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Choe et al., (2017) USA Case Control $N_{Initial}$=29 N_{Final}=28	**Population**: SCI (n=18): Mean age=46.72±14.47yr; Gender: males=14, females=4; Level of injury: C=18; Time since injury=9.83±11.45yr; AIS: A=3, B=2, C=6, D=7. Healthy Controls (n=10): Mean age=33yr (range=21-49); Gender: males=6, females=4. **Intervention:** Diffusion fiber tractography was performed on all participants with a Philips 3-T scanner using a 16-channel neurovascular coil. Images were acquired using multi-slice pulsed gradient spin echo sequence, b=0 and 500s/mm2, 16 diffusion-weighted directions that sample a prolate tensor, TR/TE=6300/63ms, SENSE factor=2, 96X96X40 volume matrix, 1.5X1.5X3mm3 resolution (axial sections of 3mm thickness; zero-filled to 0.57X0.57X3mm3), and matrix size=256X256X40. The entire length of the spinal cord serves as the field of view. Regions of interest included the following regions relative to injury (RRI); epicenter RRI (ERRI); superior RRI (SRRI) defined as the region located above the superior edge of the ERRI up to approximately one vertebral level; inferior RRI (IRRI) defined as the region below the inferior edge of the ERRI to the length of approximately one vertebral level. Diffusion Tensor Imaging (DTI) indices were also averaged over all RRI to create an all-level region (AL) value for each index. DTI indices were measured for each spinal cord column region (left, right, dorsal, and ventral columns) within each RRI (ERRI, SRRI, IRRI). The International Standard of Neurological Classification for SCI (ISNCSCI) total score was determined for each SCI participant by summing the total motor score (upper and lower motor extremity scores) and total sensory score (left and right light touch). **Outcome Measures**: DTI indices: Fractional Anisotropy (FA); axial diffusivity (AD); radial diffusivity.	1. All DTI indices of different RRIs differed significantly ($p<0.05$). 2. DTI indices did not differ between spinal cord columns (i.e., left, right, dorsal, and ventral columns) ($p>0.05$). 3. There were no significant relationships between DTI indices and total ISNCSCI scores from different spinal cord columns ($p>0.05$). 4. For the AL region, individuals with SCI had significantly decreased and increased FA and RD compared to normal controls, respectively ($p<0.05$). There was no significant difference in AD in the AL region ($p>0.05$).
D'Souza et al., (2017) India Case Control N=50	**Population**: SCI (n=20): Mean age=35.95±10.86yr; Gender: males=14, females=6; Level of injury: C=20; Time since injury=≤7d; AIS: NR. Healthy Controls (n=30): Mean age=35.90±10.13yr; Gender: males=20, females=10. **Intervention:** All participants underwent Diffusion Tensor Imaging (DTI) using a single shot echo planar imaging (EPI)	1. At the level of injury, FA was significantly lower for SCI when compared to healthy controls ($p<0.001$). However, MD was significantly higher for SCI at the level of injury when compared to healthy controls ($p<0.001$). 2. There were no significant differences in MD and FA above and below the injury when comparing

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	sequence (b-value=0,700 s/mm^2) using 20 diffusion encoding directions. Images were acquired using Sagittal T1: repetition time/echo time(TR/TE)=450/9.5ms; Sagittal T2:TR/TE–3630/104ms; Axial T1: TR/TE–450/9.6ms and Axial T2: TR/TE-500/15 ms. Images were acquired in the axial plane with an image matrix of 128X128, 5mm slice thickness with no inter-slice gap, and a 280X280mm field of view. SCI participants were reassessed clinically 1-2 mo after imaging. **Outcome Measures**: Mean diffusivity (MD); fractional anisotropy (FA); Frankel grading system score (FGS).	SCI to healthy controls (p>0.05). 3. There was a statistically significant positive correlation between FA values at the level of injury and FGS (r=0.86, p<0.001). In contrast, there was no significant correlation between MD at the level of injury and FGS (p>0.05). 4. Qualitative analysis of the cord on tractography revealed that 12 cases suggested disruption in cord integrity.
