



HEAD IMAGING GUIDELINES

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MedSolutions, Inc. Clinical Decision Support Tool for Advanced Diagnostic Imaging

Common symptoms and symptom complexes are addressed by this tool. Imaging requests for patients with atypical symptoms or clinical presentations that are not specifically addressed will require physician review. Consultation with the referring physician may provide additional insight.

This version incorporates MSI accepted revisions prior to 7/22/11

2011 HEAD IMAGING GUIDELINES

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ABBREVIATIONS for HEAD GUIDELINES

ACTH	adrenocorticotrophic hormone	AD	Alzheimer's Disease
AIDS	acquired immune deficiency syndrome	ADH	antidiuretic hormone
AION	arteritic ischemic optic neuritis	AVM	arteriovenous malformation
CBCT	Cone-beam computerized tomography		
CMV	cytomegalovirus		
CSF	cerebrospinal fluid	CT	computed tomography
CTA	computed tomography angiography		
DNA	deoxyribonucleic acid		
DWI	diffusion weighted imaging (for MRI)		
EEG	electroencephalogram	ENT	Ear, Nose, Throat
ESR	erythrocyte sedimentation rate		
FDG	fluorodeoxyglucose	FSH	follicle-stimulating hormone
FTD	Frontotemporal Dementia		
GCA	giant cell arteritis	GCS	Glasgow Coma Scale
HIV	human immunodeficiency virus	LH	luteinizing hormone
MMSE	mini mental status examination		
MRA	magnetic resonance angiography		
MRI	magnetic resonance imaging		
MRN	magnetic resonance neurography		
MS	multiple sclerosis	MSI	magnetic source imaging
NAION	non-arteritic ischemic optic neuritis		
NPH	normal pressure hydrocephalus		
PET	positron emission tomography		
PML	progressive multifocal leukoencephalopathy		
PNET	primitive neuro ectodermal tumor		
PWI	perfusion weighted imaging (for MRI)		
SAH	subarachnoid hemorrhage	SLE	systemic lupus erythematosus
SIADH	Syndrome of Inappropriate Antidiuretic Hormone Secretion		
TIA	transient ischemic attack	TMJ	temporomandibular joint disease
TSH	thyroid-stimulating hormone		
VBI	vertebrobasilar	VP	ventriculoperitoneal
XRT	radiation therapy		

2011 HEAD IMAGING GUIDELINES

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HD-1~GENERAL GUIDELINES

- These head imaging guidelines cover a variety of medical conditions and the imaging studies generally appropriate to them. Imaging studies that are not mentioned in conjunction with a particular clinical condition are generally not indicated, but their value will be reviewed on a case by case basis.
- Advanced neuroimaging is only appropriate when there is either evidence of a cranial disorder or a clinically supported reason to search for cranial involvement in a systemic process.
- Prior to considering advanced neuroimaging, patients should undergo a recent detailed history, physical examination, including a neurological examination, appropriate laboratory studies, and a clinical plan relevant to the problem should be documented.
 - Symptoms such as headache and lightheadedness are present in many systemic illnesses--in such a setting; advanced neuroimaging is generally not indicated.
 - **Exception:** One noncontrast brain MRI (CPT[®] 70551) can be performed in patients with persistent, unexplained nausea and vomiting and a negative GI evaluation (see **AB-2 Abdominal Pain, Nonspecific** and **AB-4 Epigastric Pain** for GI evaluation guidelines).
- **HD-1.1 Anatomic Issues**
 - Neuroimaging studies should be directed at the area of clinical interest. If two studies using the same modality both cover the area of clinical interest, only one is generally needed. Certain exceptions are discussed as they arise.
 - **Maxillofacial versus orbital/temporal bone CT:** both orbital CT and maxillofacial CT cover the structures of the orbits, sinuses, and face. Unless there is a grounded suspicion of simultaneous involvement of more posterior lesions, especially of the region involving the middle or inner ear, one of these studies only should be sufficient.
 - **Pituitary Gland:** one study (either brain MRI [CPT[®]70553] or MRI Orbit, Face, Neck [CPT[®] 70543]) is adequate to image the pituitary. The ordering physician should specify that the study is specifically to evaluate the pituitary gland. The use of two CPT[®] codes to image the pituitary is not indicated.
 - **Mandible (jaw):** maxillofacial CT (CPT[®]**70486**, 70488) or neck CT (CPT[®]70490, **70491**, 70492) can be used to image the mandible. Neck CT will also image the

- submandibular space. The use of the two CPT[®] codes to image the mandible is not indicated.
- If MRI is indicated, MRI of orbit, face, neck (CPT[®]70540, 70542, 70543) can be used to image the mandible and submandibular space.
 - MRI of the temporomandibular joint (TMJ) is reported as CPT[®]70336.
- **HD-1.2 Screening**
 - In the well-defined situations listed below, certain advanced neuroimaging studies may be useful in screening. Otherwise, screening is not generally indicated.
 - Screening noncontrast head MRI (CPT[®] 70551) can be performed in first degree relatives (parents, siblings, and children) of patients with known familial cerebral cavernous malformations (cavernomas).
 - Screening for cerebral aneurysm
See [HD-17.2 Intracranial Aneurysms \(saccular or berry aneurysm\)](#)
 - Screening for von Hippel Lindau Disease
See [HD-23.12 von Hippel Lindau Disease](#)
 - Screening in sickle cell disease - See [PACHD-24.6 Sickle Cell Disease](#) in the Pediatric and Congenital Head Imaging Guidelines.
 - Screening based on a family history of a disorder is not appropriate if the disorder is not known to be familial.
 - Screening of asymptomatic individuals using advanced imaging is inappropriate in most circumstances, especially those in which the presence of clinical features is required to make the diagnosis (e.g. multiple sclerosis).
 - **HD-1.3 CT vs. MRI**
 - MRI is usually preferable to CT for brain imaging. However in some situations the difference in value between the two is small.
 - **CT is the initial procedure of choice for the following:**
 - Urgent/emergent settings due to availability and speed of CT
 - Trauma
 - Evaluation for recent hemorrhage, whether traumatic or spontaneous
 - Evaluation of the bony structures of the head
 - Evaluation and follow-up of hydrocephalus
 - In patients dependent on life support
 - CT without contrast (CPT[®]70450) is normally performed prior to lumbar puncture in patients with cranial complaints.
 - On occasion MRI may be substituted. The need for contrast in these MRI studies depends on the clinical setting.
 - In some low yield imaging settings such as dementia in the elderly and headache in patients with normal neurological examinations, CT continues to be useful despite the theoretical superiority of MRI.
 - CT has little role in epilepsy, multiple sclerosis, pituitary disorders, characterization of known tumors, or the evaluation of the late effects of stroke or head trauma.
 - **HD-1.4 Coding Issues**
 - **Brain PET:** should be reported as metabolic brain PET (CPT[®]78608).
 - **Echoencephalography** is reported as CPT[®]76506

- Echoencephalogram (CPT®76506) is an ultrasound study primarily performed on a child or infant less than 12 to 14 months of age. It is used to determine intracranial pathology such as intracranial hemorrhage, fluid collections, masses, or other structural abnormalities.
- **Transcranial Doppler Study**
 - **CPT®93886** Transcranial Doppler study of the intracranial arteries; complete study
 - **CPT®93888** Transcranial Doppler study of the intracranial arteries; limited study
 - **CPT®93890** Transcranial Doppler study of the intracranial arteries; vasoreactive study
 - **CPT®93892** Transcranial Doppler study of the intracranial arteries; emboli detection without intravenous microbubble injection
 - **CPT®93893** Transcranial Doppler study of the intracranial arteries; emboli detection with intravenous microbubble injection
 - These studies are most often performed in an inpatient setting
 - **Requests for these studies should be sent for Medical Director review**
- **HD-1.5 References**
 - Yousem DM, Grossman RI. *Neuroradiology, the requisites*. 3rd Ed. Philadelphia, Mosby, 2010
 - Latchaw RE, Kucharczyk J, MoseleyME. *Imaging of the Nervous System*. Philadelphia, Elsevier, 2005
 - Rowland LP (Ed.). *Merritt's Neurology*. 12th Ed. Philadelphia, Lippincott, 2010
 - Menkes JH, Sarnat HB, Maria BL. *Child Neurology*. 7th Ed. Philadelphia, Lippincott, 2006

2011 HEAD IMAGING GUIDELINES

HD-2~CONTRAST USE IN HEAD IMAGING

- **HD-2.1 Contrast in CT:** Head CT is normally performed without contrast **except** in certain situations in which it is being used as a necessary alternative to MRI: e.g. evaluating tumor, abscess, or the pituitary gland in patients who cannot have MRI.
 - **In these guidelines, head CT is without contrast (CPT®70450) unless otherwise specified.**
 - **Sinus CT (CPT®70486) and temporal bone CT (CPT®70480)** are generally performed without using contrast. Exceptions are noted in the appropriate locations below.
 - The iodide contrast used in CT reveals breakdown of the blood brain barrier and shows vasculature.
 - Mass effect, blood/blood products, and abnormal tissue are shown on noncontrast CT.
 - In patients who can have MRI, any abnormality on noncontrast CT is almost always better evaluated by MRI rather than CT with contrast.
 - MRI done in follow-up of an abnormal CT finding is usually done without and with contrast.
 - Contrast only head CT (CPT®70460) has almost no indications.
 - Unless there has been a noncontrast CT done within a few days with abnormal results (but see the comments above), such requests are almost always made in error (i.e. the request for “CT with contrast” should be interpreted as without and with contrast [CPT®70470]).
 - Neurologists, neurosurgeons, ENT specialists and ophthalmologists should have the option of not using contrast when they believe it to be unnecessary.
- **HD-2.2 Contrast in Brain MRI**
 - MRI is done without contrast to find masses, simple infarcts, anatomical abnormalities, and blood or blood products. Otherwise, contrast is often useful
 - MRI contrast (Gadolinium) also shows breakdown of the blood brain barrier (including inflammation), displays blood supply to advantage in certain setting, reveals contrast patterns which make a number of lesions easier to characterize, and can visualize the meninges when this is needed. It often helps to characterize posterior fossa lesions and to characterize known masses.
 - Contrast only MRI (CPT®70552) is “never” ordered in the head except to follow-up a very recent noncontrast study (within one to two weeks at most). Otherwise, requests for brain MRI with contrast only are almost always made in error and should be coded as without and with contrast (CPT®70553). Neurologists, neurosurgeons, ENT specialists and ophthalmologists should have the option of not using contrast when they believe it to be unnecessary.
 - **References:**
 - Yousem DM, Grossman RI *Neuroradiology, the requisites*. 3rd Ed. Philadelphia, Mosby, 2010
 - Latchaw RE, Kucharczyk J, Moseley ME. *Imaging of the Nervous System*. Philadelphia, Elsevier, 2005
 - Rowland LP (Ed.). *Merritt's Neurology*. 12th Ed. Philadelphia, Lippincott, 2010

- Menkes JH, Sarnat HB, Maria BL. *Child Neurology*. 7th Ed. Philadelphia, Lippincott, 2006

2011 HEAD IMAGING GUIDELINES

HD-3~CT and MR ANGIOGRAPHY and VENOGRAPHY

- Indications for CT and MR angiography and venography are well defined, and it is inappropriate to request these studies as simply an “add-on” to head CT or brain MRI without clinical information that supports performing the angiography or venography studies.
- **CT and MR Angiography: (CTA and MRA):** These have been regarded as equivalents, but for most uses, CTA seems to be somewhat superior. For *many* purposes, but not all, CTA has replaced catheter angiography.
 - CT angiography of head or neck is often ordered to resolve uncertainties identified on MRA of those regions, and this is acceptable.
 - **Head MRA in these guidelines means without contrast (CPT®70544).**
 - Head MRA is generally done without contrast (CPT®70544). Some cerebrovascular experts prefer contrast MRA (CPT®70545) to evaluate certain strokes and AVM’s and to follow known aneurysms, but for technical reasons, the addition of contrast usually has little to offer.
 - Requests for head MRA with contrast (CPT®70545) from neuro specialists are acceptable.
 - In patients with documented marked reduction in cardiac output, head MRA with contrast (CPT®70545) may be useful to improve image quality.
 - **There are no generally recognized indications for head MRA without and with contrast (CPT® 70546).**
 - MRA of the neck vessels is usually done with contrast only (CPT®70548), and ‘Cervical MRA’ “or neck MRA” in these guidelines refers to contrast only MRA (CPT® 70548) unless otherwise indicated.
 - Some specialists use noncontrast MRA of the cervical vessels (CPT®70547) and this is acceptable when specifically requested.
 - A reasonable suspicion of carotid or vertebral dissection is the only indication for performing cervical MRA without and with contrast (CPT®70549).
 - **References:**
 - Yousem DM, Grossman RI. *Neuroradiology, the requisites*. 3rd Ed. Philadelphia, Mosby, 2010
 - Latchaw RE, Kucharczyk J, Moseley ME. *Imaging of the Nervous System*. Philadelphia, Elsevier, 2005
 - Rowland LP (Ed.). *Merritt’s Neurology*. 12th Ed. Philadelphia, Lippincott, 2010
 - Menkes JH, Sarnat HB, Maria BL. *Child Neurology*. 7th Ed. Philadelphia, Lippincott, 2006
- **CT and MR Venography (CTV and MRV):**
 - The same CPT® codes that are used for CTA are also used for CTV.
 - The same CPT® codes that are used for MRA are also used for MRV.
 - If both arterial and venous CT or MR are performed in the same sitting, only ONE CPT® code should be used to report both procedures.
 - For example, CTA of the head and CTV of the head done during the same sitting should be reported with one procedure code (CPT®70544)

2011 HEAD IMAGING GUIDELINES

HD-4~SCREENING for METALLIC FRAGMENTS

- The use of orbital CT to rule out orbital metallic fragments prior to MRI is rarely necessary: Plain x-rays are generally sufficient. X-ray detects fragments of 0.12 mm or more; CT, those of 0.07 mm or more.*
 - **References:**
 - [*Am J Neuroradiol* 2000;21:245–247](#)
 - [*Am J Neuroradiol* 2000;21:426–433](#)
 - [*ACR Guidance Document for Safe MR Practices, 2007, p.5.*](#)
www.acr.org/SecondaryMainMenuCategories/quality_safety/MRSafety/safe_mr07.aspx. Accessed May 16, 2011
- Plain x-ray is sufficient to determine the presence of a cerebral aneurysm clip. Head CT is not indicated.
 - Neither plain x-ray nor head CT can give information as to whether an aneurysm clip is non-ferromagnetic (safe for MRI) or not.

HD-5~ANOSMIA and DYSGEUSIA

- Unilateral anosmia of unknown origin suggests the presence of a tumor of the olfactory groove (esp. meningioma). Brain MRI without and with contrast (CPT[®]70553) is appropriate.
- Bilateral anosmia is generally a consequence of trauma or of olfactory damage from an otherwise banal viral infection. However, because of the fear of anterior basal tumor, brain MRI without and with contrast (CPT[®]70553) is acceptable in patients in whom the history is uncertain.
- Maxillofacial (sinus) CT (CPT[®]70486) may be of value if anosmia occurs in the setting of sinus or facial bone disorders.
- MRA/CTA Head and/or Neck are not appropriate in the initial evaluation of patients with anosmia.
 - If brain MRI results suggest a cerebrovascular abnormality, then head MRA, without contrast, (CPT[®]70544) or head CTA (CPT[®]70496) can be performed.
- The use of 3D rendering in conjunction with MRI or CT is generally unnecessary in these cases.
- Anosmia is frequently found in patients with dementia. In such cases, the advanced imaging studies appropriate for the dementia itself are generally sufficient.
- Dysgeusia (loss of taste without loss of smell) is uncommon and often reflects brain stem disease. Brain MRI without and with contrast (CPT[®]70553) is indicated unless the symptom is seen as a part of Bell's palsy (see [HD-9 Facial Palsy](#)).

2011 HEAD IMAGING GUIDELINES

HD-6~ATAXIA

- **Adults:**

- Differential diagnosis of ataxia includes:
 - alcoholic cerebellar degeneration
 - drugs/toxins
 - Multiple sclerosis (MS)
 - stroke
 - posterior fossa mass
 - sporadic cerebellar degenerations
 - dominantly or recessively inherited cerebellar degenerations
 - “normal pressure hydrocephalus” (NPH) see also [HD-13 Dementia](#)
 - paraneoplastic subacute cerebellar degeneration.
- Cervical spinal disorders and sensory ataxia from large fiber polyneuropathy cause “sensory ataxia” and must at times be considered.
- Noncontrast brain MRI (CPT[®] 70551) is most often the appropriate imaging study, but MRI without and with contrast (CPT[®] 70553) is reasonable when tumor or MS is being considered.
 - If stroke is a primary consideration, either brain MRI (CPT[®]70551 or 70553) or head CT (CPT[®]70450 or CPT[®]70470) can be performed.
- In patients with suspected paraneoplastic subacute cerebellar degeneration, chest x-ray and/or chest CT (CPT[®]71260) are also appropriate because of the connection to small cell lung tumors.
- Detailed neurological history and recent clinical examination are indicated prior to selection of neuroimaging in the evaluation of ataxia.
- Neurological consultation is helpful in determining the appropriate imaging pathway.
- **Cervical Spine Imaging:** in both adults and children, MRI of the cervical spine (CPT[®]72141 or CPT[®]72156) is appropriate when no etiology for the ataxia has been discovered after other evaluation.
- **Reference:**
 - *ACR Appropriateness Criteria, Ataxia 2009*

HD-7~BEHAVIORAL DISORDERS IN ADULTS

- **Autism:** See [PACHD-4 Autism and Autism Spectrum Disorders](#)
- **Panic attacks, anxiety states, and obsessive compulsive disorder**
 - Advanced neuroimaging is not generally indicated for the usual manifestations of these disorders.
- **Characterologic disorders**
 - Advanced neuroimaging is not generally indicated in patients evaluated or treated for character disorders or sociopathic behavior unless there is a specific indication beyond that disorder or the range of behavior associated with it.
- **Bipolar disorder, schizophrenia, and related disorders**
 - Advanced neuroimaging is not generally required in these disorders.

- In patients who fail to respond to treatment in the expected manner or who manifest features suggestive of an organic brain disorder, noncontrast head MRI (CPT[®]70551) or CT (CPT[®]70450) may be appropriate.
 - Detailed psychiatric and neurological examinations are appropriate prior to considering advanced imaging.
 - Neurology or Psychiatry consultation is helpful in determining the need for advanced imaging.
- **Memory loss in young or middle aged adults**
 - This is most commonly a symptom of depression in the absence of other neurological/neuropsychological abnormalities or of substantial head trauma.
 - Advanced imaging is not indicated unless the patient has failed to respond to an adequate trial of anti-depressant treatment nor has cognitive or neurological abnormalities discovered on detailed neurological/neuropsychological examination.
 - Neurology or Psychiatry consultation is helpful in determining the need for advanced imaging.
 - Acute confusional states in individuals over age 60 often arise from structural lesions. Initial head CT without contrast (CPT[®]70450) or brain MRI, contrast as requested, is reasonable in such cases.
- **References:**
 - Ropper AH and Brown RH. *Adams and Victor's Principles of Neurology*. 8th Ed. New York, McGraw-Hill, 2005, pp.1285-1332
 - Rowland LP (Ed.). *Merritt's Neurology*. 12th Ed. Philadelphia, Lippincott, 2010, pp.1053-1075

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HD-8~CHIARI AND SKULL- BASE MALFORMATION

- **HD-8.1 Chiari Malformation:** (properly Chiari I; formerly called Arnold-Chiari) is location of the cerebellar tonsils at least 5 mm below the foramen magnum.
 - Most patients have no or very vague symptoms and diagnosis is usually made unexpectedly on a head MRI done for other purposes.
 - A significant minority of these patients have an associated syringomyelia or hydromyelia.
 - A small number have hydrocephalus.
 - Noncontrast brain MRI (CPT[®]70551) is appropriate if not already performed.
 - If the Chiari malformation has been identified, noncontrast MRI cervical spine (CPT[®]72141), with or without also performing MRI thoracic spine (CPT[®]72146) is recommended to exclude syrinx.
 - Follow-up spinal MRI without and with contrast (CPT[®]72156, with or without CPT[®]72157) will be needed if hydro/syringomyelia is seen. (See **SP-15 Syringomyelia** in the Spine Imaging guidelines).
 - Spinal CT is inferior to spinal MRI in the evaluation of syringomyelia.
 - MRA and CTA of either head or neck are not generally indicated in the evaluation of syringomyelia unless ordered by the operating surgeon for preoperative planning.
 - Once the diagnosis has been established by MRI, repeat brain MRI is generally appropriate only in patients with increasing symptoms or signs, or as a preoperative study.
 - CSF flow studies may be appropriate in selected patients with evidence of hydrocephalus (See [HD-34.5 CSF Flow Imaging](#)), but the coverage policy of the involved health plan regarding this study should be consulted.
 - Chiari malformation is not itself familial and family screening is not appropriate.
 - Chiari II, III, and IV are very rare and involve much more extensive malformations at all levels of the neural axis which are not further discussed in these guidelines.
- **HD-8.2 Skull-Base Malformations**
 - **Platybasia** is a malformation of the skull base: the clivus is too horizontal.
 - Symptoms are not frequent, but noncontrast brain MRI (CPT[®]70551) or CT (CPT[®]70450) is appropriate if a case comes to notice.
 - **Basilar impression** involves malformation of the occipital bone in relation to C1/2.
 - The top of the spinal cord is inside the posterior fossa and the foramen magnum is undersized which can lead to brain stem and upper spinal cord compression over time.

- Can be associated with the Chiari malformation, producing very complex anatomical abnormalities.
- Noncontrast brain MRI (CPT®70551) and cervical spine MRI (CPT®72141) are appropriate.
 - If surgery is being considered, noncontrast head and cervical spine CT scans (CPT®70450 and CPT®72125) can be performed.
- Basilar impression appears to be partly genetic, and screening of first degree relatives with noncontrast brain MRI (CPT®70551) may be appropriate.
- **HD-8.3 Reference:**
 - Menkes JH, Sarnat HB, Maria BL. *Child Neurology*. 7th Ed. Philadelphia, Lippincott, 2006, pp.306-307

CRANIAL NERVE (CN) PROBLEMS

HD-9~FACIAL PALSY (BELL'S PALSY)

- **Facial Palsy:** acute facial weakness from peripheral lesions of the Facial nerve (CN VII) is common.
 - Facial weakness can arise from stroke or other brain lesion (“central” weakness) but this weakness very rarely involves the forehead muscles. In contrast, the hallmark of peripheral palsies is that they do include forehead weakness.
 - With only mild weakness, it may be hard to tell the two apart.
 - In peripheral palsies, taste and tearing on the side of weakness may be affected.
 - **Bell's Palsy:** Most cases of peripheral facial palsy are of unknown cause (Bell's Palsy) and recurrences are not typical.
 - Ear, temporal, mastoid, and facial pain are commonly seen in Bell's palsy. This helps to confirm the diagnosis and is not an indication for imaging.
 - Patients often complain that the involved side of the face feels numb, but objective sensory loss, if reproducible and anatomical, suggests another diagnosis.
 - Imaging is generally unnecessary in a first episode of peripheral facial palsy in an otherwise healthy patient. Imaging may show either swelling or enhancement of the facial nerve in the canal, but neither finding will influence management.
 - The presence of a complete vs. partial facial paralysis in patients with Bell's palsy affects prognosis for recovery, but does not affect the indications for advanced imaging.
 - **Brain MRI without and with contrast (CPT[®]70553) is appropriate in the following:**
 - If the patient has failed to show improvement by six weeks from onset
 - Patients who manifest visible hemifacial spasm at onset
 - Recurrent cases
 - Brain MRI (contrast as requested) can be performed in patients in whom a clinical distinction between peripheral and central facial weakness cannot be made reliably.
- **Other Facial Palsies:**
 - Facial palsy can arise from HIV infection, Lyme disease, zoster infection of CN VII, parotid tumors, or the Guillain-Barré syndrome (usually bilateral in the last).
 - Recurrent facial palsy can arise from sarcoidosis, the Melkerson-Rosenthal syndrome, or Sjögren's syndrome.
 - Such cases are not properly called Bell's palsy, and their evaluation depends on the nature of the underlying disease.
- **Reference:**
 - *N Engl J Med* 2004;351:1323-1331

CRANIAL NERVE (CN) PROBLEMS

HD-10~RECURRENT LARYNGEAL PALSY

- **Recurrent laryngeal palsy** (unilateral vocal cord palsy): the patient presents with a breathy hoarseness and the weakness is seen on laryngoscopy.
 - The term “vocal fold” is a synonym for “vocal cord.”
 - The involved nerve is the recurrent laryngeal branch of the vagus (CN X).
- **Etiology:**
 - Surgical injury to the nerve (e.g. thyroid surgery, carotid endarterectomy, anterior cervical spinal fusion, chest operations)
 - When no cause is apparent, many cases are idiopathic (post-viral), but it is necessary to exclude tumors (skull base, lungs, esophagus, metastatic disease).
 - Imaging of the entire course of the ipsilateral recurrent laryngeal nerve is appropriate, either by contrast only CT or (less often) by MRI without and with contrast. This course differs between the sides:
 - **Left:** skull base to mid-chest (neck and chest CT with contrast-- CPT[®]70491 and CPT[®]71260—not cervical-spine)
 - **Right:** skull base to clavicle (neck soft tissue CT with contrast CPT[®]70491).
 - Brain imaging is not usually required since central involvement of a vagus nerve can generally be clinically distinguished from pure recurrent laryngeal palsy, but there are situations when it is needed (upper vagus weakness).
- **References:**
 - *Otolaryngol Clin N Am* 2004;37:25-44
 - *Otolaryngol Clin N Am* 2004;37:45-58

CRANIAL NERVE (CN) PROBLEMS

HD-11	DIPLOPIA	
11.1	Diplopia	18
11.2	Internuclear Ophthalmoplegia	18
11.3	Abducens Nerve (CN VI) Palsies	18
11.4	Trochlear Nerve (CN IV) Palsies	19
11.5	Oculomotor Nerve (III) Palsies	19

HD-11~DIPLOPIA

- **HD-11.1 Diplopia:** double vision with both eyes open (binocular).
 - Monocular diplopia reflects ocular disorders (dislocated lens or retinal detachment).
 - This guideline addresses binocular diplopia.
 - **Variable and inconsistent diplopia:** neuromuscular diseases, esp. myasthenia gravis, should be considered before neuroimaging.
 - Cranial nerve disorders (III, IV, and VI): See below.
- **HD-11.2 Internuclear Ophthalmoplegia:** when looking to one side, the out-turning (abducting) eye turns as it should, but the other eye does not turn in (adduct).
 - In older patients, this usually indicates a pontine stroke (See [HD-30.1 Vertebrobasilar Ischemia](#)).
 - In younger patients, it is a classic feature of MS.
 - About 25% of cases are from other causes (trauma, transtentorial herniation, tumor, infection, hemorrhage, and vasculitis).
 - Brain MRI is appropriate. CT is inadequate.
 - The need for contrast depends on the clinical setting (mostly age), but MRI either without contrast (CPT®70551) or without and with contrast (CPT®70553) can be performed.
 - **Reference:**
 - *Arch Neurol* 2005;62:714-717
- **HD-11.3 Abducens Nerve (CN VI) Palsies:** CN VI supplies the lateral rectus muscle which abducts the eye. VIth nerve palsies present with horizontal binocular diplopia worse when looking toward the involved side.
 - Ophthalmology or Neurology consultation is helpful in formulating the differential diagnosis, which affects choice of imaging studies.
 - Pure abducens palsies are common after trauma and as a so-called false localizing sign with increased intracranial pressure.
 - Abducens palsies can also occur with intracranial inflammatory disorders (sarcoidosis, MS, Lyme disease, non-viral meningitis) and from tumors in the region of the cavernous sinus.
 - Most abducens palsies, especially in the elderly, are “idiopathic,” probably from tiny infarcts of the nerve itself. These tend to resolve over a few months.

