2026 JULY 19–22 VANCOUVER, BC
JOINT AAPM | COMP MEETING

Evaluation of Skin Dose in TomoHelical TBI Virtual Bolus Across Two Treatment Planning Systems

Jackson Browne, MS[1,2]; Austin Sanders, MS[1,2]; Chulhaeng Huh, PhD[1,2];
John T Barrett, MD, PhD[1,2]; and Farshad Mostafaei, PhD[1,2]
[1]Dept. of Radiation Oncology, Augusta University, [2]Georgia Radiation Therapy Center, Wellstar-MCG Health

ABSTRACT

Purpose: This study evaluates the effect of virtual bolus (VB) thickness on skin dose in TomoHelical total body irradiation (TBI) using two treatment planning systems (TPSs): Accuray Precision and RaySearch Laboratories RayStation (RS).

Methods: Bolus materials of tissue-equivalent density are used to increase surface dose, a critical consideration in TBI. Treatment plans were generated in both TPSs using VB configurations: no VB, 0.5 cm, 1.0 cm, and 1.5 cm. A 5-mm skin contour was defined for quantitative skin dose assessment. Due to differences in optimization algorithms between the TPSs, plans were optimized to achieve comparable dose distributions and target coverage metrics. In RS, beam spoilers lining the treatment bore were modeled and evaluated as an alternative to VB. Dosimetric indices for the skin and planning target volume (PTV) were recorded and compared.

Results: Increasing VB thickness resulted in higher skin dose across all plans, with the greatest skin coverage observed for the 1.5 cm VB (V95% = 84.8% in Precision and 82.4% in RS). The mean skin dose differed between TPSs by an average of 6.25 ± 2.1cGy, with Precision consistently producing higher skin doses than RS. Despite these differences, both systems achieved comparable PTV coverage, with similar V105%, V100%, D95%, and D50% values. For skin dose metrics, Precision exceeded RS by approximately 3cGy at D98% and 5cGy at D95%. Beam spoiler modeling in RS demonstrated increased skin dose with spoiler thickness while maintaining target coverage and lower overall high-dose exposure compared to VB. In contrast, VB produced higher skin dose but also increased high-dose regions.

Conclusion: RayStation can generate TomoHelical TBI plans comparable to Precision in terms of target coverage and skin dose. Both VB thickness and beam spoilers significantly influence skin dose. Future work will include physical measurements and Monte Carlo simulations to validate TPS-based findings.

CONTACT

Jackson Browne
Georgia Radiation Therapy Center
821 St. Sebastian Way
Augusta, GA 30912
Jackson.Browne@wellstar.org

INTRODUCTION

Bolus materials of tissue-equivalent density are used to increase surface dose, a critical consideration in TBI. This study evaluates the effect of virtual bolus (VB) thickness on skin dose in TomoHelical total body irradiation (TBI) using two treatment planning systems (TPSs): Accuray Precision and RaySearch Laboratories RayStation (RS).

METHODS AND MATERIALS

Treatment plans were generated in both TPSs using VB configurations: no VB, 0.5 cm, 1.0 cm, and 1.5 cm. A 5-mm skin contour was defined for quantitative skin dose assessment. Due to differences in optimization algorithms between the TPSs, plans were optimized to achieve comparable dose distributions and target coverage metrics. In RS, beam spoilers lining the treatment bore were modeled and evaluated as an alternative to VB. Dosimetric indices for the skin and planning target volume (PTV) were recorded and compared.

CONCLUSIONS

RayStation can generate TomoHelical TBI plans comparable to Precision in terms of target coverage and skin dose. Both VB thickness and beam spoilers significantly influence skin dose. Future work will include physical measurements and Monte Carlo simulations to validate TPS-based findings.

REFERENCES

1. Gondre, M., Vallet, V., Bourhis, J., Bochud, F., & Moeckli, R. (2024, December 19). *Dosimetric comparison of M6 CyberKnife plans optimized with Precision and RayStation 12A treatment planning systems*. American Association of Physicists in Medicine. https://aapm.onlinelibrary.wiley.com/doi/pdf/10.1002/acm2.14585
2. De Martino, F., Clemente, S., Graeff, C., Palma, G., & Cella, L. (2021). Dose Calculation Algorithms for External Radiation Therapy: An Overview for Practitioners. *Applied Sciences*, *11*(15), 6806. https://doi.org/10.3390/app11156806