Shanmuganathan et al., (2017) USA Case Control $N_{Initial}$=45 N_{Final}=31	**Population**: SCI (n=16): Median age=53(range=20-79)yr; Gender: males=13, females=3; Level of injury: C=16; Time since injury=≤5d; The International Standard of Neurological Classification for SCI (ISNCSCI) at discharge: A=5, B=2, C=3, D=6. Healthy Controls (n=15): Median age=46(range=26-69)yr; Gender: males=12, females=3. **Intervention:** All participants underwent Diffusion Tensor Imaging (DTI) with a 1.5-T Avanto scanner with a 12-channel head and four-channel neck array using single-shot echo planar imaging (EPI) sequence at a TE/TR of 87/2800 msec. Sagittal T2 (echo time/ repetition time (TE/TR)=109/4000 ms), fluid attenuation inversion recovery (FLAIR) (TE/TR=102/8000 msec, echo train length (ETL)=13), and axial T2 and T2*, three-dimensional [3D] susceptibility weighted imaging (SWI) (TE/TR: 16/30msec, flip angle: 20 degrees) images were included. For SCI, Regions of interest included areas of edema (confirmed by T2 and STIR sequences) and hemorrhage (confirmed by SWI and T2* sequences). For healthy controls, regions of interest included upper (lower brainstem-lower C2), mid (upper C3-lower C5), and lower (upper C6-lower T1) regions. The International Standard of Neurological Classification for SCI (ISNCSCI) was assessed at discharge and at 1-yr follow-up. **Outcome Measures**: ISNCSCI motor score; Spinal cord independence measure III (SCIM); Radial diffusivity (RD); axial diffusivity (AD); mean diffusivity (MD); fractional anisotropy (FA).	1. FA was significantly lower in SCI when compared to lower (p<0.001), mid (p<0.001), and upper (p<0.001) regions in healthy controls. 2. AD was significantly lower in SCI when compared to lower (p<0.001), mid (p<0.001), and upper (p<0.001) regions in healthy controls. 3. RD was significantly higher in SCI when compared to mid (p<0.001) and upper (p<0.001) regions of healthy controls. There was no significant difference in RD when comparing SCI to the lower region of healthy control (p>0.05). 4. There was no significant difference in MD when comparing SCI to all regions of healthy controls (p>0.05). 5. Pearson correlations revealed significant correlations between MD and the presence of hemorrhagic contusions (r=0.42, p<0.05), ISNCSCI motor score (r=0.66, p<0.05), and SCIM (r=0.64, p<0.05). 6. There was a significant correlation between FA and age (r=-0.55, p<0.05). 7. AD was significantly correlated with presence of hemorrhagic contusion (r=0.42, p<0.05), ISNCSCI motor score (r=0.76, p<0.001), and SCIM (r=0.77, p<0.01). 8. RD was significantly correlated with age (r=0.5, p<0.05) and ISNCSCI motor score (r=0.53, p<0.05). 9. Step-wise regression revealed MD (r^2=0.89, p=0.002), AD (r^2=0.0.93, p<0.001), and RD (r^2=0.86, p=0.014) were significant predictors of ISNCSCI motor score at the 1-year follow-up for participants with or without hemorrhage spinal cord

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		injury. FA was not a significant predictor in the model (p>0.05). 10. MD, AD, FA, and RD were not significant predictors of SCIM at 1-year follow-up for both hemorrhagic and non-hemorrhagic spinal cord injury (p>0.05).
Wang et al., (2016) China Observational N=35	**Population**: SCI (n=35): Mean age=57.2yr (range=42-69); Gender: males=21, females=14; Level of injury: C=35; Time since injury=NR; AIS scale: NR. **Intervention:** Imaging was performed on a 3.0T dual gradient superconductor MR with a gradient strength of 40mT/m and switching rate of 150mT/ms^{-1}. Difusion Tensor Imaging (DTI) consisted of a single-shot spin-echo-planar sequence (b value=1000 s/mm^2, repetition time/echo time=8000/87.6ms, section thickness=4mm, interlamellar spacing=0mm, bandwidth=250 kHz, field of view=180X180mm, image matrix=130X128, number of signals averaged=2. DTI grading was performed by two radiologists; Grade 1, 2, and 3 constituted mixed signal in lesion area but complete and continuous fiber bundle, abnormal signal and disordered fiber bundle in local lesion, interrupted fiber bundle, respectively. Outcome measures were evaluated before surgery and 1 yr after surgery. **Outcome Measures:** Motor score; sensory score; American Spinal Injury Association (ASIA) index score (AIS).	1. There was a significant correlation between AIS and DTI grading before and after surgery (p<0.05, r=0.475; p<0.01, r=-0.529, respectively). 2. There was also a significant correlation between DTI grading and motor score, as well as sensory score after surgery (p=<0.01, r=0.492; p<0.05, r=0.476, respectively). 3. There were no significant correlations between DTI grading and motor score and sensory score before surgery (p>0.05).
