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Defining Appropriate Tolerances to Help Mitigate Intrafraction Motion for ExacTrac Spine SBRT

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Objectives: The objective of this study was to reassess the current intrafraction IGRT shift tolerances (1.5 mm and 1°) for spine SBRT.

Methods: X-ray intrafraction correction shifts were analyzed for 60 patients (11 cervical spine, 34 thoracic spine, 11 lumbar spine and 4 sacrum) comprising of 800 image registrations. The patient positioning report was exported in .csv format from ExacTrac. This file contains the translational and rotational shifts for each registration. The magnitude of the intrafraction motion was calculated by finding the magnitude of the vector ($r = \sqrt{x^2 + y^2 + z^2}$) for both the translations and rotations. The intrafraction motion was calculated for all image registrations for all fractions and the mean and mode were calculated for translations and rotations separately.

Results: The mean for translational intrafraction motion was 1.12 mm and the mode was 0.68 mm. The mean for rotational intrafraction motion was 0.77° and the mode was 0.62°.

Conclusion(s): As our SBRT program grew, we struggled to find research or vendor information with tolerance values for our technology. Following this analysis, the tolerance was changed to 1 mm since the mean was below our current tolerance of 1.5mm. Although the mean was 1.12 mm, the mode was 0.68 mm meaning the value was often below that average value and lowering the tolerance wouldn't lead to added treatment time due to over-imaging. Our revised tolerance permitted intrafraction patient imaging with ExacTrac and that allowed for much smaller 6DOF shifts to be corrected and more accurate SBRT delivery.

