

# Real Time Ultrasound Guidance for Optimizing High Dose Rate Prostate Brachytherapy

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University of Virginia Health  
System

# Conflicts of Interest

- Royalties from UpToDate.com
- Shareholder in Varian, Inc.
- Non-disclosure agreement with Varian Brachytherapy



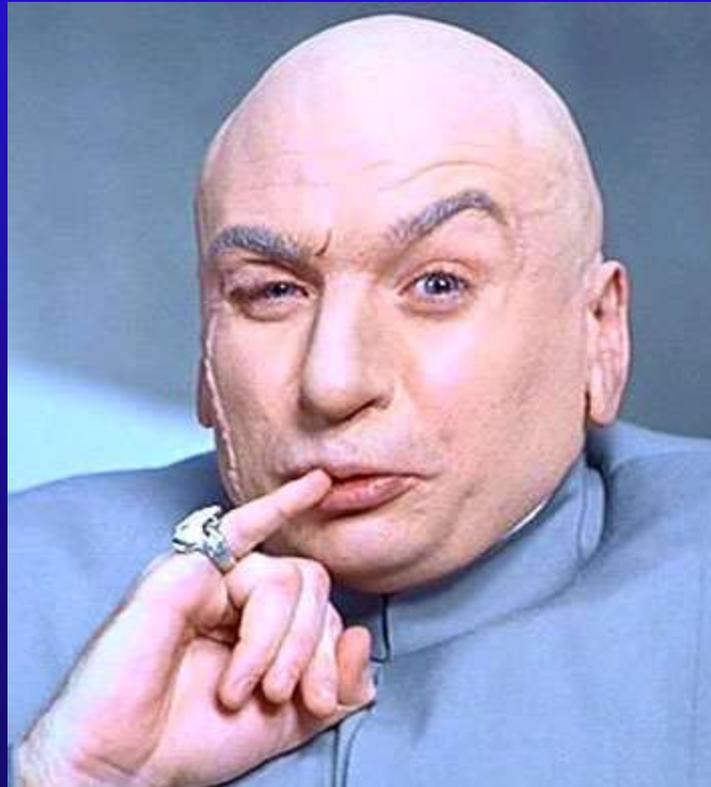
My neighborhood bear

# Timeline of Events

# August 1, 2012- Timothy Showalter, MD starts at UVa

“I want to do partial prostate brachytherapy

~~with sharks with lasers~~ with HDR”



# Timeline cont'd

- Varian introduces Vitesse 3.0- Dec 2012
- Invitation to give this talk- Feb 2013
- Receive Vitesse 3.0- March 2013
- Acceptance testing, commissioning, dry runs, “buttonology”- April- August 2013
- First treatment ????????

# IGBT Suite at UVa

anesthesia  
equipment

OR lights



Siemens  
Somatom  
Sliding  
Gantry CT

Trumpf OR table

# Scan-Plan-Treat Workflow at UVa

(time from CT scan to initiation of treatment)

- vaginal cylinder ~ 13 minutes
- T&O ~ 25 minutes
- Gyn Interstitial ~ 1 hour
- (Contura-can place, scan, plan, & treat within ~2 hours)
- HDR Prostate Brachytherapy-????

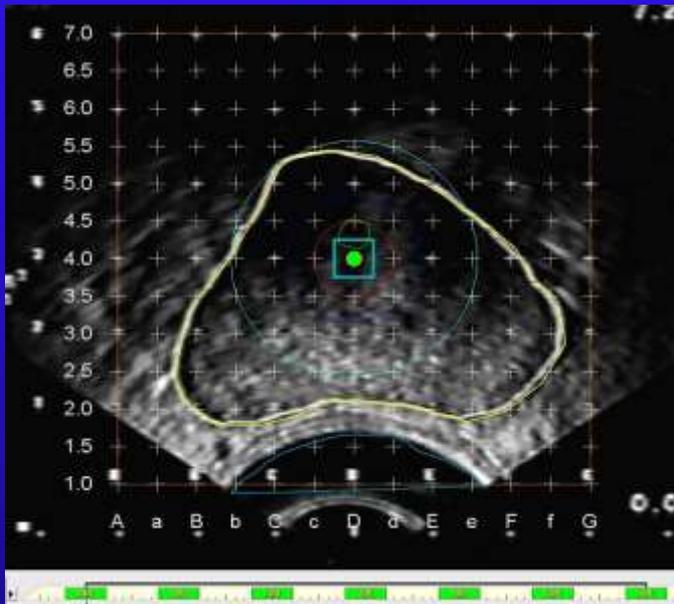
# Why prostate HDR?

