

manipulation) with Excalibur and two commercially available hand-controllers (Sigma 7 and PHANToM Premium 3.0). A modified Kuka endeffector with bipolar forceps, and Leica microscope completed the remote robotic site. Comparisons were made based on training time, task completion time and number of errors. All participants completed a questionnaire. **Results:** Repeated measures ANOVA demonstrated significance for task completion time ($p=0.004$), training time ($p=0.021$) and number of errors ($p=0.004$). Surgeons were faster with Excalibur (72s) than with Sigma (96s, $p=0.005$) and PHANToM (96s, $p=0.036$). Training time was shorter with Excalibur than with PHANToM (210s vs 310s, $p=0.013$), and users made fewer errors (0.7 vs 2.1, $p=0.008$). Training time required for Sigma (285s) and the number of errors (1.3) were not significant. The surgeons found Excalibur smoother, more comfortable, less tiring and easier to maneuver, with more realistic force feedback and superior movement fidelity. **Conclusions:** Surgical performance was superior with Excalibur compared to the other handcontrollers. This may reflect the microsurgical requirements and unique design architecture of Excalibur.

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Impact of postoperative discharge destination on length of stay

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Background: The aim of this study is to assess factors impacting the postoperative length of stay (LOS) for patients undergoing microvascular decompression (MVD) surgery. **Methods:** A consecutive series of patients undergoing MVD at the Winnipeg Centre for Cranial Nerve Disorders were reviewed. All patients were monitored in a neurosurgical stepdown unit for at least 6 hours postoperatively and when medically stable discharged at their own discretion. The hospital LOS was measured in hours from midnight after day of surgery and categorized by days in hospital. **Results:** The 112 patients included 53 Manitobans (MB) and 59 from out of province (OOP). The overall LOS was 38 ± 52 hours, and not significantly different between genders, diagnosis or age. LOS was significantly shorter for OOP versus MB patients ($28\pm 23/48\pm 71$ hours; $p=0.02$). OOP patients were also more often discharged on the first postoperative day (59% versus 32%; $p=0.02$) and 85% of them stayed at the hotel within the hospital complex prior to travelling home. **Conclusions:** Postoperative discharge to an adjacent hotel appears to have led to shorter LOS. These patients may have been reassured by the physical proximity to medical care. The utilization of discharge to an adjacent hotel or comparable facility may reduce hospitalization days and associated costs.

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Rapid intraoperative reconstruction of cranial implants for craniotomy procedures: a feasibility study

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Background: The aim of this study was to investigate intraoperative methods to generate patient-specific PMMA bone implants during a craniotomy. The proposed methods combine a cost-efficient, and non-invasive structured light scanner (SLS) as an imaging modality and a prototype printer for rapid generation of implant molds.

Methods: This simulation study was performed using retrospective data from three craniotomy patients. The extracted bone flap and the cranial defect were scanned using a SLS, which generates a 3D surface model of an object by projecting a series of light-patterns on it. Prototype printed implant models were generated using two different techniques. The molds were then used to shape PMMA bone implants. These implants were evaluated regarding their accuracy to reconstruct the natural skull anatomy and compared to freehand formed implants. **Results:** The patient-specific bone implants reconstructed the preoperative anatomy with an average RMS error of 1.37mm (StDev 0.27), compared to an error of 1.5mm (StDev 0.43) for the freehand shaped implants. On average the intraoperative scanning time was 4.7min. The average time to generate and print the implant molds was 204 min. **Conclusions:** Results of this study have shown great promise for the proposed method to be used for patient-specific bone flap reconstruction during craniotomies.

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The prediction of outcome after shunting for idiopathic normal pressure hydrocephalus

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Background: Idiopathic normal pressure hydrocephalus (iNPH) is a triad of impaired gait, cognition and urinary control in the setting of normal pressure ventriculomegaly. Various options for shunt implantation exist, but there is limited ability to predict outcome. **Methods:** This study is a retrospective chart review of 82 shunted patients for iNPH between 2007 and 2018. Factors examined included age, sex, lumbar puncture results, use of laparoscopic approach, type of shunt used, Charlson Comorbidity Index and imaging (callosal angle and DESH). Patient outcome was assessed via modified Rankin Scale (mRS). **Results:** 52 patients were male and 30 were female. Average age at surgery was 71.4 years. 58/62 (94%) improved following lumbar puncture. 41% of patients had VP shunt, and 59% of patients had LP shunt. 30/79 (38%) had laparoscopic placement of the distal catheter. 23/75 (31%) and 30/81 (36%) had a complication and required reoperation, respectively. Callosal angle showed statistically significant increase post-shunting (76 to 94 degrees, $p<0.005$). Presence of DESH did not change post-shunting. Average Charlson Comorbidity Index was 4.4. The mRS decreased from 3.84 to 2.66 postoperatively ($p<0.005$). **Conclusions:** In our centre, iNPH patients had clinicoradiologic improvement following shunting. We will perform regression statistics to elucidate the factors influencing outcomes.

