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Stereotactic Body Radiation Therapy for Spinal Metastases

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Metastases

- A metastases is a secondary malignant growth that develops somewhere else in the body as a result of the primary cancer.
- A spinal metastases is when cancer from the original site spreads to the spine or spinal cord.
- The spine is a common site for metastases.
- Radioresistant tumors are tumors that are resistant to the effects of radiation.
- Spinal metastases such as renal cell, sarcoma, melanoma, and colorectal are considered radioresistant, but can now be treated with Stereotactic Body Radiation Therapy (SBRT).

Stereotactic Body Radiation Therapy

- SBRT is used in Radiation Therapy to deliver high doses of tightly focused radiation to a tumor in one or more fractions/ treatments.
- SBRT is used for ablative intent and spares dose to the spinal cord.
- One to five fractions are a typical treatment plan for patients receiving SBRT.
- Dose varies per fraction but typically follows:
 - 1 fraction- 16-24 Gy
 - 2-3 fractions- 24-30 Gy
 - 4-5 fractions- 30-40 Gy
- Patient immobilization, treatment planning, treatment volume definitions, and image-guidance are important aspects of SBRT.

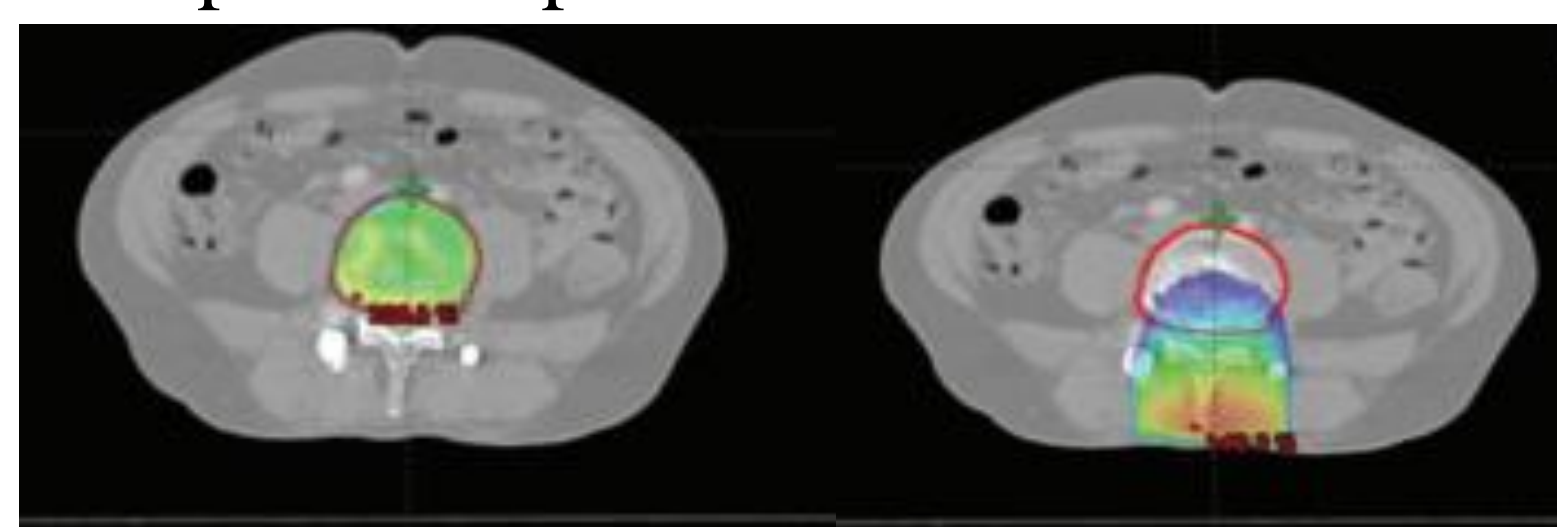


Fig. 1 Planned spinal treatment

Procedure

- Patient selection is dependent upon certain criteria that is evaluated by medical and radiation oncologists, radiologists, and spine surgeons.
- A thermoplastic mask or vacuum bag are custom made for the patient and used as an immobilization device to ensure the patient is in the same position for every treatment.
- A CT or MRI scan is required as well as a cone beam CT prior to treatment to confirm location.

Statistics

- 40% of cancer patients will develop metastatic disease of the spine (Gong et al., 2019).
- Over 180,000 spinal metastases are diagnosed in the United States every year.
- Compared to conventional external beam Radiation Therapy (cEBRT), patients have 40% more pain relief with SBRT.
- Pain response to SBRT treatment is between 46-92% regardless the number of fractions given (Zeng et al., 2019).
- One study gathered data from multiple studies which evaluation local control (LC) and overall survival (OS) after one year:
 - One fraction- 92.7% LC and 53% OS
 - Two fraction- 84.6% LC and 70.4% OS
 - Three fraction- 86.8% LC and 60.1% OS
 - Four fraction- 82.6% LC and 48% OS
 - Five fraction- 80.6% LC and 80% OS
- Other studies have compared pain control for one fraction of SBRT treatment to 8-10 fractions of cEBRT. Results showed an upward trend towards complete pain response rates at 3 and almost a complete response to pain relief at 6 months (Dunne, Liu, Lo, & Sahgal, 2022).