Kim et al., (2015) Korea Case Control N=38	**Population**: SCI (n=17): Mean age=47.0±13.4yr; Gender: males=11, females=6; Level of injury: C=17; Time since injury=13.1±19.9mo; Etiology: Vertebral fracture=5, compressive myelopathy=3, degenerative myelopathy=1, transverse myelopathy=2, cervical myelopathy=1, spinal cord contusion=4, ossification of posterior longitudinal ligament=1; AIS: A=4, B=1, C=2, D=10. Healthy Controls (n=21): Mean age=38.5±15.7yr; Gender: males=13, females=8. **Intervention:** All participants were assessed with Diffusion Tensor Imging (DTI) using a Tim 3-Tesla MR scanner with a 12-channel head coil and 4-channel neck coil. Axial images had the following parameters; repetition time/echo time (TR/TE)=5100/77ms;	1. SCI had significantly lower FA in all three regions (lateral, dorsal, ventral) and all levels (at injury, above injury, below injury) compared to healthy controls (p<0.05). 2. SCI had significantly higher ADC in all three regions (lateral, dorsal, ventral) and at two levels (injury level and below injury) compared to healthy controls (p<0.05). However, there was no significant difference in ADC above the injury for all three regions (lateral, dorsal, ventral) (p>0.05). 3. Peak systolic vCSF was significantly higher in SCI at the injury level when compared to healthy controls (p<0.05). 4. Peak diastolic cCSF was significantly lower in SCI below the

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	number of signals averaged (NEX)=10; b-value=0, 750s mm−2; diffusion direction=6; image matrix=140 X 36; field of view (FOV)=140X36 mm2; slice thickness=5 mm; total number of slices=17; voxel resolution=1.0X1.0X5mm3; bandwidth=916 Hz per pixel; and total acquisition time(TA)=6min and 2s. Sagittal T2-weighted images were acquired using a T2-weighted fast spin-echo (FSE) sequence. In the SCI participants, DTI indices were measured at the level of injury, above the injury (at least one vertebral segment above), and below the injury (at least one vertebral segment below). DTI indices of healthy controls were measured at C2-C3, C4-C5, and C6-C7 for comparison against above the injury, at the level of injury, and below the injury of SCI, respectively. DTI indices were assessed along the lateral, dorsal, and ventral regions of the spinal cord in all participants. **Outcome Measures**: AIS; American Spinal Injury Association (ASIA) motor and sensory scores; modified Barthel index score (MBI); Spinal cord independence measure III (SCIM); somatosensory evoked potentials (SEP) latency and amplitude; DTI indices: Intramedullary fractional anisotropy (FA), apparent diffusion coefficient (ADC); cerebrospinal fluid velocity (vCSF);	injury when compared to healthy controls (p<0.05). 5. In SCI participants, FA was significantly correlated with systolic and diastolic vCSF above the injury and at the level of the injury (p<0.05). Systolic and diastolic vCSF at the injury and below the injury were significantly correlated with changes in FA at the injury level and above the injury (p<0.05) 6. There were no significant correlations between ADC and vCSF (p>0.05). 7. In SCI, there were significant negative correlations between both right and left ulnar nerve SEP latency and right lateral FA (r=-0.560, p=0.046; r=-0.676, p=0.041), left lateral FA (r=-0.676, p=0.011; r=-0.675, p=0.011), and dorsal FA (r=-0.641, p=0.018; r=-0.652, p=0.016). 8. There was also a significant negative correlation between the right tibial nerve SEP latency and dorsal FA (p=0.010), as well as the left tibial nerve and both left lateral FA (r=-0.632, p=0.021) and dorsal FA (r=-0.695, p=0.008). 9. There was a significant positive correlation between left tibial nerve SEP amplitude and ventral FA (r=0.585, p=0.036). 10. FA of the ventral area at the level of injury was significantly correlated with ASIA sensory score (r=0.687, p=0.009). 11. FA below the level of injury significantly correlated with AIS (r=-0.773, p=0.014) and SCIM (r=0.680, p=0.044). 12. There was no significant correlation between both FA and ADC and ASIA motor score or MBI (p>0.05).
