



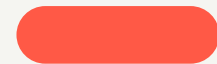
ACCURAY



# Clinical Value of Motion Synchronization for Prostate SBRT

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**Disclosure**

**Accuray Clinical Consultant**

# Accuray Disclaimers and Disclosure

## Disclosure

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## Safety Statement

Most side effects of radiotherapy, including radiotherapy delivered with Accuray systems, are mild and temporary, often involving fatigue, nausea, and skin irritation. Side effects can be severe, however, leading to pain, alterations in normal body functions (for example, urinary or salivary function), deterioration of quality of life, permanent injury and even death. Side effects can occur during or shortly after radiation treatment or in the months and years following radiation. The nature and severity of side effects depend on many factors, including the size and location of the treated tumor, the treatment technique (for example, the radiation dose), the patient's general medical condition, to name a few. For more details about the side effects of your radiation therapy, and if treatment with an Accuray product is right for you, ask your doctor.

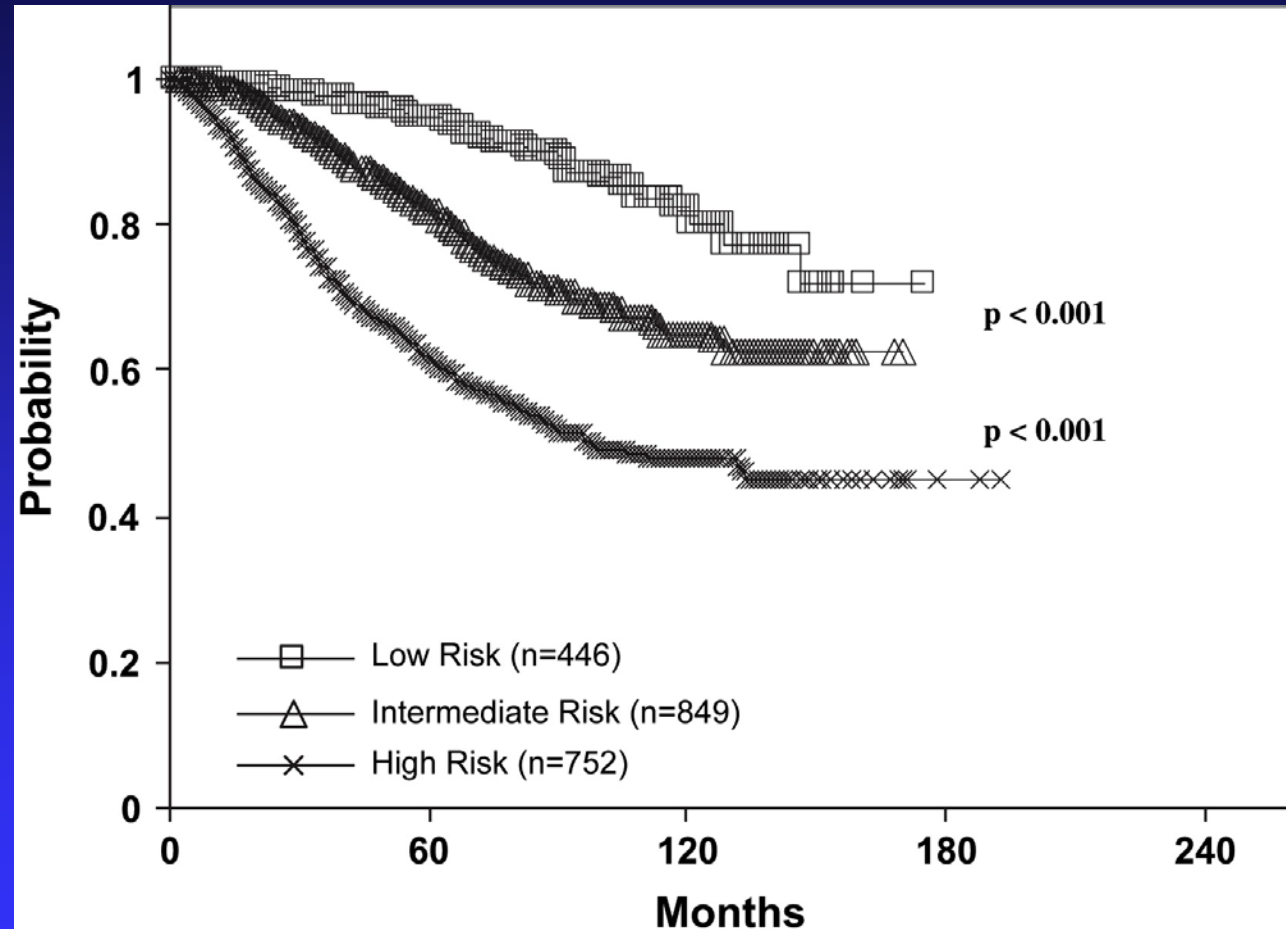
# PSA Failures Following Conventional Radiation Therapy

□ BDFS (5 yrs)

□ Low 95%

□ Inter. 82%

□ High 62%



□ Zelefsky et al, IJROBP 2008

# Primary Reasons for Radiation Therapy Failures

## ❑ Missed the Cancer

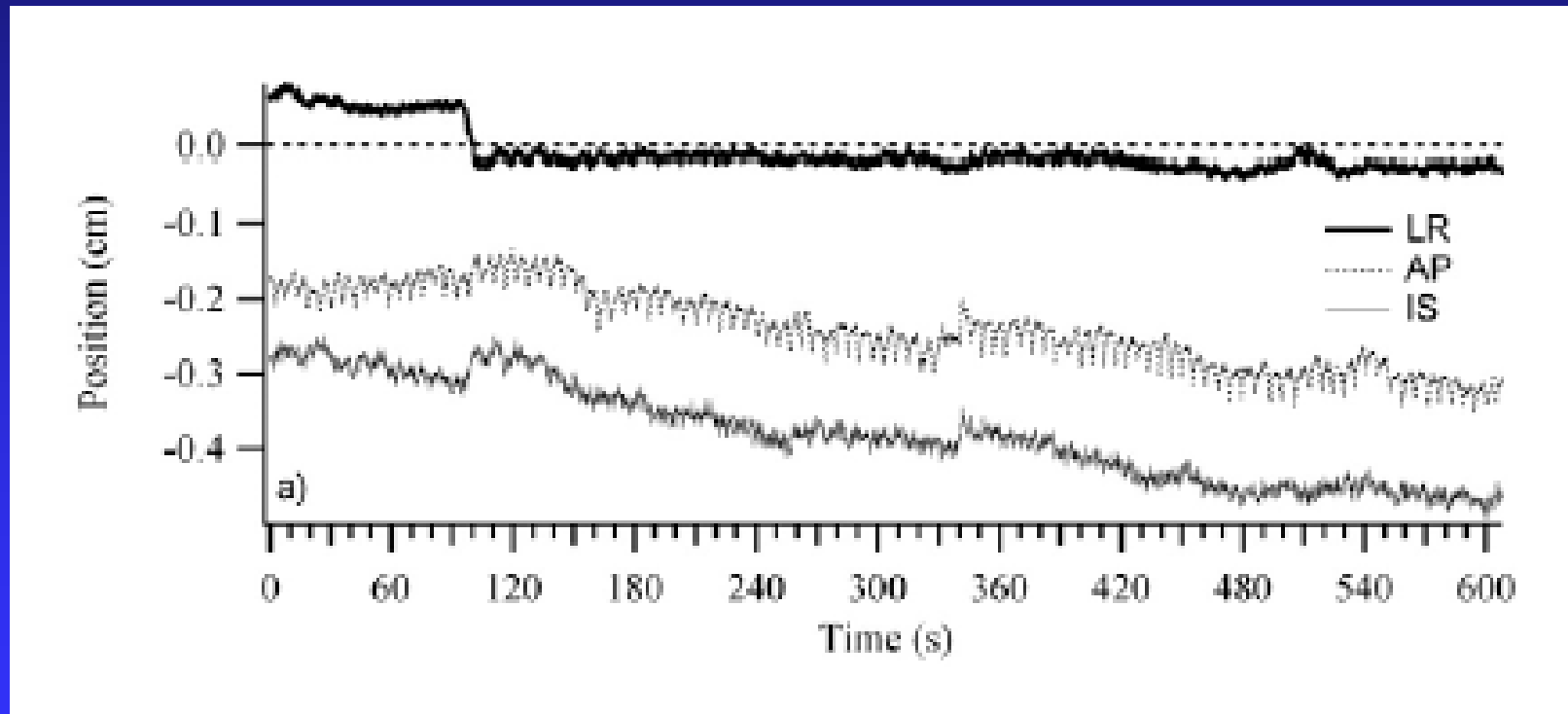
- The prostate moves during treatment
- **Motion Synchronization** can minimize this problem

## ❑ Radiation Dose Inadequate

- Post-treatment positive biopsy rate 30-40%
- Dose limited by surrounding normal tissue tolerance
- **Motion Synchronization** may allow for safer dose escalation

