fiducials (AFIDs) was recently developed and validated to provide quantitative measures of image registration. We applied the AFIDs protocol to magnetic resonance images (MRIs) obtained from patients with Parkinson's Disease (PD). **Methods:** Two expert and three novice raters placed AFIDs on MRIs of 39 PD patients. Localization and registration errors were calculated. To investigate for unique morphometric features, pairwise distances between AFIDs were calculated and compared to 30 controls who previously had AFIDs placed. Wilcoxon rank-sum tests with Bonferroni corrections were used. **Results:** 6240 AFIDs were placed with a mean localization error (±SD) of 1.57mm±1.16mm and mean registration error of 3.34mm±1.94mm. Out of the 496 pairwise distances, 40 were statistically significant ($p<0.05/496$). PD patients had a decreased pairwise distance between the left temporal horn, brainstem and pineal gland. **Conclusions:** AFIDs can be successfully applied with millimetric accuracy in a clinical setting and utilized to provide localized and quantitative measures of registration error. AFIDs provide clinicians and researchers with a common, open framework for quality control and validation of spatial correspondence, facilitating accurate aggregation of imaging datasets and comparisons between various neurological conditions.

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Prediction of Pituitary Adenoma Recurrence using the SIPAP Classification

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Background: Pituitary tumor recurrence following endoscopic endonasal transsphenoidal surgery (EETS) has been reported widely. We evaluated a modified score using the SIPAP classification system, combining the suprasellar and paraseller extension scores of the pituitary tumor, to determine its impact on adenoma recurrence. **Methods:** A retrospective cohort study design with patient characteristics, tumor type, endocrine, operation, imaging data collected. Preoperative MRI images were reviewed and SIPAP classification applied. Postoperative data were extracted for the follow-up period available for each patient.The suprasellar score and the highest parasellar scoring from both sides were numerically summed in a bilateral suprasellar and parasellar (SaP) score and combined to make 4 grades. **Results:** 276 patients were identified, 56.5% of the cohort was male. The mean cohort age was 54 years old.The mean follow up period was 32 months. Patient perioperative tumor grade according to SaP classification and recurrence rate was: Grade 1: 11%: Grade 2: 10%; Grade 3: 15%; Grade 4: 22%. The results followed a pattern of logarithmic curve. **Conclusions:** The SaP classification was useful in determining the pituitary tumor expected recurrence following EETS. The advanced tumors had the highest recurrence rates. Use of the SaP score may allow for more accurate preoperative counselling of patients with pituitary adenoma.

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Reduced radiation CT imaging for augmented reality spinal surgery applications

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Background: There is growing evidence for the use of augmented reality (AR) in pedicle screw placement in spinal surgery to increase surgical accuracy, improve clinical outcomes and reduce the radiation exposure required for intraoperative navigation. Auto-segmentation is the cornerstone of AR applications because it correlates patient-specific anatomy to structures segmented from preoperative computed tomography (pCT) images. These AR techniques allow for a reduction in the radiation dose required to acquire CT images while maintaining accurate segmentation. **Methods:** In this study, we methodically increase the noise that is introduced into CT images to determine the image quality threshold that is required for auto-segmentation on pCT. We then enhance the images with denoising algorithms to evaluate the effect on the segmentation. **Results:** The pCT radiation dose is decreased to below the current lowest clinical threshold and the resulting images still produce segmentations that are appropriate for input into AR applications. The application of denoising algorithms to the images resulted in increased artifacts and decreased bone density. **Conclusions:** The CT image quality that is required for successful AR auto-segmentation is lower than that which is currently employed in spine surgery. Future research is required to identify the specific, clinically relevant radiation dose thresholds.