RESULTS

- The greatest skin coverage was observed for the 1.5 cm VB
  - **V95% = 84.8% in Precision and 82.4% in RS**
- Mean skin dose differed between TPSs by an average of 6.25 ± 2.1cGy
  - **Precision consistently produced the higher skin doses than RS**
- Both systems achieved comparable PTV coverage, with similar V105%, V100%, D95%, and D50% values.
  - **Precision exceeded RS by approximately 3cGy at D98% and 5cGy at D95%**
- Beam spoiler modeled in RS demonstrated increased skin dose with spoiler thickness while maintaining target coverage and lower overall high-dose exposure compared to VB
- VB produced higher skin dose but also lead to increased regions of high-dose

DISCUSSION

- Precision
  - **Voxel-less optimization (VOLO™Ultra)**
  - **Dose calculations are performed with a fluence-convolved broad-beam (FCBB)**
- Raystation
  - **Uses both collapsed cone convolution (CCC) and Monte Carlo (MC)**
- Comparable TBI treatment plans
  - **Identical beam geometry**
  - **Similar objective functions and dose grid**
  - **Virtual bolus reduces optimizer edge effects**
- Potential for physical measurements and MC simulation

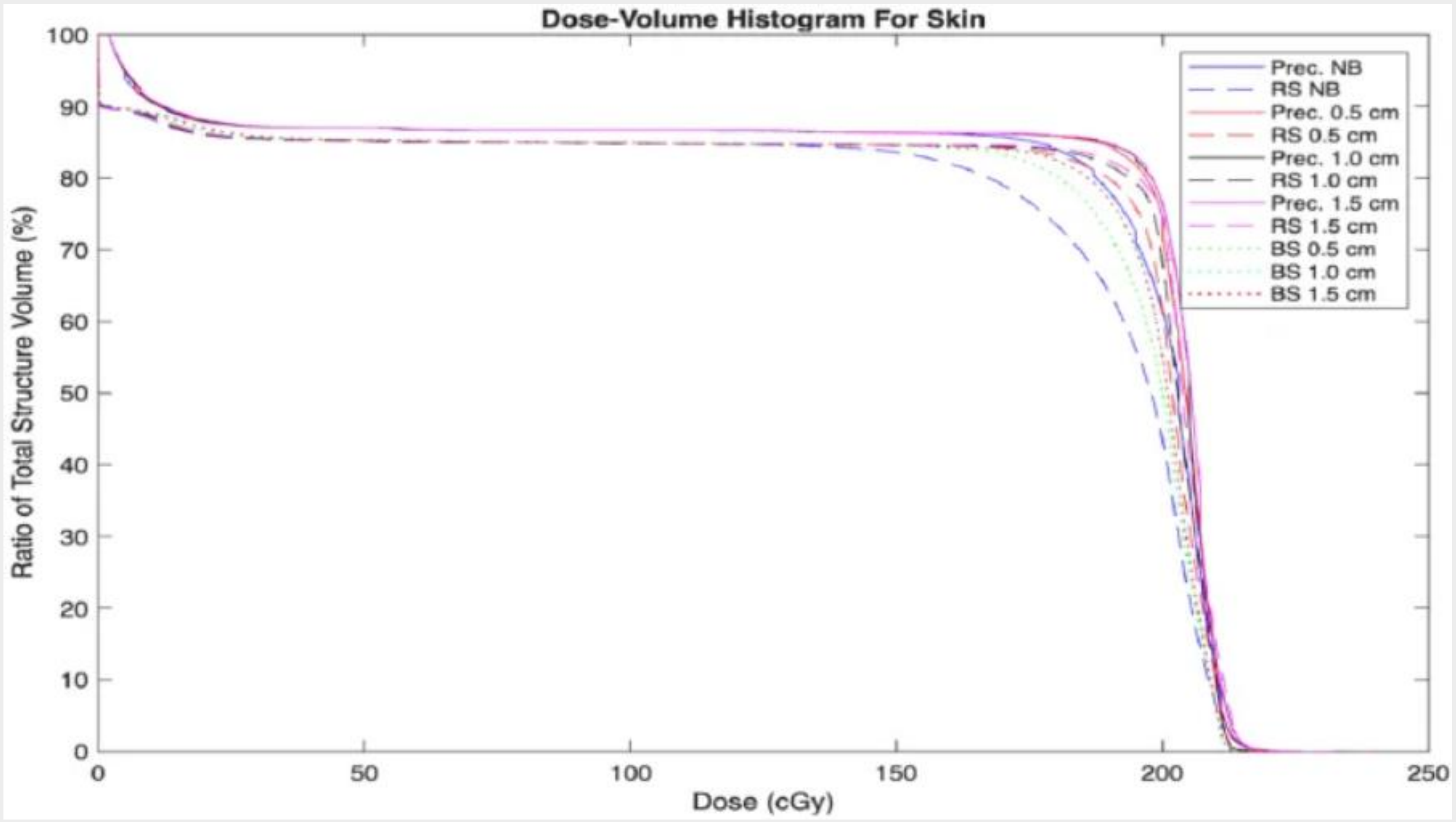

Chart 1. Dose-volume histogram (DVH) comparing skin coverage for no virtual bolus (VB), 0.5 cm VB, 1.0 cm VB, and 1.5 cm VB, in each treatment plan (Prec.) and RS. As well as 0.5 cm beam spoiler (BS), 1.0 cm BS, and 1.5 cm BS in RS

Table 1. Precsion and Raystation (RS) TomoHelical total body irradiation (TBI) plans DVH values for PTV and Skin for no VB, 0.5 cm VB, 1.0 cm VB, and 1.5 cm VB , 0.5 cm BS, 1.0 cm BS, and 1.5 cm BS

			Dose Stastitics														
