

**OTOLARYNGOLOGY**  
**HEAD & NECK**  
**SURGERY**

**CLINICAL REFERENCE GUIDE**

**Fifth Edition**



# **OTOLARYNGOLOGY**

## **HEAD & NECK**

### **S U R G E R Y**

**CLINICAL REFERENCE GUIDE**

**Fifth Edition**

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# PREFACE TO THE FIFTH EDITION

The fourth begets a fifth and, like a cauldron of cooling magma, these editions are becoming more and more challenging to churn. This initial pet project when I was jet-black-haired has now become that insatiable Waponian volcano god that demands and demands episodic updates. So here you go, the public, for your consumption. I've asked for a reprieve for at least a few years or so until the beast requires another sacrifice of an epoch of time and effort.

But I kid!! True, it's not always the best of times revisiting Alport versus Aport on my holiday, yet I'm happy to serve. This edition bookmarks the era of Trump . . . a divided nation of ballooners and anti-ballooners. I only ask one thing . . . stop taking out uvulas. That little punching bag has God's/Darwinian purposes beyond all of us. Oh, and also never ever use the term uvulopharyngopalatoplasty. That term belongs in a song from *Mary Poppins*. Quite frankly it sounds dumb, no one knows what it means anymore, and I'm tired of hearing they were told that "it" doesn't work. "Palatal reconstruction" please; it's sexier.

OK, off the sermon, enjoy the book, study hard, and all the best. See you at conference.

—*Raza Pasha*

P.S. Need to give a shout out to Abdullah Al-Bader who humbled the authors and editors by providing 5 pages of errata from the fourth edition. Dr. Al-Bader would later provide 23 alternative pathways to our academy's position paper on cerumen impaction (total joke . . . we appreciate Abdullah).

# PREFACE TO THE FOURTH EDITION

This fourth edition evens out my staggered, shadow-boxed display in my office waiting room. It also satisfies an essential update and provides an introduction to our more-than-welcome Little People chapter for those of you entrenched in transmittable conjunctivitis and the everlasting cold/influenza rotation.

As for me, I've spent the last few years as a target for academics and skeptics alike lecturing cross-country on "hot button" topics such as indications of in-office balloon sinuplasty and the surgical management of sleep apnea. Should you ever find yourself with a desire to nettle to the brink of combat, walk into a rhinology conference and brag about how balloon sinuplasty is the greatest thing since electrocautery. Better yet, whisper to your pulmonologist colleague that you operated on his 23-year-old bachelor referral last week by jerking his 4+ tonsils without offering him a CPAP machine. "What?!!! You didn't even have the decency to offer him a dental appliance so he can experience referred otalgia and teeth shifting first!?"

No worries though. You'd be pressed to find any controversial points in this handbook. No need for naked disclosures. We're once again, no nonsense. We've kept to the highlights so you can pass your boards and possibly prevent an occasional cauliflower ear now and then.

No specific acknowledgments section this year, since a well-deserved Justin Golub is now blazed in the front of the book and authors are credited within.

Deeply entrenched in midlife, with three sprouting legacies, my time is apportioned between soccer matches, Super Mario marathons, and piano recitals. I dream about Mary's Little Lamb as an adjuvant remedy for psycho-physiological insomnia. The fourth edition is a product of my free time. I was tempted to include illustrations of the cochlear labyrinth crafted by my 5-year-old. Wanting to minimize distractions and leaving something for inclusion in the fifth edition, I opted to leave those out.

Thanks for your support.

