AmeriHealth Caritas Louisiana

National Imaging Associates, Inc.*	
Clinical guidelines **TEMPORAL BONE, MASTOID, ORBITS, SELLA, INTERNAL AUDITORY CANAL CT**	**Original Date: September 1997**
CPT Codes: 70480, 70481, 70482	**Last Revised Date: ~~April~~ March 202~~1~~1**
Guideline Number: NIA_CG_006 - 1	**Implementation Date: January 2022**

INDICATIONS FOR ORBIT CT

Note:

CT is preferred for visualizing bony detail and calcifications. MRI is superior for the evaluation of the visual pathways, globe, and soft tissues[1, 2] ~~(Hande, 2012; Kennedy, 2018)~~

- Abnormal external or direct eye exam[1] ~~(Hande, 2012)~~:
  - Exophthalmos (proptosis) or enophthalmos
  - Ophthalmoplegia with concern for orbital pathology[3] ~~(Stalcup, 2013)~~
  - Unilateral optic disk swelling if MRI is contraindicated or cannot be performed[4-6] ~~(Hata, 2017; Margolin, 2019; Passi, 2013)~~
  - Documented visual defect if MRI is contraindicated or cannot be performed[7-10] ~~(Fadzil, 2013; Kedar, 2011; Prasad, 2012; Sadun, 2011)~~
    - Unilateral or with abnormal optic disc(s) (i.e., optic disc blurring, edema, or pallor); AND
    - Not explained by an underlying diagnosis, glaucoma, or macular degeneration
- Optic Neuritis if MRI is contraindicated or cannot be performed
  - **If atypical presentation (bilateral, absence of pain, optic nerve hemorrhages, severe visual impairment, lack of response to steroids, poor recovery or recurrence)**[11-14]
  - ~~With an atypical presentation, severe visual impairment or poor recovery following initial onset or treatment onset[13, 14] (CMSC, 2018; Voss, 2011)~~
  - If needed to confirm optic neuritis and rule out compressive lesions
- Orbital trauma
  - Physical findings of direct eye injury

* **National Imaging Associates, Inc. (NIA) is a subsidiary of Magellan Healthcare, Inc.**

- Suspected orbital trauma with indeterminate x-ray
- For further evaluation of a fracture seen on x-ray for treatment or surgical planning

- Orbital or ocular mass/tumor, suspected, or known[1, 7] ~~(Hande, 2012; Kedar, 2011)~~
- Clinical suspicion of orbital infection[15, 16] ~~(Gavito-Higuera, 2016; Kirsch, 2017)~~
- Clinical suspicion of osteomyelitis[17, 18] ~~(Arunkumar, 2011; Lee, 2016)~~
  - Direct visualization of bony deformity OR
  - Abnormal x-rays
- Clinical suspicion of Orbital Inflammatory Disease (e.g., eye pain and restricted eye movement with suspected orbital pseudotumor) **if MRI is contraindicated or cannot be performed**[~~17~~19] ~~(Pakdaman, 2014)~~
- Congenital orbital anomalies[20] ~~(Tawfik, 2012)~~
- Complex strabismus **(with ophthalmoplegia or ophthalmoparesis)** to aid in diagnosis, treatment and/or surgical planning[21-23] ~~(Demer; 2002; Kadom, 2008)~~

Combination Studies with Orbit CT

- Brain CT/Orbit CT if MRI is contraindicated or cannot be performed
  - Optic neuropathy or unilateral optic disk swelling of unclear etiology to distinguish between a compressive lesion of the optic nerve, optic neuritis, ischemic optic neuropathy (arteritic or non-arteritic), central retinal vein occlusion, or optic nerve infiltrative disorders[24] ~~(Behbehani, 2007)~~
  - Bilateral optic disk swelling (papilledema) with vision loss[5] ~~(Margolin, 2019)~~
  - Approved indications as noted above and being performed in high-risk populations and will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology[25] ~~(Lawson, 2000)~~

INDICATIONS FOR SELLA CT[26]

When MRI is contraindicated or cannot be performed[27, 28] ~~(ACR NE, 2018; Chaudhary, 2011)~~

- For further evaluation of known sellar and parasellar masses
- Suspected pituitary gland disorder[29] ~~(Wu, 2014)~~ based on **any of the following**:
  - Documented visual field defect suggesting compression of the optic chiasm; **OR**
  - Laboratory findings suggesting pituitary dysfunction[30] ~~(Freda, 2011)~~; **OR**
  - Pituitary apoplexy with sudden onset of neurological and hormonal symptoms~~;~~ **OR**
  - ~~Follow-up to o~~**O**ther imaging suggesting sella (pituitary) mass

INDICATIONS FOR TEMPORAL/MASTOID/INTERNAL AUDITORY CANAL CT

Hearing loss (documented on audiogram)[31, 32]
~~(Cunnane, 2019; Sharma, 2018)~~

- Asymmetric sensorineural when MRI is contraindicated[33, 34] ~~(Krause, 2010; Verbist, 2012)~~
- Conductive or mixed[35] ~~(Trojanowska, 2012)~~
- Congenital[35] ~~(Trojanowska, 2012)~~
- Cochlear implant evaluation[36] ~~(Juliano, 2015)~~

~~•~~

•

Tinnitus[37-39]

~~(Kessler, 2017; Pegge, 2017; Yew, 2014)~~

- Pulsatile tinnitus **with concern for osseous pathology of the temporal bone**
- Unilateral non-pulsatile tinnitus and MRI is contraindicated or cannot be performed

