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Commissioning and Early Clinical Experience with a Preplan-Based MRI-Assisted Radiosurgery (MARS) HDR Prostate Brachytherapy Workflow

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INTRODUCTION

Preplanning is a standard practice for MRI-Assisted Radiosurgery (MARS) LDR prostate brachytherapy; however, HDR procedures often rely on generic needle patterns rather than individualized preplans. Implementing a patient-specific HDR preplan has many benefits, it:

- Ensures the entire clinical team has a clear and consistent understanding of the intended treatment plan
- Provides an opportunity for quality assurance review and feedback prior to the procedure
- Improves procedural safety, efficiency, and overall workflow on the day of implant
- Supports optimization of target coverage and organ-at-risk sparing, leading to improved patient outcomes
- Serves as an effective educational tool for residents and faculty who are new to HDR prostate brachytherapy
- Enables practical comparison of HDR prostate brachytherapy with alternative treatment options during clinical decision-making

This study evaluates and commissions a commercially available preplanning treatment planning system (TPS), MIM Symphony HDR.

METHODS AND MATERIALS

The preplanning TPS enabled clinicians to preplan virtual needle compositions on the virtual Martinez template (Elekta) and virtual needle digitization on a pre-implant diagnostic MRI, which was resliced to reflect the dorsal lithotomy position used during needle implants. Preplanned needle digitization and contouring were exported to a standard TPS (Oncentra) for optimization and dose calculation. Data transfer integrity was validated by comparing DICOM coordinates of the needle tips and 10th dwell positions, alongside contour volumes. Martinez template and BK ultrasound were also commissioned, and the overall workflow was developed. Three patients were treated using the preplan technique with 240mm plastic needles implanted with ultrasound guidance. Pre- and post-implant dosimetry was compared

RESULTS

Technical specifications of the digital template and needles were successfully verified in both TPS platforms. Data transfer between two TPS platforms was accurate, with maximum coordinate difference < 0.2 mm for needle positions (Figure 1), and volume differences < 3% for the prostate, bladder, and rectum (Table 1). Intraoperative needle positions successfully replicated the patient-specific preplans, requiring only minor adjustments to match day-of-treatment anatomy variations. Post-implant dosimetry met or exceeded preplanned dosimetry for both the target and OARs goals, with treated target V100% within 3% of the preplanned value (Table 2).

Figure 1: Dwell positions difference (16 needles, 32 dicom locations) for two test patients between MIM HDR Symphony and Oncentra treatment planning software in preplans.

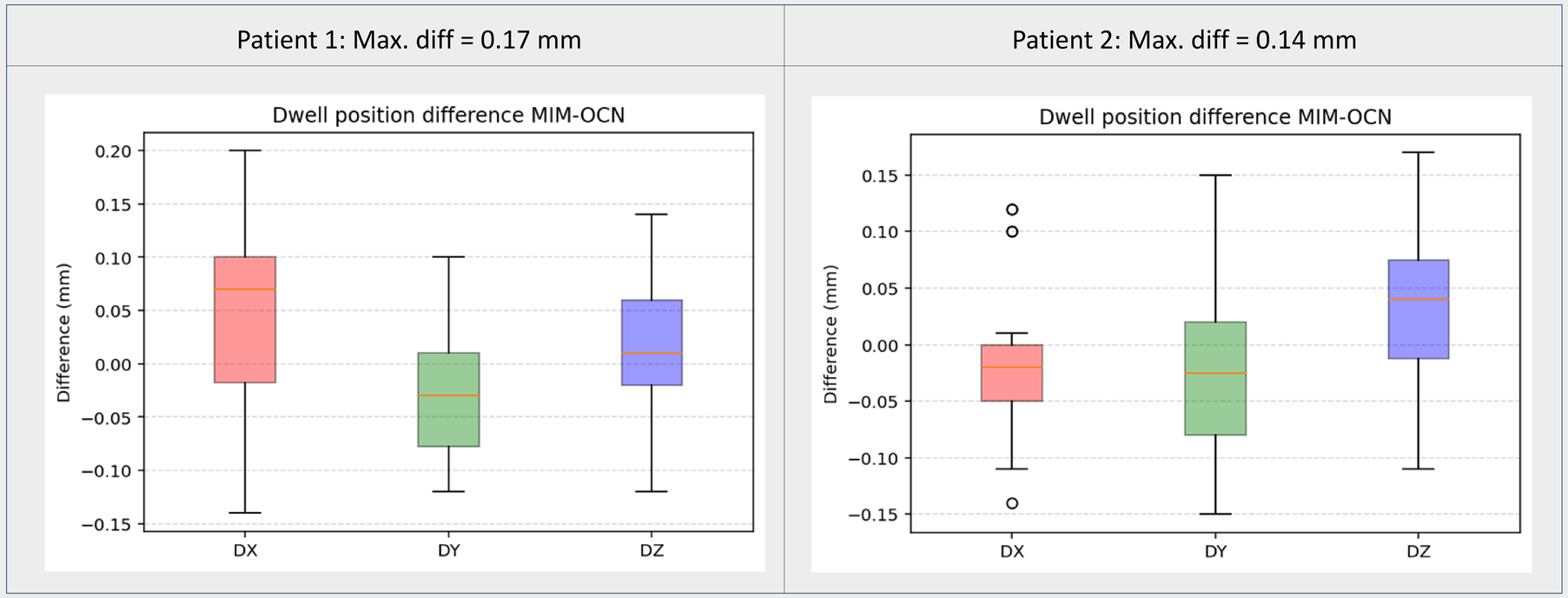

Table 2: Dosimetric comparison between preplan and pos-implant treatment plan for 3 patients.

ROI Objective/Constraint	Preplan (%)	Post-plan (%)	Difference
Target V100%	96.13	95.14	1%
	95.02	95.83	1%
	92.6	95.22	3%
Rectum D0.1cc	72.16	48.53	33%
	49.22	41.52	16%
	51.13	49.38	3%
Urethra D0cc	136	130	4%
	168	132	21%
	126	132	5%

Table 1: Contour volumes percent difference between MIM HDR Symphony and Oncentra TPS in preplans.

	MIM vs. Oncentra average vol. diff. %	
Organs	**Production server**	**Fail-safe server**
Target	0.8	0.9
Bladder	1.6	2.4
Rectum	0.6	2.3

CONCLUSIONS

A patient-specific MARS HDR preplanning workflow was successfully commissioned and deemed clinically feasible. Early clinical experience of three implants suggests improved efficiency of workflow and efficacy of dosimetry. A preplanning strategy is important because it:

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