—*Raza Pasha*

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# COMMON ABBREVIATIONS IN OTOLARYNGOLOGY—HEAD AND NECK SURGERY

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

CNS	central nervous system	DPOAE	distortion product otoacoustic emissions
COM	chronic otitis media	Dx	diagnosis
COMMANDO	combined mandibulectomy and neck dissection operation	EAC	external auditory canal
		EBV	Epstein-Barr virus
CPA	cerebellopontine angle, conditioned play audiometry	ECA	external carotid artery
		ECG	electrocardiogram
CPAP	continuous positive airway pressure	ECMO	extracorporeal membrane oxygenation
		ECoG	electrocochleography
CROS	contralateral routing of sound	ECS	extracapsular spread
		EEG	electroencephalography
CRP	C-reactive protein		
CRS	chronic rhinosinusitis	EGFR	epidermal growth factor receptor
CSA	central sleep apnea		
CSF	cerebrospinal fluid	EJV	external jugular vein
CT	computed tomography	EMG	electromyogram
CTA	computed tomographic angiography	END	elective neck dissection
		ENE	extranodal extension
CVA	cerebrovascular accident	ENG	electronystagmography
		ENoG	electroneuronography
cVEMP	cervical vestibular evoked myogenic potential	EOG	electrooculography
		ESR	erythrocyte sedimentation rate
CXR	chest x-ray		
dB	decibel	ESS	endoscopic sinus surgery
dB HL	decibel hearing level		
dB SL	decibel sensation level	ET	eustachian tube, endotracheal
dB SPL	decibel sound pressure level	ETD	eustachian tube dysfunction
DCR	dacryocystorhinostomy	ETT	endotracheal tube
DDx	differential diagnosis	EUA	examination under anesthesia
DL	direct laryngoscopy		
DLB	direct laryngoscopy and bronchoscopy	EXIT	ex-utero intrapartum
		FB	foreign body
DLBE	direct laryngoscopy, bronchoscopy, and esophagoscopy (panendoscopy)	FEES	functional endoscopic evaluation of swallowing

FEESSST	functional endoscopic evaluation of swallowing with sensory testing	HINT	hearing-in-noise test
FESS	functional endoscopic sinus surgery	HIV	human immunodeficiency virus
FEV	forced expiratory volume	HL	hearing level, hearing loss
FNA	fine-needle aspiration	HNSCC	head and neck squamous cell carcinoma
FOM	floor of mouth	HPV	human papilloma virus
FTA-ABS	fluorescent treponemal antibody-absorption test	HSV	herpes simplex virus
FTSG	full-thickness skin graft	I&D	incision and drainage
FVPTC	follicular variant of papillary thyroid carcinoma	IAC	internal auditory canal
GABHS	group A $\beta$ -hemolytic streptococci	ICA	internal carotid artery
GCS	Glasgow Coma Scale	ICP	intracranial pressure
GERD	gastroesophageal reflux disease	IFN	interferon
GI	gastrointestinal	Ig	immunoglobulin
GPA	granulomatosis with polyangiitis (Wegner's)	IHC	inner hair cell, immunohistochemistry
GRBAS	grade, roughness, breathiness, asthenia, strain	IJV	internal jugular vein
GSPN	greater superficial petrosal nerve	IL	interleukin
Gy	gray	IM	intramuscularly
H&N	head and neck	IMF	intermaxillary fixation ( <i>see</i> MMF)
HA	hearing aid, headache	IMRT	intensity-modulated radiation therapy
HB	House-Brackmann	IS	incudostapedial (joint)
HBO	hyperbaric oxygen	ISSNHL	idiopathic sudden sensorineural hearing loss
HFSNHL	high frequency sensorineural hearing loss	ITC	in the canal
HHT	hereditary hemorrhagic telangiectasia	ITE	in the ear
		ITM	in the mouth
		IVIG	intravenous immunoglobulin
		JNA	juvenile nasopharyngeal angiofibroma