Koskinen et al., (2013) Finland Case Control N=68	**Population:** *SCI group (n=28)*: Mean age: 59.9yr; Gender: males=22, females=6; Injury etiology: motor vehicle accident (n=10), fall (n=12), sports (n=3), assault (n=1), other (n=2); Level of injury: cervical=27, thoracic=1; Level of severity: AIS A=7, B=1, C=3, D=16, E=1; Mean time since injury: 13.1yr. *Healthy Control (CG) group (n=40)*: Mean age: 40.6yr; Gender: males=20, females=20. **Intervention:** Researchers aimed to	1. The FA values of the SCI were group were significantly lower than those of the CG group (p<0.001). 2. ADC and RD values of the SCI group were significantly higher than those in the CG group (p<0.0001 and p<0.00001, respectively). 3. In the SCI group, the FA values were positively correlated with the motor (p<0.01) and sensory (p<0.001) scores of ISNCSCI. 4. In the SCI group, the FA values were positively correlated with the motor

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	quantify the association between diffusion tensor imaging (DTI) parameters in individuals with cervical traumatic SCI. **Outcome Measures:** Apparent Diffusion Coefficient (ADC), Fractional Anisotropy (FA), Radial Diffusivity (RD), International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI), Functional Independence Measure (FIM).	subscale of FIM (p<0.01). 5. DTI revealed SCI pathology, which was undetectable using conventional MRI.
Ellingson et al., (2008b) USA Case Control N=8	**Population**: SCI (n=4): Mean age=42.25±14.04yr; Gender: NR; Level of injury: C=3, T=1; Time since injury=13±11.09yr; AIS: A=1, B=1, C=2. Healthy Controls (n=4): Mean age=29±4.85yr; Gender: NR **Intervention:** Diffusion Tensor Imaging (DTI) images were obtained for all participants using a head coil and a 1.5T scanner. Twelve axial slices throughout the upper cervical spine using a single-shot EPI/SE (dual spin echo) pulse sequence were acquired with repetition time/echo time (TR/TE)=6000/88.1ms, field of view (FOV)=200 mm, and number of signals averaged (NEX)=4 (T2-weighted image only) for each participant. Images were taken rostral to the injury site and in equivalent regions for SCI and healthy participants, respectively. Morphology analysis was done by FIS tissue classification. **Outcome Measures**: Fractional anisotropy (FA); longitudinal apparent diffusion coefficient (LADC); transverse apparent diffusion coefficient (TADC); mean diffusivity (MD); cross-sectional area (CA).	1. FIS images of SCI participants were less clear compared to healthy control vis-à-vis presence of distinct gray matter shape. Additionally, there seemed to be a changes in shape and decreases in size of the spinal cord in SCI comparted to controls. 2. SCI had significantly lower TADC, LADC, and MD in gray matter (p=0.008; p=0.033; p=0.007, respectively), white matter (p=0.002; p=0.005; p<0.001, respectively), as well as individual white matter regions including the dorsal funiculus (p=0.039; p<0.001; p<0.001, respectively), and lateral funiculi (pp<0.001; p=0.01; p<0.001, respectively). 3. There was no significant difference in TADC, LADC, and MD for cerebrospinal fluid (p>0.05). 4. SCI had significantly smaller whole cord and white matter tract cross-sectional area compared to controls (p=0.001; p<0.001, respectively). There was no significant difference in cross-sectional area of gray matter (p=0.109). 5. Frontal and sagittal diameters were significantly smaller in SCI (p<0.001; p=0.009, respectively), suggesting spinal cord atrophy.
Ellingson et al., (2008a) USA Case Control N=23	**Population**: SCI (n=10): Median age=37yr (range=25-67); Gender: NR; Level of injury: C=6, T=5; Time since injury=>4yr; Injury type: complete=4, incomplete=6. Healthy Controls (n=13): Median age=25yr (range=25-67); Gender: NR **Intervention:** Diffusion Tensor Imaging (DTI) images of the entire spinal cord (c1-L1) were obtained for all participants using a CTL Spine Coil with anterior neck coil attachment. Images were acquired with TE/TR=96.3/6000ms, matrix size=128X128, number of signals	1. Controls had higher whole cord FA compared to SCI, especially in white matter dense areas (p<0.001). 2. Subjects with complete SCI had significantly higher TADC and MD throughout the whole spinal cord compared to subjects with incomplete SCI (p=0.011; p=0.037, respectively). However, there was no significant difference in LADC (p>0.05). 3. Subjects with lower cervical lesions showed significantly lower TADC and MD throughout the spinal cord

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	averaged (NEX)=1, FOV=200mm, and a section thickness of 5mm with no intersection gap. Diffusion-weighted images (DWIs) were acquired with b=1500s/mm^2 in 25 equidistant directions. A single T2-weighted (T2WI) (b =0s/mm^2) was acquired for each section. **Outcome Measures**: Fractional anisotropy (FA); Transverse apparent diffusion coefficient (TADC); longitudinal apparent diffusion coefficient (LADC); mean diffusivity (MD).	compared with thoracic lesions (p=0.012; p=0.019, respectively). 4. TADC, LADC, and MD were significantly higher at the lesion in SCI compared to healthy controls (p<0.05 for all). 5. Completeness of injury and level of injury were not significant factors for changes in LADC, TADC, and MD in the cervical spinal cord (p>0.05). 6. There were no significant interactions between lesion level and vertebral level, as well as completeness of injury and vertebral level for TADC (p>0.05). However, FA was significantly lower in subjects with complete SCI compared to those with incomplete SCI (p<0.001). 7. Comparisons between SCI with upper cervical lesions and healthy controls revealed significantly lower LADC, TADC, and MD for SCI at C1, C2, and C3 (p<0.05).
