PO0249: Assessment of Anatomical Variation for Patient-Tailored Cervical Cancer Brachytherapy Applicator Development

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case. The mean total MRgRT treatment time from simulation through last fraction was 20 days, compared to 12.5 days for BT. The mean patient time on table per fraction with MRgRT was 2.24 hours compared to 1.6 hours/fraction for BT at our institution. The MRgRT time on table was calculated from the time of first image acquisition to end of treatment. We noted significant organ motion with MRgRT leading to re-plans, which lengthened the average time. For a typical patient undergoing a 4 fraction MRgRT boost, the billed amount was $66,306/course compared to approximately $68,560/course for a typical patient undergoing 5 fraction BT boost. The highest MRgRT acute toxicity reported was grade 2 fatigue and constipation (n= 1). There were no severe (grade 3+) acute toxicities. All acute toxicities resolved at follow up.

Conclusions: In our small case series, MRgRT provided acceptable target coverage with good OAR dosimetry utilizing the superior soft tissue delineation of MRI for contouring and daily adaptive planning. The total boost treatment time and time on table were each longer than typical BT cases at our institution, and total cost appears similar. BT boost remains the preferred modality for curative intent treatment of LACC and MIUC; however, MRgRT is a reasonable alternative in highly select patients who are unsuitable for BT.

	MRgRT		Standard T&O	MRgRT	Standard Y-Applicator
Boost Target Volume	Cervix	Cervix	Cervix	Uterus	Uterus
Age (years)	49	79	50	56	73
ECOG	0	1	0	1	1
Primary site	Cervical	Cervical	Cervical	Endometrial	Endometrial
Histology	Squamous Cell Carcinoma	Squamous Cell Carcinoma		Clear Cell	
FIGO Stage	IIIC1	IIIC1		IIIC2	
Boost Prescription	28 Gy / 4 Fx	28 Gy / 4 Fx	25 - 27.5 Gy / 5 Fx	20 Gy / 4 Fx	17 Gy / 2 Fx
Target Dose Objectives	HR-CTV D₉₀ at 28.6 Gy GTV D₁₀₀ at 33 Gy	HR CTV D₉₀ at 28 Gy IR-CTV D₉₀ at 28 Gy	HR CTV D90 >100%	HR CTV D₉₀ at 20 Gy GTV D₉₈ at 20 Gy	HR CTV D90 >100%
Delivered Target Dose (Gy total)	HR-CTV D90: 29.93 GTV D90: 32.83	CTV D90: 31.51 IR-CTV D90: 24.58		CTV D90: 20.44 GTV D98: 21.0	
OAR Dose Objectives (D2cc)	Bladder < 4.7 Gy/Fx Rectum < 3.9 Gy/Fx Sigmoid < 4 Gy/Fx	Bladder < 4 Gy/Fx Rectum < 3.4 Gy/Fx Sigmoid < 3.6 Gy/Fx	Bladder < 4 Gy/Fx Rectum < 3.4 Gy/Fx Sigmoid < 3.6 Gy/Fx	Bladder < 4 Gy/Fx Rectum < 3.6 Gy/Fx Sigmoid < 3.6 Gy/Fx	Bladder < 7.5 Gy/Fx Rectum < 7 Gy/Fx Sigmoid < 7 Gy/Fx
Mean Delivered OAR Doses (D2cc)					
Bladder (Gy/Fx)	3.97	3.55		3.31	
Rectum (Gy/Fx)	3.11	2.57		3.20	
Sigmoid (Gy/Fx)	3.23	3.41		3.27	
Bowel (Gy/Fx)	0.10	3.21		2.95	
Total Treatment Time (Days)	56	84	53	92	69.5
Total Treatment Time for Boost (Days)	11	25	12	24	13
Mean Treatment Time per Fraction (Hours)	2.5	1.7	1.5-2	2.5	2
Total Charges	*NA*	*NA*	$68,560	$66,306	$22,662
Acute Toxicity Grade	1	2		1	
Acute Toxicities	Fatigue, Pain, Nausea, Vomiting, Insomnia	Fatigue, Pain, Constipation, Weight Loss		Gas	

PO0249

Assessment of Anatomical Variation for Patient-Tailored Cervical Cancer Brachytherapy Applicator Development

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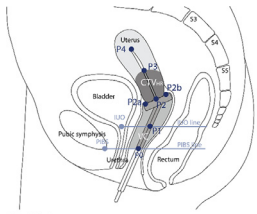
Purpose: In image-guided adaptive brachytherapy (IGABT) for locally advanced cervical cancer (LACC), standardized applicators with fixed catheter positions are currently used. Patient-tailored applicators with optimized catheter channels could improve treatment plan quality over conventional applicators with fixed catheter positions in patient cases with a challenging anatomy. The purpose of this study is to evaluate the geometry and patient variability of the distended vaginal and uterine cavity, as well as the high-risk clinical target volume (CTV_{HR}). These results will help guide catheter placement and shape modelling of patient-tailored applicators.