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Primary motor cortex metabolite levels correlate with dexterity following spinal surgery for degenerative cervical myelopathy

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Background: Spinal cord compression from degenerative cervical myelopathy is characterized by progressive loss of hand dexterity, alongside changes in the metabolite profiles in the brain and spinal cord. Correlating the changing metabolite profile with measures of dexterity following decompression surgery may assist in identifying which patients may benefit most from surgery. **Methods:** Thirty operative myelopathy patients consented to receive spectroscopy and GRASSP-M dexterity assessments both preoperatively and 6-weeks postoperatively. Magnetic resonance spectroscopy (TE=135) was performed in the motor cortex using a 3 Tesla Siemens MRI scanner at Robarts Research Institute. Spearman correlations were used to evaluate associations between metabolite levels and dexterity ($p<0.05$ was

considered significant). Paired two-tailed Student t-tests were used to assess for postoperative changes in metabolite levels. **Results:** Postoperatively, we observed a statistically significant ($p<0.05$) negative correlation ($r=-0.44$) between the N-acetylaspartate-to-creatine ratio (NAA/Cr) and GRASSP-M dexterity scores. There was no significant difference in NAA, Cr, or NAA/Cr postoperatively. **Conclusions:** These findings demonstrate that patients with lower postoperative NAA/Cr usually have better recovery of dexterity. This link between the myelopathic metabolite profile and clinically meaningful dexterity values requires further investigation to understand the role of both NAA and Cr in mechanisms of postoperative recovery from myelopathy.

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Diffusion MRI characteristics change in select cerebral white matter tracts after decompressive surgery for degenerative cervical myelopathy

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Background: Degenerative cervical myelopathy is characterized by progressive compression of the spinal cord resulting in debilitating loss of dexterity, independent ambulation, and sphincter control. Diffusion tensor imaging (DTI) has shown that, compared to healthy controls, myelopathy patients have decreased integrity of the corticospinal tracts and corpus callosum (Bernabeu-Sanz et al, 2020). **Methods:** Twenty-six myelopathy patients consented to cerebral diffusion tensor imaging (3 Tesla, 32 directions, b=1000) preoperatively, as well as 6-weeks, 12-weeks, and 6-months postoperatively. Average mean diffusivity (MD), fractional anisotropy (FA), radial diffusivity (RD), and axial diffusivity (AD) were measured in the corticospinal tracts, forceps major, and forceps minor. **Results:** Both MD and RD decreased from 6-12 weeks postoperatively in the right corticospinal tract. The forceps major of the corpus callosum showed an initial postoperative increase in MD followed by a subsequent increase in FA and decrease in RD 3-6 months postoperatively. The AD of the forceps major increased both immediately and 3-6 months postoperatively. **Conclusions:** Changes in microstructural integrity of the corticospinal tract and forceps major over the postoperative recovery period suggest a pattern of recovery in myelopathy patients. This study is the first to report postoperative DTI changes in myelopathy-relevant white matter tracts in the brain.

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Evaluation of Arterial Spin Labeling (ASL) Perfusion Imaging in Poorly-Defined Focal Epilepsy in Children

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Background: Poorly-defined cases (PDCs) of focal epilepsy are cases with no/subtle MRI abnormalities or have abnormalities extending beyond the lesion visible on MRI. Here, we evaluated the utility of Arterial Spin Labeling (ASL) MRI perfusion in PDCs of pediatric focal epilepsy. **Methods:** ASL MRI was obtained in 25 consecutive children presenting with poorly-defined focal epilepsy (20 MRI- positive, 5 MRI-negative). Qualitative visual inspection and quantitative analysis with asymmetry and Z-score maps were used to detect perfusion abnormalities. ASL results were compared to the hypothesized epileptogenic zone (EZ) derived from other clinical/imaging data and the resection zone in patients with Engel I/II outcome and >18 month follow-up. **Results:** Qualitative analysis revealed perfusion abnormalities in 17/25 total cases (68%), 17/20 MRI-positive cases (85%) and none of the MRI-negative cases. Quantitative analysis confirmed all cases with abnormalities on qualitative analysis, but found 1 additional true-positive and 4 false-positives. Concordance with the surgically-proven EZ was found in 10/11 cases qualitatively (sensitivity=91%, specificity=50%), and 11/11 cases quantitatively (sensitivity=100%, specificity=23%). **Conclusions:** ASL perfusion may support the hypothesized EZ, but has limited localization benefit in MRI-negative cases. Nevertheless, owing to its non-invasiveness and ease of acquisition, ASL could be a useful addition to the pre-surgical MRI evaluation of pediatric focal epilepsy.

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Accuracy of pedicle screw placement with X-ray versus O-arm image-guided navigation

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Background: Image-guided navigation is routinely used in spine surgery to improve placement of pedicle screws. However, most reports have relied on two-dimensional X-ray evaluation to determine accuracy of screw positioning. In this study, computed