TPS	Bolus & Spoiler Thickness	Structure	V105% (%)	V100% (%)	V95%(%)	V90% (%)	D98% (cGy)	D95% (cGy)	D80% (cGy)	D50%(cGy)	D2% (cGy)	D1% (cGy)	Min (cGy)	Max (cGy)	Mean (cGy)	HI	CI
Raystation	No Bolus	PTV	17.1	96.5	99.8	99.9	199	200	202	205	213	213	171	239	206	0.95	0.93
		Skin	6.5	43.4	67.7	73.5	0	0	167	198	212	213	0	236	167	N/A	N/A
	0.5 cm Bolus	PTV	13.6	95.5	99.8	100.0	199	200	202	205	212	213	170	242	207	0.95	0.93
		Skin	9.6	61.3	79.9	83.1	0	0	190	202	212	213	0	239	172	N/A	N/A
	1.0 cm Bolus	PTV	13.1	96.8	99.9	100	200	200	202	205	212	212	177	234	205	0.95	0.93
		Skin	10.8	68.2	81.7	83.9	0	0	194	203	212	212	0	232	173	N/A	N/A
	1.5 cm Bolus	PTV	15.7	98.4	99.9	100	200	201	201	205	213	214	176	240	206	0.95	0.93
		Skin	15.3	74.6	82.4	84.2	0	0	195	204	214	215	0	233	175	N/A	N/A
	0.5 cm Spoiler	PTV	18.2	96.4	99.9	99.9	199	200	200	206	212	212	174	229	206	0.95	0.96
		Skin	6.5	50.0	72.1	80.2	0	0	181	200	211	212	0	229	170	N/A	N/A
	1.0 cm Spoiler	PTV	17.7	97.0	100.0	100.0	200	201	201	206	211	212	178	229	206	0.95	0.96
		Skin	6.7	55.3	77.0	82.6	0	0	186	201	211	212	0	228	172	N/A	N/A
	1.5 cm Spoiler	PTV	14.0	96.1	100.0	100.0	199	200	200	205	212	212	178	230	206	0.95	0.96
		Skin	5.8	54.9	76.9	82.5	0	0	186	201	211	212	0	226	172	N/A	N/A
Precision	No Bolus	PTV	15.1	99	99.9	100	201	202	204	207	213	214	172	240	207	1.27	1.18
		Skin	9.8	61.1	78.2	84.1	3	5	188	203	213	215	2	229	176	N/A	N/A
	0.5 cm Bolus	PTV	14	99.1	99.9	100	201	202	204	207	212	213	168	245	207	1.24	1.19
		Skin	11.1	73.3	84.4	85.8	3	5	197	204	213	214	2	234	178	N/A	N/A
	1.0 cm Bolus	PTV	14.9	99.3	99.9	100	201	202	204	207	212	213	171	238	207	1.23	1.23
		Skin	13.1	76.4	84.8	85.9	3	5	198	205	214	215	2	236	179	N/A	N/A
	1.5 cm Bolus	PTV	15.5	99.4	99.9	100	201	202	203	204	212	213	171	242	207	1.28	1.26
		Skin	13.3	76.8	84.8	85.9	3	5	198	205	214	215	2	233	179	N/A	N/A