Ear Infection

- Clinical suspicion of acute mastoiditis as a complication of acute otitis media[40-43] ~~(Kann, 2016; Luntz, 2012; Patel, 2014; Platzek, 2014)~~
    - Systemic illness or toxic appearance
    - Signs of extracranial complications (e.g., postauricular swelling/erythema, auricular protrusion, retro-orbital pain, hearing loss, tinnitus, vertigo, nystagmus)
    - Not responding to treatment

  Note: MRI is also indicated if there are signs of intracranial complications (e.g., meningeal signs, cranial nerve deficits, focal neurological findings, altered mental status).
  This is most common in the pediatric population

- Chronic Otitis Media (with or without cholesteatoma on exam)[42, 44]
  ~~(Gomaa, 2013; Patel, 2014)~~
    - Failed treatment for acute otitis media

Cholesteatoma[45, 46]

~~(Barath, 2011; Chen, 2018)~~

CSF Otorrhea[47, 48]

~~(Hiremath, 2019; Vemuri, 2017)~~

- When looking to characterize a bony defect (for intermittent leaks and complex cases consider CT/MR/Nuclear Cisternography). CSF fluid should always be confirmed with laboratory testing (Beta-2 transferrin assay.)

Temporal Bone Fracture[49-51]

~~(Collins, 2012; Kennedy, 2014; Lantos, 2019)~~

- Suspected based on mechanism of injury OR
- Indeterminate findings on initial imaging OR
- For further evaluation of a known fracture for treatment or surgical planning

Vascular Indications[52, 53]

~~(Bozek, 2016; Muderris, 2011)~~

- Suspected or known with need for further evaluation
    - Dehiscence of the jugular bulb or carotid canal OR
    - ~~o~~ Other vascular anomalies of the temporal bone (i.e., aberrant internal carotid artery, high jugular bulb, persistent stapedial artery, aberrant petrosal sinus)

-

Peripheral vertigo[32, 54, 55]
~~(Muncie, 2017; Sharma, 2018; Strupp, 2013)~~

- Based on clinical exam (Head-Impulse with saccade, Spontaneous unidirectional horizontal nystagmus, Dix-Hallpike maneuver); **AND**
    - Persistent symptoms after a trial of medication and four weeks of vestibular therapy (e.g., Epley's maneuvers)

Bell's Palsy/hemifacial spasm if MRI is contraindicated or cannot be performed (for evaluation of the extracranial nerve course)

- ~~If atypical signs, slow resolution beyond three weeks, no improvement at four months, or facial twitching/spasms prior to onset~~[56] ~~(Quesnel, 2010)~~
-

OTHER INDICATIONS FOR TEMPORAL BONE, MASTOID, ORBIT~~S~~, SELLA, INTERNAL AUDITORY CANAL CT

Pre-operative/procedural evaluation

- Pre-operative evaluation for a planned surgery or procedure

Post- operative/procedural evaluation

- When imaging, physical, or laboratory findings indicate surgical or procedural complications
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND

Computed tomography's use of thin sections with multi-planar reconstruction (e.g., axial, coronal, and sagittal planes), along with its three-dimensional rendering, permits thorough diagnosis and management of ocular and orbital disorders. Brain CT is often ordered along with CT of the orbit for head injury with orbital trauma. MRI Orbits is preferred over CT Orbits except in the case of orbital trauma, infection, or bone abnormalities

Temporal bone, mastoid, and internal auditory canal computed tomography (CT) is a unique study performed for problems, such as conductive hearing loss, chronic otitis media, mastoiditis, cholesteatoma, congenital hearing loss and cochlear implants. It is a modality of choice because it provides 3D positional information and offers a high degree of anatomic detail. It is rarely used for evaluation of VIIth or VIIIth nerve tumors.

POLICY HISTORY

Date	Summary
March 2022	Updated References Re-ordered indications Clarified: • Optic neuritis If atypical presentation (bilateral, absence of pain, optic nerve hemorrhages, severe visual impairment, lack of response to steroids, poor recovery or recurrence • Clinical suspicion of Orbital Inflammatory Disease if MRI is contraindicated or cannot be performed • Pulsatile tinnitus with concern for osseous pathology of the temporal bone — • Complex strabismus syndromes (with ophthalmoplegia or ophthalmoparesis)
April 2021	Updated References Reordered Indications Added: • Complex strabismus to aid in diagnosis, treatment and/or surgical planning • Temporal Bone Fracture- Suspected based on mechanism of injury OR Indeterminate findings on initial imaging OR For further evaluation of a known fracture for treatment or surgical planning • If needed to confirm optic neuritis and rule out compressive lesions Clarified: • Documented visual defect if MRI is contraindicated or cannot be performed - *Unilateral or with abnormal optic disc(s) (i.e., Optic disc blurring, edema, or pallor);* • Clinical Suspicion of osteomyelitis: Direct visualization of bony deformity *OR* Abnormal X-rays • *Optic neuropathy* or unilateral optic disk swelling of unclear etiology (Combo Orbit/Brain CT) • CSF Otorrhea - *When looking to characterize a bony defect (for intermittent leaks and complex cases consider CT/MR/Nuclear Cisternography). CSF fluid should always be confirmed with laboratory testing (Beta-2 transferrin assay)*
May 2020	Clarified: • Ophthalmoplegia with concern for orbital pathology • Documented visual field defect if MRI is contraindicated or cannot be performed • Orbital or ocular mass/tumor, suspected or known • Clinical Suspicion of orbital infection

