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**Dose Changes in Bladder During Volumetric
Modulated Arc Therapy (VMAT) Treatment of
Prostate Cancer**

Gülcihan CÖDEL



Introduction

- The aim of this study is to evaluate the changes in bladder doses during the volumetric modulated arc therapy (VMAT) treatment of prostate cancer patients using weekly cone beam computed tomography (CBCT) data.
- Prostate-implanted fiducial markers have been used as surrogate indicators for the position of the prostate gland for image-guided radiotherapy (IGRT). When there is no fiducial on patient, positioning made based on bony anatomy of patient.

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- CBCT of the patient in the treatment position has gained wider applications for setup verification during radiotherapy.
 - This IGRT method enables therapists to visualize soft-tissue images of the target organs, as well as the status of surrounding normal structures, during fractionated radiotherapy and therefore provides greater confidence for the use of smaller margins.
 - This is particularly important for target organs, such as the prostate, that are highly mobile and located in close proximity to other critical structures.

Method

- Ten consecutive patients with prostate cancer treated by radical RT were considered in this study.
- For each patient, pre-treatment CBCT performed on a weekly basis.
- CBCTs were analyzed by using two different methods of target localization
 - Matching based on intraprostatic fiducials
 - Matching based on bony anatomy

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- To evaluate the changes in bladder doses, organs of interest were contoured on each weekly treatment CBCT data set and the images, along with the contours were registered to the original planning CT.
 - The replanning was made on planning CT using contours transferred from CBCT for two different matching methods.
 - Bladder doses were determined using dose volume histograms generated from treatment plans.
 - The doses received by 20%, 40% and 50% volume of bladder were compared to those of the original treatment plans.

Result

- Bladder doses in treatment plans of bony anatomy matched CBCT images,

591.7 cGy (276) → D20%

413.6 cGy (178) → D40%

367.4 cGy (93) → D50%

lower than the planned dose for respectively.

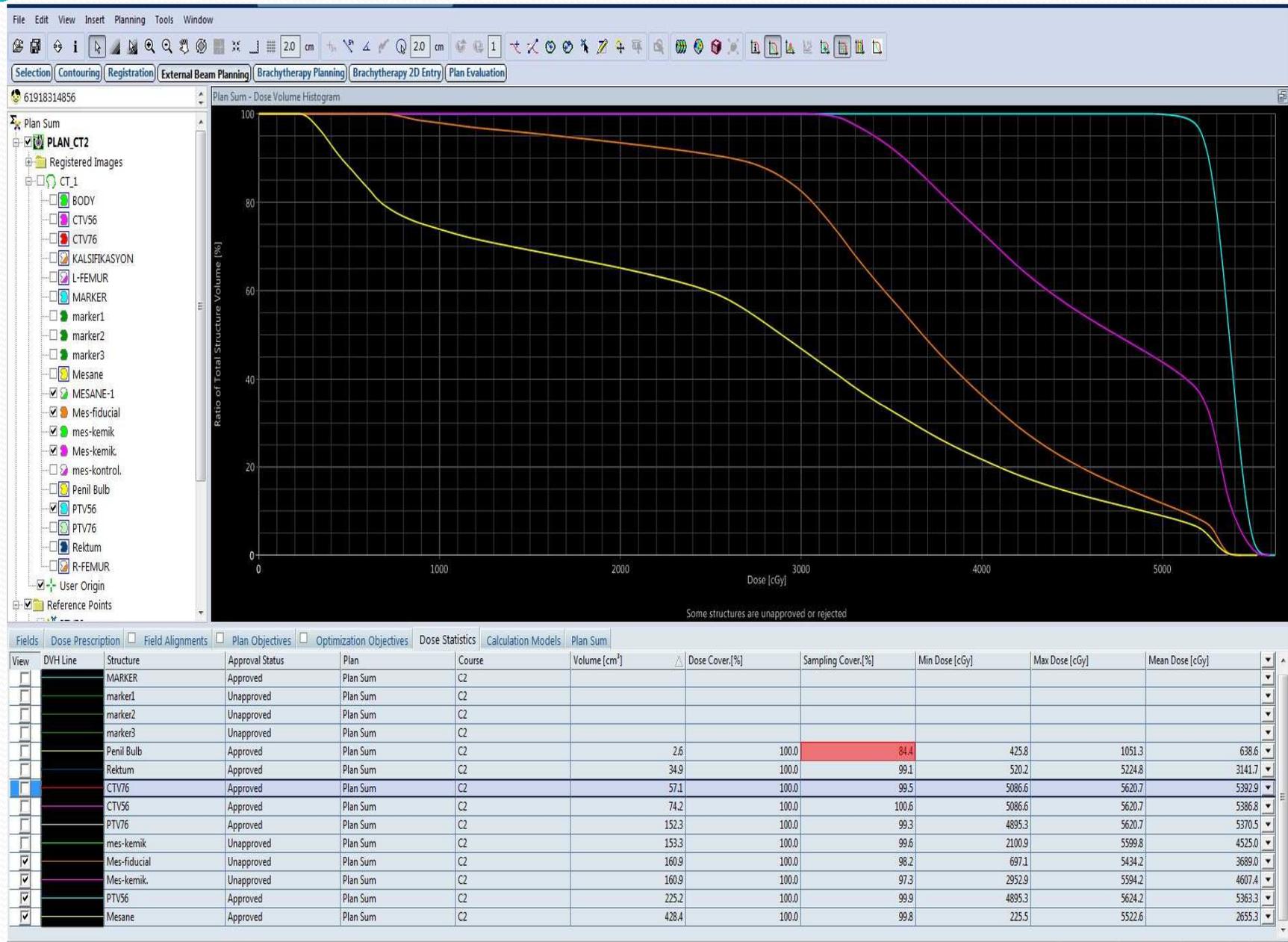
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- Bladder doses in treatment plans of fiducial marker matched CBCT images,

