A Mask Immobilization Study: Comparison Between Two Immobilization Systems for Brain Stereotactic Radiosurgery

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How to cite this abstract
Pannullo S C., Nedialkova L, Sabbas A, et al. (November 02, 2017) A Mask Immobilization Study: Comparison Between Two Immobilization Systems for Brain Stereotactic Radiosurgery. Cureus 9(11): a288

Abstract

Objectives: In stereotactic radiosurgery (SRS), switching from frame to frameless immobilization, provides increased patient comfort and ability to render hypofractionated treatment. It requires a sub-millimeter precision and reliable method of immobilization. We adapted frameless immobilization to treat patients on LINAC, equipped with Image Guided ExacTrac X-Ray system and 6D Robotic couch. In this study, we set out to compare two immobilization treatment systems in terms of set up and treatment accuracy.

Methods: After IRB 0511008245R010 approval, a retrospective review of 20 consecutive patients treated with SRS/SBRT between 2015-2016 using IGRT with ExacTrac X-Ray imaging system on the LINAC, was conducted. The patients were CT-simulated with Civco and BrainLab masks. The IR cameras and IR Patient Head Array allowed for automatic pre-positioning of the patient directly to the isocenter. The corrections were implemented using: two angular corrections with Robotic 6D couch top and one angular correction and three translational shifts with LINAC 4D-console. Patient positioning verification was done during the treatment. The acquired set of noncoplanar X-ray images was compared to the corresponding DRRs.

Descriptive statistics, standard deviation (SD) and Mann-Whitney U test were used for analysis.

Results: Of the entire cohort, 9/20 (45%) patients were treated with a single fraction SRS to a dose 20Gy, and 11/20 (55%) patients treated with SBRT with mean dose 26Gy (range, 24-30Gy) over 3-5 fractions (39 total fractions). 8/20 (40%) of patients were treated in a Civco mask and 12/20 (60%) were treated in BrainLab masks. The total number if images obtained during treatments was 324: for all SRS patients treated in the BrainLab mask was 96 (10 images/patient/1fraction) and for SBRT 228 images (6 images/patient/1fraction). Our measurements demonstrated that the Brainlab mask has a mean distance shift of 0.5 mm (range, 0-1.2mm) (SD, 0.45 mm, median 0.37 mm) from isocenter compared to 1.0 mm (range, 0-3mm) (SD 1.25, median 0.61 mm) for Civco one (P < 0.001). In fact, in 243/324 (75%) of the obtained images revealed the shift from the isocenter of < 1.2 mm for the Civco mask and < 0.6 mm for the Brainlab mask.

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Conclusions: Our data demonstrated that the BrainLab immobilization mask system provides better positioning accuracy and smaller shifts from the isocenter during treatment in a statistically more significantly manner, as compared to the Civco immobilization mask. The BrainLab immobilization mask may provide less inter-fraction variability in the fractionated SBRT cases.

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