THE CONSULT

A PUBLICATION OF THE RAYUS QUALITY INSTITUTE • WINTER 2022

Appropriateness of Advanced Imaging Procedures in Patients With Rhinosinusitis

Rhinosinusitis AUC Summary:

- **Acute rhinosinusitis**, generally defined as an episode lasting less than 4 weeks, is usually diagnosed by history and physical examination. Advanced imaging tests are not recommended unless the condition persists despite treatment or there is a suspected complication. When the acute rhinosinusitis is recurrent (four or more episodes per year), imaging with CT can be useful to confirm the diagnosis, plan for surgical intervention, and/or identify suspected complications.

- For cases of **chronic rhinosinusitis** (CRS), generally defined as an episode lasting more than 12 weeks, CT imaging, as opposed to plain radiography or MRI, is the radiologic modality of choice. It can be useful for confirming CRS, as an alternative to nasal endoscopy, and/or for evaluating CRS prior to surgical intervention. MRI is not considered a first-line study in this scenario because of a lack of bone detail and length of imaging time.

- **Before surgical intervention**, noncontrast CT of the paranasal sinuses is indicated for evaluation of either recurrent acute rhinosinusitis or chronic rhinosinusitis, providing the best preoperative information for endoscopic surgery, with excellent delineation of the complex ethmoidal anatomy, ostiomeatal unit, and anatomic variations.

- **Complications of rhinosinusitis** are typically classified as orbital, intracranial, and osseous. Initial signs and symptoms can be diagnosed on CT imaging. CT is also superior to MRI for foreign body assessment, calcification detection, and osseous evaluation. MRI provides an accurate evaluation of complex sinus secretions and extension of disease into adjacent soft tissues. For intracranial complications, MRI is more sensitive than CT and is the imaging modality of choice where available. Additional imaging via CT angiography or MR angiography may be needed if there is concern for carotid/vascular invasion and pseudoaneurysm formation; however, they are not first-line examinations.

INSIDE THIS ISSUE

BLAKE JOHNSON, MD, FACR
RAYUS Medical Director and Director of Neuroimaging; MN

This material summarizes key elements of Appropriate Use Criteria (AUC) developed by the RAYUS Quality Institute's Provider Led Entity (PLE). The RAYUS Quality Institute PLE has been qualified by the Centers for Medicare and Medicaid Services to develop AUC to guide the ordering of advanced imaging. The entire AUC library is available at rayusradiology.com/ple.

This edition of *The Consult* summarizes criteria developed by Dr. Johnson and a panel of experts:

- **ERIC BECKEN, MD,** Otolaryngologist, Midwest Ear, Nose & Throat; MN
- **THOMAS GILBERT, MD, MPP,** RAYUS Chief Clinical Officer and PLE Chair
- **VINCENT MATHEWS, MD, FACR,** Department of Radiology Chair; Medical College of WI
- **DAVID POETKER, MD, MA,** Professor and Chief, Department of Otolaryngology; Medical College of WI
- **CAROL STARK, MD,** Family Physician, Entira Family Clinics; MN

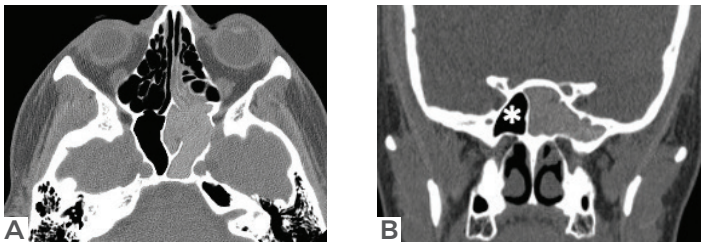
Clinical decision support (CDS) is not intended to replace clinician judgment, but rather to provide information to assist care team members in managing the complex and expanding volume of biomedical and person-specific data needed to make timely, informed, and higher-quality decisions based on current clinical science (National Academy of Medicine, 2017).

