

## CT head scanning indications

Computerised axial tomography (commonly called CT scanning) was first used at the Atkinson Morley Hospital in London in 1972. CT scans rapidly became the mainstay of the diagnosis of structural brain disease until the advent of magnetic resonance imaging (MRI) during the late 1980s.

However, CT remains an extremely valuable method of investigation, particularly in the acute situation and because of the very high expense of MRI systems. CT scans have a relatively high radiation dose so should be avoided in pregnancy. Claustrophobia is less of a problem in CT scans compared with MRI.

### Indications

- CT remains the investigation for the diagnosis and management of many central nervous system diseases.
- MRI is superior in the posterior fossa and parasellar region and for the assessment in [multiple sclerosis](#), [epilepsy](#) and tumours.
- CT is preferred to MRI in the assessment of [head injury](#).<sup>[1]</sup>

Indications for CT imaging, CT angiography, and CT venography include:

#### Cranial

- **Acute stroke:** immediate CT scan should be performed in the following:<sup>[2]</sup>
  - Those who might benefit from acute thrombolysis or early anticoagulation.
  - Anyone with a bleeding tendency or on anticoagulants.
  - Glasgow Coma Score (GCS) <13.
  - Progressive or changing symptoms.
  - Severe **headache**.
  - Any features suggestive of meningoencephalitis - eg, **papilloedema**, neck stiffness.
- Those who do not have any of the features above should have a scan within 24 hours.
- CT scanning is reliable in excluding primary **intracerebral haemorrhage** as a cause of acute stroke.
- The CT signs of ischaemia are more subtle and detection of acute infarction is variable depending on the timing of the examination.
- The area of infarction matures over the first week or more with the development of progressively better-defined low attenuation and loss of volume in the damaged area.
- **Transient ischaemic attack (TIA):** can help to distinguish infarction from haemorrhage and also differentiate from other causes such as extracerebral haemorrhage or glioma.
- **Acute subarachnoid haemorrhage:** CT will provide evidence of subarachnoid haemorrhage in over 90% of cases if performed within 48-72 hours.<sup>[3]</sup> CT is indicated in acute headache with focal neurological signs, nausea, vomiting or GCS <14. MRI is better for inflammatory causes of acute headache.
- **Acute head injury:** the table below provides the current guidance for CT scanning the head in a patient with a head injury. <sup>[1]</sup>

CT Scan in Head Injuries [1]	
Selection of adults for CT scan	Selection of children (under 16 years) for CT scan
<p>CT scan of the brain within one hour (with a written radiology report within one hour of the scan being undertaken):            Glasgow Coma Scale (GCS) 12 or less when first assessed or GCS &lt;15 two hours after injury.            Suspected open or depressed skull fracture.            Signs of base of skull fracture*.            Post-traumatic seizure.            Focal neurological deficit.            &gt;1 episode of vomiting.</p> <p>All patients with a coagulopathy or on oral anticoagulants should have a CT brain scan within eight hours of the injury, provided there are no other identified risk factors, as listed above.            Again, a written radiology report should be available within one hour of the scan being undertaken.</p>	<p>CT scan of the brain within one hour (with a written radiology report within one hour of the scan being undertaken):            Clinical suspicion of non-accidental injury.            Post-traumatic seizure (no past medical history of epilepsy).            GCS &lt;14 on initial assessment or, if &lt;1 year, GCS &lt;15.            GCS &lt;15 two hours after injury            Suspected open or depressed skull fracture or tense fontanelle.            Signs of base of skull fracture*.            Focal neurological deficit.            Aged &lt;1 – bruise, swelling or laceration &gt;5 cm on the head.</p> <p>If none of the above are present then CT brain scan within one hour if more than one of the following are present (with a written radiology report within one hour of the scan being undertaken):            Witnessed loss of consciousness &gt;5 minutes.            Amnesia (antegrade or retrograde) &gt;5 minutes.            Abnormal drowsiness.            ≥3 Discrete episodes of vomiting.            Dangerous mechanism of injury (high-speed RTA, fall from &gt;3 m, high-speed projectile).</p>

