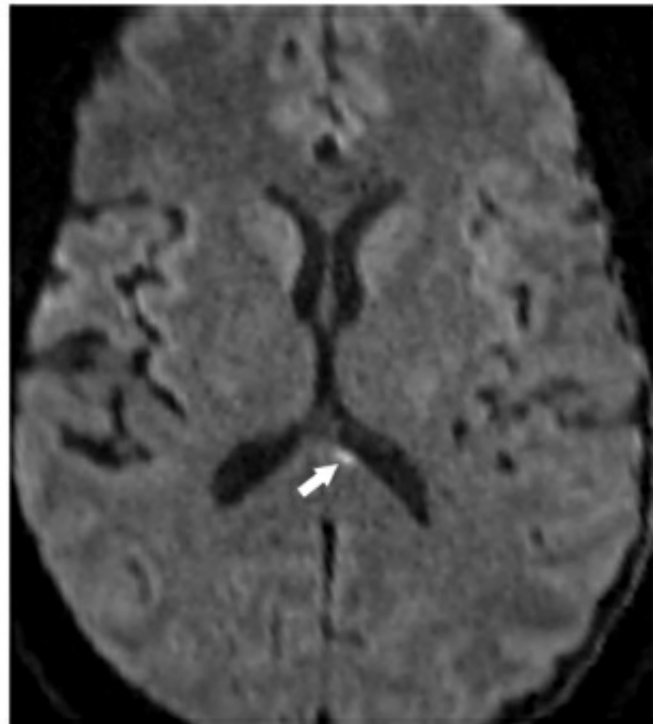
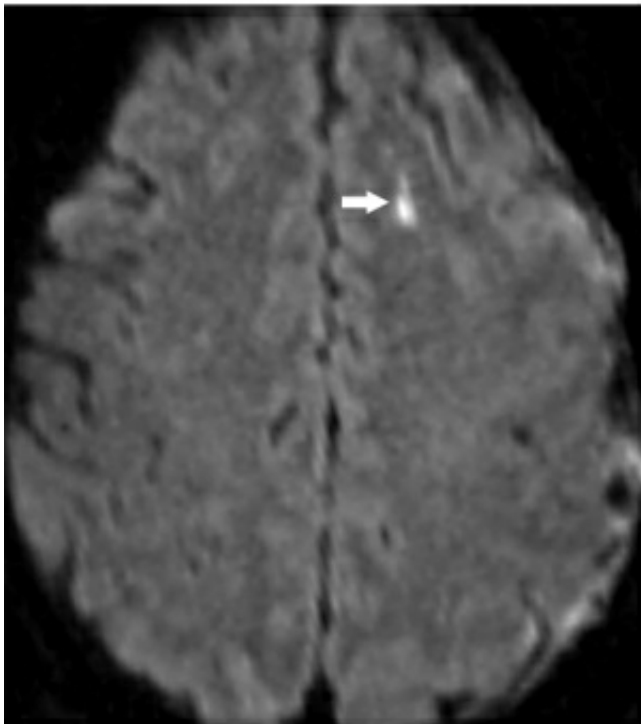
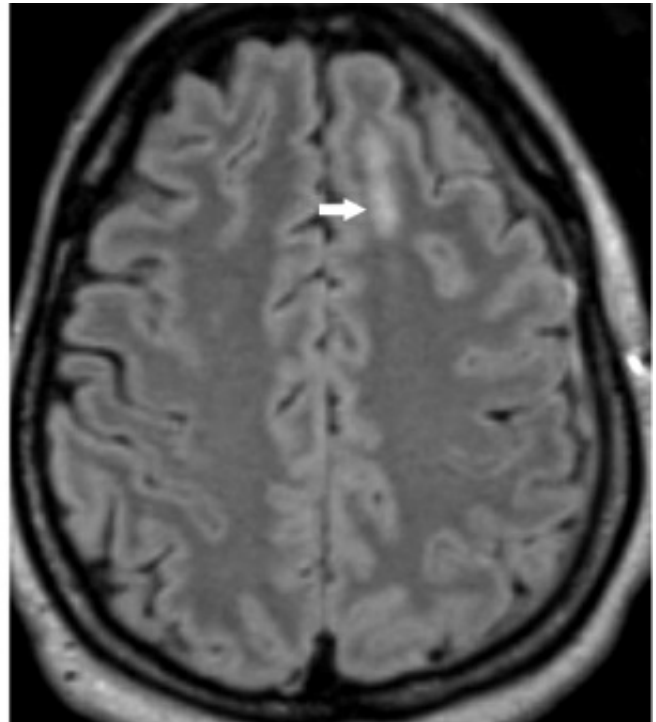
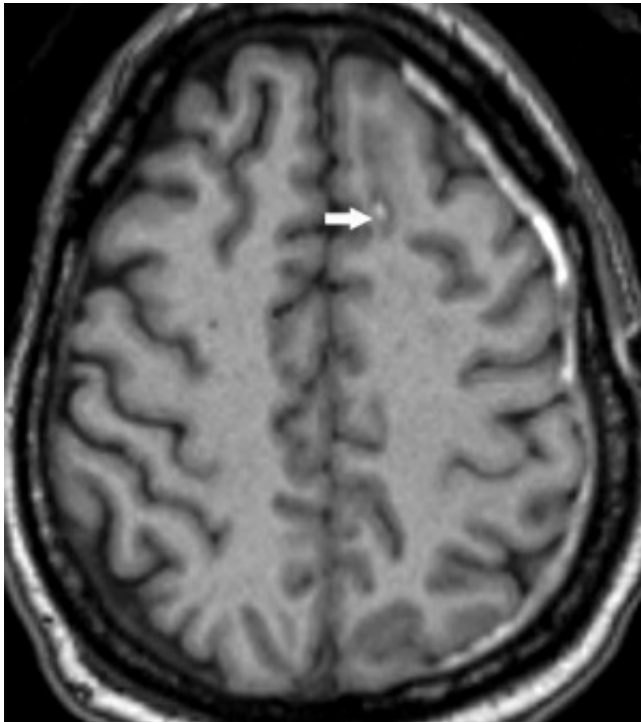