- There is no strong association with diabetes as there is with CN III nerve palsies although abducens palsies appear to be more common in diabetics.
- MRI of the brain without and with contrast (CPT[®]70553) is the usual investigation. **The tiny peripheral infarcts mentioned above are far too small for MRA or CTA to be useful.** This is small vessel disease outside the brain.
 - Lesions around the cavernous sinus may be difficult to see on routine head MRI and at least a 1.5T brain MRI without and with contrast (CPT[®]70553) with special attention to the area may be needed when such lesions are suspected.
- **HD-11.4 Trochlear Nerve (CN IV) Palsies:** CN IV supplies the superior oblique muscle which intorts the adducted depressed eye in near vision (while reading, for example).
 - Most CN IV palsies are post-traumatic.
 - Patients have minimal vertical diplopia which they often correct by tilting the head.
 - Imaging is usually performed to evaluate associated brain or eye trauma or when the expected improvement fails to occur within a few months.
- **HD-11.5 Oculomotor Nerve (III) Palsies:** CN III innervates the pupil, the levator of the upper lid, and all of the extraocular muscles except the lateral rectus and superior oblique.
 - Painful extra-ocular palsies are discussed in [HD-17.2 Intracranial Aneurysms \(saccular or berry aneurysm\)](#) and their presence influence all CN III nerve evaluations.
 - In a full-blown CN III palsy, the upper lid is closed, the pupil is fully dilated and fixed (“blown”), and all motions but abduction are absent.
 - The pattern of a partial oculomotor palsy may indicate an intra-orbital lesion. In this circumstance, orbital MRI or CT (contrast as requested) may be appropriate, rather than brain imaging.
 - Diabetics are prone to microvascular infarctions causing a third nerve palsy which typically spares the pupil. These generally resolve over about 4-6 months.
 - Those physicians who do not routinely image these “pupil sparing IIIrd nerve palsies” will image those which fail to resolve using brain MRI without and with contrast (CPT[®]70553) and brain MRA (CPT[®]70544) or head CTA (CPT[®]70496).
 - The sympathetic innervation of the eye travels with CN III but is discussed separately (see [HD-37 Horner’s Syndrome](#)).

CRANIAL NERVE (CN) PROBLEMS

HD-12~PUPILLARY DISORDERS

- Examination of the pupils may show abnormalities of no significance following iridectomy or other surgery involving the iris.
- **Mild Isolated Anisocoria:**
 - Evaluation should start with old photographs, since up to about 1 mm of anisocoria is common in the normal population.
 - Evaluation of old photographs is not needed if the asymmetry is >1mm.
 - In patients with mild isolated anisocoria, it may be necessary to obtain full ophthalmologic or neurological evaluation to determine which is the abnormal side.
- **Adie's (tonic) Pupil:** an apparently fixed and dilated pupil in an otherwise normal patient. Accommodation to near remains, and there is no pain.
 - Imaging is generally unnecessary since the diagnosis can be established clinically in most cases.
 - In time these pupils become smaller than their mate.
 - Absent ankle jerks are common in these patients.
- **A dilated pupil with pain or neurological findings** must be assumed to reflect CN III nerve disease. See the following guidelines:
 - [HD-11 Diplopia](#)
 - [HD-17 Hyperacute Headache](#)
 - [HD-16.2 Migraine and Tension Headaches, under "Complex Migraine"](#)
 - Unless the cause is already known, brain MRI without and with contrast (CPT[®] 70553), and brain MRA (CPT[®]70544) or CTA (CPT[®]70496) are appropriate.
 - If the dilatation is isolated or if any accompanying IIIrd nerve palsy is partial, orbital MRI without and with contrast (CPT[®] 70543) can also be performed.
- **Small Pupil:** the differential diagnosis is Horner's syndrome, "little old Adie's", and normal variation (if <1 mm difference).
 - Also see [HD-37 Horner's Syndrome](#)

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HD-13~DEMENTIA

- **HD-13.1 Diagnosis:** The diagnosis of dementia is established clinically.
 - Neuropsychological evaluation is necessary, whether by mini mental status examination (MMSE or Folstein exam), by formal neuropsychological testing, or by less formal mental evaluation often used by neurologists, psychiatrists, or gerontologists.
 - Recent full neurological examination as part of the physical examination is also appropriate initially.
 - A raw MMSE (Folstein) cut-off score of <25 is a specific but insensitive measure of dementia (65% sensitivity), and scores should be adjusted for the patient's background rather than looked at rigidly.
 - A score ≥ 2 points below expected is significant (e.g. a score of 28 is very abnormal for a former college professor).
 - Advanced neuroimaging is used chiefly to exclude an unexpected brain tumor or subdural hematoma.
 - Either noncontrast head CT (CPT[®]70450) or noncontrast brain MRI (CPT[®]70551) is generally sufficient.
 - MRI has the advantage of superior evaluation for multi-infarct states and subcortical white matter diseases and is strongly preferable when those diagnoses are being considered.
- **HD-13.2 Normal Pressure Hydrocephalus**
 - The extremely rare syndrome called normal pressure hydrocephalus is really a differential diagnosis of gait ataxia. No controlled studies have shown intellectual benefit from shunting.
 - Candidates for the diagnosis should undergo noncontrast brain MRI (CPT[®]70551), but there is no agreement on the need for further imaging.

- **HD-13.3 Dementia in the Elderly**
 - Depression can masquerade as dementia.
 - Separate neuropsychological testing for depression may be necessary in some cases prior to consideration of neuroimaging, although a large minority of these patients have both diagnoses.
- **HD-13.4 Premature Dementia**
 - Alzheimer's Disease is rare before age 60, and brain MRI, contrast as requested (but not CT) can be obtained.
- **HD-13.5 Mild Cognitive Impairment, Including Isolated Memory Problems**
 - The value of advanced imaging in such patients with an otherwise normal examination has not been established.
 - A detailed neurological and neuropsychological examination should precede neuroimaging. If significant memory loss or cognitive impairment is found on such an evaluation, noncontrast head CT (CPT®70450) or brain MRI (CPT®70551) can be performed.
- **HD-13.6 Follow-up of Known Cases of Dementia**
 - Clinical and neuropsychological re-evaluation should be performed.
 - Repeat imaging studies performed solely to document the progression of dementia are not appropriate
- **HD-13.7 Screening**
 - The use of advanced neuroimaging to screen neurologically normal patients for dementia is inappropriate.
- **HD-13.8 Reference**
 - *Neurology* 2001;56:1143-1153
- **HD-13.9 PET in Dementia**
 - PET scanning for dementia should be reported as metabolic brain PET (CPT®78608).
 - The established role of PET is limited to differentiating Alzheimer's Disease (AD) from Frontotemporal Dementia (FTD).
 - **Candidates for PET should have:**
 - a clinical history of confirmed dementia involving more than one area of mental dysfunction present for at least six months
 - a non-diagnostic head CT or brain MRI
 - a neuropsychological profile which fulfills the diagnostic criteria for BOTH AD and FTD
 - Note that the rare entity of semantic dementia or progressive aphasia can be a manifestation of either FTD or AD, so such patients are candidates for PET.
 - PET cannot be used reliably to distinguish Lewy body dementias from AD.
 - Consultation with a neurologist or other dementia specialist is helpful in determining the need for PET and is required by CMS prior to PET.

- **References:**
 - Medicare National Coverage Determination Manual. Ch 1, Part 4: coverage determinations. 220.6.13, 2004. revised 2009.
http://www.cms.gov/manuals/downloads/ncd103c1_Part4.pdf. Accessed June 13, 2011
 - Fed. Reg 70 (197) Oct 13, 2005
 - Ann Neuro 2006;59:156-165
- **Repeat PET (initial study positive):**
 - There is no indication to repeat PET when a prior study was diagnostic.
 - PET cannot reliably be used to follow the progression of dementia. Clinical evaluation should be performed.
- **Repeat PET (initial study nondiagnostic):**
 - May be of value when the patient has shown progressive dementia which has remained clinically uncharacterized for two years since the initial PET. This is a rare situation.
- **PET in mild cognitive impairment:**
 - The term mild cognitive impairment refers to a loss of function limited to one area of mentation, most commonly memory loss in the elderly.
 - PET is not indicated; a normal PET in that setting is 98% accurate in predicting the absence of underlying dementia, but the 15% rate of false positives with PET is unacceptably high.*
*Silverman DH, dir., *Neurologic PET: expanding neurology, 2005. Society of Nuclear Medicine.* Silverman DH, *Using clinical brain PET for evaluation of dementia.*

2011 HEAD IMAGING GUIDELINES

HD-14~ADULT EPILEPSY/SEIZURE

- The diagnosis of epilepsy is essentially a clinical one and has immense medical, economic and social consequences to the patient. Neurological consultation to avoid misdiagnosis of epilepsy is very often in the patient's best interest.
 - In patients suspected of having seizures, a detailed history and neurological examination, including accounts of witnesses to the event when possible, is appropriate prior to consideration of imaging.
 - No imaging study can determine the presence or absence of seizures or of epilepsy.
 - **Postictal paralysis or aphasia (Todd's palsy):**
 - The clinical distinction between a TIA or minor stroke and postictal palsy can be difficult and advanced imaging to rule out TIA/stroke may be necessary in this situation. (See [HD-29 General Stroke/TIA](#)).
- Head CT is of limited use in establishing the source of epilepsy and it is not generally appropriate unless MRI is impossible.
 - **Reference:**
 - [Neurology 2007;69:1772-1780](#)
- Brain MRI without and with contrast (CPT[®]70553) is generally the appropriate study in the initial evaluation of new onset seizures in adults.
 - Noncontrast brain MRI (CPT[®]70551) is sufficient when cerebral anatomic malformations are suspected.
- Brain MRI (contrast as requested) is also appropriate for many patients with recurrent intractable epilepsy.
- MRA/CTA of the head and neck are generally not indicated in the evaluation of epilepsy unless an arteriovenous malformation (AVM) has been seen on MRI or there are documented clinical reasons to suspect stroke as the etiology of the seizures (See [HD-29 General Stroke/TIA](#)).
- If an AVM is found on MRI, head and neck MRA (typically CPT[®]70544 and CPT[®]70548) or head and neck CTA (CPT[®]70496 and CPT[®]70498) are indicated unless catheter angiography is planned.
 - If the initial MRI was done without contrast, MRI with contrast (CPT[®]70552 or CPT[®]70553) can be performed.
- Repeat brain MRI (contrast as requested) may be approved for **surveillance** after 1 to 2 years of treatment for epilepsy, especially if the seizures are not under complete control.
 - Further surveillance should be every 3-5 years unless there is a specific indication.
- Repeat MRI brain studies may also be indicated in the setting of an unexplained sustained increase in seizure frequency, change in seizure type, or the appearance of new neurological findings.
 - Evaluation of medication changes and the possibility that anticonvulsant doses have become inadequate should be addressed prior to considering repeat MRI.
 - The occurrence of one to a few breakthrough seizures in an established epileptic is not generally an indication for re-imaging.
- It is not necessary to repeat imaging before making the decision to withdraw anticonvulsant medications.*

**American Academy of Neurology Practice Parameter:*

A guideline for discontinuing antiepileptic drugs in seizure free patients, 1996.
<http://www.aan.com/professionals/practice/pdfs/gl0007.pdf>. Accessed June 13, 2011

- **Epilepsy Surgery and Intractable Epilepsy:**
 - PET (CPT[®]78608) can be performed in patients with intractable seizures who are actively being considered for a surgical procedure.
 - Since this is done to aid in selection of potential epilepsy surgical candidates, such patients will be under the care of a neurologist or other epileptologist.
 - **Reference:**
 - *Neurology* 2003;60:538-547 Re-affirmed 10-15-2005
- **Reference:**
 - Bazil CW, Morrell MJ, Pedley TJ. *Epilepsy*. In Rowland LP (Ed.). *Merritt's Neurology*. 12th Ed. Philadelphia, Lippincott, 2010, pp. 927-928

HD-15~FACIAL PAIN/TRIGEMINAL NEURALGIA

- Because of the complex differential diagnosis, difficulty with obtaining precise history which seems to be unique to this condition, and need for detailed examination, specialist consultation (ENT, neurology, or ophthalmology) is helpful prior to consideration of advanced imaging for facial pain.
- When the diagnosis of tic douloureux (or its IX or VII nerve variants) has been confirmed, brain MRI without and with contrast (CPT[®]70553) with special attention to the skull base, is appropriate.*
 - **Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2001;92:424-429
- In patients with tic douloureux who have failed medical therapy and who are being considered for posterior fossa decompressive procedures, head MRA (CPT[®]70544) or CTA (CPT[®]70496) may be useful.
 - Specialist evaluation is helpful in determining the need for imaging since these imaging studies are essentially preoperative studies.
- In cases of trigeminal neuralgia which involve the ophthalmic nerve, (peri-orbital or forehead pain), once herpetic neuralgia has been excluded, orbital MRI without and with contrast (CPT[®]70543) may also be appropriate.
- The differential diagnosis of atypical facial pain is extensive, complex, and difficult, and there is considerable case-to-case variation in optimal imaging pathway. Both brain and facial imaging may be of value in a given case.
 - Specialist consultation is helpful prior to selection of advanced imaging studies in these cases.

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HD-16~HEADACHE, ADULT

- Accurate diagnosis of a headache problem is mainly achieved by detailed history combined with careful neurological and physical examination.
 - The vast majority of adults with headache will receive no benefit from advanced neuroimaging.
 - **Exception:** Features associated with headache that raise the likelihood of a significantly abnormal imaging study include the following:
 - ❖ Abnormal neurological findings on examination
 - ❖ Hyperacute onset of headache such as thunderclap headache (see [HD-17.2 Intracranial Aneurysms \(saccular or berry aneurysm\)](#))
 - ❖ Associated head trauma (see [HD-18 Head Trauma](#))
 - ❖ Cluster headache (see [HD-16.4 Cluster Headache](#))
- Headache is a common symptom of acute systemic infections. In the absence of either meningeal neck stiffness or abnormal neurological findings on examination, advanced neuroimaging is not generally indicated in this setting.
- **HD-16.1 New Onset Headaches**
 - A thorough headache history and careful neurological and physical examination should be performed initially.
 - If there are no “**Indications for imaging prior to a trial of treatment**” (see below), a four week trial of symptomatic management, including both prophylactic and abortive treatment, should be performed prior to considering advanced imaging.
 - **Indications for imaging prior to a trial of treatment:**
 - Abnormal focal findings on neurological examination. Brain MRI, contrast as requested, is preferred
 - Note that dizziness, non-specific blurry vision, migraine auras, lightheadedness (near syncope), and numbness are **not** focal findings
 - Mental status changes not arising from medication use and confirmed on examination. Brain MRI, contrast as requested, or noncontrast head CT (CPT®70450) can be performed.
 - Ataxia or impaired coordination confirmed on neurological examination. Brain

- MRI, contrast as requested can be performed.
- Papilledema (see [HD-24 Papilledema/Pseudotumor Cerebri](#))
- Thunderclap onset (see [HD-17.2 Intracranial Aneurysms \(saccular or berry aneurysm\)](#))
- New diagnosis of cluster headache. Brain MRI without and with contrast (CPT®70553) can be performed (see [HD-16.4 Cluster Headache](#))
 - **NOTE:** “Cluster migraine” is most likely migraine rather than cluster headache
- Current use of anticoagulants (Plavix®, warfarin/Coumadin®, dabigatran/Pradaxa®, heparin, or heparinoids). Noncontrast head CT (CPT®70450) is preferred, but noncontrast brain MRI (CPT®70551) is acceptable.
- Head trauma within a year (see [HD-18 Head Trauma](#))
- The headaches are produced (not merely worsened) by straining (Valsalva maneuver). Noncontrast head CT (CPT®70450) or noncontrast brain MRI (CPT®70551) can be performed.
- Headache frequently awakens the individual at night. Noncontrast head CT (CPT®70450) or noncontrast brain MRI (CPT®70551) can be performed.
- Age greater than 50 years with no history of headaches. Noncontrast head CT (CPT®70450) or noncontrast brain MRI (CPT®70551) can be performed.
 - If the headache is strictly unilateral, temporal arteritis (giant cell arteritis) should first be excluded by ESR (sedimentation rate).
- Low pressure headaches (see [HD-16.5 Low Pressure Headache](#))
- Headaches that are not typical of any primary headache disorder. This is an unusual indication for neuroimaging, but can be appropriate when the requesting physician is a neurologist or other headache specialist.
 - Noncontrast head CT (CPT®70450) or noncontrast brain MRI (CPT®70551) can be performed.
- **References:**
 - Frishberg BM, et al. *Evidence-based guidelines in the primary care setting: neuroimaging in patients with nonacute headache.* (The Headache Consortium imaging guideline). <http://www.aan.com/professionals/practice/pdfs/gl0088.pdf>. Accessed December 18, 2009
 - McCrory DC, et al. *Evidence-based guidelines for migraine headache: overview of program description and methodology.* <http://www.aan.com/professionals/practice/pdfs/gl0086.pdf>. Accessed November 29, 2006
 - *Neurology* 2000;55:754-763
 - *Am J Epidemiol* 2005;161(11):1066-1073
- **HD-16.2 Migraine and Tension Headaches**
 - Individuals with migraine or tension headaches do not generally require neuroimaging when these conditions are stable.
 - Head MRA and CTA are generally not indicated in the evaluation of migraine and tension headaches, or for recurrent headaches in general.
 - **NOTE:** the presence of scattered T2 hyperintensities or small “silent infarcts” on brain MRI is common in those with migraine and is not an indication for head CTA/MRA or other further imaging.

- Migraine associated features such as dizziness, non-specific blurry vision, migraine auras, lightheadedness (near syncope), mild vertigo with motion, neck pain, and numbness (paresthesias) are common with migraine and tension headaches and are not indications for head or neck imaging.
- Migraine attacks commonly worsen with physical activity, postural change, and straining, and these features are not indications for neuroimaging.
- The presence of typical migraine auras such as flashing lights or transient visual field loss are not indications for neuroimaging.
- Attacks always occurring on the same side are seen in about 15% of individuals with migraines and are not an indication for neuroimaging if the migraine is otherwise typical.
- **Indications for neuroimaging in migraine/tension headaches:**
 - Intractability—failure to achieve satisfactory results after four weeks of treatment, including at least two abortive medications and two prophylactic medications. This includes a worsening of frequency or severity of headaches despite at least four weeks of treatment.
 - Brain MRI, contrast as requested, can be performed
 - ❖ If brain MRI has been performed and is non-diagnostic, CTV (CPT®70496) or MRV (CPT®70544) can be approved if specifically requested by the treating neurologist or headache specialist.
 - A distinct change in the pattern of the headache attacks (this does not refer to severity or frequency). This includes transformation of established migraine to chronic daily headaches.
 - Noncontrast head CT (CPT®70450) or noncontrast brain MRI (CPT®70551) can be performed
 - **Complex Migraine**—Individuals with **new onset** of hemiplegic migraine (migraine associated with stroke-like weakness) or ophthalmoplegic migraine (binocular diplopia)
 - Brain MRI, contrast as requested, can be performed
 - ❖ CTA or MRA of head and neck can be approved if requested by neurologist or headache specialist.
 - Coital headache (see [HD-16.6 Headache Associated with Coitus or Strenuous Physical Activity](#))
- **References:**
 - [Cephalgia 2004;24 \(suppl 1\):S1-S151](#)
 - [JAMA 2006;296:1274-1283](#)
 - [Neurology 1992;42:1657-1662](#)
- **HD-16.3 Cervicogenic Headache**
 - Cervicogenic headache remains an un-established diagnosis despite much speculation on the subject.
 - Proposed diagnostic criteria are difficult to distinguish from those for migraine.
 - Degenerative changes are seen on cervical MRI in most adults over age 40, whether or not they have posterior head pain. It is not clear that such changes are more common in those with “cervicogenic headache.”
 - MRI or CT of the cervical spine is not generally indicated in the evaluation of headache with or without associated neck pain.
 - [Spine J 2001;1:31-46](#)

- [Cephalgia 2003;3:85-92](#)
- [JAOA 2005;105\(4\)\(Suppl 2\):S16-S22](#)
- Pascual J, Silberstein SD. *Headache associated with cervical spine dysfunction*. Medlink, January 14, 2011, <http://www.medlink.com/medlinkcontent.asp>. Accessed June 7, 2011

- **HD-16.4 Cluster Headache**

- Cluster headache is distinct from migraine and is characterized by clusters of strictly unilateral severe pain lasting at most a few hours, often including Horner's syndrome ipsilateral to the pain as well as tearing and nasal congestion on the same side. The pain stays on the same side from attack to attack.
- The clusters typically last several weeks and recur at varying intervals — approximately once a year or every two years is common.
- Unlike migraine, cluster headaches do not run in families.
- The diagnosis is made clinically, but there is an unexplained association with pituitary macroadenomas, which are found in 5%-10% of cluster headache patients.
 - Brain MRI without and with contrast with attention to the pituitary (CPT®70553) can be performed once in an individual's lifetime
 - There is no role for head MRA or head CTA
- Cluster headache is the only relatively common member of a family of headache disorders collectively called the trigeminal autonomic cephalgias.
 - The others are rare and are characterized by short attacks: paroxysmal hemicrania, hemicrania continua, hypnic headaches, and SUNCT (an acronym for "short unilateral neuralgiform headaches attacks with unilateral conjunctival injection and tearing"). SUNCT can occur without the unilateral conjunctival injection and tearing.
 - All of these are diagnosed clinically, but head MRI (contrast as requested) is appropriate since secondary cases do occur.
 - Head MRA/CTA are not usually indicated initially
 - On occasion, the ophthalmic form of trigeminal neuralgia can be confused with these entities (see [HD-15 Facial Pain/Trigeminal Neuralgia](#))
- **References:**
 - [Arch Neurol 2007;64:25-31](#)
 - [Brain 2005;128:1921-1930](#)

- **HD-16.5 Post-Lumbar Puncture Headache & Low Pressure Headache**

- **Post-lumbar puncture headache:**
 - Brain MRI without and with contrast (CPT®70553) can be performed for post-lumbar puncture headache only if headache does not improve following blood patch or similar intervention, or there are other documented features inconsistent with typical post-lumbar puncture headache.
 - If brain MRI is nondiagnostic and a spinal problem is suspected, noncontrast MRI of the cervical, thoracic, and/or lumbar spine (CPT®72141, 72146, and/or 72148) can be performed.
- **Evaluate CSF Leak**
 - Cases that are not associated with post-lumbar puncture headache should be sent for Medical Director review.

