

Spinal Chordoma: First experiences of combined surgical and radiosurgical treatment with refined intra- and perioperative imaging

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Background

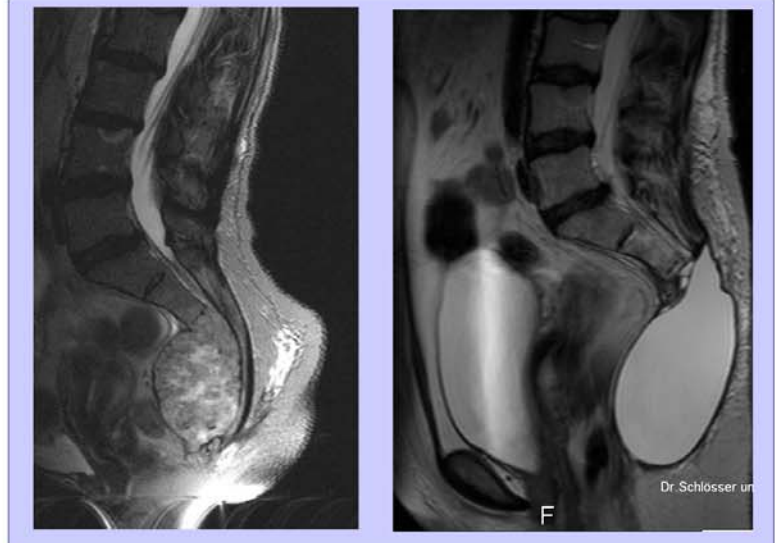
Spinal chordomas are mostly sacrally located, invasive neoplasms arising from ectopic rests of notochordal tissue; sacrectomy with consecutive severe deficits is widely advocated the primary treatment. We analyzed a pilot series of patients with combined treatment by microsurgery and spinal robotic radiosurgery. Benefit of pre- and postoperative PET-CT-imaging, intraoperative CT-imaging in combination with neuronavigation and clinical outcome were evaluated

Patients and Methods

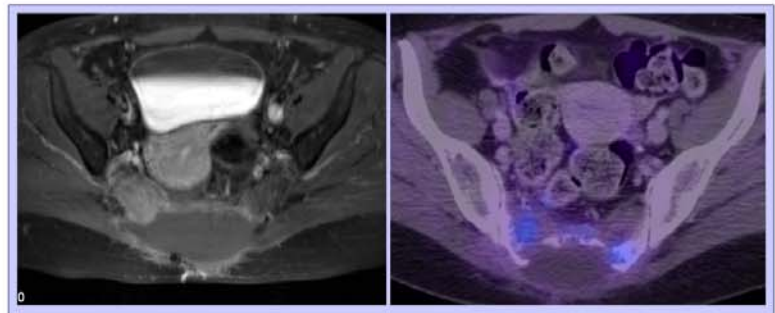
- Five patients (4 sacral, one cervical chordoma; disease up to now: 52 ± 38 mo) were operated altogether ten times since 1/2007.
- None of the patients had severe neurological deficit at start of treatment in our clinic.
- Surgery with intraoperative CT-imaging for resection control and exclusion of lesions of adjacent structures, and, in two patients, for generation of image data for navigation.
- Two patients with conventional radiotherapy (60-68 Gy). In 4 patients remnant tumor masses were treated altogether 13 times by spinal robotic radiosurgery (CyberKnife, Accuray; Ca, USA)
- In 3 patients repetitive PET/CT scans using [F-18]Fluorodeoxyglucose (FDG) were performed.



Multidetector row CT with frameless neuronavigation system in a multidisciplinary operating room suitable for neurosurgery, abdominal and trauma surgery. The patient is positioned on a radiolucent operating table that fits within the bore of the gantry. During image acquisition the gantry moves over the patient.



Pre- and postoperative MRI after resection of bulky tumor masses S3-5



Postoperative axial MRI of the same patient after 1 year with adjacent scarring vs. remnant/recurrent tumor. PET/CT images show recurrent active tumor helping to focus further surgical or radiosurgical interventions.

Results

- 4 patients with stable disease without new deficits; one patient (female, tumor known since 3/06, presently progressive disease with imatinib chemotherapy) had developed slight bladder disturbance since initial removal of bulky tumor masses S 3-5.
- All tumors identified by KM-enhanced intraoperative CT; image acquisition of iCT was rapidly (15±5 min) to perform and anatomical and fluoroscopic landmark validation showed sufficient accuracy of neuronavigation in the area of sacrum and gluteal muscle. Data of iCT for neuronavigation were especially useful in tracking small, deeply intramuscularly or near the retroperitoneal space located tumors.
- All patients tolerated the radiosurgical procedure well. Tumor volume ranged from 1.4 to 100.5 ccm, median:17.1 ccm. The prescribed tumor dose was maintained at 22 to 33 Gy, median: 28 Gy to the 70% isodose line. No radiation toxicity, new neurological deficits or growth of radiosurgically treated tumor occurred.
- FDG PET/CT indicated tumour recurrence/progression by pathologically increased FDG uptake in all 3 patients, concordant with the histopathological results. PET/CT was especially useful in cases of recurrent tumor with difficult to interpret MRI and diffuse soft tissue scarring.

Conclusion

Combined surgical and radiosurgical treatment by robotic radiosurgery offers a safe and effective treatment modality for spinal chordomas, especially for patients with lesions not completely amenable to surgery. Combined treatment seems to offer periods of non-recurrence and survival comparable to those of conventionally operated patients without the severe deficits attributable to sacrectomy. Intraoperative CT in combination with neuronavigation provided rapid and easy detection of spinal chordomas, tumor resection control and exclusion of hematoma or violation of adjacent organs. FDG PET/CT offered an improved tumor/scar tissue delineation in cases of recurrent tumor by particularly detecting "vital" parts of the tumor. PET/CT, therefore, seems to be helpful in focussing recurrent surgical and radiosurgical interventions.