Cureus

Dosimetric Comparison of Robotic Radiosurgery System and VMAT Plans in Postoperative Intracranial Cavity Irradiation

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Abstract
Published 03/06/2024

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Categories: Medical Physics, Radiation Oncology
Keywords: robotic radiosurgery

How to cite this abstract
Abbak Tanisan O, Kurt M, Altay A (March 06, 2024) Dosimetric Comparison of Robotic Radiosurgery System and VMAT Plans in Postoperative Intracranial Cavity Irradiation. Cureus 16(3): a1107

Abstract

Objectives:

The aim of this study is to perform a dosimetric comparison of VMAT and Robotic Radiosurgery System(RRS) treatment plans in cases of brain metastasis treated with stereotactic radiotherapy within the postoperative cavity.

Methods:

Cranial CT images of 9 patients who were treated with RRS were replanned in VMAT with Monaco treatment system. RRS plans were created using the MLC with the VOLO treatment system. 1 mm margin was added to cavity and 24 Gy was prescribed to PTV in 3 fractions. Organs at risk were contoured in both systems and did not exceed the defined dose constraints. Plans were ensured to cover 95% of the target volume with the prescription isodose. Dmean and Dmax of Brain-PTV, V18, V24, Paddick Conformity Index(PCI), Homogeneity Index(HI), Monitor Units(MU), Dmax of OAR, PTV volumes, Dmax and Dmean of PTV were compared for all patients in both planning systems. Dose volume histograms and dose distributions from the generated plans were obtained. The data was analyzed in the SPSS v25 program.

Results:

The average cavity volume was 7.65 (4.2-52.05) cc. PCI and MU with RRS was significantly higher compared to VMAT plans (PCI 1.18 vs 0.76 p=0.008, MU 4342 vs 1966 p=0.008). No significant differences were found between the two groups in the comparison of other variables (p>0.05). Dmean Brain-PTV for tumors located in the occipital region(n=5) was higher in RRS and was statistically significant (p=0.043). Dmax of PTV in RRS showed a statistically significant inverse relationship with tumor volume (r=-0.767, p=0.016), while in the VMAT method, it did not show statistically significant (r=-0.417, p=0.265).

Conclusion(s):

RRS beams provide better conformity in target volume but result in higher MU. Despite RRS providing better dose conformity, the higher Dmean of Brain-PTV in posteriorly located tumors is thought to be due to the robotic arm not having 360-degree posterior access.