- Work-up of a known or suspected CSF leak typically includes brain MRI without and with contrast (CPT®70553) and may include noncontrast MRI of the cervical, thoracic, and lumbar spine (CPT®72141, 72146, and 72148).
 - CT or MR myelography may be needed if an abnormality is seen in the spine.
- **Low Pressure Headache:**
 - Headaches from intracranial hypotension are usually characterized by an impressive increase in severity in the upright posture and relief by lying flat (similar to the pattern of post-lumbar puncture headaches).
 - Brain MRI without and with contrast (CPT®70553) is the appropriate initial imaging study. Contrast is helpful to visualize the typical basilar dural venous enhancement.
 - **Subsequent imaging:** one third of these cases have a spinal origin, so both spinal MRI and CT myelography are often needed, sometimes in combination.
- **References:**
 - *Headache Currents* 2005;2(1):11-22
 - *Practical Neurology* 2002;2:192-197
- **HD-16.6 Headache Associated with Coitus or Strenuous Physical Activity**
 - Usually benign
 - Can either be a dull, posterior headache with non-explosive onset, or a severe, thunderclap headache.
 - Imaging is indicated once after the initial attack to exclude both subarachnoid hemorrhage and cerebrovascular dissection.
 - Noncontrast head CT (CPT®70450) or noncontrast brain MRI (CPT®70551) plus either head CTA (CPT®70496) or head MRA (CPT®70544) can be performed.
 - Neck CTA (CPT®70498) or MRA (CPT®70549) can be performed if the headache is occipital and the presentation is consistent with vertebral artery dissection (this includes cases with dull, evolving, posterior head pain). (see [HD-17.1 Hyperacute/Thunderclap Headache](#) and [HD-30 Special Stroke/TIA](#))
 - Repeat imaging is not indicated if the headaches become recurrent.
 - **Reference:**
 - *Practical Neurology* 2005;5:350-356
- **HD-16.7 Sinus CT in Evaluation of Headaches**
(See [HD-44 Sinus and Facial Imaging](#))

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HD-17~HYPERACUTE HEADACHE, INTRACRANIAL ANEURYSM, AVM, SUBARACHNOID HEMORRHAGE

- **HD-17.1 Hyperacute/Thunderclap Headache**

- Headaches that occur with snap-of-the fingers suddenness raise fear of a subarachnoid hemorrhage, but they are a relatively common variant of migraine.
- Sometimes the term ice pick headache is used to describe a localized, very brief thunderclap headache, usually lasting from seconds to two minutes or so.
- It is the sudden nature of an attack, not its intensity, which is relevant—there is no increased frequency of abnormal imaging studies associated with “the worst headache of my life.”
- If there has been no prior advanced imaging for these types of headaches, noncontrast head CT (CPT[®]70450) or noncontrast brain MRI (CPT[®]70551) can be performed one time.
- Imaging is not necessary in individuals who have recurrent episodes.
- Headache associated with coitus or strenuous physical activity—see [HD-16.6](#)
- **New Onset of a Thunderclap Headache**
 - Noncontrast head CT (CPT[®]70450) is the usual imaging study, but noncontrast brain MRI (CPT[®]70551) can be performed instead if it has been greater than 12 hours since the attack.
 - Subarachnoid hemorrhage must be promptly ruled in or out
 - Within the first 12 hours, MRI is “blind” to subarachnoid blood. MRI “sees,” not blood, but the products of hemoglobin breakdown.
 - CTA/MRA of the neck is generally unnecessary unless there is documentation that the presentation is consistent with cervical vascular dissection (e.g. acute pain extending from the angle of the jaw to the temple, often with Horner’s syndrome). Vertebrobasilar dissection can be associated with occipital thunderclap headache.
 - If the initial head CT or MRI is negative, and hemorrhage is still a concern, lumbar puncture (LP) is appropriate before further advanced imaging is considered. If the spinal fluid is negative for hemorrhage, further imaging will generally not be useful.
 - Individuals who clearly had a thunderclap headache but were not evaluated until several days or more after the event can have head CTA (CPT[®]70496) or head

MRA (CPT[®]70544) even if head CT or brain MRI is negative, since blood clears from spinal fluid over that period of time

(See [HD-17 in Evidence Based Clinical Support](#) section)

- **HD-17.2 Intracranial Aneurysms (saccular or berry aneurysm)**

- Ruptured berry aneurysm is the most common reason for non-traumatic subarachnoid hemorrhage in adults. Trauma is the most common reason for subarachnoid hemorrhage.
- Small aneurysms are present in about 2% of adults, but very few ever reach a size for which bleeding is a risk.
- Head CTA (CPT[®]70496) or head MRA (CPT[®]70544) can be performed if brain MRI or head CT shows a new aneurysm or suspected aneurysm.
- **Posterior communicating artery aneurysms compressing cranial nerve III**
 - Presents with fixed, dilated pupil and severe headache on the side of the aneurysm along with other elements of a CNIII nerve palsy.
(See [HD-11.5 Oculomotor Nerve \(III\) Palsies](#))
 - Emergency noncontrast head CT (CPT[®]70450) or noncontrast brain MRI (CPT[®]70551) plus head CTA (CPT[®]70496) is appropriate.
 - Head MRA (CPT[®]70544) is inferior to head CTA in this setting but can be approved if requested.
- **Mycotic Aneurysms**
 - Refers to aneurysms arising from bacterial endocarditis and IV drug use.
 - Despite the name, rarely related to fungal disease.
 - Due to risk of bleeding, brain MRI without and with contrast (CPT[®]70553) plus either head MRA (CPT[®]70544) or head CTA (CPT[®]70496) can be performed in individuals with known or suspected mycotic aneurysms who present with thunderclap headache.
 - Since mycotic aneurysms regress when the underlying disease is treated, it is generally not necessary to perform imaging studies on endocarditis patients to screen for these aneurysms
- **Giant or Arteriosclerotic Aneurysms**
 - These aneurysms can bleed but usually present as masses, and will not be further addressed in this guideline section
- **Screening for Aneurysms**
 - Head CTA (CPT[®]70496) or head MRA (CPT[®]70544) for screening is appropriate for the following:
 - Individuals with two first degree relatives (biological parents, siblings, children) with an intracranial aneurysm
 - ❖ An identical twin counts for two relatives
 - ❖ Head CTA or MRA can be performed at ten year intervals beginning at age 20 until age 65
 - Individuals aged 20 to 65 years old with one first degree relative (biological parents, siblings, children) with an intracranial aneurysm can have **one** screening head CTA (CPT[®]70496) or head MRA (CPT[®]70544)
 - Individuals with autosomal dominant polycystic kidney disease
 - ❖ Head CTA or MRA can be performed at ten year intervals beginning at age 20 until age 65

- Individuals with Ehlers-Danlos syndrome, pseudoxanthoma elasticum, aortic coarctation, or sickle cell disease
 - ❖ These individuals are at slightly increased risk for intracranial aneurysm
 - ❖ **NOTE:** sickle cell patients have other reasons to consider head MRA (see **PACHD-24.6 Sickle Cell Disease** in the Pediatric & Congenital Head Imaging guidelines)
- Individuals who qualify for screening head CTA/MRA as outlined above and also present with headache, can have noncontrast head CT (CPT[®]70450) or noncontrast brain MRI (CPT[®]70551) added to the head CTA or head MRA.
- **Repeat Imaging Studies in Aneurysmal Disease**
 - The appropriateness of repeat imaging studies is best considered by scenario, since there are no clear standards regarding re-imaging:
 - **Prior subarachnoid hemorrhage and no known untreated aneurysms (e.g. individuals who have had aneurysms treated with coiling or clipping):**
 - ❖ A repeat head CTA (CPT[®]70496) or head MRA (CPT[®]70544) at some point during the first year after the subarachnoid hemorrhage, then every five years until age 70.
 - **Prior subarachnoid hemorrhage and known aneurysms which were not felt to require treatment:**
 - ❖ A repeat head CTA (CPT[®]70496) or head MRA (CPT[®]70544) at one year after the subarachnoid hemorrhage, then every five years until age 70.
 - **Individuals with known incidentally discovered aneurysms which have never bled:**
 - ❖ A repeat head CTA (CPT[®]70496) or head MRA (CPT[®]70544) at one year following the discovery of the aneurysm(s) and then every 10 years until age 65.
 - **Individuals who have lesions of uncertain nature in which aneurysm is in the differential diagnosis:**
 - ❖ Head CTA (CPT[®]70496) or head MRA (CPT[®]70544) can be performed if the uncertainty was identified on brain MRI
 - ❖ Head CTA (CPT[®]70496) should be performed to resolve uncertainties noted on a relatively recent head MRA.
 - If a repeat study shows a new aneurysm or ≥ 2 mm expansion of a known aneurysm, head CTA (CPT[®]70496) or head MRA (CPT[®]70544) can be repeated in one year.
 - **References:**
 - *Brain* 2005;128:2421-2429
 - *Nature Clin Pract Neurology* 2006;2:184-185
 - *Neurology* 2008 May ;70(22):2053-2062
 - *Stroke* 2009;40:406-411
 - *Am J Neuroradiol* 2009;30:303-307
 - *Radiology* 1999 Aug;212:348-356
 - *Lancet Neurol* 2004;3:85-92
 - *N Engl J Med* 1998;339:1725-1733
 - *Lancet* 2003 July;362(9378):103-110
 - *N Engl J Med* 2000;342:29-36

- *N Engl J Med* 2006;354:387-396
- Yousem DM, Grossman RI. *Neuroradiology, the requisites*. 3rd Ed. Philadelphia, Mosby, 2010, pp.157-164
- *Neurology* 2010 May;74:1671-1679
- *Neurology* 2009 July;73(4):258-265

- **HD-17.3 Arteriovenous Malformations (AVM's) and Related Lesions**

- **Arteriovenous malformations (AVM's)**

- AVM's most often come to clinical notice either by bleeding or by acting as a seizure focus.
 - Usually congenital but often are not recognized until later in life
 - Risk of hemorrhage is about 2% per year for those with no prior hemorrhage, but increases to 20%/year for those with prior hemorrhage.
- AVM's are well-visualized on brain MRI, even without contrast
- Brain MRI without contrast (CPT[®]70551) is appropriate if there is a fairly low index of suspicion for AVM.
- Brain MRI without and with contrast (CPT[®]70553) can be performed if there is a high index of suspicion for AVM—this includes patients with confirmed subarachnoid hemorrhage.
- Head CTA (CPT[®]70496) or head MRA (CPT[®]70544) can be performed in patients with known AVM who are being evaluated for embolization or surgery of the AVM.
- **Re-imaging of AVM's**
 - AVM's are often observed, rather than treated.
 - Annual brain MRI, contrast as requested, plus head MRA (CPT[®]70544) or head CTA (CPT[®]70496) can be performed in patients with known AVM who are being “treated by observation”
 - Immediate brain MRI, contrast as requested, plus head MRA (CPT[®]70544) or head CTA (CPT[®]70496) can be performed for the following:
 - ❖ a new hemorrhage is likely
 - ❖ new onset of seizures or focal neurological signs
 - ❖ change in an established seizure disorder
- **Screening for AVM's**
 - AVM's are not familial lesions except in conditions such as hereditary hemorrhagic telangiectasia syndrome (OHR).
 - Head imaging for screening is not indicated except for a family history of familial cavernoma. If there is family history of familial cavernoma, **one** head CTA (CPT[®]70496) or brain MRA (CPT[®]70544) can be performed for screening. If negative, no further screening studies are indicated.

- **References:**

- Yousem DM, Grossman RI. *Neuroradiology, the requisites*. 3rd Ed. Philadelphia, Mosby, 2010, pp.164-168
- Mohr JP, Pile-Spellman J. *Vascular tumors and malformations*. In Rowland LP (Ed.). *Merritt's Neurology*. 12th Ed. Philadelphia, Lippincott, 2010, pp. 340-344

2011 HEAD IMAGING GUIDELINES

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HD-18~HEAD TRAUMA

- Detailed medical history, recent general physical examination, and recent neurological examination are the initial phase in evaluating patients with potential neurological trauma.
- CT is the primary imaging modality in patients with acute head trauma. MRI is used chiefly in severe acute head trauma when the clinical findings are not explained by the CT results (“the patient is much worse than the CT”) or to evaluate late effect of brain injury.
- When more than evaluation for potential neurosurgical lesions is needed, MRI is superior to CT in recognizing non-hemorrhagic cortical contusions, diffuse axonal injury (“shears”), and brain stem injury.
- Patients with head trauma are often at risk for associated facial and cervical trauma.
 - Consult the relevant guidelines when such cases are under review.
- **HD-18.1 Head CT (without contrast) Use in Trauma is Appropriate**
 - after minor acute trauma in patients whose modified Canadian CT Head Rule inventory has any positive feature (see below)
 - any head trauma patient who is:
 - taking one anticoagulant or two antiaggregants, (e.g. aspirin and Plavix)
 - has a known platelet or clotting disorder
 - has significant renal failure (creatinine>6)
 - **The modified Canadian CT Head Rule:**

Positives include:

 - Glasgow coma scale (GCS) score of less than 15 at 2 hours following injury
 - >30 minutes of amnesia
 - any “dangerous mechanism of injury”
 - a suspected open skull fracture
 - any signs of basilar skull fracture
 - two or more episodes of vomiting
 - patient > 64 years old
 - There must be no positives to omit scanning
 - **References:**
 - JAMA 2005;294:1551-1553

- [JAMA 2005;294:1511-1518](#)
- [JAMA 2005;294:1519-1525](#)
- [N Engl J Med 2000;343:100-105](#)
- [Lancet 2001;357:1391-1396](#)
- In the six months following such injuries, whether or not there has been an initial scan, head CT or MRI without contrast (CPT[®]70450 or CPT[®]70551) is appropriate if the patient develops dementia, alteration of alertness, or focal neurological deficits (e.g. hemiparesis, diplopia). This includes fluctuating problems.
- See **SP-13 Mechanical Neck Pain** in the Spine Imaging Guidelines for guidelines pertaining to cervical spine trauma.
- **HD-18.2 Brain MRI (non-contrasted) Use in Trauma**
 - Brain MRI is not generally recommended as a first study, but noncontrast brain MRI (CPT[®]70551) is appropriate in:
 - Patients (acute or chronic) who after head trauma have neurological features not explained by CT results;
 - As part of a neurological or Pain Management evaluation following non-acute head trauma with documented neurological or neuropsychological deficits.
- **HD-18.3 Head MRA/CTA and Brain MRI (contrasted) Use in Trauma**
 - Head MRA (CPT[®]70544) or CTA (CPT[®]70496) and brain MRI without and with contrast (CPT[®]70553) can be performed:
 - If there is a clinically grounded reason to have high suspicion for vascular injury;
 - To evaluate for post-traumatic aneurysm following penetrating trauma.
- **HD-18.4 Follow-up of Known Subdural or Epidural Hematomas**
 - Can be by either head CT or MRI (contrast as requested)
 - The preference of neurosurgeons and neurologists should be honored
 - There is no precise schedule for follow-up imaging studies.
 - These patients are usually under the care of a neuro specialist.
- **HD-18.5 Patients with Post-Traumatic Headache**
 - Persistent headaches past the acute phase (a week or two) but without specific findings are best evaluated with noncontrast brain MRI (CPT[®]70551) but noncontrast head CT (CPT[®]70450) is acceptable.
- **HD-18.6 References:**
 - [Zee CS, et al. *Computed tomography and magnetic resonance imaging in traumatic brain injury.* \(Ch 3\). In Evans RW. *Neurology and Trauma.* 2nd Ed. Oxford, 2006](#)
 - [Gutierrez-Cadavid, JE. *Imaging of head trauma.* \(Ch 43\). In Latchaw RE, Kucharczyk J, Moseley ME. *Imaging of the Nervous System.* Philadelphia, Elsevier, 2005](#)

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HD-19~CNS INFECTION

- **HD-19.1 Acquired Immune Deficiency Syndrome**
 - Neurological disorders are seen in most patients with AIDS.
 - **Etiologies include:**
 - the HIV infection itself
 - opportunistic superinfection
 - tumor
 - effects of treatment
 - **Meningeal Syndromes:**
 - Meningeal syndromes include cryptococcal meningitis and tuberculous meningitis. Also, there may be persistence of the aseptic meningitis which is often seen with the initial HIV infection.
 - Diagnosis is primarily by lumbar puncture.
 - Brain MRI without and with contrast (CPT® 70553) should be done initially to exclude other possibilities and to visualize the meninges.
 - Head CT (CPT®70450 or CPT®70470) is an acceptable alternative.
 - **Nonfocal syndromes:**
 - AIDS associated dementia presents with psychiatric syndromes, dementia, and a scattering of motor findings.
 - Diagnosis is by exclusion, and initial brain MRI without and with contrast (CPT® 70553) is appropriate.
 - Cytomegalovirus (CMV) infection in AIDS presenting as a meningoencephalitis occurs, but is uncommon in the United States.
 - Brain MRI without and with contrast (CPT®70553) to exclude other entities.
 - **Focal syndromes:**
 - Differential diagnosis includes: toxoplasmosis, tuberculomas, and Epstein-Barr virus-associated lymphoma of the CNS.
 - Patients present with combinations of focal neurological deficit, altered mentation, and seizures.
 - Brain MRI without and with contrast (CPT®70553) is appropriate. Contrast is especially important to recognize the ring enhancing lesions typical of toxoplasmosis.
 - **Reference:**
 - Britton CB. *Acquired Immune Deficiency Syndrome*. In Rowland LP (Ed.). *Merritt's Neurology*. 12th Ed. Philadelphia, Lippincott, 2010, pp.186-201

- **HD-19.2 Lyme Disease**

- Serologic studies should be done initially.
- Meningitis or encephalitis can occur (headache, neck stiffness, mental changes, facial palsy)
 - If the diagnosis cannot be made clinically, lumbar puncture and brain MRI without and with contrast (CPT[®]70553) can be performed.
- Usual geographic range of Lyme disease in the United States:
 - Maryland to Massachusetts
 - Minnesota to Wisconsin
 - California to Oregon
- **References:**
 - Jubelt J. *Spirochete infections, Lyme disease*. In Rowland LP (Ed.). *Merritt's Neurology*. 12th Ed. Philadelphia, Lippincott, 2010, pp. 225-227
 - Meyerhoff JO, Edlow JA, Elston DM, et al. *Lyme Disease*. eMedicine, April 15, 2011, <http://emedicine.medscape.com/article/330178-overview>. Accessed June 13, 2011
 - *Neurology* 1996;46:619-627

- **HD-19.3 Cysticercosis**

- May be the most common cause of seizures in non-industrialized countries and must be considered in immigrants to the United States from such countries who present with seizures or signs of a cerebral mass.
- The cysts are best seen on brain MRI without and with contrast (CPT[®]70553).
 - If there is marked calcification of the cysts, supplementary head CT (CPT[®]70450) may be useful.
- In the United States, cysts are usually found during evaluations for epilepsy.

- **HD-19.4 Meningoencephalitis and Viral Encephalitis**

- Brain MRI without and with contrast (CPT[®]70553) is useful in diagnosis and, for severe illness, in management.
- Head CT without contrast (CPT[®]70450) performed as a safety measure prior to lumbar puncture is appropriate.

2011 HEAD IMAGING GUIDELINES

HD-20~MEDICATION INTOXICATION

- Patients with mental confusion, ataxia, or diplopia who are taking medications known to cause those symptoms (especially sedatives and anticonvulsants) should be evaluated for drug intoxication before consideration of advanced imaging.
 - Noncontrast head CT (CPT®70450) may be appropriate in emergent/urgent situations.
- Serotonin syndrome:
 - Arises in patients taking pro-serotonergic agents, particularly antidepressants and antipsychotics.
 - Mental confusion, agitation, autonomic hyperactivity, and tremor or muscular rigidity can be present.
 - Unless there is urgency, discontinuation of relevant medications should be accomplished prior to considering advanced imaging.
 - **Reference:**
 - [*N Engl J Med* 2005;352:1112-1120](#)

HD-21~MOVEMENT DISORDERS

- The initial step and most important aid to the diagnosis of movement disorders is a careful history and recent neurological examination documenting the nature, frequency, and exacerbating factors of the abnormal movements.
 - Advanced imaging plays a secondary role in these disorders.
- **Typical Parkinson's Disease** is diagnosed clinically, and no imaging is needed in typical cases. Unilateral abnormalities early on are typical and are not an indication for imaging.
- **Atypical Parkinsonism:**
 - Noncontrast brain MRI (CPT®70551) may be useful in the differential diagnosis of certain "Parkinsonian syndromes"(multiple system atrophy, progressive supranuclear palsy, and corticobasal degeneration). CT is not sufficient for this purpose.
 - A history of failure of response to dopaminergic treatment, prominent ataxia at presentation, limb alienation, an unexpected degree of dementia, parkinsonism without tremor, or severe postural hypotension early in the disease should be documented.
 - Various cerebral vasculitides can present with a parkinsonian syndrome of premature onset (< age 45) or other movement disorder. When this is suspected, MRI of the head without and with contrast (CPT®70553) is appropriate.*
 - Also see [HD-32.1 Vasculitis Involving Small to Medium-sized Arteries](#)
*[*Neurology* 2007;69:644-653](#)
 - Detailed history and neurological examination is appropriate prior to advanced imaging, and neurological consultation is helpful to aid in differential diagnosis and selection of cases for imaging.
 - **References:**
 - [*Neurology* 2000;54:697-702](#)

- [Radiology 2006;239:825-830](#)
- [Neurology 2006;66:968-975](#)
- **Essential Tremor**: imaging is not required for diagnosis.
- **Tremors of Anxiety and Weakness**: advanced imaging is not generally required for diagnosis.
- **Huntington's Chorea**
 - Diagnosis does not require imaging: a direct DNA study is more accurate.
 - If DNA results are equivocal, noncontrast brain MRI (CPT®70551) or CT (CPT®70450) may be considered.
- **Dystonia**: in adults and children with dystonia, brain MRI (contrast as requested) is indicated if there are other neurological features beside the dystonia itself.*
 - *[N Engl J Med 2006;355:818-829](#)
- **Restless Legs Syndrome**: neuroimaging is generally unnecessary. This condition is diagnosed clinically. EMG testing is sometimes used.
 - Also see [HD-26 Sleep Disorders](#)
- **Hemifacial Spasm and Tics**
 - **Hemifacial spasm**
 - Consistent presence of visibly obvious contractions of the muscles on one side of the face in a pattern which cannot be duplicated at will.
 - Brain MRI without and with contrast (CPT®70553) is appropriate
 - In some cases, Head MRA or CTA (CPT®70544 or CPT®70496) may be appropriate in addition to brain MRI, especially when surgical treatment is being considered
 - **Tics**
 - Also see PACHD-28 Tourette's Syndrome in the Pediatric and Congenital Head guidelines
 - Recurrent twitching of facial muscles that can be duplicated at will.
 - Brain MRI (contrast as requested) is not often useful in these disorders, but can be considered to help clarify a diagnosis, especially if the tics are strictly one-sided.
- **Palatal Myoclonus**
 - Rhythmic contraction of the palate
 - In younger patients, "essential palatal myoclonus" and MS are the most likely etiologies
 - In older patients, brain stem infarct is a possible etiology
 - Brain MRI (CPT®70551 or CPT®70553) is appropriate for evaluation
- **MRA/CTA**: These studies are generally not medically necessary in the evaluation or management of movement disorders. Documentation of the specific indication for their use in these settings is needed.
- **PET**: At this time, there is no firmly established basis for the use of PET in the evaluation or management of movement disorders.

2011 HEAD IMAGING GUIDELINES

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HD-22~ MULTIPLE SCLEROSIS (MS) and RELATED CONDITIONS

- **HD-22.1 Introduction**

- Multiple Sclerosis (MS) is a relatively common neurological disorder and an extremely variable one.
 - Prevalence in the United States is 350,000 cases and annual incidence is about 5/100,000.
 - Women are affected twice as often as men. Most cases begin between ages 20 and 40. Onset is unlikely past the age of 60.
- MS tends to go through three stages:
 - 1) Relapsing-remitting in which the individual has episodes of neurological disability, but improves between the episodes.
 - 2) Relapsing-progressive in which disability accumulates in association with the attacks
 - 3) Chronic progressive in which there is a gradual, but steady increase of disability.
- MS which begins later in life often features chronic progressive spinal cord dysfunction from the onset.
- A benign form of MS consisting only of the relapsing-remitting stage also occurs.
- Early in the disease, involvement of any combination of the optic nerves, brain stem, cerebellum, and spinal cord tends to predominate. Later in the disease, diffuse cerebral involvement often becomes more prominent.
- **Diagnosis of MS:**
 - Detailed neurological history and examination are necessary in the evaluation of known or suspected MS.
 - MS is a clinical diagnosis, traditionally recognized by “lesions dispersed in time and space,” which means involvement of different areas of the neuraxis at different times. The goal is to establish the diagnosis of MS as early as possible so that treatment can begin.
 - (See [HD-22 Evidence Based Clinical Support](#) section)
 - Imaging of the brain and spinal cord is often used to fulfill either the time or space requirement when the other requirement (either time or space) has been **clinically** diagnosed.

