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Florida Atlantic University

Charles E. Schmidt College of Science

Immobilization Devices in High Dose Rate Brachytherapy

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Physics/Medical Physics(MSMP); Florida Atlantic University

High dose rate (HDR) brachytherapy is a highly localized mode of radiation therapy that also has a very sharp dose fall-off. Thus one of the most important parts of the treatment is the immobilization. The smallest movement of the patient can result in a miss of a large part of the tumor to be treated.

The purpose of this study is to revise most of the HDR types of treatments with their applicators and their localization challenges. Since every millimeter of misplacement counts the study will look into the necessity of increasing the immobilization for each type of applicator.

The study took over 200 treatment plans generated by the treatment planning system (TPS) looking into the applicator's placement in regard to the organs at risk (OR) and analyzed all possibilities of motion for each applicator trying several accessories to improve the localization and prevent motion before and during the treatment delivery.

Many of the present immobilization devices produced for external radiotherapy can be used to improve the localization of HDR applicators during transportation of the patient and during treatment.

This study data suggest that an improvement of the immobilization devices for HDR is absolutely necessary. Developing new immobilization devices for the applicators like Miami or Leipzig is recommended.

Motion Challenges in High Dose Rate (HDR) Brachytherapy

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Purpose

The purpose of this study is to investigate the dose variations at certain points of interest (POIs) in High Dose Rate (HDR) Brachytherapy. The focus of this study is on the treatment applicators and their localization challenges. Since every millimeter of misplacement counts, this study will look into the necessity of increasing the immobilization for each type of applicator.

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Materials & Methods

- The study took 136 treatment plans generated by the treatment planning system (TPS) looking into the applicator's placement in regard to the organs at risk (OAR) and analyzed possibilities of motion for each applicator.
- Measured the dose variations in the range of +/- 1mm from border of the points of interest

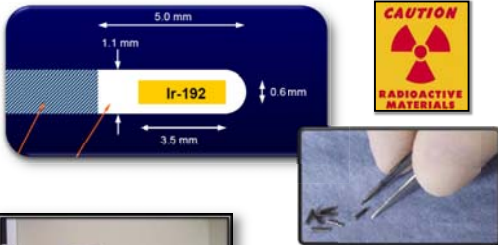
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HDR

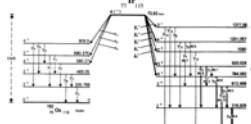
- High dose rate brachytherapy is a highly localized mode of radiation therapy that has a very sharp dose gradient.
- Sealed source (¹⁹²Ir) is placed inside or in contact with a tumor to provide a high dose to the tumor while sparing the normal tissue.
- The smallest movement of the patient or applicator can result in dose variation to the surrounding tissues as well as to the tumor to be treated.

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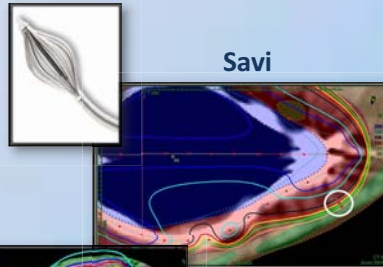
Remote Afterloader



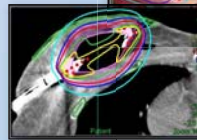
- ¹⁹²Ir Source
- One Cable Check
- 18 Channels
- Treats Prostate, Breast, Cervix, Head and Neck, Brain, Bladder, Esophagus,



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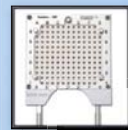
Savi



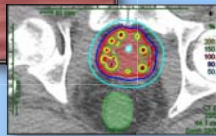
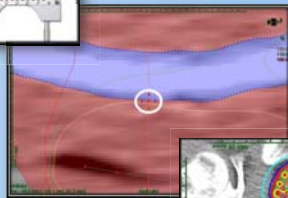
Legend

A/P: Anterior/Posterior
S/I: Superior/Inferior
CA: Central Axis
OA: Off Axis
ROT: Due to Rotation
Possible Medical Event (>20%)
Possible Recordable Event (>10%)

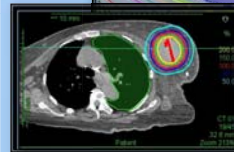
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Prostate



Contura/MLM



Results

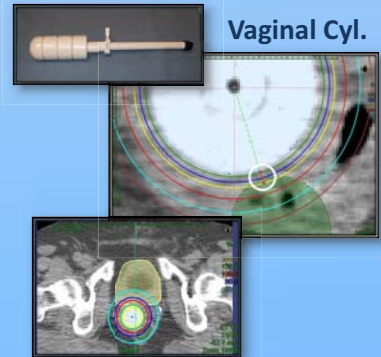
	Dose Variation	Avg. Variation
<u>Prostate</u>	0.01% - 11.86%	A/P: 3.13%
		S/I: 1.18%
<u>Miami</u>	0% - 27.69%	CA: 15.77%
		OA: 16.84%
		ROT: 3.21%
<u>Vaginal Cyl.</u>	11.30% - 34.02%	19.40%
<u>T&O</u>	0.01% - 14.57%	CA: 10.85%
		OA: 10.70%
		ROT: 0.64%
<u>Contura</u>	10.93% - 11.84%	11.39%
<u>Savi</u>	3.76% - 24.16%	13.31%
<u>MLM</u>	8.13% - 19.22%	13.24%

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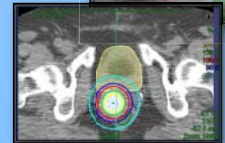
Summary

- Every millimeter counts.
- This study assumes a small displacement (i.e. +/- 1mm; 5° and 15° rotation); The reality of the processes involved will usually result in a much larger displacement than those used in this study.
- This study data suggests that an improvement of the immobilization devices for HDR is absolutely necessary.
- Developing new immobilization devices for each HDR treatment and applicator is recommended.
- Many of the present immobilization devices produced for external radiotherapy can be used to improve the localization of HDR applicators.
- This project is still in progress .

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Vaginal Cyl.



References

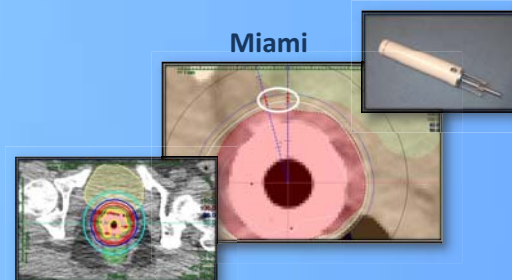
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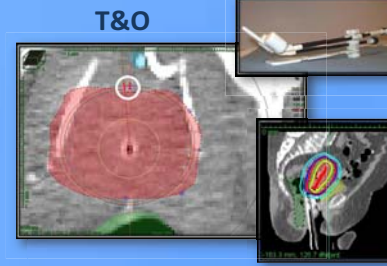
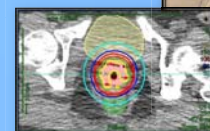
Acknowledgements

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Miami



T&O