# Prostate Motion During a Radiation Treatment

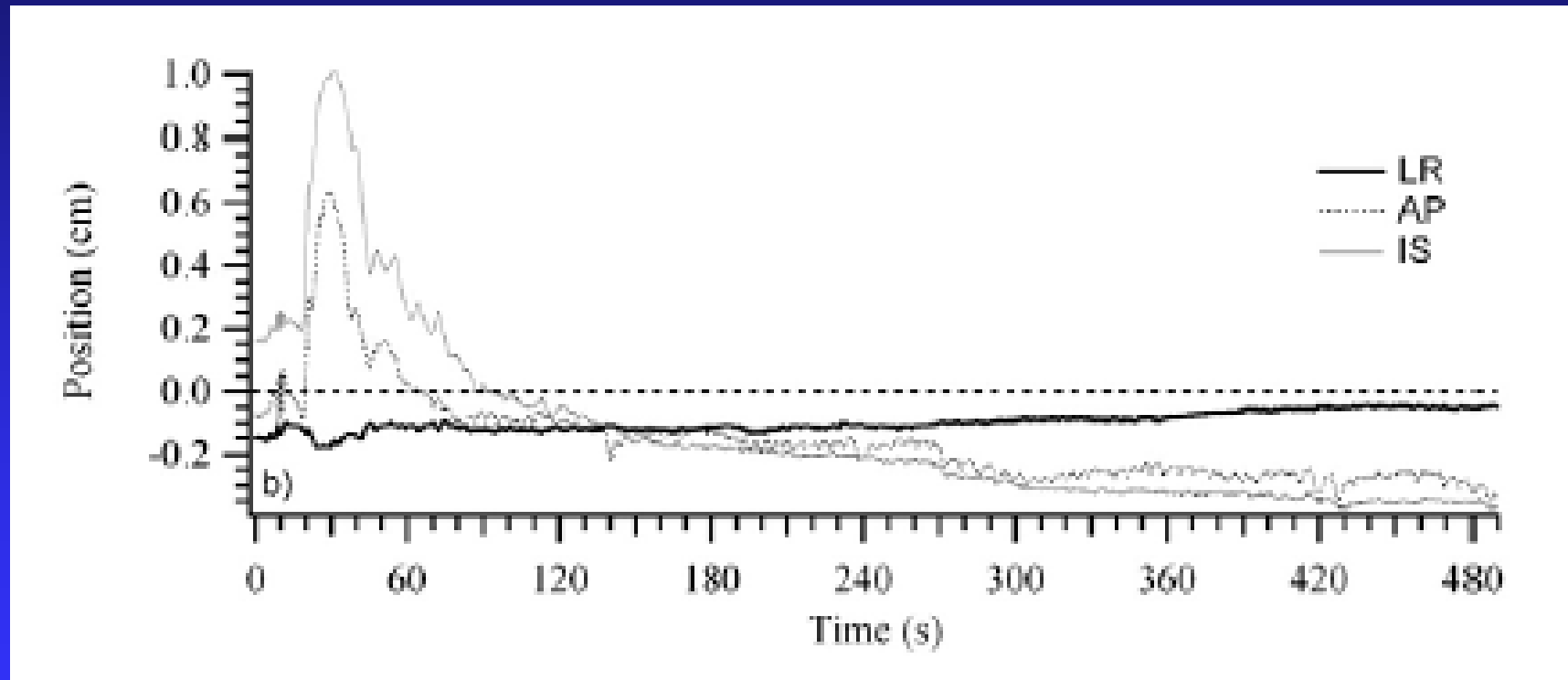
- Intra-fraction motion varies from 1 to 10 mm over seconds to minutes
- Commonly, a drift in the prostate position over course of single treatment



□ *Litzenberg et al, IJROBP 2006*

# Prostate Motion During a Radiation Treatment

□ However, large early motions seen in 20-30% treatments



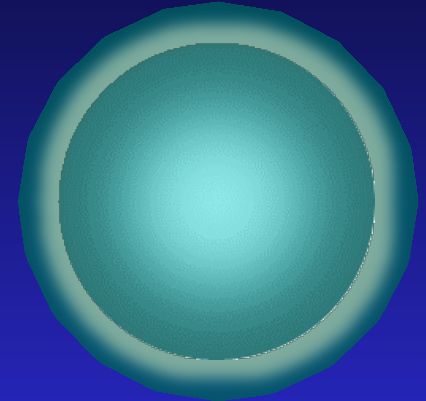
□ *Litzenberg et al, IJROBP 2006*



# Advantages of Robotic SBRT

- Relative normal structure sparing is achieved by:
  - Image guidance with **motion synchronization**
    - Improved set-up accuracy
    - Prostate motion is taken into account
    - Smaller treatment margins required
  - Hypofractionation
    - 5 fractions over 1-2 weeks
    - May be radiobiologically superior to 42 fractions

IMRT



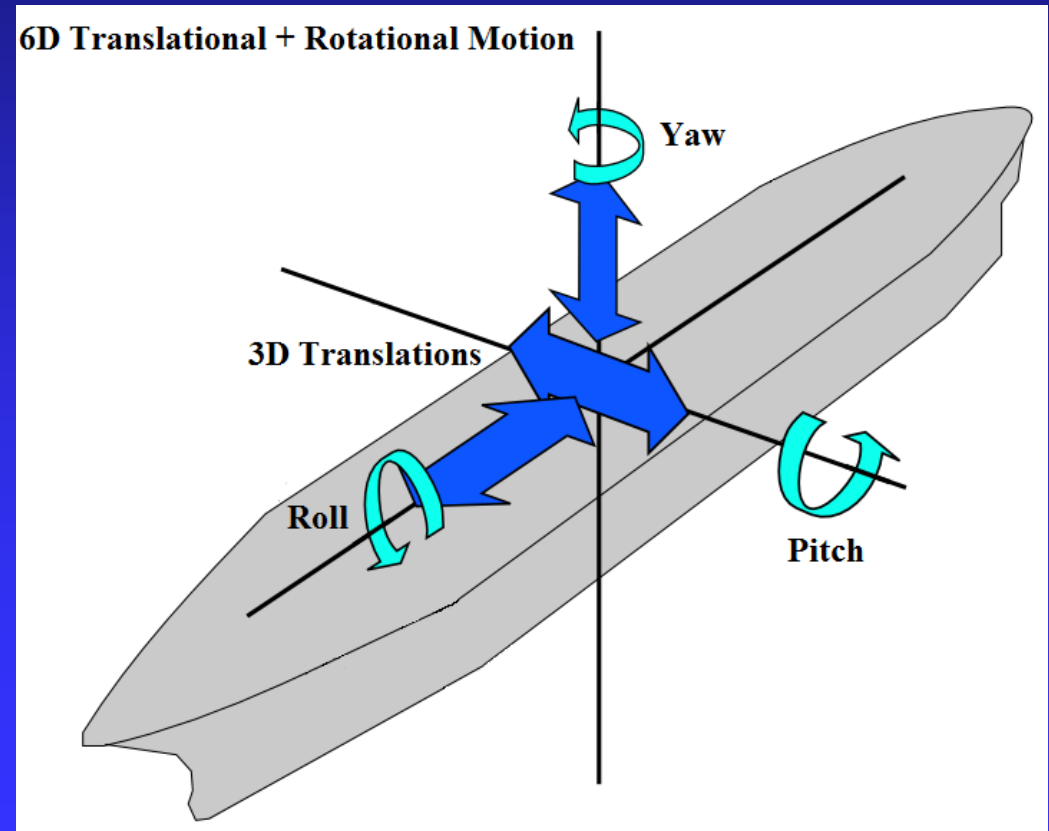
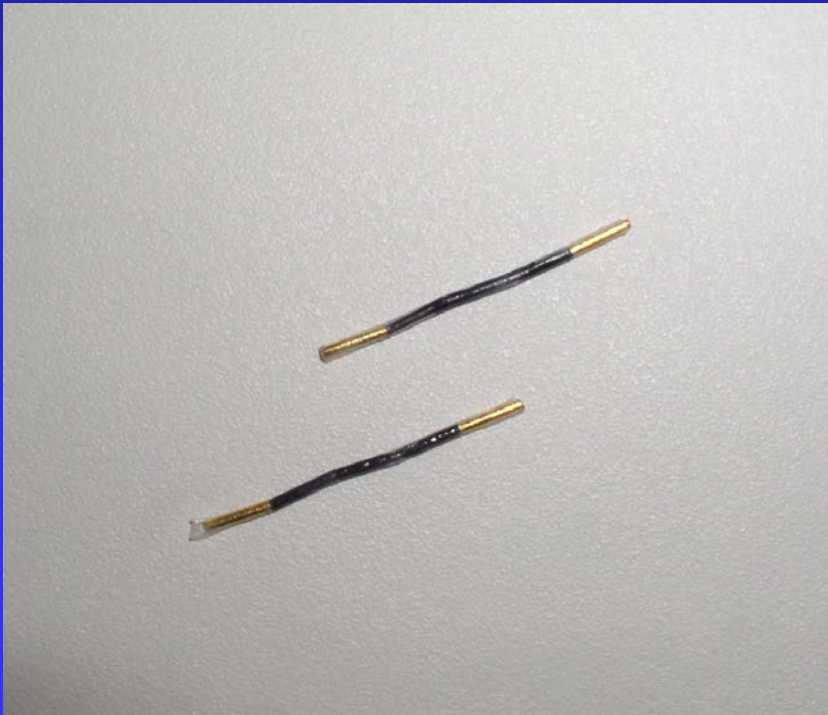
SBRT



