

# Assessing the impact of site-specific KBP models on planning dosimetry

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## INTRODUCTION

**Purpose:** In this study, we explore whether site-specific knowledge-based planning (KBP) models lead to important differences in plan quality for head-and-neck (HN) patients

- Radiation therapy is offered to nearly 75% of patients diagnosed with HN cancer
- Treatment planning is often difficult and time consuming
- KBP is a tool that assists in the generation of clinically acceptable plans based on patient specific anatomy and the prescribed dose
  - KBP can increase quality and reduce variability
- We created two Emory Healthcare HN models, unilateral and bilateral, to test our hypothesis that site-specific KBP models can improve plan quality in comparison with general purpose or slightly mismatched KBP models

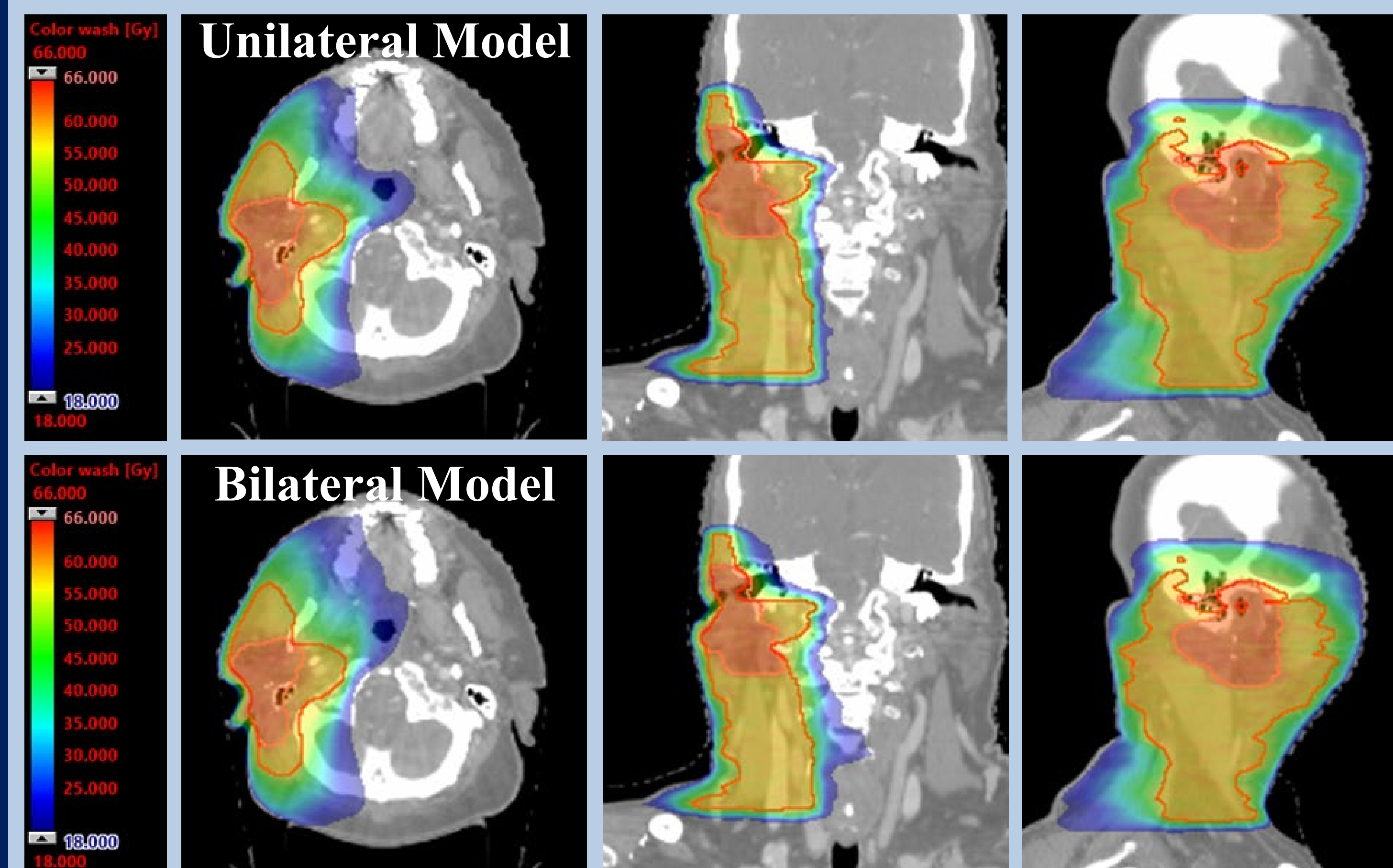
## METHODS

- One KBP model was created from prior VMAT cases that treated unilateral HN lymph nodes while a second model was created from VMAT cases with bilateral HN nodal involvement
  - Each case was unique to its respective model
- The two KBP models were applied to 60 HN test cases
  - 30 unilateral and 30 bilateral to generate 120 VMAT plans
  - Training cases were not used for testing
- Optimization objectives were derived directly from the KBP model without any planner adjustments
- Clinically relevant dose metrics were compared between plans generated from matched and mismatched models
- Paired-sample t-tests were used for statistical analysis, with the threshold for statistical significance set *a priori* at 0.05

