Purpose:
To find the most robust strategies of objective setting and starting stage for online plan re-optimization, so it can be automatically executed within 1 min while providing high quality adaptive plans.

Methods:
10 prostate cancer patients, each with 1 planning-CT and 5 CBCTs, were retrospectively studied to simulate daily re-optimization. PTV objectives were (same across plans): D95>100% and Dmax<110%. Three OAR optimization objectives were compared: RTOG objectives (same across patients); DVH parameters extracted from original CT-plans (CT objectives); and DVH parameters extracted from "goal" dose distributions obtained through deformable registration between planning-CT and CBCT (Deformed-CT objectives). Two starting stages were compared: optimal-fluence in original CT-plan (Warm-start) and unity-intensity within PTV (Cold-start). Conformity index (CI) and homogeneity index (HI) were calculated to assess the target coverage. OAR sparing was evaluated by V50%/V100% for the bladder and V50%/V70Gy for the rectum. Delivery efficiency was evaluated by total-MU of each plan.

Results:
(1)Target: CIs (all<1.2) were similar for all objective settings with either Warm- or Cold-start. However, HIs were consistently lower for RTOG ($p<0.0001$).

(2)Rectum: Deformed-CT objectives achieved slightly lower V70Gy (<2.5cc) than CT or RTOG ($p<0.0001$). Both CT and Deformed-CT objectives achieved lower V50% ($p<0.0001$) than RTOG by 5.7%-23.6%.

(3)Bladder: Deformed-CT and CT objectives had small differences in V100%/V50%, but were better than RTOG ($p<0.0001$), especially for V50% (6.8%-16.9% reduction).

(4)Warm-start increased total-MU by 23%±11% for all plans, but also reduced V50% by 9.7%-26.9% for rectum with all objective settings, and reduced V50% by ~10% for bladder with RTOG setting.

(5)Deformed-CT objectives showed greater advantage over CT objectives when OAR volume in CBCT is >30% larger than planning-CT.

Conclusions:
CT and Deformed-CT objectives are in general superior to RTOG for OAR sparing. Deformed-CT objective is more robust when OAR volume significantly increases. Warm-start has better OAR sparing, but significantly increases total-MU.

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