Purpose: To perform a dosimetric comparison for spatially fractionated external beam radiation (GRID) using linear accelerator with a dedicated GRID block and Helical Tomotherapy using a virtual TOMOGRID template.

Methods: The GRID phantom treatment plan was generated with dedicated GRID block (Radiation Products Design, Inc.) using the Pinnacle v9.0 TPS. The dose profiles were measured using EDR2 films with 100cm SSD at depths of dmax and 10cm for both 6MV X-rays and 18MV X-rays beam. TOMOGRID targets were generated using a virtual TOMOGRID template (VTT) provided by an in-house software (DICOMan). The programmable VTT was configured in various settings to generate TOMOGRID targets (GRID GTV) and a structure of avoidance (SOA). TomoTherapy Plans based on GRID GTVs and SOAs were generated on HiArt TomoTherapy v4.0.4 TPS.

Results: For the dose under linac block, the dose decreases with increasing depth under the open area, while the dose under block area is nearly constant. At dmax, the average valley to peak (V/P) ratio is around 0.2 for 6MV X-rays and 0.3 for 18MV X-rays. Ten treated linac-based GRID patients were selected and the same average V/P ratio was obtained. The dose distribution with the properly designed virtual TOMOGRID templates was similar to the linac-based GRID dose distribution. At isocenter, The V/P ratio is 0.5 and 0.42 for the two TOMOGRID plans used in this study. The V/P ratio is almost constant under linac block across the isocenter plane while the ratio was different under TOMOGRID plans across the isocenter plane.

Conclusions: GRID radiation using Tomotherapy is a breakthrough technique. Helical Tomotherapy-based GRID can provide at least equivalent GTV coverage compared to linac-based GRID while allowing 3-D optimization to achieve superior sparing of organs-at-risk and no high-dose spill outside the GRID GTV.