Purpose: To investigate normal liver tissue density changes as a function of dose and time for patients with metastatic liver tumors treated with stereotactic body radiation therapy (SBRT).

Methods: Seventy-one non-contrast follow-up computed-tomography (CT) scans of 18 patients with liver metastases were retrospectively analyzed from the time of treatment to their final follow-up scan [range, 1-24 months] [median, 8.2 months]. All patients received a prescription dose of 40-60 Gy [median, 57 Gy] in 3-5 fractions delivered with 3DCRT or dynamic conformal arcs. The follow-up scans were binned into the following time periods: 3, 6, 9, 12, 18, and 24 months. The liver volume was contoured on all scans for each patient and registered to the planning CT. Dose-response curves (DRC) were calculated by averaging Hounsfield unit changes (HU) in liver regions (excluding PTV) receiving the same dose in 5 Gy intervals.

Results: For early follow-ups, a small decrease in normal liver CT numbers (up to -10 HU) was observed from the first to the second follow-up periods (3 to 6 months); however, this decrease was not observed from treatment to the first follow-up period. For later follow-ups (9, 12, and 18 months), a significant increase in liver CT numbers was seen [up to 20 HU]. A return to the baseline planning CT values was observed for the last follow-up period (24 months), but only within lower dose regions [< 25 Gy].

Conclusions: The early pathologic veno-occlusive disease response [Olsen et al., IJROBP 2009] in normal liver after SBRT produces minimal quantitative density change despite its characteristic hypodense CT appearance. The subsequent tissue regenerative process involves transiently increased density that appears to consolidate over time. The high dose region tissue changes are possibly triggered by the mechanism of sinusoidal endothelial cell disruption described in preclinical models [Yamanouchi et al., Hepatology 2009].