all but who can compete with a soulmate without a soul? Nonetheless, next edition will be the quantum edition, a joint colab with Lumon Industry. It'll be injected directly into the anterior cingulate cortex using wave technology or something like that. It'll be super easier to digest but you'll sacrifice a little empathy and impulse control.

That being said, this odd edition number 7 will continue as it does—save lives, both patients and residents. This book is high protein, keto-based info without the refined carbs and sugars. Think the Otolaryngological Tiktok. Updated to the last second into 2025 with every chapter getting a solid refresh. So keep it in your pocket or by your toilet and scroll, rather than page turn for those dopamine hits. It's really all you need.

Welcome also our newest authors, plucked out of a pool of academics that are worth their weight in cryptocurrency. And for my co-editors, Alex and Justin, these guys are warriors in quest of truth and precision; gladiators actually, afraid of absolutely nothing except for maybe a misplaced semicolon. I mean that'll keep them up all night. I owe them my sanity and you owe them a hip, hip, hooray for keeping this book alive. Seriously, it wouldn't have happened without them.

Moving on. Embrace, entrust, digest the truth within the cult that is this edition. And if by chance you catch a misstep or flagrant foul, feel free to report it to the authorities at PashaGolubGuide@gmail.com. Here at Lumon we appreciate any good-willed suggestions and perhaps may reward you with a Chinese finger trap, customized eraser, or for the well-deserved, a waffle party!

R. Pasha @DJPa5ha (IG)

Dig deep!! Find the Prefaces from the previous editions by scanning the QR code below.

ABOUT THE EDITORS

Raza Pasha, MD, as an official quinquagenarian focuses on all things healthy, obsessing over longevity remedies and mindfulness. His very much seasoned practice in Houston thrives as he moves in packs with students and residents, appreciating any audience that will listen to his banter. His CV momentum is slowing down, as he has stripped most of his board titles and business roles as he has settled into family, friends, and music production. There's not a podcast he hasn't heard, and will debate to death the existence of an advanced ancient civilization or the physiology of the immortal jellyfish. He may pull out a few more publications by year end, but more likely you'll see him out and about at a restaurant deep in conversation or on an EDM festival tour mainstage as DJPa5ha.

Justin S. Golub, MD, MS, is an Associate Professor of Otolaryngology–Head and Neck Surgery and Vice Chair of Faculty Development at the Columbia University Vagelos College of Physicians and Surgeons and NewYork-Presbyterian/Columbia University Irving Medical Center. He attended Emory University School of Medicine, residency at the University of Washington in Seattle, and fellowship in neurotology at the University of Cincinnati. He obtained a masters in biostatistics/patient-oriented research at the Columbia University Mailman School of Public Health. He is the author of more than a hundred peer-reviewed research publications and has co-edited five books. Dr. Golub runs a research program and clinical trial investigating the brain effects of age-related hearing loss. He has lectured internationally and his research has been reported in the national press, including *The New York Times*. He is also a leading pioneer in transcanal endoscopic ear surgery. When not toiling on books with Drs. Pasha and Chern, he enjoys skiing, running, and sipping Nutella-laced espresso at his home in Westchester County, New York.

Alexander Chern, MD, is an Assistant Professor of Otorhinolaryngology–Head & Neck Surgery at the Hospital of the University of Pennsylvania. He recently completed his fellowship in neurotology at Johns Hopkins and his residency training in otolaryngology–head and neck surgery at NewYork-Presbyterian Hospital (Columbia/Weill Cornell). He earned his medical degree from Vanderbilt University School of Medicine and completed his undergraduate studies at Yale University. Dr. Chern is the author of numerous peer-reviewed publications, book chapters, and educational articles on hearing loss. His research interests center on the intersection of musicality, hearing, and cognition. In his spare time, he enjoys cooking and dining with friends and family, playing the violin, and creating latte art.

