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Critical neurological structure sparing radiosurgery of vestibular schwannoma: dosimetric comparison of different techniques and dose prescription methods.

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Abstract

AIM: To investigate potential sparing of critical neurological structures (CNSs) during radiosurgery of vestibular schwannoma (VS) employing different techniques and dose prescription methods.

MATERIALS AND METHODS: Fused CT and MRI datasets of eight patients with unilateral VS representing a wide range of target volume (0.48 to 12.08 cc; mean = 3.56 cc), shape and proximity to CNSs such as cochlea, trigeminal nerve and brainstem were re-planned employing static conformal field (SCF), dynamic conformal arc (DCA) and intensity modulated radiosurgery (IMRS) techniques. For every patient, five plans were created for a fixed margin dose of 12 Gy prescribed at 80% in three plans (SCF_80%, DCA_80%, and IMRS_80%) and 50% in another two plans (SCF_50% and DCA_50%). All plans were compared using standard dosimetric indices.

RESULTS: Primary goal of every plan to cover $\geq 99\%$ of target volume with 12 Gy was fulfilled for all patients with minimum significant dose to target (D_{99}) ≥ 11.99 Gy. Best conformity index (CI Paddick = 0.62 ± 0.12) was observed in SCF_80% and DCA_80% plans whereas; sharpest dose gradient index of 3.40 ± 0.40 was resulted from DCA_50%. All five plans resulted similar maximum dose to brainstem (11.04 ± 2.23 to 11.53 ± 1.10 Gy), cochlea (9.02 ± 1.79 to 10.15 ± 1.26 Gy) and trigeminal nerve (11.55 ± 1.38 to 12.19 ± 2.12 Gy). Among 80% prescription plans, IMRS_80% reduces mean and D_5 ($P < 0.05$) to all CNSs. Prescription of dose at 50% isodose sharpened the dose gradient and significantly ($P < 0.05$) reduced mean dose and D_5 to all CNSs at the cost of target conformity ($P = 0.01$). Mean dose to cochlea and trigeminal nerve were least at 4.53 ± 0.86 and 6.95 ± 2.02 Gy from SCF_50% and highest at 6.65 ± 0.70 and 8.40 ± 2.11 Gy from DCA_80% plans respectively.

CONCLUSION: This dosimetric data provides a guideline for choosing optimum treatment option and scope of inter institutional dosimetric comparison for further improvement in radiosurgery of