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Normal pressure hydrocephalus with associated tremor

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Background: Normal pressure hydrocephalus is a frequent cause of cognitive and functional impairment. Many symptoms are shared between Parkinson's disease and normal pressure hydrocephalus. Only few studies examine extrapyramidal signs in NPH, and only one case report exists describing tremor improvement with shunting. **Methods:** We performed a retrospective chart review of our

NPH database. We selected patients who had both NPH and question of Parkinsonism due to tremor. **Results:** Six patients with both NPH diagnosis and tremor were identified. Three patients were treated for Parkinson's disease and followed by neurology. After shunting, all three improved and attempt was made to wean medications, which led to functional decline. The other three patients improved with shunting and after titration of the shunt had resolution of tremor. **Conclusions:** We provide evidence that NPH can result in tremor, treatable by shunting. We also emphasize that those patients do exist who have both diseases. This likely exists along a continuum. Careful consideration of NPH should be undertaken in those patients with suspected Parkinson's disease and imaging findings reminiscent of NPH.

SPINE AND PERIPHERAL NERVE SURGERY

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Back "pane" secondary to glass coffee table mishap: a very unusual penetrating injury to the thoracic dura without spinal cord injury

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Background: Non-gunshot wound penetrating injury to the spinal canal have been known to have variable injury patterns with respect to trajectory and depth. **Methods:** We present a case of a penetrating glass fragment injury to the T11-12 level with a cerebrospinal fluid leak. **Results:** A T11-12 bilateral laminectomy and duraplasty with motor-evoked potential monitoring was performed to remove the foreign object and associated hematoma. The clinical presentation and surgical management are discussed with respect to other non-gunshot-related penetrating spine injuries in the literature. **Conclusions:** This case demonstrates a very rare injury pattern, as the vast majority of intradural penetrating injuries to the thoracic spine result in complete or incomplete spinal cord injury. This patient was neurologically intact, which is remarkable, given the 7cm glass fragment crossing the thoracic spinal canal transversely from the right to left.

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Enhancing patient understanding of spinal conditions through advanced imaging platforms

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Background: In spite of the shift towards "personalized medicine," ambulatory medicine lags behind the cutting edge technology employed in non-medical fields to convey information in unique ways to enhance customer interactions. Furthermore, the complex nature of neurosurgical concepts can be difficult to convey within the confines of a short outpatient visit. These factors, coupled with potentially long wait times, can limit a patient's engagement in the treatment process. We propose that application of advanced video platforms will empower patients to feel that neurosurgical concepts are accessible and understandable and enable the face-to-face time with the physician to begin at a more sophisticated level, ultimately improving patient

engagement. **Methods:** 3D modeling, animation, and video game design were used in conjunction with tablet computers and VR headsets to create a video-driven "choose-your-own-adventure style patient experience" with initial use during waiting times prior to face-to-face interaction with the neurosurgery providers. **Results:** 3D modeling, animation, and virtual reality were successfully implemented in the Northwestern Medicine neurosurgery clinic with positive impact on patient engagement, including preliminary improvements in multiple patient satisfaction/"Likelihood to Recommend" scores. **Conclusions:** Advanced imaging platforms, including 3D modeling, animation, and virtual reality show great promise in improving patient engagement, patient retention, and "Likelihood to Recommend" scores.

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Preventing C5 palsy after cervical decompression by nerve root untethering and intraforaminal ligament release

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Background: Postoperative C5 palsy (C5P) is a common complication after cervical decompression, potentially related to nerve root tethering. To our knowledge, this is the first study to investigate this hypothesis by comparing C5/C6 root translation and tension before and after root untethering by cutting cervical intraforaminal ligaments (IFL). **Methods:** Six cadaveric dissections were performed. Nerve roots were exposed and translation and tension measured after the roots and spinal-cord were dorsally displaced 5mm before and after IFL cutting. These were also measured during shoulder depression to simulate intraoperative positioning. Clinical feasibility of IFL release was examined by comparing standard and extended foraminotomies to compare resultant root translation. **Results:** IFL-cutting increased translation at both C5/C6 roots (P=0.001). There was no difference between root levels (P=0.33). IFL-cutting increased translation upon shoulder depression at both C5/C6 roots (P=0.003) with a difference also being found between root levels (P=0.02). An extended cervical foraminotomy was technically feasible which enabled complete IFL release and root untethering, whereas a standard foraminotomy did not. **Conclusions:** IFL-cutting increases root translation, suggesting they are either protective (preventing peripheral nerve strain from being transmitted to the spinal-cord) or harmful (by tethering intraforaminal nerve roots and potentially contributing to postoperative C5P) depending on the clinical context.

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Percutaneous cortical screws: a novel approach to posterior spinal stabilization

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Background: Pedicle screw (PS) fixation is considered the gold-standard for spine stabilization. However, minimally invasive surgery (MIS) and cortical screw (CS) fixation have become commonplace. The biomechanical and safety profiles of CS compared to PS have yet to be determined. To our knowledge, this is the first study