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Planning study comparing TrueBeam and TrueBeamSTx 10MV FFF VMAT beams for single fraction treatment of brain metastases

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With its high-resolution MLC and flattening-filter free mode, the emerging Varian TrueBeamSTx platform has recently been shown to improve the efficiency of stereotactic radiosurgery of brain metastases without significantly compromising target coverage, conformity and homogeneity. Given that our center is equipped with 5 TrueBeams with Millenium MLC and only 1 TrueBeamSTx with high-resolution MLC, we investigated the differences in plan quality between the high-resolution and Millenium MLC for single fraction treatment of brain metastases using 10MV FFF beams. Ten CT datasets were randomly selected from previously treated patients with brain metastases. For every patient, 2 VMAT 10MV FFF plans were generated, one using the TrueBeam with Millenium MLC and the other one using the TrueBeamSTx with high-resolution MLC. A third VMAT-plan was created using the standard 6MV beam on the TrueBeamSTx for baseline comparison. Plan quality was assessed by analysis of conformity, homogeneity & dose gradients (50%, 25% & 10%). As previously reported, no significant differences in plan quality was observed between the TrueBeamSTx 10MV FFF and standard 6MV VMAT plans. Statistically significant differences in homogeneity (1.15 vs. 1.17) and the 50% and 25% dose gradients (50%: 6.62cc vs. 7.92cc; 25%: 40.38cc vs. 46.74cc) were observed between the high-resolution and Millenium MLC 10MV FFF plans. However, all 10MV FFF plans (high-resolution & Millenium) met the clinical objectives without major deviations enabling the time-sensitive single fraction treatment of brain metastases to be potentially delivered on either TrueBeam linear accelerator.

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Cancer immunoedition modified by low-level ionizing radiation

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The cancer immunoediting hypothesis, put forward at the beginning of the 21st century by Robert Schreiber and his co-workers, assumes that the immune system not only protects the host against the development of primary cancers, but also contributes to tumor progression. In fact, in the course of three consecutive phases of cancer immunoediting called elimination, equilibrium, and escape, tumor cells progressively become invisible or resistant to elimination by the immune system. Thus, the long-debated cancer immuno surveillance theory has now been incorporated as an integral part of the general concept of cancer immunoedition. During the recent twenty or so years experimental evidence has also accumulated indicating that exposures to low-level ionizing radiation (LLR, i.e., <0.1 Gy absorbed within a short time and < 0.1 mGy/min. dose rate during a protracted exposure) attenuate the development and growth of both primary and metastatic neoplasms, the effect being often associated with stimulation of anti-cancer immunity. In the present review, the LLR-induced modifications of various functions of the immune system pertinent to tumor development will be tracked and commented in relation to different phases of the cancer immunoediting process. This will likely update a basis for employment of exposures to LLR (alone or as an adjuvant to conventional therapeutic modalities) aimed at targeting the equilibrium and escape phases of cancer immunoediting in order to restore the efficacy of anti-tumor functions of the immune system, the most potent natural guardian against neoplasia.

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