	• Clinical Suspicion of Orbital Inflammatory Disease (eg, eye pain and restricted eye movement with suspected orbital pseudotumor)
	• Brain CT/Orbit CT if MRI is contraindicated or cannot be performed
	• Bilateral optic disk swelling (papilledema) with vision loss
	• Reworded: Unilateral optic disk swelling/optic neuropathy of unclear etiology to distinguish between a compressive lesion of the optic nerve, optic neuritis, ischemic optic neuropathy (arteritic or non-arteritic), central retinal vein occlusion or optic nerve infiltrative disorders
	• Under INDICATIONS FOR SELLA CT: clarified when MRI is contraindicated or cannot be performed
	• Unilateral non-pulsatile tinnitus and MRI is contraindicated or cannot be performed
	• Vascular Indications
	• Suspected or known with need for further evaluation
	• Dehiscence of the jugular bulb or carotid canal OR
	• Other vascular anomalies of the temporal bone (i.e. aberrant internal carotid artery, high jugular bulb, persistent stapedial artery, aberrant petrosal sinus)
	• Persistent symptoms after a trial of medication and four weeks of vestibular therapy (eg, Epley's maneuvers)
	<u>Added:</u>
	• CT is preferred for visualizing bony detail and calcifications, MRI is superior for the evaluation of the visual pathways, globe and soft tissues
	• Unilateral optic disk swelling if MRI is contraindicated or cannot be performed
	• Under Orbital trauma
	  ○ For further evaluation of a fracture seen on X-ray for treatment or surgical planning
	• Congenital orbital anomalies
	• Under indications for Sella CT:
	  ○ Pituitary apoplexy with sudden onset of neurological and hormonal symptoms
	• Clinical Suspicion of acute mastoiditis as a complication of acute otitis
	  ○ Systemic illness or toxic appearance
	  ○ Signs of extracranial complications (e.g., postauricular swelling/erythema, auricular protrusion, retro-orbital pain, hearing loss, tinnitus, vertigo, nystagmus)
	  ○ Not responding to treatment

	* MRI is also indicated if there are signs of intracranial complications (e.g., meningeal signs, cranial nerve deficits, focal neurological findings, altered mental status) * This is most common in the pediatric population • Cholesteatoma • CSF Otorrhea • Bell's Palsy/hemifacial spasm if MRI is contraindicated or cannot be performed (for evaluation of the extracranial nerve course) o If atypical signs, slow resolution beyond three weeks, no improvement at four months, or facial twitching/spasms prior to onset <u>Deleted:</u> • Unilateral papilledema, approve dedicated Orbits CT even if Brain CT approved • "Or known" from Suspected or known pituitary gland disorder • Clinical Suspicion of acute mastoiditis with some of the following signs or symptoms o Ear infection o Postauricular swelling o Postauricular erythema o Protrusion of the auricle o Otalgia
May 2019	<u>Orbit CT:</u> • Added clinical suspicion of osteomyelitis • Removed orbital asymmetry; vision loss with etiology not identified on ophthalmologic; diplopia; suspected hyperthyroidism such as Graves' disease <u>Combination Brain CT/Orbit CT:</u> • Added bilateral papilledema w/vision loss if MRI is contraindicated <u>Sella CT:</u> • Added suspected or known pituitary gland disorder <u>Temporal/Mastoid/IAC CT:</u> • Expanded peripheral vertigo indication to include persistent symptoms after four weeks of treatment, medication, and vestibular therapy • Removed: acoustic neuroma or peripheral cranial nerve palsy

REFERENCES

Abuabara A. Cerebrospinal fluid rhinorrhoea: diagnosis and management. *Med Oral Patol Oral Cir Bucal*. 2007;12(5):E397-400.

American College of Radiology ACR Appropriateness Criteria® - Neuroendocrine Imaging. 2018. https://acsearch.acr.org/docs/69485/Narrative/.

Arunkumar JS, Naik AS, Prasad KC, et al. Role of nasal endoscopy in chronic osteomyelitis of maxilla and zygoma: A case report. Case Reports in Medicine. 2011; Article ID 802964.

Baráth K, Huber AM, Stämpfli P, Varga Z, Kollias S. Neuroradiology of cholesteatomas. *AJNR Am J Neuroradiol*. 2011;32(2):221-229. doi:10.3174/ajnr.A2052.

Behbehani R. Clinical approach to optic neuropathies. *Clin Ophthalmol*. 2007; 1(3):233-246.

Bożek P, Kluczewska E, Misiołek M, et al. The prevalence of persistent petrosquamosal sinus and other temporal bone anatomical variations on high-resolution temporal bone computed tomography. *Med Sci Monit*. 2016; 22:4177-4185. http://doi.org/10.12659/MSM.898546. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5108369/.

Chaudhary V, Bano S. Imaging of the pituitary: Recent advances. *Indian J Endocrinol Metab*. 2011; 15 Suppl 3(Suppl3):S216-S223. doi:10.4103/2230-8210.84871

Chen Y, Li P. Application of high-resolution computer tomography in external ear canal cholesteatoma diagnosis. *J Otol*. 2018;13(1):25-28. doi:10.1016/j.joto.2017.10.004.