- ❖ The main use of MRI in the initial diagnosis of MS is in individuals with so-called clinically isolated syndromes. The goal of imaging is either to find evidence of more diffuse disease (space) or evidence of prior demyelinating episodes (time)—this would support the fact that the clinical syndrome is not truly isolated.
- ❖ The misdiagnosis of MS has dire personal and medical consequences.
 - ✚ The use of imaging to “rule out MS” in individuals whose clinical presentation is uncertain or ill-defined is inappropriate.
 - ✚ MRI scans that may be read as “consistent with MS” can actually be signs of another disease or even normal.
- **References:**
 - *Continuum: Lifelong Learning in Neurology* 2010;16(5):37-57
 - Consortium of Multiple Sclerosis Centers working group. *Consortium of MS centers MRI protocol for the diagnosis and follow-up of MS*. 2009. <http://www.ms-care.org/cmssc/images/pdf/mriprotocol2009.pdf>. Accessed June 12, 2011
- **HD-22.2 Imaging Modalities in MS**
 - CT is usually not of value in determining the presence or absence of MS activity and will rarely be indicated.
 - MRI is the imaging modality of choice in MS and is usually performed without and with contrast.
 - When MRI is appropriate, both the brain and spinal cord will usually be imaged.
 - Brain MRI (CPT[®]70553)
 - Spine MRI:
 - Cervical and thoracic spine MRI scans visualize the entire spinal cord, and lumbar spine MRI usually is not needed.
 - Sagittal MRI of the spinal cord with phased array detector coil (CPT[®]72156 or CPT[®]72157) **OR** full MRI of the cervical (CPT[®]72156) and thoracic spine (CPT[®]72157) can be performed to visualize the entire spinal cord.
 - CTA, MRA, CTV, and MRV are not often of value in MS unless there is a documented reason for suspecting a cerebrovascular disorder.
 - The potential role of cerebral venous disorders in the etiology of MS is far from established at this point.
 - Orbital MRI is not often indicated in the evaluation of MS, although brain and/or spine imaging may be indicated in patients diagnosed with optic neuritis.
 - See [HD-35 Optic Neuritis](#)
 - **References:**
 - *J Neurol Sci* 2009;282:21-27
 - *J Neurol Neurosurg Psychiatry* 2009;80:392-399
 - *Ann Neurol* 2010 Aug;68(2):255-259
 - *Ann Neurol* 2010 Mar;67(3):286-290
- **HD-22.3 Clinically Isolated Syndromes**
 - Describes a single episode with features consistent with a first MS episode such as optic neuritis, diplopia not arising from a single cranial nerve palsy, ataxia, onset of tic doloureux before age 40, transverse myelitis, or migratory paresthesia.
 - Lightheadedness, syncope, and vertigo without other more specific neurological features do not qualify as clinically isolated syndromes.

- Individuals who have had prior clinically isolated syndromes in different areas are considered to have established MS
 - See **HD-22.5 Imaging with Established MS (or Probable MS)**
- **Optic neuritis and premature tic doloureux:**
 - Brain MRI without and with contrast (CPT®70553) can be performed
 - If brain MRI is completely normal, MRI of the spine is **not** indicated.
 - If brain MRI is suggestive of MS, MRI of the spine can be performed.
 - If brain MRI confirms the diagnosis of MS, MRI of the spine can be performed.
 - See **HD-22.2 Imaging Modalities in MS** for appropriate coding of the spine MRI scans
- **Other clinically isolated syndromes:**
 - Brain MRI without and with contrast (CPT®70553) plus MRI of the spine can be performed initially
 - See **HD-22.2 Imaging Modalities in MS** for appropriate coding of the spine MRI scans
- **Transverse myelitis:**
 - Brain MRI without and with contrast (CPT®70553) plus MRI of the spine can be performed initially
 - See **HD-22.2 Imaging Modalities in MS** for appropriate coding of the spine MRI scans
- **Wandering paresthesias:**
 - Individuals with attacks of paresthesia, each lasting at least a full day and affecting different body areas at different times, can have brain MRI without and with contrast (CPT®70553) and, if requested, MRI of the spine. See **HD-22.2 Imaging Modalities in MS** for appropriate coding of the spine MRI scans
- **Repeat Imaging:**
 - If the initial imaging study(ies) was negative or equivocal, repeat imaging can be performed at three to six months and again at one year.
- **References:**
 - *Neurology* 2003;61:602-611
 - *Ann Neurol* 2005 Dec;58(6):840-846
 - *Ann Neurol* 2001 Jul;50(1):121-127
 - *Lancet Neurol* 2007;6:677-686.
 - *AJNR Am J Neuroradiol* 2006;27:455-461
 - *Eur J Neurol* 2006 Apr;13(4):313-325
 - Whiting P, Harbord R, Main C, et al. Accuracy of magnetic resonance imaging for the diagnosis of multiple sclerosis: systematic review. *BMJ* 2006 Mar;332(7546). <http://www.bmj.com/content/332/7546/875.full>. Accessed June 12, 2011
- **HD-22.4 Familial MS and Screening Studies**
 - Using imaging studies to screen for MS in family members or other relatives is not indicated in the absence of a well defined clinical indication.
 - The lifetime risk of developing MS is about 4% if one parent has MS and about 30% if two parents or an identical twin has MS.
 - **References:**
 - *Lancet Neurology* 2004;3:104-110
 - *Continuum: Lifelong Learning in Neurology* 2010 Oct;16(5):147-165

- **HD-22.5 Imaging with Established MS (or Probable MS)**
 - **Patients with MS and other medical conditions:**
 - Individuals with MS may develop unrelated neurological or general medical conditions, and imaging appropriate for these conditions should be performed.
 - In patients with spinal cord dysfunction, clinical evaluation of abdominal and other general medical conditions can be very difficult. The absence of clinical signs and symptoms can be misleading. Requests for imaging studies should be evaluated with this in mind.
 - Patients with impaired ability to walk: the practical difficulty of arranging imaging sessions in these patients should be considered before recommending a serial approach to imaging.
 - Many patients with MS are immunocompromised due to their treatment regimens. This needs to be taken into account when selecting the most appropriate imaging studies for other medical conditions.
 - **Repeat imaging on indication**
 - Repeat MRI is appropriate when there is an episode with significant new neurological deficit. Whether the imaging should include brain, spine, or both depends on the situation, which is best judged by the attending neurologist.
 - Repeat brain MRI without and with contrast (CPT[®]70553) plus MRI of the spine can be performed (see **HD-22.2 Imaging Modalities in MS** for appropriate coding of the spine MRI scans) to establish a baseline when the decision has been made to begin a new immune-modulating agent.
 - **Immune-modulating agents include the following:**
 - ❖ beta interferons (Avonex[®], Betaseron[®], and Rebif[®])
 - ❖ mitoxantrone (Novantrone[®])
 - ✚ This is a cardiotoxic agent and risk of cardiomyopathy persists for many years even after the patient has stopped taking it. Annual evaluation of left ventricular ejection fraction (preferably by echo) should be performed for life—see **CD-3.7 MUGA Study**
 - ❖ glatiramir (Copaxone[®])
 - ❖ natalizumab (Tysabri[®])
 - ✚ This agent has been associated with some cases of a neurological viral infection called progressive multifocal leukoencephalopathy (PML). PML commonly presents with either a series of stroke-like events or a subacutely progressive dementia. Clinical re-evaluation 3 months after treatment starts and then every 6 months should be performed. Brain MRI without and with contrast (CPT[®]70553) is appropriate if requested by the attending neurologist
 - **Surveillance imaging**
 - Annual brain MRI without and with contrast (CPT[®]70553) plus MRI of the spine can be performed (see **HD-22.2 Imaging Modalities in MS** for appropriate coding of the spine MRI scans) in individuals with definite or probably MS who are either on immune-modulating therapy or are candidates for this treatment.
 - **See bullet on Immune-modulating agents include the following** above for a list of these agents.
 - For individuals with the progressive spinal form of MS, the attending

neurologist may choose not to re-image the brain if the imaging has been negative in the past.

- There is generally no need to perform surveillance imaging in an asymptomatic individual who has had no evidence of disease activity in the past 10 years, especially if the individual is over age 60.

- **References:**

- [AJNR Am J Neuroradiol 2006;27:455-461](#)
- [Eur J Neurol 2006 Apr;13\(4\):313-325](#)

- **HD-22.6 Neuromyelitis Optica (DeVic's Disease)**

- An uncommon demyelinating syndrome characterized by involvement of the optic nerves and spinal cord without symptomatic cerebral lesions.
 - Most patients have normal brain MRI, but some have hypothalamic lesions or non-specific changes.
 - The spinal cord lesions in DeVic's Disease involve three or more segmental levels, while those in MS involve no more than two.
- A specific serum immune marker for this disease has been discovered.
- Initial imaging can include brain MRI without and with contrast (CPT[®]70553) plus MRI of the spine (see **HD-22.2 Imaging Modalities in MS** for appropriate coding of the spine MRI scans).
- Follow-up MRI can be limited to MRI of the spine in typical cases.
 - See **HD-22.2 Imaging Modalities in MS** for appropriate coding of the spine MRI scans
- **Reference:**
 - *Neurology* 2006 May;66(10):1485-1489

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HD-23~NEURO-ONCOLOGY - BRAIN TUMORS

- **HD-23.1 General Remarks**
 - Unless otherwise stated, this guideline concerns patients in whom a diagnosis of brain tumor has been established.
 - Brain MRI without and with contrast (CPT®70553) is indicated for both characterization and follow-up of brain tumors. However, occasionally neurologists, neurosurgeons, and oncologists treating such patients will find appropriate use for CT or noncontrast MRI. Their preferences should be honored in such cases.
 - In general, MRA/CTA scans are not necessary for the diagnosis or management of brain tumor without a clearly documented indication.
 - Astrocytomas and other malignant brain tumors are not familial (except in certain defined inherited syndromes), and advanced imaging studies for screening based on family history alone are generally not appropriate.
 - Postoperative brain MRI is standard, usually 24 to 72 hours following brain tumor surgery.
 - Repeat imaging is appropriate when patients deteriorate or develop new features.
 - MRI of the entire neural axis without and with contrast includes CPT®70553, CPT®72156, CPT®72157, and CPT®72158.

- **HD-23.2 Neurofibromatosis, Type 1: (von Recklinghausen's Disease, NF 1)**
 - Autosomal dominant. Incidence 1 per 5000. Only half have family history.
 - Subcutaneous neurofibromas and multiple café au lait spots are typical.
 - Kyphoscoliosis is common and may cause cord compression. Spinal dural ectasias and meningoceles occur.
 - Intraspinal tumors are frequent.
 - Screening those without symptoms or signs is usually not useful, since most occult neurofibromas do not grow aggressively.
 - Optic nerve and brain stem gliomas are common (brain MRI without and with contrast [CPT®70553] and also orbits [CPT®70543] for those with optic nerve lesions.)
 - These tumors require monitoring when present, but do not behave as malignantly as their names suggest. Growth can be heralded by precocious puberty.
 - Headache is common, and because of elevated tumor risk and a high incidence of aqueductal stenosis (hydrocephalus), prompt brain MRI without and with contrast (CPT®70553) is appropriate.
 - Neurofibromatosis I is a known cause of strokes and of Moya moya disease. Imaging should follow guidelines appropriate for pediatric stroke (see PACHD-24 Stroke in the Pediatric and Congenital Head Imaging Guidelines).
 - Imaging to screen family members without signs of the disease is generally inappropriate since the clinical picture is readily recognized.
 - Imaging to screen children without symptoms is not generally appropriate.
 - **Neurofibromatosis, type II** is a separate and extremely rare disease characterized by either bilateral acoustic neuromas or a combination of familial acoustic neuroma and another brain tumor. The tumors determine the imaging. It is mentioned only to avoid confusion with NF I.
 - **Reference:**
 - Maria BD, Menkes JH. *Neurocutaneous syndromes*. In Menkes JH, Sarnat HB, Maria BL. *Child Neurology*. 7th Ed. Philadelphia, Lippincott, 2006, pp.803-824
- **HD-23.3 Grade I-II Astrocytoma and Benign Oligodendroglioma (low grade)**
 - After initial biopsy or other treatment, repeat MRI brain without and with contrast (CPT®70553) is appropriate.
 - Surveillance for posterior fossa tumors in this class is by brain MRI without and with contrast (CPT®70553) repeated every 3 to 6 months for 5 years and then annually.
 - Supratentorial (cerebral proper) tumors should be re-imaged at approximately 3 months, 6 months, and then annually.
- **HD-23.4 Glioblastoma and Other Malignant Glial Tumors (including Grade III Astrocytoma)**
 - Following surgery and radiation therapy (XRT) with or without adjuvant chemotherapy, brain MRI without and with contrast (CPT®70553) is usually performed 2 to 6 weeks following completion of treatment, and then every 2 to 3 months.
 - During chemotherapy treatments or a course of XRT, MRI brain without and with contrast (CPT®70553) every 8 to 10 weeks is usual.
 - PET: see [HD-23.13 PET in Brain Tumor](#)

- **HD-23.5 Ependymoma**

- These tumors usually occur below the tentorium in children and above it in adults. The more malignant ones can seed the entire neural axis.
- Postoperatively, MRI of the entire neural axis is appropriate (brain and entire spine without and with contrast).
- Surveillance scanning should be every 3 to 4 months the first year, every 6 months the next year, and then every 6 to 12 months depending on the malignancy of the tumor. For malignant ependymoma, entire neural axis scans are appropriate, but for benign ependymomas, imaging limited to the level of the tumor is appropriate. While the child remains under active treatment with radiation and/or chemotherapy, bimonthly imaging is acceptable. MRS may be useful to evaluate response to therapy.

- **HD-23.6 CNS Lymphoma**

(also known as microglioma): often seen in the immunocompromised.

- This malignancy is so sensitive to corticosteroids that it is often necessary to take patients off those drugs to obtain a positive biopsy.
- Initial staging usually requires total neural axis MRI without and with contrast to evaluate for meningeal seeding.
- Extra-neural evaluation for the primary will be needed when the origin of the lymphoma is unclear, and this often includes body imaging (usually contrast only CT).
- Follow-up neural axis imaging is appropriate every 3 months for at least a year following a positive biopsy because of meningeal spread.
- Follow-up otherwise, esp. in the immunocompromised, is similar to that of glioblastoma if there is no meningeal seeding.
(See [HD-23.4 Glioblastoma and Other Malignant Glial Tumors](#))
- If meningeal seeding is present, follow-up is similar to that of malignant ependymoma or PNET (see [HD-23.5 Ependymoma](#) and [PACHD-18 Neuro-oncology](#) in the Pediatric and Congenital Head Imaging Guidelines).

- **HD-23.7 Metastatic Brain Tumors**

- **Systemic cancer staging:** brain imaging is included in staging certain systemic cancers (see Oncology guidelines).
 - If the patient has no history of prior brain metastases and no current neurological complaints, either brain MRI without and with contrast (CPT[®]70553) or head CT without and with contrast (CPT[®]70470) is acceptable.
 - Otherwise, MRI rather than CT should be used.
- **Pretreatment evaluation of known cerebral metastases:** Brain MRI without and with contrast (CPT[®]70553) is the appropriate study. MRI is much better than CT at finding multiple lesions, which is important in this situation.
- **Metastatic brain deposits and no known primary:** patients with no known diagnosis of malignancy who are found on brain MRI to have cerebral metastases should have CT scan of the chest with contrast (CPT[®]71260) as the initial advanced imaging study to identify a source or a biopsy site. Women should also have mammography performed. CT scan of the chest and mammography will identify the most appropriate biopsy site in over 95% of cases.

- **Reference:**
 - *Neurology* 2005;65:908-911
- **Carcinomatous Meningitis:** most commonly arises in breast cancer but can be seen in lymphoma. Neural axis MRI without and with contrast is usually appropriate.
 - If an Omayra reservoir is placed, CSF flow studies may be needed (see HD-34 Newer MRI Techniques).
- **PET in metastatic brain tumors:** See [HD-23.13 PET in Brain Tumor](#).
- **HD-23.8 Meningiomas**
 - Meningiomas are tumors of the dura and are usually benign.
 - Initial imaging should be a brain MRI without and with contrast (CPT® 70553).
 - In selected cases, noncontrast head CT (CPT®70450) may also be required to evaluate bony involvement.
 - As a preoperative study, CTA/MRA of head (CPT®70496/70544) and/or neck (CPT®70498/70548) may be appropriate.
 - Following documented complete resection, repeat imaging at 6 months, 2 years, and 5 years is sufficient.
 - For skull base meningiomas or any meningioma subtotally resected, follow-up imaging every 6 months for 2 years and then annually for life is recommended.
 - Malignant meningiomas (by pathology): re-image at 3 and 6 months post resection and then annually for life.
 - Meningiomas that are being observed (no resection):
 - Imaging can be performed if new signs/symptoms/neurological findings related to the meningioma occur.
 - In asymptomatic patients, imaging can be performed once a year for ten years and then every five years.
- **HD-23.9 Acoustic Neuroma and Other Cerebellopontine Angle Tumors**
 - MRI of the head without and with contrast with attention to the internal auditory canals (CPT®70553) is sufficient for initial diagnosis.
 - Adding separate temporal bone MRI without and with contrast (CPT®70543) is not generally required, but may be appropriate in patients with audiologic or clinical features of retrocochlear hearing loss and negative head MRI and in the rare patient in whom a detailed search is indicated for both a lesion of the cerebellopontine angle AND lesions of the cerebral hemispheres.
 - **Follow-up Imaging:**
 - Following resection, repeat brain MRI without and with contrast with attention to the internal auditory canals (CPT®70553) at 1 and 5 years is sufficient.
 - For acoustic neuromas managed without surgery, repeat brain MRI without and with contrast with attention to the internal auditory canals (CPT®70553) is performed at 6 months after diagnosis and then once a year.
 - **References:**
 - Perry BP, Gantz BJ, Rubinstein JT. Acoustic neuromas in the elderly. *Otol Neurotol* 2001;22:389-391
 - Hain TC. *Acoustic neuroma*. Dizziness-and-balance.com, May 7, 2011, http://www.dizziness-and-balance.com/disorders/tumors/acoustic_neuroma.htm. Accessed June 13, 2011
 - *British Association of Otorhinolaryngologists Head and Neck Surgeons, Clinical Effectiveness Guidelines: acoustic neuroma. 2002.*

- **HD-23.10 Pineal Cysts**
 - Apparently benign pineal cysts may be re-imaged 1 to 2 years after discovery to prove stability.
 - Further imaging of a stable benign cyst is not necessary.
 - If there is mass effect, yearly imaging to identify either increase in size or the appearance of hydrocephalus is appropriate.
 - For pineal region tumors other than cysts, appropriate imaging will depend on the nature and clinical effects of the tumor.
- **HD-23.11 Arachnoid Cysts:** these "cysts" generally reflect an underlying anomaly of brain development, and once identified as such, require no further imaging. If there is mass effect, yearly imaging to identify growth or the appearance of hydrocephalus is appropriate.
- **Pituitary Tumors:** See [HD-27 Pituitary](#)
- **Orbital Tumors:** See Ophthalmology Guidelines:
 - [HD-35 Optic Neuritis](#)
 - [HD-36 Visual Field Deficits](#)
 - [HD-37 Horner's Syndrome](#)
 - [HD-38 Ophthalmology Conditions](#)
- **HD-23.12 von Hippel Lindau Disease**
 - Uncommon autosomal dominant disorder
 - Principal features are retinal angiomas and hemangioblastoma of the cerebellum.
 - Pheochromocytomas (10%) and renal carcinoma are also relatively frequent.
 - The hemangioblastomas are benign cystic tumors and may be associated with secondary polycythemia.
 - Hemangiomas in other regions and benign renal and hepatic cysts occur.
 - DNA testing can identify family members **not** at risk.
 - No screening imaging is needed for those members.
 - For those at risk, abdominal screening by ultrasound (CPT[®]76700 or CPT[®]76705) should be done during the teenage years.
 - If the ultrasound is abnormal, CT of the abdomen with contrast (CPT[®]74160) can be performed.
 - MRI of the brain and spine without and with contrast are recommended annually during the teenage years and then every two years.
 - Temporal bone CT (CPT[®]70482) or MRI (CPT[®]70543) to rule out tumors of the endolymphatic sac is appropriate if hearing loss is present.
 - **References:**
 - *von Hippel Lindau Family Alliance. Screening recommendation. Revision 3, 2005.*
<http://www.vhl.org/handbook/>. Accessed June 13, 2011
 - *von Hippel Lindau syndrome. Online Mendelian Inheritance in Man.*
<http://bioportal.bioontology.org/ontologies/40398?p=terms&conceptid=608537.0003>. Accessed June 13, 2011

- **HD-23.13 PET in Brain Tumor (Metabolic Brain PET—CPT®78608)**
 - Certain payers consider the use of brain PET in tumors to be investigational, and their coverage policies will take precedence over MedSolutions' guidelines.
 - The chief use of PET in the management of brain tumor is to aid in distinguishing recurrent tumor from radiation cerebritis in patients with known anaplastic tumors of glial origin (glioblastoma, anaplastic astrocytoma, and anaplastic oligodendroglioma) and prior XRT.
 - Candidates for PET will have had a very recent brain MRI showing enhancing new lesions compatible with either recurrent tumor or radiation necrosis.
 - On rare occasion, brain PET (or MR Spectroscopy) may be useful in resolving a differential diagnostic issue in a patient when MRI and clinical course cannot distinguish tumor from “tumefactive” MS plaque, non-acute inflammation, or infarct. Such cases require review by a Medical Director.
 - MR Spectroscopy (CPT®76390) is sometimes used to distinguish recurrent tumor from radiation cerebritis, and this is an acceptable alternative to PET.
(See [HD-34.2 MR Spectroscopy](#)).
 - Certain payers consider MR Spectroscopy investigational, and their coverage policies will take precedence over MedSolutions' guidelines.
 - Brain, especially gray matter, takes up FDG avidly, and only very metabolically active tumors are more “PET avid” than this.
 - FDG-PET is therefore generally not useful in the evaluation of most metastatic deposits and well-differentiated brain tumors.

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HD-24~PAPILLEDEMA/PSEUDOTUMOR CEREBRI

- Pseudotumor cerebri is also called benign intracranial hypertension.
- The first step in evaluation is a detailed history and recent neurological examination.
- Papilledema indicates the presence of elevated intracranial pressure.
 - Brain MRI without and with contrast (CPT[®]70553) is indicated.
 - The vast majority of alert neurologically normal patients will have idiopathic intracranial hypertension (pseudotumor cerebri) and normal imaging studies.
 - Brain MRI is performed to exclude cerebral mass lesions, obstructive hydrocephalus, and occult meningeal disease.
 - Patients with papilledema will generally require lumbar puncture, but for reasons of patient safety, lumbar puncture is done after the initial brain imaging study.
- MRV/CTV (CPT[®]70544/CPT[®]70496) is appropriate to exclude venous sinus thrombosis in atypical cases of pseudotumor.
- Typically, pseudotumor occurs in overweight women of childbearing years and responds to medical treatment.
- **Atypical cases include:**
 - male patients
 - slender patients
 - women > age 45
 - children (< age16) unless there is an apparent cause
 - patients with known intrinsic system clotting disorders
 - patients who fail to respond to pharmacologic treatment
- MRA/CTA is not generally appropriate in these cases without a specific indication. Since MRA/CTA share the same CPT[®] codes with MRV/CTV, it will be necessary to know which study is being requested.
- Orbital MRI or CT is not indicated initially unless there is a documented concern for orbital pseudotumor or a primary bilateral orbital disorder.
- Ophthalmology or Neurology consultation may be helpful to:
 - distinguish papilledema from papillitis
 - distinguish pseudopapilledema from genuine papilledema
 - establish the presence of mild papilledema
- Re-imaging is infrequently indicated unless done to evaluate possible shunt dysfunction in those patients who have had ventriculoperitoneal (VP) or lumboperitoneal (LP) shunts or because of distinct clinical deterioration.
- See [HD-16.1 New Onset Headaches](#)
- **Reference:**
 - *Headache Currents* 2005;2:1-10

2011 HEAD IMAGING GUIDELINES

HD-25~PARESTHESIAS

- Paresthesia (localized numbness and tingling) can be a symptom of all but a few neurological disorders, so that no general guidance to the use of advanced imaging in its differential diagnosis or management can be of value. This guideline addresses some specific clinical problems but is not exhaustive.
- **HD-25.1 Circumoral Paresthesia**
 - Circumoral paresthesia, often with tingling of the distal limbs and a sense of breathlessness, is a common symptom of hyperventilation, and advanced imaging is not indicated.
- **HD-25.2 Paresthesia Localized to the Distribution of a Particular Somatic Peripheral Nerve:** (with or without “objective” sensory loss)
 - Localization of such lesions is accomplished by detailed clinical examination and correlation with anatomical knowledge.
 - If the cause is clinically apparent, advanced imaging will infrequently be of value unless an interventional procedure is planned.
 - See **PN-2 Focal Neuropathy** in the Peripheral Nerve Disorders Imaging Guidelines.
- **HD-25.3 Paresthesia in Spinal Radiculopathy**
 - Paresthesia in spinal radiculopathy is a common symptom of these disorders and is not of itself an indication for advanced imaging.
 - Consult the relevant sections of the Spine Imaging Guidelines.
- **Wandering Paresthesia:** See **HD-22 Multiple Sclerosis and Related Conditions**
- **HD-25.4 Facial Paresthesia or Sensory Loss**
 - Isolated painless paresthesia of the cheek or upper lip, generally without objective sensory loss, is commonly seen with maxillary sinus disease since the maxillary nerve runs along the roof of the sinus. Maxillofacial CT (CPT[®]70486) may be appropriate.
 - Paresthesias of the chin or lower gum on one side may follow mandibular trauma or surgery (including removal of lower wisdom teeth) since the inferior alveolar nerve lies in this area.
 - Advanced imaging is infrequently necessary unless the cause is obscure or surgical intervention is planned.
 - Paresthesia, which may include sensory loss, can be seen following trauma to the supraorbital nerve. The supraorbital nerve also supplies the anterior scalp.
 - Orbital CT may be appropriate.
 - The need for brain imaging will depend upon the nature of the trauma.
 - Many patients with Bell’s palsy complain of subjective paresthesia on the involved side but have no objective sensory loss.
 - The presence of this symptom is not relevant to the need for imaging.
 - Also see **HD-9 Facial Palsy (Bell’s Palsy)**

- Non-traumatic objective facial sensory loss is uncommon, and advanced imaging will usually be appropriate (brain MRI without and with contrast [CPT[®]70553] or facial CT depending on clinical details).
 - **Unilateral**: raises concern for benign or malignant tumor along the course of the trigeminal nerve or one of its branches.
 - **Bilateral**: raises concern for scleroderma or a related collagen vascular disease.
 - Head MRI without and with contrast (CPT[®]70553) may be appropriate to evaluate for cerebral vasculitis or meningeal inflammation and to exclude bilateral trigeminal nerve lesions.

