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Abstract
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Implementation of ZAP-X Gyroscopic Radiosurgery System, a Novel Radiosurgical Platform for the Treatment of Multiple Brain Metastases: Analysis of the First Case Series

Morena Sallabanda [1], Borja Aguilar [2], Enrique Pascual [1], Kita Sallabanda [1]

1. Radiation Oncology, Institute of Advanced Radiosurgery (IRCA), Madrid, ESP 2. Medical Physics, Mercurius Health - IRCA, Lisbon, PRT

Corresponding author: Morena Sallabanda, msallabanda@institutorca.com

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Abstract

Objectives:

The aim of this study is to describe the potential clinical and dosimetric benefits of the implementation of ZAP-X gyroscopic frameless radiosurgery (GRS) for the treatment of multiple brain metastases (BM) by analyzing the first series of 20 patients treated in our institution.

Methods:

Clinical and treatment information of 20 patients with 118 BM treated with GRS between October 2022 and Septembrer 2023 were prospectively included in a database and analyzed with specific focus on primary tumor, lesion volumes, number of fractions and total dose, dosimetric parameters, treatment delivery characteristics and acute and late tolerance.

Results:

Twenty patients with a mean of 6 BM (range 1 – 21) underwent GRS during the study period. The primary tumors were lung in 7 patients, breast in 7 patients, melanoma in 4 patients and esophageal cancer in 2 patients. A margin up to 1 mm was applied to the GTV. The median (1.03 cm3), minimum (0.06 cm3), and maximum PTV volume (48 cm3) were registered for each of the 118 treated lesions. 7 of the lesions were contacting or inside the brainstem. Six patients had received previous whole brain radiation therapy and three patients had received previous hypofractionated stereotactic radiotherapy. 90% (n = 106) of the lesions were treated in 1 fraction, 5% (n = 6) in 3 fractions and 5% (n = 6) in 3 fractions. Median dose in 1 fraction was 18 Gy (range 13 - 20 Gy). All the patients treaded in 5 fractions received 30 Gy and the patients treated in 3 fractions received 27 or 28.5 Gy. Median conformity index was 1.36 (1.07 - 1.96), median homogeneity index was 1.51 (1.20 - 2.08) and median gradient index 3.07 (2.39 – 4.08). Median coverage of the prescribed dose was 97% (91 - 100%). Median number of placed isocentres per lesion was 1 (1 - 19) and median number of beams used per lesion or groups of lesions included in the same plan was 113 (35 – 401). Median delivery time per plan was 26 minutes (15 – 80 minutes). All plans complied with dose restriction to organs at risk. Mean dose to the healthy brain was 2.2 Gy (range 0.2-7.5 Gy). Median clinical follow-up was 5 months (range 1-11). No local recurrences were registered for treated lesions. 3 patients died of systemic disease and 4 patients needed radiosurgery for new BM. Acute and late treatment tolerance was excellent, 17 patients remained asymptomatic or had clinical improvement after treatment, one patient with a cystic lesion had persistent symptoms and needed cyst drainage, only two patients that had received previous radiation courses had increased instability and grade I asthenia.

Conclusion(s):

The implementation of GRS showed excellent clinical and dosimetric results for the treatment of multiple BM, achieving good coverage while protecting organs at risk and minimizing integral dose to the brain. Longer follow-up and larger series is needed to validate these results.