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COMMON ABBREVIATIONS IN OTOLARYNGOLOGY-HEAD AND NECK SURGERY

3D	3 dimensional
5-FU	5-fluorouracil
A-E	aryepiglottic
AA	arytenoid abduction
ABG	arterial blood gas, air-bone gap
ABI	auditory brainstem implant
ABR	auditory brainstem response
AC	air conduction
ACE	angiotensin converting enzyme
AHI	apnea-hypopnea index
AI	apnea index
AIDS	acquired immunodeficiency syndrome
AJCC	American Joint Commission on Cancer
ALD	assisted listening device
ALS	amyotrophic lateral sclerosis
ANA	antinuclear antibody
AOM	acute otitis media
APAP	auto-titrating positive airway pressure
ASA	aspirin
ASSR	auditory steady-state response
AVM	arteriovenous malformation
BAEP	brainstem auditory evoked potential
BAER	brainstem auditory evoked response
BAHA	bone-anchored hearing aid
BC	bone conduction
BCC	basal cell carcinoma
BID	twice a day
BiPAP	bilevel positive airway pressure
BMT	bilateral myringotomy and tubes
BOA	behavioral observation audiometry
BPD	bronchopulmonary dysplasia
BPPV	benign paroxysmal positional vertigo
BTE	behind the ear
BUN	blood urea nitrogen
CAPE-V	Consensus Auditory-Perceptual Evaluation of Voice
CBC	complete blood count
cGy	centigray
CHL	conductive hearing loss
CIC	completely in canal
CMV	cytomegalovirus
CN	cranial nerve
CNS	central nervous system
COM	chronic otitis media
COMMANDO	combined mandibulectomy and neck dissection operation
CPA	cerebellopontine angle, conditioned play audiometry
CPAP	continuous positive airway pressure
CROS	contralateral routing of sound
CRP	C-reactive protein

CRS	chronic rhinosinusitis
CSA	central sleep apnea
CSF	cerebrospinal fluid
CT	computed tomography
CTA	computed tomographic angiography
CVA	cerebrovascular accident
cVEMP	cervical vestibular evoked myogenic potential
CXR	chest x-ray
dB	decibel
dB HL	decibel hearing level
dB SL	decibel sensation level
dB SPL	decibel sound pressure level
DCR	dacryocystorhinostomy
DDx	differential diagnosis
DISE	drug-induced sleep endoscopy
DL	direct laryngoscopy
DLB	direct laryngoscopy and bronchoscopy
DLBE	direct laryngoscopy, bronchoscopy, and esophagoscopy (panendoscopy)
DPOAE	distortion product otoacoustic emissions
Dx	diagnosis
EAC	external auditory canal
EBV	Epstein-Barr virus
ECA	external carotid artery
ECG	electrocardiogram
ECMO	extracorporeal membrane oxygenation
ECoG	electrocochleography
ECS	extracapsular spread
EEG	electroencephalography
EGFR	epidermal growth factor receptor
EJV	external jugular vein
EMG	electromyogram
END	elective neck dissection
ENG	electronystagmography
ENoG	electroneuronography
EOG	electrooculography
ESR	erythrocyte sedimentation rate
ESS	endoscopic sinus surgery
ET	Eustachian tube, endotracheal
ETD	Eustachian tube dysfunction
ETT	endotracheal tube
EUA	examination under anesthesia
FB	foreign body
FEES	functional endoscopic evaluation of swallowing
FEESST	functional endoscopic evaluation of swallowing with sensory testing
FESS	functional endoscopic sinus surgery
FEV	forced expiratory volume
FNA	fine-needle aspiration
FOM	floor of mouth
FTA-ABS	fluorescent treponemal antibody-absorption test
FTSG	full-thickness skin graft
FVPTC	follicular variant of papillary thyroid carcinoma
GABHS	group A ß-hemolytic streptococci
GCS	Glasgow Coma Scale
GERD	gastroesophageal reflux disease
GI	gastrointestinal
GPA	granulomatosis with polyangiitis (Wegener)
GRBAS	grade, roughness, breathiness, asthenia, strain
GSPN	greater superficial petrosal nerve
Gy	gray
H&N	head and neck
HA	hearing aid, headache
HBO	hyperbaric oxygen