KCOT	keratocystic odontogenic tumor	MHL	mixed hearing loss
KTP	potassium titanyl phosphate	MMA	maxillomandibular advancement
LAD	lymphadenopathy	MMF	maxillomandibular fixation
LARP	left anterior, right posterior semicircular canal pair	MND	modified neck dissection
LCA	lateral cricoarytenoid muscle	MRA	magnetic resonance angiography
LDH	lactate dehydrogenase	MRI	magnetic resonance imaging
LDL	loudness discomfort level	MRND	modified radical neck dissection
LEMG	laryngeal electromyography	MRSA	methicillin resistant <i>Staphylococcus aureus</i>
LES	lower esophageal sphincter	MSLT	multiple sleep latency test
LFT	liver function test	MWT	maintenance of wakefulness test
LMA	laryngeal mask airway	M $\phi$	macrophage
LP	lumbar puncture	NCCN	National Comprehensive Cancer Network
LSPN	lesser superficial petrosal nerve	ND	neck dissection
LTB	laryngotracheobron- chitis	NET	nerve excitability test
MBS	modified barium swallow	NF	neurofibromatosis
MBSS	modified barium swallow study	NHL	non-Hodgkin's lymphoma
MCL	medial canthal ligament	NIHL	noise-induced hearing loss
MDL	microdirect laryngoscopy	NOE	naso-orbitoethmoid
MDLB	microdirect laryngoscopy and bronchoscopy	NP	nasopharynx
ME	middle ear	NPC	nasopharyngeal carcinoma
MEE	middle ear effusion	NPO	nothing by mouth
MEN	multiple endocrine neoplasia	NREM	nonrapid eye movement
		NSAID	nonsteroidal anti- inflammatory drug
		NSTI	necrotizing soft tissue infection

OAE	otoacoustic emissions	PET	pressure equalization tube, positron emission tomography
OC	oral cavity		
OCR	ossicular chain reconstruction	PLM	periodic leg movement
OE	otitis externa		
OHC	outer hair cell	PLMD	periodic limb movement disorder
OM	otitis media		
OMC	ostiomeatal complex	PORP	partial ossicular replacement prosthesis
OME	otitis media with effusion		
OP	oropharynx	PPI	proton-pump inhibitor
ORIF	open reduction internal fixation	PSG	polysomnography
ORL	otorhinolaryngology	PT	prothrombin time
OSA	obstructive sleep apnea	PTA	pure-tone average, peritonsillar abscess
OSAS	obstructive sleep apnea syndrome	PTH	parathyroid hormone
		PTT	partial thromboplastin time
OTC	over-the-counter		
OTE	over-the-ear	PVFD	paradoxical vocal fold motion disorder
oVEMP	ocular vestibular evoked myogenic potential	PVFM	paradoxical vocal fold motion
OW	oval window	QOL	quality of life
PB max	phonetically balanced maximum	RALP	right anterior, left posterior semicircular canal pair
PCA	posterior cricoarytenoid muscle	RAST	radioallergosorbent test
PCR	polymerase chain reaction	RDI	respiratory disturbance index
PDT	percutaneous dilational tracheotomy	REM	rapid eye movement
		RERA	respiratory effort-related arousal
PE	physical examination, pressure equalization, pulmonary embolus	RF	rheumatoid factor, radiofrequency
PEEP	positive end-expiratory pressure	RFFF	radial forearm free flap
		RLN	recurrent laryngeal nerve
PEG	percutaneous endoscopic gastrostomy	RPA	retropharyngeal abscess

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

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

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*Dedicated to my family:*

*Dad, Mom, Mamta, Aramay Ocean, Zaedyn Bear, Ayla Sofia,  
Little Brother (Nasir), Anita, Jamie, Tasnim, Imran, Jazair,  
Rahul Uncle, Swati Auntie, Dave, Rumi, and Zephyr*

—Raza

*To my wife, Katrina, for her infinite support and patience;  
my daughters, Lily and Mia, for keeping me young; and  
my mother, Carol, father, Larry, and sister, Danielle, for  
their unwavering kindness and encouragement.*