Materials and Methods: Between May 2021 and September 2023, a total of 90 LACC patients were included in this study. For 60 patients a pre-BT MRI scan with vaginal ultrasound gel (BT0), maximally 1 week prior to BT, and a first fraction BT MRI scan with applicator in situ (BT1) were obtained. Additionally, from 30 patients a BT1 MRI scan was available. Tree-dimensional models of the vaginal cavity and CTV_{HR} were constructed based on their delineations on T2 weighted MRI. Defined geometric features of the vaginal and uterine cavity, and CTV_{HR} were extracted. These features included the lengths and angles of the mid vagina (P0-P1), upper vagina (P1-P2), anterior cervix (P2-P2a), posterior cervix (P2-P2b), endocervical canal (P2-P3), and uterine body (P3-P4). The maximum anterior-posterior (A-P), left-right (L-R) and cranial-caudal (C-C) length of the vaginal cavity in relation to the mid vaginal axis (P0-P1), and CTV_{HR} in relation to the endocervical canal axis (P2-P3) were determined. In addition, the volumes of the vaginal cavity and CTV_{HR} were evaluated.

Results: The anatomical parameters with their corresponding results are presented in Figure 1. Introduction of a conventional applicator at BT1 fixed the angles with respect to BT0. Changes in BT0 and BT1 lengths and were not significant. Subgroup analysis showed an asymmetric CTV_{HR} of more than 10 mm to the A-P and L-R side in 10 and 8 patients respectively. Furthermore, 15 patients had a CTV_{HR}>40 ml and 26 patients had a vaginal extension of more than 10 mm. During BT1, the A-P length and L-R length at the introitus (P0) was 32 ± 11 mm and 33 ± 8 mm respectively. These measurements resulted in a ratio of P0 to maximum A-P length and L-R length of 0.7 ± 0.2 in both directions.

Conclusions: This study provides valuable quantitative insights in anatomical variations of LACC patients before and during IGABT. These insights in anatomical parameters can be used as design requirements for the development of patient-tailored applicators, aiming to enhance user friendliness, treatment quality and improving patient outcome. The outer geometry of a patient-tailored applicator should facilitate insertion through a narrow introitus whilst ensuring reliable placement at the apex. Due to the tapered form of the vaginal cavity, the utilization of a modular patient-tailored applicator is recommended. As some patients have a more extended CTV_{HR} in the A-P, L-R or C-C direction, class-based solutions may serve as a promising approach for intracavitary and interstitial catheter planning.



Variables (mean ± SD)		*BT0 (n=60)*	*BT1 (n=90)*
P0-P1	Length [mm]	28 ± 5	29 ± 5
P1-P2	Length [mm]	34 ± 10	33 ± 13
P2-P2a	Length [mm]	15 ± 7	14 ± 3
P2-P2b	Length [mm]	14 ± 6	15 ± 3
P2-P3	Length [mm]	31 ± 9	35 ± 8
P3-P4	Length [mm]	26 ± 9	28 ± 9
Anterior-posterior length	Maximum VC [mm]	44 ± 12	44 ± 4
	Maximum CTV$_{HR}$ [mm]	36 ± 10	35 ± 7
Left-right length	Maximum VC [mm]	54 ± 10	46 ± 6
	Maximum CTV$_{HR}$ [mm]	44 ± 10	47 ± 9
Cranial-caudal length	Maximum VC [mm]	69 ± 12	67 ± 14
	Maximum CTV$_{HR}$ [mm]	41 ± 11	45 ± 13
Volume	VC [ml]	53 ± 20	73 ± 21
	CTV$_{HR}$ [ml]	27 ± 23	31 ± 22

Figure 1. Anatomical parameters and results of vaginal cavity, uterine cavity and high-risk clinical target volume. Vaginal and uterine parameters are in relation to the mid vaginal axis (P0-P1), CTV_{HR} parameters are in relation to the endocervical canal axis (P2-P3).

PO0250

Development and Evaluation of a Self Paced Online Course on Vaginal Cuff Brachytherapy

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Purpose: Brachytherapy (BT) educational resources are scarce, adding to the lack of BT accessibility. The optimal methodology to fill this gap remains unknown, with traditional approaches involving hands-on patient treatment under direct supervision. Our project introduces an innovative strategy, utilizing self-paced modules that cover theory and practice. The platform simulates real-world clinical decision-making, with adaptive learning paths. This project aims to create a comprehensive course on vaginal cuff brachytherapy (VBT) and evaluate its effectiveness in enhancing BT education, as a supplement to traditional learning.

Materials and Methods: This project was screened by the institutional review board and designated as a QA. The process started with rounds of informal iterative discussions with domain experts at our institution