Collins JM, Krishnamoorthy AK, Kubal WS, Johnson MH, Poon CS. Multidetector CT of temporal bone fractures. *Semin Ultrasound CT MR*. 2012;33(5):418-431. doi:10.1053/j.sult.2012.06.006

Consortium of Multiple Sclerosis Centers (CMSC). MRI Protocol and Clinical Guidelines for the Diagnosis and Follow-up of MS. February 2018.

Cunnane MB. Imaging of tinnitus. *Neuroimaging Clinics*. 2019 Feb; 29(1):49-56.

Demer JL, Clark RA, Kono R, Wright W, Velez F, Rosenbaum AL. A 12-year, prospective study of extraocular muscle imaging in complex strabismus. *J AAPOS*. 2002;6(6):337-347. doi:10.1067/mpa.2002.129040.

Fadzil F, Ramli N, Ramli NM. MRI of optic tract lesions: review and correlation with visual field defects. *Clin Radiol*. 2013 Oct; 68(10):e538-51.

Freda PU, Beckers AM, Katznelson L, et al. Pituitary incidentaloma: An endocrine society clinical practice guideline. *J Clin Endocrinol Metab*. 2011 Apr; 96(4):894-904.

Gala F. Magnetic resonance imaging of optic nerve. *Indian J Radiol Imaging*. 2015;25(4):421-438. doi:10.4103/0971-3026.169462

Gavito-Higuera J, Mullins CB, Ramos-Duran L, et al. Sinonasal fungal infections and complications: A pictorial review. *J Clin Imaging Sci*. 2016 Jun 14; 6:23.

Gomaa MA, Rahim A, Karim AA, et al. Evaluation of temporal bone cholesteatoma and the correlation between high resolution computed tomography and surgical finding. *Clin Med Insights Ear Nose Throat*. 2013; 6: 21-28.

Hande PC, Talwar I. Multimodality imaging of the orbit. *Indian J Radiol Imaging*. 2012; 22(3):227-239. http://doi.org/10.4103/0971-3026.107184. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3624745/.

Hata M, Miyamoto K. Causes and prognosis of unilateral and bilateral optic disc swelling *Neuroophthalmology*. 2017 Aug; 41(4):187-191.

Hiremath SB, Gautam AA, Sasindran V, et al. Cerebrospinal fluid rhinorrhea and otorrhea: A multimodality imaging approach. *Diagn Interven Imaging*. 2019 Jan; 100(1):3-15. https://doi.org/10.1016/j.diii.2018.05.003.

Juliano AF, Ginat DT, Moonis G. Imaging review of the temporal bone: Part II. Traumatic, postoperative, and noninflammatory nonneoplastic conditions. *Radiology*. 2015. 276(3).

Kadom N. Pediatric strabismus imaging. *Current Opinion in Ophthalmology*. 2008;19(5):371-378. doi:10.1097/ICU.0b013e328309f165.

Kann K. Acute mastoiditis: Pearls and pitfalls. emDocs website. 2016 Mar 27. http://www.emdocs.net/acute-mastoiditis-pearls-and-pitfalls/.

Kanda T, Miyazaki A, Zeng F, et al. Magnetic resonance imaging of intraocular optic nerve disorders: review article. *pjr*. 2020;85(1):67-81. doi:10.5114/pjr.2020.93364.

Kedar S, Ghate D, Corbett JJ. Visual fields in neuro-ophthalmology. *Indian J Ophthalmol*. 2011 Mar-Apr; 59(2):103-109.

Kennedy TA, Avey GD, Gentry LR. Imaging of temporal bone trauma. *Neuroimaging Clin N Am*. 2014;24(3):467-486, viii. doi:10.1016/j.nic.2014.03.003.

Kennedy TA, Corey AS, Policeni B, et al. American College of Radiology (ACR) Appropriateness Criteria. Expert Panel on Neurologic Imaging: Orbits, Vision and Visual Loss. https://acsearch.acr.org/docs/69486/Narrative/. Published 2018.

Kessler MM, Moussa M, Bykowski J, et al. Expert Panel on Neurologic Imaging. American College of Radiology (ACR) Appropriateness Criteria: Tinnitus. https://acsearch.acr.org/docs/3094199/Narrative/. Published 2017.

Kirsch CFE, Bykowski J, et al. ACR Appropriateness Criteria - Sinonasal Disease. *J Am Coll Radiol*. 2017 Nov; 14(11S):S550-S559.

Krause N, Fink KT, Fink JR. Asymmetric sensorineural hearing loss caused by vestibular schwannoma: Characteristic imaging features before and after treatment with stereotactic radiosurgery. *Radiol Case Rep*. 2010; 5(2):437.

Lantos JE, Leeman K, Weidman EK, Dean KE, Peng T, Pearlman AN. Imaging of temporal bone trauma: A clinicoradiologic perspective. *Neuroimaging Clin N Am*. 2019;29(1):129-143. doi:10.1016/j.nic.2018.08.005.

Lawson, GR. Sedation of children for magnetic resonance imaging. *Archives Dis Childhood*. 2000; 82(2).

Lee YJ, Sadigh S, Mankad K, et al. The imaging of osteomyelitis. Quant Imaging Med Surg. 2016; 6(2):184-198. http://doi.org/10.21037/qims.2016.04.01 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4858469/.

Luntz M, Bartal K, Brodsky A, et al. Acute mastoiditis: The role of imaging for identifying intracranial complications. *Laryngoscope*. 2012 Dec; 122(12):2813-7. https://doi.org/10.1002/lary.22193.