—Justin



# CHAPTER

# 1

## Rhinology and Paranasal Sinuses

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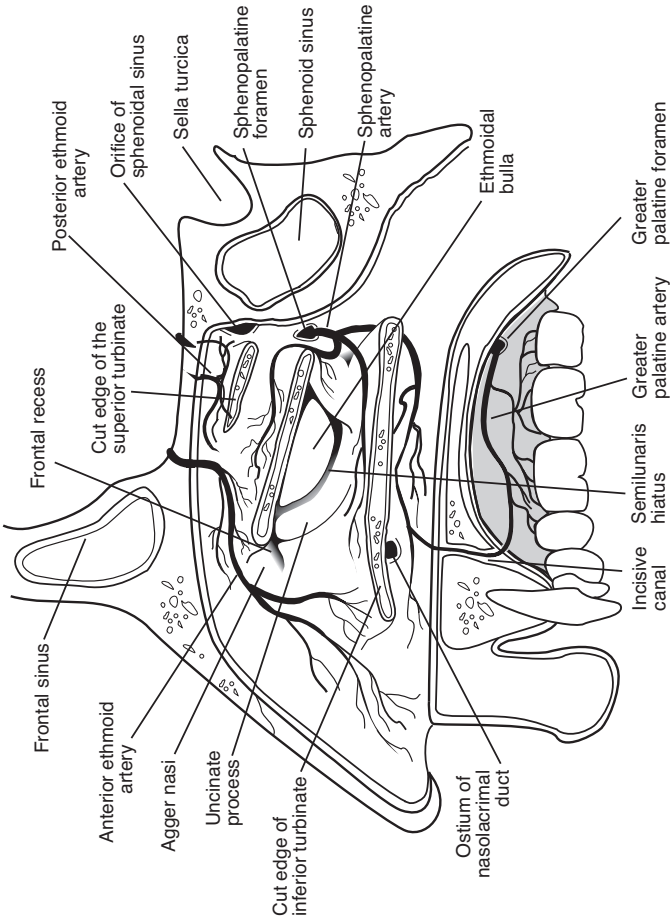
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## ANATOMY OF THE NOSE AND PARANASAL SINUSES

### Paranasal Sinus Anatomy

#### Lateral Nasal Wall (*see* 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, moisture, and filter airflow
- **Meatuses:** spaces located beneath each turbinate
  1. **Superior Meatus:** drainage pathway of the sphenoid and posterior ethmoid sinuses
  2. **Middle Meatus:** drainage pathway of the frontal, anterior ethmoid, and maxillary sinuses
  3. **Inferior Meatus:** contains orifice of the nasolacrimal duct
- **Uncinate Process:** sickle-shaped thin bony part of the ethmoid bone covered by mucoperiosteum; anteriorly attaches to lacrimal bones; inferiorly attaches to the inferior turbinate; superiorly attaches to lamina papyracea (80%), roof of the ethmoid (base of skull), or middle turbinate
- **Ethmoid Infundibulum:** pyramidal space that houses the drainage of the maxillary, anterior ethmoid, and frontal sinuses
- **Recess Terminalis:** blind pouch in the infundibulum created when the uncinate inserts superiorly into the lamina papyracea
- **Semilunar Hiatus:** gap that empties the ethmoid infundibulum, located between the uncinate process and the ethmoid bulla
- **Sphenopalatine Foramen:** posterior to inferior attachment of the middle turbinate; contains sphenopalatine artery, sensory nerve fibers, and secretomotor fibers (parasympathetic fibers from vidian nerve to pterygopalatine ganglion)
- **Concha Bullosa:** a pneumatized turbinate (middle turbinate most common), may result in nasal obstruction or obstruction of the osteomeatal complex
- **Paradoxical Middle Turbinate:** a middle turbinate that is “turned” medially instead of laterally
- **Ostiomeatal Complex (OMC):** region referring to the anterior ethmoids containing the ostia of the maxillary, frontal, and 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 Duct and Sac:** duct is located lateral to the anterior uncinat process, sac is lateral to the agger nasi cell and opens into the inferior meatus via **Hasner's 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 uncinat (when uncinat attaches superiorly to the lamina papyracea) or lateral to the uncinat (when uncinat 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<sub>1</sub>)
- **Frontal Recess:** drainage space between the frontal sinus and semilunar hiatus/middle meatus; bounded by the posterior wall of the agger nasi cell, lamina papyracea, and middle turbinate
- **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
- **Frontal Cells:** anterior ethmoid cells that pneumatize the frontal recess, may cause obstruction or persistent disease, posterior to the agger nasi cell, 4 types (as defined by Bent and Kuhn)
  - Type I:** single cell above agger nasi cell but below the floor of the frontal sinus (infundibulum)
  - Type II:** multiple cells above agger nasi cell, may extend into the frontal sinus proper
  - Type III:** single large cell that extends supraorbitally through the floor of the frontal sinus, attaches to the anterior table
  - Type IV:** single isolated cell that is within the frontal sinus