- optimization (can compensate for poor placement of the needles)
- fewer radiation safety concerns
- no post plan

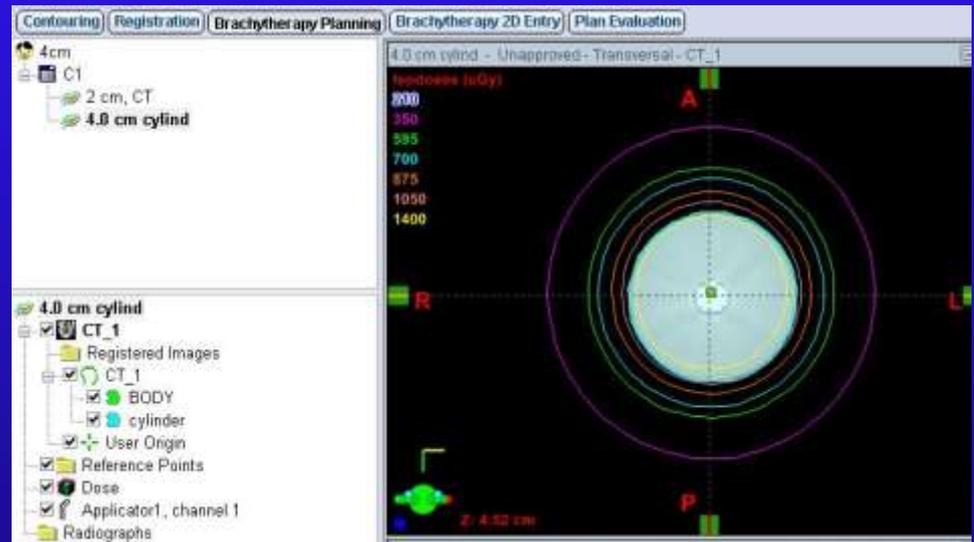
# Why Ultrasound Based Treatment Planning?

- WYSIWYG (better visualization of base and apex of the prostate)
- Real time visualization of needle insertion
- Obviate the need to move the patient for CT or MR
- Works well in a scan-plan-treat environment (we have experience in maintaining patients under anesthesia during planning and treatment)