Mantur M, Łukaszewicz-Zając M, Mroczko B, et al. Cerebrospinal fluid leakage—Reliable diagnostic methods. *Clinica Chimica Acta*. 2011;412(11-12):837-840. doi:10.1016/j.cca.2011.02.017

Margolin E. Swollen optic nerve: An approach to diagnosis and management. Pract Neurol. 2019 Jun 13. Epub ahead of print.

Muderris T, Bercin S, **Sevil E**, et al. A potentially catastrophic anatomical variation: Aberrant internal carotid artery in the middle ear cavity. *Case Rep Otolaryngol*. 2013; 2013:743021. https://doi.org/10.1155/2013/743021.

Muncie H. Dizziness: Approach to evaluation and management. *Am Fam Physician*. February 1, 2017; 95(3):154-162. https://www.aafp.org/afp/2017/0201/p154.html.

Othman BA, FitzGibbon EJ, Wendt S. Optic Atrophy. EyeWiki. Published December 29, 2020. Accessed July 2, 2021. https://eyewiki.aao.org/Optic_Atrophy

Pakdaman MN, Sepahdari AR, Elkhamary SM. Orbital inflammatory disease:

Pictorial review and differential diagnosis. *World J Radiol*. 2014 Apr 28; 6(4):106-15. doi: 10.4329/wjr.v6.i4.106.

Passi N, Degnan AJ, Levy LM. MR imaging of papilledema and visual pathways: Effects of increased intracranial pressure and pathophysiologic mechanisms. Am J Neuroradiol. 2013 May; 34(5):919-924.

Patel KM, Almutairi A, Mafee MF. Acute otomastoiditis and its complications: Role of imaging. Operative Techniques in Otolaryngology. 2014; 25:21-28.

Pegge SAH, Steens SCA, Kunst HPM et. Al. Pulsatile Tinnitus: Differential Diagnosis and Radiological Work-Up. Curr Radiol Rep. 2017; 5(1):5

Platzek I, Kitzler HH, Gudziol V, et al. Magnetic resonance imaging in acute mastoiditis. *Acta Radiol Short Rep*. 2014 Feb; 3(2):2047981614523415.

Prasad S, Galetta SL. Approach to the patient with acute monocular visual loss. *Neurol Clin Pract*. 2012; 2(1):14-23.

Quesnel AM, Lindsay RW, Hadlock TA. When the bell tolls on Bell's palsy: Finding occult malignancy in acute-onset facial paralysis. Am J Otolaryngol. 2010 Sep-Oct; 31(5):339-42. Epub 2009 Jun 24.

Sadun AA, Wang MY. Abnormalities of the optic disc. *Handb Clin Neurol*. 2011; 102:117-57. doi: 10.1016/B978-0-444-52903-9.00011-X.

Sharma A, Kirsch CF, Aulino JM, et al. Expert Panel on Neurologic Imaging. American College of Radiology (ACR) Appropriateness Criteria: Hearing Loss and/or Vertigo. https://acsearch.acr.org/docs/69488/Narrative. Published 2018.

Stalcup ST, Tuan AS, Hesselink JR. Intracranial causes of ophthalmoplegia: The visual reflex pathways. *RadioGraphics*. 2013; 33(5).

Strupp M, Dieterich M, Brandt T. The treatment and natural course of peripheral and central vertigo. *Dtsch Arztebl Int*. 2013 Jul; 110(29-30):505–16.

Tawfik HA, Abdelhalim A, Elkafrawy MH. Computed tomography of the orbit--A review and an update. *Saudi J Ophthalmol*. 2012; 26(4):409-418. doi:10.1016/j.sjopt.2012.07.004

Trojanowska A, Drop A, Trojanowski P, et. al. External and middle ear diseases: Radiological diagnosis based on clinical signs and symptoms. *Insights Imaging*. 2012 Feb; 3(1):33-48.

Vemuri N, Karanam LP, Manchikanti V, Dandamudi S, Puvvada S, Vemuri V. Imaging review of cerebrospinal fluid leaks. *Indian J Radiol Imaging*. 2017;27(4):441. doi:10.4103/ijri.IJRI_380_16.

Verbist BM. Imaging of sensorineural hearing loss: A pattern-based approach to diseases of the inner ear and cerebellopontine angle Insights Imaging. 2012 Apr; 3(2):139-153.

Voss E, Raab P, Trebst C, et al. Clinical approach to optic neuritis: Pitfalls, red flags and differential diagnosis. *Ther Adv Neurol Disord*. 2011; 4(2):123-34. http://doi.org/10.1177/1756285611398702. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3105615/.

Wu L, Li Y, Yin Y, et al. Usefulness of dual-energy computed tomography imaging in the differential diagnosis of sellar meningiomas and pituitary adenomas: Preliminary report. *PLoS One*. 2014 Mar; 9(3):e90658.

Yew K. Diagnostic approach to patients with tinnitus. *Am Fam Physician*. January 15, 2014; 89(2):106-13. https://www.aafp.org/afp/2014/0115/p106.html.