# Intra-Prostatic Fiducials Allow for Motion Synchronization During Robotic SBRT Treatment

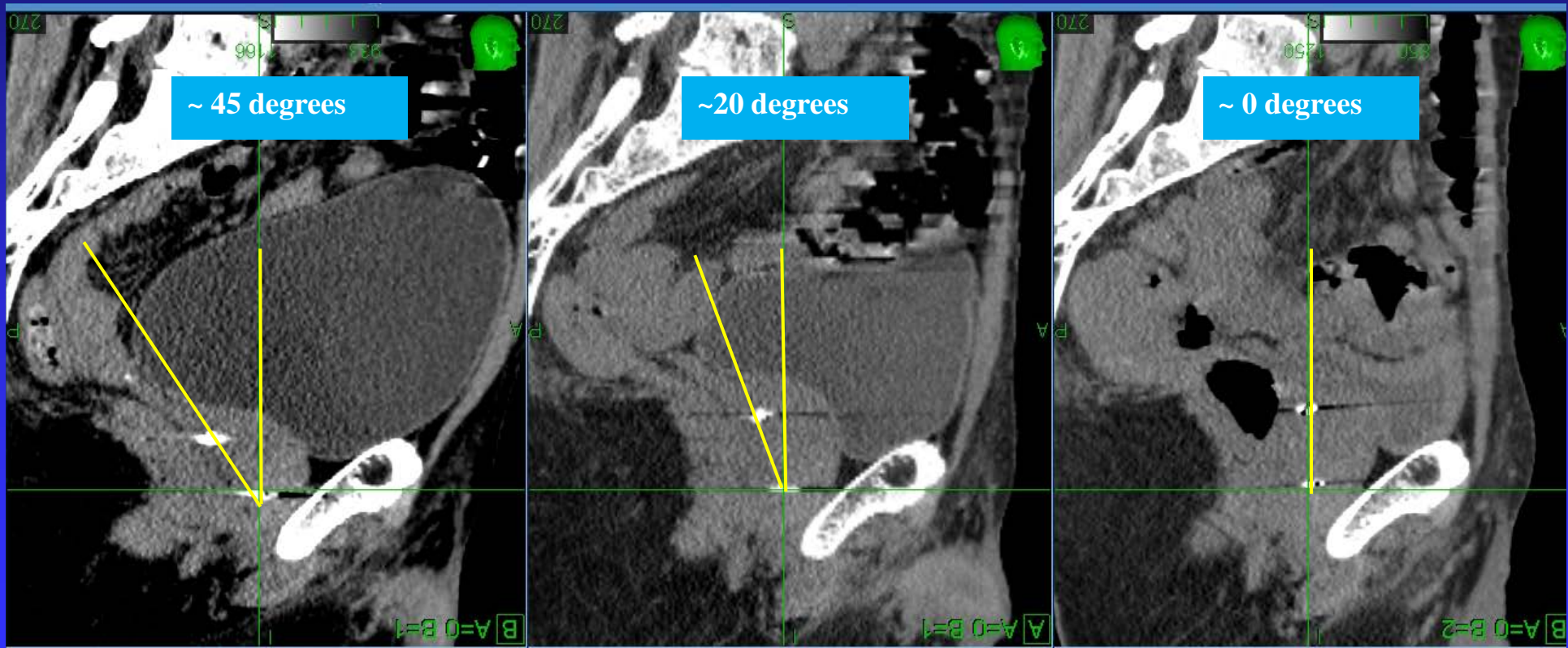
## □ Fiducials

□ Place 3-4 to take into account six possible types of movement



# Importance of Correcting for Prostatic Pitch During Robotic SBRT Treatment

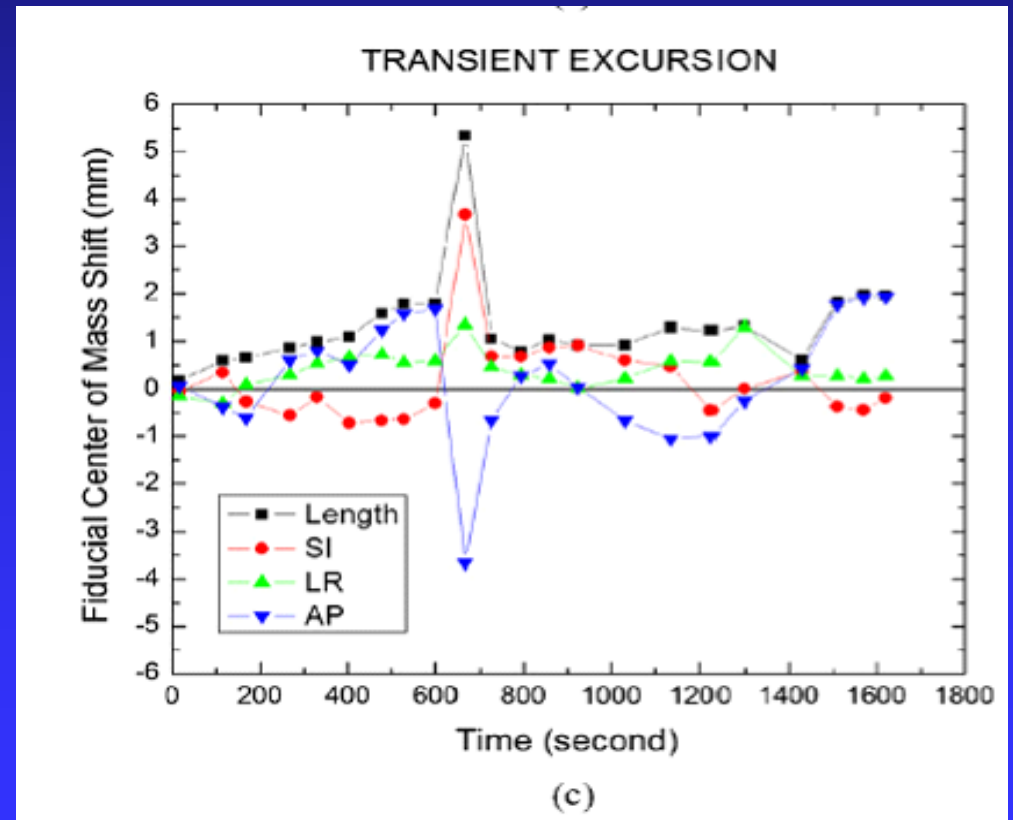
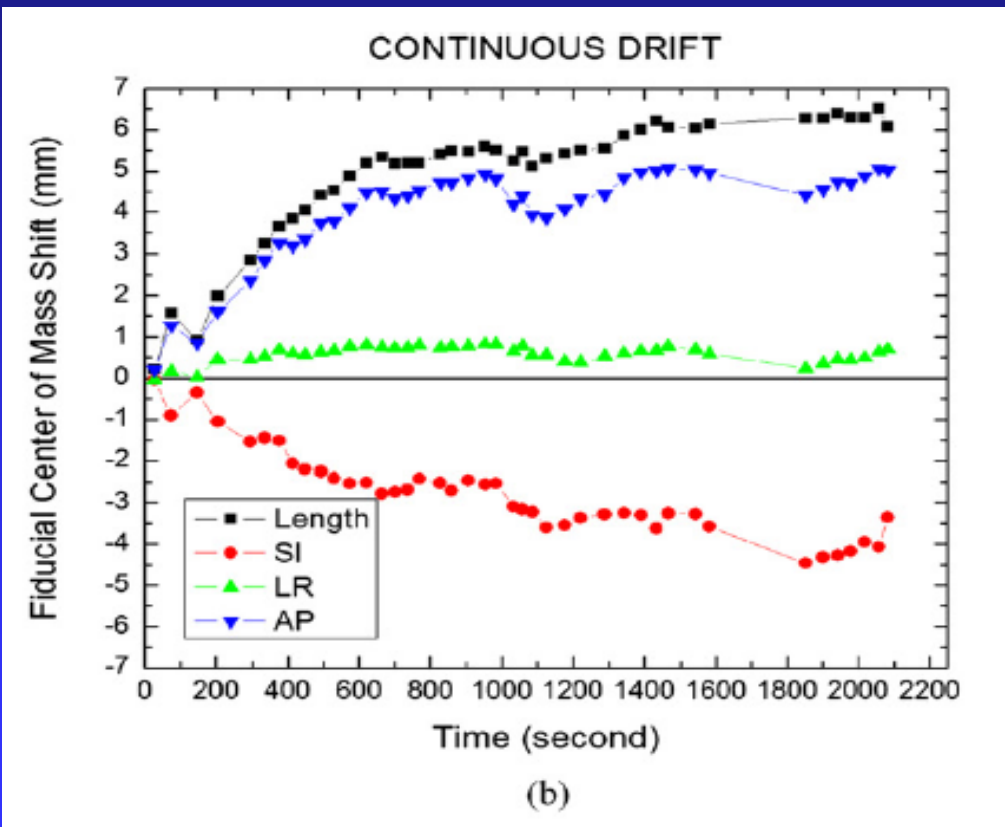
- Rotations around left-right axis at apex is the dominant form of motion



□ Debra Freeman, M.D.

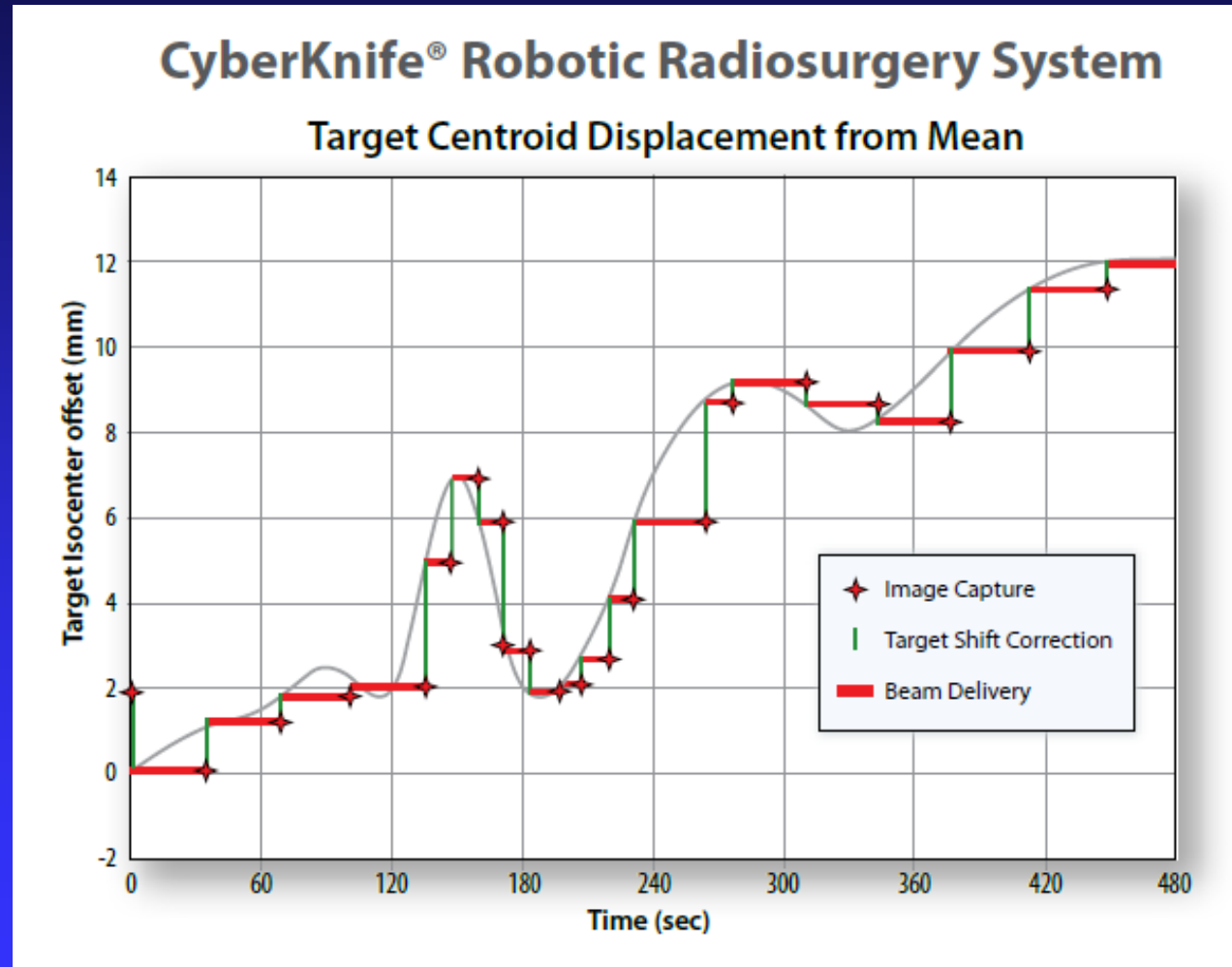
# Motion Synchronization During Robotic SBRT Treatment