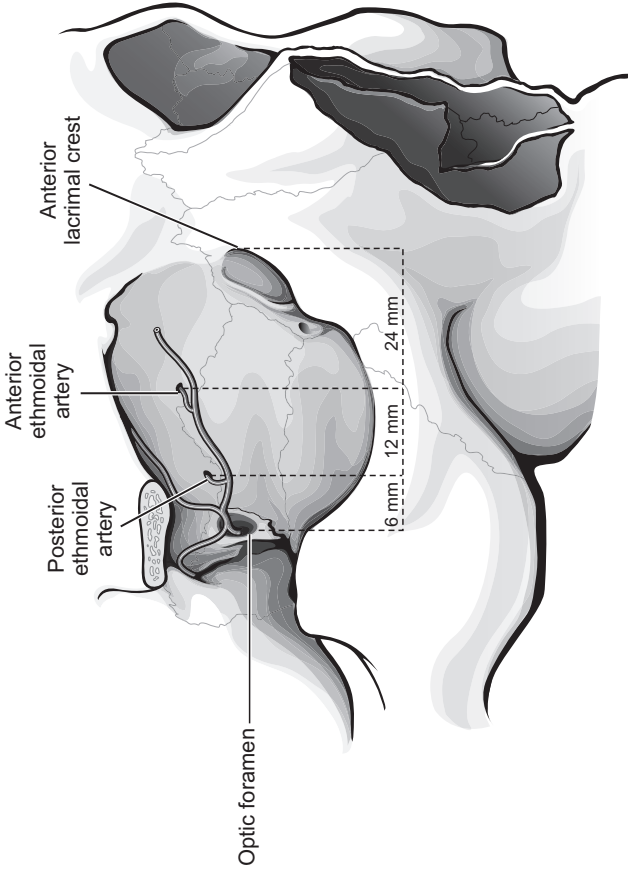
## Maxillary Sinus

- **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<sub>2</sub>)
- **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<sub>2</sub>)

## Ethmoid Sinus

- **Embryology:** three to four cells at birth (most developed paranasal sinus at birth), formed from 5 ethmoturbinals (1 = agger nasi, uncinata; 2 = middle turbinate; 3 = superior turbinate; 4–5 = supreme turbinate; *may vary by source*)
- **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 the ethmoid infundibulum (middle meatus), posterior cells drain into the superior meatus
- **Vasculature:** anterior and posterior ethmoid arteries (from ophthalmic artery), branches of sphenopalatine artery; *see* Figure 1–2 for distance relationships of anterior and posterior ethmoid arteries and optic foramen to the anterior lacrimal crest (“24/12/6 rule”); maxillary and ethmoid veins (cavernous sinus)
- **Innervation:** anterior and posterior ethmoidal nerves (from nasociliary nerve, CN V<sub>1</sub>)
- **Adjacent Structures:** skull base, anterior ethmoid artery (roof of anterior ethmoid cells), nasal cavity, orbit
- **Agger Nasi Cells:** most anterior of anterior ethmoid cells found anterior and superior to the middle turbinate attachment to the lateral wall, the posterior wall of the agger nasi cells forms the anterior wall of the frontal recess
- **Ethmoid Bulla:** the largest of the anterior ethmoid cells that lies above the infundibulum, the anterior ethmoid artery courses superior and posterior to this cell
- **Basal (Ground) Lamella of the Middle Turbinate:** bony attachment of the middle turbinate to lateral nasal wall that separates anterior and posterior ethmoid cells; **anterior** part inserts vertically into the crista ethmoidalis, **middle** part inserts obliquely into the lamina papyracea, **posterior** third attaches to the lamina horizontally
- **Onodi Cells:** ethmoid cells that pneumatize lateral or posterior to anterior wall of the sphenoid, commonly mistaken as sphenoid cells; optic nerve or carotid artery may indent into the lateral wall
- **Haller Cells:** ethmoid cells that extend into maxillary sinus above the ostium, pneumatize the medial and inferior orbital walls
- **Lamina Papyracea:** lateral thin bony wall of the ethmoid sinus, separates orbit from ethmoid cells as a part of the medial orbital wall



