Use Of Advanced Intraoperative Imaging For Resection Of Cervical Intramedullary Spinal Cord Tumors: A Case Series

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CNS 2017 ANNUAL MEETING BOSTON, MASSACHUSETTS OCTOBER 7–11,2017

Learning Objectives

This case series of two patients with ISCN is the first of its kind to combine the use of DTI, virtual reality preoperative planning software, intraoperative utilization of 3 –D virtual reality imaging, and microscope integrated navigation with heads up tumor display.

Introduction

Intramedullary spinal cord neoplasms (ISCN) pose significant management challenges. While surgical resection can reduce disease burden, it also carries a significant risk of morbidity. Advances in MRI techniques such as diffusion tensor imaging (DTI) have been utilized to determine the infiltrative nature and thus the respectability of ISCN (1,2). However, this has not been applied to intraoperative navigation and decision making.

Figure 1A

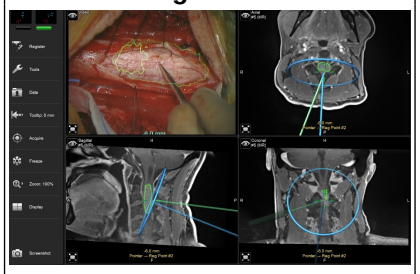


Image demonstrating the use of intraoperative navigation with the brainlab MRI which correlated with the tumor outline on the heads up display for case 1.

Methods

Two patients who underwent surgery for ISCN were included. DTI images were obtained and 3D images were created using the surgical theater software. Fiducials over the back of the scalp were used to achieve accurate surface registration to C4. Navigation confirmed the levels of laminectomy necessary to access to the tumor. The microscope was integrated with brainlab and the tumor projected in the heads up display. The surgical theater system was integrated with brainlab to allow for real time evaluation of the 3D tractography (Figure1A, 1B). The navigation probe was placed over the area for the planned myelotomy and matched to the midline raphe visualized on the surgical theater.

Figure 1B

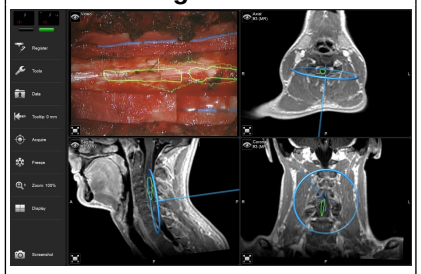


Image demonstrating the use of intraoperative navigation with the brainlab MRI which correlated with the tumor outline on the heads-up display for case 2.

Results

Case 1: all tracts were pushed away from the tumor, suggesting it was not infiltrative. Surgical theater and brainlab assisted in finding midline despite the abnormal swelling of the cord so the myelotomy could be performed. The heads up display outline demonstrated excellent correlation to the tumor (Figure 2A, 2B). A gross total resection was achieved. It was confirmed to be an ependymoma.

Case 2: Some tracts were going through the tumor itself, suggesting an infiltrative process. Surgical theater and brainlab allowed for the precise identification of the midline raphe. A near total resection of the enhancing portion was achieved. The diagnosis of glioblastoma was confirmed.

Figure 2A

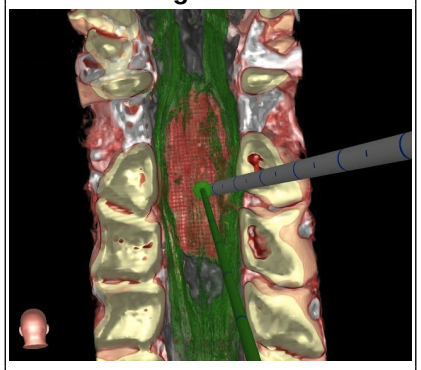


Image from surgical theater that was integrated with the neuronavigation system and allowed for real time visualization of the 3D tractography for case 1. Note that the fiber tracts are pushed laterally by the tumor.

Figure 2B

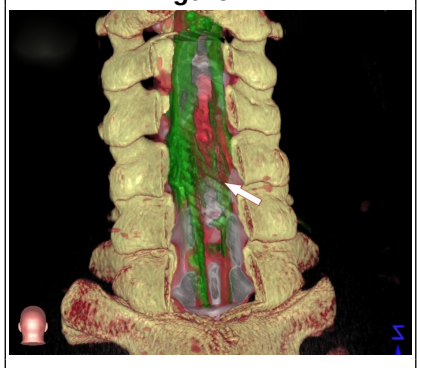
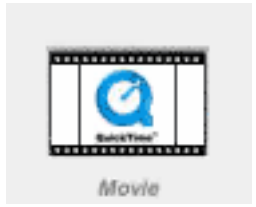
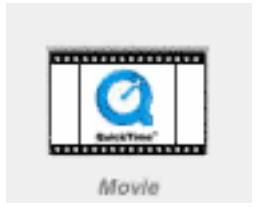


Image from surgical theater revealing the 3D tractography for case 2, where the fiber tracts are going through the tumor (arrow).





References

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2. Setzer M, Murtagh RD, Murtagh FR, et al. Diffusion tensor imaging tractography in patients with intramedullary tumors: comparison with intraoperative findings and value for prediction of tumor resectability. Journal of neurosurgery. Spine. 2010;13(3):371-380.