Purpose:
In stereotactic body radiotherapy (SBRT) of liver tumors, daily image guidance based on contrast enhanced CT-scans enables precise delivery of high tumor doses with small margins. However non-rigid patient anatomy changes could still cause OAR dose constraint violations. In this study we evaluated the impact of daily re-planning based on contrast-enhanced CT-scans to compensate for non-rigid anatomy changes.

Methods:
For eight patients with twelve tumors in different liver regions, three planning strategies were simulated. In all strategies, the patient was shifted each fraction to correct for the tumor displacement derived from registration of the daily CT-scan. In the first strategy, the patient is irradiated with the non-coplanar treatment plan that was based on the planning CT-scan. In the second strategy the fluence profiles of the treatment beams were re-optimized based on the daily CT scan (beam angles remained the same as for the planning scan). In the last strategy, for each fraction a completely new plan (beam angles and profiles) was generated based on the daily CT-scan. Non-rigid registration and LQ-corrections were used to obtain cumulative dose distributions.

Results:
In 50% of the patients, constraint violations occurred for the repeated plan when we look at the dose distributions of the single fractions. For 33% of those patients, severe constraint violations in a single fraction even resulted in constraint violations in the integral dose distribution. In those cases, the beamweight plan and adaptive plan were easily capable of taking those OAR deformations into account and both methods designed good treatment plans without constraint violations. The adaptive plan performed slightly better than the beamweight plan, but the latter requires only some minutes computation time while full re-optimization would take a few hours.

Conclusions:
Adaptive re-optimization of fluence profiles based on daily CT scans can significantly improve dose distributions in liver SBRT.