## C5 MALIGNANT PERIPHERAL NERVE SHEATH TUMOR

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Case History
Malignant peripheral nerve sheath tumors (MPNST) are rare spindle-cell sarcomas derived from Schwann cells or pluripotent cells of the neural crest. The estimated incidence of MPNST in patients with Neurofibromatosis Type 1 (NF1) is 2-5% compared with 0.001% in the general population. MPNST originate from peripheral nerve root trunks, extremities, and the head and neck region. The tumor can be located intraspinally, foraminaly, and extend extraforaminaly. These tumors pose specific therapeutic challenges as they recur locally after surgery. Adjuvant conventional radiation therapy improves survival rate or local control in some series but not in others.\textsuperscript{1,2,3}

We present here a rare case of a recurrent spinal non-NF1 MPNST treated by spinal radiosurgery. This 56-year-old female patient was transferred for progressive gait disturbances accompanied by severe neck pain. She was on morphine medication for 8 weeks. Incomplete surgery for a cervical non-NF1 MPNST at the level of C5 was performed 6 months prior to admission. After surgery the patient underwent a course of conventional fractionated radiotherapy (40 Gy) covering the whole spinal canal. Magnetic resonance imaging (MRI) of the cervical spine on admission revealed a large contrast enhancing extradural mass compressing the ventral spinal cord at C5.

CyberKnife\textsuperscript{®} Treatment Rationale
There were no further treatment possibilities as surgery, conventional radiation therapy and chemotherapy were already attempted without preventing tumor growth. It was hoped that additional robotic radiosurgery targeting only the tumor mass could help to prevent further tumor progression and to reduce cervical pain.

T2-weighted pre-treatment MRI scan. The lesion is clearly visualized at C5 significantly compressing the ventral aspect of the cervical spinal cord resulting in severe neck pain.
Treatment Planning Process

Treatment planning utilized CT, T1- and T2-weighted MRI scans +/- Gd with the patient positioned supine. These data sets were transferred to the MultiPlan® Treatment Planning System and registered using an algorithm based on normalized mutual information. The target volume, spinal cord, and other structures were defined mainly using the T2 MRI data. A treatment plan was generated using an iterative inverse planning algorithm. A dose of 13.5 Gy was prescribed to the 80% isodose, and delivered in a single fraction.

Treatment Delivery

The patient was positioned supine and fitted with a thermoplastic mask only. Treatment was delivered using the Xsight™ fiducial-less spine tracking system. With this system the position of the spinal vertebrae are calculated automatically from orthogonal X-ray images acquired during treatment. These are compared with digitally reconstructed radiographs (DRRs) calculated from the pre-treatment CT. The offset required to maintain the alignment of each individual beam to the target volume is calculated by a deformable registration algorithm which also compensates for any non-rigid change in patient position between pre-treatment imaging and treatment delivery. By repeating this process throughout treatment, intra-fraction patient motion, which can be significant in spinal treatments, is effectively negated.4
Outcome and Follow-Up
The patient was seen for multiple follow-up evaluations after completing CyberKnife® Stereotactic Radiosurgery.

- One week after therapy the patient was able to stop pain medication
- Neck pain completely resolved after two weeks and walking improved considerably
- MRI follow-up scan four weeks after therapy showed tumor shrinkage, with considerable reduction in the spinal cord compression
- Three months after treatment she continued to be off pain medication and pain free
- There were no adverse treatment effects during the follow-up period

Conclusion and CyberKnife Advantages
Robotic radiosurgery with the Xsight™ fiducial-less spine tracking system was shown for this patient, to be a safe and effective tool to treat spinal lesions, either as the primary treatment modality or within the framework of a multidisciplinary treatment strategy. This technique might be particularly valuable for recurrent tumors after conventional treatments such as surgery and/or radiation therapy.

T2-weighted MRI scan acquired four weeks post-treatment. There was significant tumor shrinkage. The compression to the spinal cord is considerably reduced.