PO-2150 Quantitative analysis of vaginal and uterine geometry for patient-tailored BT applicator development

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Conclusion

Re-Imaging prior to dose delivery showed anatomical changes in the OARs at treatment time compared to the time of planning and this was quantifiable dosimetrically. Further investigation on more data is needed to understand these effects and allow interventions to ensure maximum target coverage and OARs sparing when planning.

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Purpose or Objective

The currently used applicators for locally advanced cervical cancer (LACC) brachytherapy (BT) do not optimally align with individual patient anatomy and have fixed catheter positions and angles limiting treatment plan conformity. Patient-tailored applicators with optimally planned catheter channels could be the solution for this problem. To develop patient-tailored applicators, and to create a representative data set for safety tests and quality management of the patient-tailored applicators, data on the dimensions of the distended vaginal and uterine shape is required. In previous studies, magnetic resonance imaging (MRI) has been successfully used to acquire data on the shape and dimensions of the vaginal cavity and uterus in a healthy population. However, little is known about the distended geometry of LACC patients after concomitant external beam radiation therapy and chemotherapy. Therefore, the aim of this study is to evaluate the vaginal and uterine geometry distended with ultrasound gel in LACC patients.

Materials and Methods

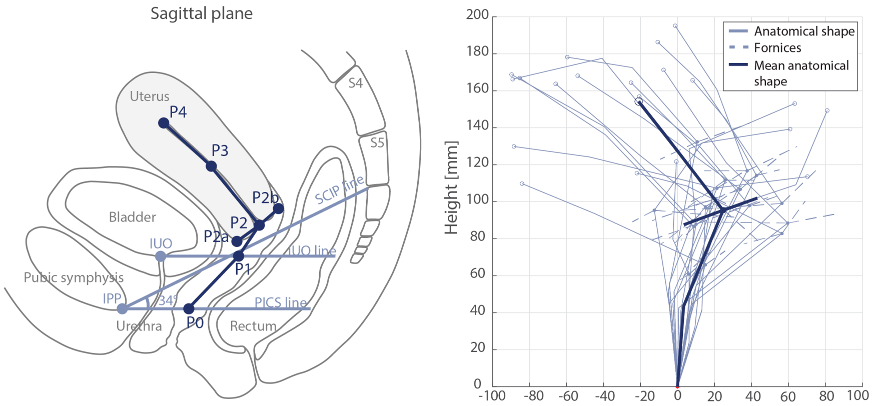
In total 20 pre-BT MRIs of LACC patients with ultrasound gel inserted in the vaginal cavity were included. The pre-BT MRIs were taken approximately one week before BT treatment. For analysis, the orientation of the MRIs was corrected based on the Pelvic Inclination Correction System (PICS). A set of parameters describing the vaginal and uterine geometry was selected (Figure 1a). The lengths and angles of mid vagina (P0-P1), upper vagina (P1-P2), anterior cervix (P2a-P2), posterior cervix (P2-P2b), endocervical canal (P2-P3), and uterine body (P3-P4) were determined. Furthermore, the left-right (LR) width at point P0, P1, and P2 were evaluated. In addition, frequency distribution maps of the vaginal cavity were made based on 3D models of the delineated MRIs.

Results

In Figure 1, the lengths and angles between the vaginal and uterine segments are depicted. The LR width (mean ± SD) was 22 ± 7 mm, 35 ± 8 mm, and 34 ± 16 mm at P0, P1, and P2 respectively. In Figure 2, frequency distribution maps of the 3D models of the vaginal cavities are depicted. The mean volume of the 3D models was 48 (range: 12-69) cm^3.

Conclusion

In this study the distended vaginal and uterine geometry was evaluated in LACC patients. The large inter-patient variation in length, angle, and width of different sections of the vaginal cavity suggests a patient-tailored design, especially in the top part of the vaginal cavity. The largest variation was seen in the region P2-P4 as indicated by the length of P2-P3, the width at P2, the angle in P3-P4, and the frequency distribution maps. The evaluated parameters and frequency distribution maps are now available and can be used as design parameters and for safety and quality assessment of the patient-tailored applicators for LACC BT.



