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DIFFUSION TRACTOGRAPHY IN SPINAL CORD INJURY: PRELIMINARY EXPERIENCE

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ABSTRACT

Diffusion tractography is a new imaging technique to display the traumatic region for valuable preoperative information with prognostic significance. We present a case of 54 year male with quadriparesis showing reduced FA values and increased ADC in injured segment with depiction of disrupted tracts on tractography.In the near future, DTI will become a part of routine imaging in trauma patients as experience with this novel meathod gains acceptance.
Key words: DTI, Spinal trauma,MRI

INTRODUCTION

Spinal cord injuries result in damage to the myelinated fibers of the spinal cord and/or nerve roots, MRI can detect these changes as increased signal intensity on T2W and STIR images. However diffusion tensor imaging (DTI) can be used detect abnormalities in the spinal cord, even in cases where routine MRI may be normal. Role of diffusion tensor imaging has been established in brain imaging however spinal cord DTI has remained largely as a research tool due to issues like small size of the spinal cord, its compactness and susceptibility to motion artifacts.

CASE REPORT

we present a case of 54 year old male who sustained trauma at a road side accident, Following trauma he developed quadriparesis. There was evidence of bladder and bowel incontinence. On CNS examination there was evidence of power grade 0 in all the limbs with areflexia. Cervical and dorsal spine MRI was requested to rule out cord injury. MRI was done using a 1.5-T machine (Siemens, somatom) 1.5 T image. STIR and T2W images in the sagittal and axial planes were obtained for cervical and dorsal spine. DTI was performed in the axial and saggital planes, using a phased array spine coil with the following parameters: 20 directions EPI tensor imaging TR: 8000; TE: 97.6; b value: 1000; frequency: 128; phase: 128; FOV (field of view): 26 X 20.8; slice thickness: 5 mm with no interslice gap.On MRI there was altere SI involving the C7 vertebra which was hypointense on T1w and hyperintense on T2w and STIR sequences s/o edema. There was altered SI and expansion of cord involving the C7-T1 level with similar SI characterstics as C7 vertebra suggestive of cord oedema. On DTI imaging the FA value was .25 + .18 which was significantly reduced than control value .56 + .14 at proximal to the injury. ADC value of 937 + 112 was present at the site of injury which was increased as compared to 432+ 110 at proximal level. Tractographic image clearly demonstrated disruption of the fibres bilaterally. Patient was managed conservatively and later underwent screw fixation to stabilize the vertebrae. There was only minimal recovery of the paresis in all the limbs.

Figure 1: saggital STIR image showing hyperintensity involving the cord (white arrow)and C7 vertebra(black arrow)

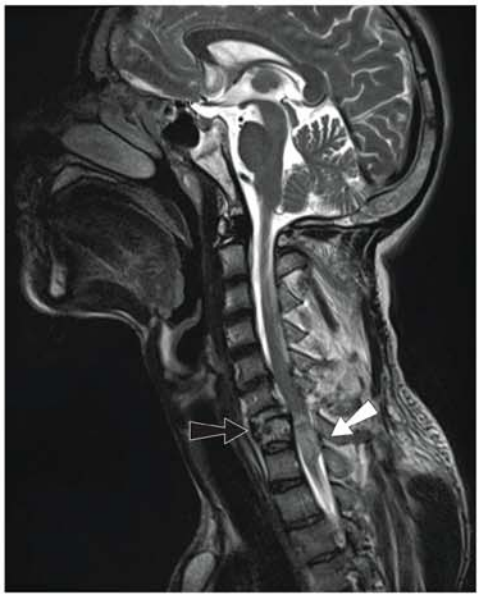

Figure 2: saggital T2w image showing hyperintensity involving the cord with oedema(white arrow)and C7 vertebra(black arrow)