HFSNHL	high frequency sensorineural hearing loss
HHT	hereditary hemorrhagic telangiectasia
HINT	hearing-in-noise test
HIV	human immunodeficiency virus
HL	hearing level, hearing loss
HNSCC	head and neck squamous cell carcinoma
HPV	human papilloma virus
HSV	herpes simplex virus
I&D	incision and drainage
IAC	internal auditory canal
ICA	internal carotid artery
ICP	intracranial pressure
IDDSI	International Dysphagia Diet Standardization Initiative
IFN	interferon
Ig	immunoglobulin
IHC	inner hair cell, immunohistochemistry
IIH	idiopathic intracranial hypertension
IJV	internal jugular vein
IL	interleukin
IM	intramuscularly
IMF	intermaxillary fixation (*see* MMF)
IMRT	intensity-modulated radiation therapy
IS	incudostapedial (joint)
ISSNHL	idiopathic sudden sensorineural hearing loss
ITC	in the canal
ITE	in the ear
ITM	in the mouth
IVIG	intravenous immunoglobulin
JNA	juvenile nasopharyngeal angiofibroma
KTP	potassium titanyl phosphate
LAD	lymphadenopathy
LARP	left anterior, right posterior semicircular canal pair
LCA	lateral cricoarytenoid muscle
LDH	lactate dehydrogenase
LDL	loudness discomfort level
LEMG	laryngeal electromyography
LES	lower esophageal sphincter
LFT	liver function test
LMA	laryngeal mask airway
LP	lumbar puncture
LPR	laryngopharyngeal reflux
LSPN	lesser superficial petrosal nerve
LTB	laryngotracheobronchitis
MBS	modified barium swallow
MBSS	modified barium swallow study
MCL	medial canthal ligament
MDL	microdirect laryngoscopy
MDLB	microdirect laryngoscopy and bronchoscopy
ME	middle ear
MEE	middle ear effusion
MEN	multiple endocrine neoplasia
MHL	mixed hearing loss
MMA	maxillomandibular advancement
MMF	maxillomandibular fixation
MND	modified neck dissection
MRA	magnetic resonance angiography

MRI	magnetic resonance imaging
MRND	modified radical neck dissection
MRSA	methicillin resistant *Staphylococcus aureus*
MSLT	multiple sleep latency test
MWT	maintenance of wakefulness test
Mϕ	macrophage
NCCN	National Comprehensive Cancer Network
ND	neck dissection
NET	nerve excitability test
NF	neurofibromatosis
NHL	non-Hodgkin lymphoma
NIHL	noise-induced hearing loss
NOE	naso-orbitoethmoid
NP	nasopharynx
NPC	nasopharyngeal carcinoma
NPO	nothing by mouth
NREM	nonrapid eye movement
NSAID	nonsteroidal anti-inflammatory drug
NSTI	necrotizing soft tissue infection
OAE	otoacoustic emissions
OC	oral cavity
OCR	ossicular chain reconstruction
OE	otitis externa
OHC	outer hair cell
OM	otitis media
OMC	ostiomeatal complex
OME	otitis media with effusion
OP	oropharynx
ORIF	open reduction internal fixation
ORL	otorhinolaryngology
OSA	obstructive sleep apnea
OSAS	obstructive sleep apnea syndrome
OTC	over-the-counter
OTE	over-the-ear
oVEMP	ocular vestibular evoked myogenic potential
OW	oval window
PAP	positive airway pressure
PB max	phonetically balanced maximum
PCA	posterior cricoarytenoid muscle
PCR	polymerase chain reaction
PDT	percutaneous dilational tracheotomy
PE	physical examination, pressure equalization, pulmonary embolus
PEEP	positive end-expiratory pressure
PEG	percutaneous endoscopic gastrostomy
PET	pressure equalization tube, positron emission tomography
PLM	periodic leg movement
PLMD	periodic limb movement disorder
PONV	postoperative nausea/vomiting
PORP	partial ossicular replacement prosthesis
PPI	proton-pump inhibitor
PROS	PIK3CA-related overgrowth spectrum
PSG	polysomnography
PT	prothrombin time
PTA	pure-tone average, peritonsillar abscess
PTH	parathyroid hormone
PTT	partial thromboplastin time
PVFD	paradoxical vocal fold motion disorder
PVFM	paradoxical vocal fold motion