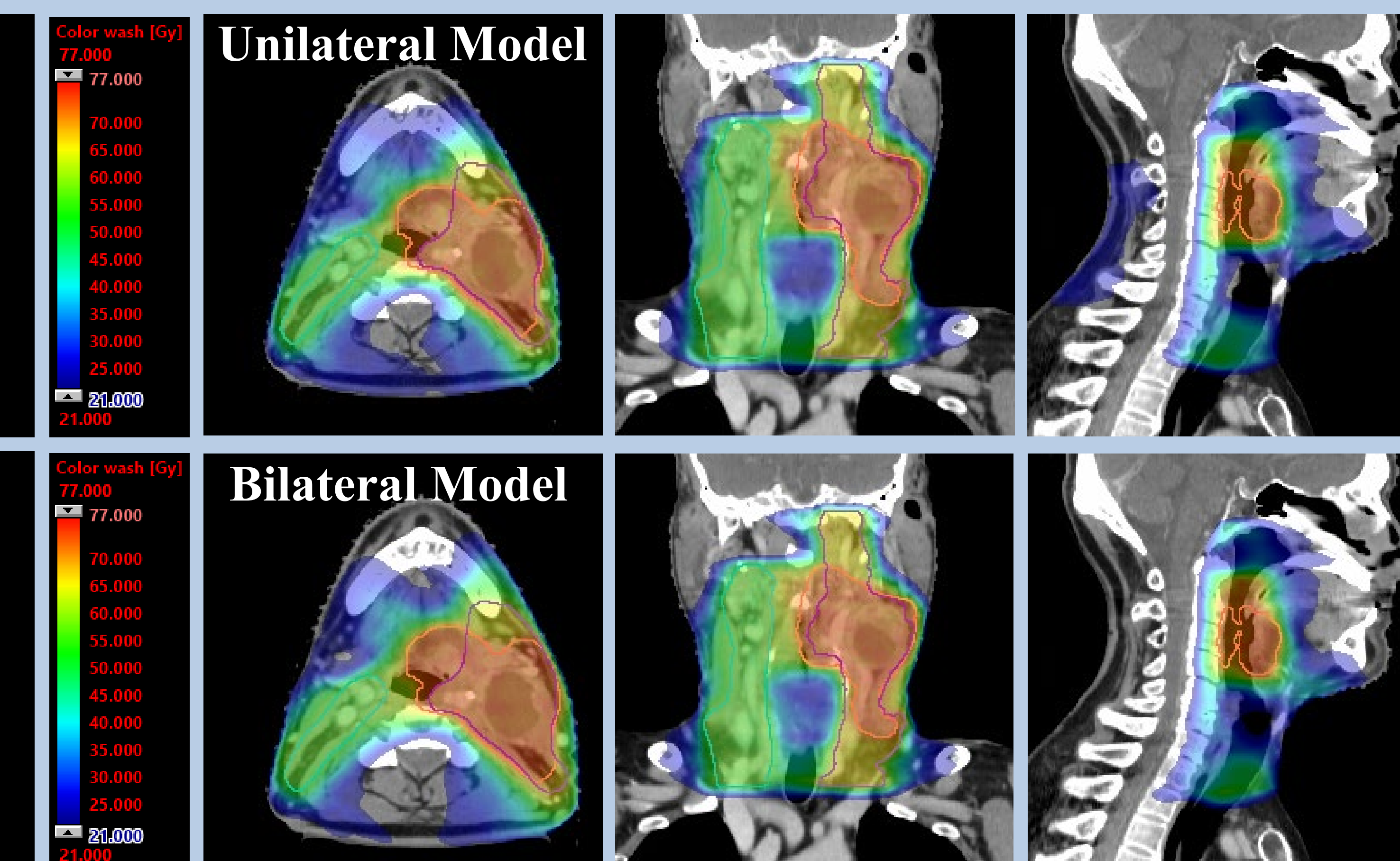
## RESULTS

- The unilateral model was superior for unilateral HN cases while the bilateral model was superior for bilateral HN cases
- For unilateral test cases, the unilateral model-generated plans had statistically significantly lower spinal cord maximum doses (12.3 Gy vs 19.3 Gy,  $p < 0.001$ ) and oral cavity mean doses (20.8 Gy vs 23.0 Gy,  $p < 0.001$ ) compared with plans from the bilateral model
- For bilateral test cases, the bilateral model created plans with significantly lower brainstem maximum doses (10.8 Gy vs 12.2 Gy,  $p < 0.001$ ) and parotid mean doses (24.1 Gy vs 25.5 Gy,  $p < 0.001$ ) compared with plans from the unilateral model
- The unilateral model-generated plans had higher monitor units

## Unilateral Case



## Bilateral Case



ID	Vol (%)	Dose (%)	Priority
<b>PTV_High</b>			
Upper	0	105	200
Upper	3	104	125
Lower	99.5	103.2	200
Lower	99.9	103.1	200
Lower	100	103	200
Lower	100	103	200
<b>PTV_Intermediate</b>			
Lower	99.5	103.2	200
Lower	99.9	103.1	200
Lower	100	103	200
Lower	100	103	200
<b>PTV_Low</b>			
Lower	99.5	103.2	200
Lower	99.9	103.1	200
Lower	100	103	200
Lower	100	103	200
<b>zPTV_Intermediate</b>			
Upper	0	105	200
Upper	3	104	125
Lower	99.5	103.2	200
Lower	99.9	103.1	200
Lower	100	103	200
Lower	100	103	200
<b>zPTV_Low</b>			
Upper	0	105	200
Upper	3	104	125
Lower	99.5	103.2	200
Lower	99.9	103.1	200
Lower	100	103	200
Lower	100	103	200

Unilateral model target objectives.

ID	Vol (%)	Dose (%)	Priority
<b>PTV_High</b>			
Upper	0	105	200
Upper	0	105	125
Upper	3	104	200
