

CBCT-based analysis of target coverage-volume changes after prostate SABR with triggered kV-imaging

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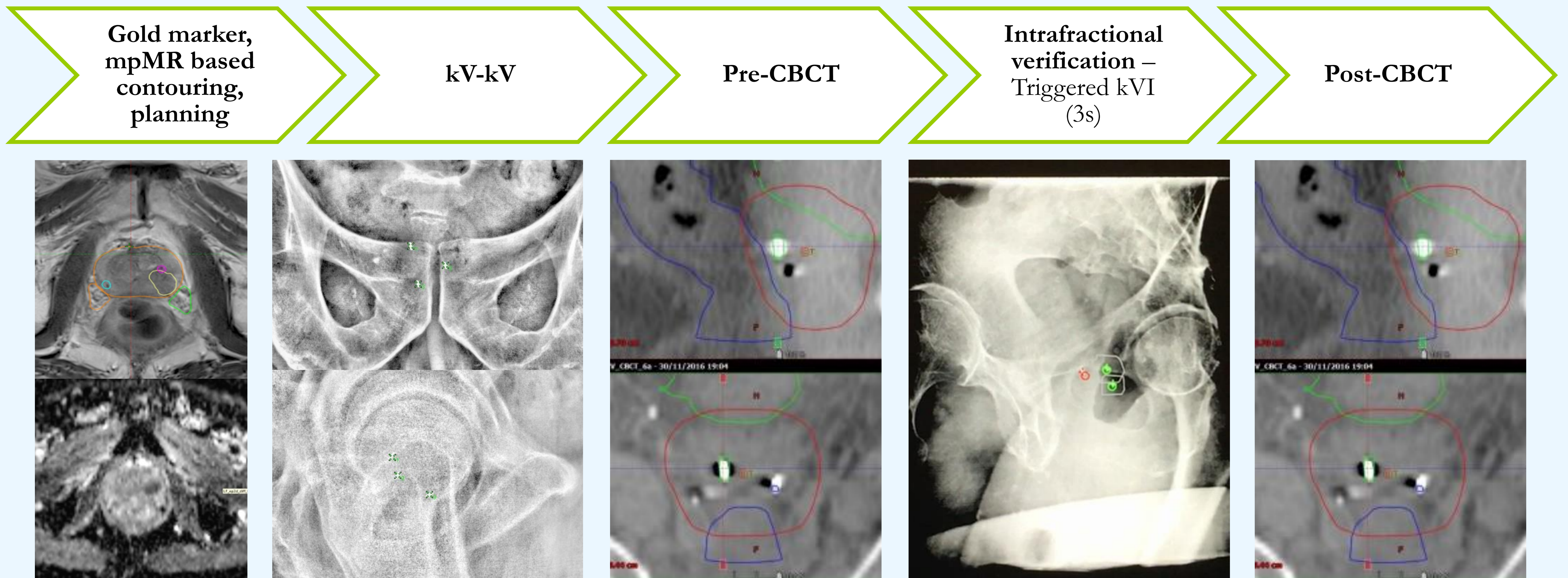
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