QOL	quality of life
RALP	right anterior, left posterior semicircular canal pair
RAST	radioallergosorbent test
RDI	respiratory disturbance index
REM	rapid eye movement
RERA	respiratory effort-related arousal
RF	rheumatoid factor, radiofrequency
RFFF	radial forearm free flap
RLN	recurrent laryngeal nerve
RPA	retropharyngeal abscess
RRP	recurrent respiratory papillomatosis
RSTL	relaxed skin tension line
RTOG	Radiation Therapy Oncology Group
RW	round window
Rx	treatment
SC	subcutaneous
SCC	squamous cell carcinoma, semicircular canal
SCM	sternocleidomastoid
SDB	sleep-disordered breathing
SIADH	syndrome of inappropriate antidiuretic hormone
SL	sensation level
SLE	systemic lupus erythematosus
SLN	superior laryngeal nerve
SLP	superficial lamina propria, speech-language pathologist
SMAS	superficial musculoaponeurotic system
SMG	submandibular gland
SML	suspension microlaryngoscopy
SNHL	sensorineural hearing loss
SPL	sound pressure level
SQ	subcutaneous
SML	suspension microlaryngoscopy
SRT	speech (spondee) reception threshold
SSD	single-sided deafness
SSNHL	sudden sensorineural hearing loss
SSx	signs and symptoms
STSG	split-thickness skin graft
T&A	tonsillectomy and adenoidectomy
TA	thyroarytenoid muscle
TB	tuberculosis
TCA	tricyclic antidepressant, trichloroacetic acid
TEOAE	transiently evoked otoacoustic emissions
TEP	tracheoesophageal puncture
TFT	thyroid function test
TGDC	thyroglossal duct cyst
TID	three times a day
TL	total laryngectomy
TLM	transoral laser microsurgery
TM	tympanic membrane
TMJ	temporomandibular joint
TNF	tumor necrosis factor
TNM	tumor, node, metastasis
TORCH	toxoplasmosis, other, rubella, cytomegalovirus, herpes simplex virus
TORP	total ossicular replacement prosthesis
Trach	tracheostomy, tracheotomy, tracheostomy tube, tracheotomy tube
TSH	thyroid-stimulating hormone

TVC	true vocal cord
TVF	true vocal fold
U/S	ultrasound
UARS	upper airway resistance syndrome
UES	upper esophageal sphincter
UP3	uvulopalatopharyngoplasty
UPPP	uvulopalatopharyngoplasty
URI	upper respiratory infection
VBI	vertebrobasilar insufficiency
VC	vocal cord
VCD	vocal cord dysfunction (*see* PVFD)
VDRL	venereal disease research laboratory
VEMP	vestibular evoked myogenic potential
VF	vocal fold
VFSS	videofluoroscopic swallow study
vHIT	video head impulse testing
VNG	videonystagmography
VOR	vestibulo-ocular reflex
VPI	velopharyngeal insufficiency
VRA	visual response audiometry
VZV	varicella zoster virus
W/U	workup
XRT	radiation therapy
YAG	yttrium aluminum garnet
ZMC	zygomaticomaxillary complex

CHAPTER

1

Rhinology

Ian F. Caplan, David A. Gudis, Michael Z. Cheng, Lauren T. Roland, Sarah K. Wise, and Daniel B. Spielman

ANATOMY OF THE NOSE AND PARANASAL SINUSES

Paranasal Sinus Anatomy

Lateral Nasal Wall (Figure 1–1)