DISCUSSION

Demonstration of human spinal cord injury by DTI tractography techniques has been described by only few studies previously. Role of diffusion tensor imaging has been established in brain imaging however spinal cord DTI has remained largely as a research tool due to issues like small size of the spinal cord, its compactness and susceptibility to motion artifacts. [1] Some studies have used 9 Tesla DTI to clearly demonstrate the discontinuous cortico-spinal tracts after a hemisection injury in common marmosets. [2] But with current setup high strength MRI is not clinically applicable for imaging humans in routine clinical practice. Studies documenting the role of DTI in acute spinal cord injuries have focused mainly on DTI anisotropy indices rather than tractography, which is more representative than the former. [3] The clinical application of tensor imaging in spinal cord lesions due to trauma, tumors, and inflammation has shown the usefulness of this technique. DTI has been successfully utilised to demonstrate displaced white matter tracts or their involvement by lesions in the cord. This has revolutionised the treatment planning and follow-up of cases. [4] Tensor imaging can show changes in white matter tracts even in cases where routine imaging is normal. Even when routine CT scan and MRI normal, the tractography has been proven to be of utility as there was reduction in diffusion anisotropy after suggesting axonal injury. [5] Reduced FA in the cervical cord has been demonstrated in patients as compared to controls, in demyelinating disease such as multiple sclerosis, even when routine MRI imaging was normal. [6] It has been seen that DTI offers better clinical correlation with neurological deficit whereas the routine MRI may not show the abnormality and shows lesser correlation with the motor deficits. [7] Only experimental and high strength use of DTI in spinal trauma patients has misled the investigators regarding the practical use of DTI in evaluating spinal cord diseases. But results from newer studies suggest that DTI of spinal cord is technically and practically possible with a 1.5 Tesla MRI1 .DTI may be beneficial in quantification of spinal injury prior to surgical treatment and help in prognostic postsurgical outcome. It can also determine the extent of injury particular below the level of diagnosed injury. [8] Studies have shown that injured segments show evidence of reduced FA and increased ADC values as compared to normal areas with depiction of disruption on tractography images 3. [9]

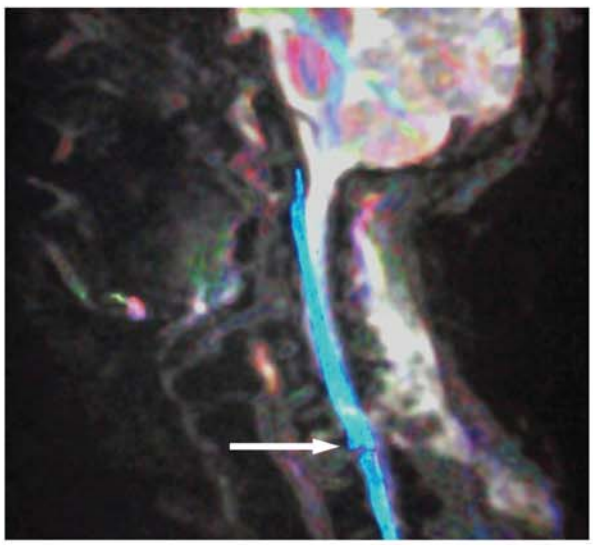

Figure 3: tractography images showing the disrupted fibres (thin white arrow)

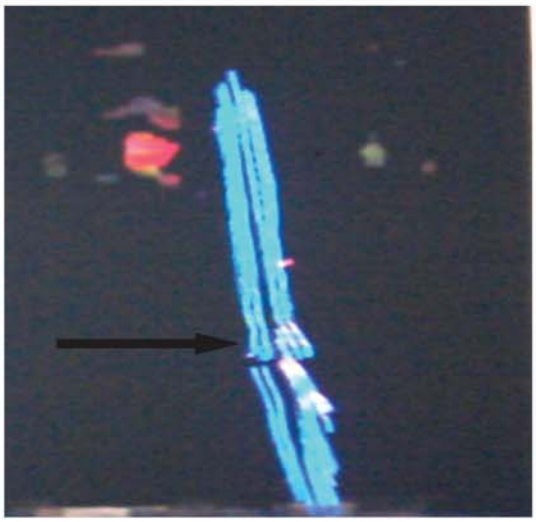

Figure 4: tractography images showing the disrupted fibres (thin black arrow)

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