RAYUS QUALITY INSTITUTE™

Appropriate Use Criteria: How to Use this Document

- **Primary recommendation:** A strong recommendation for initial imaging for this presentation; there is confidence that the desirable effects of imaging outweigh its undesirable effects.
- **Alternative recommendation:** A conditional recommendation for imaging; the desirable effects of imaging likely outweigh its undesirable effects, although some uncertainty may exist. The individual patient's circumstances, preferences, and values should be considered on a case-by-case basis.
- **Recommendation against imaging:** The undesirable effects of imaging outweigh any desirable effects. Additionally, the recommendation may be impractical or not feasible in the targeted population and/or practice setting(s).

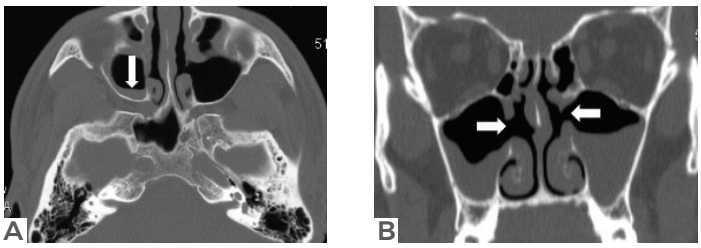
Acute Uncomplicated Rhinosinusitis (< 4 weeks duration)
No advanced imaging is recommended



Axial CT (A) reveals a completely opacified left sphenoid sinus chamber. The sphenoethmoidal recess is obstructed, and there is involvement of the posterior ethmoid air cells. The coronal image (B) demonstrates a completely opacified left sphenoid sinus, with normal aeration of the smaller right sphenoid sinus chamber (white asterisk).

- In acute rhinosinusitis, the diagnosis is usually made on clinical grounds (history and physical examination), and imaging tests are not recommended unless the condition persists despite treatment or a complication is suspected (Fokkens et al 2020; Orlandi et al 2020; Chow et al 2012; Kirsch et al 2017; Desrosiers et al 2011; Short et al 2017; Rosenfeld et al 2015; Peters et al 2014).
- Acute rhinosinusitis is defined as sinonasal inflammation lasting less than 4 weeks and associated with the sudden onset of symptoms. Symptoms must include both: 1) nasal blockage/obstruction/congestion or nasal discharge AND 2) facial pain/pressure or reduction/loss of smell (Orlandi et al 2020; Kirsch et al 2017; Short et al 2017).
- By definition, uncomplicated rhinosinusitis is symptomatic inflammatory change involving the nasal cavity and paranasal sinuses without extension beyond the paranasal sinuses or nasal cavity at time of diagnosis (Kirsch et al 2017; Rosenfeld et al 2015).
- Acute rhinosinusitis of < 4 weeks is subdivided into acute bacterial rhinosinusitis (< 10% of cases) or viral rhinosinusitis (> 90% of cases). The distinction is clinical, determined by illness pattern and length of occurrence (Kirsch et al 2017; Chow et al 2012).

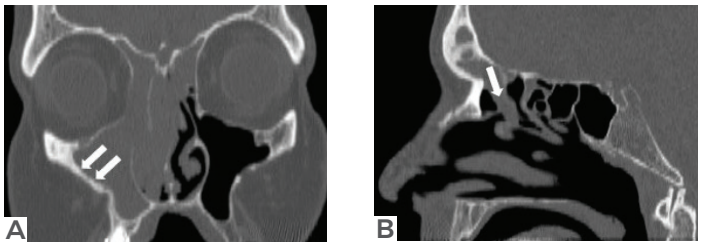
Recurrent Acute Rhinosinusitis
CT paranasal sinuses without IV contrast
CT cone beam paranasal sinuses without IV contrast
CT paranasal sinuses with IV contrast
CT paranasal sinuses without and with IV contrast
MRI



Axial CT (A) reveals retained secretions with an air-fluid level (white arrow) in the right maxillary sinus chamber. The coronal image (B) demonstrates bilateral nasoantral windows in this postoperative patient, with mucosal thickening in both maxillary sinus chambers.

