Debate III: For prostate radiation treatments a non-ionizing imaging system is a better IGRT

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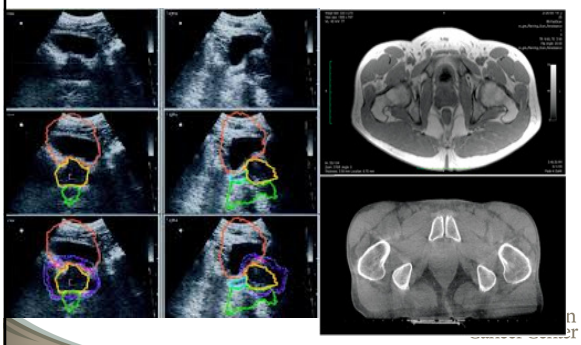
AAPM-SEFM-AMPR Joint Symposium

August 1, 2012

Twyla Willoughby, M.S.

Ultrasound & MRI localization



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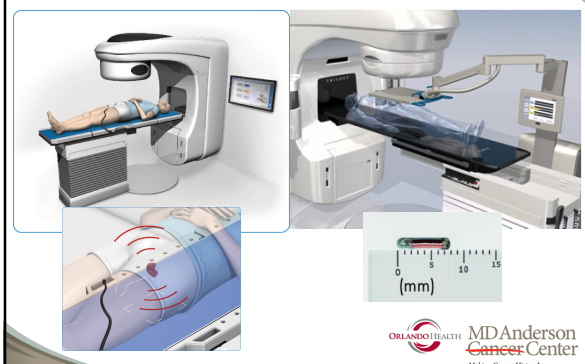
EM localization - Calypso® & RayPilot®



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Advantages of non-ionizing IGRT system

- No added radiation exposure
- Accurate
- Based on prostate position (markers in prostate/prostate)
- EM systems are non-ambiguous – no interpretation needed
- MRI has superior soft tissue anatomy
- Quick alignment
- Quick Intra-Fraction motion management
- Decreased margins

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Advantage: Accurate & non-ambiguous

A comparison of radiographic techniques and electromagnetic transponders for localization of the prostate

Foster, R, Pistenmaa D, Solberg, T.

Localization of the prostate using electromagnetic transponders agrees well with radiographic techniques and each technology is suitable for high precision radiotherapy. This study finds that there is a more uncertainty in CBCT localization of the prostate than in 2D orthogonal imaging, but the difference is not clinically significant.

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MRI: Better Visualization + real-time monitoring (ViewRay)

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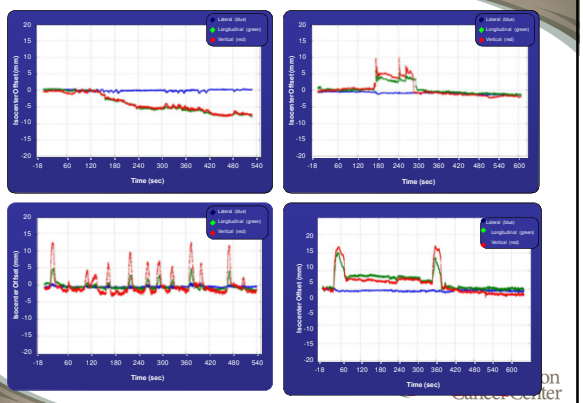
Advantage: Intrafraction motion management

Intra-fraction prostate displacement in radiotherapy estimated from pre- and post-treatment imaging of patients with implanted fiducial markers

Tomas Kron[1, 2, *], Jessica Thomas[3], Chris Fox[3], Ann Thompson[2], Rebecca Owen[2], Alan Herschtal[4], Annette Haworth[1, 2], Keen-Hun Tai[1, 5], Farshad Foroudi[1, 2]

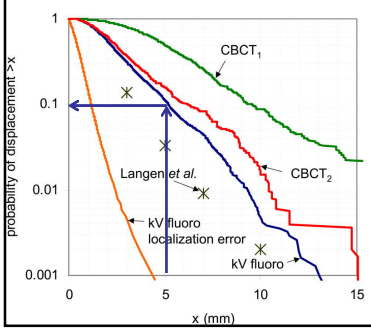
Intra-fraction motion of the prostate gland appears to be a limiting factor when considering margins for radiotherapy. Given the variation between patients, a uniform set of margins for all patients may not be satisfactory when high target doses are to be delivered.



Intrafraction Motion - Frequency

PROSTATE INTRAFRACTION MOTION ASSESSED BY SIMULTANEOUS KV FLUOROSCOPY AT MV DELIVERY I: CLINICAL OBSERVATIONS AND PATTERN ANALYSIS

Justus Adamson, PhD[1,2,3] and Qiuwen Wu, PhD[1,3]
William Beaumont Hospital, Wayne State University, Duke University Medical Center



Displacement >5mm occurs about 10% of the time.

Intra-Fraction motion – Magnitude

Prostate Intrafraction Translation Margins for Real-Time Monitoring and Correction Strategies

Dale W. Litzenberg, James M. Balter, Scott W. Hadley, Daniel A. Hamstra, Twyla R. Willoughby, Patrick A. Kupelian, Toufik Djemil, Arul Mahadevan, Ahirish Jani, Geoffrey Weinstein, Timothy Solberg, Charles Enke, Lisa Levine, and Howard M. Sandler

Continuous electromagnetic monitoring and automated correction have the potential to reduce prostate margins to 2-3 mm, while ensuring that a higher percentage of patients (99% versus 90%) receive a greater percentage (99% versus 95%) of the prescription dose.

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Assessment of Planning Target Volume Margins for Intensity Modulated Radiotherapy of the Prostate Gland: Role of Daily Inter- and Intrafraction Motion

International Journal of Radiation Oncology * Biology * Physics Volume 78, Issue 5 , Pages 1579-1585, 1 December 2010

James A. Tanyi, Ph.D., Tongming He, Ph.D., Paige A. Summers, B.S., Ruth G. Mburu, Catherine M. Kato , Stephen M. Rhodes, B.S., R.T.(T). , Arthur Y. Hung, M.D., Martin Fuss, M.D., Ph.D.

Oregon Health and Science University, Portland, OR

	LR (mm)	SI (mm)	AP (mm)
Skin	7.5	11.4	16.3
Bony Anatomy	2.1	9.4	10.5
Inter-fraction	2.8	3.7	3.2
Intra-Fraction	1.4	2.6	2.3

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Advantage: Decreased margin

Reduction in Patient-reported Acute Morbidity in Prostate Cancer Patients Treated With 81-Gy Intensity-modulated Radiotherapy Using Reduced Planning Target Volume Margins and Electromagnetic Tracking: Assessing the Impact of Margin Reduction Study. *Urology* 75 no. 5, (2010): 1004-1008.

Howard M. Sandler, Ping-Yu Liu, Rodney L. Dunn, David C. Khan, Scott E. Tropper, Martin G. Sanda, Constantine A. Mantz.

"Prostate cancer patients treated with reduced margins and tumor tracking had less radiotherapy-related morbidity than their counterparts treated with conventional margins."

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Intrafraction Motion – Time from alignment

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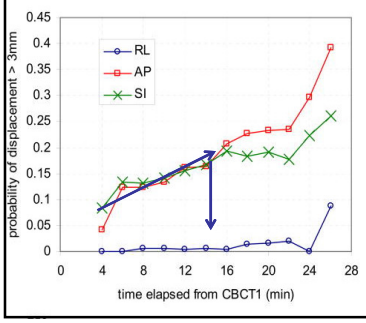

Displacement increase with time: Advantage: Intervention at any time