□ Real-time tracking system that provides updated prostate position and corrects the targeting of the therapeutic beam during treatment



# Motion Synchronization

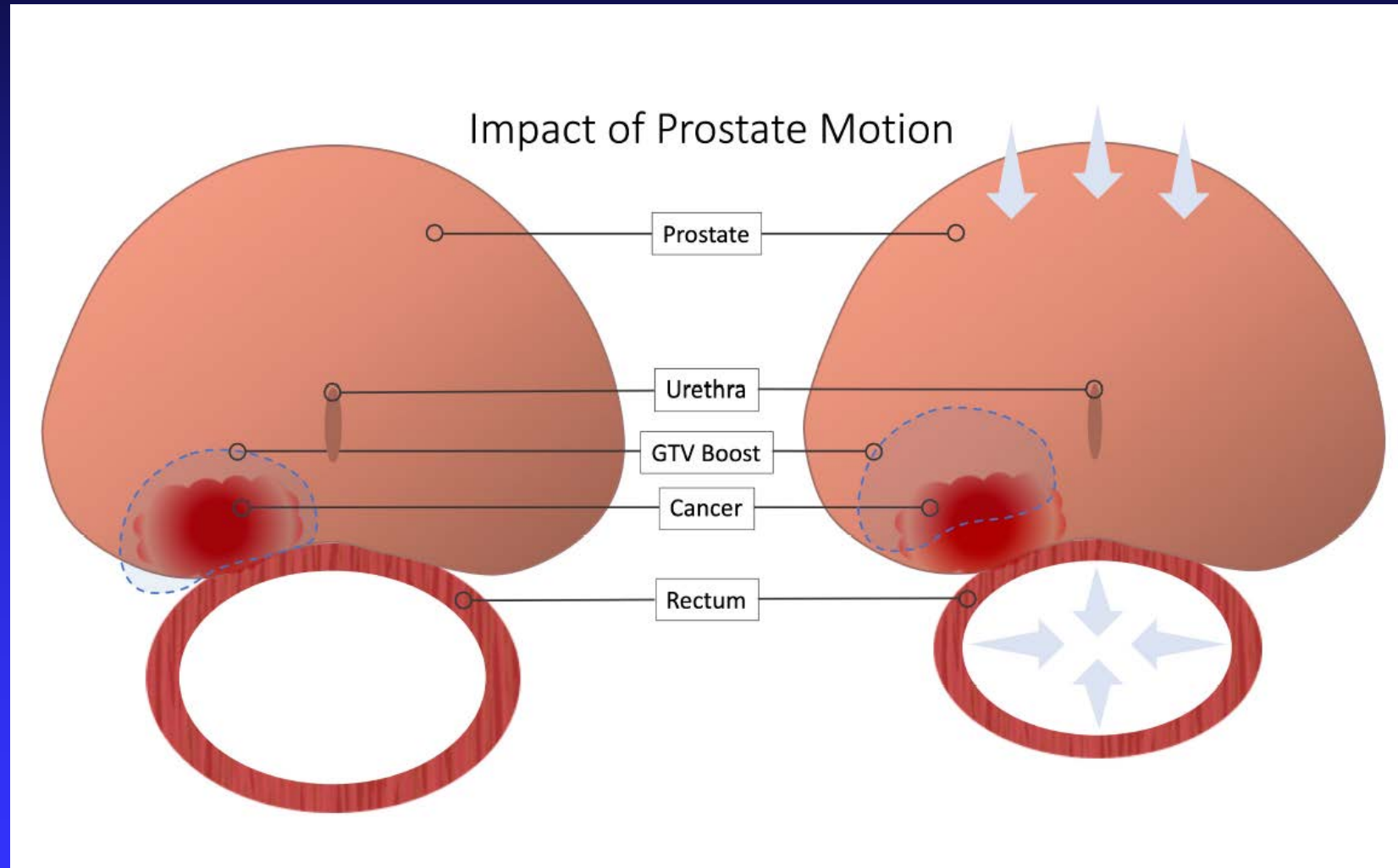
□ Verifies target accuracy numerous times during single treatment!



□ Accuracy



# Importance of Adjusting for Intrafraction Motion



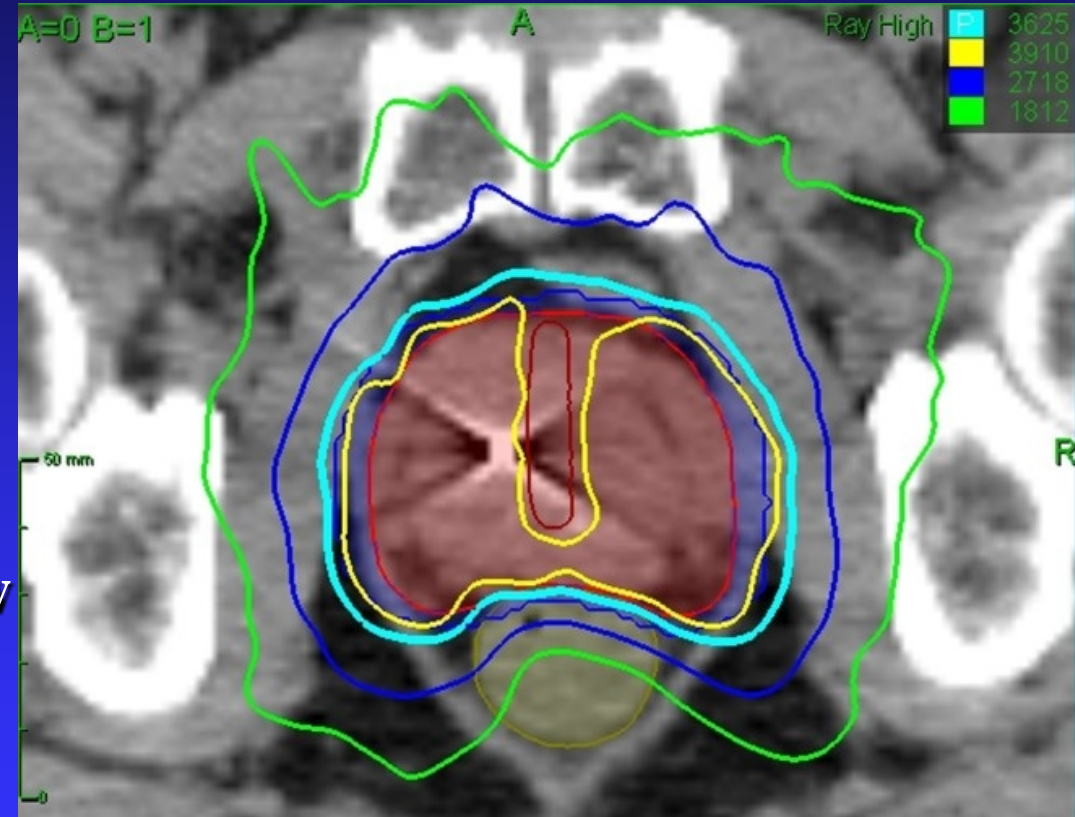
*Courtesy of Michael Creswell, B.S.*

# Continuous Motion Synchronization Allows for Smaller Treatment Margins

□ **Motion Synchronization** allows for reduced treatment margins

- Posterior 3 mm
- All others 5 mm

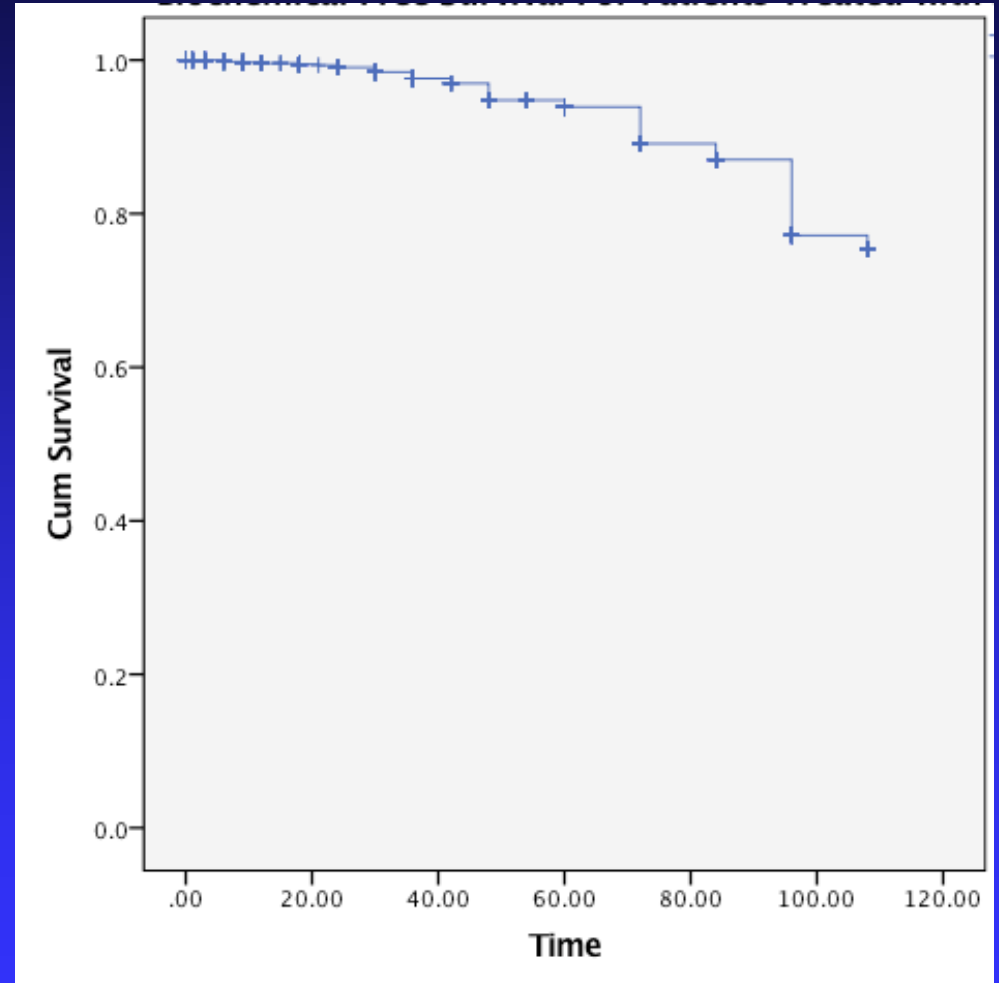
□ Reduced treatment margins allow for safer delivery of fewer high dose fractions