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HD-26~SLEEP DISORDERS

- **HD-26.1 Excessive Daytime Sleepiness**
 - Excessive daytime sleepiness is a symptom which can arise from a variety of sleep disorders.
 - Evaluation begins with a detailed history, examination, and sleep studies.
 - This entity is discussed in connection with the various disorders below.
- **HD-26.2 Narcolepsy**
 - Narcolepsy is a relatively common disorder (prevalence ca 50/100,000) characterized by attacks of irresistible daytime sleepiness, usually accompanied by cataplexy, and often by phenomena called sleep paralysis and benign hypnagogic hallucinations. This combination of symptoms is called the narcolepsy tetrad
 - **Primary narcolepsy** accounts for almost all cases: patients usually have HLA type DR2/DQ6 (DQB1*0602) and very low spinal fluid hypocretin levels. The vast majority of patients present by age 30.
 - Advanced neuroimaging is generally not useful in this disorder.
 - **Secondary narcolepsy** is quite uncommon, but it may be clinically indistinguishable from the primary type and may include reduced spinal fluid hypocretin.
 - Cases arising from tumors (esp. of the hypothalamus or brain stem), head trauma, multiple sclerosis, and other brain disorders have been reported.
 - The diagnosis of narcolepsy should be confirmed by appropriate sleep studies or by consultation with a neurologist or sleep disorders specialist.
 - When imaging studies are requested in a patient with **confirmed** narcolepsy thought not to be primary, MRI head without and with contrast (CPT®70553) is appropriate.
 - In general these patients will be HLA negative, present later in life, or have associated neurological features.
 - Sleep paralysis can occur without narcolepsy in healthy individuals, and when it does, advanced imaging is not indicated.
 - Sleep paralysis is in effect a dream whose content consists of awakening and being paralyzed. There is no residual abnormality upon actual awakening.
 - Cataplexy is brief loss of postural tone usually provoked by startle or sudden emotion. It may be partial. Attacks last from seconds to 1-2 minutes.

- Advanced imaging is usually not appropriate in patients with isolated cataplexy. However, drop attacks are similar in nature to cataplexy (see [HD-31 Syncope](#)).
- Hypnagogic hallucinations occur as one falls asleep, and are common in otherwise normal individuals. When they occur without narcolepsy, imaging is not indicated
- **References:**
 - Ropper AH and Brown RH. *Adams and Victor's Principles of Neurology*. 8th Ed. New York, McGraw-Hill, 2005, pp.347-349.
 - *Sleep Med Rev* 2005;9:269-310
- **HD-26.3 Sleep Apnea**
 - Sleep apnea is defined as episodes of **abnormal** cessation of breathing with significant arterial oxygen desaturation which occur during sleep.
 - Sleep apnea is either central or obstructive.
 - Sleep studies are necessary initially to distinguish these types.
 - Central sleep apnea is a consequence of a variety of disorders involving the brain stem.
 - Brain MRI, usually without contrast (CPT[®]70551), is appropriate in confirmed cases.
 - The need for further advanced imaging depends on the results of the MRI and the clinical specifics of the case, but cervical spine MRI is appropriate in those cases which follow cervical spine surgery or trauma.
 - Obstructive sleep apnea arises from dysfunction of the oropharynx during sleep and can be diagnosed via sleep studies. Lateral radiographs of the upper airway are useful in some patients.
 - Unless a mass lesion in the upper airway is identified clinically, the role of advanced imaging in the evaluation of these patients is unproven at this time.
 - In selected adult and pediatric patients undergoing surgical correction of obstructive sleep apnea, preoperative maxillofacial CT may be of value.
 - **Reference:**
 - Ropper AH and Brown RH. *Adams and Victor's Principles of Neurology*. 8th Ed. New York, McGraw-Hill, 2005, pp.344-346
- **HD-26.4 Restless Legs Syndrome**
 - Neuroimaging is generally unnecessary. This condition is diagnosed clinically. EMG testing is sometimes used.
 - Also see [HD-21 Movement Disorders](#)
- **HD-26.5 Sleepwalking (somnambulism) and Sleep Terrors**
 - There are generally no indications for advanced neuroimaging in these conditions
- **HD-26.6 Insomnia**
 - The benefit of advanced imaging in the evaluation of these patients is unproven at this time.

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HD-27~PITUITARY

- The initial step in the evaluation of all potential pituitary masses is a detailed history, recent physical examination, and thorough neurological exam, including evaluation of the visual fields.
- Endocrine laboratory studies should be performed prior to considering advanced imaging.
- Pituitary imaging is accomplished by brain MRI, generally done without and with contrast (CPT[®]70553). Noncontrast MRI (CPT[®]70551) or MRI Orbit, Face, Neck (CPT[®]70543) is used at times. Head CT without and with contrast (CPT[®]70470) is acceptable in patients who cannot have MRI.
 - Head CT without and with contrast (CPT[®]70470) is occasionally used in addition to MRI to visualize perisellar bony structures in the preoperative evaluation of certain sellar tumors.
 - One study (either brain MRI [CPT[®]70553] or MRI Orbit, Face, Neck [CPT[®]70543]) is adequate to image the pituitary. **The ordering physician should specify that the study is specifically to evaluate the pituitary gland. The use of two CPT[®] codes to report the imaging of the pituitary is not indicated.**
- **HD-27.1 Microadenomas**
 - Microadenomas are less than 1.0 cm in diameter. They may be either functioning (hormone secreting) or not. Hormone secreting microadenomas can be recognized by their hormonal effects.
 - Non-functional microadenomas are discovered incidentally since they have no hormonal effects and are generally too small to exert a mass effect. Microadenomas of the pituitary are found incidentally in about 7% of autopsies. Studies suggest that very few grow to significant size.
 - **Non-functioning microadenomas:** these lack hormonal effects, so endocrinological follow-up is impossible. About 25% of pituitary adenomas are

- nonfunctioning. About 10% secrete more than one hormone, the combination of prolactin and growth hormone being the most common.
- Repeat brain MRI without and with contrast (CPT[®]70553) of non-functioning microadenomas can be performed after 1 to 2 years to ensure stability.
 - A further repeat study can be performed again at 5 years.
 - **Unexplained pituitary asymmetries or small low density regions:** re-imaging is as for non-functioning adenomas.
 - **Prolactinomas:** the most common secreting microadenomas (>50%). These are generally identified in the work-up of elevated prolactin levels in women with galactorrhea or men with hypogonadism.
 - Those that secrete only prolactin are commonly left in place and treated pharmacologically. This creates separate follow-up issues specific to them.
 - Elevated prolactin levels:
 - Normal prolactin levels range up to 25 µg/l in non-lactating, non-pregnant women and up to 20 µg/l in males. Transient elevation up to 40 µg/l can occur with many activities, so a single elevated value of less than 40 µg/l requires repeating prior to consideration of advanced imaging.
 - Pregnancy, renal failure, and several medications—chiefly antipsychotics, metaclopramide (Reglan), and tricyclic antidepressants—can elevate prolactin, although not often above 100 µg/l.
 - Therefore, before an elevated prolactin level of less than 100 µg/l can be regarded as requiring imaging, these other causes of hyper-prolactinemia should be ruled out. Prolactin levels should fall to normal within 7-10 days of withholding the relevant drug.
 - **Initial Imaging** (CPT[®]70553) is appropriate when a significant, unexplained elevation of prolactin is identified. Imaging is not necessary in women with galactorrhea and normal prolactin levels. However, a single imaging study (CPT[®]70553) is supported if galactorrhea that is not associated with pregnancy or breast feeding persists for more than six months even if prolactin levels are normal.
 - **Re-imaging** is generally not indicated unless hormonal levels rise or visual or neurological findings appear. Only about 5% of prolactinomas exhibit significant growth after discovery. Dopamine agonists should be withdrawn for about a week before prolactin is checked to avoid false normals.
 - **Reference:**
 - *N Engl J Med* 2003;349:2035-2041
 - The next most common functioning microadenomas produce either ACTH (pituitary Cushing's Disease/Nelson's syndrome) or growth hormone (acromegaly or gigantism).
 - When found, these will generally be ablated because of the seriousness of their hormonal effects.
 - Follow-up imaging is as for macroadenomas.
 - TSH, FSH, and LH producing microadenomas are uncommon. TSH producing tumors are appropriately sought via imaging in patients who have elevated TSH in the face of documented hyperthyroidism, and the others, on discovery of inappropriately elevated hormone levels.

- **Reference:**
 - Kucharczyk W, Montanera WJ, Kucharczyk J. *The sella turcica and parasellar region*. In Latchaw RE, Kucharczyk J, Moseley ME. *Imaging of the Nervous System*. Philadelphia, Elsevier, 2005, pp.1033-1061
- **HD-27.2 Macroadenomas**
 - Macroadenomas are > 1 cm in diameter. They may present with hormonal abnormalities or visual/neurological effects. Bitemporal hemianopsia is the classic finding (see [HD-36 Visual Field Deficits](#)).
 - Imaging (CPT[®] 70553) is appropriate initially in patients with visual symptoms of a sellar mass regardless of endocrine status.
 - Post-treatment follow-up should include repeat brain MRI (CPT[®]70553) every six months for the first year and then annually for 5 years
 - Longer follow-up is required for craniopharyngiomas, which are tumors of Rathke's pouch in the pituitary region.
 - If treatment of a pituitary tumor must be deferred (e.g. during pregnancy), brain MRI (CPT[®]70553) should be repeated every six months during the period of observation.
 - **Reference:**
 - Neurosurg Clin N Am 2003;14:167-171
- **HD-27.3 Male Hypogonadism**
 - Male hypogonadism is occasionally caused by pituitary tumors.
 - Other causes (depression, systemic illness, diabetes, and certain medications including psychoactive agents) should be excluded before advanced imaging is considered.
 - If there are still borderline to low pituitary hormones (LH and FSH) and serum total testosterone of less than 80% of the lower limit of normal (i.e. <150 ng/l for most labs), brain MRI without and with contrast (CPT[®]70553) is appropriate.
 - Mildly low testosterone levels (>60% of normal) should be repeated before advanced neuroimaging is considered.
 - Repeat imaging is generally not appropriate in this setting.
 - **Reference:**
 - Endocr Pract 2002;8:440-456
- **HD-27.4 Galactorrhea Without Elevated Prolactin**
 - Repeat imaging is generally not appropriate in the setting of galactorrhea without elevated prolactin.
 - Advanced neuroimaging is, in general, not appropriate. However, a single brain MRI without and with contrast (CPT[®]70553) is supported if galactorrhea that is not associated with pregnancy or breast feeding persists for more than one year even if prolactin levels are normal.
- **HD-27.5 Abnormalities of Antidiuretic Hormone (ADH)**
 - **Diabetes Insipidus**
 - There is difficulty concentrating urine which leads to dehydration, generally with a high or normal serum sodium.
 - Usually the cause is self-evident (e.g. trauma, transphenoidal surgery), but approximately 15% of cases are due to pituitary region neoplasms.

- The diagnosis of diabetes insipidus is generally confirmed by fluid and electrolyte testing, which often includes measuring the ability to concentrate urine when fluids are briefly withheld.
- If laboratory testing is consistent with a diagnosis of diabetes insipidus and the etiology remains uncertain, brain MRI without and with contrast (CPT®70553) can be performed.
- **Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH)**
 - There is excessive concentration of urine so that urine remains concentrated (high osmolality) while plasma shows low osmolality (usually including low serum sodium levels).
 - SIADH can occur postoperatively or as a complication of many medical conditions.
 - The diagnosis of SIADH should be confirmed by urine and plasma osmolality measurements (urine with high osmolality; plasma with low osmolality) prior to considering advanced imaging.
 - The cause of SIADH is usually clinically apparent or is discovered in the course of directed body imaging, but if the etiology remains uncertain or is thought to be in the nervous system, brain MRI without and with contrast (CPT®70553) can be performed.
- **HD-27.6 Panhypopituitarism**
 - Endocrinological confirmation is appropriate initially, but brain imaging (CPT®70553) is appropriate in confirmed cases (including hypothyroidism with low TSH).
- **HD-27.7 Other Pituitary Region Tumors**
 - Craniopharyngiomas arise in the parasellar area, and are the most common tumor of that region in children. Over half of these tumors present by about age 20. Few general rules can be given for follow-up, especially for the adamantinomatous variety generally seen in children.
 - **Meningiomas:** about 10% of meningiomas arise in this area. Evaluation may require CT in addition to MRI at times to evaluate for hyperostosis. Follow-up imaging is as for basal meningiomas in general (see [HD-23.8 Meningiomas](#)).
- **HD-27.8 Enlarged (“empty”) Sella Turcica**
 - An enlarged sella turcica without evident tumor is an occasional incidental finding on head MRI or CT. It can arise from a defect in the dural diaphragm of the sella (especially if there is elevated intracranial pressure from another cause), pituitary surgery, or as a result of a pituitary tumor which has expanded the sella and then infarcted (pituitary apoplexy).
 - An “empty” sella causes no symptoms unless the optic chiasm herniates into the sella, causing Chiasmatic-type visual loss.
 - If the initial study was a CT, brain MRI without and with contrast (CPT®70553) is appropriate to exclude residual pituitary tumor and to assess the position of the chiasm.
 - If MRI has shown no abnormality other than the enlarged sella itself, further imaging is generally not necessary unless documented endocrine abnormalities occur.
 - However, to ensure stability and lack of residual pituitary tumor, a single repeat brain MRI without and with contrast (CPT®70553) 1-5 years after the initial study can be performed.

- In patients whose sella is enlarged because of prior neurosurgery, the appropriate neuro-oncology guideline would apply.

2011 HEAD IMAGING GUIDELINES

HD-28~SCALP and SKULL LESIONS

- **Scalp Soft Tissue Masses:** these are almost always benign, especially if cystic. Advanced imaging is usually of limited value since sebaceous cysts and other common benign scalp lesions are generally recognized reliably by physical examination.
- **Skull Bumps or Irregularities:** Skull x-rays are recommended initially. Surgical consultation is helpful prior to considering advanced imaging if x-rays are normal or show only benign osteoma.
 - When advanced imaging is indicated, head CT without and with contrast (CPT[®]70470) is recommended initially, although other choices by consulting neurosurgeons or oncologists are acceptable.
- Head CT (CPT[®]70450 or CPT[®]70470) using bone windows is appropriate in patients with Langerhans' cell histiocytosis, myeloma, and metastatic cancer, when symptoms suggest bony lesions. Contrast may be useful.

2011 HEAD IMAGING GUIDELINES – GENERAL STROKE/TIA

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HD-29~GENERAL STROKE/TIA

- **HD-29.0 GENERAL REMARKS**

- Stroke is fairly common, with about 700,000 new strokes per year in the United States. However, it is probably somewhat over-diagnosed, since a variety of events in the elderly are often attributed to stroke, even when no clinical evidence of a stroke is apparent.
- A stroke is a vascular event in the brain leading to death of neurons and manifested by the creation of a relatively fixed neurological deficit.
 - The most common symptoms of stroke are hemiparesis and aphasia. Binocular diplopia, dysarthria, and ataxia are also seen. Acute confusional spells can arise from a stroke, although this is NOT a typical stroke symptom.
 - Hemiparesis, hemisensory loss, aphasia, and homonymous hemianopsia are the typical deficits of stroke. (See [HD-36 Visual Field Deficits](#))
 - Headache, syncope, and nonspecific lightheadedness may occur with a stroke, but they are not in and of themselves reasons to suspect that an individual is having a stroke.
 - Small strokes which do not involve so-called eloquent areas of brain may be silent or have symptoms too ill-defined to permit clinical recognition.
- A TIA is a transient stroke-like episode lasting less than an hour and typically lasting 5 to 120 minutes.
 - Typical symptoms are hemiparesis, aphasia, and a sense of heaviness or weakness on one side of the body.
 - Amaurosis fugax is a TIA involving a retinal artery which presents with loss of vision in one eye lasting from 5 minutes to an hour.
 - Apparent TIA's lasting over an hour or leaving minor fixed deficits are probably minor strokes.
- TIA's can provide a warning of impending stroke, and the time window of the warning is brief. American guidelines support a maximum of one week to complete evaluation, and the briefer the delay, the better. (See [HD-29 Evidence Based Clinical Support](#))
- **References:**
 - [Stroke 1999;30:1991-1994](#)
 - [Neurology 2004;62:569-573](#)
 - [Neurology 2005;64:817-820](#)
 - [Lancet 2007 Jan;369:283-292](#)

- **HD-29.1 INITIAL IMAGING**

- **Imaging modalities in stroke:**

- **Head CT without contrast (CPT®70450)**

- Commonly used if symptoms or clinical findings suggest a recent stroke or TIA. In this setting, CT is used to exclude other diagnoses, such as hemorrhage or tumor.
- CT is not often useful outside of the acute stroke period, but acutely, it is the most common initial imaging study if stroke or TIA is suspected.

- **Brain MRI (usually without contrast CPT®70551)**

- Can be performed initially in place of head CT if stroke or TIA is strongly suspected based on signs/symptoms/clinical findings (see **HD-29.0 General Remarks**).
- Brain MRI gives better visualization than CT of any infarct that happens to be present, but in most cases, this is not clinically important. The clinically important task is to exclude diagnoses other than stroke (and this can be done by head CT as well).

- **CTA and MRA**

- These studies are used to visualize the cerebral vasculature in patients who have had a stroke or TIA. They are **not** used to diagnose whether or not a patient has had a stroke or TIA.

- **Duplex ultrasound**

- This study can be used to visualize the area around the carotid bifurcation, but it gives very limited information about the vertebral arteries and no information about the circulation in the head itself.

- **Patients presenting within two weeks of the onset** of typical TIA or minor stroke symptoms, as defined above, should have either noncontrast head CT (CPT®70450) or noncontrast brain MRI (CPT®70551) performed as soon as practical. Cervical MRA (CPT®70548) or CTA (CPT®70498) can also be approved initially. Head MRA (CPT®70544) or CTA (CPT®70496) can also be approved in this setting.

- **Hyperacute stroke:** The first few hours of stroke care are usually an issue in emergency or inpatient care.

- Within three to six hours of stroke/TIA onset, centers which have diffusion weighted MRI capability may appropriately request both noncontrast head CT (CPT®70450) to exclude hemorrhage and brain MRI (contrast as requested) to evaluate for actual stroke and the presence of salvageable brain tissue.

- CT perfusion studies (Category III code 0042T) are a reasonable substitute for MRI diffusion/perfusion studies in most strokes which are evaluated within 9 hours of onset, but many health plans currently regard them as experimental (see **HD-34.6 CT Perfusion**).

- These are usually issues in inpatient care, but some requests may be received on an outpatient basis, and they will require expeditious handling.

- **Patients who present more than two weeks after the onset** of typical stroke or TIA as described above should have a detailed neurological examination documented before advanced imaging, but after that, noncontrast head CT (CPT®70450) or noncontrast brain MRI (CPT®70551) and cervical MRA (CPT®70548) or CTA (CPT®70498) can be performed. Brain MRA (CPT®70544) or

CTA (CPT[®]70496) can also be considered.

- If the picture is less clear (such as pure vertigo, lightheadedness, intermittent arm numbness only or pure facial weakness or numbness), a detailed neurological examination should precede use of advanced imaging.
- **Vertebrobasilar TIA/stroke (VBI)** presents both a more complex and, for the present, less urgent situation. A detailed neurological examination should precede selection of advanced imaging.
 - Isolated syncope, “presyncope”, and vertigo are of themselves not often an indication of VBI. See [HD-30 Special Stroke](#) guideline.
- **HD-29.2 LATER IMAGING**
 - Brain MRI without contrast (CPT[®]70551) is appropriate in patients who have had a documented non remote stroke if no initial MRI was performed.
 - Head and neck CTA (CPT[®]70496 and 70498) or MRA (CPT[®]70544 and CPT[®]70548) are appropriate in patients with a documented stroke whose prior evaluation did not include this imaging.
 - **Patients at increased risk of cerebral hemorrhage:** CT head without contrast (CPT[®]70450) is appropriate in patients on either an anticoagulant (e.g. Coumadin, Plavix, Pradaxa[®]) or combined antiaggregant therapy (e.g. aspirin and Plavix together) who develop headache or new neurological findings or who sustain head trauma.
 - **Surveillance imaging** by MRI or CT is not routinely indicated for stroke, especially after the subacute period (several months).
 - **Re-imaging** is indicated if the patient develops features suggesting a new stroke or the appearance of seizures. Without imaging, it can be very difficult to distinguish a new stroke from partial seizures with prolonged Todd’s (postictal) palsy consequent to the original stroke.
 - **Screening:** Screening asymptomatic individuals for stroke using CT, MRI, CTA, or MRA is inappropriate except in certain well-defined clinical settings such as sickle cell anemia.
 - **Asymptomatic Strokes**
 - Small, clinically silent cerebral infarctions incidentally discovered on head imaging are commonly seen in otherwise healthy older adults.
 - Unless there are multiple lesions confined to a single arterial territory or an abnormality present on an ultrasound of the carotid arteries, further advanced neuroimaging is not indicated.
 - **Incidentally noted T-2 hyperintensities**
 - Also see [HD-16.2 Migraine and Tension Headaches](#)
 - The presence of white matter hyperintensities is an age-dependent entity and is especially common in diabetic patients and patients with migraines.
 - Unless there are an unusually high number of lesions or well-defined neurological signs or symptoms, further advanced neuroimaging is not indicated.
 - **Asymptomatic carotid stenosis**
 - See PVD-3 Cerebrovascular and Carotid Disease in the Peripheral Vascular Disease Imaging Guidelines
 - **General Stroke imaging references:**
 - [Hennerici MG. *Imaging in Stroke*. London, Remedica Publishing, 2003](#)

- Latchaw RE, Kucharczyk J, Moseley ME. *Imaging of the Nervous System*. Philadelphia, Elsevier, 2005, *Part II: Cerebrovascular Disease*, pp.141-742.
- ACR Appropriateness Criteria, Focal neurologic deficit 2008

2011 HEAD IMAGING GUIDELINES – SPECIAL STROKE/TIA

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HD-30~SPECIAL STROKE/TIA

- **HD-30.1 Vertebrobasilar Ischemia**
 - The typical features of brain stem and cerebellar stroke are complex. Recognition of vertebrobasilar ischemia also requires detailed knowledge of brain stem vascular anatomy.
 - Isolated vertigo with no other findings and without ataxia is NOT a typical symptom of stroke.
 - A recent detailed neurological examination should precede requests for advanced imaging.
 - Cervical duplex ultrasound (CPT[®]93880 bilateral study or CPT[®]93882 unilateral study) is not adequate to image the vertebrobasilar system in any detail, but can be useful to identify patency and direction of flow of the vertebral arteries.
 - When neuroimaging is indicated, brain MRI (contrast as requested) and head MRA without contrast (CPT[®]70544) or CTA (CPT[®]70496) are generally appropriate. Neck MRA (CPT[®]70548) or CTA (CPT[®]70498) are also acceptable.
 - Acute cerebellar infarcts can develop life-threatening mass effect. A repeat noncontrast brain MRI (CPT[®]70551) or CT (CPT[®]70450) to ensure the stability of a known cerebellar infarction may be appropriate within a month of the stroke. Specialist input regarding the need for such re-imaging is helpful, but should not delay imaging in patients with worsening clinical signs.
- **HD-30.2 Transient Global Amnesia** a syndrome very well defined by a striking clinical presentation. Neuroimaging is not generally required, but if there is uncertainty about the diagnosis, noncontrast CT or MRI of the brain (CPT[®]70450 or CPT[®]70551) is reasonable. A small minority of patients will have a second episode, and in these patients, brain MRI without and with contrast (CPT[®]70553) and head MRA (CPT[®]70544) or head CTA (CPT[®]70496) are appropriate.
 - **Reference:**
 - Ardila A and Farlow M. *Transient global amnesia*. Medlink Neurology, May 25, 2010. <http://www.medlink.com/medlinkcontent.asp>. Accessed June 13, 2011
- **HD-30.3 Venous Infarcts**
 - These are a small percentage of strokes (incidence ~3 per million per year vs. ~2000 per million for all stroke), but most occur in children or young adults (75% of those being in women). Half of puerperal strokes are venous (~12 per 100,000

- confinements). They can arise either from cortical vein or venous sinus thrombosis. Those from sinus thrombosis typically cause elevated intracranial pressure.
- The most common outpatient presentation is intracranial hypertension with papilledema from venous sinus thrombosis.
 - Brain MRI without and with contrast (CPT[®]70553) should be performed initially. MRV (CPT[®]70544) or CTV (CPT[®]70496) is appropriate when the typical pattern of venous infarction is seen on MRI.
 - In women with postpartum stroke or postpartum papilledema, both brain MRI (CPT[®]70553) and MRV (CPT[®]70544) or CTV (CPT[®]70496) can be ordered initially.
 - Children or young adults who present with a stroke in which headache and seizures are prominent, or who are known to have an intrinsic system clotting disorder, can have brain MRI (CPT[®]70553) and MRV (CPT[®]70544) or CTV (CPT[®]70496) initially.
 - Head CT is often the first procedure done in stroke, and will usually indicate the presence of venous infarcts, but MRI/MRV or CTV will still be required if CT shows a venous infarct. Most of these cases are treated in hospital.
 - **Reference:**
 - [N Engl J Med 2005;352:1791-1798](#)

