Purpose: With lung lesion treatment being a major indication of the use of the CyberKnife (CK) robotic radiosurgery system (Accuray Inc, Sunnyvale, CA), the ability for the CK's stereoscopic kV imaging system to accurately track implanted fiducial markers becomes vital in the accurate delivery of therapeutic radiation. This study examines a novel fixed-space fiducial marker delivery system which is capable of delivering two VISICOIL (IBA Dosimetry America, Memphis, TN) non-migrating fiducial markers simultaneously at a fixed spacing through a single 20-gauge needle. More specifically, presented herein is a preliminary study which tests the CK's treatment localization system's (TLS) ability to track markers of varying size and spacing, comparing subsequent stereoscopic kV imaging to DRR's generated during the planning stages.

Methods: Three markers were placed in an XLT Lung Phantom (CIRS Inc, Norfolk, VA); two markers inserted along a diagonal line in a coronal plane, separated by biocompatible spacers of varying size, and a common third marker being placed in a non-varying location in a coronal plane anterior to the marker pair. This third marker allows the calculation of rotational and translation corrections. Different combinations were scanned, planned, and simulated; 3.5mm- and 5.0mm-long markers, each 5mm in diameter, were separated by 15mm, 17mm, and 20mm spacers.

Results: The TLS system was able to track each of the aforementioned configurations with standard lung imaging parameters. Longer markers were not included in the study since earlier studies showed that without the natural deformation that would occur upon implantation, the length would induce false tracking.

Conclusions: This is a necessary first-step in determining the minimum spacing with which the CK's TLS can track, a study which can now proceed with the use of phantom treatments delivered to orthogonally-overlapping radiochromic film, bisecting a tumor volume which is implanted with this fiducial marker system.

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