- If four or more episodes of acute bacterial rhinosinusitis occur annually, without signs or symptoms between the episodes, the term recurrent acute rhinosinusitis is used (Fokkens et al 2020; Kirsch et al 2017; Rosenfeld et al 2015; Desrosiers et al 2011; Orlandi et al 2020).
- Imaging, specifically CT without IV contrast, is an option during at least one episode of suspected recurrent acute rhinosinusitis to appropriately confirm the diagnosis, plan for surgical intervention, identify suspected complications, and/or distinguish it from other diagnoses such as allergy exacerbation or primary headache syndromes (Kirsch et al 2017; Orlandi et al 2020).
- Cone-beam CT may be useful to assess paranasal anatomy and pathology, although it is limited in evaluating the adjacent soft tissues (Kirsch et al 2017).
- CT examinations of the paranasal sinuses should utilize thin sections (< 1.25 mm) with sagittal reformations, coronal reformations, and thick (2–3 mm) soft tissue axial reformations (PLE expert panel consensus opinion).

Chronic Uncomplicated Rhinosinusitis	
●	CT paranasal sinuses without IV contrast
●	CT cone beam paranasal sinuses without IV contrast
●	MRI orbit, face & neck without and with IV contrast
●	MRI orbit, face & neck without IV contrast [patient unable to receive IV contrast]
●	CT paranasal sinuses with IV contrast [patient unable to undergo MRI]
●	CT paranasal sinuses without and with IV contrast



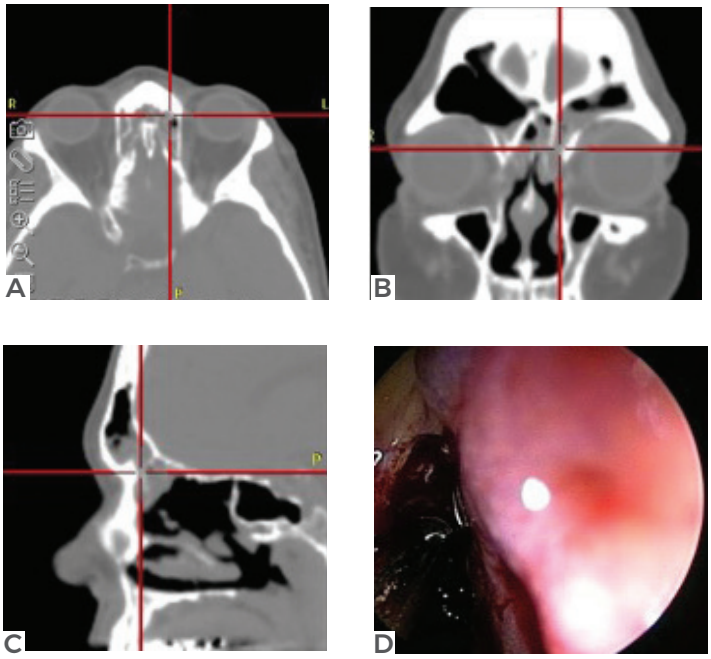
Coronal CT (A) reveals complete opacification of the right maxillary sinus chamber, inferior frontal and ethmoid sinuses, as well as the left frontal sinus and right nasal cavity. There is thickening of the lateral maxillary sinus wall with sclerosis (dual arrows) reflecting hyperostosis due to chronic inflammatory sequelae. A sagittal CT image (B) reveals the opacified frontal sinus with an obstructed frontal recess (white arrow).

