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Volumetric Arc Intensity Modulated Radiotherapy (VMAT) for soft tissue sarcomas: a planning study comparison with step and shoot IMRT.

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Introduction:

Radiotherapy is often used in addition to surgical excision in the treatment of soft tissue sarcomas (STS) to minimise local recurrence. However, where the tumour develops in close proximity to critical organs such as the spinal cord, optic chiasm, brachial plexus and lung, it is difficult to deliver radical doses of radiotherapy without increased risk of normal tissue damage. In such situations, we have previously employed Intensity Modulated Radiotherapy (IMRT) and shown that radical radiotherapy doses can be maintained whilst sparing adjacent dose limiting structures. This method allows greater flexibility in shaping the dose to the target area by modulating radiation fluence through a discrete number of static beams.

Volumetric Arc Intensity Modulated Radiotherapy (VMAT) is a promising new method of radiotherapy delivery. Standard step and shoot IMRT radiotherapy delivers radiation from a set number of static radiation beams at specific angles around the patient, whereas VMAT delivers treatment using a continuous beam in an arc around the patient. This gives VMAT greater flexibility during treatment planning and overall treatment times. The Christie NHS Foundation Trust has already made use of VMAT in the treatment of prostate cancer. However, VMAT may offer the potential to increase dose conformity to more complicated treatment areas, and may therefore have a role in the treatment of STS lying in close proximity to critical structures. This study describes a retrospective planning comparison between standard step and shoot IMRT and VMAT.

Methods

Six STS patients previously treated with step and shoot IMRT were identified. Previous treatment volumes were used to produce a VMAT plan for each patient using Pinnacle TPS SmartArc (v8.9) software. Plans were created using one, two or three arcs; start and finish points for the arc were chosen relative to the treatment site; arc times were limited to approximately 90 seconds. Evaluation of plan quality was based on the observed dose and distribution and Dose Volume Histograms for treatment volumes and organs at risk.

Results

VMAT delivered with 2-3 arcs produced conformal radiotherapy plans similar to the original IMRT plan. Three arcs were necessary when treatment volumes were more concave and high dose areas needed to be wrapped around critical structures such as the spinal cord. Doses to organs at risk such the spinal cord and lungs were similar to the original IMRT plan, although VMAT planning sometimes resulted in a higher volume of lung receiving 5Gy. Treatment delivery times were estimated at around 5 minutes, compared to around 10-15 minutes for a standard IMRT plan.

Conclusions

Although VMAT technology is in its infancy, this study has shown its ability to produce highly conformal treatment plans for difficult treatment sites. As VMAT offers the potential of shorter treatment times, it is a promising modality for future radiotherapy treatment of soft tissue sarcomas.