□ *Repka et al, Front Oncol 2016*

# SBRT for Prostate Cancer: Georgetown University Experience (2007-2019)

- Phase II
- 1136 patients
- Median FU      3 yrs
- BDFS (5 yrs)   93%



□ *Unpublished data*



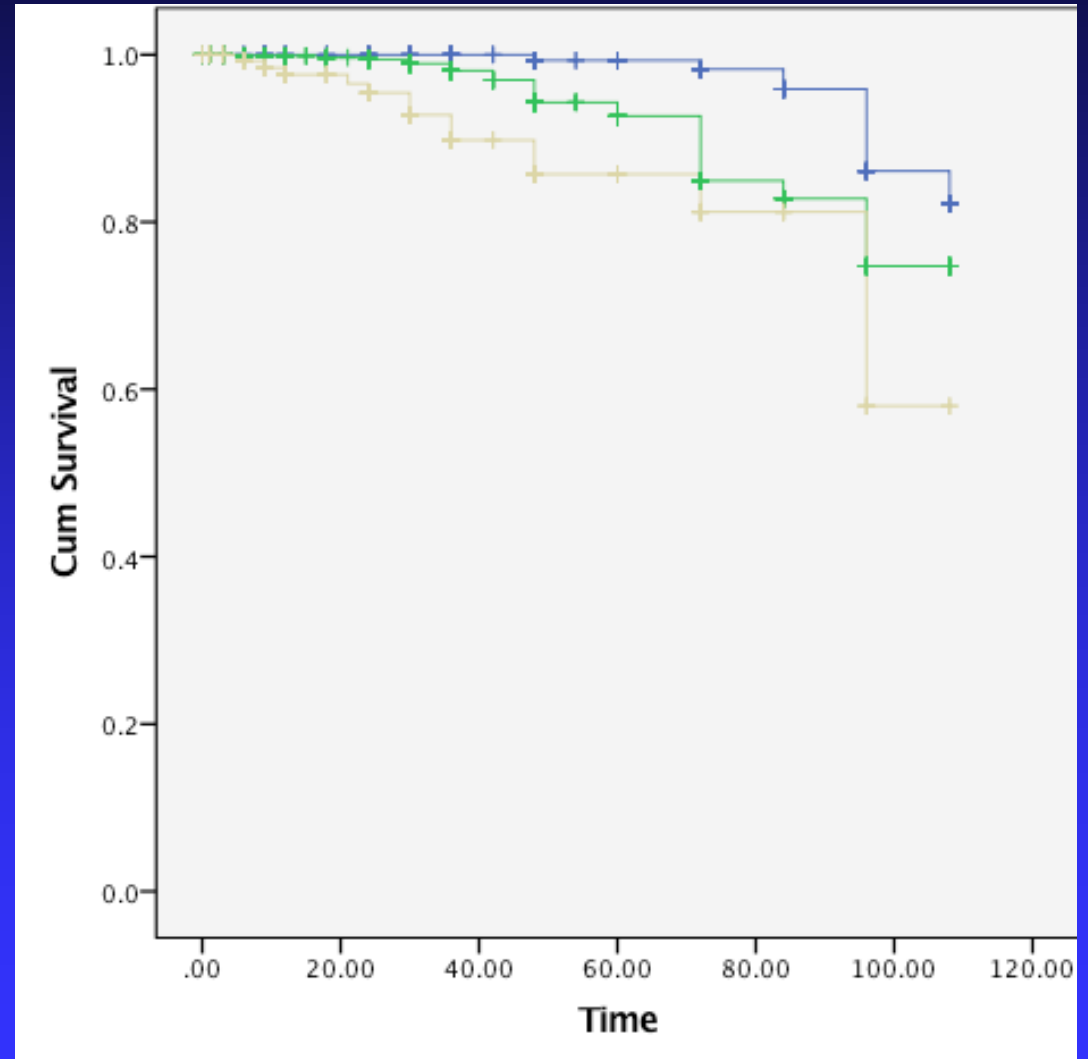
# SBRT for Prostate Cancer: Georgetown University Experience (2007-2019)

□ BDFS (5 yrs)

