seven were female and five were male. The age range was 39-77 years and the mean age was 60 years. Persistent trigeminal arteries were distributed evenly between left and right. Seven of the cases had Saltzman type I, and five of the cases had Saltzman type II PTAs. Eleven of 12 patients had lateral PTAs and one of 12 had a medial PTA. One of the patients had a dural arteriovenous fistula on the contralateral side and one of the patients had a left posterior communicating aneurysm on the ipsilateral side. Two of 12 of the patients presented with vertiginous or stroke-like symptoms. Thin section CTA was performed in 6/12 (Figure). High-resolution MR imaging [defined as three-dimensional T1 or T2 (Figure) weighted imaging, time of flight magnetic resonance angiography or thin section T2-weighted imaging] was obtained in 8/12. The PTA was adequately characterized in 12/12 cases. The determination of Saltzman type was possible in 100%.

Conclusion
When a hypoplastic posterior circulation is encountered, a persistent carotid-basilar anastomosis should be suspected. The most common persistent carotid-basilar anastomosis is the PTA. High-resolution CT angiography and MRI/MRA provide useful adjuncts in characterizing the relationship of the PTA to the PCA and determining the Saltzman type. If small vertebral and proximal basilar arteries are detected on routine imaging, an abnormal vessel at the level of the persistent trigeminal artery should prompt a high resolution CT or MR evaluation to better characterize this anomalous vessel.

KEYWORDS: Anatomical variation, High-resolution imaging

MR-Based Measurement of Spinal Cord Motion during Flexion of the Spine: Implications for Intradural Spinal Cord Stimulator Systems

Smittkamp, C. A.1·Viljoen, S.1·Dalm, B. D.1·Wilson, S.1·Reddy, C. G.1·Gillies, G. T.2·Howard, M. A.2
1University of Iowa, Iowa City, IA, 2University of Virginia, Charlottesville, VA.

Purpose
We are developing the Human Spinal Cord Modulation System (HSCMS) as a new means of delivering electrical stimuli directly to the pial surface of the spinal cord for treatment of intractable pain via neurornodulation of targeted dorsal column pathways. To optimize device performance and avoid risk of injury to the spinal cord, the HSCMS implant must remain in gentle yet direct contact with the spinal cord even as it moves within the spinal canal. Functional anatomical knowledge of the spinal cord movement within the spinal canal therefore is needed to inform design requirements for the HSCMS. We have conducted an experiment to assess this movement at the anticipated lower thoracic location of the HSCMS.

Materials & Methods
The lower thoracic cord in healthy volunteers was imaged in both supine neutral and supine maximal spinal flexion positions. A bariatric MR was utilized as its larger bore size could accommodate volunteers while in the flexed position. CISS pulse sequences were selected for their high spatial frequency, allowing for the most accurate measurements. The distance between the T10 dorsal nerve root entry zone (DREZ) and T11 DREZ on the cord surface was measured in flexed and neutral positions and used as an assessment of spinal cord compression/expansion along the cranial-caudal axis. Next, the distance from the T10 DREZ to the inferior aspect of the T10 pedicle was measured. The difference in this measurement between flexed and neutral position is a measurement of cranial-caudal movement of the cord within the canal. Finally, a similar measurement was made on the conus tip to assess cranial-caudal movement at the distal-most cord.

Results
The T10-DREZ distance across all patients between the neutral and flexion positions ranged from -2.0 mm to +6.7 mm, with a mean and standard deviation of 3.5 ± 2.6 mm. The measured change in the pedicle-to-DREZ distance across all patients between the neutral and flexion positions ranged from 1.9 mm to 18.0 mm, with a mean and standard deviation of 8.5 ± 6.0 mm. The mean and standard deviation for the rostral-caudal conus movement was found to be 6.4 ± 4.1 mm within an overall range of 1.1 to 11.4 mm.