- Chronic rhinosinusitis (CRS) is defined when signs and symptoms of rhinosinusitis occur for 12 weeks or longer and include two or more of the following symptoms: nasal discharge, nasal obstruction and congestion, hyposmia, facial pressure or pain AND evidence of either inflammation on nasal endoscopy or computed tomography OR evidence of purulence coming from paranasal sinuses or ostiomeatal complex (Orlandi et al 2020; Kirsch et al 2017; Desrosiers et al 2011; Peters et al 2014).
- Rhinosinusitis lasting 4-12 weeks should be assessed on an individual clinical basis to determine if the pattern is acute or chronic, because timeline definitions are consensusconsensus- rather than evidence-based (Kirsch et al 2017).
- Symptoms alone have a high sensitivity but low specificity, which is why they must be accompanied by objective evidence of disease. Objective evidence is defined either by imaging evidence of sinonasal inflammation or by mucopurulent mucus, edema, or polyps on examination (Orlandi et al 2020).
- Conversely, in the absence of symptoms, diagnosis of CRS based on imaging alone is not appropriate because it is a clinical diagnosis and there is a high incidence of radiological anomalies on CT scans in normal individuals (Desrosiers et al 2011).
- CT remains the gold standard in the radiologic evaluation of CRS (Fokkens et al 2020), and clinical practice guidelines uniformly state that CT imaging, as opposed to plain radiography or MRI, is the radiologic modality of choice for confirming CRS, as an alternative to nasal endoscopy, and/or for evaluating CRS prior to surgical intervention (Orlandi et al 2020; Kirsch et al 2017; Seidman et al 2015).
- A patient's history of radiation exposure and preferences should be taken into account when deciding to confirm CRS with CT. Multi-detector CT scanners and cone-beam CT can reduce the radiation dose and also preserve image quality by shortening scan time and using post-processing techniques without compromising anatomical accuracy, making them increasingly attractive (Fokkens et al 2020).
- The utility of MRI for diagnosis of CRS is limited, and MRI should not be considered a first-line study for routine sinus imaging because of lack of bone detail and length of imaging time (Kirsch et al 2017). MRI is generally useful only in specific instances such as for delineation of mucoceles and assessing for complications (Orlandi et al 2020; Kirsch et al 2017).
- The CT Lund-Mackay score is a method for the staging of CRS on CT (Lund & Mackay, 1993). The reader assigns each sinus a score of:
  - 0 (no abnormality)
  - 1 (partial opacification) or
  - 2 (complete opacification)

  The sinuses are grouped into:
  - frontal sinus
  - anterior ethmoidal cells
  - posterior ethmoidal cells
  - maxillary sinus
  - sphenoid sinus
  - ostiomeatal complex

  The ostiomeatal complex is assigned a score of either 0 (not obstructed) or 2 (obstructed). Each side is graded separately. A combined score of up to 24 is possible. Of note, an aplastic (absent) frontal sinus receives a score of 0.

Pre-operative Evaluation for Routine Functional Endoscopic Sinus Surgery	
●	CT paranasal sinuses without IV contrast
●	CT cone beam paranasal sinuses without IV contrast
●	CT paranasal sinuses with IV contrast
●	CT paranasal sinuses without and with IV contrast
●	MRI



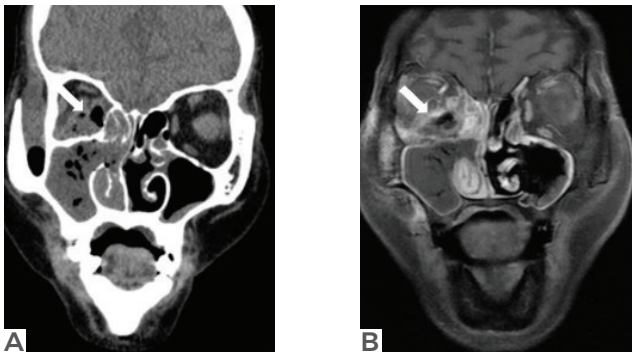
Axial (A), coronal (B), and sagittal (C) images generated from the CT data assist with endoscopic surgery using image-guided navigation. The surgeon would otherwise rely on the limited field of view in the endoscope (D) for orientation within the sinonasal cavity.

