Cureus

ZAP-X Gyroscopical Radiosurgery - Introduction of the Technology and First Preliminary Results

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Abstract
Published 04/02/2023

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Categories: Radiation Oncology, Neurosurgery
Keywords: zap-x radiosurgical system, stereotactic radiosurgery

How to cite this abstract
Weber C, Picardi C, Dettinger B, et al. (April 02, 2023) ZAP-X Gyroscopical Radiosurgery - Introduction of the Technology and First Preliminary Results. Cureus 15(4): a842

Abstract

Objectives:

ZAP-X is a dedicated high-precision cranial radiosurgery irradiator, that uses a self-shielded gyroscopically suspended linac instead of Co60 sources. Beam geometry and beam quality are similar to the Gamma Knife (SAD 45 cm, 3 MV) and the tracking algorithms are derived from the CyberKnife. The linac moves within two hemispheres, whose axes are tilted at a 45° angle to each other and radiate onto the intrinsic unit center point, through which the target is moved on a 3-axis table [1].

Methods:

5 plans each calculated on different platforms (CyberKnife, Varian Edge and ZAP-X) for 4 indications (vestibular schwannoma, meningioma, pituitary adenoma and trigeminal neuralgia) were compared with regard to coverage, Paddick Conformity Index, Gradient Index, load of the respective risk structures (OARs) and the out-of-field dose. In addition to the Winston-Lutz test a complex system test (end-to-end test) was also carried out.

Results:

The planning comparison of the different device types resulted in an average coverage of 98.18 (SD 0.15) for the CyberKnife, 98.26 (SD 0.13) for the Varian Edge and 98.46 (SD 0.11) for the ZAP-X. The mean conformity was 1.34 (SD 0.19) for the CyberKnife, 1.38 (SD 0.21) for the Varian Edge and 1.29 (SD 0.16) for the ZAP-X. With the ZAP-X, a somewhat steeper dose gradient could be achieved in almost all plans (GI approx. 3). The isocenter stability, averaged over a time interval of 6 months, was 0.39 mm (SD 0.1) for the CyberKnife, 0.37 mm (SD 0.1) for the Varian Edge and 0.32 mm for the ZAP-X (SD 0.1) and were therefore almost identical for all device classes.

Conclusions:

The planning comparison shows that a very steep dose gradient can be achieved with the ZAP-X due to the beam guidance, the short distance (SAD) and the small penumbra, and the out-of-field dose can thus be reduced. Clinical results are expected to be comparable to those of the Gamma Knife.