# Intro to Vitesse 3.0



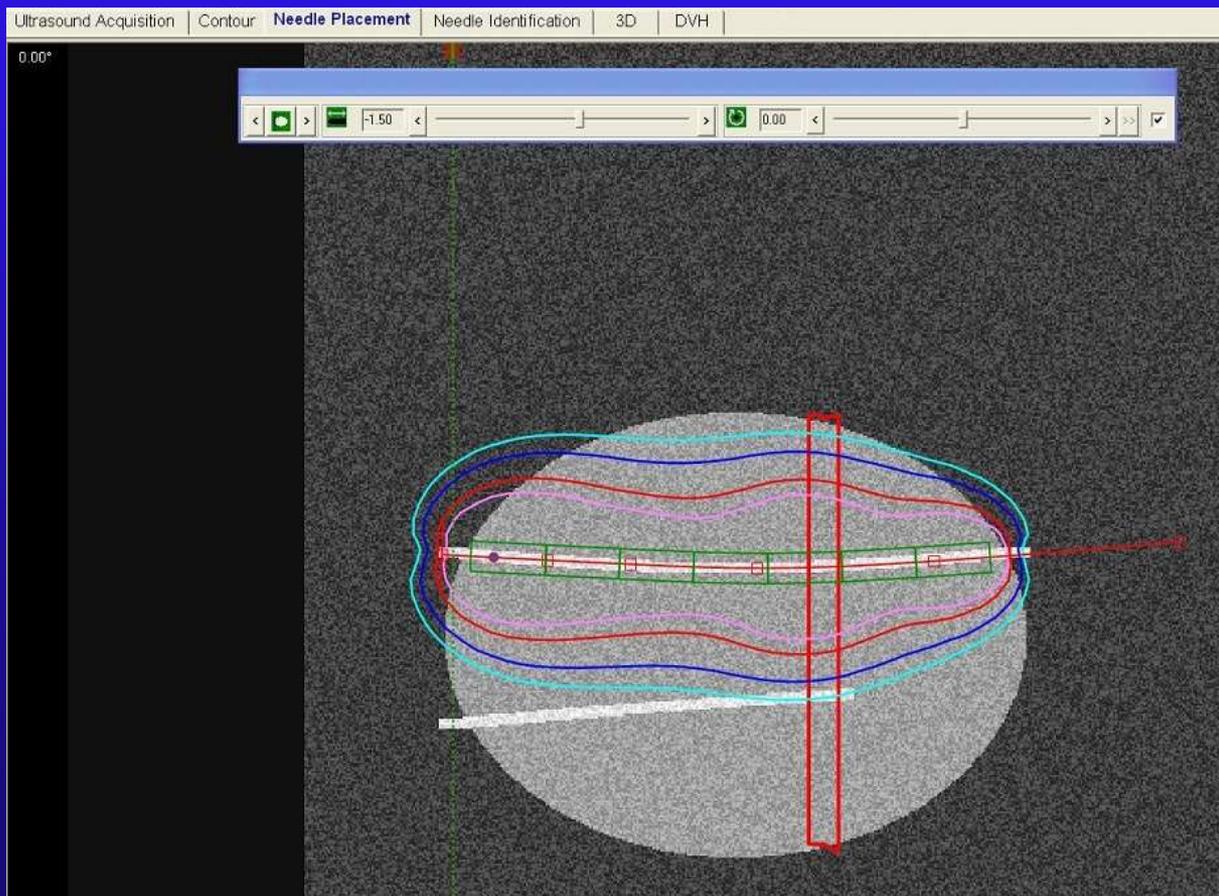
Variseed



BrachyVision

# Vitesse

Variseed-like menu



HDR source activity



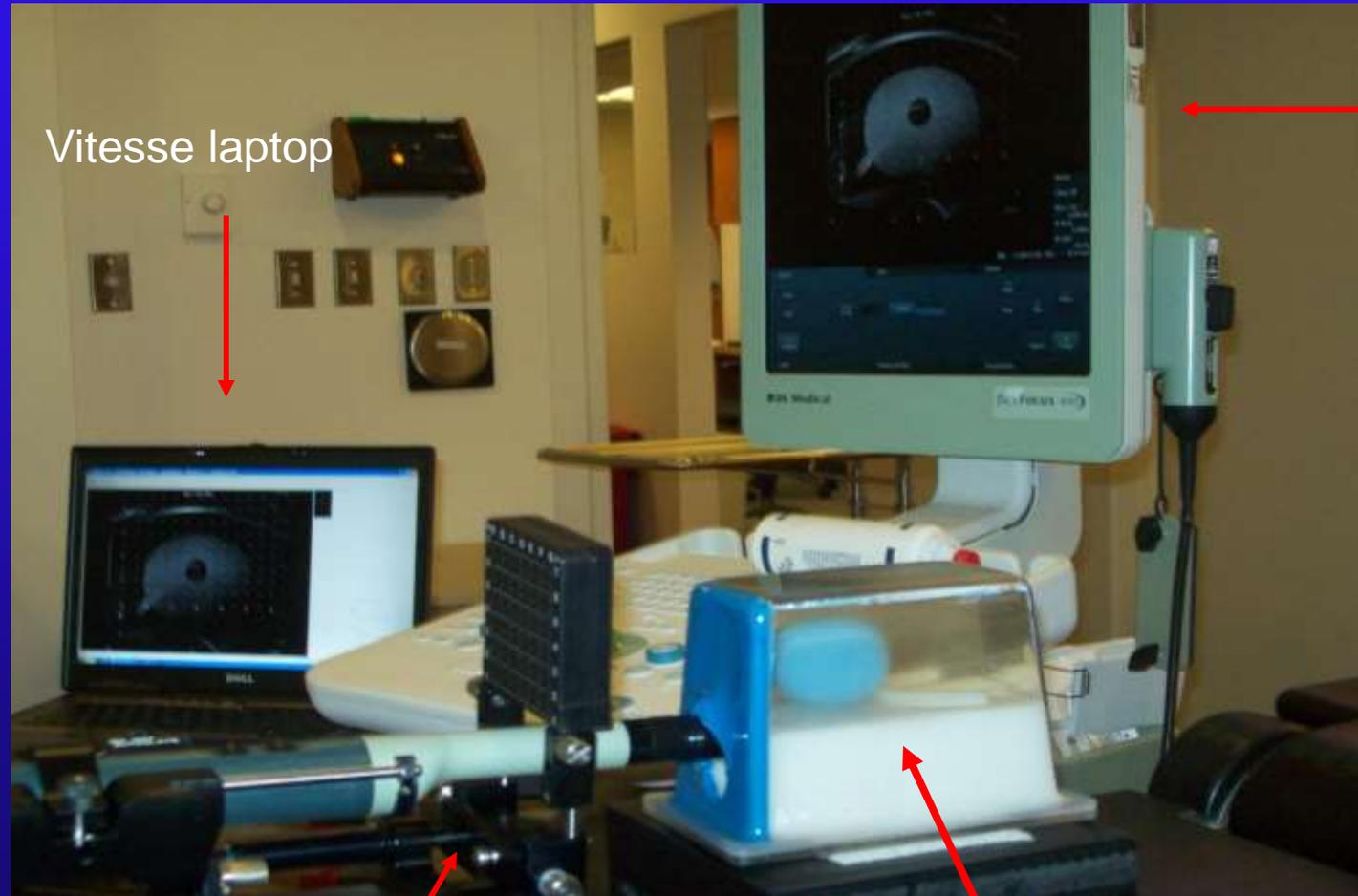
Treatment Date: 5/21/2013  
Planning Air kerma: 13318.42 U

Needle List				
#	Name	Length	Unit	Lock
1	D-3.0	130.00	cm	<input type="checkbox"/>

