First Report for a New Pd-103 Line Source for Prostate Brachytherapy

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Background and Objective

LDR brachytherapy typically relies on loose or stranded isotope whose dosimetry is characterized as point sources. A polymer encapsulated ^{103}Pd source with a unique linear radioactive distribution may provide a useful refinement on prostate brachytherapy. A feasibility study was performed in a small cohort to assess the pre and post implant dosimetry trends, the ease and efficiency of use, and the patient side effects.

Methods

With IRB approval, volunteers with early prostate cancer were implanted at one of 2 centers. Implants were preplanned using the CivaString ^{103}Pd and VariSeed or Brachy-Vision treatment planning software. Implantation was performed using needles pre-loaded with CivaStrings as ordered at one of two centers: Arizona or New York. The planned prescription dose was 125Gy for monotherapy and 100Gy when given as a boost. Post implant dosimetry was performed based on CT images obtained at 3-6 weeks and are reported in percentages to account for differences between boost and monotherapy prescription doses. The number of needles required for adequate coverage was a primary endpoint, With secondary endpoints including full dosimetry parameters, active length of source, and reported ease of use.

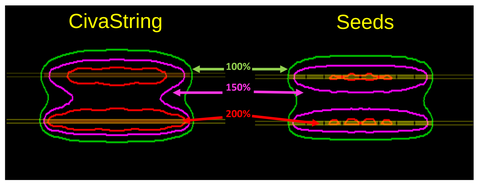


Figure 1: Isodose distribution (at 100%, 150%, and 200% of prescription) is shown for 2 adjacent line sources compared to identically spaced seeds. Activity is held constant with 4 U/cm for line sources and 2 U/seed with sources placed end to end. Note that due to differences in anisotropy, the dose between line sources is higher and thus greater spacing could be used without compromising the prescription isodose.

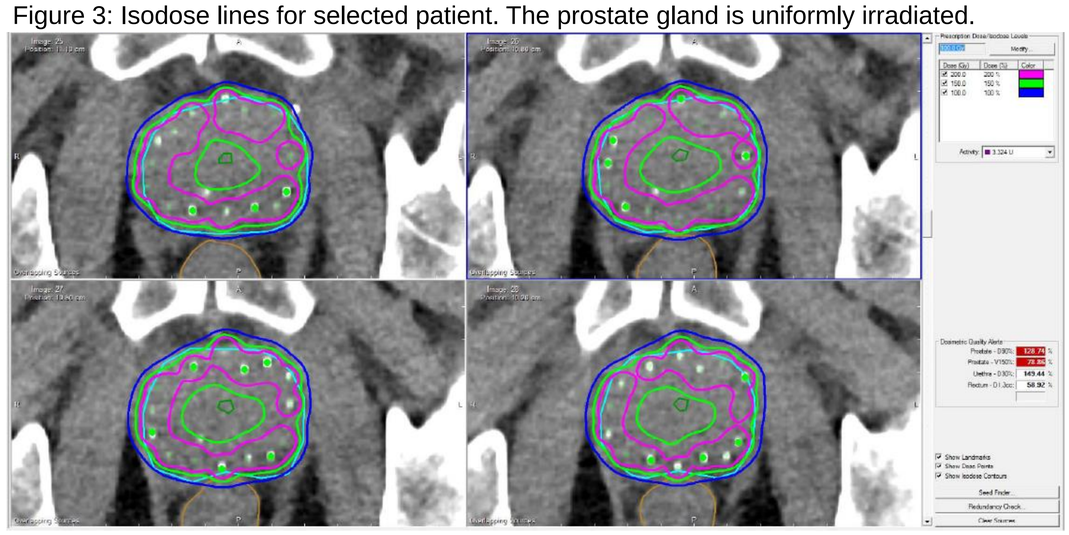
Figure 2: A schematic of the line source is shown in blue, with radiographic markers imbedded. For the study, sources were utilized in lengths from 1 cm to 6 cm.

Results

Table 1: Patient characteristics

Variable	Patient Data
n	21
Monotherapy	9
Boost	12
# Needles Planned	14-25 (median 17)
Prostate Sizes	20-100cc (median)
Cases <= 17 needles	12 (66.7%)

Figure 3: Isodose lines for selected patient. The prostate gland is uniformly irradiated.



Planning was consistent between centers with mean D90% and V150%, 124% and 66% (AZ) and 126% and 78% (NY). One month post implant dosimetry was available for 18 patients.

Table 2: Planning and Post-operative dosimetric parameter values for patient prescribed **125 Gy** monotherapy and **100 Gy** combined therapy.

125 Gy			100 Gy		
Parameter	Pre-Op	Post-Op	Parameter	Pre-Op	Post-Op
Prostate Size (cc)	**35.11**	**36.47**	Prostate Size (cc)	**48.28**	**46.87**
V150% (%)	**69.0%**	**59.1%**	V150% (%)	**78.2%**	**73.5%**
V100% (%)	**98.4%**	**88.6%**	V100% (%)	**98.1%**	**91.9%**
D100% (%)	**68.8%**	**51.5%**	D100% (%)	**62.5%**	**44.5%**
D90% (%)	**125.1%**	**101.7%**	D90% (%)	**127.5%**	**108.1%**

Figure 4: The number of planned needles and prostate sizes ranged from 15 to 25 and 20 to 100cc, respectively. The prescription dose 125 Gy (blue) or 100 Gy (red) did not impact the needle number. Nine of 13 cases required 17 or fewer needles.

