of rotation is exhaustively searched on a grid of 9 different points separated by 1cm from the center of the insertion area (Figure 1b). For the needle angulation, the method by Poulin (2013) for parallel needle positioning was adapted as follows: a heuristic is determined by projecting the planning target volume (PTV) from the center of rotation into a transverse plane and k-means clustering on the indices of the latter surface is applied (Figure 1c). The dwell time is determined by the resolution of linear equations following a similar method described by Goldman (2009) for external beam radiotherapy, called Fast Inverse Dose Optimization (FIDO). To test this optimizer, a planning study for focal prostate brachytherapy was performed. The optimal parameters were determined to obtain the desired coverage (PTV D95 of 19 Gy) without exceeding the constraints of the organs at risk (D10% urethra of 21 Gy, D1 cc bladder and rectum of 12 Gy). The dose distribution was calculated on 10 patients (PTV volumes ranged from 8,5cc to 23,3cc with a median of 16,1cc) for 2, 4, 6, 8, 10, 12 and 14 needles by using the earlier mentioned constraints as input.

Results: The average coverage (D95 of PTV) and the dose on the organs at risk (D10% urethra, D1cc of bladder and rectum) for all 10 patients are depicted in Figure 1d. The quality of the dose plan increases with the number of needle insertions. On average, a clinical acceptable plan is already reached by using four needle insertions. The complete optimization workflow took less than 20 minutes on a PC with a 3.10GHz Intel® CoreTM i5-2400 processor and 8GB RAM using MATLAB R2013a.

Conclusions: The efficacy of the automated optimization tool was demonstrated for focal HDR prostate brachytherapy with divergent needles. On average, clinically acceptable plans were achieved using 4 needles or more.

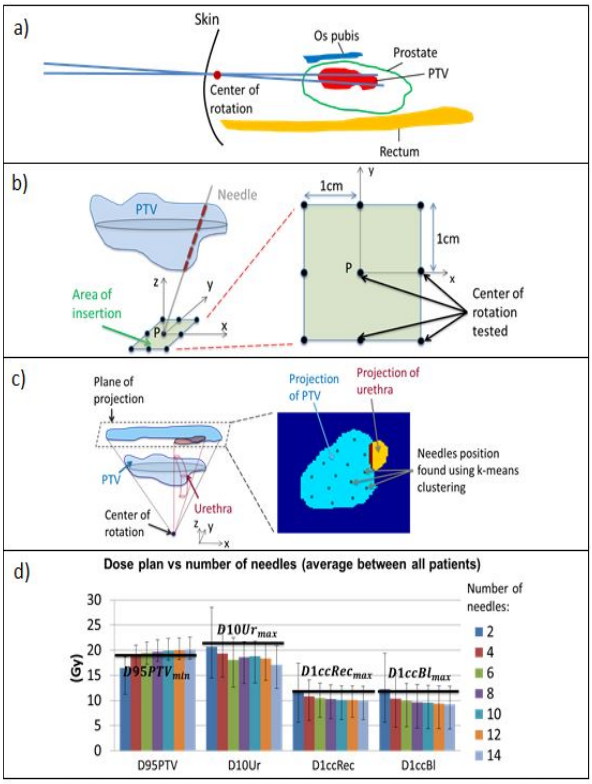

Figure 1: a) Schematic depiction of HDR brachytherapy with divergent needles and one point of rotation, b) Grid used to exhaustively search the most optimal location of the center of rotation, c) Determination of the heuristic for the angulation of the needles, d) Average coverage (D95 of PTV) and the dose on the organs at risk (D10% urethra, D1cc of bladder and rectum) for all 10 patients for a different number of needle insertions. The vertical lines represent the range. The clinical constraints are presented by the black horizontal solid lines

PD-0180

Use of 3D-ultrasound for cervical cancer brachytherapy : an imaging technique to improve contouring

P. St-Amant[1], W. Foster[1], M.A. Froment[1], P. Noel[1], S. Aubin[1], L. Beaulieu[1]
[1]*CHU de Quebec, Radiation Oncology, Quebec, Canada*

Purpose/Objective: To determine whether a real-time 3D-ultrasound (3DUS) imaging improves brachytherapy structure delineations for cervical cancer.

Materials and Methods: MRI, CT, 3DUS (Clarity AutoScan, Elekta, Montreal) and CT-3DUS fusion were all used for imaging the structures of interest (HR-CTV, cervix, uterus and rectum/sigmoid) for cervical cancer brachytherapy treatments of 8 consecutive patients. MRI images were acquired prior to brachytherapy following EBRT. 3DUS was performed simultaneously to the CT planning in the treatment room. Fusion between 3DUS and CT was performed on the Clarity workstation and the contours were traced using the OncentraBrachy planning system (Elekta). Coutouring was done by 3 physicians: 2 radiation oncologists (RO1 and RO2) and 1 diagnostic radiologist (DR) specialised in gynaecology. MRI contours traced by the DR were used as the reference set even though the applicators were not yet in place. The cervix and the HR-CTV were contoured three times by the DR to validate the stability of the reference. The absolute volumes and the transverse and longitudinal dimensions of the HR-CTV were compared with the reference for each imaging modality and physician.

Results: As expected the CT volumes are larger than MRI (Table 1). The MRI contours of the DR and the ROs are significatively larger than the intra-observer variability. The difference comes from the fact that ROs include treatment considerations, which is not the case with the DR. The 3DUS volumes are closer to the MRI volumes for each physician, but standard deviations are the largest (32% to 42%). CT-3DUS fusions keep the benefit of 3DUS alone for volume denifition while reducing significantly the variability for each physician. The variation in longitudinal dimension of the contours was found to have the largest impact on both inter-observers and inter-modalities differences in volumes.

Table 1: The mean and standard deviation of the difference of the contours compared to the MRI reference in percentage. The results are shown for the absolute volumes on each imaging modalities for the 3 physicians

	DR	RO1	RO2
MRI	0 (11)	-44 (13)	-34 (16)
CT	17(29)	-16 (19)	-11 (11)
3DUS	8 (39)	-26 (32)	-22 (42)
CT-3DUS	8 (9)	-25 (21)	-19 (25)

Conclusions: Generally, 3DUS allows for contours closer to MRI, but offers little information on the OARs. The CT-3DUS helps to get that extra information and offers, in axial slices, contours closer to MRI in all cases for the ROs compared to the CT alone. The learning curve of 3DUS could also explain the large standard deviation seen. This technology is promising and requires further investigation to determine its usefulness in treatment planning.

PD-0181

Image-guided adaptive brachytherapy for cervix cancer: higher target dose by increasing planning aim

A. Li[1], L.H. Djupvik[1], K. Bruheim[2], E. Nakken[2], K. Skipar[2], T.P. Hellebust[1]
[1]*DNR - Norwegian Radium Hospital, Department of Medical Physics, Oslo, Norway*
[2]*DNR - Norwegian Radium Hospital, Department of Oncology, Oslo, Norway*