Indications & Contraindications

- SBRT is indicated for patients with metastases on the spine or patients with a history of radioresistant tumors.
- SBRT is a concern for patients with epidural extension, spinal cord compression, and paraspinal compression (Balakrishnan, Sebastian, & Zaveri, 2022).

Case Study

- The patient is a 53-year-old female with a history of stage 3A grade 3 invasive ductal carcinoma of the right breast. She received radiation and chemotherapy as treatment for the breast cancer.
- In 2021, images revealed progression of metastatic carcinoma to the thoracic spine at the level of T10.
- Stereotactic Body Radiation Therapy was advised to treat the T10 vertebral body lesion.
- The treatment plan consisted of 3 treatment fractions that would be given every other day.
- 900 cGy was given per fraction, with a total dose of 2700 cGy (27Gy) (Northeast Radiation Oncology Center, 2022).

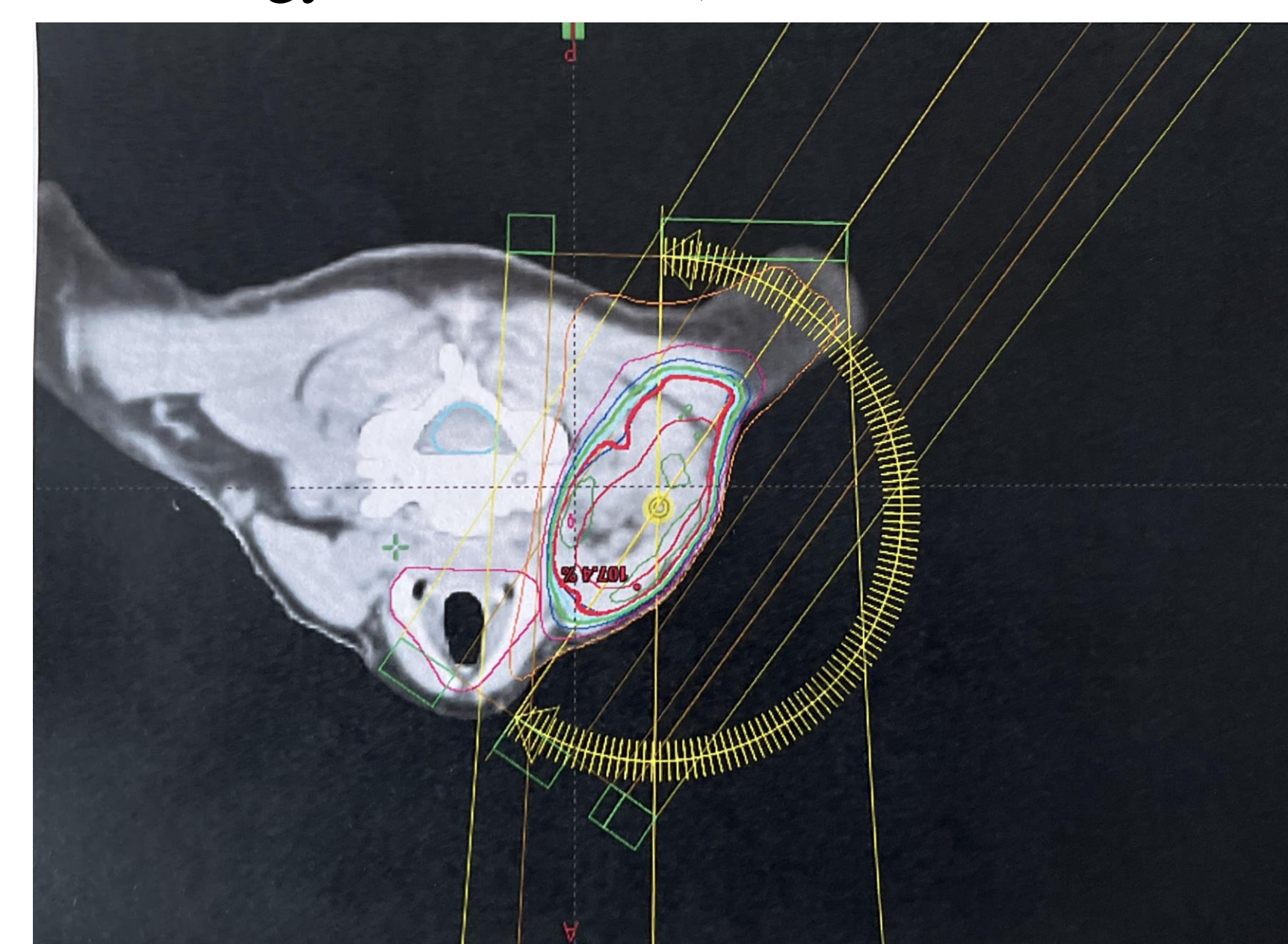


Fig. 2 Spine image

- The image shows the spinal lesion and how the radiation will intersect through the patient's body.

