Purpose: To evaluate the added value of 6 degree-of-freedom (DOF) patient positioning with robotic couch compared to 4DOF positioning for intracranial lesions and to estimate the immobilization characteristics of the Brainlab frameless mask, more specifically the setup errors and the intrafraction motion.

Methods: Forty patients with 66 brain metastases treated with frameless stereotactic radiosurgery and 6DOF robotic couch were enrolled. Patient positioning was performed with the Brainlab ExacTrac stereoscopic x-ray system. Positioning results were collected before and after treatment to assess patient setup error and intrafraction motion. Existing treatment plannings were loaded and simulated for 4DOF positioning and compared to the 6DOF positioning. The clinical relevance was analyzed by means of the Paddick conformity index (CI) and the ratio of prescribed isodose volume covered with 4DOF to that obtained with the 6DOF positioning.

Results: Results.
The mean 3D setup error before 6DOF correction was 1.91 mm (SD1.25mm). The rotational errors were larger in the longitudinal (0.23° SD0.82°) direction compared to the lateral (-0.09° SD0.72°) and vertical (-0.10° SD1.03°) ones ($p<0.05$). The mean 3D intrafraction shift was 0.58 (SD0.42mm). The intrafractional rotational errors were comparable,0.01° (SD0.35°), 0.03° (SD0.31°), -0.03° (SD0.33°), for the vertical, longitudinal and lateral, respectively. The mean CI decreased from 0.68 (SD 0.08) (6DOF) to 0.59 (SD 0.12) (4DOF) ($p<0.05$). A loss of prescribed isodose coverage of 5% (SD0.08) was found with the 4DOF positioning ($p<0.05$). Half a degree for longitudinal and lateral rotations can be identified as a threshold for coverage loss.

Conclusions: With a mask immobilization, patient setup error and intrafraction motions need to be evaluated and corrected for. The 6DOF patient positioning with 6DOF robotic couch to correct translational and rotational setup errors improves target positioning with respect to treatment isocenter, which is in direct relation with the clinical outcome, compared to 4DOF positioning.