

Retrospective Dose Reduction Analysis Comparing Treatment Plans Using Forced Hounsfield Units (FHU) & Non-Forced Hounsfield Units (N-FHU) for Prostate SBRT Patients with Bilateral Hip Prosthetics

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PURPOSE/OBJECTIVES

Conducting a retrospective analysis of 10 patients who underwent SBRT for prostate cancer with bilateral hip prosthetics (Titanium Alloy/HU = 4105) to assess the impact of varying treatment planning techniques such as Forced Hounsfield Units (FHU) and Non-Forced Hounsfield Units (NFHU) on hip prosthetic dose

MATERIALS and METHODS

Varian Medical Systems, Inc.'s Eclipse software (Version: 16.01.00; Calculation Model: AAA_16.1.2) was employed to create 80 prostate SBRT plans. Patient inclusion criteria comprised bilateral hip prostheses and completion of Prostate SBRT treatment at our institution. Immobilization utilized a Vac-Loc system with consistent couch tops for optimization.

CT scans were reconstructed using Metal Artifact Reduction for Orthopedic Implants (O-MAR). Dose prescriptions were set at 800cGy in 5 fractions. Treatment plans included calculated beam entry through prosthetics for TrueBeam, TrueBeam with HDMLC, and Trilogy with set treatment parameters. Prosthetic Hounsfield Units set to 4105 (Titanium Alloy) and 3071 (highest CT value without forcing HU). Six dose calculation points were placed on each prosthesis, and treatment optimization focused on Prostate-PTV while adhering to departmental constraints.

Automatic NTO, hot spot limits (<110%), and MU objectives were applied. Data collection included all points at the prosthesis edge, averaged for total dose assessment across 5 fractions.