141.2 cGy (84) → D20%

82.2 cGy (61) → D40%

67.3 cGy (47) → D50%

lower than the planned dose respectively.



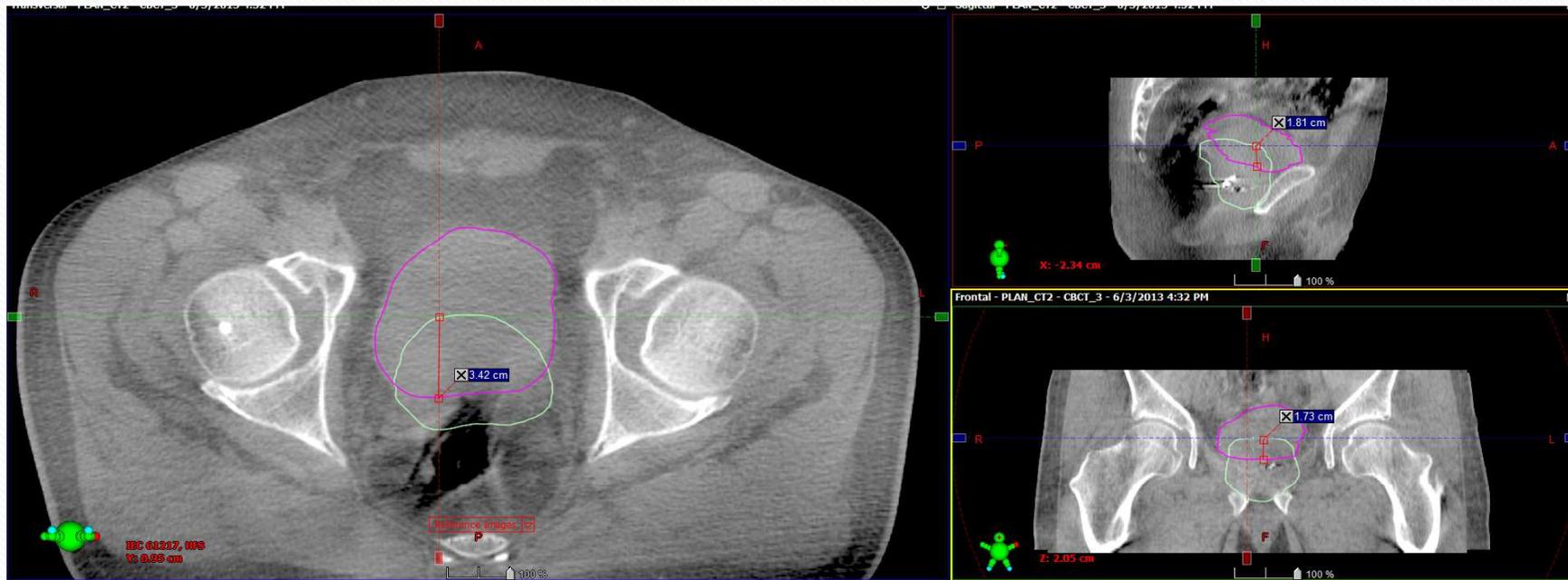


Figure: Bony anatomy matching

Purple: Bladder

Green:PTV

The shift of 3.42 cm in transverse, 1.81 cm sagittal, 1.73 cm frontal

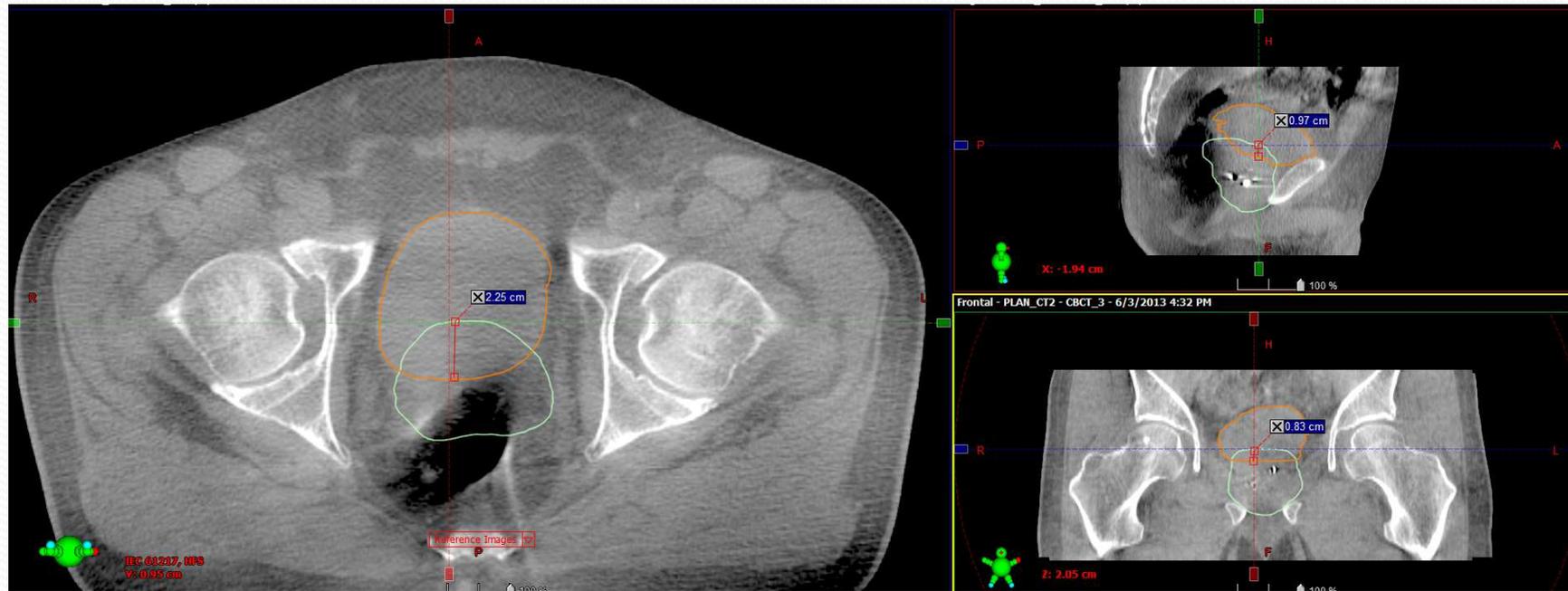


Figure: fiducial matching

Orange: Bladder

Green: PTV

The shift of 2.25 cm in transverse, 0.97 cm in sagittal, 0.83 cm in frontal

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- The dose difference between planned and delivered dose shows the greatest variation depending on the bladder filling among the fractions.
 - Although, significant differences in bladder volumes and so subsequent increases in dose were observed in two out of ten patients, the bladder doses are still within the acceptance criteria.

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- Results indicate that the bladder doses widely changes throughout the treatment,
 - The change in bladder doses partly depends on the methods used for patient positioning
 - Between the two patient positioning methods evaluated, the least amount of bladder dose variability is seen when target localization was made using intraprostatic fiducials.



Conclusion

- Large interfraction variations in bladder filling hamper accurate radiotherapy of prostate cancer.
- Since the observed mean bladder volume on CBCT images is generally larger when compared its volume on the planning CT scan, the bladder doses are still within the tolerance limits.
- However, the results of our study shows that the reproducibility of bladder filling during treatment is low.



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Thank you for listening