- For patients with rhinosinusitis, the goal of surgery is to re-establish sinus drainage by removing excess tissue responsible for obstruction and bony areas in narrow areas. The extent of surgery is guided by the degree of sinus involvement (Desrosiers et al 2011).
- Noncontrast CT of the paranasal sinuses is indicated for evaluation of recurrent acute rhinosinusitis and chronic rhinosinusitis before surgical intervention (Kirsch et al 2017; Peters et al 2014; Rosenfeld et al 2015).
- CT scanning provides the best preoperative information for endoscopic surgery, with excellent delineation of the complex ethmoidal anatomy, ostiomeatal unit, and anatomic variations, including the presence of sphenoethmoidal (Onodi) air cells, which increase the risk of injury to the optic nerves or carotid arteries (Kirsch et al 2017; Seidman et al 2015). It also demonstrates abnormal mucosa and opacified sinuses (Rosenfeld et al 2015).
- CT should not be used as the sole criteria for determining need for surgical intervention, but rather should be used as an objective tool for confirming the diagnosis and for surgical planning (Desrosiers et al 2011).
- Cone-beam CT may be useful for the assessment of paranasal anatomy and pathology in uncomplicated sinusitis, although it is limited in evaluating the adjacent soft tissues (Kirsch et al 2017).
- CT imaging can be imported into computer navigation systems for image-based guidance surgery during endoscopic sinus surgery. Imaging protocols should be aligned with any image-guided procedure requirements to eliminate redundant imaging for surgical guidance (Kirsch et al 2017).

Diagnosis of Complications of Rhinosinusitis	
	Imaging of Sinuses and Orbits
●	CT paranasal sinuses without IV contrast
●	CT orbits without or with IV contrast
●	MRI orbit, face & neck without and with IV contrast
●	MRI orbit, face & neck without IV contrast [patient unable to receive IV contrast]
●	CT paranasal sinuses with IV contrast [patient unable to undergo MRI]
●	CT (sinuses/orbits) without and with IV contrast
●	CT cone beam

	Intracranial Imaging
●	MRI brain without and with IV contrast
●	MRI brain without IV contrast [patient unable to receive IV contrast]
●	CT head without and/or with IV contrast [patient unable to undergo MRI]

	Vascular Imaging
●	MR angiography brain [evaluate for suspected vascular complications]
●	CT angiography brain [evaluate for suspected vascular complications]



Coronal CT image (A) demonstrates near complete opacification of the right maxillary sinus chamber with loculated air within the secretions. There is extension of the infection into the inferomedial right orbit (white arrow). Coronal MR image (B) demonstrates enhancing mucosa in both maxillary sinus chambers and the nasal cavity, as well as inflammatory changes within the orbit surrounding the phlegmon/abscess with air collection centrally (white arrow). (Case courtesy of C. Doug Phillips, M.D.)