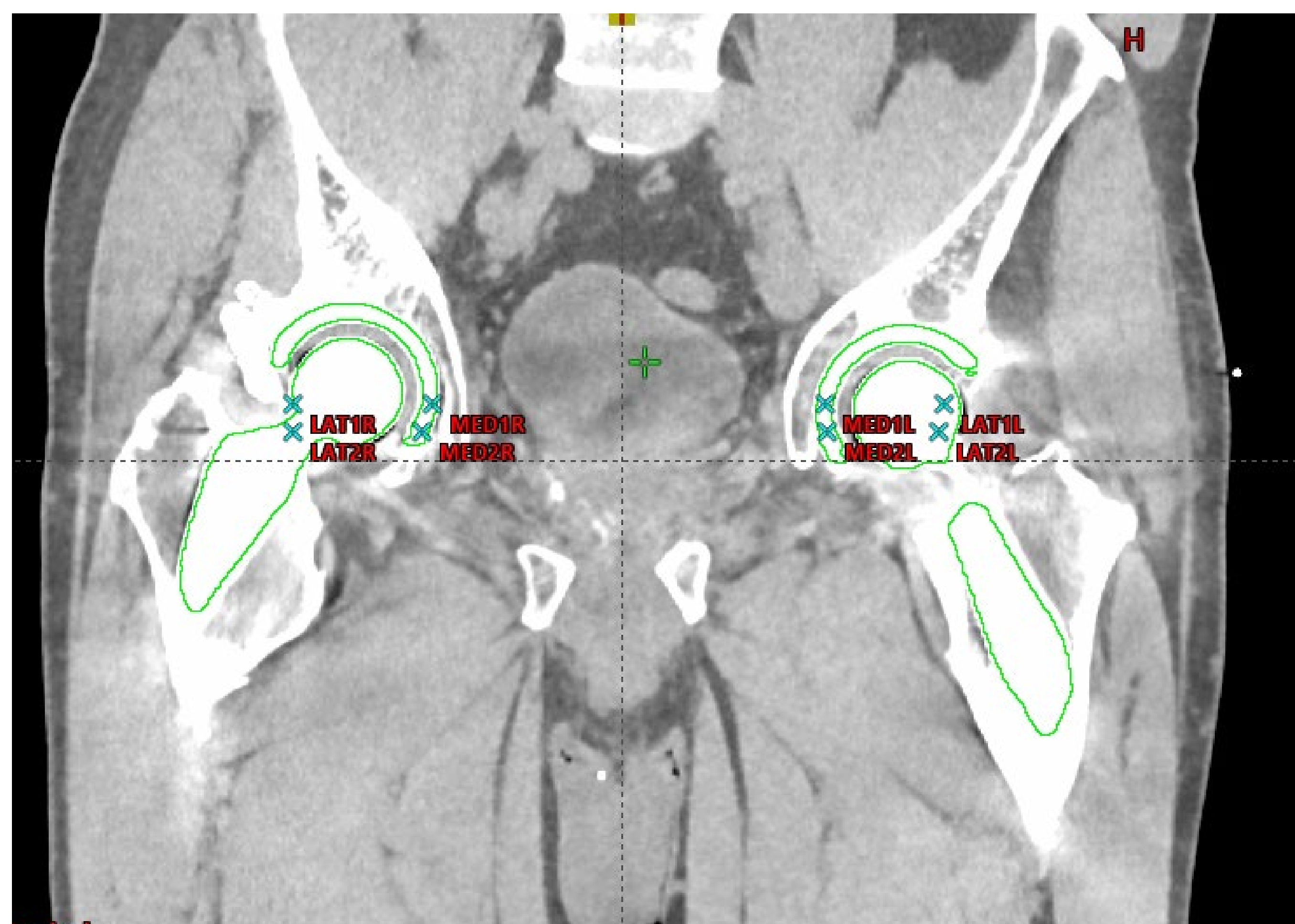


Image 1: CT Scan of Patient with Bilateral Hip Prosthetics & Reference Points

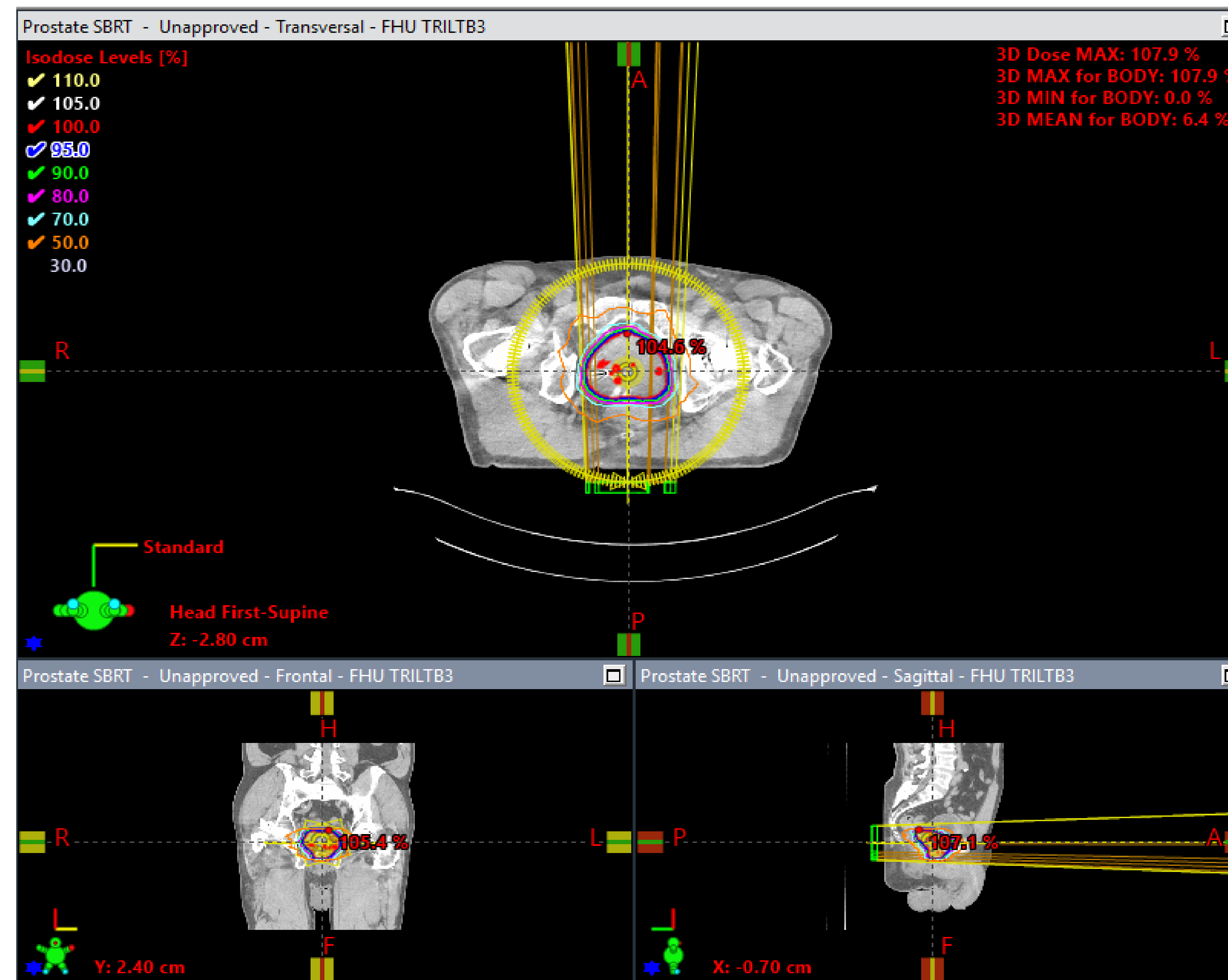


Image 2: Three Orthogonal Views of Prostate SBRT Plan

Point Location	Percentage Difference
Lateral _L	-3.8%
Lateral _R	-8.5%
Medial _L	-0.9%
Medial _R	-2.1%

Table 1: Percentage Difference of Dose to Hip Prosthesis of Forced Hounsfield Units to Not-Forced Hounsfield Units Across All Patients



Image 3: Varian Truebeam Linear Accelerator

RESULTS

Dose points were categorized into forced and non-forced Hounsfield units, both medially and laterally, and averaged. Percentage differences were calculated by dividing average doses of forced Hounsfield unit points by non-forced points, then plotted by patient. Overall, percentage differences among all patients were 3.8% for lateral left points, 8.5% for lateral right, 0.9% for medial left, and 2.1% for medial right. The presence of high-Z materials adjacent to bone and soft tissue necessitates consideration of electron density by the optimizer. However, limitations of CT scanners in capturing a wide range of HU may lead to underestimation of dose, particularly with implants exceeding 7000 HU.

CONCLUSION

The study findings highlight a greater impact of Hounsfield Unit forced correction on lateral points compared to medial ones. Additionally, notable differences were observed in the doses delivered by TrueBeam with HDMLCs, showing higher doses overall compared to TrueBeam and Trilogy machines. Further investigation is warranted, particularly when evaluating Forced Hounsfield Units (FHU) and Non-Forced Hounsfield Units (N-FHU) without beam entry through the prostheses.

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