**FIGURE 1-2.** Anatomic relationship between ethmoidal arteries and bony landmarks (“24/12/6 rule”).



- **Fovea Ethmoidalis:** roof of ethmoid sinus
- **Supraorbital Cell:** pneumatization of the posterior orbital plate of the frontal bone often forms septations in the frontal recess
- **Olfactory Fossa:** depression in anterior cranial cavity with floor formed by cribriform plate, below which lies the olfactory cleft; **Keros classification** describes distance relationship between fossa and ethmoid roof (Type 1: 1–3 mm, Type 2: 4–7 mm, Type 3: 8–16 mm); Type 3 has higher risk of violating skull base
- **Lamellae of Ethmoid Bone (anterior to posterior):** 1 = uncinata process, 2 = bulla ethmoidalis, 3 = basal lamella of middle turbinate, 4 = lamella of superior turbinate

## Sphenoid Sinus

- **Embryology:** evagination of nasal mucosa into sphenoid bone
- **Volume at Adult:** 0.5–8 mL (adult size at 12–18 years old)
- **Drainage:** sphenoethmoidal recess
- **Vasculature:** posterior ethmoidal and sphenopalatine arteries, maxillary vein (pterygoid plexus)
- **Innervation:** posterior ethmoidal nerves (CN V<sub>1</sub>)
- **Adjacent Structures:** pons, pituitary (sella turcica), carotid artery (lateral wall, **25% dehiscent**), optic nerve (lateral wall, **5% dehiscent**), cavernous sinus (laterally), CN V<sub>2</sub> and VI, clivus, septal branch of the sphenopalatine artery (inferior aspect of the sphenoid os)

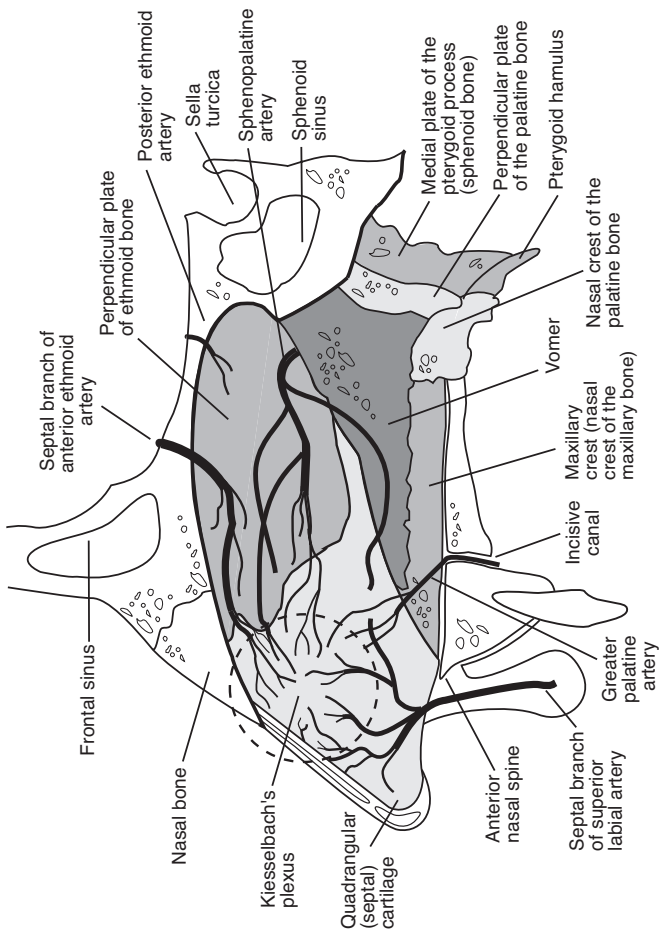
## Nose Anatomy

### External Nose

- **Piriform Aperture:** bounded inferolaterally by maxilla and superiorly by nasal bones
- **Upper Lateral Cartilage:** inferior to nasal bone (paired)
- **Lower Lateral (Greater) Alar Cartilage:** cartilage inferior to the upper lateral cartilage, composed of lateral and medial crura (paired)
- **Lesser Alar Cartilage:** small cartilaginous plates that are lateral to the lower lateral alar cartilage (paired)
- **Septum:** *see* below
- **Muscles:** procerus, nasalis, dilator naris anterior, depressor septi and levator labii superioris alaeque nasi; all innervated by CN VII
- **Nasal (Aesthetic) Subunits:** *see* pp. 485–487