- **HD-30.4 Carotid and Vertebral Artery Dissections**

- Account for about 20% of premature strokes and should be considered in patients under age 50. They probably occur more often in those with neck trauma, fibromuscular dysplasia, Ehlers-Danlos syndrome, and very recent chiropractic neck manipulation. An association with Marfan's syndrome is uncertain.
- **Carotid dissection:** the classic presentation is the appearance of a painful Horner's syndrome in a young adult, often followed by amaurosis fugax or stroke/TIA like symptoms. Sudden severe neck pain radiating to the angle of the jaw and temple is especially suggestive.
- **Vertebral dissection** causes more posterior neck to occiput pain, often with a thunderclap onset.
- CTA or MRA of the neck (without and with contrast--CPT[®]70549 is best) is reliable for diagnosis. CTA or MRA of the brain (CPT[®]70496 or CPT[®]70546) can also be performed if suspicion is very strong.
- Noncontrast brain MRI (CPT[®]70551) to rule out stroke should be done in all confirmed cases, and can be done at the same time as the neck MRA in patients with neurological features.
- Brain MRA without and with contrast (CPT[®]70546) is often useful, especially in patients in their 20's to rule out intracranial dissection and in patients with vertebral/basilar dissection.
- Rarely, carotid or vertebral artery dissections may be seen on a neck MRI obtained for other reasons. Cervical MRA (CPT[®]70549) or CTA (CPT[®]70498) can be obtained for further evaluation in this situation.
- Dissections resolve over time, and re-imaging (MRA neck CPT[®]70548 or CPT[®]70549) several months after onset is appropriate to document this.
 - Long term follow-up imaging is generally unnecessary.
- **References:**
 - [N Engl J Med 2001;344:898-906](#)
 - [Practical Neurology 2005;5:100-109](#)

- **Cerebral Vasculitis:** see [HD-32 Cerebral Vasculitis](#)
- **HD-30.5 Premature Stroke:** (patients under age 45, esp. those without marked conventional risk factors for atherosclerotic disease):
 - Accounts for 5%-10% of all strokes.
 - The differential diagnosis should include cranio-cervical dissections, fibromuscular dysplasia, arteritis, venous infarction, cardioembolic stroke, MELAS, sickle cell disease, Moya moya disease, etc.
 - Due to the more unusual etiologies, brain MRI without and with contrast (CPT[®]70553) is appropriate, even if an initial head CT to exclude hemorrhage was done.
 - Brain and neck MRA, or CTA will generally be indicated as well. Neck MRA should be without and with contrast (CPT[®]70549) when dissection is suspected. (See [HD-30.4 Carotid and Vertebral Artery Dissections](#))
 - Specialty consultation is strongly supported to aid in the best selection of imaging studies.
 - **Reference:**
 - Rowland LP (Ed.). *Merritt's Neurology*. 12th Ed. Philadelphia, Lippincott, 2010, pp.281-294

2011 HEAD IMAGING GUIDELINES

HD-31~SYNCOPE

- Also see **CD-11 Syncope** in the Cardiac Imaging Guidelines
- Complete medical history and recent physical/neurological examination, often supplemented by EKG, are the initial steps in the evaluation of syncope.
- Syncope and near syncope (lightheadedness) are infrequently of primary neurological origin. Neuroimaging is appropriate only when the history or physical examination points in that direction (for example, focal neurological signs/symptoms, evidence of seizure activity, syncope associated with an aura such as an out of body feeling, gustatory or olfactory symptoms, or prolonged post-ictal confusion).
 - The preferred study will vary in those settings, but noncontrast brain CT or MRI (CPT®70450 or CPT®70551) is most often recommended.
 - Neuroimaging is not indicated in patients with clinically typical isolated or recurrent syncope or near syncope and a normal neurological examination.
- **Near Syncope:** the feeling that one is lightheaded, giddy, or about to faint.
 - Occasional, transient near syncope is very common and generally does not require extensive medical evaluation or advanced imaging.
 - The first step is a detailed history and careful physical examination, including a review of medications, evaluation of cardiac and autonomic function (including postural blood pressure measurement), and neurological examination.
 - Extensive evaluation of cardiac function may be appropriate in patients with frequent recurrent attacks.
 - In the absence of documented neurological abnormalities, advanced neuroimaging is generally not necessary.
- Syncope without other neurologic features can be an unusual presentation of vertebrobasilar TIA. A detailed neurological examination should precede the choice of imaging and Neurology consultation is helpful prior to considering advanced imaging in these patients.
- If there is uncertainty as to whether the correct diagnosis is syncope or seizure, Neurology evaluation is helpful. Imaging studies will most often not help to make the correct diagnosis, and syncope is much more often misdiagnosed as epilepsy than the reverse. Note that postictal confusion does raise the issue of seizures.
 - **References:**
 - *Heart* 2003;89:353-358
 - *Eur Heart J* 2004;25:2054-2072
 - *Circulation* 2006;113:316-327 (section “neurological evaluation”)
- Neuroimaging is of little value in situational syncope (e.g. syncope associated with cough, postural syncope, exercise induced, volume depletion, post voiding syncope, fainting at the sight of blood, etc.). The occurrence of postural syncope is often delayed for about twenty minutes in the upright posture unless the postural drop in blood pressure is unusually severe.
- A drop attack is a sudden loss of postural tone with a hard fall (cataplexy) rather than a true syncopal attack, but the two can be confused. Unless drop attacks present as a part of the narcolepsy syndrome, they can be a symptom of brain stem dysfunction, and brain MRI (contrast as requested) with brain MRA (CPT®70544) or CTA (CPT®70496)

may be useful. Cardiac causes also need to be considered. Neurologic or cardiac consultation is helpful.

- **References:**

- *N Engl J Med* 2000;343:1856-1862
- *N Engl J Med* 2002;347:878-885
- *N Engl J Med* 2005;352:1004-1010

2011 HEAD IMAGING GUIDELINES

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HD-32~CEREBRAL VASCULITIS

- **Definition:** Brain dysfunction caused by inflammation of cerebral arteries supplying either neural tissue or the meninges.
- There is a very rare primary cerebral vasculitis, but most cases of cerebral vasculitis are neurological complications in patients with a known systemic small vessel vasculitis.
 - Patients with normal spinal fluid examination and normal brain MRI (especially if FLAIR and DWI are normal) are extremely unlikely to suffer from a primary cerebral vasculitis.
 - Cerebral angiography: Catheter angiography is of established, but limited value in this condition.
 - The value of both CTA and MRA remains to be established. Of the two tests, CTA is more useful and can be performed if the clinical pattern, brain MRI and spinal fluid examination are all consistent with a diagnosis of cerebral vasculitis. MRA is of little value in evaluating for cerebral vasculitis.
- Brain MRI without and with contrast (CPT[®]70553) is usually the most useful diagnostic study, and head CT is not often of value.
- **HD-32.1 Vasculitis Involving Small to Medium-sized Arteries**
 - Systemic lupus erythematosus (SLE) is the most common (>60%), and is a special case among them.
 - SLE can involve the nervous system at any level: brain, meninges, spinal cord, peripheral nerves, even muscles.
 - **Lupus cerebritis** is an ill- defined encephalopathy. Psychiatric symptoms and confusional states are the most common manifestation (75% of cases), followed by seizures (about 20%). Meningeal involvement can lead to cranial nerve syndromes, esp. optic neuritis (10%). The occurrence of the movement disorders in young adults is another fairly common presentation (see [HD-21 Movement Disorders](#)).
 - Brain MRI without and with contrast (CPT[®] 70553) is appropriate
 - MRA is not often useful since the involved arteries are too small to be imaged well.
 - The value of CTA is being defined.
 - **Strokes in SLE:**
 - SLE causes hypercoagulability in many patients and can create sources of cardiogenic embolization (Libman-Sachs endocarditis). About 15% of patients with neurological involvement in SLE have strokes.

- Brain MRI without and with contrast (CPT[®]70553) and head and neck MRA (CPT[®]70544 and CPT[®]70548) or CTA (CPT[®]70496 and CPT[®]70498) are appropriate for initial evaluation.
- Venous infarcts can occur. If venous infarction is recognized on MRI or if there is papilledema, MRV (CPT[®]70544) or CTV (CPT[®]70496) is appropriate (See [HD-30.3 Venous Infarcts](#)).
- **Other collagen vascular diseases** involving small to middle size arteries can affect the brain. Brain MRI without and with contrast (CPT[®]70553) is indicated when this occurs, but MRA and CTA are generally not useful.
 - **Behçet's Disease:** a third of patients have cerebral complications similar to those seen in SLE.
 - **Wegener's Granulomatosis:** the usual neurological complication is peripheral neuropathy, but involvement of the meninges, skull base, or middle ear can lead to cranial nerve palsies or orbital pseudotumor. Temporal bone or orbital MRI without and with contrast (CPT[®]70543) is appropriate. (See [HD-38 Ophthalmology Conditions](#))
 - **Churg-Strauss:** (eosinophilia, atopy, asthma and a polyarteritis-like combination of glomerulonephritis and neuropathy) involves the CNS (encephalopathy) in 5% of cases. Brain MRI without and with contrast (CPT[®]70553) is appropriate in such cases.
 - **Seropositive rheumatoid arthritis, scleroderma, and Sjögren's syndrome:** premature strokes occur (see [HD-30.5 Premature Stroke](#)).
- **HD-32.2 Cocaine and Methamphetamine Use**
 - Cocaine and methamphetamine use are associated with premature vascular occlusive events, but whether this reflects spasm or arteritis is uncertain. Brain MRI without and with contrast (CPT[®]70553) is useful if neurological changes are present. Head CTA (CPT[®]70496) may be useful to demonstrate arterial abnormalities.
- **HD-32.3 Sarcoidosis**
 - Sarcoidosis involves the nervous system in about 5% of cases, but neuro-sarcoidosis is rare in patients without established involvement elsewhere.
 - Meningeal involvement is common, leading to hydrocephalus or to cranial nerve palsies, esp. CN VII. Diffuse encephalopathy and spinal cord involvement can occur, but not commonly.
 - Brain MRI without and with contrast (CPT[®]70553) is generally the best study.
 - The use of head CT is largely limited to evaluation of shunt integrity in those with treated hydrocephalus.
- Sarcoid involvement of the sinuses is common. Sinus CT (contrast as requested) is appropriate when this is suspected (see [HD-44 Sinus and Facial Imaging](#))
- **HD-32.4 Large Vessel Arteritis (Giant cell arteritis)**
 - **Temporal arteritis:** a fairly common disorder in patients over age 50 (incidence of ~20/100,000 persons over age 50).
 - Marked elevation of ESR is almost always identified, and ESR is the initial test in evaluation for this diagnosis.
 - Monocular visual loss (arteritic ischemic optic neuritis—AION) is the only frequent vascular complication (see [HD-38 Ophthalmology Conditions](#)), although there are reports of vertebrobasilar strokes.

- Neuroimaging is indicated for evaluation of suspected vertebrobasilar stroke. (See [HD-29 General Stroke/TIA](#)).
- **Takayasu's Arteritis** (pulseless disease): is suspected in patients under age 40 with loss of at least one peripheral pulse, symptoms of limb claudication, and blood pressure asymmetries between limbs. About half of the patients have recurrent syncope.
 - Strokes, TIA's, amaurosis fugax, and cardiovascular events are common.
 - The illness is seen in young children also.
 - The site of involvement is the aorta and its major branches, including the coronary arteries (see CD-8.6 Other Indications for CCTA in the Cardiac Imaging Guidelines).
 - MRA or CTA is useful for diagnosis and follow-up, and multiple studies (brain to lower limbs) are commonplace.
 - Brain MRI (CPT[®]70553) is appropriate if there are focal neurological complaints or substantial changes on head or cervical MRA or CTA.
 - Periodic re-evaluation with extensive MRA of the aorta and its primary branches is standard (annual studies are acceptable).
- **Reference:**
 - *Practical Neurology 2002;2:80-93*

2011 HEAD IMAGING GUIDELINES

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HD-33~VERTIGO

- Also see [HD-30.1 Vertebrobasilar Ischemia](#)
- A detailed history and description of the vertigo as well as a recent focused neurological/otological examination are the initial steps in the evaluation of patients with vertigo. The duration of attacks is critically important in formulating a differential diagnosis.
- **Vertigo**, in contrast to lightheadedness (near syncope), is a false sense that either oneself or the world is rotating. It is fairly common, almost always episodic, quite distressing, and generally benign.
 - “Dizziness” is a term without defined medical meaning and is best avoided since it does not distinguish vertigo from lightheadedness.
 - Dizziness that is not vertigo is usually not a reflection of neurological disease and advanced imaging is not generally indicated.
 - **NOTE:** Vertigo that is accompanied by ataxia or falling is generally an indication for advanced imaging (most often brain MRI without contrast [CPT[®]70551] or brain MRI without and with contrast [CPT[®]70553]).
- **HD-33.1 Benign Positional Vertigo**
 - Characterized by vertigo lasting seconds, provoked by certain movements, and should be self-limited. It can be diagnosed at the bedside (Dix-Hallpike maneuvers), and imaging is not generally needed.
 - Patients with persistent attacks (continuing for >2 weeks) not resolved by Positional Maneuvers (including Epley's maneuver) may require either brain MRI without and with contrast (CPT[®]70553) or temporal bone CT without contrast (CPT[®]70480) to visualize the superior labyrinth.
 - CT offers better visualization of the labyrinth, while MRI is better for visualization of the brain.
 - A detailed neuro-otological examination is critical to the evaluation of positional vertigo.
 - **References:**
 - *N Engl J Med* 1999;341:1590-1596
 - *Practical Neurology* 2005;5:114-117 (Very striking illustrations of Epley's Maneuver and the Dix-Hallpike tests)

- **HD-33.2 Vascular Vertigo**: Episodes of vertigo lasting 5 to 20 minutes, especially if associated with other neurological events, raise a suspicion of vertebrobasilar TIA's (see [HD-30.1 Vertebrobasilar Ischemia](#)). Patients are generally ataxic during the episodes. A detailed neurological or otological examination may be helpful in determining both etiology and the need for advanced imaging.
 - **Reference**:
 - [Arch Neurol 1989;46:281-284](#)
- **HD-33.3 Meniere's Disease (labyrinthine hydrops)**: episodes lasting from 20 minutes to several hours, often accompanied by tinnitus and, over time, documented unilateral hearing loss. Because of the extensive differential diagnosis and the importance of specialized bedside testing, detailed neurological or ENT evaluation is helpful prior to consideration of advanced imaging.
 - Clinical examination and audiological testing should be performed initially.
 - Brain MRI without and with contrast (CPT®70553) can be performed for confirmation of the diagnosis.
 - **Reference**:
 - [Otolaryngol Head Neck Surg 1995;113:181-185](#)
- **HD-33.4 Acute Labyrinthitis (vestibular neuritis)**: acute usually severe vertigo, sometimes with hearing loss. An attack typically resolves over days.
 - Advanced imaging is not usually indicated.
 - Noncontrast brain MRI (CPT®70551) is recommended for the following:
 - Sudden onset in a patient with diabetes or hypertension
 - Onset accompanied by severe headache
 - If neurological findings other than vertigo are also present (such as inability to stand, incoordination of limbs, diplopia, dysarthria, hemiparesis, or altered level of awareness) or clinical examination otherwise supports a "central" source.
 - If there is associated hearing loss with any of these features, brain MRI without and with contrast (CPT®70553) is appropriate.
 - Brain MRI (CPT®70553) is appropriate for patients with apparent acute labyrinthitis who fail to improve markedly within 2 weeks and in those who on careful examination fail to show abnormal head thrust bedside testing.
 - **References**:
 - [N Engl J Med 2003; 348:1027-1032](#)
 - [Neurology 2006;67:1178-1183](#)
- **HD-33.5 Superior Semicircular Canal Dehiscence**: syndrome characterized by dehiscence of bone overlying the superior canal. Diagnosis is by audiology followed by high resolution temporal bone CT (CPT®70480). The patients usually have vertigo and nystagmus provoked by loud noises and an increased sensitivity to bone conducted sounds.
 - **Reference**:
 - [Laryngoscope 2005;115\(10\):1717-1727](#)

2011 HEAD IMAGING GUIDELINES

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HD-34~NEWER IMAGING TECHNIQUES

- Continuing development of CT and MRI technology has led to potential new uses. Established clinical utility has been found for some of these newer techniques while others should still be regarded as experimental.
- **HD-34.1 Functional MRI (f-MRI)**
 - **CPT[®] codes for functional MRI:**
 - **70554** MRI Brain, functional MRI, including test selection and administration of repetitive body part movement and/or visual stimulation, not requiring physician or psychologist administration
 - **70555** MRI Brain, functional MRI; requiring physician or psychologist administration of entire neurofunctional testing
 - Certain payers consider f-MRI investigational, and their coverage policies will take precedence over MedSolutions' guidelines.
 - See [HD-34 Evidence Based Clinical Support](#) section for a detailed explanation of fMRI. Currently, fMRI is a technique used preoperatively to define “eloquent” areas of brain, esp. the sensorimotor strip and the regions involved in language use. Avoidance of regions within 2 cm of eloquent cortex reduces postoperative neurological deficits.
 - **f-MRI** is appropriate as a part of the preoperative evaluation of patients undergoing craniotomy for regions in which the presence of eloquent cortex is an issue (patients with appropriately located tumor, AVM, or epileptic focus).
 - For f-MRI, use of 3T MRI scanner is appropriate when available.
 - Involvement of a neurologist or neurosurgeon is necessary since the test is preoperative.

- At this time, any use of f-MRI for diagnostic purposes, rather than for preoperative localization, is experimental.
- **References:**
 - Haughton VM, et al. *Mapping brain function with functional magnetic resonance imaging.* In Latchaw RE, Kucharuczyk J, Moseley ME. *Imaging of the Nervous System.* Philadelphia, Elsevier, 2005, pp.89-100
 - *Neurosurgery* 2004;54:902-915.
 - *Radiology* 2005;236:247-253
 - *Neuroimag Clin N Amer* 2006;16:285-297
 - *Radiology* 2006;240:793-802
 - Stippich C (Ed.). *Clinical Functional MRI.* Springer, Berlin Heidelberg, 2007
- **HD-34.2 Magnetic Resonance Spectroscopy (MRS):** analysis of the levels of certain chemicals in a pre-selected voxels (small regions) on an MRI scan done at the same time (see discussion in [HD-34 Evidence Based Clinical Support](#) section).
 - Certain payers consider MRS investigational, and their coverage policies will take precedence over MedSolutions' guidelines.
 - **Adult brain tumor:** MRS is generally regarded as experimental in the management or diagnosis of brain tumor in adults for most purposes. For instance, the results of MRS cannot reliably distinguish neoplasms from benign inflammatory lesions, or reliably distinguish malignant oligodendrogliomas likely to respond to chemotherapy from other malignant gliomatous tumors.
 - **Reference:**
 - CMS, *Decision memo for magnetic resonance spectroscopy for brain tumors (CAG-00141N)*
<http://www.cms.gov/hhs.gov/mcd/viewdecisionmemo.asp?id=52>
Accessed December 18, 2009
 - *Neurology* 2005;64:2085-2089
 - After radiation treatment of brain tumors, it may be difficult to distinguish radiation necrosis from recurrent tumor without awaiting the results of serial MRI scans. In cases of glioblastoma or other highly anaplastic tumor, metabolic PET (CPT[®]78608) is widely used to make this distinction, but MRS is an acceptable alternative to PET for this purpose. **Such cases should be referred for Medical Director review.**
 - There may be a role for MRS in the follow-up of treated patients with less anaplastic tumors (in which FDG PET is not useful) esp. in the management of surgically inaccessible tumors. This circumstance arises especially in pediatric cases.
 - MRS is clearly useful in the diagnosis and subsequent management of certain rare inborn errors of metabolism affecting the CNS, including adrenoleukodystrophy, creatinine pathway disorders, and others. Cases should be referred for Medical Director review.
 - **References:**
 - *Neuroimaging Clin N Am* 2006;16:87-116. *An encyclopedic review of current knowledge regarding use of MRS in inborn errors, disease by disease.*
 - *Neurology* 2005;64:434-441
 - *Neurology* 2005;64:406-407
 - MRS produces highly variable results in MS, varying with the pathological process. It does not appear to be useful in distinguishing multiple sclerosis plaques from tumors, since both can produce similar results.
 - The use of MRS in multiple sclerosis, especially in making the differential

- diagnosis of MS versus tumor, is experimental at this time.
- Use of MRS in patients with cerebral metastases of systemic cancers is currently regarded as experimental.
- **HD-34.3 Diffusion Weighted Imaging (DWI)**: Diffusion weighted images are obtained without contrast and have in many centers become a routine or semi-routine part of the noncontrast MRI head examination. They are useful in a variety of situations, but especially in acute stroke evaluation.
See **Evidence Based Clinical Support section** for [HD 29](#) and [HD 34](#).
 - Use of diffusion weighted imaging does not require separate CPT[®] coding.
- **HD-34.4 Perfusion Weighted Imaging (PWI)**: performed with contrast and has become a common part of initial acute stroke evaluation.
See **HD-34 Evidence Based Clinical Support** section.
 - Use of PWI does not require separate CPT[®] coding.
 - CT perfusion imaging is an alternative to MRI DWI/PWI imaging.
See **HD-34.6 CT Perfusion**
- **HD-34.5 CSF Flow Imaging**: imaging of CSF flow is sometimes useful in preoperative evaluation of hydrocephalus and Chiari syndrome with either features of hydrocephalus or syrinx. There are various techniques for this.
 - Generally done as a part of a head MRI examination and is not often coded separately.
 - Certain payers consider CSF flow imaging investigational, and their coverage policies will take precedence over MedSolutions' guidelines.
 - **Reference**:
 - Latchaw RE, Kucharczyk J, Moseley ME. *Imaging of the Nervous System*. Philadelphia, Elsevier, 2005, pp.1089-1100
- **HD-34.6 CT Perfusion**
 - **CPT[®] 0042T** - "cerebral perfusion analysis using CT"
 - Certain payers consider CT perfusion studies as investigational, and their coverage policies will take precedence over MedSolutions' guidelines.
 - A contrasted CT technique that currently is used to measure regional cerebral blood flow (rCBF=mean transit time or r-MTT) and regional cerebral blood volume (rCBV).
 - Performed as part of a head CT examination and adds only a few minutes to the procedure.
 - Thus far, the only established use for CT perfusion studies is in the emergent evaluation of patients with very new strokes still within the window permitting thrombolytic use (probably about 6 to 9 hours).
 - Since this is emergent, preauthorization will rarely be requested.
 - CT perfusion studies have been shown to be similar in value for this purpose to MRI DWI/PWI imaging for strokes within the middle cerebral distribution, which is by far the most common location for stroke. (Stroke location can usually be determined clinically).
 - CT perfusion studies are done on one or two axial cuts of the CT examination, so in strokes outside the middle cerebral territory, MRI DWI/PWI imaging will normally be preferred.
 - Performance of both CT perfusion and MRI DWI/PWI will rarely be indicated.

- Currently, the use of CT perfusion is experimental except for its use to evaluate new stroke patients as described above.
- **References:**
 - [Ann Neurol 2006;60:508-517](#)
 - [Neurology 2007;68:694-697](#)
 - [Stroke 2001;32:2021-36](#)
 - [Neurology 2007;68:730-736](#)
- **HD-34.7 Magnetic Resonance Neurography (MRN)**
 - Also see PN-7 Newer Imaging Techniques
 - These studies code as MRI of the relevant area, usually without contrast.
 - MRN produces striking T2 weighted images of Wallerian degeneration in nerves involved in a variety of pathological processes. However, at this time there is no compelling evidence indicating that MRN adds significant information affecting patient management.
 - MRN is considered experimental at this time.
 - **References:**
 - [Nature Clin Pract Neurol 2005;1:45-53](#)
 - [Neurology 2002;58:1597-1602](#)
- **HD-34.8 Positional MRI:** Currently, there is no body of evidence substantial enough to support the medical necessity of this procedure. The range of normal findings needs to be established, as does the clinical significance of variant findings on positional MRI. It should be considered experimental at this time.
- **HD-34.9 MRI Using 3T and Higher Magnets**
 - A role for the use of 3T MRI scanners is known in functional MRI studies.
 - Except for use in functional MRI studies, the usefulness of 3T and higher field strengths is yet undetermined, and they should be considered experimental at this time.
 - See [HD-34.1 Functional MRI](#)
- **HD-34.10 Magnetic Source Imaging (MSI)**
 - Magnetic source imaging code: **HCPCS S8035**.
 - Certain payers consider MEG and MSI investigational, and their coverage policies will take precedence over MedSolutions' guidelines.
 - Magnetoencephalography (MEG) without MSI does not require preauthorization by MedSolutions at this time.
 - Magnetoencephalography (MEG) is an EEG-like technique which measures magnetic rather than electric fields created by living brain tissue. These signals can be averaged and those averages can be registered to brain MRI images to create a magnetic field brain map. This is called Magnetic Source Imaging (MSI).
 - See discussion in HD-34 Evidence Based Clinical Support section.
 - MSI imaging can in theory be used to map the location of sensitive brain areas such as those involved in speech and sensorimotor function. Such maps can, in principle, be used to guide neurosurgical procedures which involve brain regions close to these sensitive functions and thereby make them safer.
 - Similar results can be obtained using f-MRI (see HD-34.1 Functional MRI).
 - Use of MEG/MSI in neurosurgical preoperative planning is still limited to a small number of centers worldwide and is widely regarded at this time as experimental.

