Purpose: To develop and evaluate a modified anthropomorphic head phantom for evaluation of stereotactic radiosurgery (SRS) dose planning and delivery.

Methods: A phantom was constructed from a water equivalent, plastic, head-shaped shell. The original phantom design, with only a spherical target, was modified to include a nonspherical target (pituitary) and an adjacent organ at risk (OAR) (optic chiasm), within 2 mm, simulating the anatomy encountered when treating acromegaly. The target and OAR spatial proximity provided a more realistic treatment planning and dose delivery exercise. A separate dosimetry insert contained two TLD for absolute dosimetry and radiochromic film, in the sagittal and coronal planes, for relative dosimetry. The prescription was 25Gy to 90% of the GTV with <= 10% of the OAR volume receiving >= 8Gy. The modified phantom was used to test the rigor of the treatment planning process, dosimeter reproducibility, and measured dose delivery agreement with calculated doses using a Gamma Knife, CyberKnife, and linear accelerator based radiosurgery systems.

Results: TLD results from multiple irradiations using either a CyberKnife or Gamma Knife agreed with the calculated target dose to within 4.7% with a maximum coefficient of variation of +/-2.0%. Gamma analysis in the coronal and sagittal film planes showed an average passing rate of 99.3% and 99.5% using +/-5%/3mm criteria, respectively. A treatment plan for linac delivery was developed meeting the prescription guidelines. Dosimeter reproducibility and dose delivery agreement for the linac is expected to have results similar to the results observed with the CyberKnife and Gamma Knife.

Conclusions: A modified anatomically realistic SRS phantom was developed that provided a realistic clinical planning and delivery challenge that can be used to credential institutions wanting to participate in NCI funded clinical trials.

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