KARNATAKA RADIOLOGY EDUCATION PROGRAM

CT ARTIFACTS

CT artifacts are common and can occur for various reasons. Knowledge of these artifacts is important because they can mimic pathology (e.g. partial volume artifact) or can degrade image quality to non-diagnostic levels.

CT artifacts can be classified according to the underlying cause of the artifact.

Patient-based artifacts

Motion Artifact
Transient Interruption Of Contrast
Clothing Artifact
Jewelry Artifact

Physics-based artifacts

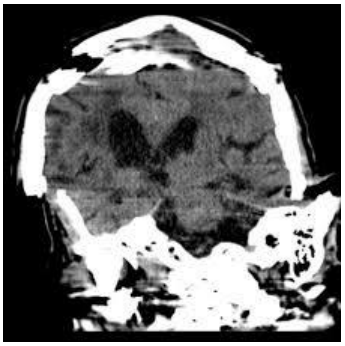
Beam Hardening
Cupping Artifact
Streak And Dark Bands
Metal Artifact / High-Density Foreign Material Artifact
Partial Volume Averaging
Quantum Mottle (Noise)
Photon Starvation
Aliasing
Truncation Artifact

Hardware-based artifacts

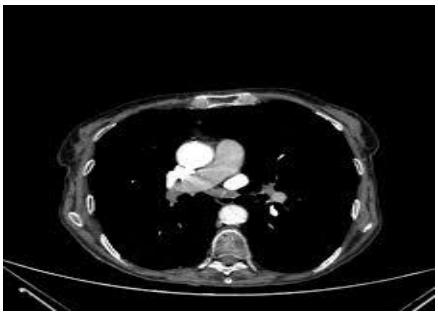
Ring Artifact
Tube Arcing
Out Of Field Artifact
Air Bubble Artifact
Helical And Multichannel Artifact

Windmill Artifact
Cone Beam Effect
Multiplanar Reconstruction (Mpr) Artifact
Zebra Artifact
Stair Step Artifact

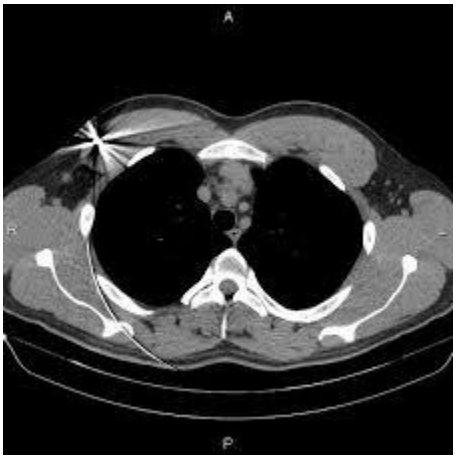
Motion artifact **is a patient-based artifact that occurs with voluntary or involuntary patient movement during image acquisition.**
Misregistration artifacts, which appear as blurring, streaking, or shading, are caused by patient movement during a CT scan. Blurring also occurs with patient movement during radiographic examinations.
If patient movement is voluntary, patients may require immobilization or sedation to prevent this.
Involuntary motion, such as respiration or cardiac motion, may cause artifacts that mimic pathology in surrounding structures.
This artifact can be reduced by using a fast scanning technique. Techniques, such as cardiac gating, may be used for examinations that concern the mediastinum.



Transient interruption of contrast **(TIC) is a common flow artifact seen in CT pulmonary angiography (CTPA) studies. The contrast opacificiation of the pulmonary arteries is suboptimal due to an increase in the flow of unopacified blood from the inferior vena cava (IVC) to the right side of the heart, often during deep inspiration.**



Clothing artifacts, like jewelry artifacts, are a regular feature on imaging examinations, especially plain radiographs, but in general are recognized for what they are, either at the time the image is taken by the radiographer, or later by the reporting radiologist.



It is common to see jewelry artifacts on imaging examinations, most commonly plain radiographs, although also on other modalities, where they can produce unhelpful artifacts that may obscure important structures and preclude confident diagnostic evaluation.

