Purpose: Image-guidance to ensure correct patient set-up prior to treatment delivery is of utmost importance in SBRT. Many studies have demonstrated high levels of concordance between radiation therapists (RTs) and radiation oncologists (ROs) on daily verification based on electronic portal imaging and simulator films. However there is a lack of data, however, on the concordance between RTs and ROs using CBCT pre-treatment images prior to SBRT. The primary objective of this study is to evaluate the levels of concordance between RTs and ROs on CBCT pre-treatment verification images for SBRT.

Methods and Materials: Twenty-one consecutively treated SBRT patients at a provincial institution were included in the study. CBCT was performed by both RO and RTs prior to delivery of each fraction for abdominal and bone SBRT treatments, and prior to first fraction for lung SBRT. RTs performed subsequent daily matches for lung SBRT. Initial CBCT match was performed by RTs as per centre guidelines or by previously specified instructions. ROs performed second match prior to SBRT delivery. Directional differences between RT and RO match were recorded and analyzed. Intraclass correlation coefficients were calculated to determine variability between RT and RO match, with values approaching 1 suggesting high concordance.

Results: Thirty-six CBCT images were analyzed. Thirteen were lung, 20 abdominal (five liver, 15 pancreas) and three were bone SBRT cases. RO made adjustments to initial RT match in 12 (33%) of CBCT matches, with six matches having a direction shift of 0.1 to < 0.2 cm in any direction, and two matches with a directional shift of ≥ 0.2 cm. Mean maximum match difference was 0.12 cm (range: 0.02, 0.31 cm). Treatments requiring adjustment to the initial RT match did not differ by treatment site. Review of the two plans with match difference of ≥ 0.2 cm revealed no appreciable change in GTV coverage and with dose to organs at risk still within accepted constraints. Intraclass correlation coefficients for all CBCT matches were 0.998 (95% CI: 0.996-0.999), 0.997 (95% CI: 0.995-0.999), 0.996 (95% CI: 0.992-0.998) in the x, y, and z directions respectively. Intraclass correlation coefficients for CBCT matches that required adjustment by RO were similar at 0.995 (95% CI: 0.982-0.998, 0.998), 0.995 (95% CI: 0.984-0.999, 0.984-0.999), 0.989 (95% CI: 0.962-0.977) in the x, y, and z directions respectively.

Conclusions: CBCT match for SBRT at our center shows high concordance between RTs and ROs. These findings support potential expansion of RT scope of practice at our institution to include independent CBCT matches for SBRT.

Purpose: Over the course of radiation therapy treatments for head and neck (H&N) cancers, many patients’ contours change shape due to weight loss. This affects the fit of the shell, and the shape of the planned dosimetric volumes. There are a variety of methods used to measure the change in a patient’s external contour over the course of their treatment. Investigation is needed to determine the effectiveness of these methods. The objective was to complete a retrospective analysis that compares the weekly use of Cone Beam Computed Tomography (CBCT) to a conventional method involving small wooden sticks.

These methods assess the change in contour based on the distance of the skin to the immobilization shell.

Methods and Materials: Measurements from eighteen H&N patients undergoing radiation therapy were used for this study. Strategic measurement points in areas with a high likelihood of contour variance due to weight loss or change in volume were provided from Dosimetry for each patient. Measurements were taken at gantry angles of 0, 90, and 270 over one week using both CBCT and conventional stick measurement techniques for the duration of treatment. A comparison of gap measurements between stick and CBCT methods was performed with a paired t-test.

Results: Irrespective of gap measurement method, mean gap measurements were significantly smaller at 0 (1.41 mm), compared to 90 (2.95 mm) and 270 (2.52 mm) degrees (p < 0.001). Mean gap measurements for week 1, 2, 3, 4, 5, 6, and 7 were 1.5, 2.0, 2.3, 3.3, 4.0, 3.1, and 3.0, respectively (p < 0.001). Including all time points and measurement angles, mean stick measurements were slightly larger than CBCT (2.5 versus 2.2 mm; p = 0.02), though these differences were significantly larger when restricting to lateral measurements (3.1 versus 2.6 mm; p = 0.002), or restricted to lateral measurements in last three weeks (2.55 versus 0.05 mm; p < 0.001).

Conclusions: Overall, conventional stick method overestimates the gap measurements compared to CBCT method. As treatment progresses, the gap measurements increase as well as the differential between the two methods. Future studies including a larger sample size of patients that extend past the four week mark of treatment could determine if the overestimation of stick gap measurements results in more patients being re-planned compared to CBCT.

Purpose: In Canada, in 2015 an estimated 25,000 women were diagnosed with breast cancer. For early-breast stage cancer, the recommended treatment is breast conserving surgery followed by radiation therapy. The standard of care is whole-breast irradiation, which requires up to six weeks for treatment delivery. Accelerated partial breast irradiation by multi-catheter interstitial brachytherapy is an alternative that is delivered in just one week or less. To achieve ideal dosimetry over the tumour bed, the catheters must be placed parallel with equal spacing in the deformable breast tissue - a technical challenge that requires image guidance. Ultrasound (US) imaging is a safe and affordable guidance modality, but it is difficult to use in the presence of interference between the catheters. We propose using real-time electromagnetic (EMT) navigation to shore up the US-guided catheter insertion process.

Methods and Materials: A tissue-locking needle and US probe are equipped with EMT. Under US guidance, the needle is inserted and locked in the tumour bed, providing a locally rigid reference. The target volume is segmented in US, yielding a tracked model of the tumour bed and a catheter needle is inserted through the guide into the tissue. Additional parallel catheters are planned on the virtual view based on the first insertion and implanted in the target. The guidance software is built on the 3D Slicer (www.slicer.org) open source platform. Anthropomorphic plastic phantoms were created, each containing a simulated tumour bed that can be visualized in both US and CT. In our experiment, two rows of five catheter needles per row, for a total of 10 catheters were inserted in two phantoms. The intention was to place each catheter 1 cm apart. The first phantom had catheter needles inserted under sole US guidance to the target and the second under combined EMT-US guidance. Both insertions were performed by the same operator.