□ Low 99%

□ Inter. 92%

□ High 85%

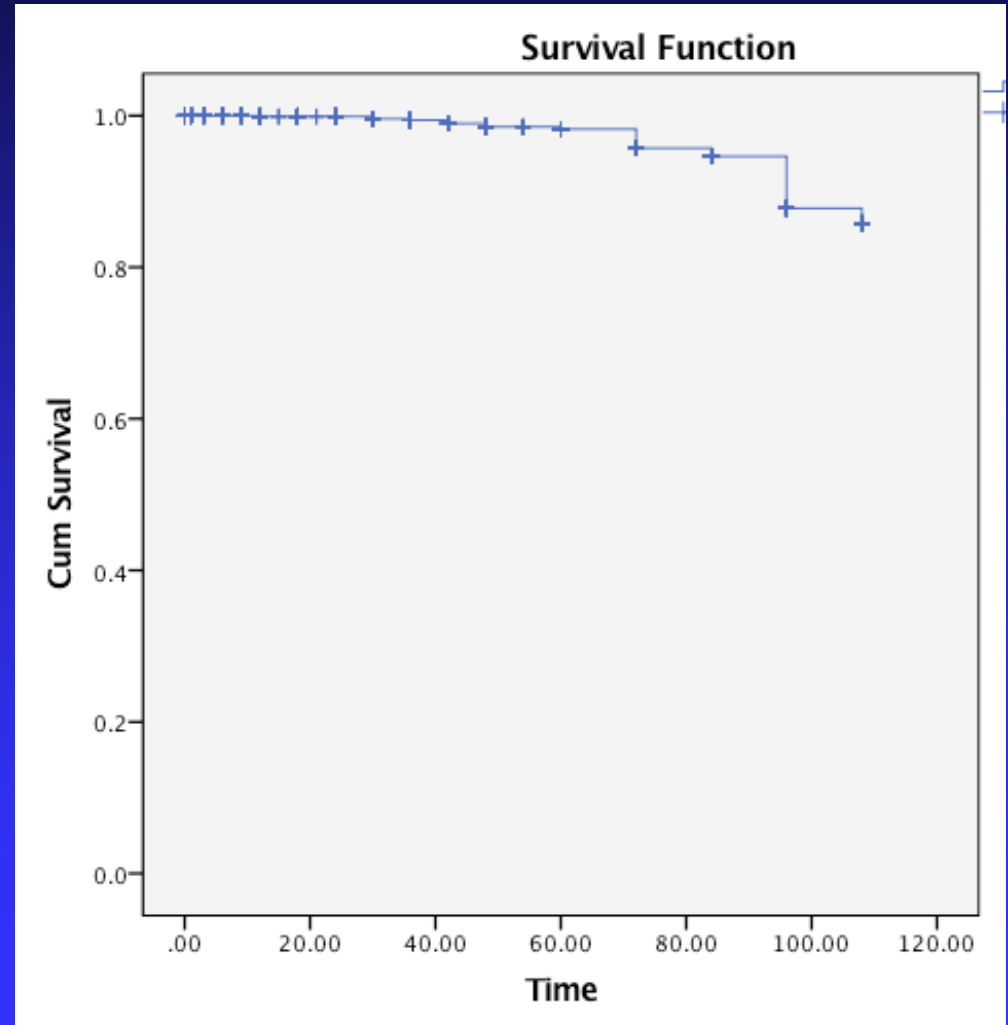


□ *Unpublished data*

# SBRT for Prostate Cancer: Georgetown University Experience (2007-2019)

□ LF (5 yrs)      2%

□ DF (5 yrs)      4%



□ *Unpublished data*

# Accuray Multi-Institutional Phase II Trial

## ➤ Homogeneous dose

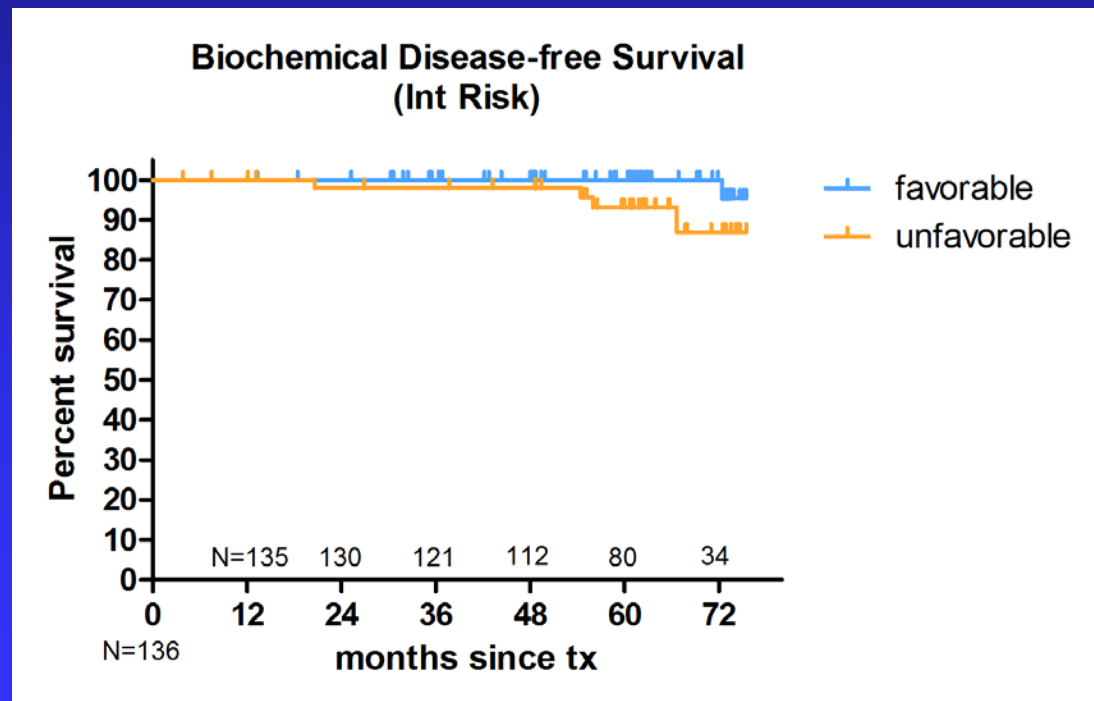
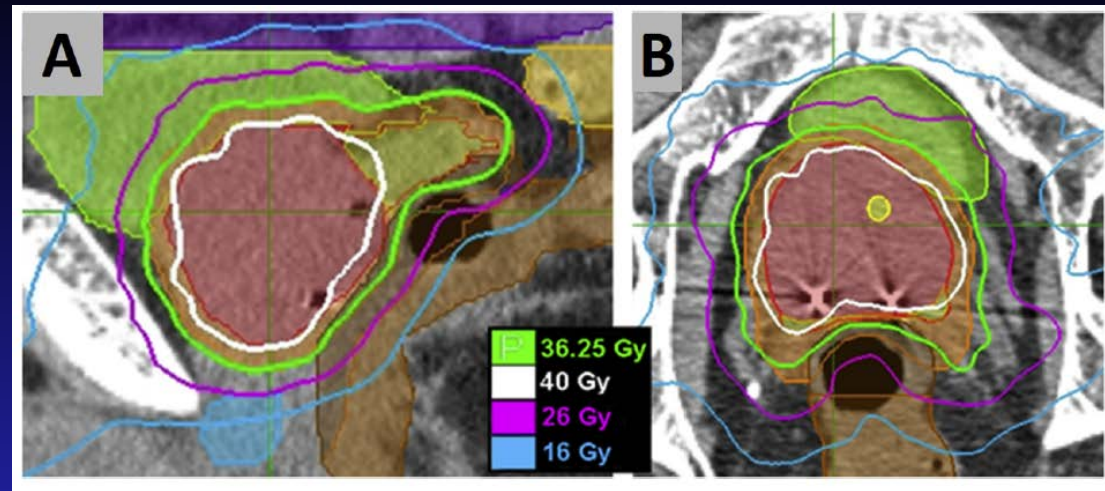
➤ PTV 7.25 Gy x 5 fx