1a. 1b.

1c.

Segment	Length (mean ± SD) [mm]	Angle (mean ± SD) [°]
P0-P1	27 ± 6	88 ± 6
P1-P2	37 ± 9	72 ± 17
P2a-P2	15 ± 8	47 ± 18
P2-P2b	13 ± 6	130 ± 28
P2-P3	33 ± 11	123 ± 36
P3-P4	28 ± 7	123 ± 53

Figure 1. *Vaginal and uterine geometry based on defined parameters.* ***1a.*** *Sagittal view of the vaginal cavity and uterus with anatomical points P0: Vaginal cavity at the height of the inferior pubic point (IPP); P1: Vaginal cavity at the height of internal ureteral ostium (IUO); P2: External ostium; P2a: Anterior cervix point; P2b: Posterior cervix point; P3: Internal ostium; P4: Internal uterine fundus.* ***1b.*** *Results of the patient data schematically depicted in PICS coordinates and normalised at P0. The purple lines show the results of 20 patients, with the filled dots showing the location of P2 and the open dots the location of P4. The blue line shows the mean shape, with the filled dot showing the location of P2 and the open dot the location of P4.* ***1c.*** *Length and angle between segment (mean ± SD). Angles defined are in relation to the x-axis, except the anterior and posterior cervix lines P2a-P2 and P2-P2b which are in relation to line P1-P2.*

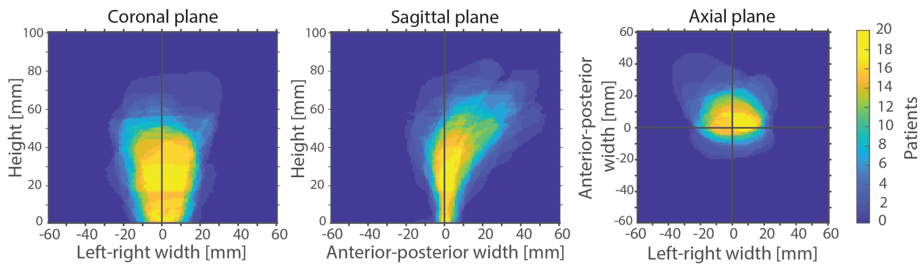


Figure 2. *Frequency distribution maps of the vaginal cavity of 20 patients at the mid-coronal, mid-sagittal, and axial plane at the height of 40 mm with the introits at the height of the inferior pubic point as origin.*

PO-2151 clinical outcomes of using 3D-printed applicators for HDR brachytherapy in gynecological malignancy

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Purpose or Objective

Brachytherapy plays an important role as the mainstay of treatment in several gynecological malignancies and image guided adaptive brachytherapy (IGABT) is considered the standard of care. The use of appropriate applicators is the key to achieve an adequate dose coverage to high-risk clinical target volume (HR-CTV). However, some patients cannot be applied with standard applicators due to the anatomy or tumor especially patients with recurrent tumor. 3D printing technology was adopted in high-dose-rate (HDR) brachytherapy treatment to create customized applicators for those patients in Siriraj hospital since 2021. This study was aimed to investigate the clinical outcome and toxicity in gynecological cancer patients treated with IGABT by using 3D-printed applicators.

Materials and Methods

14 patients with gynecological cancer, both primary and recurrent patients treated with in-house 3D-printed applicators during 2021-2022 were retrospectively reviewed. Staging for each malignancy was based on FIGO 2018. Timing and pattern of response after treatment was reported and Kaplan-Meier estimates at 1 years were analyzed for relapse-free survival, distant metastasis-free survival, progression-free survival, and overall survival. The actuarial rates of acute and late genitourinary (GU), gastrointestinal (GI), skin and mucosa toxicity were reported.