Conclusion
Although mean values for cranial-caudal movement and compression/expansion are calculated and reported as intended, much more interesting results are seen when evaluating the ranges of measurements obtained. An unexpected result was immense intersubject variability in how the spinal cord accommodates maximal flexion. Some subjects have nearly two centimeters of cranial cord movement with very little stretching while others have almost no cord movement while stretching over 25% along the measured segment. Because the spinal cord’s structure and anchoring elements vary somewhat over its length, some difference in degree of motion and stretch is expected. Our measurement data further suggests that the intersubject variance in these quantities can be quite large even over a localized segment of the cord. Our findings thus highlight the need for the HSCMS design to accommodate large patient-to-patient variations in spinal cord dynamic movement properties.
ADC is not able to predict tumor recurrence, it may prove ADC images in an individual patient. While in and of itself, statistical basis, great care must be taken in interpreting the high degree of variability, while this is true on a are more predictive of tumor recurrence. However, given the correlated nature of the data (R software).

Results
An overall trend was identified such that ROIs in regions without tumor had the lowest ADC values (mean 945 x 10-6 mm2/s) compared to those with low (mean 984 x 10-6 mm2/s), medium (mean 1034 x 10-6 mm2/s) or high-grade (mean 1057 x 10-6 mm2/s). A significant association was found between tumor grade and ADC, with a statistically significant difference between regions where no tumor was observed and regions where high-grade tumor was observed (p = 0.016). Sensitivity to outliers analysis was performed leading to the same conclusions.

Conclusion
In the setting of GBM treated with BV, higher ADC values are more predictive of tumor recurrence. However, given the high degree of variability, while this is true on a statistical basis, great care must be taken in interpreting ADC images in an individual patient. While in and of itself, ADC is not able to predict tumor recurrence, it may prove to be a useful biomarker when combined with other laboratory, immunohistochemical, clinical and/or MRI data.

KEYWORDS: Spinal imaging, Spinal cord, movement

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Postmortem Radiology-Pathology Correlation of Recurrent Tumor after Bevacizumab Treatment and Apparent Diffusion Coefficient

Tufts Medical Center
Boston, MA.

Purpose
After the introduction of bevacizumab (BV) in the treatment of glioblastome multiforme (GBM), it has become increasingly difficult to separate post-treatment changes from recurrent tumor. This is because BV, an anti-angiogenesis agent, often results in recurrent tumor which doesn’t enhance on Gadolinium -enhanced MRI. This study sought to determine if apparent diffusion coefficient (ADC) correlated with residual tumor when compared to histologic evaluation in patients with GBM treated with bevacizumab.

Materials & Methods
Eleven patients with GBM treated with bevacizumab consented to postmortem autopsy and inclusion in the current study. The last in vivo MRI was co-registered with a postmortem MRI, and multiple histologic samples were selected based on the presence of FLAIR signal abnormality on the in vivo MRI. Regions of interest (ROI) correlating with the areas of histologic sampling were made on the ADC maps. Histologic analysis was made by a neuropathologist, who graded the amount of tumor present in the region of interest as either absent, low, medium or high-grade (utilizing similar criteria as used to distinguish Grade 2 through 4 astrocytomas). The association between tumor grade and ADC then was evaluated using a mixed linear model with a fixed tumor grade effect and a random subject effect to account for the correlated nature of the data (R software).

Results
A central T2 hypointensity was observed in 100% of both eyes throughout bilateral optic nerves. A cylindrical T2 hyperintensity also was present in bilateral eyes in all astronauts.

Conclusion
Previous literature describes a central T2 hyperintensity at the center of the optic nerve when imaged with 1.5T MRI. In our study, we describe a new finding seen in all study participants: a central T2 hypointensity in the epicenter of the previously described hyperintensity with the increased resolution made possible by 3T imaging. We speculate that this T2 hypointensity may represent flow voids caused by the central retinal vessels. Further research is necessary to determine if changes regarding this anatomical finding could potentially predict or be seen in certain disease states affecting the central nervous system. Although this finding was seen in the two astronauts not yet exposed to microgravity, further evaluation of a normal population is needed.