Purpose: IMRT and VMAT showed superior total scalp coverage and uniformity over conventional photon/electron combination technique. This study is to investigate and compare the dosimetric effects of translational setup errors for these techniques.

Methods: Three total scalp irradiation patients were studied. For each patient, three treatment plans were generated using conventional, IMRT and SmartArc VMAT technique. In order to evaluate the dosimetric effect due to translational setup errors, 36 additional plans were calculated for each patient on the planning-CT image, which included isocenter shift of 2mm and 5mm in lateral (LR), anterior-posterior (AP) and superior-inferior (SI) directions for each of the three plans. The dose distributions for target and organs at risk (OAR) (brain, brainstem and spinal cord) from the 36 plans were compared to the original plans and among the three techniques using dose-volume histograms, tumor-volume coverage of prescription dose and the maximum OAR dose.

Results: Conventional plans were robust to lateral shift (less than 0.8% tumor coverage drop and less than 0.8cGy brain mean dose increases for up to 5mm isocenter shift) because only lateral beams were used. Tumor coverage drops were apparent when isocenter moved towards posterior and superior scalp. At 2mm shift, tumor coverage drop for VMAT plans were comparable to conventional plans (LR 0.4%, AP 1.4%, SI 2.3%), while for IMRT plans, the coverage dropped 3.3%, 3.0% and 2.6% in LR, AP and SI direction, respectively. At 5mm shift, both IMRT and VMAT plans had significant higher coverage drop than conventional plans with IMRT plans the worst in all directions. OAR dose increases were less than 50cGy for conventional plans, and were up to 150cGy for IMRT and VMAT plans at 2mm isocenter shift.

Conclusions: The dosimetric effect were comparable between VMAT and conventional technique when translational setup errors were within 2mm. IMRT plans showed worse effect than VMAT.