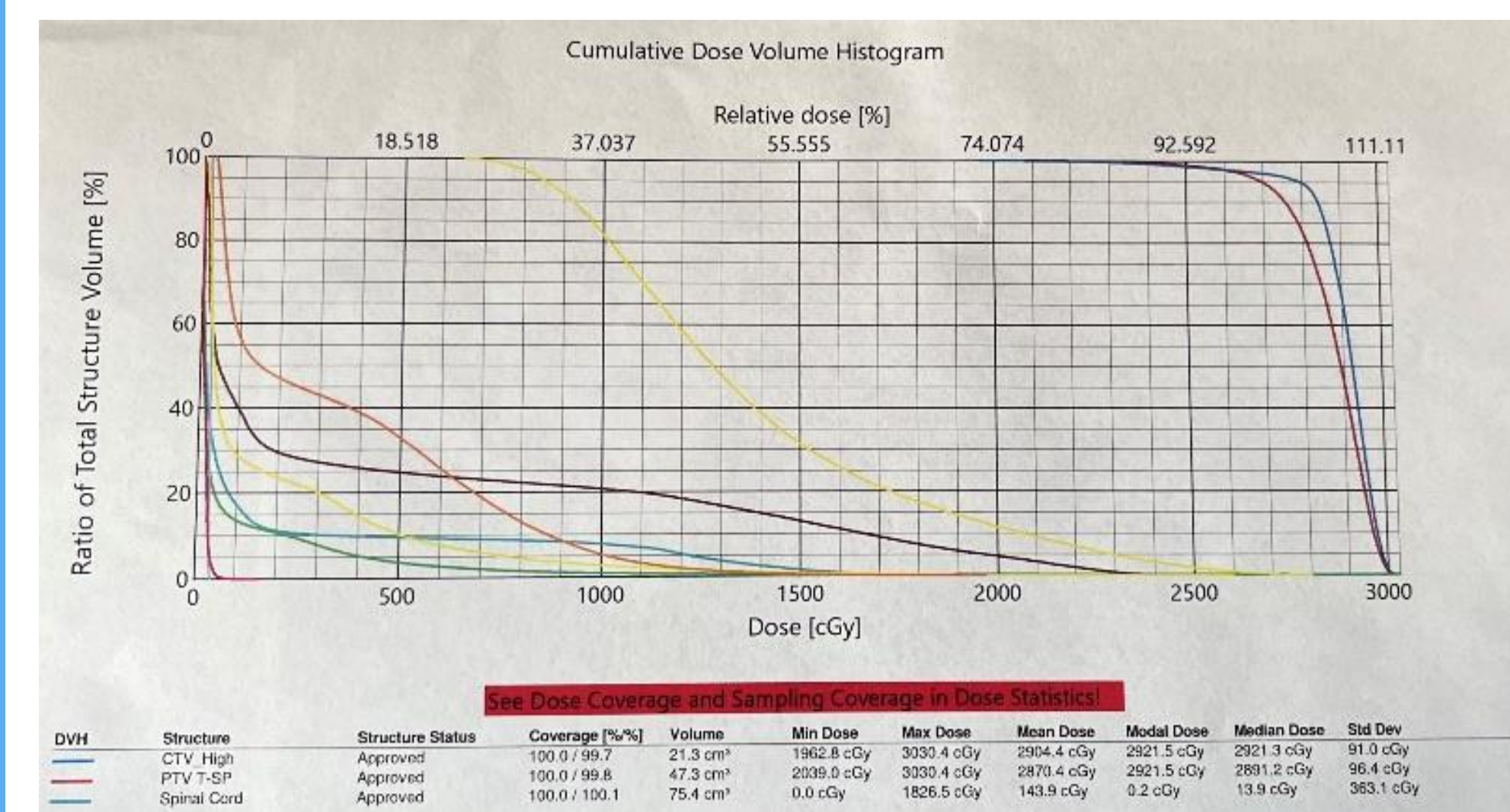


Fig. 3 Histogram Image

- The histogram demonstrates how much radiation each structure next to the spinal lesion is receiving.
- The spinal cord dose was planned to be less than 2190.0 cGy. The actual spinal cord dose was 1826.5 cGy after treatment.

