

Analysis of the Impact of ExacTrac Dynamic Upgrade on Spine SBRT Treatment

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Purpose

Spine stereotactic body radiation therapy (SBRT) treatment involves the precise delivery of high doses of radiation treatment to tumor with submillimeter accuracy. Intrafraction motion monitoring using the ExacTrac (ET) imaging system for pre-treatment and mid-treatment imaging verification enables a faster alternative to CBCT imaging, reducing treatment time and the risk of marginal miss due to patient motion. Since 2013, our institutional spine SBRT workflow acquires kV, CBCT imaging at setup. Intrafraction ET is acquired prior to every treatment arc to monitor motion, with repeat CBCT images acquired if the patient is out-of-tolerance (1mm/1deg). We sought to analyze the impact of the ET Dynamic upgrade on spine SBRT set up and treatment times and mid-imaging.

Materials and Methods

All patients receiving spine SBRT to a single isocenter using an ET pre- and mid-imaging workflow at our institution were analyzed, beginning 1/3/2022 and up to 10 weeks following ET Dynamic upgrade Go-Live 4/13/2023. Treatment times and number of images acquired was extracted for all treatment appointments and analyzed through statistical process control (SPC) with use of an XmR chart of set up, delivery, total treatment time, and kV, ET, CBCT images acquired per fraction from 1/2022 to 6/22/2023. Special cause rules were based on IHI rules and conducted with QI Macros for Excel version 2020.01 (KnowWare Inc. Denver, CO).

Results

From 1/1/2022 to 6/21/23, 765 fractions of spine SBRT were delivered to 150 patients at our institution using an ET Imaging workflow (86 multi-site, 638 single). 70 of the 638 fractions were delivered post ET Dynamic Upgrade 4/13/2023. Pre-upgrade, the average set up time and total treatment time for single iso was 12 (SD=4.2) and 14.5 (SD=3.6) minutes, respectively, with an average of 3 kV, 5 ET, and 1.5 CBCT images acquired per fraction. Post-upgrade, the average set up time and total treatment time was 8.5 (SD=3.0) and 12.5(SD=2.8) minutes, respectively, with an average of 2 kV, 3 ET and 1 CBCT images acquired per fraction. There was no special cause variation observed post-upgrade however there was reduced variation and increased process control for all aspects of treatment time and imaging analyzed (Fig. 1).

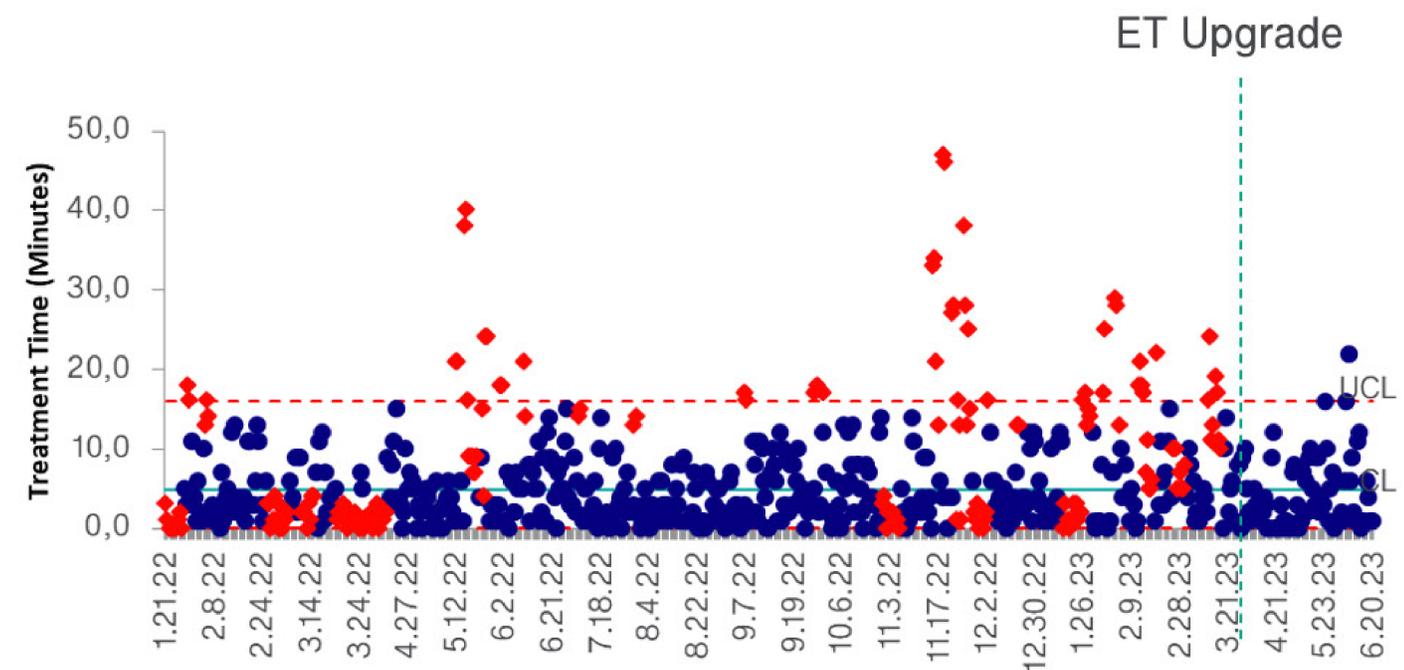


Figure 1. Statistical Process Control Chart for Spine SBRT Treatment Time. UCL (upper confidence limit), Lower Confidence Limit (LCL) based on 3 sigma with baseline data collected pre-ET Upgrade

Conclusion

The average set up and total treatment times for single isocenter spine SBRT were reduced post-ET Dynamic upgrade at our institution. The average number of kV, ET, and CBCT images acquired also decreased post-ET Dynamic upgrade. Although there was no special cause variation observed associated with the upgrade; all measures analyzed (set up, treatment time, and number of kV, ET, and CBCT images) were observed to be in greater control post upgrade. Future investigations evaluating the clinical impacts of implementing ET Dynamic surface monitoring for set up and intrafraction motion monitoring on spine SBRT and as a substitute for initial CBCT are warranted.