➤ GTV 8 Gy x 5 fx

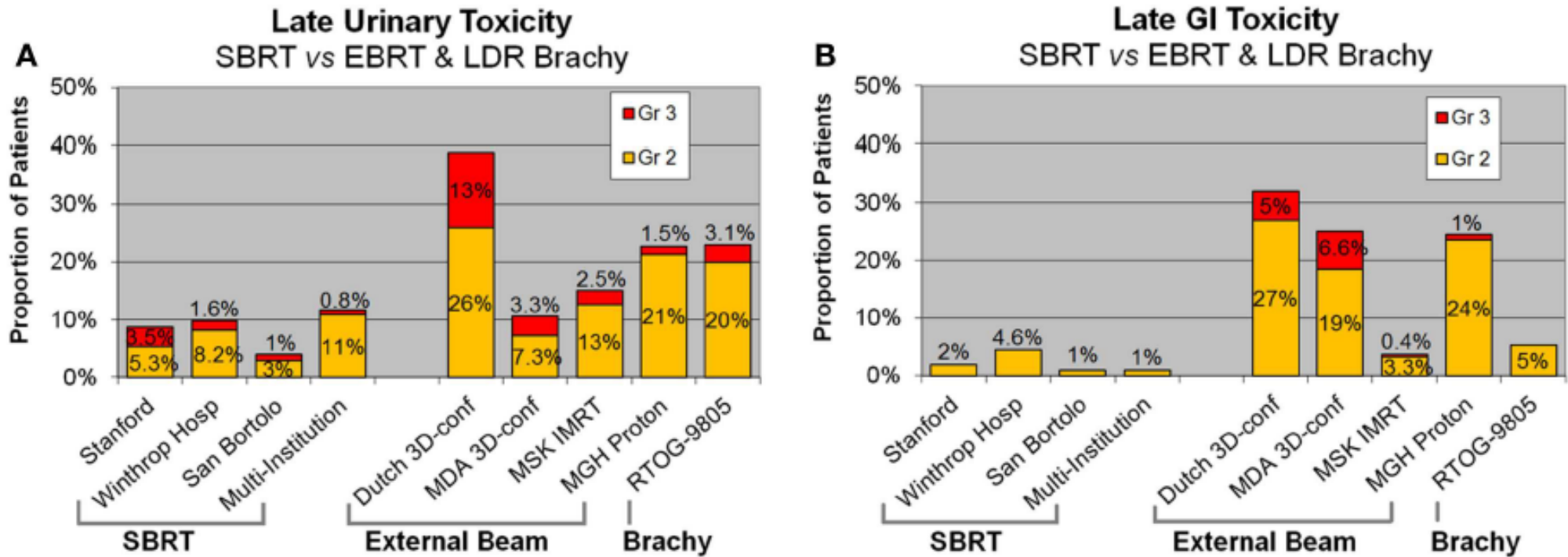
## ➤ Median Follow-up 60 months

## ➤ Excellent PSA response

- BDFS (5 yr)
  - Fav. 100%
  - Unfav. 93.1%



# Prevalence of CTC graded GU and GI Toxicities



*Meier R., Front Oncol 2015*

# Accuray Phase II Trial of Heterogeneous-dosing SBRT for Favorable Prostate Cancer

## ➤ Heterogeneous dose

❑ ➤ PTV 38 Gy in 4 fx

## ➤ Urethral identification with catheter

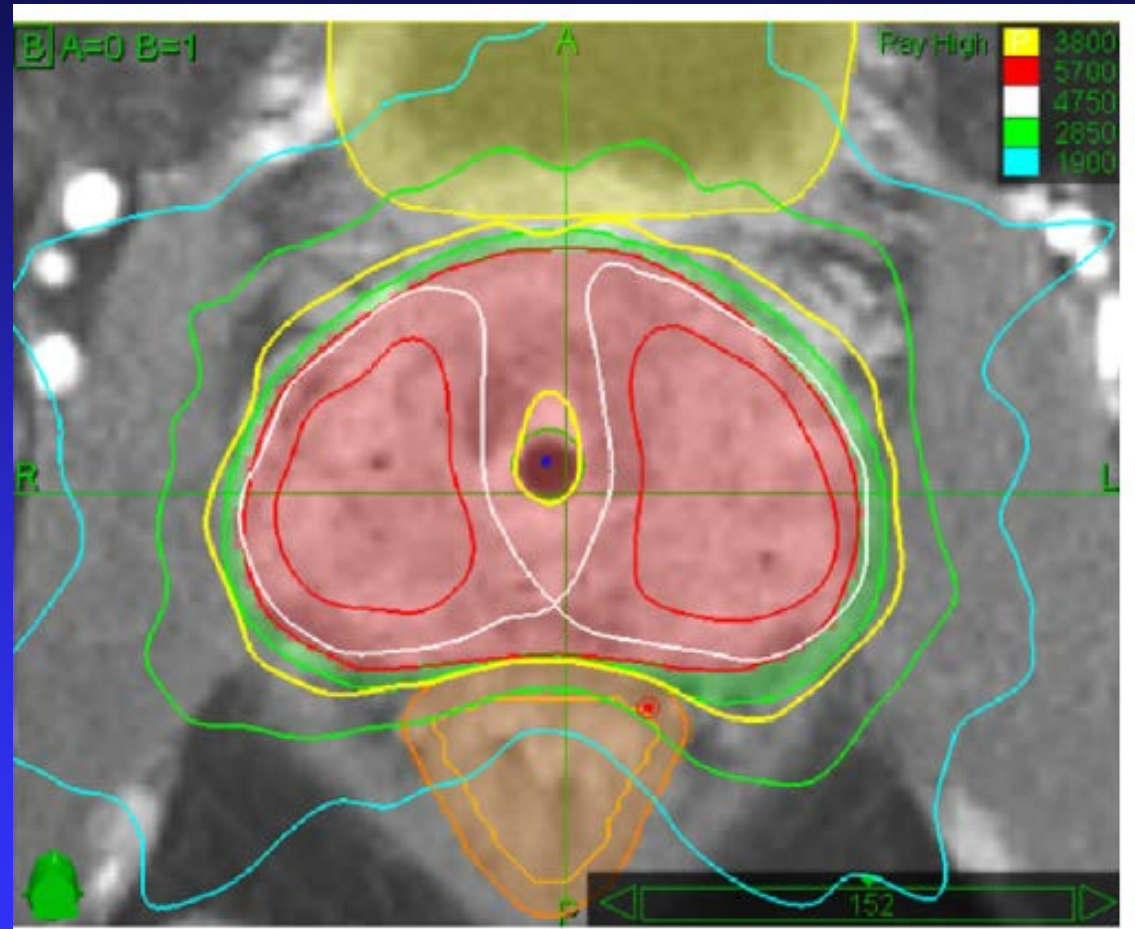
## ➤ Intrapostatic dose escalation

### ➤ Isodose Lines

➤ 100% Yellow line

➤ 125% White Line

➤ 150% Red line



❑ *Fuller et al, Eur. Uro. Onc. 2018*

# Accuray Phase II Trial of Heterogeneous-dosing SBRT for Favorable Prostate Cancer

## □ Very low PSA nadirs

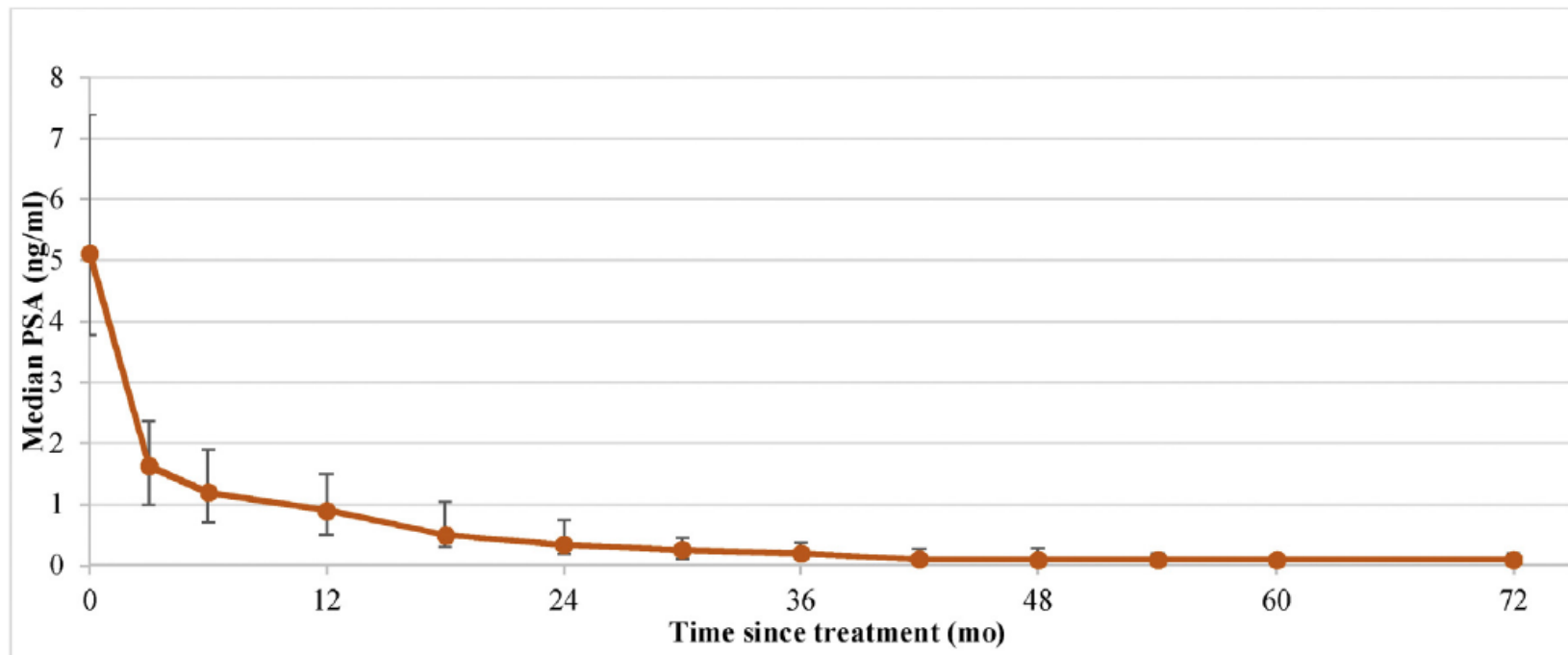


Fig. 2 – Median prostate-specific antigen (PSA) over time for the overall trial population. The median and interquartile range are plotted.

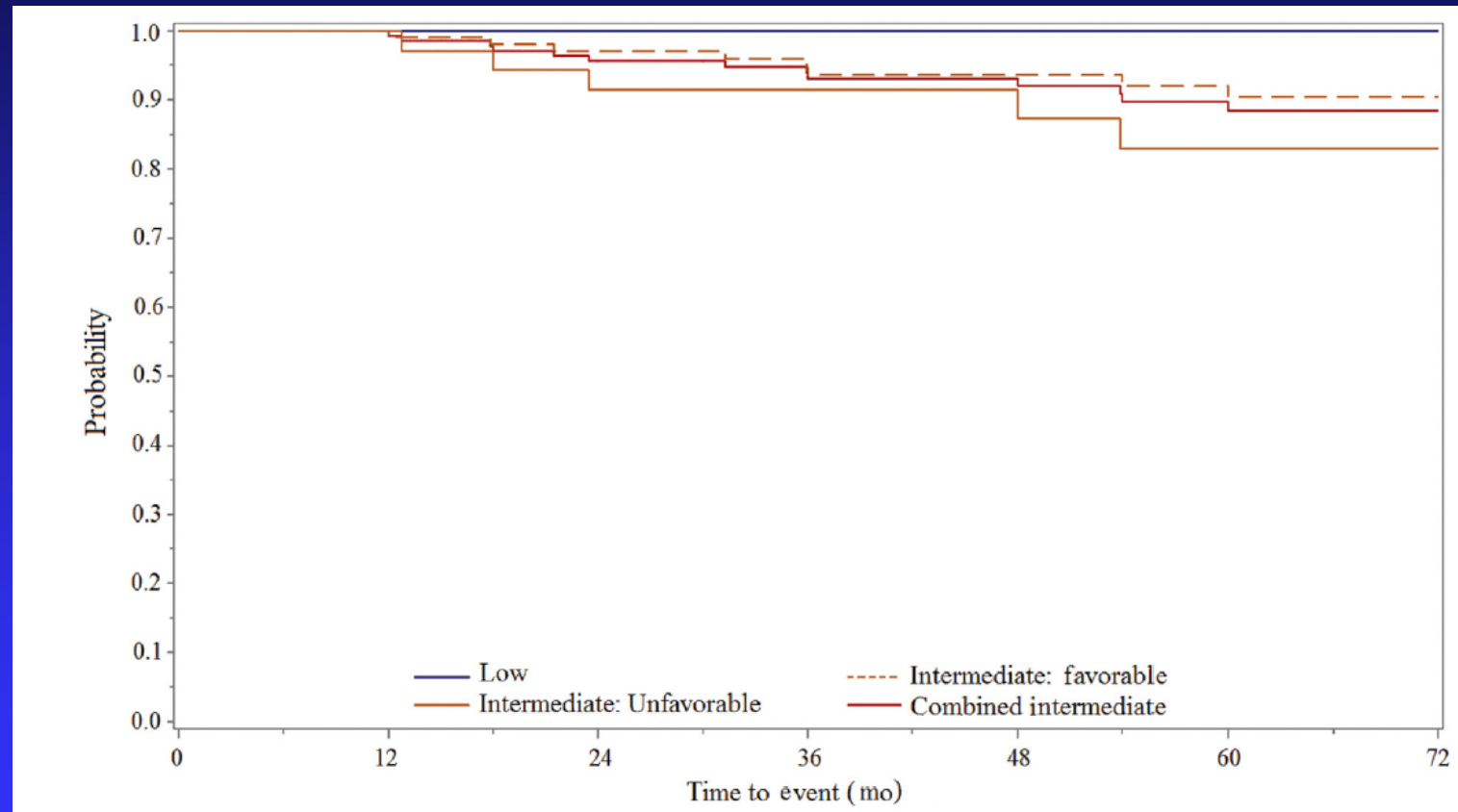
□ *Fuller et al, Eur. Uro. Onc. 2018*

# Accuray Phase II Trial of Heterogeneous-dosing SBRT for Favorable Prostate Cancer

□ BDFS (5 yr)

□ Low Risk 100%

□ Inter. Risk 89%



□ *Fuller et al, Eur. Uro. Onc. 2018*

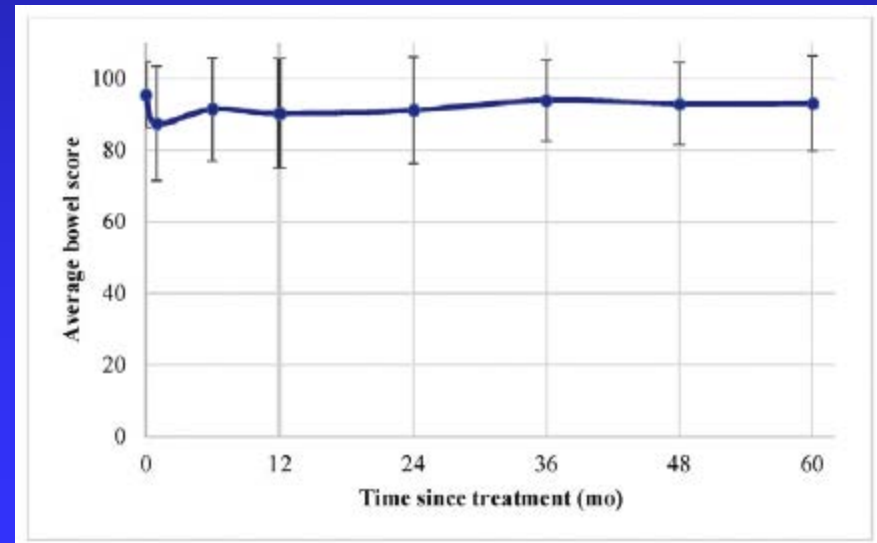
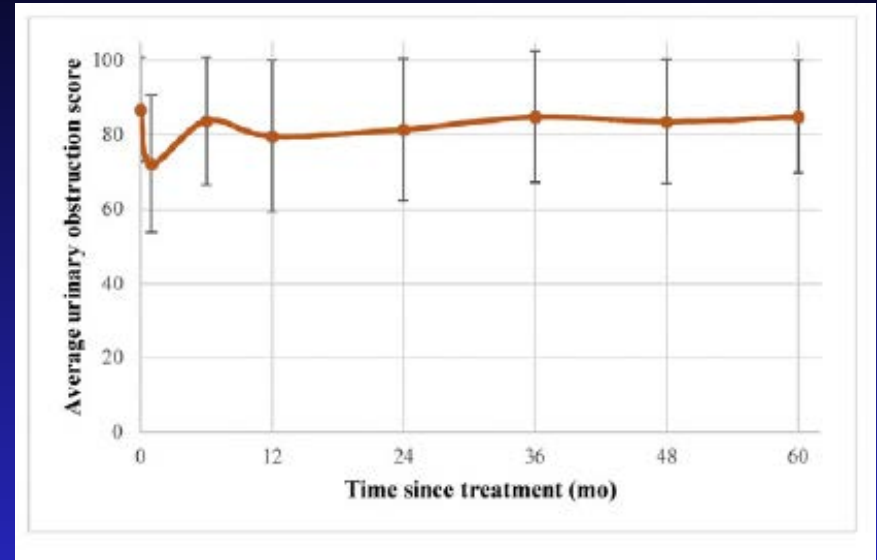


