

## Dose escalation in treatment of a paraspinal tumor using Elekta Synergy<sup>®</sup> S

<b>Institution:</b>	Universitätsklinikum Würzburg, Germany
<b>Patient:</b>	21-year-old female
<b>Diagnosis:</b>	Nerve sheath tumor
<b>Plan:</b>	Seven-field IMRT
<b>Image guidance:</b>	VolumeView <sup>™</sup> with on-line image registration
<b>Positioning:</b>	BlueBAG <sup>™</sup> vacuum cushion with BodyFIX <sup>®</sup> RT system
<b>Treatment:</b>	Mean dose 57.6Gy in 29 fractions to PTV Spinal cord dose limited to 37.5Gy

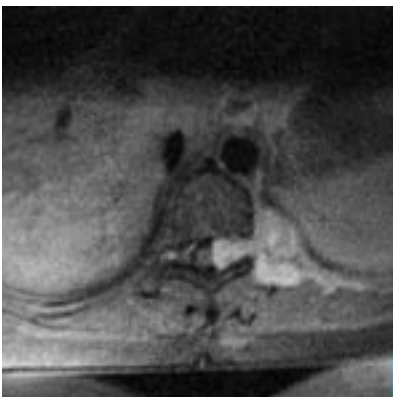
## Dose escalation in treatment of a paraspinal tumor using Elekta Synergy® S

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### Patient history and diagnosis

A two-year-old female patient was diagnosed with medulloblastoma in 1986 at which time she was treated with a total CNS irradiation to 35Gy and a boost to the posterior fossa to a total dose of 55Gy.

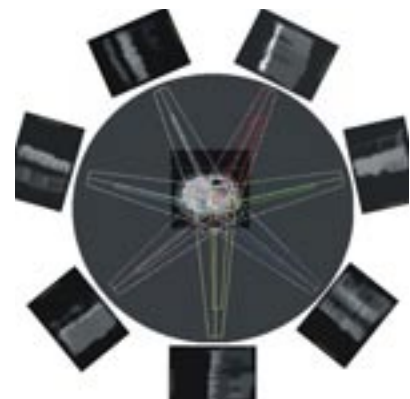
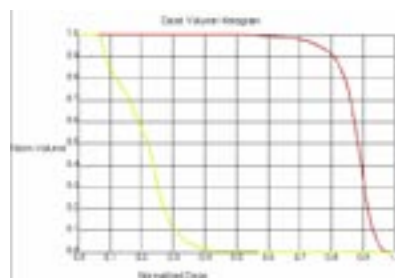
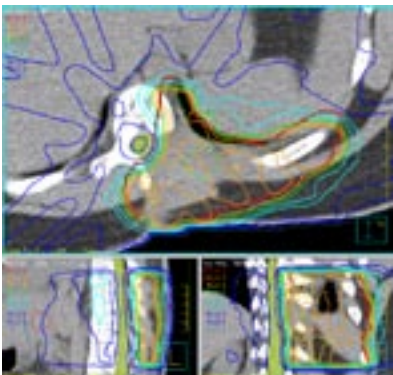
In 2005 the same patient presented with a malignant nerve sheath tumor at the level of thoracic vertebrae 9/10 – probably a secondary cancer 19 years after total CNS irradiation. The patient received surgery and the tumor was partially resected.



### Planned treatment

A treatment plan was generated using ADAC Pinnacle 3 planning system for treatment on Elekta Synergy® S. A forward-planned IMRT technique was applied for the generation of highly conformal dose distributions. For each of the seven beams, three segments were generated based on geometrical considerations. Dose objectives for the target volume and organs-at-risk (spinal cord, lung) were specified and based on these objectives the weighting of the segments was done automatically.

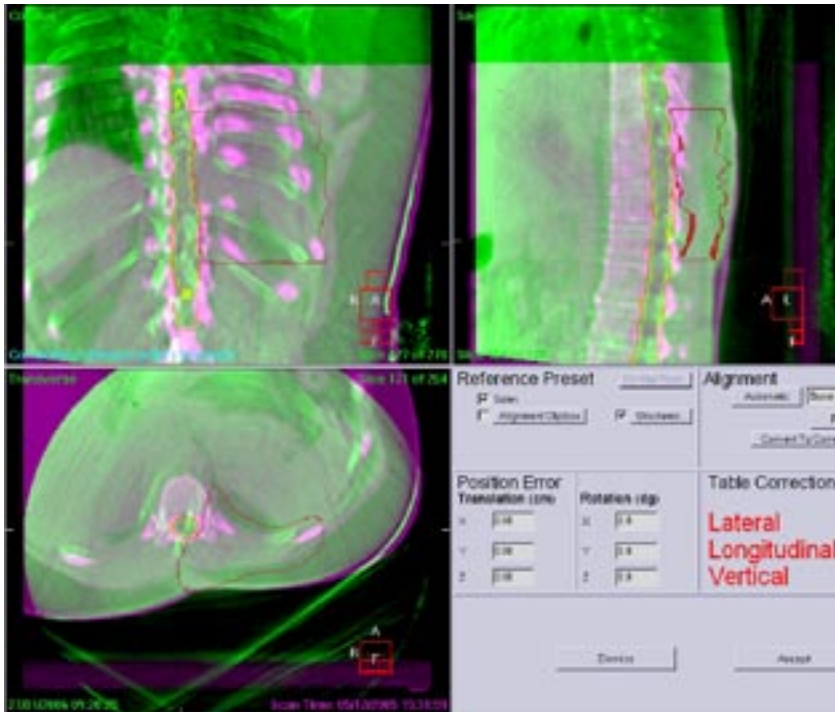
It was planned to deliver a mean dose of 57.6Gy in 29 fractions to the PTV. The maximum dose to the spinal cord was limited to 37.5Gy (D5 = 22.3Gy).



