
SUMMARY & CONCLUSION

Traumatic injuries of the cervical spine are potentially catastrophic. When associated with neurologic damage, they can result in devastating medical, social, emotional, and financial consequences. Fractures with bony retropulsion, disk extrusions, and epidural hematomas can result in cord compression. Spinal cord injury may be complete or incomplete.

Spinal cord injury (SCI) results in drastic functional disabilities in patients. Due to the interference of spinal shock with functional assessment of SCI patients in the clinical setting, it is important to develop a noninvasive imaging technique for early evaluation of spinal cord integrity after injury.

X-ray and better CT are useful in delineating bony details and are important in preoperative planning. The cord is vulnerable to transection if the applied forces are sufficient. It should be noted, that diagnosis of cord transection cannot be made, even with a severe fracture dislocation evident on CT.

Magnetic resonant imaging (MRI) is the method of choice for detection and diagnosis of many disorders in the spine because of its inherent sensitivity to subtle soft tissue changes and its capability to displaying long segment of vertebral column in one examination. In the context of trauma MRI can detect ligamentous injury and internal derangement of the spinal cord.

Diffusion weighted MRI (DWI) promises to add to the diagnostic specificity of MRI in the spine. Based on its ability to depict the microscopic motion of water protons, DWI can be used to sensitize image contrast to microstructural changes and thus can provide important information complimentary to regular MRI sequences.

DWI provides important biological information about the composition of tissues, their physical properties, their microstructure, and their architectural organization. This information is available non invasively and without contrast administration. DWI generates images that are based on the molecular motion of water, which is altered by disease.

Water molecules held in a container outside the body are in constant random motion. This uninhibited motion of water molecules is what's called *free diffusion*. By contrast, the movement of water molecules in biologic tissues is *restricted* because their motion is modified and limited by interactions with cell membranes and macromolecules. The degree of restriction to water diffusion in biologic tissue is inversely correlated to the tissue cellularity and the integrity of cell membranes.

Water diffusion in the white matter is defined based on axonal alignment. Water diffuses preferentially in a direction parallel to the axon's longitudinal axis, but diffusion is relatively restricted in the perpendicular axis.

Diffusion tensor imaging (DTI) is an application of DWI that provides unique quantitative information about the structural and orientational features of central nervous system tissue. This method offers in vivo localization of neuronal fiber tracts, which was previously impossible.

Two DWI methods, *diffusion tensor imaging (DTI)* and *diffusion tensor tractography (DTT)* are used to study the white matter tracts in the central nervous system.

1) Fractional Anisotropy (FA):

It depends on how the water molecules diffuse in the living body depending on the nature of the local environment, and this variation is called (anisotropic diffusion). The white matter fibers constituting the spinal cord are highly anisotropic, and visualization of their anisotropy should delineate axonal arrangement. An image representing anisotropy two-dimensionally is called an (anisotropy map) or an (FA map). In a color FA map, different colors are assigned to different axes; thus, fibers can be distinguished from each other by using different colors according to the direction of their arrangement.

2) Diffusion tensor tractography (DTT):

DTT (diffusion tensor tractography) is an imaging technique in which direction of maximum anisotropy for each voxel is traced. Before spinal DTT can be applied clinically, it is indispensable to conduct detailed analyses to determine the extent to which DTT reflects each tissue type, and the reliability with which DTT depict axonal information.

Unlike conventional MRI, which depicts the injured spinal cord only as changes in signal intensity on T1 and T2 weighted images, DTT allows visualization of the injury in the form of *interrupted white matter fibers*.

The most important limitation of the technique is that it is not fully validated. Attempts to clinically validate this technique have been made

in the past. Most of these efforts are based on comparisons of the tractographic images and known neuroanatomy. The technique is also quite operator dependant and FT still depends on a qualitative visual analysis by the radiologist and requires further development of the quantification and standardization methods.

The ability of DTI-FT in demonstrating the white matter architecture is unparalleled by any other imaging modality and further active clinical trials & applications are required.