Longitudinal | Transverse

-1.50 cm Probe Depth  
0.0 deg Zero Probe Angle

# Dry-run set up



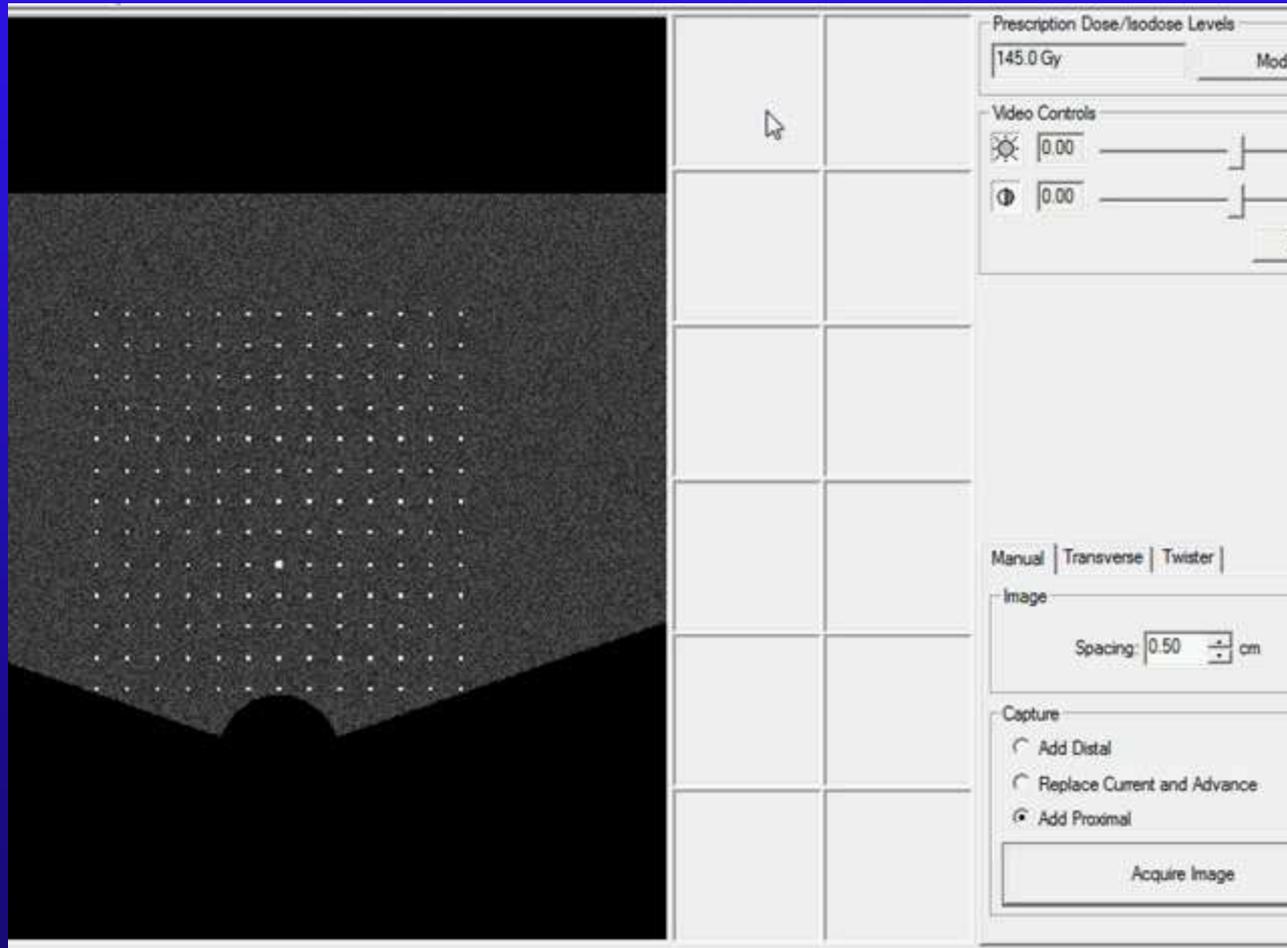
Vitesse laptop

B&K flex  
focus  
ultrasound

Civco EXII stepper

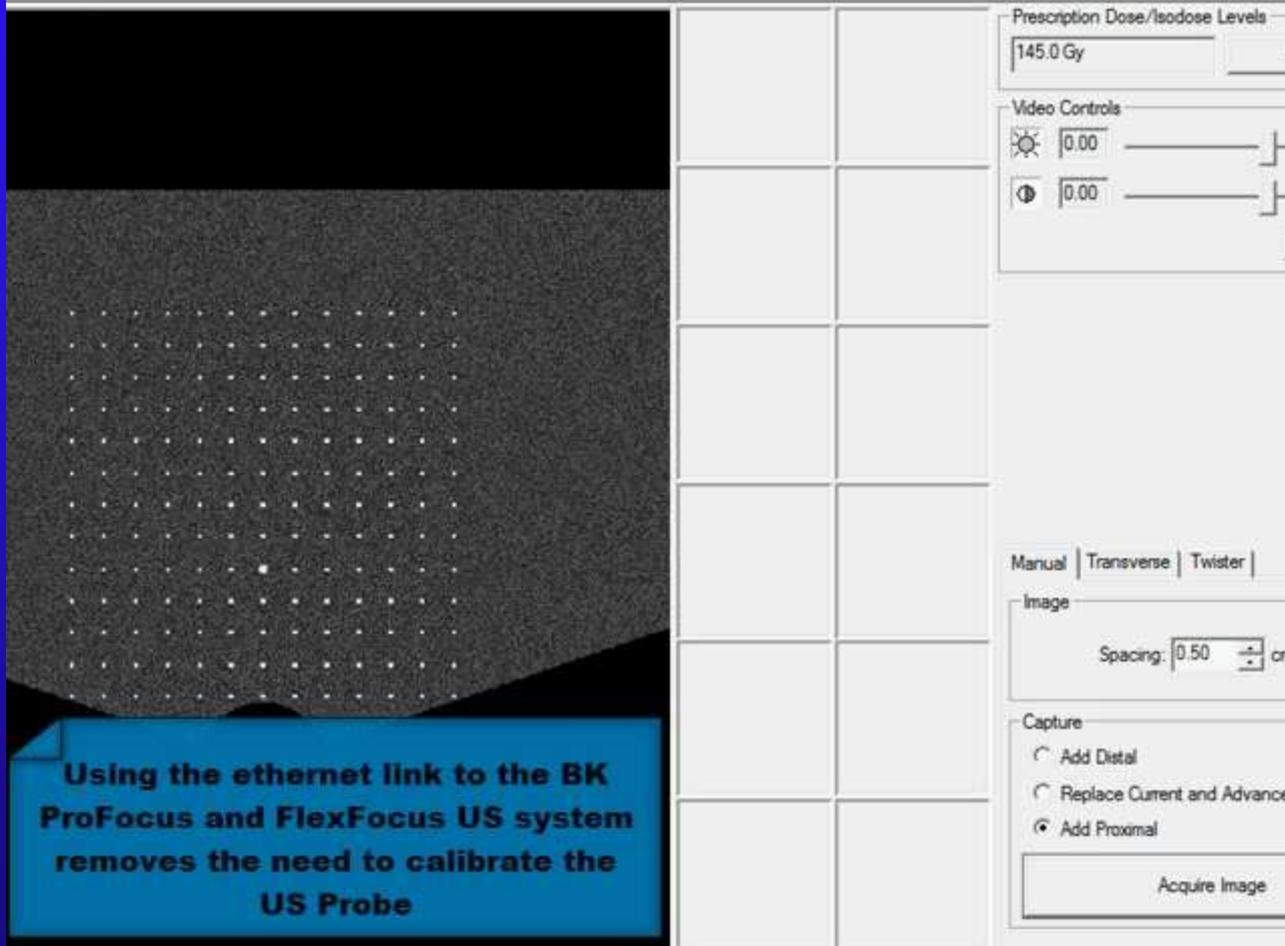
prostate phantom

# Ultrasound Capture



manual capture

# Ultrasound Capture



The image displays a software interface for ultrasound capture. On the left, a dark, grainy ultrasound image shows a grid of small white dots, indicating a tracked stepper capture. A blue callout box at the bottom left of this image contains the text: "Using the ethernet link to the BK ProFocus and FlexFocus US system removes the need to calibrate the US Probe". To the right of the image is a control panel with several sections: "Prescription Dose/Isodose Levels" with a value of 145.0 Gy; "Video Controls" with two sliders set to 0.00; a mode selector with "Manual", "Transverse", and "Twister" options; an "Image" section with a "Spacing" of 0.50 cm; and a "Capture" section with three radio button options: "Add Distal", "Replace Current and Advance", and "Add Proximal" (which is selected). An "Acquire Image" button is located at the bottom of the control panel.

Using the ethernet link to the BK ProFocus and FlexFocus US system removes the need to calibrate the US Probe