	<p>Any current bleeding or clotting disorder.</p> <p>If only one of the aforementioned risk factors is present then observe for a minimum of four hours – CT scan of the brain within one hour if any of the following occur (with a written radiology report within one hour of the scan being undertaken):</p> <p>GCS &lt;15. Further vomiting. Abnormal drowsiness.</p>
<p>*Signs of basal skull fracture: haemotympanum, 'panda' eyes (bruising around the eyes), CSF leakage (ears or nose) or Battle's sign (bruising which sometimes occurs behind the ear in cases of basal skull fracture).</p>	

- **Space-occupying lesions:** suspected tumour or mass – eg, cerebral abscess. MRI is more sensitive for early tumours and posterior fossa lesions but CT is usually adequate for supratentorial lesions. MRI may miss calcification. Enhanced CT modalities, such as perfusion CT, may also be helpful. [4]
- Suspected **hydrocephalus** or shunt revision. MRI may be more appropriate for children. Ultrasound is the first choice for infants.

- **Chronic headache:** CT or MRI are not usually useful if there are no focal neurological signs but are more likely to detect an abnormality if there is:<sup>[5]</sup>
  - Recent onset and a progressive worsening of symptoms and frequency or a change in their pattern.
  - Association with the onset of **epilepsy** (especially focal epilepsy).
  - Change in personality.
  - Associated dizziness, lack of co-ordination, tingling or numbness.
  - History of recent head injury or falls (to exclude **subdural haemorrhage**).
- **Intracranial infection:** in cases of childhood bacterial **meningitis**, CT is accurate in the diagnosis of intracranial complications of bacterial meningitis and is indicated mainly in children with persistent neurological dysfunction such as complex seizure disorder; it is of little value in children with prolonged fever alone.
- Detection or evaluation of calcification: for example, the radiological hallmark of an oligodendroglioma is calcification, which is best detected on CT scanning. Calcification may be invisible on MRI.
- Other: mental status change, **increased intracranial pressure**, headache, acute neurological deficits, congenital lesions (eg, craniosynostosis, macrocephaly, and microcephaly), evaluation of patients with psychiatric disorders and brain herniation. In the assessment of **psychosis**, CT scan should be reserved for those with recent-onset, rapid unexplained deterioration, focal neurological signs, recent head injury before onset or if there has been urinary incontinence or gait disturbance early in the illness.
- Secondary indications (eg, when access to MRI is not available): diplopia, cranial nerve dysfunction, **seizures**, apnoea, **syncope**, **ataxia**, suspicion of neurodegenerative disease, **developmental delay**, neuroendocrine dysfunction, encephalitis, vascular occlusive disease or **vasculitis** (including use of CT angiography and/or venography), aneurysm, cortical dysplasia, and migration anomalies.

## Extracranial

- Middle or inner ear symptoms, including [vertigo](#). If felt necessary following specialist assessment. MRI is much better, especially for [acoustic neuromas](#).
- Sinus disease if there has been failure of maximal medical treatment, complications – eg, [orbital cellulitis](#) or suspicion of malignancy.
- Congenital anomalies, benign and malignant neoplasms, trauma, vascular malformations, evaluation of palpable masses, planning and follow-up of radiotherapy.
- Orbital lesions, including eye trauma in which there may be an associated facial fracture. Ultrasound may be appropriate for intraocular lesions. CT scan may also be indicated for strong suspicion of an intraocular foreign body that has not been shown on X-ray.<sup>[6]</sup>
- Fractures of the temporal bone, skull, and face.
- Evaluation of the skull base including primary and secondary bone lesions.
- Cranio-maxillofacial surgery: the CT scan delineates lesions in the oral and maxillofacial complex to aid in planning surgical treatment. It can also be used to assess bisphosphonate-associated osteonecrosis of the jaw but functional imaging may be superior for diagnosis.<sup>[7]</sup>
- Secondary indications (eg, when access to MRI is not available): evaluation of lesions involving the orbit, larynx, pharynx, oral cavity and soft tissue spaces of the face.

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## Further reading

- [Head injury](#); NICE CKS, July 2021 (UK access only)

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