Purpose:
Aim of this work is to show the procedure to assess the overall accuracy associated with Gammaknife treatment planning using source plugging which is used to create dose falloff in the junction between a target and a critical structure.

Methods:
The MAGAT polymer gel contained in a head size glass container simulated the entire treatment process of Gamma knife radiosurgery. The 3D-dose distribution recorded in the gel dosimeter was read using 1.5 Tesla MRI scanner (Siemens, Sonata). Scanning protocol was CPMG pulse sequence with 8 equidistant echoes, TR = 7 s, echo step = 14 ms, pixel size = 1 mm x 1 mm. Interleave acquisition mode was used to obtain 40 2-mm thick slices. Using calibration relationship between absorbed dose and spin-spin relaxation rate (R2), we converted R2 images to dose images. The dose comparison was accomplished using an in-house MATLAB-based program.

Results:
Calibrations indicated that the dose response of current polymer gel was non-linear for doses higher than 12 Gy. The isodose overlay of measured and computed dose distribution on transverse planes showed very good agreement. We are able to demonstrate a mean dose difference of 3% between gel measured and Treatment Planning system (TPS) calculated dose. Since there is no 3D “gold standard” to compare our results, a film dosimetry with Gafchromic® EBT2 film was performed to compare the results with calculated TPS dose. The isodose comparison and gamma index analysis of film measurement agreed very closely but was restricted to 2D plane.

Conclusions:
In summary, verification of Gammaplan calculated dose on account of shield is not part of acceptance testing of Leksell Gamma Knife. Through this study we performed a true comprehensive comparison between 3D dose distributions measured with a polymer gel dosimeter and LGP calculations for plans using plugging.

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