Prescription Dose/Isodose Levels  
145.0 Gy

Video Controls  
0.00  
0.00

Manual | Transverse | Twister

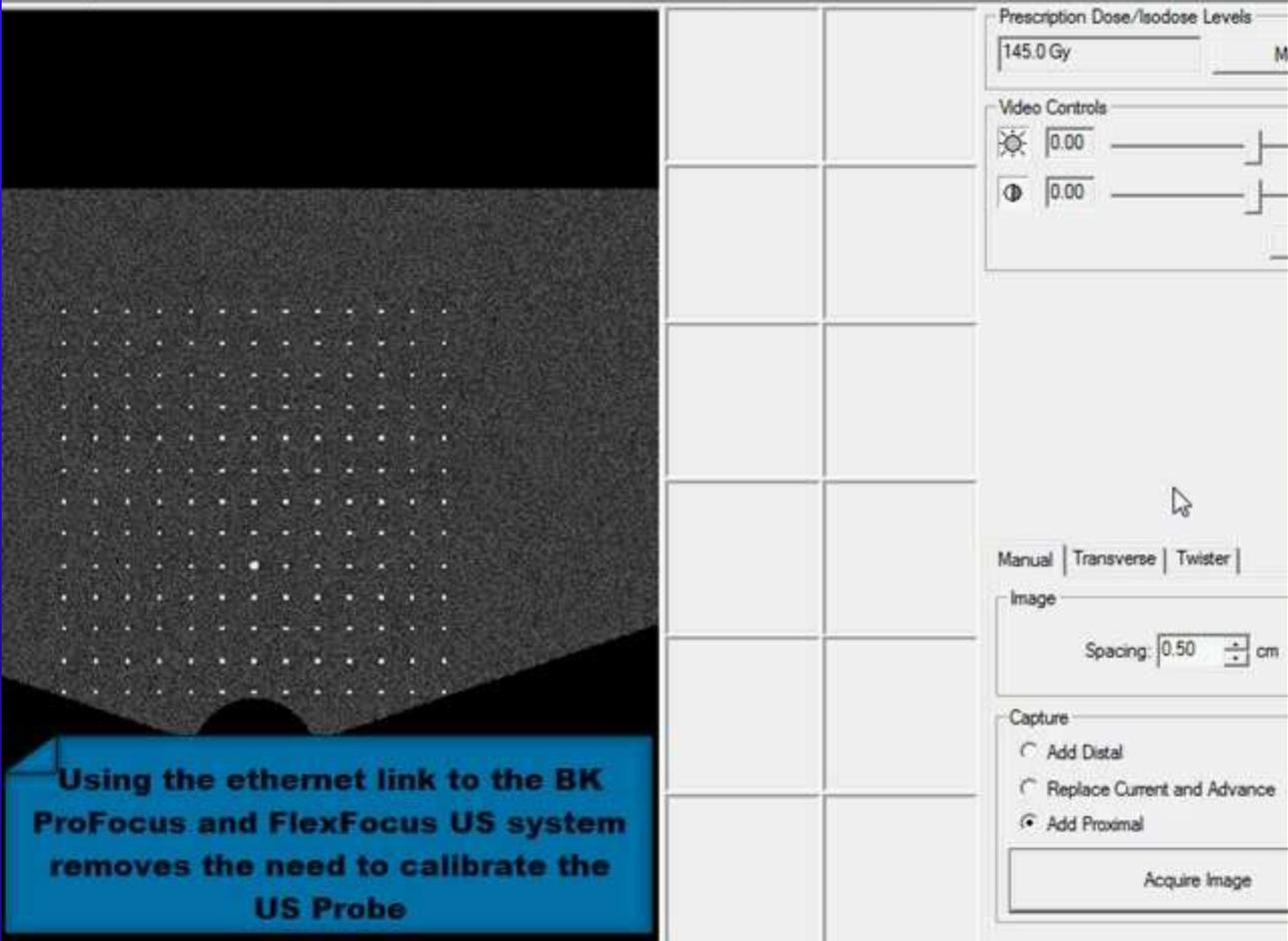
Image  
Spacing: 0.50 cm

Capture  
 Add Distal  
 Replace Current and Advance  
 Add Proximal

Acquire Image

Tracked stepper capture

# Ultrasound Capture



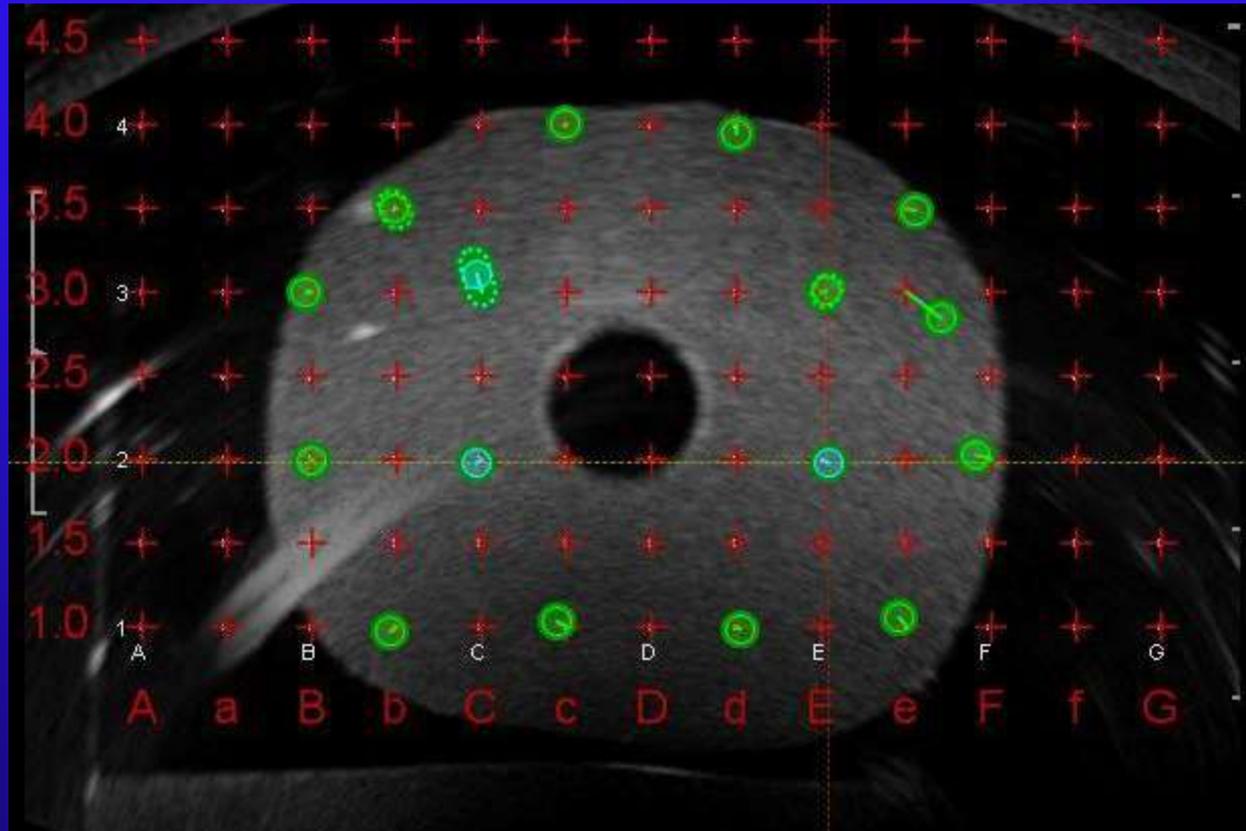
The screenshot displays the ultrasound software interface. On the left, a dark field contains a grid of small white dots, representing the captured ultrasound data. On the right, there are several control panels:

- Prescription Dose/Isodose Levels:** A text box containing "145.0 Gy".
- Video Controls:** Two sliders, both set to "0.00".
- Manual | Transverse | Twister |** A set of tabs, with "Twister" selected.
- Image:** A text box labeled "Spacing:" containing "0.50" and "cm".
- Capture:** Three radio buttons: "Add Distal", "Replace Current and Advance", and "Add Proximal" (which is selected).
- Acquire Image:** A button at the bottom of the capture section.