- MSI images have also been used to identify seizure foci in patients being considered for epilepsy surgery.
 - The value of this technique and its eventual role are not yet established, and this indication is widely regarded as experimental.
- At this time, there is no indication for using MEG/MSI in diagnostic testing.
- **References:**
 - [Radiology 2006;241:213-222](#)
 - [Neurosurgery 2006;59:493-511](#)
 - [Latchaw RE, Kucharczyk J, Moseley ME. *Imaging of the Nervous System*. Philadelphia, Elsevier, 2005, pp. 101-120 and 1225-1239](#)
- **HD-34.11 Cone Beam Computed Tomography (CBCT)**
 - **CPT® Codes: 70486, 70487, 70488, 70480, 70482**
(NO separate 3-D rendering codes should be reported)
 - See [HD-45 Temporomandibular Joint Disease \(TMJ\)](#) and Dental/Periodontal/Maxillofacial Imaging for guidelines regarding medical indications for CBCT.
 - Utilizes a cone-shaped source of ionizing radiation which encompasses an entire field of view; thus, a single rotation is sufficient to acquire enough information to produce either 2D reconstruction or 3D rendering of the image.
 - Decreases image distortion and gives more accurate spatial resolution for the measurements required in certain maxillofacial procedures such as implant placement, orthodontic analysis, etc.
 - In current clinical practice, CBCT is being used to replace the need for two dimensional studies such as dental periapical x-rays, panorex x-rays, tomograms, facial x-rays, and cephalometric films.
 - Radiation dosage is variable and not standardized but is less than a conventional CT scanner. There is a lack of evidence-based data on the radiation dose for CBCT imaging.
 - Terminology and technical device properties and settings are not consistent in the literature.
 - Currently there are no published guidelines from any specialty society such as the American Association of Oral and Maxillofacial Surgeons regarding the appropriate use of cone beam CT for dentoalveolar conditions, maxillofacial conditions, orthodontics, endodontics, or dental implants.
 - **Reference:**
 - [International Journal of Oral & Maxillofacial Surgery 2009 June;38\(6\):609-625](#)

OPHTHALMOLOGY GUIDELINES

HD-35~OPTIC NEURITIS

- Also see [HD-22 MS](#)
- The diagnosis of optic neuritis can be made clinically—without imaging—with over 99% accuracy.
 - Imaging is done to find associated evidence of Multiple Sclerosis (MS); therefore, brain MRI without and with contrast (CPT[®] 70553) is indicated on initial presentation.
 - Spinal cord imaging (cervical and thoracic spine) may be useful if brain imaging is neither normal nor firmly diagnostic of MS, but in apparently isolated optic neuritis, spinal cord imaging is not often useful.
 - **Reference:**
 - [Neurology 2004;62:226-233](#)
- Dedicated orbital imaging will usually show demyelination/inflammation of the optic nerve. However, this information is rarely clinically useful and in patients with optic neuritis, it is not relevant to McDonald criteria scoring for MS.
 - **Orbital MRI is appropriate only in atypical cases.**
 - MRI of the orbits without and with contrast (CPT[®]70543) is appropriate in the presence of at least one of the atypical features listed below:
 - Visual loss progressing in severity for more than 10 days
 - Patient age > 45
 - Lack of *any* pain or soreness with the visual loss.
 - *Severe* disc edema on clinical examination. Mild disc edema is common in optic neuritis, but severe edema with hemorrhages and exudates is not.
 - Evidence of iritis or uveitis (eye disease not limited to the optic nerve)
 - Failure to manifest at least some improvement in visual acuity within a month of onset.
 - **References:**
 - [Magn Reson Imaging Clin N Am 2002;10:663-678](#)
 - [Lancet Neurology 2005;4:111-121](#)
- In adults, optic neuritis is generally unilateral.
 - **Reference:**
 - [Neurology 2006;67:258-262](#)

HD-36~VISUAL FIELD DEFICITS

- Detailed history and recent physical examination, including testing of the visual fields, should be performed initially prior to considering advanced imaging.
- Neurology or Ophthalmology evaluation is helpful in determining the appropriate imaging pathway.
- Visual loss limited to a single eye generally reflects involvement of the optic nerve or the globe itself.
 - Imaging of the orbit should be performed and brain imaging is not indicated initially.
 - **Exceptions:**
 - Patients with typical optic neuritis should have brain imaging initially rather than orbital imaging (see [HD-35 Optic Neuritis](#)).

- In certain ocular neoplasms, brain imaging may be needed also, since the lesion may extend into the cranial cavity.
- Chiasmatic field defects generally involve the temporal (lateral) visual fields of both eyes.
 - The cause of a chiasmic defect is near the pituitary.
 - Brain imaging is critical, but the orbits may need to be imaged as well, if the lesion is one prone to infiltrate “forward” to the orbits.
- Homonymous visual field defects (the kind common in strokes) are also called retrochiasmatic. The visual field loss is of *the same side of the world* in both eyes. The lesion is in the posterior half of the brain.
 - Brain imaging is needed, but orbital imaging is not.

HD-37~HORNER’S SYNDROME

- Patients with isolated anisocoria and presumed meiosis should have other causes (physiologic anisocoria, contracted Adie’s pupil) excluded by the examination of old photographs for evidence of previous abnormality prior to consideration of advanced imaging.
- Ptosis from Horner’s syndrome is mild (<2 mm). More severe ptosis suggests another diagnosis. Ptosis without anisocoria is very infrequently from Horner’s syndrome.
- Age and clinical setting determine the differential diagnosis and therefore the appropriate order of evaluation in patients with Horner’s syndrome.
 - In patients with Horner’s syndrome combined with other neurological features, the appropriate evaluation is determined by those other features, not the Horner’s syndrome, and the appropriate guideline should be consulted (e.g. noncontrast brain MRI [CPT®70551] if there are features of lateral brain stem infarction, etc.).
 - The coincidence of Horner’s syndrome with extraocular palsies suggests involvement in the region of the cavernous sinus.
 - Brain MRI without and with contrast (CPT®70553) (earmarked for attention to the area) is indicated, along with head CTA (CPT®70496) or MRA (CPT®70544) if requested.
 - When there are associated features suggesting sinus involvement, such as facial pain or bloody nasal discharge, sinus CT (contrast as requested) is appropriate.
 - In patients between age 15 and 50 who present with pure Horner’s syndrome, carotid artery dissection is likely. Classically, there is pain radiating from neck to temple and facial sweating is noted to be spared.
 - Brain MRI (CPT®70553) and cervical CTA (CPT®70498) or cervical MRA without and with contrast (CPT®70549) are indicated initially.
 - Patients over age 50 with pure Horner’s syndrome should have chest CT (CPT®71260) as the initial imaging study to exclude apical lung masses. Chest x-ray is not reliable in the apical region.
 - In patients with Horner’s syndrome and features of a cervical spinal lesion, imaging should begin with cervical spine MRI (contrast as requested).
 - Horner’s syndrome during attacks is a typical feature of cluster headaches, and in some patients, a mild Horner’s syndrome is apparent between attacks: **this is not an indication for imaging** for the Horner’s syndrome, though head imaging for the

cluster headaches themselves may be appropriate if not already done.
(See [HD-16.4 Cluster Headache](#)).

- **Reference:**
 - *Practical Neurology* 2001;1:42-49
- Horner's syndrome associated with ophthalmic zoster does not generally require the use of advanced imaging.

OPHTHALMOLOGY GUIDELINES

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HD-38~OPHTHALMOLOGY CONDITIONS

- **HD-38.1 Imaging Studies**

- **Orbital CT and MRI**

- Both orbital CT (CPT®70480, CPT®70482) and orbital MRI (CPT®70540, CPT®70543) are useful in certain orbital disorders, and in those disorders, the preferences of an ordering ophthalmologist for one modality or the other should be honored.
- Orbital MRI or CT should not be added to head MRI or CT as a matter of routine: there must be documentation of a need to exclude an orbital disorder for which the head imaging study would not provide sufficient evaluation.
- Head MRI or CT similarly should not be added to orbital MRI or CT as a matter of routine unless the ocular disorder is such that brain imaging is also warranted.
- Except in the evaluation of potential aneurysm, TIA, or stroke, head CTA or MRA is not ordinarily useful in the evaluation of visual disorders.
- Except in the evaluation of potential dissection, TIA, or stroke, cervical CTA or MRA is not ordinarily useful in the evaluation of visual disorders.

- **Ophthalmic Ultrasound**

- **Coding**

- CPT®76510 Ophthalmic ultrasound, diagnostic; B-scan and quantitative A-scan performed during the same patient encounter
- CPT®76511 Ophthalmic ultrasound, diagnostic; quantitative A-scan only

- CPT[®]76512 Ophthalmic ultrasound, diagnostic; B-scan (with or without superimposed non-quantitative A-scan)
- CPT[®]76513 Ophthalmic ultrasound, diagnostic; anterior segment ultrasound, immersion (water bath) B-scan or high resolution biomicroscopy immersion
- CPT[®]76514 Ophthalmic ultrasound, diagnostic; corneal pachymetry, unilateral or bilateral
- CPT[®]76516 Ophthalmic biometry by ultrasound echography, A-scan
- CPT[®]76519 Ophthalmic biometry by ultrasound echography, A-scan; with lens power calculation
- CPT[®]76529 Ophthalmic ultrasonic foreign body localization
- **Ophthalmic ultrasound** involves placement of an ultrasound probe on the surface of the anesthetized eye to measure the axial length of the eye and precisely identify the size and type of abnormal tissue.
 - Ophthalmology or optometry specialist consultation is helpful in determining the appropriate imaging pathway
 - A-scan (CPT[®]76510 when quantitative A-scan is completed with B-scan, or CPT[®]76511, A-scan only) is performed for the following:
 - ❖ To measure tumor size
 - ❖ To differentiate both intraocular and orbital pathology
 - B-scan (CPT[®]76510, CPT[®]76512, or CPT[®]76513) is performed for the following:
 - ❖ When clouding of the ocular tissues prevents proper visualization of the structure of the eye
 - ❖ To evaluate the retina
 - ❖ To evaluate intraocular tumors or other intraocular disorders
 - CPT[®]76510 and CPT[®]76511 should not be reported nor billed together for the same imaging session.
 - Repeat imaging for the same condition is not indicated unless previous imaging results are indeterminate or symptoms have changed.
- **Ophthalmic biometry**
 - A-scan technology (CPT[®]76516) is performed prior to cataract surgery to determine the axial length of the eye and to identify any abnormalities in globe length.
 - If the strength of the intraocular lens (IOL) needed for cataract surgery is calculated during the same session, report with CPT[®]76519.
 - By CPT[®] definition, any diagnostic ultrasound requires “permanently recorded images.”
 - ❖ Exceptions to this rule include those studies whose result is a biometric measurement such as CPT[®]76514, CPT[®]76516, and CPT[®]76519.
 - Repeat imaging for the same condition is not indicated unless previous imaging results are indeterminate or symptoms have changed.
- **Foreign body localization**
 - CPT[®]76529 is performed to localize a foreign body in the eye and to guide its removal

- **HD-38.2 Ill-defined Visual Symptoms:** A detailed visual and ophthalmological examination should be performed prior to considering advanced neuroimaging in patients with no objective abnormalities on general physical examination who have nonspecific visual changes (blurry vision, seeing spots, floaters, etc.).
- **HD-38.3 Orbital Trauma:** orbital CT without contrast (CPT®70480) is preferred.
- **HD-38.4 Orbital Calcifications:** orbital CT without and with contrast (CPT®70482) is preferred.
- **HD-38.5 Bony Erosion of Orbit:** noncontrast orbital CT (CPT®70480) is useful to define the presence of erosions, but MRI (contrast as requested) may be needed to define their source.
- **HD-38.6 Orbital Cellulitis:** orbital or maxillofacial CT without and with contrast is indicated (CPT® 70482 or CPT®70488), but MRI may be substituted at the request of a consulting ophthalmologist or ENT specialist.
 - Brain imaging (CT or MRI without and with contrast—CPT®70470 or CPT®70553) may also be useful if there is a suggestion of intracranial extension of the infection.
- **HD-38.7 Orbital Pseudotumor and Thyroid Exophthalmos:** noncontrast orbital CT (CPT®70480) or MRI without and with contrast (CPT®70543) is indicated. CT is usually the preferred initial study.
- **HD-38.8 Proptosis:** noncontrast orbital CT (CPT®70480) is generally appropriate initially.
 - Patients with tumors of the globe or orbit (other than retinoblastoma), MRI of orbit without and with contrast (CPT®70543) is indicated.
 - For optic nerve glioma, brain MRI (contrast as requested) can also be performed.
- **HD-38.9 Optic Neuropathy or “Non-arteritic Ischemic Optic Neuropathy (NAION)”:** generally, imaging is not required.
 - If there is reason to believe this is part of more generalized cerebrovascular disease, stroke/TIA imaging guidelines apply.
(See [HD-29 General Stroke/TIA](#) and [HD-30 Special Stroke/TIA](#))
- **HD-38.10 Arteritic Ischemic Optic Neuropathy (AION):** this is a complication of temporal arteritis (giant cell arteritis)
 - Requests for imaging in this complex situation should be referred for Medical Director review.
 - Temporal arteritis usually does not significantly involve the cerebral circulation, but it can on occasion.
- **HD-38.11 Simple Retinal Detachment:** imaging is usually not required.

- **HD-38.12 Uveitis:** orbital MRI without and with contrast (CPT®70543) may be indicated.
 - There are uveal-meningeal syndromes which may require the addition of brain MRI without and with contrast (CPT®70553) to visualize the meninges.
- **HD-38.13 Benign Eyelid Myokymia:** this common condition can generally be recognized clinically. In typical cases, advanced imaging is not often of value.
- **HD-38.14 References:**
 - Latchaw RE, Kucharczyk J, Moseley ME. *Imaging of the Nervous System.* (Ch 47-48). Philadelphia, Elsevier, 2005
 - Yousem DM, Grossman RI. *Neuroradiology, the requisites.* 3rd Ed. (Ch10). Philadelphia, Mosby, 2010
 - *Magn Reson Imaging Clin N Am* 2002;10:663-678
 - *Clin Experiment Ophthalmol* 2009;37:30-53

EAR and NOSE GUIDELINES

HD-39~EPISTAXIS

- Initial evaluation of epistaxis (nose bleed), including recurrent epistaxis, is by direct or endoscopic visualization of the relevant portions of the upper airway.
 - If the initial clinical evaluation is unrevealing, ENT examination may be helpful.
 - Maxillofacial CT may be useful in individual cases, depending upon the findings during the initial clinical evaluation.

HD-40~MASTOID DISEASE

- Temporal bone CT without contrast (CPT[®]70480) is the usual initial imaging study for disease of the mastoid region, including mastoiditis.
- Minor degrees of mastoid cell mucosal thickening are often seen on head MRI or other cranial imaging studies, and do not, in general, require further imaging.

HD-41~FACIAL TRAUMA

- **CT without contrast** is the preferred imaging study in facial trauma.
- Coding of Facial imaging:
 - **Maxillofacial versus orbital/temporal bone CT:** both orbital/facial bone CT (CPT[®]70480, and CPT[®]70482) and maxillofacial CT (CPT[®]70486, CPT[®]70487, and CPT[®]70488) cover the structures of the orbits, sinuses, and face. Unless there is a grounded suspicion of simultaneous involvement of more posterior lesions, especially of the region involving the middle or inner ear, one of these studies only should be sufficient.
- Mild mucosal thickening in the paranasal sinuses or mastoids without other abnormalities is common in healthy individuals and not of itself an indication for imaging.
- ENT, Plastic surgery, or other relevant specialist evaluation is helpful in determining the appropriate imaging pathway.
- Maxillofacial CT (CPT[®]70486) is the usual study (except in orbital or temporal bone trauma), but the preference of a requesting ENT or neurologist/neurosurgeon should be honored.
- Patients with facial trauma are often at risk for associated injury of both the cranial contents and the cervical spine.

HD-42~HEARING LOSS

- Otoscope and audiological examinations are the initial steps in evaluating hearing loss of all types.
- **Conductive Hearing Loss**
 - Advanced imaging is generally inappropriate in patients with hearing loss caused by benign impaction of one or both external auditory canals.
 - In patients with unilateral conductive hearing loss, especially those with abnormal otoscopic findings, temporal bone CT without contrast (CPT[®]70480) may be useful.

- When advanced imaging is necessary in patients with bilateral conductive hearing loss, CT of the temporal bone (CPT[®]70480) is usually appropriate.
 - ENT physicians often use contrasted CT or MRI when malignancy is identified, and this is acceptable.
- **Cochlear Hearing Loss**
 - ENT consultation is of benefit in patients with unexplained bilateral cochlear hearing loss.
 - In patients with unilateral cochlear loss, advanced imaging with either brain MRI without and with contrast (CPT[®]70553) or temporal bone CT (CPT[®]70480) may be appropriate.
 - MRI is generally preferred when a retrocochlear lesion cannot be definitely excluded by other means.
- **Retrocochlear Hearing Loss**: MRI of the head with attention to the internal auditory canals and without and with contrast (CPT[®]70553) is helpful in both unilateral and bilateral cases.
- **Cochlear Implants**: the surgeon's choice among preoperative craniofacial studies should be honored
- **Cholesteatoma**
 - If cholesteatoma is suspected by clinical exam and/or symptoms (e.g. painless drainage from the ear, conductive hearing loss, chronic/recurrent ear infections), CT of the temporal bone, contrast as requested (CPT[®] 70480, or CPT[®]70482), can be performed.
 - 3D rendering can be performed in conjunction with the temporal bone CT if requested.
 - Brain MRI, contrast as requested, is used if specific problems involving the surrounding soft tissues are suspected such as dural involvement, abscess, herniated brain into the mastoid cavity, inflammation of the membranous labyrinth or facial nerve, or sigmoid sinus thrombosis.
 - Also see [HD-23.9 Acoustic Neuroma and Other Cerebellopontine Angle Tumors](#) since acoustic neuroma is often in the differential diagnosis with cholesteatoma.
 - The following imaging studies can be performed for preoperative planning of a known cholesteatoma if ordered by the operating surgeon:
 - CT of the temporal bone, contrast as requested (CPT[®]70480 or CPT[®]70482), with or without 3D rendering
 - Brain MRI, contrast as requested
 - **Reference**:
 - Roland PS. *Cholesteatoma*. eMedicine, June 29, 2009. <http://emedicine.medscape.com/article/860080-overview>. Accessed June 13, 2011

HD-43~EAR PAIN (OTALGIA)

- A recent detailed history and physical examination, including an otoscopic examination, should be performed initially.
- Common causes of ear pain include ear infections, dental problems, sinus infection, neck problems, tonsillitis, and pharyngitis.
 - Advanced imaging is not indicated in patients with improvement of symptoms following an episode of one of these common causes of ear pain, including otitis media.
 - Advanced imaging is not indicated in patients with otitis externa.

- If ear pain persists with no obvious cause, CT scan of the temporal bone without contrast, (CPT[®]70480) is the usual initial advanced imaging study.
 - CT scan of the temporal bone without and with contrast (CPT[®]70482) can be performed initially if requested by an ENT specialist.
- In selected cases, brain MRI, contrast as requested, may be necessary
 - Usually brain MRI is considered if a cerebellopontine angle or other intracranial tumor is suspected
 - Also see:
 - [HD-23.9 Acoustic Neuroma and Other Cerebellopontine Angle Tumors](#)
 - Brain MRI, contrast as requested, can be performed in cases of nervus intermedius neuralgia in order to exclude a structural lesion
- **Cholesteatoma:** See [HD-42 Hearing Loss](#)
- **Reference:**
 - [Li JC and Brunk J. Otagia. eMedicine. March 16, 2010.
http://emedicine.medscape.com/article/845173-overview. Accessed June 13, 2011](#)

2011 HEAD IMAGING GUIDELINES

HD-44	SINUS and FACIAL IMAGING	
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HD-44~SINUS AND FACIAL IMAGING

- Acute sinusitis is normally treated on an empirical basis without the use of imaging studies. Some combination of antibiotics and corticosteroids is usual. Current patterns of likely microbial sensitivity to antibiotics should be taken into account when those agents are used.
- Mild mucosal thickening in the paranasal sinuses or mastoids without other abnormalities is common in healthy individuals and not of itself an indication for advanced imaging.
- **HD-44.1 Indications for Imaging by Noncontrast Sinus CT (CPT®70486)**
 - **Generally reserved for those with:**
 - Poor response to appropriate treatment for four or more weeks.
 - Recurrence within two months of an apparently successful medical treatment. (Recurrence suggests obstruction).
 - Apparent sinusitis in an immunocompromised patient (including transplant patients).
 - Sinus CT without and with contrast (CPT®70488) may be appropriate, since occult neoplasm and ill-contained infection are often issues.
 - Fungal sinusitis.
 - Sinusitis complicated by facial or orbital cellulitis.
 - Preoperative evaluation for planned sinus surgery
 - When sinus CT is used to direct surgical planning and is ordered by the operating surgeon, 3D Rendering (CPT®76377) can be obtained.
 - Sinus CT is also useful when there is a need to clarify a differential diagnosis (especially with concern about neoplasm), and in asthmatics when the physician suspects a sinus contribution to the asthmatic problems.
 - Patients are usually not referred to ENT or Allergy specialists unless their sinus symptoms are recurrent. Therefore imaging is often appropriate at the time of initial specialist evaluation for chronic sinus disease.
 - Contrast may be appropriate in evaluation of possible malignancy and when there is extension of inflammation beyond the sinuses.
 - Sinus MRI without and with contrast (CPT®70543) is superior to CT for evaluation of most aggressive or invasive processes (esp. tumor) and to reveal perineural spread.

CT is the preferred study for evaluation of bony detail, for most fungal infections, for fibrous lesions, and for chondrosarcomas.

- Mucosal thickening is seen well by both techniques, and CT is preferred for both convenience and expense.

- **HD-44.2 Combined Head and Sinus Imaging**

- Head CT does not visualize all of the sinuses.
- Head MRI provides excellent visualization of the sinuses sufficient to recognize sinusitis, and addition of sinus CT for this purpose is unnecessary.
 - In patients being evaluated for potential sinus surgery, separate sinus CT is often appropriate even after a head MRI in order to visualize obstructions to spontaneous mucous flow.
- Separate head imaging is not generally indicated in patients with a nonfocal neurological examination who have headaches associated with sinus symptoms.
- Sinus CT or MRI is not indicated for the evaluation of headaches without a more specific indication pointing to a sinus etiology.

- **HD-44.3 Repeat Sinus Imaging**

- Repeat sinus CT or MRI is appropriately ordered to address a specific issue in management, and the reasons for the repeat study should be documented.
- Generally, re-imaging of a patient who has responded satisfactorily to treatment is not appropriate unless needed for preoperative planning of an interventional procedure.

- **HD-44.4 Mucous Retention Cysts**

- Unless there is evidence of associated bony erosion or of uncertainty regarding the radiological diagnosis, repeat imaging is not indicated.