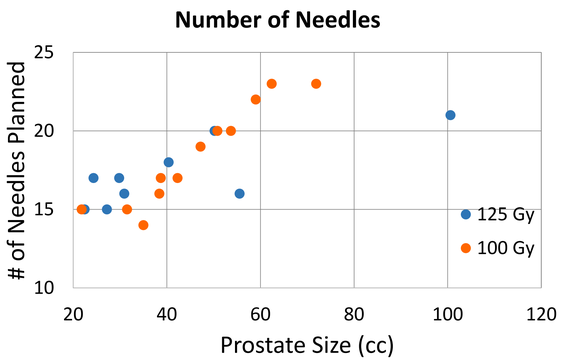


Figure 5: The percent difference between the post implant and pre-plan volume was typically less than 10% change. The very low prostate volume change indicates minimally swelling.

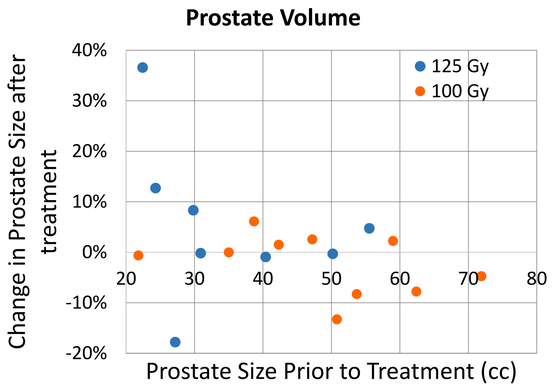


Figure 6: For monotherapy (blue markers), the total activity ranged from 129.5-261.8U; for boost (red markers), activity ranged from 92.4-244.8U. This allows for the generation of a nomogram for this line source at both prescription dose levels.

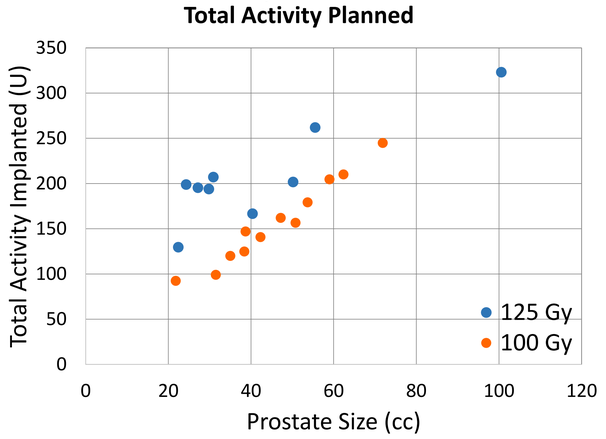
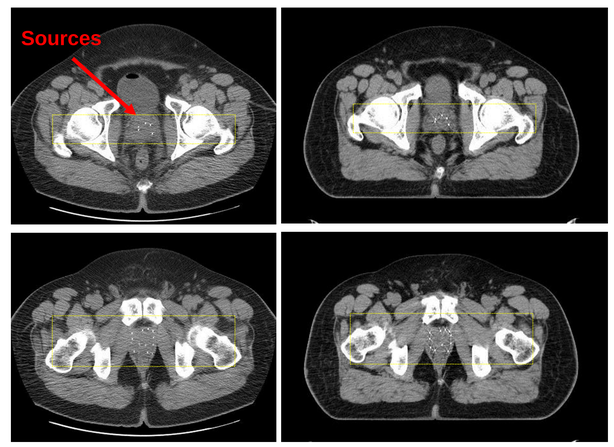


Figure 7: Comparison of the location of the sources on day of implant (left column) to 30 days post implant (right column). Sources appear as white spots in the prostate gland. Note the location of the sources with respect to the boney anatomy does not change between the day of implant and 30 days post.



Conclusions

An initial experience with this new line source is presented. Excellent implants across a range of gland sizes were accomplished. Prostate volume changes were minimal suggesting minimal swelling using the linear sources. Good dosimetry is achieved for both preplans and eventual implants. Using a line source, the number of needles required per patient is less than that reported with standard brachytherapy sources[4]. Intraoperative ease of use is good. The pre and post implant IPSS difference for these patients is in line with scores for patients treated with other LDR sources. With a line source, fewer needles are required but follow up is ongoing for this study to characterize clinical benefits.

Acknowledgements

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References

1. Davis, et al. *Brachytherapy* 2012 vol. 11, pp 6-19.
2. Rivard, et al. *Med Phys* 2014 vol 41.
3. Reed, et al. *Brachytherapy* 2014 vol. 13, pp 657-667.
4. Merreck, et al. *Brachytherapy* 2005 vol. 4, pp 241-251.