Lower	100	103	200
Lower	100	103	200
<b>PTV_Intermediate</b>			
Lower	100	103	200
Lower	100	103	200
<b>PTV_Low</b>			
Lower	100	103	200
Lower	100	103	200
<b>zPTV_Intermediate</b>			
Upper	0	105	200
Upper	0	105	125
Upper	3	104	200
Lower	100	103	200
Lower	100	103	200
<b>zPTV_Low</b>			
Upper	0	105	200
Upper	0	105	125
Upper	3	104	200
Lower	100	103	200
Lower	100	103	200

Bilateral model target objectives.

Unilateral Test Cases	Unilateral Model	Bilateral Model	p-value
MU	717.6	630.0	<0.001*
Dmax(%)	110.4	109.9	0.21
Brainstem Dmax (Gy)	8.9	9.1	0.59
Spinal Cord Dmax (Gy)	12.3	19.3	<0.001*
Oral Cavity Dmean (Gy)	20.8	23.0	<0.001*
L Parotid Dmean (Gy)	11.3	11.9	0.17
R Parotid Dmean (Gy)	18.0	18.6	0.25

Dosimetric comparison results for the 30 unilateral test cases.

\*Denotes a significant result

Bilateral Test Cases	Unilateral Model	Bilateral Model	p-value
MU	925.3	854.3	<0.001*
Dmax(%)	110.0	109.9	0.21
Brainstem Dmax (Gy)	12.2	10.8	<0.001*
Spinal Cord Dmax (Gy)	15.8	15.1	0.11
Oral Cavity Dmean (Gy)	36.7	36.7	0.99
L Parotid Dmean (Gy)	26.2	24.4	<0.001*
R Parotid Dmean (Gy)	24.8	23.8	<0.001*

Dosimetric comparison results for the 30 bilateral test cases.

\*Denotes a significant result

## CONCLUSIONS

- This study demonstrates that tailored, site-specific KBP models lead to small but significant improvements in plan quality and supports the development of distinct KBP models for specific clinical scenarios

## ACKNOWLEDGEMENTS

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## REFERENCES

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