Reviewed / Approved by NIA Clinical Guideline Committee

~~**GENERAL INFORMATION**~~

~~It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.~~

1. Hande PC, Talwar I. Multimodality imaging of the orbit. *Indian J Radiol Imaging*. Jul 2012;22(3):227-39. doi:10.4103/0971-3026.107184
2. Kennedy TA, Corey AS, Policeni B, et al. ACR Appropriateness Criteria(®) Orbits Vision and Visual Loss. *J Am Coll Radiol*. May 2018;15(5s):S116-s131. doi:10.1016/j.jacr.2018.03.023
3. Stalcup ST, Tuan AS, Hesselink JR. Intracranial causes of ophthalmoplegia: the visual reflex pathways. *Radiographics*. Sep-Oct 2013;33(5):E153-69. doi:10.1148/rg.335125142
4. Hata M, Miyamoto K. Causes and Prognosis of Unilateral and Bilateral Optic Disc Swelling. *Neuroophthalmology*. Aug 2017;41(4):187-191. doi:10.1080/01658107.2017.1299766
5. Margolin E. The swollen optic nerve: an approach to diagnosis and management. *Pract Neurol*. Aug 2019;19(4):302-309. doi:10.1136/practneurol-2018-002057
6. Passi N, Degnan AJ, Levy LM. MR imaging of papilledema and visual pathways: effects of increased intracranial pressure and pathophysiologic mechanisms. *AJNR Am J Neuroradiol*. May 2013;34(5):919-24. doi:10.3174/ajnr.A3022
7. Kedar S, Ghate D, Corbett JJ. Visual fields in neuro-ophthalmology. *Indian J Ophthalmol*. Mar-Apr 2011;59(2):103-9. doi:10.4103/0301-4738.77013
8. Fadzli F, Ramli N, Ramli NM. MRI of optic tract lesions: review and correlation with visual field defects. *Clin Radiol*. Oct 2013;68(10):e538-51. doi:10.1016/j.crad.2013.05.104
9. Prasad S, Galetta SL. Approach to the patient with acute monocular visual loss. *Neurol Clin Pract*. Mar 2012;2(1):14-23. doi:10.1212/CPJ.0b013e31824cb084
10. Sadun AA, Wang MY. Abnormalities of the optic disc. *Handb Clin Neurol*. 2011;102:117-57. doi:10.1016/b978-0-444-52903-9.00011-x

11. Kaur K, Gurnani B, Devy N. Atypical optic neuritis - a case with a new surprise every visit. *GMS Ophthalmol Cases*. 2020;10:Doc11. doi:10.3205/oc000138
12. Phuljhele S, Kedar S, Saxena R. Approach to optic neuritis: An update. *Indian J Ophthalmol*. Sep 2021;69(9):2266-2276. doi:10.4103/ijo.IJO_3415_20
13. Consortium of Multiple Sclerosis Centers. 2018 MRI Protocol and Clinical Guidelines for MS. Consortium of Multiple Sclerosis Centers (CMSC). Updated May 22, 2018. Accessed November 2, 2021. https://www.mscare.org/page/MRI_protocol
14. Voss E, Raab P, Trebst C, Stangel M. Clinical approach to optic neuritis: pitfalls, red flags and differential diagnosis. *Ther Adv Neurol Disord*. Mar 2011;4(2):123-34. doi:10.1177/1756285611398702
15. Gavito-Higuera J, Mullins CB, Ramos-Duran L, Sandoval H, Akle N, Figueroa R. Sinonasal Fungal Infections and Complications: A Pictorial Review. *J Clin Imaging Sci*. 2016;6:23. doi:10.4103/2156-7514.184010
16. Kirsch CFE, Bykowski J, Aulino JM, et al. ACR Appropriateness Criteria(®) Sinonasal Disease. *J Am Coll Radiol*. Nov 2017;14(11s):S550-s559. doi:10.1016/j.jacr.2017.08.041
17. Arunkumar JS, Naik AS, Prasad KC, Santhosh SG. Role of nasal endoscopy in chronic osteomyelitis of maxilla and zygoma: a case report. *Case Rep Med*. 2011;2011:802964. doi:10.1155/2011/802964
18. Lee YJ, Sadigh S, Mankad K, Kapse N, Rajeswaran G. The imaging of osteomyelitis. *Quant Imaging Med Surg*. Apr 2016;6(2):184-98. doi:10.21037/qims.2016.04.01
19. Ferreira TA, Saraiva P, Genders SW, Buchem MV, Luyten GPM, Beenakker JW. CT and MR imaging of orbital inflammation. *Neuroradiology*. Dec 2018;60(12):1253-1266. doi:10.1007/s00234-018-2103-4
20. Tawfik HA, Abdelhalim A, Elkafrawy MH. Computed tomography of the orbit - A review and an update. *Saudi J Ophthalmol*. Oct 2012;26(4):409-18. doi:10.1016/j.sjopt.2012.07.004
21. Demer JL, Clark RA, Kono R, Wright W, Velez F, Rosenbaum AL. A 12-year, prospective study of extraocular muscle imaging in complex strabismus. *J aapos*. Dec 2002;6(6):337-47. doi:10.1067/mpa.2002.129040
22. Kadom N. Pediatric strabismus imaging. *Curr Opin Ophthalmol*. Sep 2008;19(5):371-8. doi:10.1097/ICU.0b013e328309f165
23. Engle EC. The genetic basis of complex strabismus. *Pediatr Res*. Mar 2006;59(3):343-8. doi:10.1203/01.pdr.0000200797.91630.08
24. Behbehani R. Clinical approach to optic neuropathies. *Clin Ophthalmol*. Sep 2007;1(3):233-46.
25. Lawson GR. Controversy: Sedation of children for magnetic resonance imaging. *Arch Dis Child*. Feb 2000;82(2):150-3. doi:10.1136/adc.82.2.150
26. Kirsch CFE. Imaging of Sella and Parasellar Region. *Neuroimaging Clin N Am*. Nov 2021;31(4):541-552. doi:10.1016/j.nic.2021.05.010
27. Chaudhary V, Bano S. Imaging of the pituitary: Recent advances. *Indian J Endocrinol Metab*. Sep 2011;15 Suppl 3(Suppl3):S216-23. doi:10.4103/2230-8210.84871
28. American College of Radiology. ACR Appropriateness Criteria® Neuroendocrine Imaging. American College of Radiology. Updated 2018. Accessed November 2, 2021. https://acsearch.acr.org/docs/69485/Narrative/