- **HD-44.5 References**

- *Otolaryngol Clin N Am 2005;38:1279-1299*
- *N Engl J Med 1997;337:254-259*
- *N Engl J Med 2004;351:902-910*
- *Otolaryngol Clin N Am 2005;38:1137-1141*

2011 HEAD IMAGING GUIDELINES

HD-45~TEMPOROMANDIBULAR JOINT DISEASE (TMJ) and DENTAL/PERIODONTAL/MAXILLOFACIAL IMAGING

- **Temporomandibular Joint Disease (TMJ)**
 - Advanced imaging is not often required to diagnose or plan treatment for patients thought to have temporomandibular joint disease (TMJ).
 - Patients with suspected TMJ should be evaluated and treated symptomatically prior to considering advanced imaging.
 - MRI (CPT®70336) should be reserved for those who fail non-surgical treatment and who are actively being considered for TMJ surgery.
 - Since specific TMJ imaging is generally requested preoperatively, evaluation by an oral surgeon, head and neck surgeon, or dentist experienced in the management of TMJ is generally appropriate prior to imaging.
- **Dental/Periodontal/Maxillofacial Imaging**
 - **Cone Beam CT--CPT® Codes: 70486, 70487, 70488, 70480, 70482**
(NO separate 3-D rendering codes should be reported)
 - Also called i-CAT scanner, mini-CAT scanner
 - See [HD-34.11 Cone Beam Computed Tomography](#) for the technical description of CBCT.
 - Requests for advanced imaging of dental/periodontal structures should be sent for Medical Director review.
 - Currently there are no published guidelines from any specialty society such as the American Association of Oral and Maxillofacial Surgeons regarding the appropriate use of cone beam CT for dentoalveolar conditions, maxillofacial conditions, orthodontics, endodontics, or dental implants.
 - Most payers do not include orthodontic clinical conditions, replacement of teeth lost due to caries or periodontal disease, non-trauma related dental implantology, or endodontic treatment not related to trauma to the natural tooth in their coverage policies. Thus, cone beam CT scans in these patients would also not be included in the coverage policy. These coverage policies will take precedence over MedSolutions' guidelines.
 - Given the above coverage policy restrictions, the most common request for CBCT scans will be from oral and maxillofacial surgeons and rarely from general dentists, endodontists, or periodontists.
 - Indications for cone beam CT if requested by an oral or maxillofacial surgeon:
 - Impacted teeth
 - Supernumerary teeth
 - Dentoalveolar trauma
 - Root resorption
 - Foreign body
 - Odontogenic cysts, tumors, or other jaw pathology
 - Cleft pathology
 - Orthognathic surgery for dentofacial anomalies
 - Osteomyelitis and odontogenic infections

- Bisphosphonate-related osteonecrosis of the jaw
- Salivary gland stones
- Maxillofacial bone graft planning
- Dental implants related to tooth loss from injury, trauma, or jaw pathology such as cysts, tumors, or cancer

➤ **References:**

- *International Journal of Oral & Maxillofacial Surgery* 2009 June;38(6):609-625
- *N Engl J Med* 2008;359:2693-2705

HD-46~TINNITUS

- Tinnitus is called objective when the examiner can hear it and subjective when only the patient can.
- **Objective Pulsatile Tinnitus:**
 - Usually arises from a vascular lesion.
 - If there is an audible cardiac source (e.g. heart murmur), then cardiac evaluation is indicated prior to considering advanced imaging of the brain or neck.
 - If there is no cardiac abnormality on physical examination, brain MRI (contrast as requested) can be performed.
 - Cervical CTA (CPT[®]70498) or MRA (CPT[®]70548) is indicated if there is a cervical bruit. Head CTA (CPT[®]70496) or MRA (CPT[®]70544) can be done at the same time.
 - Head CTA (CPT[®]70496) or MRA (CPT[®]70544) is indicated if there is a cranial bruit.
- **Subjective Pulsatile Tinnitus:** evaluation begins with an otoscopic examination.
 - If this is abnormal, temporal bone CT (usually without contrast-- CPT[®]70480) is indicated initially.
 - If the otoscopic examination is normal, brain MRI (contrast as requested) +/- head MRA/CTA is appropriate.
 - Some discretion is necessary in the evaluation of subjective pulsatile tinnitus: everyone has at one time or another briefly experienced tinnitus, and if not persistent or striking, it is unlikely to be significant.
- **For both Objective and Subjective Pulsatile Tinnitus:**
 - If a lesion involving bone is found on MRI, CT may be needed to further characterize the lesion.
 - If a vascular dissection is suspected, cranial and cervical MRA/CTA are appropriate (see [HD-30.4 Carotid and Vertebral Artery Dissections](#)).
- **Non-Pulsatile Tinnitus:**
 - Audiologic evaluation, careful history, and recent physical examination, including otoscopic exam, should be performed initially.
 - If the audiologic exam is normal, no further evaluation is generally needed.
 - Medications, especially aspirin, can cause tinnitus without hearing loss.
 - Cochlear hearing loss in adults with normal otoscopic examination generally requires no imaging.
 - Retrocochlear hearing loss indicates the need for brain MRI without and with contrast (CPT[®]70553).
 - Conductive hearing loss: temporal bone CT (CPT[®]70480) may be indicated.
- **References:**
 - *Radiology* 2000;216:342-349

- *N Engl J Med* 2002;347:904-910
- *Am Fam Physician* 2004;69:120-126

EVIDENCE BASED CLINICAL SUPPORT

EVIDENCE BASED CLINICAL SUPPORT HD-1~GENERAL GUIDELINES

- **A Brief Note on Clinical Neurology:**
 - Signs are what doctors find on examination. Symptoms are what patients experience. The terms are used with precision in these neurological guidelines: symptoms and signs should not be confused.
 - Examples can help make this clear. Numbness is a symptom. Loss of sensation in a specific body area on examination is a sign. A feeling of weakness is a symptom. Loss of strength in performing certain tasks during examination is a sign.
 - The chief signs of brain lesions are Babinski's sign (upgoing toes), spasticity, and marked hyperreflexia, all on one side of the body (and face). One-sided weakness and sensory loss are others. Aphasia is usually a sign of left cerebral disease. Certain kinds of visual field loss are cerebral signs. **Cerebral lesions cause clinical pictures that all point to one side of the body.**
 - There are few signs of brain stem disease that come with a guarantee, and those few are infrequently seen.
 - Vertical nystagmus, palatal myoclonus, and internuclear ophthalmoplegia are the only reliable signs seen with any frequency in awake patients.
 - Deep Coma is the most common of the intrinsic brain stem signs, but has no application in outpatient medicine.
 - Most often, brain stem disease is recognized by complex patterns which share involvement of one side of the body and the other side of the head or face, often including balance disorders that cannot be explained by weakness. Those classic brain stem signs are infrequently present.
 - The principal sign of spinal cord disease is the loss of functions on *both* sides below a certain level. This can take the form of sensory loss on one side and spastic weakness on the other, but there will still be a level.
 - Loss of deep tendon reflexes, and stocking sensory loss are the traditional signs of peripheral neuropathy, but neither is always reliable either by its presence or absence.
 - CNS infections generally cause fever with severe headache and a meningeal stiff neck (the neck resists flexion only--Brudzinski's or Kernig's sign). Confusion or delirium is frequent. In the immunocompromised, signs may be subtle.

EVIDENCE BASED CLINICAL SUPPORT HD-2~CONTRAST USE IN HEAD IMAGING

- Any discrepancies between the criteria below and a specific guideline (HD-1 through HD-46) should be resolved in favor of the condition-specific guideline.
- **Indications for Head CT without and with contrast (CPT®70470):**
 - Patients in whom MRI without and with contrast is indicated but who cannot have an MRI (example: a patient with a pituitary tumor and a pacemaker).

- Staging systemic cancer patients who have no overt neurological abnormality or only nonspecific symptoms such as headache. Note: MRI without and with contrast is desirable in a patient in whom there is every reason to expect metastases: they are being evaluated for neurosurgery, not being staged.
 - Remember that most neurologically asymptomatic cancer patients do not need any brain imaging for staging--there are only a few tumor types in which it is appropriate.
- **Indications for Head CT without contrast (CPT®70450):**
 - Acute or recent head trauma
 - Nonacute but not remote head trauma (within 6 months) when the concern is to evaluate for chronic subdural hematoma.
 - Recent hemorrhage or a concern about recent hemorrhage. CT is helpful within about a week of the event in identifying subarachnoid hemorrhage and 2-3 weeks for intracerebral hemorrhage.
 - Headache evaluation in patients without neurological abnormalities, papilledema, or active cancer history.
 - In children and young adults (ages 6 to 30), noncontrast MRI should be considered to minimize radiation exposure, although noncontrast CT can be approved when it is strongly indicated.
 - Recurrent syncope: a normal noncontrast CT is sufficient cerebral evaluation in most a case in which neuroimaging is indicated.
 - Uncomplicated dementia in patients over age 70.
 - Urgent exclusion of intracranial mass lesions. CT can generally be obtained readily 24/7. Contrast is not needed since any positive findings will likely require follow up by MRI.
 - Most patients in whom noncontrast MRI is appropriate who cannot have MRI done.
- **Indications for Noncontrast Brain MRI (CPT®70551):**
 - Headache without papilledema or neurological signs (see exceptions in HD-16 Headache, Adult).
 - Stroke in patients over 45 years old.
 - Dementia in patients over 60 years old.
 - Movement disorders, when any imaging at all is indicated.
 - Some seizure patients.
- **Indications for Brain MRI without and with Contrast (CPT®70553):**
 - Evaluation or follow-up of known tumors.
 - Evaluation of potential masses in the area of the pituitary or in the posterior fossa.
 - Evaluation for spinal fluid leaks.
 - CNS inflammatory disorders, including lupus cerebritis, encephalitis, and fungal, tuberculous, and carcinomatous meningitis.
 - Epilepsy, esp. evaluation of new onset seizures in adults.
 - Evaluation and follow-up of MS.
 - Diagnosis of cerebral arteriovenous malformations.
 - Evaluation of cerebral venous infarcts and premature strokes (patients < age 45).
 - The usual study to follow up abnormalities seen on CT that require further characterization.

EVIDENCE BASED CLINICAL SUPPORT HD-13~DEMENTIA

- Tests for B-12 deficiency and hypothyroidism rarely discover the cause of dementia, and it is generally not appropriate to delay imaging while awaiting their results.
- Neurology consultation is helpful in evaluating patients with suspected dementia (especially patients less than 60 years old). However, it may be impractical to expect this to be obtained in all elderly patients.
- Dementia is a disease of the elderly. The diagnosis should be scrutinized carefully in those below age 60.

EVIDENCE BASED CLINICAL SUPPORT HD-14~ADULT EPILEPSY/SEIZURE

- Up to 1% of Americans will have a single seizure at some time in their life, and half that number will turn out to have epilepsy.
- Generalized epilepsies commonly begin in childhood and rarely do so after age 30.
- Adult onset epilepsy is generally from a focal brain disorder (partial epilepsy), but the actual source is more often than not never identified.
 - In rural Mexico, that focal disorder is usually cysticercosis. Immigration will make this more common in the United States.

EVIDENCE BASED CLINICAL SUPPORT HD-15~FACIAL PAIN/TRIGEMINAL NEURALGIA

- Facial pain is much less common than headache, but when it occurs, it is extremely severe and likelier than headache to arise from a serious underlying cause.
- The differential diagnosis includes: disorders of the teeth, sinuses or skull base, tumors or vascular abnormalities affecting the sensory nerves of the face, multiple sclerosis, and even migraine.
- The most notorious form is an especially severe recurrent lancinating facial pain called trigeminal neuralgia or tic douloureux. Tic causes extremely severe bouts of momentary pain often triggered by touching or moving a small region of the face or mouth. It is not a steady ache. The name tic comes from the brief facial contortion that often accompanies the pain. Tic douloureux is recognized by the very specific pattern of pain elicited on history, but it can take considerable skill and experience with the condition to obtain that history. As time goes by, patients with this disorder also tend to develop longer lasting facial pain which makes history taking even harder.
- Traditionally it has been believed that very careful neurological examination and response to treatment could separate the 10% or so of such cases caused by a compressive lesion affecting CN V, but the available evidence suggests that this is not so, and that MRI is indicated in these cases at the time of initial diagnosis.
- Only 5% of cases of tic douloureux involve the ophthalmic nerve, the first branch of the trigeminal (supplies the forehead and anterior scalp with feeling). The differential diagnosis is different from the usual case of tic, from other conditions of the cavernous

sinus or orbit, and from post-herpetic neuralgia. This may require additional imaging studies.

- The glossopharyngeal nerve (CN IX) and the nervus intermedius, the small sensory branch of the facial nerve (CN VII), can be affected by a condition similar to trigeminal neuralgia, with the paroxysms arising from the throat (CN IX) or external ear canal (CN VII). Management is as for trigeminal neuralgia.
- Tic douloureux in patients under age 40 raises reasonable concerns about an underlying diagnosis of multiple sclerosis.
- Non-neuralgic facial pain is often called atypical facial pain. The use of advanced imaging in its evaluation varies depending on the specific clinical features, and no general rules can be given.

EVIDENCE BASED CLINICAL SUPPORT
HD-17~HYPERACUTE HEADACHE, INTRACRANIAL ANEURYSM,
AVM, SUBARACHNOID HEMORRHAGE

- Known aneurysms and cases of subarachnoid hemorrhage (SAH) are currently evaluated by catheter angiography or by CTA. MRA and CTA are both used to follow known aneurysms, to discover either asymptomatic aneurysms in those with no personal history of aneurysm or to discover new aneurysms in those with such history.
- Small (< 3-4 mm) unruptured aneurysms in those with no personal history of SAH have a very low rate of bleeding: 0.1% per year for those in the anterior circulation (carotid) and 0.5% a year for the much less common posterior circulation aneurysms. The risk of surgery (operative stroke or death) rises with age, but is never less than a few percent. Coiling is safer, but complication rates are not much below 1%-2%.
- Risk and family history of aneurysm:
 - The baseline risk of having an aneurysm is about 1%-2%
 - The risk rises to 2%-4% with one first degree relative with history of aneurysm
 - The risk rises to 6% with two such relatives.
 - With an identical twin, the risk rises sharply to about 35%, and with two parents, to about 30%.
- Intracranial hemorrhage on MRI and CT. For convenience, the table below summarizes the evolving appearances of blood on CT and MRI:

Time	Pigment	CT	T1	T2
<24 hrs	Oxy-Hb	↑	=, Slt ↓	↑
1-3 days (dy)	Desoxy-Hb	↑	=, Slt ↓	↓
Subacute 4-7 dy	Intracell Met-Hb	↑	↑	↓
Subacute 7-21 dy	Extracell Met-Hb	=	↑↑	↓
Chronic > 3 wks	Extracell Met-Hb	=	↑↑	↓
	Hemosiderin	varies	↓	
	Serous-resorbed	↓	↓	

EVIDENCE BASED CLINICAL SUPPORT HD-18~HEAD TRAUMA

- The vexed main issue of head trauma imaging concerns when to image alert, neurologically normal patients with apparently mild head trauma. This is especially important in the Emergency Department, but the problem arises in the office setting also. Fewer than 1% of these patients will have injuries requiring neurosurgical intervention, but it is imperative that those patients be identified. Imaging all head trauma patients is impractical, and “the best clinical judgment of first providers” misses about 1/5 of the surgical lesions.
- Two clinical algorithms have been widely used to deal with the problem, the Canadian CT Head Rule (CCHR, 2001) and the New Orleans Criteria (NOC, 2000). Both have been subjected to extensive practical testing. Both are reliable: no surgical lesions were missed in thousands of cases.
 - The NOC identified a larger number of non-surgical lesions (99% vs. 93% for CCHR and 98% for modified CCHR).
 - Use of the NOC reduced Emergency Department head scanning by about 25% vs. 70% for CCHR and 50% for modified CCHR.
 - The modified CCHR (see [HD-18.1 Head Trauma, Head CT](#)): the amnesia and dangerous mechanism rules are the modified part. Common sense identifies a dangerous mechanism of injury (e.g. high velocity speed vehicular collisions).
 - The NOC: GCS of 15, absence of headache, no emesis, age < 60, not drug or alcohol intoxicated, no signs of trauma above the clavicles, no post-traumatic seizures, no short-term memory deficits (again, scan if any positive).
 - Glasgow coma scale: range of total score 3-15.
 - Three sections:
 - Eye opening: spontaneous....4, to command....3, to pain....2, none....1.
 - Verbal response: oriented....4, confused conversation....3, non-lucid words....2, none....1.
 - Best motor response: obeys commands....6, localizes to pain....5, normal flexion....4, abnormal (reflex) flexion....3, extension....2, none....1.
 - The Glasgow coma scale is now used universally for trauma and as “neuro vitals”.

EVIDENCE BASED CLINICAL SUPPORT HD-22~ MULTIPLE SCLEROSIS (MS) and RELATED CONDITIONS

- MS typically presents with episodic neurological events **lasting at least a full day** and involving different areas of the CNS. It is diagnosed by recognizing events which indicate dispersion in space (different places in the CNS) and time (events separated by **at least a month**).
- MRI (but not CT) can be used to prove dispersion in space and time early. There must still be one documented clinical episode regardless of imaging results.
- Over the past several years, there have evolved a series of MRI criteria whose goal is to permit the accurate diagnosis of MS by means more rapid than waiting for subsequent clinical events. Findings on both brain and spinal cord imaging can be used to fulfill

these criteria, but spinal cord findings are only useful with certain brain findings. The current incarnation of these diagnostic rules is the McDonald 2005 Criteria.

- The McDonald 2005 Criteria for use of MRI in diagnosis of suspected MS.:
 - **Time:** the presence of one new contrast-enhancing lesion identified > 3 months following the initial event OR the presence of one new T2 weighted lesion clearly not related to the previous lesion > 3 months following the previous event. In those centers with neuroradiologic expertise sufficient to repeat the scan with precisely duplicate protocols, cuts, and positioning of the patient, a repeat at > 1 month is permissible, again if it can be known with certainty that the “new” lesion is separate from those seen previously.
 - **Space:** at least 3 of the following 4:
 - One contrast-enhancing lesion or 9 T2 hyperintense lesions.
 - At least one infratentorial lesion (Contrast-enhancing or T2 hyperintense).
 - At least one juxtacortical lesion.
 - At least 3 periventricular lesions.
 - **Spinal cord lesions (space and time)**
 - A cord lesion can count for the infratentorial lesion.
 - A contrast-enhancing cord lesion can count for both a contrast-enhancing brain lesion and an infratentorial lesion.
 - A cord lesion cannot count for a juxtacortical or periventricular lesion.
 - Individual separate cord lesions can each count toward the total of 9 T2 hyperintense lesions (in the 2001 McDonald criteria, only one cord lesion could be counted toward the total).
- As a practical matter, this means that spinal cord imaging is more often appropriate under the McDonald 2005 criteria than previously and could always fulfill the time requirement. Still, if no reasonably expectable cord results would result in fulfilling the space requirement also, the diagnostic value of adding cord imaging to the non-diagnostic brain imaging approaches zero.
 - For instance, with either a fully normal brain MRI or one contrast-enhancing lesion which is not juxtacortical and no other findings, cord imaging is not going to permit the space requirement to be met whatever its results.
- In 2006, Swanton et. al.* proposed a simplified version of these criteria which seems to be as accurate:
 - Dispersion in space is satisfied by at least one T2 lesion (FLAIR included) in at least two of four MS typical regions (juxtacortical, periventricular, infratentorial, spinal cord).
 - Dispersion in time requires a new T2 lesion on a follow-up scan. It is early to evaluate the adequateness of this set of criteria. If they are confirmed, the use of contrast in evaluation for MS will become superfluous.
 - **J Neurol Neurosurg Psychiatry* 2006;77:830-833
- Despite widespread acceptance of the McDonald criteria, there are serious questions regarding them, both because of reliance on short term cohort studies and because of insufficient attention to Bayesian issues concerning how sensitive and specific the criteria are in comparison to clinical diagnosis in these cases—for an experienced clinician, how much certainty do they add and how many errors do they permit or even encourage? The interested reader is referred to careful study of:

- Whiting P, et al. Accuracy of magnetic resonance imaging for the diagnosis of multiple sclerosis: a systematic review March 2006
<http://www.bmj.com>. Accessed November 30, 2006

EVIDENCE BASED CLINICAL SUPPORT HD-27~PITUITARY

- Pituitary microadenomas may be found in about 20% of the normal population and rarely cause visual or neurological symptoms. They are discovered either accidentally or, for the hormonally active ones, if their hormonal activities cause symptoms.

EVIDENCE BASED CLINICAL SUPPORT HD-29~GENERAL STROKE/TIA

- About 25% of strokes are preceded by TIA's, and about 25% of TIA patients will experience a stroke within a year or so of the onset of TIA's. Roughly $\frac{1}{2}$ of the strokes to come will occur within a week of the warning TIA and $\frac{1}{4}$ will occur within two days. That means that one new TIA patient in 16 will have a stroke within two days and one in eight, within a week. There is simply not the time to mull over choices and obtain consultations prior to imaging. This risk is greatest with those with significant large artery atherosclerosis (those who will have positive MRA or CTA of the neck).
- The Stroke Council of the American Heart Association states that evaluation should be completed in a week, and the British NHS has a two week rule (remember that their rule is a RULE not a guideline).
- The exceptions mentioned in the guideline are meant to avert extensive stroke work-ups for Bell's palsy, post-ictal palsies, migraine, carpal tunnel syndrome, and radial nerve palsies.
- Brain MRI is appropriate in patients who have had a documented non remote stroke whose initial imaging did not include MRI. This aids in identifying stroke subtype, which is helpful for both prognosticating and direction of treatment. Neurological consultants may at times find this useful even in patients whose predicate stroke was more than several months ago, since, among other advantages, MRI's ability to recognize border zone infarction and small, perhaps asymptomatic secondary infarcts often provides the strongest clue to a cardioembolic origin.
- Vertebrobasilar TIA/stroke is a less urgent situation only because, for now, there is not much we can do to intervene.
- In those of "a certain age" the differential diagnosis of stroke is about 30% each for small vessel cerebrovascular disease, large cervical vessel disease, and cardiogenic embolization. Other causes operate in fewer than 10%.
 - In the young, this is far from true, and therefore different pathways are appropriate.

EVIDENCE BASED CLINICAL SUPPORT HD-31~SYNCOPE

- There are few people who have never experienced lightheadedness (near syncope). About one third of adults have fainted once. Few require extensive evaluation. Generally, evaluation should be cardiovascular in nature.
- It is important to remember that syncopal episodes are brief (less than two minutes) and not followed by postictal confusion. Scattered twitching is common during faints and has no diagnostic significance.
- Syncope is misdiagnosed as epilepsy far more often than epilepsy is misdiagnosed as syncope. Generalized tonic-clonic seizures are hard to mistake for anything else.
- Patients are rarely hurt by being misdiagnosed as not having seizures. Their lives are almost always badly hurt by being told they have seizures when they don't (jobs, insurance, driver's licenses, personal relationships).
- Drop attacks are usually seen in known narcoleptics or in patients above age 50. In men, they are usually from cardiac arrhythmias, but in women much less often so. When they occur as part of narcolepsy, the cause is known and imaging is not indicated.

EVIDENCE BASED CLINICAL SUPPORT HD-34~NEWER IMAGING TECHNIQUES

- **Functional MRI** depends on the BOLD effect (Blood Oxygenation Level Dependent) and on the paramagnetic properties of desoxy-hemoglobin, which enhances relaxation. Activation of an area of brain increases its oxygen consumption. But for about two seconds following activation, its increased oxygen consumption is not matched by increased blood flow and desoxy-Hb accumulates relative to oxy-Hb. An overcorrection follows in which the desoxy-Hb to oxy-Hb ratio falls below baseline, and then at about 5 seconds, baseline ratios are restored. The overall shifts of the ratio are by about 15%. The equipment must include triggering devices which identify the time of activation, and it requires the patient to be an active participant. Localization of sensorimotor cortex (activities like repetitive finger tapping or having a hand repetitively stroked) and of speech ("say all the words all the words you can think of that begin with L" or some such) are useful.
 - f-MRI is used along with Wada testing to identify language bearing cortex. The Wada test is an invasive technique used to identify the hemisphere dominant for speech. At catheter angiography, amobarbital or another hypnotic is injected into a carotid artery and the patient's speech is tested. Injection on the speech dominant side will produce a temporary aphasia, but injection on the non-speech related side will not. The Wada test is traditional, but f-MRI offers more precise localization. f-MRI can also be used to identify the primary sensorimotor cortex. Both uses provide for safer and at the same time more extensive neurosurgical procedures.
 - F-MRI currently has no established *diagnostic* utility, but the technique's full usefulness has yet to be determined.
 - BOLD signals are weak and more accurately detected in stronger magnetic fields. 3T magnets are clearly more useful for f-MRI.

- **CT Perfusion Imaging and MRI DWI/PWI:**
 - Immediate thrombolytic treatment of strokes improves outcomes but does have hazards. Without the use of perfusion imaging, it is necessary to limit its use to the first three hours after a stroke occurs, and the briefness of this window of opportunity has severely limited its use. Perfusion imaging permits us to extend that window to 9 hours in a large number of patients with new strokes, and this should greatly expand the usefulness of this treatment.
 - In the hours following a stroke, both CT and MR technology can be used to determine the presence of viable brain tissue at risk (the ischemic penumbra) and compare its extent to that of the infarct core (brain tissue no longer able to survive).
 - Thrombolysis appears to be useful as long as the ischemic penumbra makes up at least 20% of the total infarct size (core + penumbra). CT perfusion and MRI diffusion/perfusion weighted studies seem equally accurate for this in lesions within the middle cerebral territory, which is the most common location of strokes.
 - It is possible that other uses for perfusion imaging will emerge in time.
- **Positional MRI:** while most of the attention has been paid to spinal imaging, there may be a rare indication for this procedure to identify spinal fluid leaks in patients with CSF rhinorrhea in whom conventional imaging has been unsuccessful at identifying the leak site.

EVIDENCE BASED CLINICAL SUPPORT HD-37~HORNER'S SYNDROME

- Horner's syndrome is caused by loss of sympathetic innervation of the eye and presents with meiosis (small pupil), mild ptosis, and (variably) loss of sweating on the involved side of the forehead.
- In order to understand the evaluation of this disorder, it is necessary to follow the course of that three neuron chain. The axons of the first neurons travel from hypothalamus through the lateral brain stem to synapse in Clarke's column in the cervical to upper thoracic spinal cord. The axons of the second neurons travel from there over the lung apex to the stellate ganglion in the neck. The third neuron axons accompany the carotid artery to join the third cranial nerve near the cavernous sinus and enter the orbit through the superior orbital foramen. When the carotid artery bifurcates, the sympathetic fibers concerned with the forehead branch off from the others, following the external carotid artery.
- Mild pupillary asymmetries are very common in normal persons and often can be diagnosed by viewing old photographs. Testing with cocaine eye drops can identify Horner's syndrome when simpler means fail. Cocaine dilates pupils which have NOT lost their sympathetic innervation, so in Horner's it will fail to cause full pupillary dilatation (compared to the normal side). A positive cocaine test proves the presence of Horner's syndrome but does not localize it.
- Involvement of the first neuron, usually by infarction, myelopathy, or a syrinx, will cause Horner's syndrome associated with other neurological findings, and can be localized by those findings. The evaluation is that of the associated neurological abnormality (stroke, MS, syringomyelia, neurotrauma, etc) as described in the appropriate guideline.

- Lesions of the second neuron generally present with a pure Horner's syndrome. Facial sweating is usually involved. Apical lung lesions, soft tissue cervical masses, and trauma are the usual causes, and contrast only CT of chest and/or soft tissues of the neck is useful. Since the sympathetic axons arise from multiple spinal segments, spinal disorders very infrequently cause second axon Horner's syndrome.
- The most common cause of third axon Horner's syndrome is dissection of the internal carotid artery. Facial sweating is spared. Conjunctival injection, pain radiating from the angle of the jaw to the temple, and contralateral neurological findings may be present. Carotid body tumors can present with a similar syndrome.
- Lesions in the region of the orbital apex or cavernous sinus can cause 3rd neuron Horner's but they will usually cause other extra-ocular symptoms including ocular pain in addition to Horner's syndrome.
- Additional clinical features will often identify third axon Horner's syndrome.

2011 HEAD IMAGING GUIDELINE REFERENCES

HEAD GUIDELINE REFERENCES

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