- **Turbinates (Conchae)**: three to four bony shelves (inferior, middle, superior, and supreme [normal variant]) covered by erectile mucosa, serve to increase the interior surface area; function to warm, moisten, and filter airflow
- Meatuses: spaces located beneath each turbinate
  1. **Inferior Meatus**: contains orifice of nasolacrimal duct (**Hasner valve**)
  2. **Middle Meatus**: drainage pathway of frontal, anterior ethmoid, and maxillary sinuses
  3. **Superior Meatus**: drainage pathway of sphenoid and posterior ethmoid sinuses
- **Uncinate Process**: sickle-shaped thin bony part of ethmoid bone covered by mucoperiosteum; anteriorly attaches to lacrimal bone; inferiorly attaches to inferior turbinate; superiorly attaches to lamina papyracea (80%), roof of ethmoid (base of skull), or middle turbinate
- **Ethmoid Infundibulum**: 3D pyramidal space lateral to the uncinate process that houses drainage of the maxillary and anterior ethmoid sinuses with the frontal sinus drainage depending on the uncinate insertion (*see below*)
- **Recess Terminalis**: blind pouch in the infundibulum created when the uncinate inserts superiorly into the lamina papyracea
- **Semilunar Hiatus**: 2D space between the uncinate process and the ethmoid bulla that empties the ethmoid infundibulum
- **Sphenopalatine Foramen**: foramen in lateral nasal wall posterior to the maxillary sinus; contains sphenopalatine artery, sensory nerve fibers, and secretomotor fibers (parasympathetic fibers from vidian nerve to pterygopalatine ganglion)
- **Concha Bullosa**: pneumatized turbinate (middle turbinate most common), may result in nasal obstruction or obstruction of the ostiomeatal complex
- **Paradoxical Middle Turbinate**: middle turbinate that is "turned" medially instead of laterally
- **Ostiomeatal Complex (OMC)**: region of the anterior ethmoid containing the uncinate process, ethmoid infundibulum, ethmoid bulla, and drainage pathway of the maxillary, frontal, and anterior ethmoid sinuses; lateral to the middle turbinate
- **Nasal Fontanelles**: areas of the lateral nasal wall where no bone exists, located above the insertion of the inferior turbinate, may be the site of accessory maxillary ostia

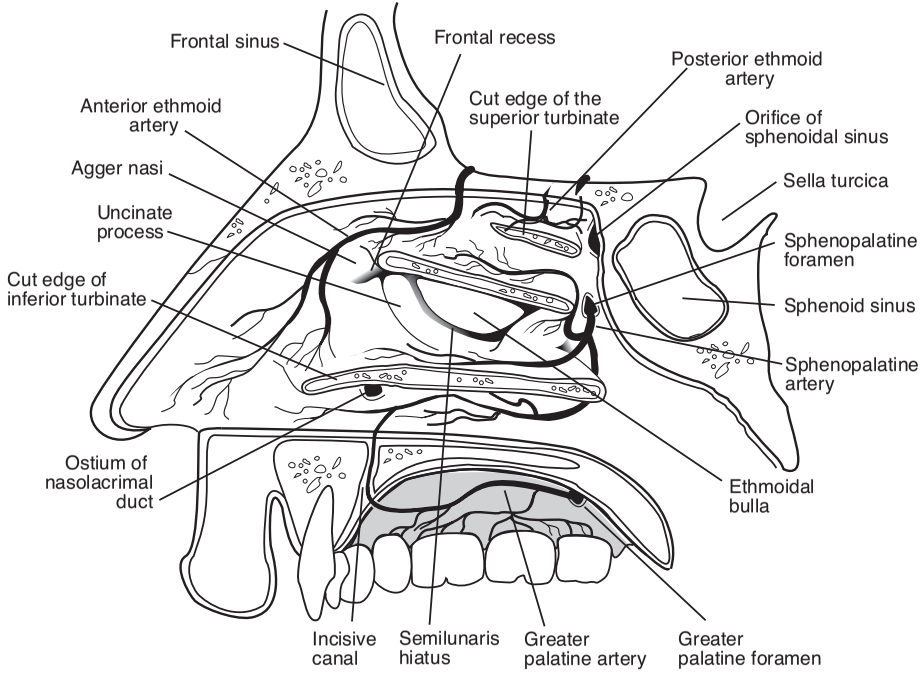

FIGURE 1–1. Anatomy of the lateral nasal wall including vascular supply.

- **Nasolacrimal Sac and Duct**: sac is in lacrimal fossa of the orbit where lacrimal bone meets frontal process of maxilla; duct courses inferiorly within lacrimal bone anterior to uncinate process and opens into the inferior meatus via **Hasner valve**, located 3–6 mm anterior to level of maxillary sinus ostium