Advantages & Disadvantages

Advantages

- The need for surgery is eliminated or diminished because SBRT safely targets the metastatic lesions.
- High does eliminate the need for multiple fractions.
- More positive outcomes compared to cEBRT.

Disadvantages

- Pain flare is reported in 15-68% of patients.
- Vertebral compression fractures occur in 11-40% of patients.
- Nerve injury occurs in 0.05% of patients.
- Myelopathy is uncommon, however most feared when the spinal cord dose increases beyond 13.85 Gy (Balakrishnan et al. 2022).

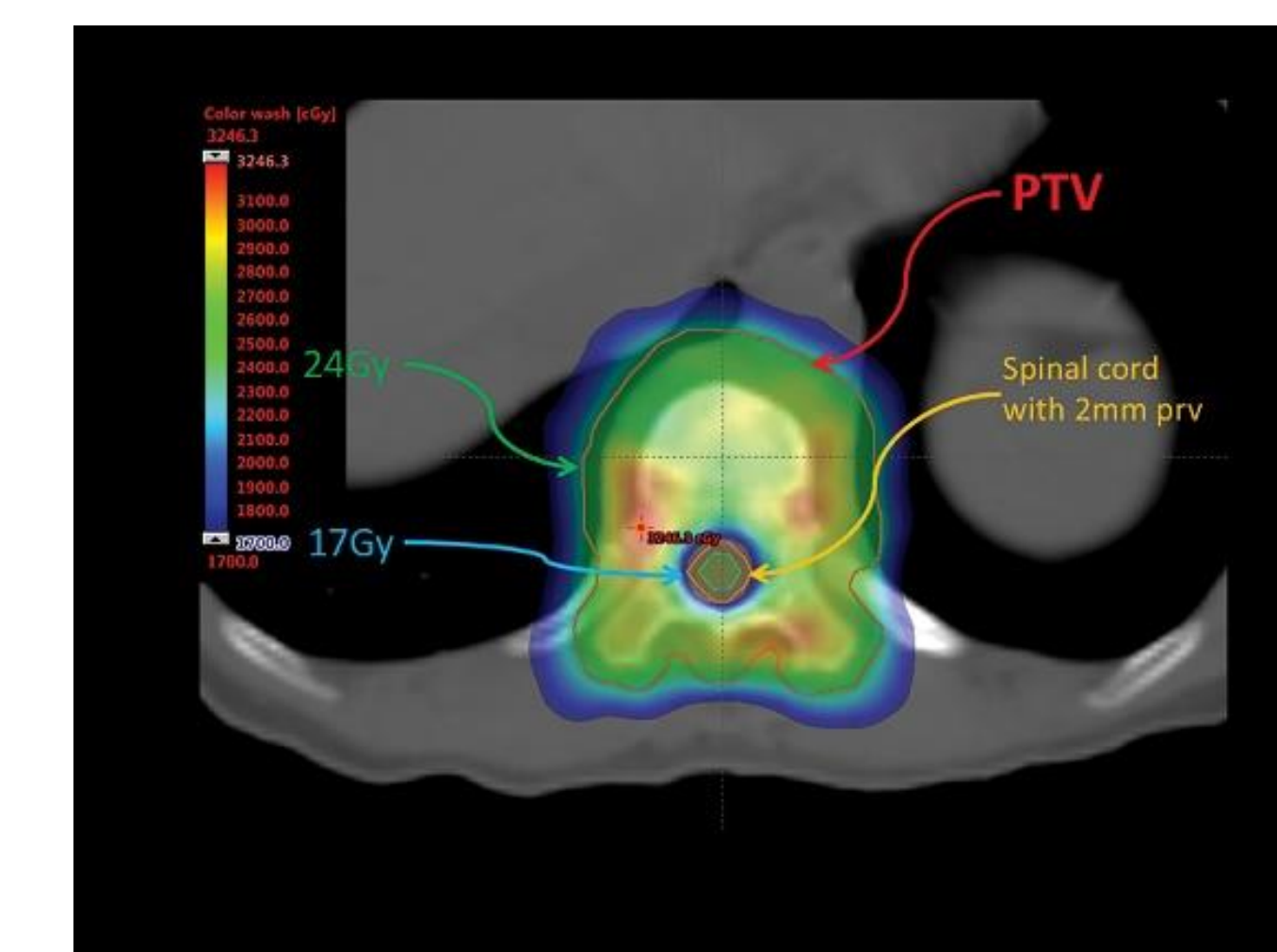


Fig. 4 Planned organ at risk volume

Conclusion

- SBRT delivers a precise dose of radiation to a small tumor on the spine.
- The entire vertebral body, pedicle, lamina, transverse process and spinous process are typically treated.
- Prognosis is generally dependent upon, age, gender, number of organs involved, previous treatment to the effected area, and physical state.