29. Wu LM, Li YL, Yin YH, et al. Usefulness of dual-energy computed tomography imaging in the differential diagnosis of sellar meningiomas and pituitary adenomas: preliminary report. *PLoS One*. 2014;9(3):e90658. doi:10.1371/journal.pone.0090658
30. Freda PU, Beckers AM, Katznelson L, et al. Pituitary incidentaloma: an endocrine society clinical practice guideline. *J Clin Endocrinol Metab*. Apr 2011;96(4):894-904. doi:10.1210/jc.2010-1048
31. Cunnane MB. Imaging of Tinnitus. *Neuroimaging Clin N Am*. Feb 2019;29(1):49-56. doi:10.1016/j.nic.2018.09.006
32. American College of Radiology. ACR Appropriateness Criteria® Hearing Loss and/or Vertigo. American College of Radiology. Updated 2018. Accessed December 21, 2021. https://acsearch.acr.org/docs/69488/Narrative
33. Krause N, Fink KT, Fink JR. Asymmetric sensorineural hearing loss caused by vestibular schwannoma: Characteristic imaging features before and after treatment with stereotactic radiosurgery. *Radiol Case Rep*. 2010;5(2):437. doi:10.2484/rcr.v5i2.437
34. Verbist BM. Imaging of sensorineural hearing loss: a pattern-based approach to diseases of the inner ear and cerebellopontine angle. *Insights Imaging*. Apr 2012;3(2):139-53. doi:10.1007/s13244-011-0134-z
35. Trojanowska A, Drop A, Trojanowski P, Rosińska-Bogusiewicz K, Klatka J, Bobek-Billewicz B. External and middle ear diseases: radiological diagnosis based on clinical signs and symptoms. *Insights Imaging*. Feb 2012;3(1):33-48. doi:10.1007/s13244-011-0126-z
36. Juliano AF, Ginat DT, Moonis G. Imaging Review of the Temporal Bone: Part II. Traumatic, Postoperative, and Noninflammatory Nonneoplastic Conditions. *Radiology*. Sep 2015;276(3):655-72. doi:10.1148/radiol.2015140800
37. American College of Radiology. ACR Appropriateness Criteria® Tinnitus. American College of Radiology. Updated 2017. Accessed December 21, 2021. https://acsearch.acr.org/docs/3094199/Narrative/
38. Pegge SAH, Steens SCA, Kunst HPM, Meijer FJA. Pulsatile Tinnitus: Differential Diagnosis and Radiological Work-Up. *Curr Radiol Rep*. 2017;5(1):5. doi:10.1007/s40134-017-0199-7
39. Yew KS. Diagnostic approach to patients with tinnitus. *Am Fam Physician*. Jan 15 2014;89(2):106-13.
40. Kann K. Acute Mastoiditis: Pearls and Pitfalls. emDOCs. Updated March 27, 2016. Accessed December 21, 2021. http://www.emdocs.net/acute-mastoiditis-pearls-and-pitfalls/
41. Luntz M, Bartal K, Brodsky A, Shihada R. Acute mastoiditis: the role of imaging for identifying intracranial complications. *Laryngoscope*. Dec 2012;122(12):2813-7. doi:10.1002/lary.22193
42. Patel KM, Almutairi A, Mafee MF. Acute otomastoiditis and its complications: Role of imaging. *Operative Techniques in Otolaryngology-Head and Neck Surgery*. 2014/03/01/ 2014;25(1):21-28. doi:https://doi.org/10.1016/j.otot.2013.11.004
43. Platzek I, Kitzler HH, Gudziol V, Laniado M, Hahn G. Magnetic resonance imaging in acute mastoiditis. *Acta Radiol Short Rep*. Feb 2014;3(2):2047981614523415. doi:10.1177/2047981614523415
44. Gomaa MA, Abdel Karim AR, Abdel Ghany HS, Elhiny AA, Sadek AA. Evaluation of temporal bone cholesteatoma and the correlation between high resolution computed tomography and surgical finding. *Clin Med Insights Ear Nose Throat*. 2013;6:21-8. doi:10.4137/cment.S10681