Physics-based artifacts

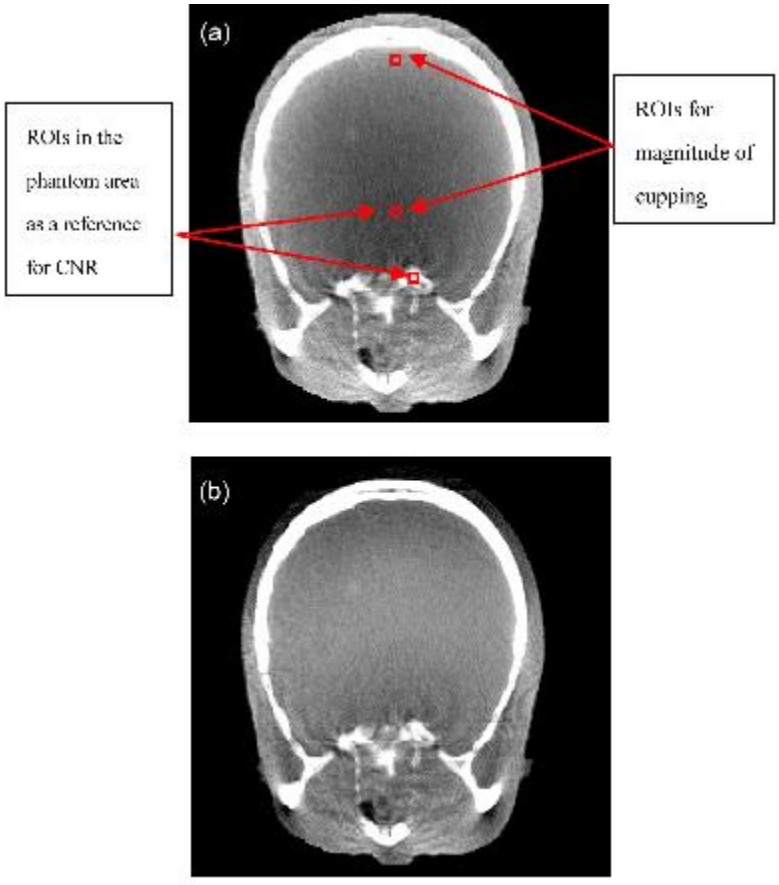
Beam hardening is the phenomenon that occurs when an x-ray beam comprised of polychromatic energies passes through an object, resulting in selective attenuation of lower energy photons. The effect is conceptually similar to a high-pass filter in that only higher energy photons are left to contribute to the beam, and thus, the mean beam energy is increased ("hardened")

Streaking artifact

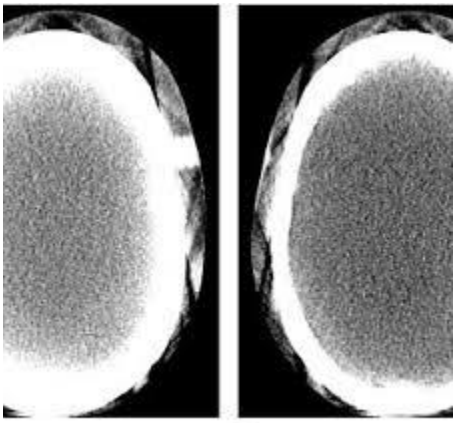
The streaking artifact appears as multiple dark streaking bands positioned between two dense objects, for example, at the posterior fossa. Streaking may also occur along the long axis of a single high-attenuation object. It is the result of the polychromatic x-ray being 'hardened' at different rates according to the rotational position of the tube/detector.

Cupping artifact

Beam hardening will cause the middle of the image to decrease in value, not increase edge value, as the lower energy photons preferentially get attenuated over longer path lengths. As the beam becomes harder and passes a higher mean beam energy, the lower attenuation coefficient means the CT number goes down for longer paths.