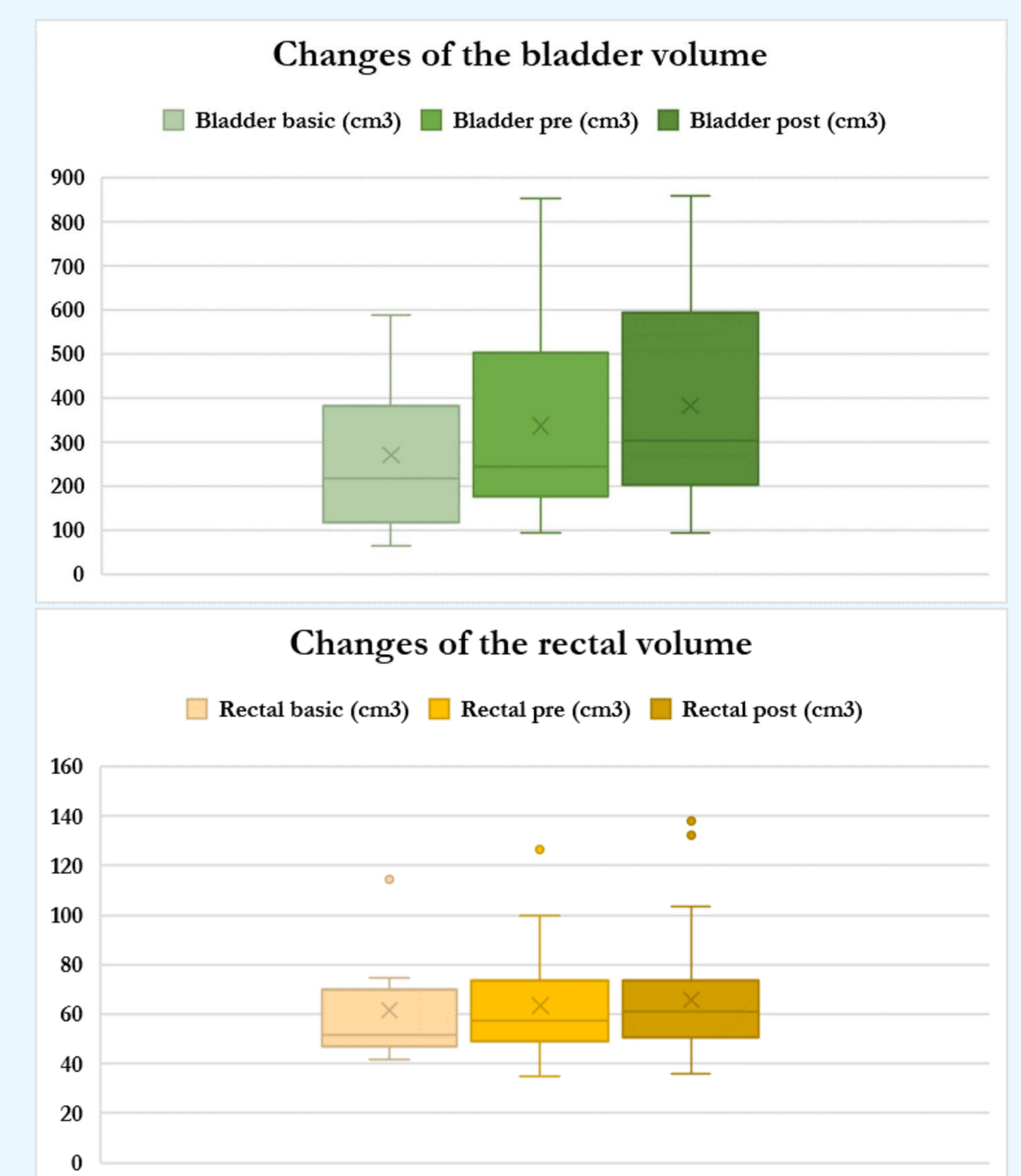
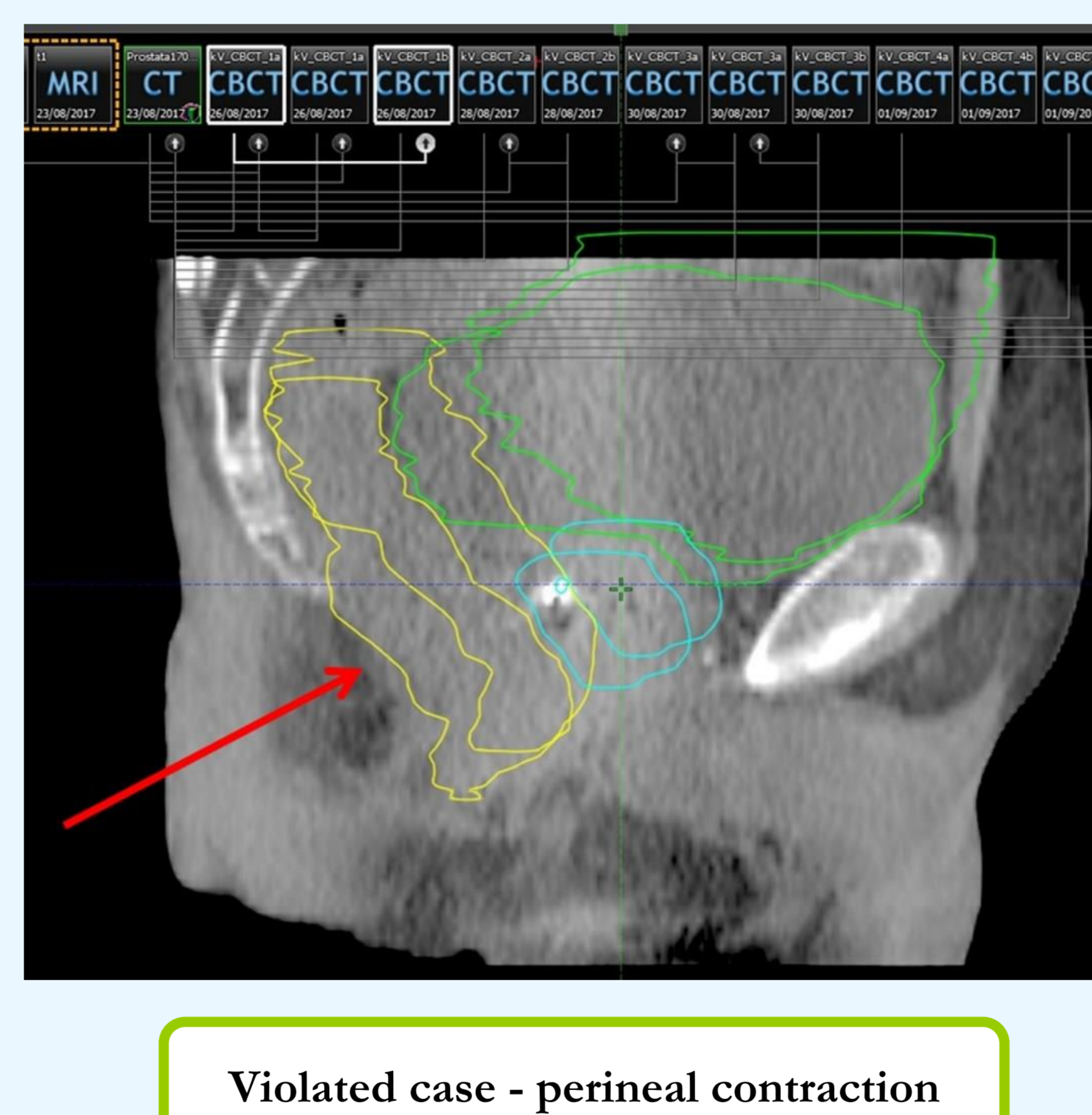
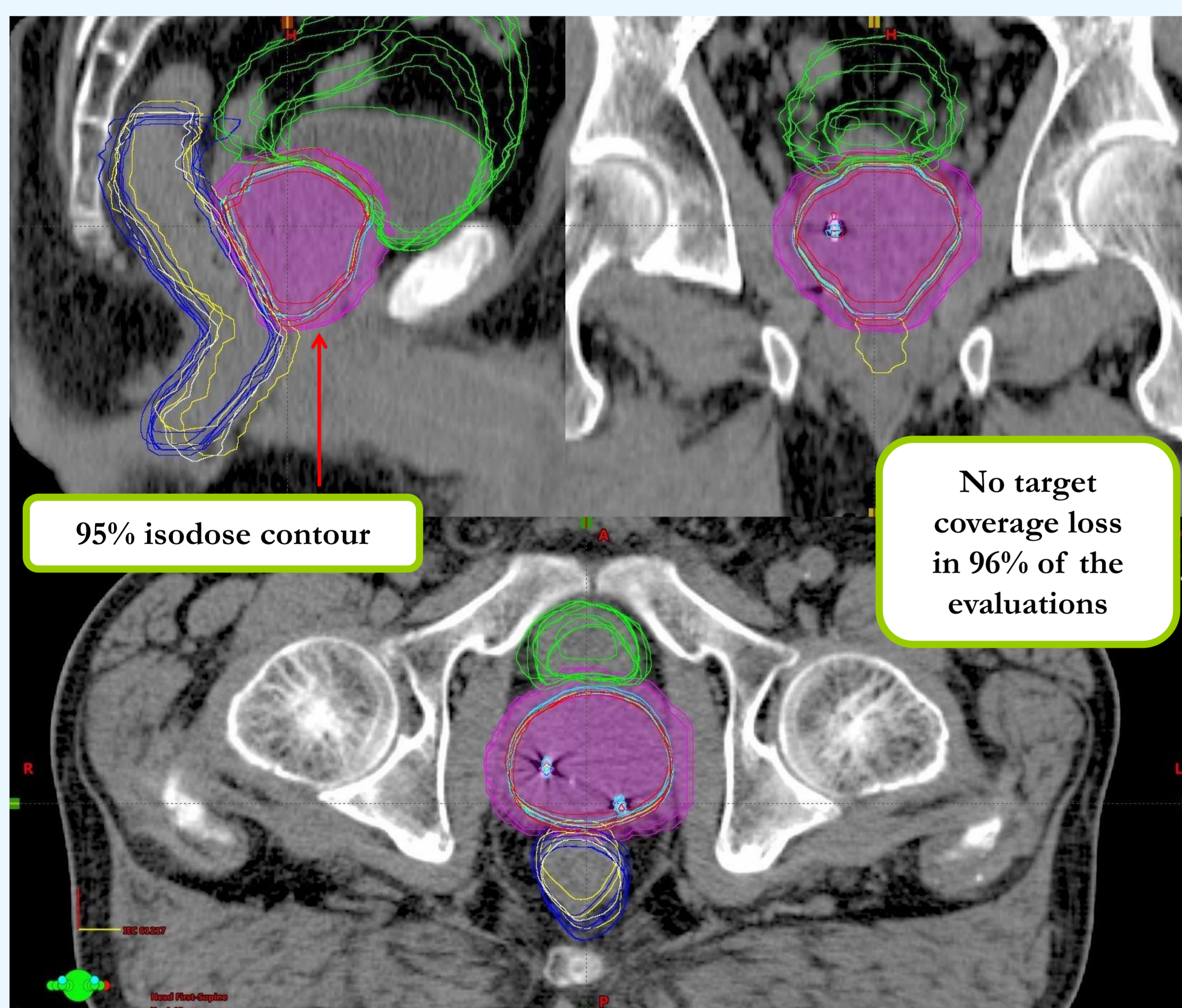
Objectives:

To evaluate target coverage and normal volume changes after gold marker-based prostate stereotactic ablative radiotherapy (SABR) with triggered kV imaging using multiple CBCTs.



Methods:

A total of 11 patients (8 monotherapy: 5x7.25 Gy, 3 boost:50.4+3x6.5 Gy) were treated with VMAT based SABR. All patients were prepared according to an institutional bladder and rectal filling protocol. Treatment verification consisted of pre-and post RT CBCTs, while during treatment online triggered kV imaging at an interval of 3 seconds was acquired. In case of ≥ 3 mm (deviation limit, DL) displacement, treatment was interrupted and corrected with additional imaging (2D/3D match, kV pair and/or CBCT). Beam interruptions, intrafractional shifts, treatment time were also recorded. Prostate, rectum, bladder were delineated on each CBCT. Target coverage was evaluated by comparing the individual prostate delineations with 95% isodose contour volumes using Supplementary Volume Contoured (% of the evaluated volumes exceeding the reference, SVC) metrics. Furthermore, volumetric changes of the delineated organs were assessed to evaluate bladder and rectal filling compared to baseline, and their intrafractional variations using paired t-test at $p < 0.05$ significance level.



Results:

The average (\pm SD) treatment time was: 16 \pm 12 min. On average, beams had to be interrupted twice (range: 0-10) per treatment sessions with a mean of 2.5 mm 3D shifts exceeding the DL in 30% (15/51) of the fractions. Patients were re-positioned 15 times due to inadequate rectal (14) or bladder (1) filling status. Only 4/98 evaluation (2 pre-, 2 post-CBCT) showed deviation from the ideal SVC (=0%) of the target (vs. 95% isodose line) with a maximum of 3%. The bladder volume on pre-CBCT was significantly larger compared to baseline (271 \pm 161 cm³ vs. 321 \pm 199 cm³, $p=0.02$), and further increased during treatment by an average of 17% ($p < 0.001$). There were no significant inter-and intrafractional changes of the rectal volume.

Conclusions:

Gold marker-based prostate SABR with triggered kV imaging and pre/post-treatment CBCT was successfully implemented in our clinic. The 3D evaluation confirmed sufficient target coverage beside significant bladder volume changes.