Shanmuganathan et al., (2008) USA Case Control N=28	**Population**: SCI (n=20): Mean age=45.7±17.7yr; Gender: males=18, females=2; Level of injury: C=20; Time since injury=2hr-15d; The International Standard of Neurological Classification for SCI at discharge: A=5, B=2, C=3, D=6. Healthy Controls (n=8): Mean age=34.2±10.7yr; Gender: males=6, females=2. **Intervention:** All participants underwent Diffusion Tensor Imaging (DTI) with a 1.5T Avanto scanner with a 12-channel head and four-channel neck array using an echo-planar imaging (EPI) sequence at a repetition time/echo time (TR/TE) =8000/76ms and a resolution of 128X128 over a 20cm field of view (FOV). Images included sagittal T2 (TR/TE=4000/109ms), fluid-attenuated inversion recovery (TE/TR/echo train=8000/102ms/13), and axial T2 and T2* images. Regions of interest included upper (lower brainstem-lower C2), mid (upper C3-lower C5), and lower (upper C6-lower T1) regions. Medical records were reviewed to determine the extent of neurological deficit (e.g., quadriplegia, hemiplegia, radiculopathy, etc.). **Outcome Measures**: Apparent diffusion coefficient (ADC); fractional anisotropy (FA); relative anisotropy (RA); volume ratio (VR).	1. ADC was significantly lower in the SCI group in the upper (p=0.013), mid (p<0.001), and lower (p<0.001) regions when compared to healthy controls. 2. There were no significant differences in FA when comparing SCI to healthy controls at all three regions (p>0.05). 3. SCI showed significantly lower RA in the mid region when compared to healthy controls (p=0.037). There was no significant difference in RA for the upper and lower regions (p>0.05). 4. There were no significant differences in VR when comparing SCI to healthy controls at all three regions (p>0.05). 5. Whole cord Diffusion Tenor Imaging parameters showed significantly lower ADC and RA in participants with SCI (p<0.001; p=0.022, respectively). 6. Whole cord ADC, FA, and RA were significantly lower in SCI with hemorrhage compared to controls (p<0.001; p=0.0037; p<0.001, respectively). However, VR was significantly higher (p=0.008). 7. Only whole cord ADC and RA were significantly higher in quadriplegic SCI compared to healthy controls

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		(p<0.001; p=0.023, respectively). 8. ADC, FA, and RA parameters at the injury site of all SCI were significantly lower compared to whole-cord healthy control Diffusion Tensor Imaging parameters (p=0.031; p<0.001; p<0.001, respectively). Whereas VR was significantly higher at the injury site (p<0.001).
Facon et al., (2005) France Case Control N=26	**Population:** *SCI group (n=15)*: Mean age: 53.9yr; Gender: males=10, females=5; Injury etiology: metastasis (n=4), degenerative (n=6), spondylodiscitis (n=5); Level of injury: C1-L1; Time since injury: >4yr. *Healthy Control (CG) group (n=11)*: Mean age: 36.7yr; Gender: males=8, females=3. **Intervention:** Researchers aimed to evaluate the diagnostic accuracy of diffusion tensor imaging (DTI) in individuals with SCI and healthy controls. Comparisons were also made against T2-weighted fast spin echo (FSE). **Outcome Measures:** Apparent Diffusion Coefficient (ADC), Fractional Anisotropy (FA).	1. For the healthy subjects, averaged ADC values ranged from 0.00096mm^2/s to 0.00105mm^2/s and averaged FA values ranged from 0.745 to 0.751. 2. Ten individuals had decreased FA (0.67), and one had increased FA values (0.831); only two individuals had increased ADC values (1.03). 3. There was a statistically significant difference in the FA values CG and SCI groups (p=0.012). 4. FA had a much higher sensitivity (SE=73.3%) and specificity (SP=100%) in spinal cord abnormalities detection compared with T2-weighted FSE imaging (SE=46.7%, SP=100%) and ADC (SE=13.4%, SP=80%).