The Diffusion Tensor Imaging (DTI) Guided Transulcul Exoscopic Radial Corridor Approach for the Resection of Lesions in the Sensorimotor Area

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Introduction: Managing subcortical lesions in the sensorimotor area can be associated with high degree of morbidity. The challenges encountered while approaching such lesions fall into one of the following categories; mapping and imaging, access, visualization, and tumor resection.

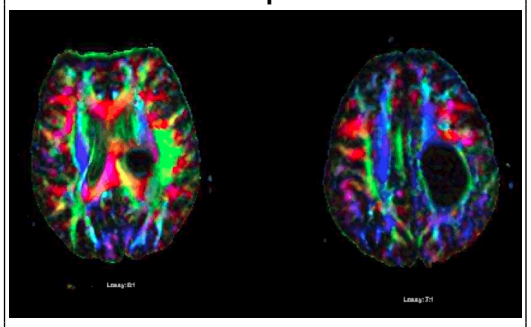
Methods: To circumvent some of the challenges described above, we created a systematic approach integrating 5 core competencies: 1) Imaging and mapping, 2) Dynamic navigation, 3) Radial transulcul access, 4) Exoscopic high definition optics, and 5) Resection with automated atraumatic mechanical instrumentation. This approach was used to manage 11 consecutive patients with lesions in the sensorimotor area.

Demographics and Patients Characteristics

Patient	Age	Gender	Symptoms	Diagnosis	PFI
1	57	F	paresis	Tumor	5
2	56	F	paresis	Tumor	2
3	34	F	Seizures	Tumor	5
4	46	F	Seizures	Tumor	2
5	33	M	paresis	Tumor	5
6	64	F	paresis	Tumor	3
7	50	M	paresis	Abscess	2
8	46	M	Plegia	ICH	4
9	62	F	Decreased LOC	ICH	5
10	70	M	Plegia	ICH	3
11	78	M	Paresis	ICH	5

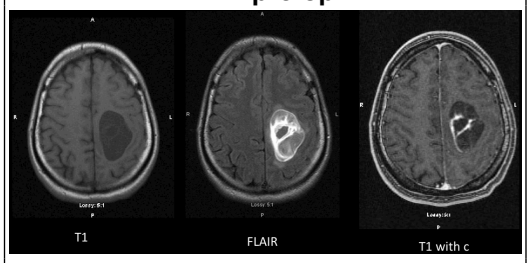
Case Illustration: 33 year-old right-handed male cyclist presented with progressive right arm and leg hemiparesis over a 6 week- period. On neurological examination, he had a power of 4/5 (MRC scale) in the right upper extremity with a pronator drift and 2/5 (MRC scale) in the right lower extremity.

Pre-op DTI



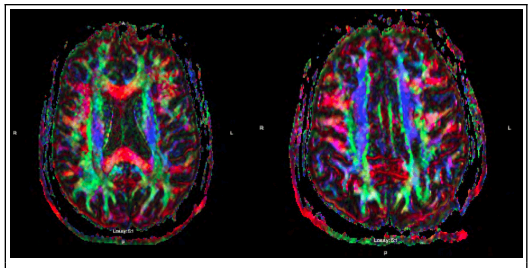
Lateral displacement of the SLF, medial displacement of the cingulum, anterior displacement of the corpus callosum, and anterolateral displacement of the motor component of the corona radiata

MRI pre-op

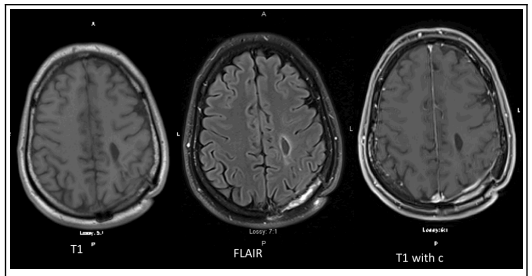


Left frontal parietal mass. Hypointense on T1, heterogenously hyperintense on T2 and FLAIR. Peripheral enhancement with avid central nodular enhancement post - gadolinium.

Surgical Procedure: Given the anterior displacement of the motor fibres and the lateral displacement of the SLF we selected a posterior medial trajectory. The trajectory was orientated to be along the long axis of the SLF in the AP projection and slightly tilted downward to be along the long axis of the Corona Radiata. The BrainPath access system coupled with neuronavigation was used. An "intra-lesion" cannulation was attained given the soft cell density and the nodule targeted. Upon cannulation and tumor resection, voluntary EMG amplitude and interference pattern greatly increased, coincident with improvement in right hip flexors and knee extensors from 2/5 to 3+/5 (able to overcome gravity). On the first post operative day, the patient recovered grade 4/5 power and was discharged from hospital. By the 6th post- operative day, the patient had full power in his upper and lower extremities and was back on his bicycle. Gross total tumor resection was confirmed on the immediate post -operative MRI.



Post- op DTI showing recovery of WMT.



Post- op MRI showing gross total resection.

Results: Five tumors (4 primary and 1 metastatic), 1 abscess, and 4 primary intracranial hemorrhages were managed at the Ottawa Hospitals from 2011-2013 using the 5 pillars approach. Seventy percent of the patients showed significant improvement while the remaining did not develop any new neurological deficits. Clinical improvement correlated with white matter tract recovery on Diffusion Tensor Imaging (DTI). One patient developed a post-operative Deep Vein Thrombosis. There were no mortalities.

Conclusions: The integration of the 5 pillars provides a safe and effective parafasicular minimally invasive corridor for resecting subcortical lesions involving the sensorimotor area.

Clinical outcomes

Patient	Pathology	Clinical Outcome	Complications	Type of Anaesthetic
1	GBM	Improved	DVT	GA
2	Metastasis	No new deficits	None	GA
3	GBM	No new deficits	None	GA
4	GBM	Improved	None	Awake
5	Pilocytic	Improved	None	Awake
6	GBM	No new deficits	None	Awake
7	Abscess	Improved	None	GA
8	ICH	Improved	None	GA
9	ICH	Improved	None	GA
10	ICH	Improved	None	GA
11	ICH	No new deficits	None	GA

Learning Objectives: Understand how multiple new technologies can be used to systematically approach lesions in eloquent areas with minimal collateral damage.