**Using the ethernet link to the BK ProFocus and FlexFocus US system removes the need to calibrate the US Probe**

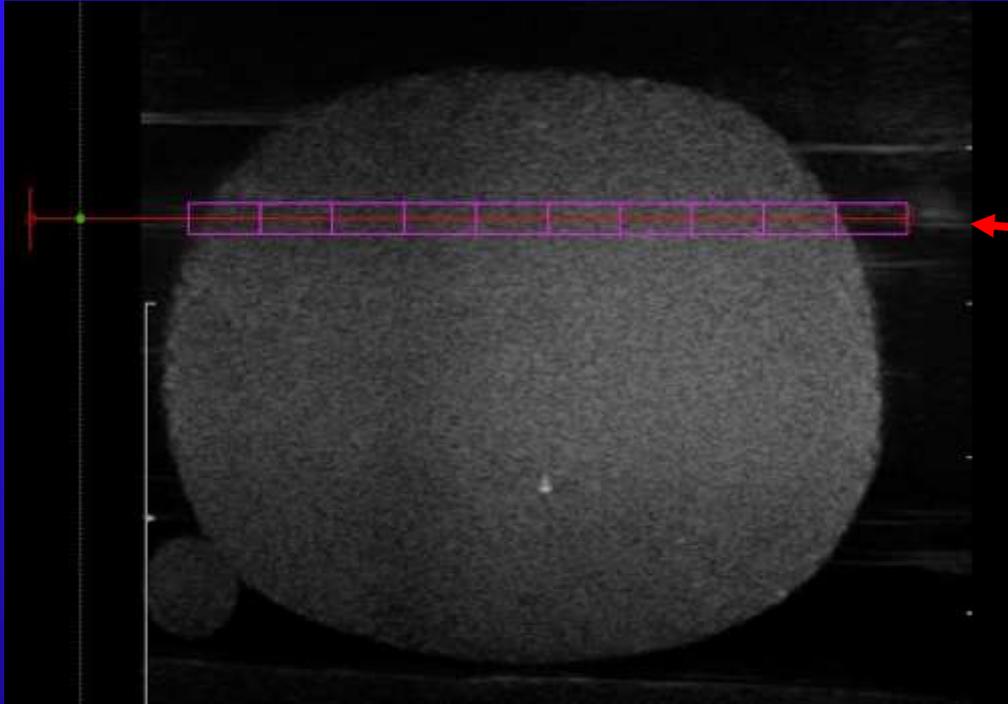
twister capture

# Needle Identification

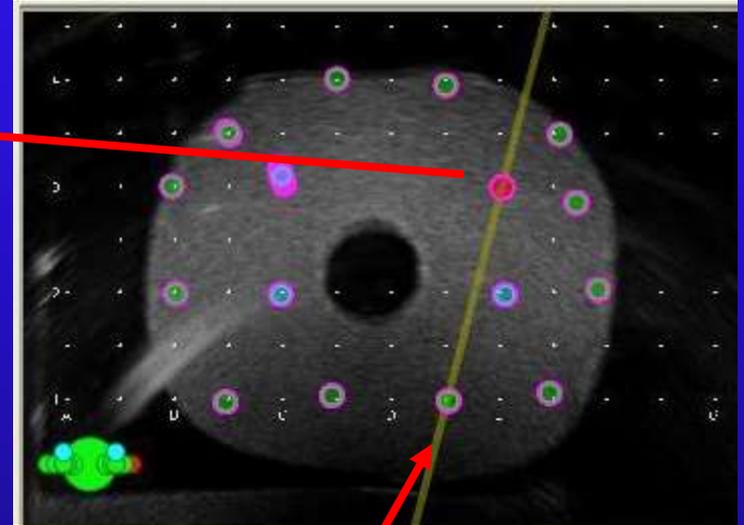


Place needles in plan where you  
think they may be used

# Preinsertion of Needle (live display)



Sagittal View (live)