- **Complications of acute bacterial rhinosinusitis are typically classified as orbital (~60-80%), intracranial (~15-20%) and rarely osseous (~5%), though occasionally some unusual complications can develop (Fokkens et al 2020).**
  - **Periorbital complications include preseptal cellulitis, orbital cellulitis, and subperiosteal or intraorbital abscess. Prompt recognition is vital in order to avoid long-term morbidity and mortality (Fokkens et al 2020).**
  - **Intracranial complications include epidural or subdural empyema, brain abscess, meningitis, encephalitis, and superior sagittal and cavernous sinus thrombosis. They may present with non-specific signs and symptoms and diagnosis requires high clinical suspicion from practitioners (Fokkens et al 2020).**
  - **Osseous complications result from osteomyelitis and may present as a subperiosteal frontal bone abscess (Pott's Puffy tumor) or a frontocutaneous fistula (Fokkens et al 2020).**
- **Sinonasal imaging, specifically CT without contrast, is indicated in patients who demonstrate initial signs and symptoms of complicated rhinosinusitis (Seidman et al 2015; Short et al 2017; Peters et al 2014: strength A recommendation), as most complications can be observed with unenhanced CT imaging (Kirsch et al 2017; Peters et al 2014).**
- **Orbital MRI without and with contrast is complementary to CT in evaluating intraorbital spread of infection, and should be considered if a more detailed assessment of intraorbital spread of infection is clinically warranted (Kennedy et al 2018).**
- **For intracranial complications of acute bacterial rhinosinusitis, a CT scan, as a minimum, is required for diagnosis as it allows for precise definition of osseous tissue involvement (Fokkens et al 2020). However, MRI is more sensitive than CT and should be the imaging modality of choice where available; it offers additional diagnostic value to exclude or confirm cavernous sinus thrombosis or intracranial abscess/phlegmon (Fokkens et al 2020; Peters et al 2014; Chow et al 2012; Kirsch et al 2017).**
- **Because fungal sinusitis in the sphenoid can result in cavernous sinus invasion and involvement of the cavernous carotid artery, additional imaging via CT angiography or MR angiography may be needed if there is concern for carotid/vascular invasion and pseudoaneurysm formation; however, they are not first-line examinations (Kirsch et al 2017; Kennedy et al 2018).**
- **Symptoms such as periorbital edema, displaced globe, diplopia, ophthalmoplegia, reduced visual acuity, severe unilateral or bilateral frontal headache, frontal headache, neurological signs, or reduced consciousness are indicative of an emergency or severe disease and require urgent referral to an otolaryngologist or to the emergency department (Fokkens et al 2020).**

References

Chow AW, Benninger MS, Brook I, et al; Infectious Diseases Society of America. IDSA clinical practice guideline for acute bacterial rhinosinusitis in children and adults. Clin Infect Dis. 2012; 54(8):e72-e112.

Desrosiers M, Evans GA, Keith PK, et al. Canadian clinical practice guidelines for acute and chronic rhinosinusitis. J Otolaryngol Head Neck Surg. 2011; 40 Suppl 2:S99-S193.

Fokkens WJ, Lund VJ, Hopkins C, et al. European position paper on rhinosinusitis and nasal polyps 2020. Rhinology. 2020; 58(Suppl S29):1-464.

Kennedy TA, Corey AS, Policeni B, et al. ACR Appropriateness Criteria® Orbits Vision and Visual Loss. J Am Coll Radiol. 2018; 15(5S):S116-S131.

Kirsch CF, Bykowski J, Aulino JM, et al. ACR Appropriateness Criteria® Sinonasal Disease. J Am Coll Radiol. 2017; 14(11S):S550-S559.

Lund VJ, Mackay IS. Staging in rhinosinusitis. Rhinology. 1993; 31(4):183-184.

Orlandi RR, Kingdom TT, Smith TL, et al. International consensus statement on rhinology and allergy: Rhinosinusitis 2021. Int Forum Allergy Rhinol. 2021; 11(3):213-739.

Peters AT, Spector S, Hsu J, et al. Joint Task Force on Practice Parameters, representing the American Academy of Allergy, Asthma and Immunology, the American College of Allergy, Asthma and Immunology, and the Joint Council of Allergy, Asthma and Immunology. Ann Allergy Asthma Immunol. 2014. 113(4):347-385.

Rosenfeld RM, Piccirillo JF, Chandrasekhar SS, et al. Clinical practice guideline (update): Adult sinusitis. Otolaryngol Head Neck Surg. 2015; 152(2 Suppl):S1-S39.

Seidman MD, Gurgel RK, Lin SY, et al. Clinical pratice guideline: Allergic rhinitis. Otolaryngol Head Neck Surg. 2015; 152(1 Suppl):S1-S43.

Short S, Bashir H, Marshall P, et al. Institute for Clinical Systems Improvement. Diagnosis and treatment of respiratory illness in children and adults. Updated September 2017.