Frontal Sinus

- Embryology: last to develop; does not pneumatize until 5–6 years old
- Volume at Adult: 4–7 mL by 12–20 years old (5–10% aplastic/hypoplastic)
- Drainage: frontal recess into the anterior middle meatus most commonly medial to the uncinate (when uncinate attaches superiorly to the lamina papyracea) or lateral to the uncinate (when uncinate attaches superiorly to skull base or middle turbinate)
- Vasculature: supraorbital and anterior ethmoidal arteries, ophthalmic (cavernous sinus) and supraorbital (anterior facial) veins
- Innervation: supraorbital nerve (CN V_1)
- **Frontal Recess**: drainage pathway between the frontal sinus and middle meatus; bounded by the agger nasi cell anteriorly, ethmoid bulla posteriorly, lamina papyracea laterally, and middle turbinate medially
- **Frontal Sinus Infundibulum**: space that drains into frontal recess, superior to the agger nasi cells
- **Foramina of Breschet**: small venules that drain the sinus mucosa into the dural veins; can serve as conduit for infection resulting in intracranial spread
- **Frontal Cells**: anterior ethmoid cells that pneumatize into frontal sinus and displace the frontal recess; may cause obstruction or persistent disease; may be anteriorly based adjacent to agger nasi or posteriorly based adjacent to ethmoid bulla
  1. Supra agger cell: anterior lateral ethmoid cell superior to agger nasi; does not enter frontal sinus
  2. Supra agger frontal cell: anterior lateral ethmoid cell superior to agger nasi that pneumatizes into the frontal sinus
  3. Supra bulla cell: cell superior to bulla ethmoidalis; does not enter frontal sinus
  4. Supra bulla frontal cell: cell superior to bulla ethmoidalis that pneumatizes into the frontal sinus
  5. Supraorbital ethmoid cell: *see* p. 8
  6. Frontal septal cell: medial cell of the anterior ethmoid or frontal sinus adjacent to the intersinus septum that displaces the outflow tract laterally and posteriorly

Maxillary Sinus

- Embryology: first to develop in utero, biphasic growth at 3 and 7–18 years old

- Volume at Adult: typically 15 mL (largest paranasal sinus)
- Drainage: ethmoid infundibulum (middle meatus, 10–30% have accessory ostium)
- Vasculature: branches of maxillary artery and corresponding veins to facial vein/pterygoid plexus
- Innervation: branches of maxillary nerve (CN V_2)
- Adjacent Structures: lateral nasal wall, alveolar process of maxilla (contains second bicuspid and first and second molars), orbital floor, posterior maxillary wall (contains pterygopalatine fossa housing the maxillary artery, pterygopalatine ganglion, and branches of CN V_2)

Ethmoid Sinus

- Embryology: three to four cells at birth (most developed paranasal sinus at birth), formed from 5 ethmoturbinals (1 = agger nasi, uncinate; 2 = middle turbinate; 3 = superior turbinate; 4–5 = supreme turbinate; *may vary by source*)
- Lamellae of Ethmoid Bone (anterior to posterior): 1 = uncinate process, 2 = bulla ethmoidalis, 3 = basal lamella of middle turbinate, 4 = lamella of superior turbinate
- Volume at Adult: 10–15 aerated cells, total volume of 2–3 mL (adult size at 12–15 years old)
- Drainage: anterior cells drain into ethmoid infundibulum (middle meatus), posterior cells drain into sphenoethmoidal recess (superior meatus)
- Vasculature: anterior and posterior ethmoid arteries (from ophthalmic artery), branches of sphenopalatine artery; Figure 1–2 shows the distance relationships of anterior and posterior ethmoid arteries and optic foramen to the anterior lacrimal crest ("***24/12/6 mm** rule*"); maxillary and ethmoid veins (cavernous sinus)
- Innervation: anterior and posterior ethmoidal nerves (from nasociliary nerve, CN V_1)
- Adjacent Structures: skull base, anterior ethmoid artery (roof of anterior ethmoid cells), nasal cavity, orbit
- **Agger Nasi Cell**: most anterior of ethmoid cells found anterior and superior to middle turbinate attachment to the lateral wall; posterior wall of the agger nasi cell forms the anterior wall of the frontal recess
- **Ethmoid Bulla**: first anterior ethmoid cell posterior to the uncinate process; anterior ethmoid artery courses superior and posterior to this cell
- **Basal (Ground) Lamella of the Middle Turbinate**: bony attachment of middle turbinate to lateral nasal wall that separates anterior and posterior ethmoid cells; **anterior** part inserts vertically into **cribriform plate, middle** part inserts obliquely into lamina papyracea, **posterior** third attaches to lateral nasal wall horizontally