# Heterogeneous-dosing SBRT for Favorable Prostate Cancer

## □ Quality of life scores

□ Declined at 1 month

□ Returned to baseline by 6 months



□ *Fuller et al, Eur. Uro. Onc. 2018*



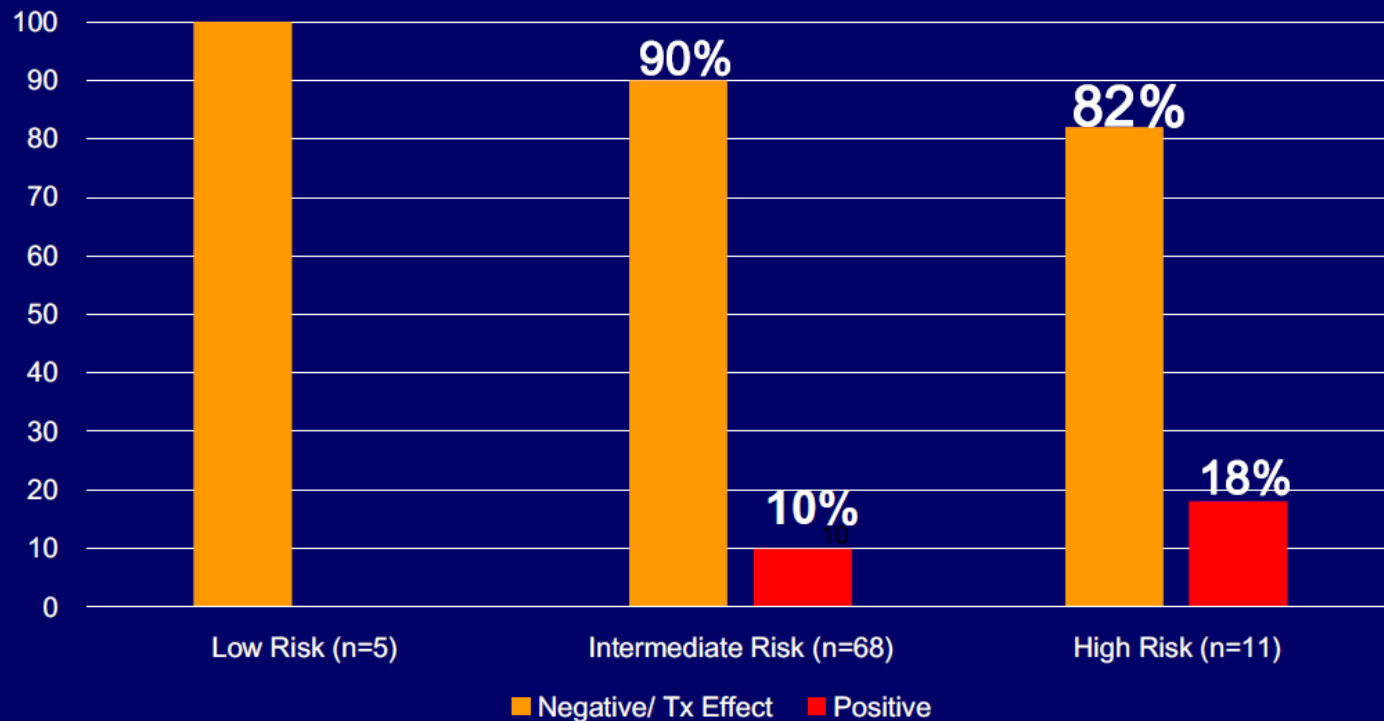
# Phase I Dose Escalation Study from MSKCC

| <b><i>dose level</i></b> | <b>% PSA failure<br/>(Nadir +2 Definition)</b> | <b>%Positive Biopsy</b> |
|--------------------------|--|-------------------------|
| 32.5 Gy                  | 20% (6/30)                                     | 48% (10/21)             |
| 35 Gy                    | 2.9% (1/35)                                    | 19% (5/26)              |
| 37.5 Gy                  | 0% (0/36)                                      | 17% (4/24)              |
| 40 Gy                    | 2.9% (1/35)                                    | 8% (2/25)               |

▣ *Zelevsky, ASTRO Presentation 2018*

# Phase I Dose Escalation Study from MSKCC

## Post-Treatment Biopsy Outcomes After 40 Gy SBRT By Initial Risk Group (n=84)

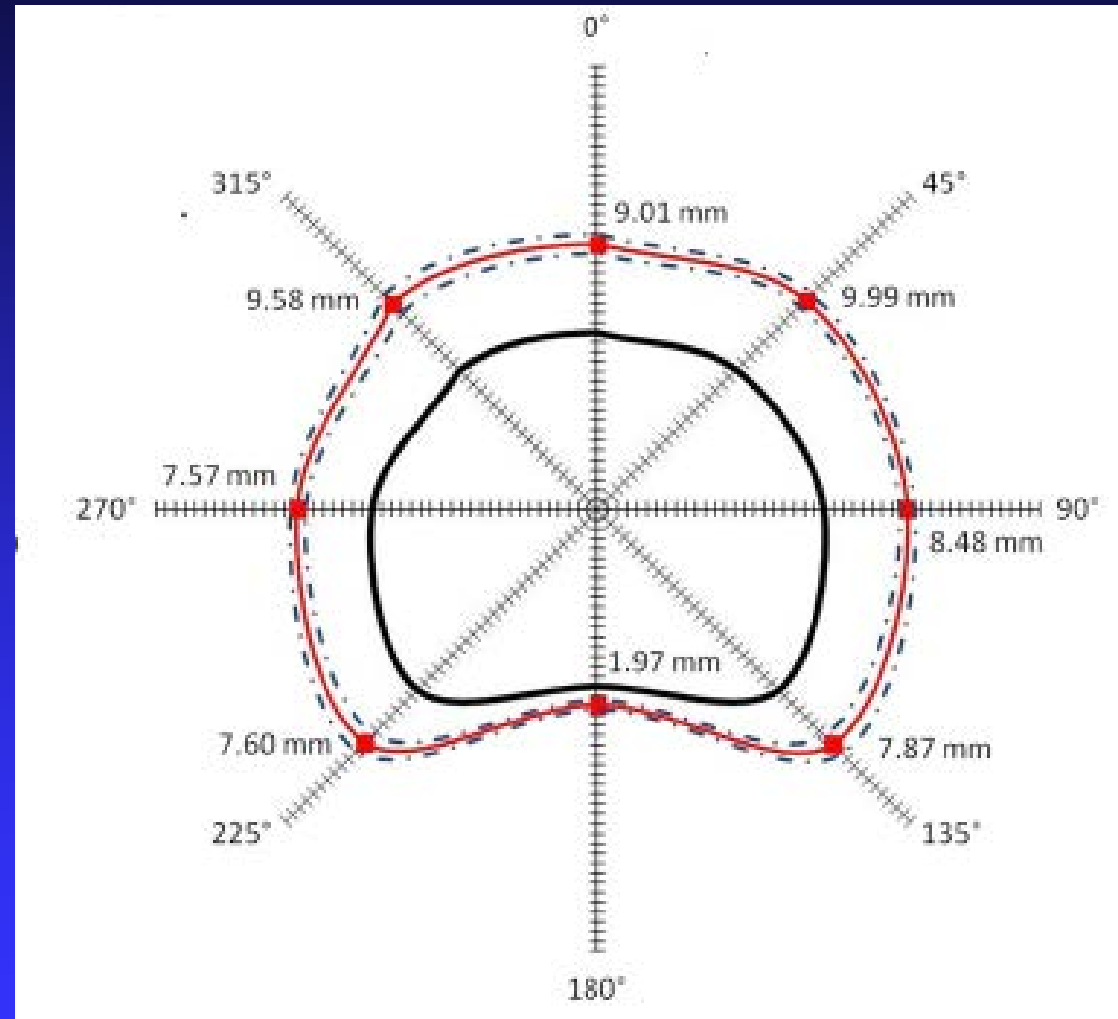


□ Zelefsky, ASTRO Presentation 2018

# Motion Synchronization will Likely be Critical to Preventing Late Local Failures

## ■ SBRT plans

- Mean coverage by the 33 Gy isodose line extends > 5 mm beyond prostatic capsule in all directions except directly posterior
- Target accuracy is critical to preventing late local failures



*Ju et al. Rad Onc 2013*

## Conclusions:

- ❑ The prostate moves during a radiation treatment
- ❑ Due to the small allowable target volume expansions to safely deliver SBRT, high clinical treatment accuracy is required (1-2 mm).
- ❑ Many clinical studies supporting the efficacy and safety of SBRT utilizing **Motion Synchronization** have been published.
- ❑ Two Phase II studies of SBRT utilizing **Motion Synchronization** have shown high five year biochemical control rates with very low rates of serious toxicity.

# Acknowledgements

□ Nima Aghdam, M.D.



□ Edina Wang, M.D.

