Redefining the possible: planning multiple complex head lesions using non-coplanar VMAT arcs

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Purpose

To demonstrate the ability to include multiple lesions over the scalp, face and brain within a single treatment plan using multiple non-coplanar VMAT beams and a single isocentre.

Introduction: A 73 year old man referred for post operative RT to Merkel Cell and SCC scalp lesions, including bilateral spread to peri-auricular and parotid nodes. During diagnostic work up an incidental finding of a right sided meningioma was also made and indicated for possible concurrent treatment.

Materials & Method

The patient was scanned in a S-Type Klarity shell with an accuform cushion for stability, on a Phillips Big Bore 64 slice scanner. A 0.5cm parafin gauze bolus “cap” was made, covering the entire scalp to ensure adequate skin dose. The dataset was imported into the TPS and diagnostic T1 and T2 MRI’s were fused for contouring.

The scalp and bilateral peri-auricular and parotid regions were contoured as a single CTV and a 0.3cm PTV margin was added. The meningioma was contoured separately, also with a 0.3cm PTV margin applied.

50.4Gy in 28 fractions was prescribed and the plan was generated in RayStation (v4.0.3) on an Elekta Synergy machine with 4° gantry spacing and a maximum delivery time of 90 seconds per beam. Two full transverse VMAT arcs were used with a partial sagittal arc added (floor at 270°). Isocentre placement was key due to potential collision risks.

Separate objectives were used for the scalp and brain PTVs to ensure maximum coverage, with particular attention paid to avoiding the optics, spinal canal and oral cavity.

Results

Planning: In order to treat all sites within a single plan, the isocentre was placed within the meningioma PTV and potential collision risk was assessed. A highly conformal distribution was achieved, with 94% of the extensive scalp and drainage PTV covered by 98% of the prescribed dose. 98% of the meningioma PTV was covered by 98% of the prescribed dose. The introduction of the sagittal arc created a ring of dose around the skull providing excellent brain sparing.

Physics: The deliverability of the arcs was assessed using a 3D diode array with 99.6% pass rate at 3%/3mm criterion (6/1605 failed diodes). To supplement this, absolute dose measurements were performed using pinpoint ionisation chambers (calibration factor traceable to a primary standard) inside both the scalp and meningioma PTVs showing agreement with the TPS to within ±3.0%.

Imaging and treatment: As per department protocol, XVI imaging was performed fractions 1 – 3, then weekly, using a grey scale match. Bony anatomy agreed very well with < 1° rotation. Total treatment delivery, including patient set up, averaged at 10 minutes each day making this beam arrangement extremely time efficient to treat.

Conclusion

This case has shown that combining traditional transverse VMAT arcs with a partial non-coplanar arc is a safe and extremely efficient technique in treating multiple complex volumes within the upper head and neck. This treatment plan allowed large, complex volumes to be treated successfully whilst providing exceptional sparing of sensitive tissues, in addition to demonstrating excellent dosimetric accuracy. The addition of the sagittal arc was integral to the effective sparing of the brain and the conformal distribution over multiple complex PTVs.

This patient has recovered well from treatment and follow up at 6 months showed no sign of residual disease.