COMPARISON OF SET-UP ERROR OF TWO STABILIZATION DEVICES IN HEAD & NECK IMRT AND EVALUATION OF IMAGE GUIDANCE STRATEGY

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Purpose: The accuracy of patient positioning throughout a course of IMRT is crucial, due to the potentially significant dosimetric impact of minor set up variations on the target volumes and critical structures. Robust stabilization together with appropriate image guidance strategies are vital to minimize set up errors. A study was designed to compare the daily set up error of two stabilization strategies and evaluate the efficacy of the current institution image guidance (IG) protocol.
Materials: Twenty patients were stabilized using the (CID) consisting of a customized head and neck support with a Civco IMRT Reinforced head and neck thermoplastic mask. Twenty patients were stabilized using a new immobilization device (NID) consisting of a body cradle extending below the level of the olecranon processes and encompassing the upper arms and shoulders together with the mask. Daily Cone Beam CT using an Elekta Synergy Linear Accelerator were acquired and displacements in medio-lateral (M-L), craniocaudal (CC) and antero-posterior (A-P) directions were analyzed. A volume of interest (VOI) placed around upper cervical vertebrae (C1-6) and displacement figures calculated using the automated bony match algorithm. Daily set up error statistics were then summarized.
Results: A total of 1080 data sets were analyzed. Using the NID, systematic displacement of the group reduced from 1.08 to 0.64mm in M-L; 1.59 to 0.54mm in CC; and 1.56 to 0.67mm in A-P directions when compared to the group treated with the CID. Similarly the random displacement reduced from 2.57 using CID to 0.96mm using NID in M-L; 2.26 to 0.86mm in C-C and 2.55 to 1.16mm in A-P directions. The displacements of 3mm or greater in M-L was 27.2% of fractions with CID compared to 5.8% for the NID, 21.7% (CID) and 7.8% (NID) in C-C and 25.2% (CID) 5.2% (NID) in A-P plane. A total of 582 data sets were available for analysis for the NID and 498 data sets for the CID.
Conclusions: Using the information from the 3D data sets, this study demonstrates that the use of a more extensive stabilization strategy, compared to conventional immobilization devices, can reduce the uncertainty in H&N IMRT patient set up. Random error is reduced to a greater extent with the new immobilization device. The evaluation of the previous institutional IGRT protocol of daily cone-beam CT in this study has identified the possibility of a tailored patient specific image acquisition protocol, where imaging frequency as well as subsequent CTV PTV margin may be tailored, based on assessment of positional and distortional stability in the first week of treatment. Furthermore patient/tumor/DVH factors may be incorporated in further analysis to help correlate the stability of our patient positioning to aid in this decision making.[...less]