45. Baráth K, Huber AM, Stämpfli P, Varga Z, Kollias S. Neuroradiology of cholesteatomas. *AJNR Am J Neuroradiol*. Feb 2011;32(2):221-9. doi:10.3174/ajnr.A2052
46. Chen Y, Li P. Application of high resolution computer tomography in external ear canal cholesteatoma diagnosis. *J Otol*. Mar 2018;13(1):25-28. doi:10.1016/j.joto.2017.10.004
47. Hiremath SB, Gautam AA, Sasindran V, Therakathu J, Benjamin G. Cerebrospinal fluid rhinorrhea and otorrhea: A multimodality imaging approach. *Diagn Interv Imaging*. Jan 2019;100(1):3-15. doi:10.1016/j.diii.2018.05.003
48. Vemuri NV, Karanam LSP, Manchikanti V, Dandamudi S, Puvvada SK, Vemuri VK. Imaging review of cerebrospinal fluid leaks. *Indian J Radiol Imaging*. Oct-Dec 2017;27(4):441-446. doi:10.4103/ijri.IJRI_380_16
49. Collins JM, Krishnamoorthy AK, Kubal WS, Johnson MH, Poon CS. Multidetector CT of temporal bone fractures. *Semin Ultrasound CT MR*. Oct 2012;33(5):418-31. doi:10.1053/j.sult.2012.06.006
50. Kennedy TA, Avey GD, Gentry LR. Imaging of temporal bone trauma. *Neuroimaging Clin N Am*. Aug 2014;24(3):467-86, viii. doi:10.1016/j.nic.2014.03.003
51. Lantos JE, Leeman K, Weidman EK, Dean KE, Peng T, Pearlman AN. Imaging of Temporal Bone Trauma: A Clinicoradiologic Perspective. *Neuroimaging Clin N Am*. Feb 2019;29(1):129-143. doi:10.1016/j.nic.2018.08.005
52. Bożek P, Kluczewska E, Misiołek M, Ścierski W, Lisowska G. The Prevalence of Persistent Petrosquamosal Sinus and Other Temporal Bone Anatomical Variations on High-Resolution Temporal Bone Computed Tomography. *Med Sci Monit*. 2016;22:4177-4185. doi:10.12659/msm.898546
53. Muderris T, Bercin S, Sevil E, Cetin H, Kiris M. A potentially catastrophic anatomical variation: aberrant internal carotid artery in the middle ear cavity. *Case Rep Otolaryngol*. 2013;2013:743021. doi:10.1155/2013/743021
54. Muncie HL, Sirmans SM, James E. Dizziness: Approach to Evaluation and Management. *Am Fam Physician*. Feb 1 2017;95(3):154-162.
55. Strupp M, Dieterich M, Brandt T. The treatment and natural course of peripheral and central vertigo. *Dtsch Arztebl Int*. Jul 2013;110(29-30):505-15; quiz 515-6. doi:10.3238/arztebl.2013.0505
56. Quesnel AM, Lindsay RW, Hadlock TA. When the bell tolls on Bell's palsy: finding occult malignancy in acute-onset facial paralysis. *Am J Otolaryngol*. Sep-Oct 2010;31(5):339-42. doi:10.1016/j.amjoto.2009.04.003

ADDITIONAL RESOURCES

1. Abuabara A. Cerebrospinal fluid rhinorrhoea: diagnosis and management. *Med Oral Patol Oral Cir Bucal*. Sep 1 2007;12(5):E397-400.
2. Beck RW, Cleary PA, Anderson MM, Jr., et al. A randomized, controlled trial of corticosteroids in the treatment of acute optic neuritis. The Optic Neuritis Study Group. *N Engl J Med*. Feb 27 1992;326(9):581-8. doi:10.1056/nejm199202273260901
3. FitzGibbon EJ, Wendt S, Feldman BH, et al. Optic Atrophy. American Academy of Ophthalmology. Updated July 17, 2021. Accessed December 21, 2021. https://eyewiki.aao.org/Optic_Atrophy

4. Gala F. Magnetic resonance imaging of optic nerve. *Indian J Radiol Imaging*. Oct-Dec 2015;25(4):421-38. doi:10.4103/0971-3026.169462
5. Kanda T, Miyazaki A, Zeng F, et al. Magnetic resonance imaging of intraocular optic nerve disorders: review article. *Pol J Radiol*. 2020;85:e67-e81. doi:10.5114/pjr.2020.93364
6. Mantur M, Łukaszewicz-Zając M, Mroczko B, et al. Cerebrospinal fluid leakage--reliable diagnostic methods. *Clin Chim Acta*. May 12 2011;412(11-12):837-40. doi:10.1016/j.cca.2011.02.017
7. Pakdaman MN, Sepahdari AR, Elkhamary SM. Orbital inflammatory disease: Pictorial review and differential diagnosis. *World J Radiol*. Apr 28 2014;6(4):106-15. doi:10.4329/wjr.v6.i4.106
~~1. Abuabara A. Cerebrospinal fluid rhinorrhoea: diagnosis and management. *Med Oral Patol Oral Cir Bucal*. Sep 1 2007;12(5):E397-400.~~
~~2. FitzGibbon EJ, Wendt S, Feldman BH, et al. Optic Atrophy. American Academy of Ophthalmology. Updated July 17, 2021. Accessed December 21, 2021. https://eyewiki.aao.org/Optic_Atrophy~~
~~3. Gala F. Magnetic resonance imaging of optic nerve. *Indian J Radiol Imaging*. Oct-Dec 2015;25(4):421-38. doi:10.4103/0971-3026.169462~~
~~4. Kanda T, Miyazaki A, Zeng F, et al. Magnetic resonance imaging of intraocular optic nerve disorders: review article. *Pol J Radiol*. 2020;85:e67-e81. doi:10.5114/pjr.2020.93364~~
~~5. Mantur M, Łukaszewicz-Zając M, Mroczko B, et al. Cerebrospinal fluid leakage--reliable diagnostic methods. *Clin Chim Acta*. May 12 2011;412(11-12):837-40. doi:10.1016/j.cca.2011.02.017~~

Reviewed / Approved by NIA Clinical Guideline Committee

GENERAL INFORMATION

It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.