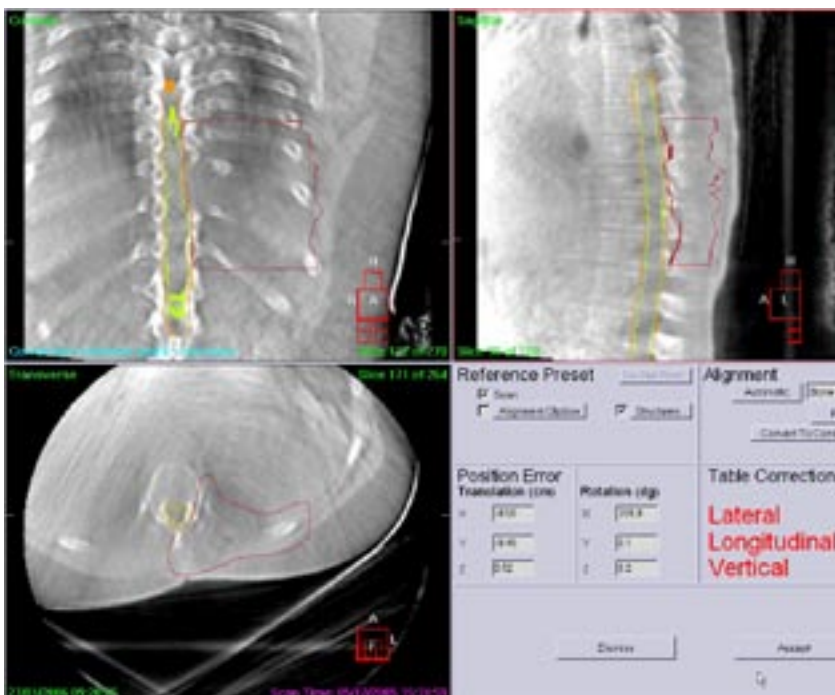
### Treatment using image guidance technique

An on-line correction protocol with daily 3D VolumeView™ imaging and correction of all set-up errors (translational and rotational set-up errors) before treatment was applied. The workflow limited the total treatment time to about 15 to 20 minutes.

The patient was positioned supine in a conformable BlueBAG™ vacuum cushion and the treatment plan was verified using Elekta Synergy® S and VolumeView™ imaging. Following image registration of planning CT study and current cone-beam CT, translational and rotational correction errors were corrected using HexaPOD™, a robotic treatment couch that allows movement in six degrees of freedom.



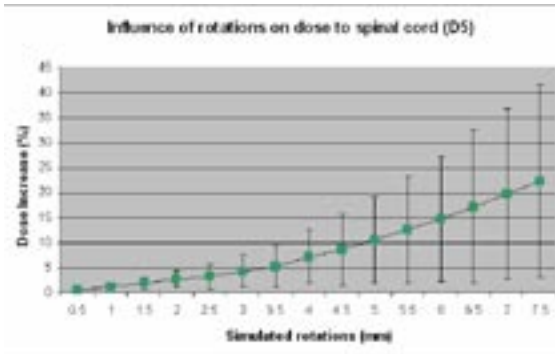
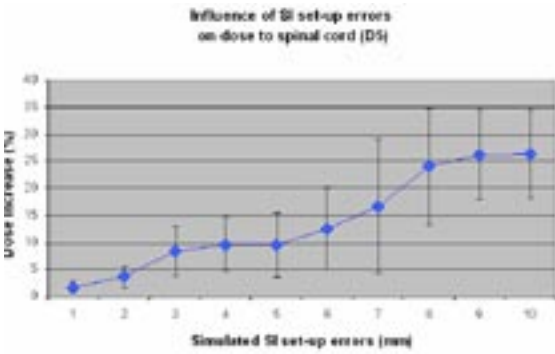
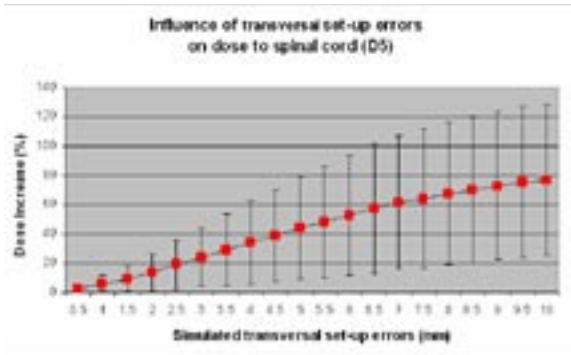
*This screen show image + structure overlay, pre-registration*



*This screen show image + structure overlay, post-registration*

**Treatment time = 22 minutes**

- 3 mins. patient set-up
- 7 mins. imaging and correction:
  - 3 min. acquisition
  - 2 mins. registration
  - 2 mins. correction
- 12 mins. treatment  
2Gy per fraction



## Outcome

The data collected from the patient's treatment and the treatment of a number of similar patients has enabled us to examine the influence of set-up errors on the dose to the spinal cord. We investigated whether correction of rotational errors is beneficial and whether off-line correction protocols would guarantee sufficient precision of the treatment.

## Conclusion

### Required precision

- Translational: transversal: 1mm
- Translational: superior inferior: 2.5mm.

### Clinical relevance of day-to-day set-up errors

- Positioning accuracy comparable to literature
- In 4/5 patients unacceptable dose increase to spinal cord (13% to 98%).

### Treatment strategy

- Correction of rotational errors may be clinically relevant
- On-line treatment protocols with daily imaging seem to be necessary.

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