### Nasal Septum (*see* Figure 1–3)

- **Quadrangular Cartilage:** septal cartilage



**FIGURE 1-3.** Anatomy of the septum including vascular supply.

- **Perpendicular Plate of the Ethmoid:** projects from cribriform plate to septal cartilage
- **Vomer:** posterior and inferior to perpendicular plate
- **Nasal Crest (Maxillary and Palatine Bone):** trough of bone that supports the septal cartilage
- **Anterior Nasal Spine:** bony projection anterior to piriform aperture

## Nasal Cavity

- **Vestibule:** lies just inside the naris anterior to the **limen nasi** (ridge that marks beginning of nasal cavity), lined by keratinized stratified squamous epithelium with coarse hair-bearing skin inferiorly
- **Roof:** bounded by nasal/frontal bone anteriorly, cribriform plate and sphenoid face posteriorly
- **Floor:** formed by palatine process of maxilla and horizontal plate of palatine bone, communicates with piriform aperture anteriorly and choana posteriorly
- **Septum and Lateral Wall**

## Sensory Innervation

### *External Innervation*

- supratrochlear and infratrochlear nerves (CN V<sub>1</sub>): nasal dorsum
- external nasal branch of anterior ethmoid (CN V<sub>1</sub>): nasal tip
- infraorbital nerve (CN V<sub>2</sub>): malar, lateral nose, and subnasal regions

### *Internal Innervation*

- internal nasal branch of anterior ethmoid (CN V<sub>1</sub>): anterosuperior nasal cavity
- posterior ethmoid nerve (CN V<sub>1</sub>): posterosuperior nasal cavity
- nasopalatine nerve (CN V<sub>2</sub>): posterior and inferior septum
- greater palatine nerve (CN V<sub>2</sub>): posterior lateral wall, floor, and roof
- superior alveolar nerve (CN V<sub>2</sub>): anterior septum, floor, and lateral wall

## Vascular Anatomy (see Figures 1–1 and 1–3)

### *External Carotid Artery Branches*

#### **Maxillary Artery (Internal Maxillary Artery)**

- descending palatine artery → greater palatine and lesser palatine arteries

- sphenopalatine artery → sphenopalatine foramen (posterior to the middle turbinate) → medial (nasoseptal) and lateral nasal artery (middle and inferior turbinates)

### **Facial Artery**

- superior labial artery → columella, nasal septum, and alar branches
- lateral nasal artery
- angular artery → nasal sidewall, tip, and dorsum

### ***Internal Carotid Artery → Ophthalmic Artery***

- anterior ethmoid artery (larger than the posterior ethmoid artery) → lateral nasal wall and septum
- posterior ethmoidal artery → superior turbinate and septum
- dorsal nasal artery → external nose

### ***Venous System***

- greater palatine vein → posterior facial vein (external jugular vein) and cavernous sinus
- septal vein → anterior facial vein (internal jugular vein)
- sphenopalatine vein → cavernous sinus and maxillary vein (internal jugular vein)
- anterior and posterior ethmoidal veins → ophthalmic veins (cavernous sinus)
- angular vein → anterior facial vein (internal jugular vein) or ophthalmic veins (cavernous sinus)
- **“Danger Triangle”**: bounded by oral commissures and nasal bridge, retrograde drainage from superficial veins may lead to intracranial extension of infection

### ***Lymphatics***

- External: primarily to level Ib, root of nose to superficial parotid nodes
- Internal: anterior nasal cavity drains superficially and then to level IB, rest drains to retropharyngeal and upper cervical nodes