Purpose: To develop a model to quantify the local displacements, rotations and deformations in head and neck during the treatment course using Cone Beam CT (CBCT).

Methods: Five patients underwent weekly CBCTs, immobilized in head and shoulder thermoplastic masks (MedTech®, Orange City, USA). CBCT images were registered to the planning CT by matching the clivus and occipital bone. Eight points located at visibly distinguishable bony landmarks in the head were identified on all images. The displacements of the CBCT points relative to the CT were computed. Head rotation was calculated from the angular change of a plane constituted by three rigid bony points. The spinal canal was contoured in all the image sets and the geometrical centroid line was used as the cord surrogate. The cord deformation relative to the CT was quantified by the variation of the centroid lines.

Results: The means of the inter-fraction displacements, varied between -0.3 and 0.3 cm (standard deviations range from 0.02 to 0.3 cm), for all bony landmark points of each patient. Centrally located points have smaller displacements (mean between -0.1 to 0.1 cm) than circumferential points. The inter-fraction average head spin (rotation in axial plane) was 2 degrees, while the rotations in the saggital and coronal planes were 4 degrees on average. Cord deformation was minimal superiorly (mean ranged over -0.1 to 0.1 cm) and increased inferiorly to the range of -0.3 to 0.4 cm (standard deviation, 0.3 cm). The deformation was larger in the sagittal plane than in the coronal plane.

Conclusion: Sequential CBCTs enable the analysis of the spatial displacements in the head and neck. This method can be used to develop localized treatment margins for this patient population and immobilization technique.