Diffuse Axonal (Shear) Injury (DAI)

Last Updated: October 1, 2018



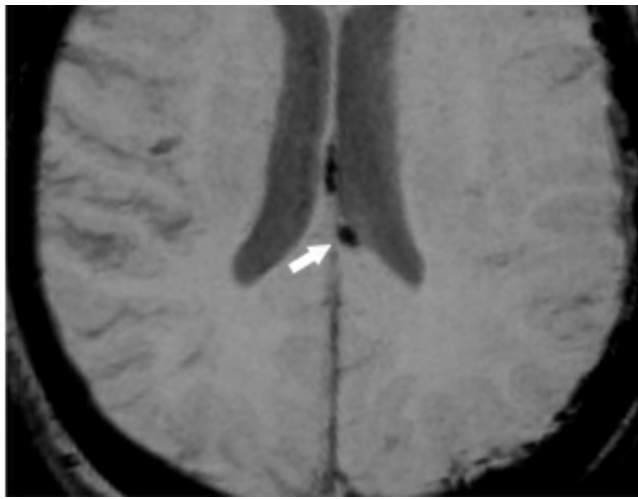


Figure 1: Shear injury is visible in the subcortical white matter of the left frontal lobe in this patient as hyperintense on T1 due to hemorrhage (top row left). The same area is bright on FLAIR due to edema (top row right) and bright on DWI due to cytotoxic edema (middle row left). The SWI (bottom row) also shows low signal blood products in this area. Similar findings in the splenium of the corpus callosum (middle row right, bottom row) and posterior septum pellucidum (bottom row) indicate a grade 2 shear injury and portend a poorer prognosis than if the involvement were only at the gray-white junction. A subacute left subdural hematoma is also visible on each sequence, but most clearly visible as hyperintense on T1 (top row left).

- Occurs secondary to acceleration and deceleration forces acting at different rates
- Results from traumatic axonal stretch injury
- Can be hemorrhagic or non-hemorrhagic
- Located within
 - The gray-white junction, in the subcortical white matter and along the deep gray matter structures (Grade 1),
 - Within the corpus callosum (Grade 2) and
 - In the brain stem (Grade 3)
- Deeper brain involvement, indicates a greater severity and worse prognosis

Neuroimaging

- CT findings
 - Normal appearance in 50-80% cases
 - Nonhemorrhagic – appear as small, hypodense foci
 - Hemorrhagic – appear as small, hyperdense foci, possibly with surrounding hypodense edema
 - Repeat scans may reveal more lesions as the injury evolves
- MRI findings (See Figure 1)
 - T1WI
 - Usually normal
 - If > 1 cm and hemorrhagic, may appear hyperintense for 3-14 days
 - T2WI
 - Nonhemorrhagic lesions appear as hyperintense foci
 - Hemorrhagic lesions appear as hypointense foci
 - FLAIR
 - Nonhemorrhagic DAI appear as hyperintense foci
 - Hemorrhagic DAI appear as hypointense foci
 - T2* GRE/SWI
 - Most sensitive sequence
 - Microbleeds may be visible only on GRE or SWI
 - Hypointense foci appear as susceptibility from blood products
 - SWI depicts significantly more DAI foci than GRE
 - Multifocal hypointense foci may remain for years
 - Number of GRE lesions correlates with intracranial hypertension and outcome

- DWI
 - May show foci of restricted diffusion
 - Damage to WM may be visible on diffusion tensor imaging (DTI) Fractional anisotropy maps
 - DTI “tractograms” allow delineation of white matter tract disruption pattern
 - DWI may help detect abnormalities when routine imaging, including GRE or SWI, is normal
- MR Spectroscopy
 - Decreased N-acetyl aspartate in white matter secondary to neuronal injury
 - Increased choline in gray matter is suggestive of inflammation
 - Abnormal NAA/Cr and Cho/Cr is predictive of outcome

For more information, please see the corresponding chapter in [Radiopaedia](#).

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