

Purpose:To evaluate the impact of patient positioning and anatomical changes over the course of craniospinal irradiation (CSI) using helical tomotherapy. This is done using daily megavoltage computed tomography (MVCT) images and MIM version 5.1, a commercial deformable image registration tool.

Methods:A summation of the daily dose delivered to four patients over their treatment courses were calculated using the pre-treatment MVCT. First, the TomoTherapy Planned Adaptive software was used to calculate the patient dose as treated using the daily MVCT and leaf motion sinogram data. Then, the dose distribution for each fraction was deformed to the dose grid of the planning kilovoltage (kV) CT based on the deformation mapping of the MVCT to the kVCT. The dose to the clinical target volume (CTV) and organs at risk, including the kidneys, lungs, and esophagus, were evaluated.

Results:The CTV dose coverage, as indicated by $D_n\%$ ($n=0, 2, 50, 98, 100$), is nearly constant throughout the CSI treatments for all four patients. This consistency is seen despite a weight loss of 4 kg for one patient. The daily CTV dose fluctuations are well within 1%, except for a single fraction where the $D_0\%$ and $D_2\%$ are nearly doubled due to a slight overlap of the treatment volume as the dose delivery was restarted after an interruption. The median dose and the volume receiving over 1 Gy for each fraction ($V1Gy$) for the kidneys and lungs change by $<1\%$ from day to day. The esophagus $V1Gy$ and $D50\%$ change by $<4\%$.

Conclusions:The consistency in dosimetric metrics for the CTV and organs at risk throughout the CSI tomotherapy treatment indicates the advantage of daily imaging verification. Our results suggest that it may not be necessary to create a new CSI treatment plan even when the patient experiences significant weight loss during the treatment.