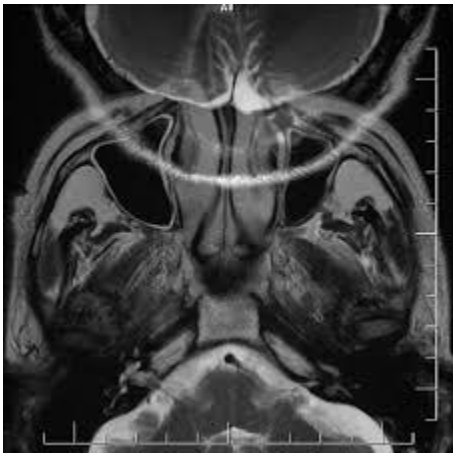
Partial volume artifact occurs when tissues of widely different absorption are encompassed on the same CT voxel producing a beam attenuation proportional to the average value of these tissues.
The latest generation of CT scanners with an associated reduction in the volume of a voxel has substantially reduced the occurrence of this artifact.



b.

Photon starvation is one source of streak artifact which may occur in CT. It is seen in high attenuation areas, particularly behind metal implants. Because of high attenuation, insufficient photons reach the detector. During the reconstruction process, the noise is greatly magnified in these areas leading to characteristic streaks in the image

Aliasing artifact, otherwise known as undersampling, in CT refers to an error in the accuracy proponent of analog to digital converter (ADC) during image digitization.

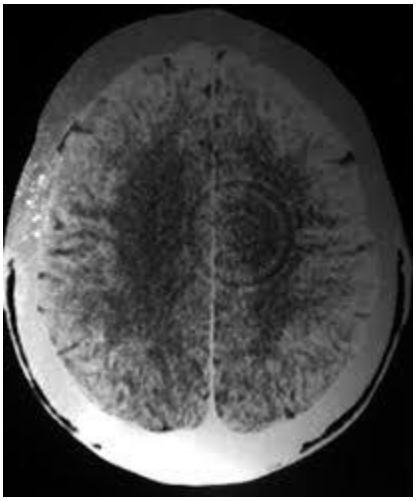


Truncation artifact in CT is an apparently increased curvilinear band of attenuation along the edge of the image.
This artifact is encountered when parts of the imaged body part remain outside the field of view (e.g. due to patient body habitus), which results in inaccurate measurement of

attenuation along the edge of the image. The artifact can be reduced - if possible - by using an extended FOV reconstruction of the affected region.

Hardware-based artifacts

Ring artifacts are a CT phenomenon that occurs due to the miscalibration or failure of one or more detector elements in a CT scanner. Less often, it can be caused by insufficient radiation dose or contrast material contamination of the detector cover 2. One should be aware of this artifact as it can be misinterpreted as pathology if goes unchecked.



Tube arcing occurs when there is a short-circuit within the tube, typically from the cathode to the tube envelope. The result is a temporary loss of x-ray output and a localized artifact.

Out of field artifact, also known as incomplete projection artifact, is due to part of the patient existing peripheral to the field of view of the CT scanner. This can be a particular issue in obese patients who only just fit within the scanner bore.

The air bubble artifact is a CT artifact that manifests from the presence of abnormal gas in the oil coolant which surrounds the x-ray tube. The artifact manifests as subtle low density, which has only been described on brain scans.

In CT imaging, the windmill artifact is an image distortion in the axial plane, encountered during helical multidetector acquisitions. The telltale appearance is characterized by equally distanced bright streaks diverging from a focal high-density structure. The streaks seemingly rotate while scrolling back and forth through the affected slices - hence the name.

Cone beam effect artifacts are seen in multidetector row CT (cone beam CT) acquisitions 1. Modern CT scanners use more detector arrays to increase the number of sections acquired per rotation. This causes the x-ray beams to become cone-shaped as opposed to fan-shaped 2. As a result instead of collecting data that corresponds to a flat plane, each detector collects data that corresponds to the volume contained between two cones 2 which can lead to under-sampling in the cone angle dimension 3. This causes noise, streaks and stair-step artifacts 1. The artifacts are more pronounced at the periphery of the field of view and worsen with an increasing number of detector rows.

Zebra stripes, a.k.a. zebra artifacts, appear as alternating bright and dark bands in a MRI image. The term has been used to describe several different kind of artifacts causing some confusion.

The CT stair-step artifact is found in straight structures which are oriented obliquely with respect to movement of the table and appear around the edges of sagittal and coronal reformatted images when wide collimations and non-overlapping reconstruction intervals are used.

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