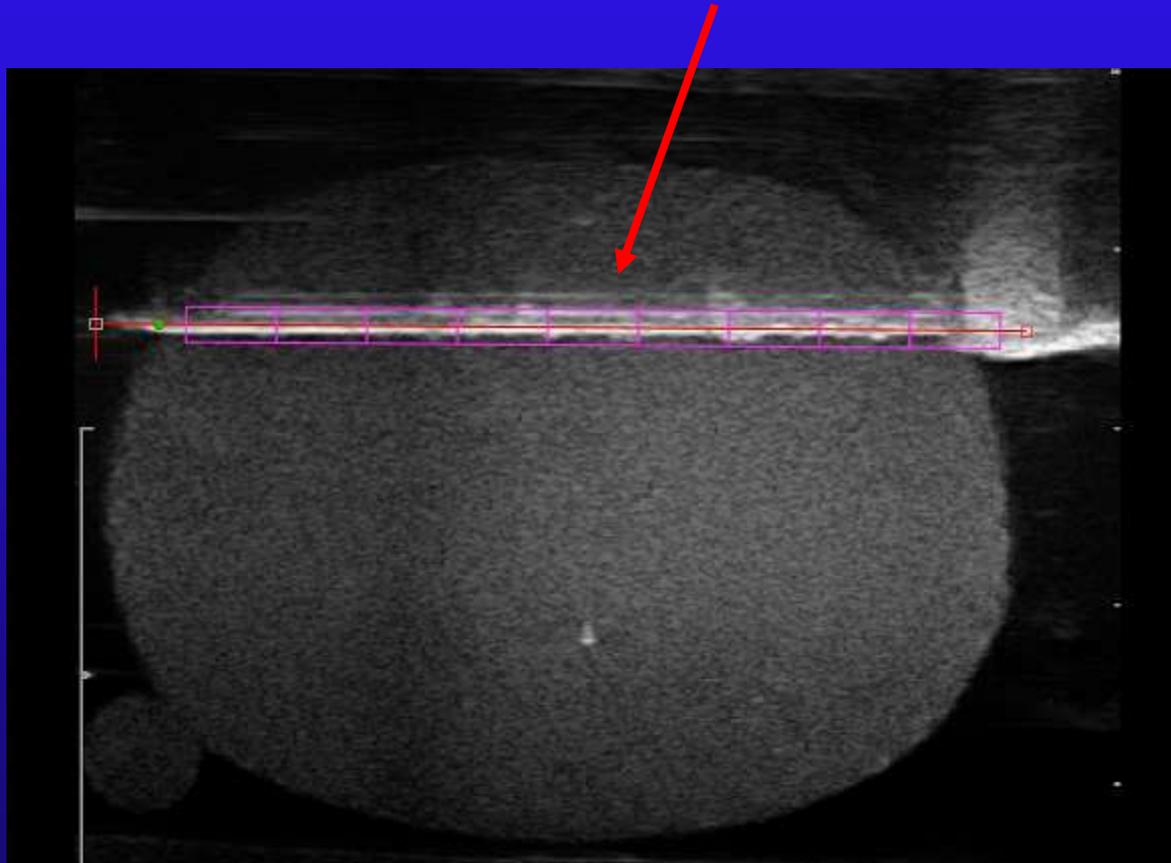


scan plane

transverse view-focus on  
needle of interest

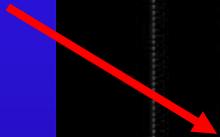
# Needle Inserted

needle flash is within the planned path

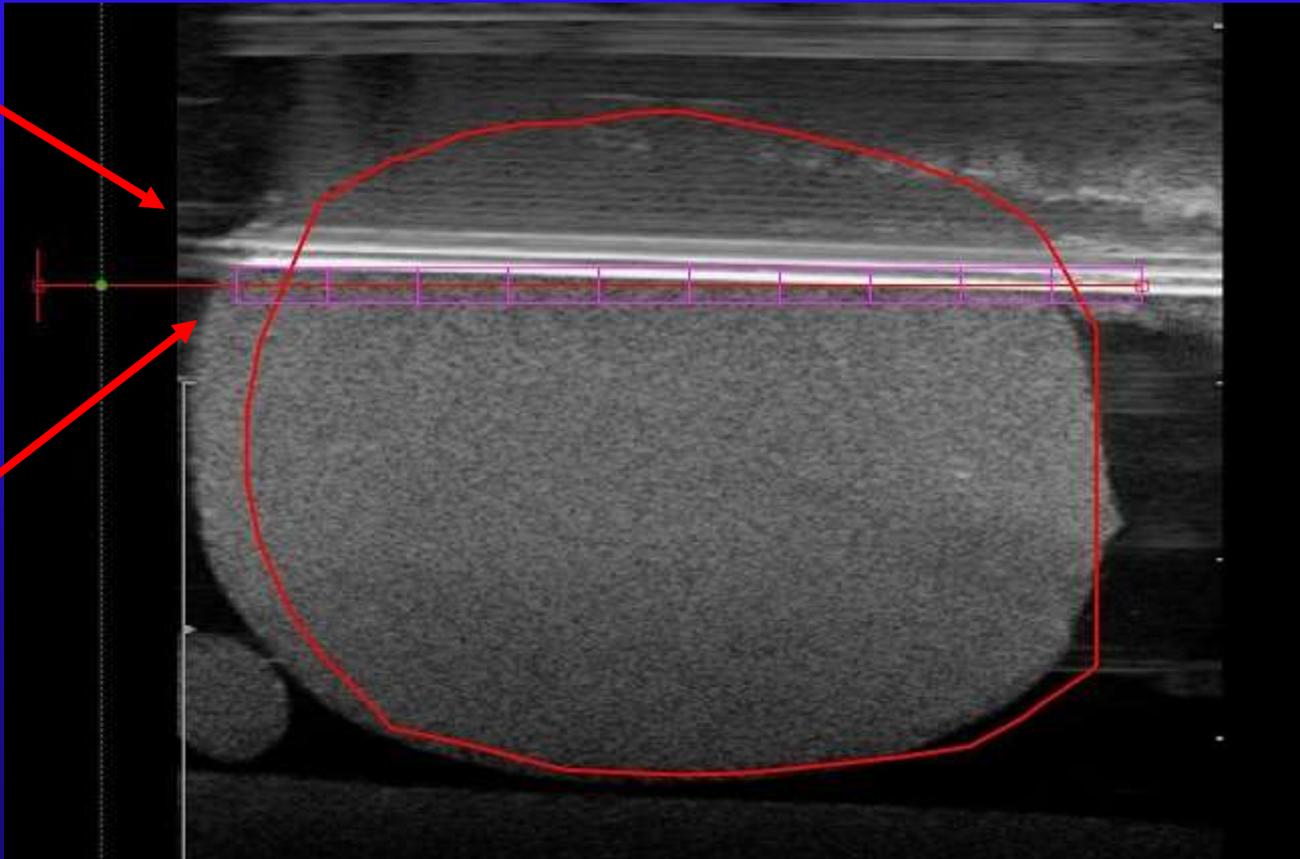
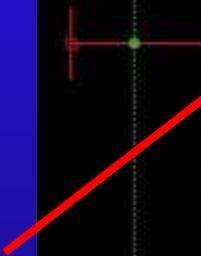


What if inserted needle does not overlie the planned needle?

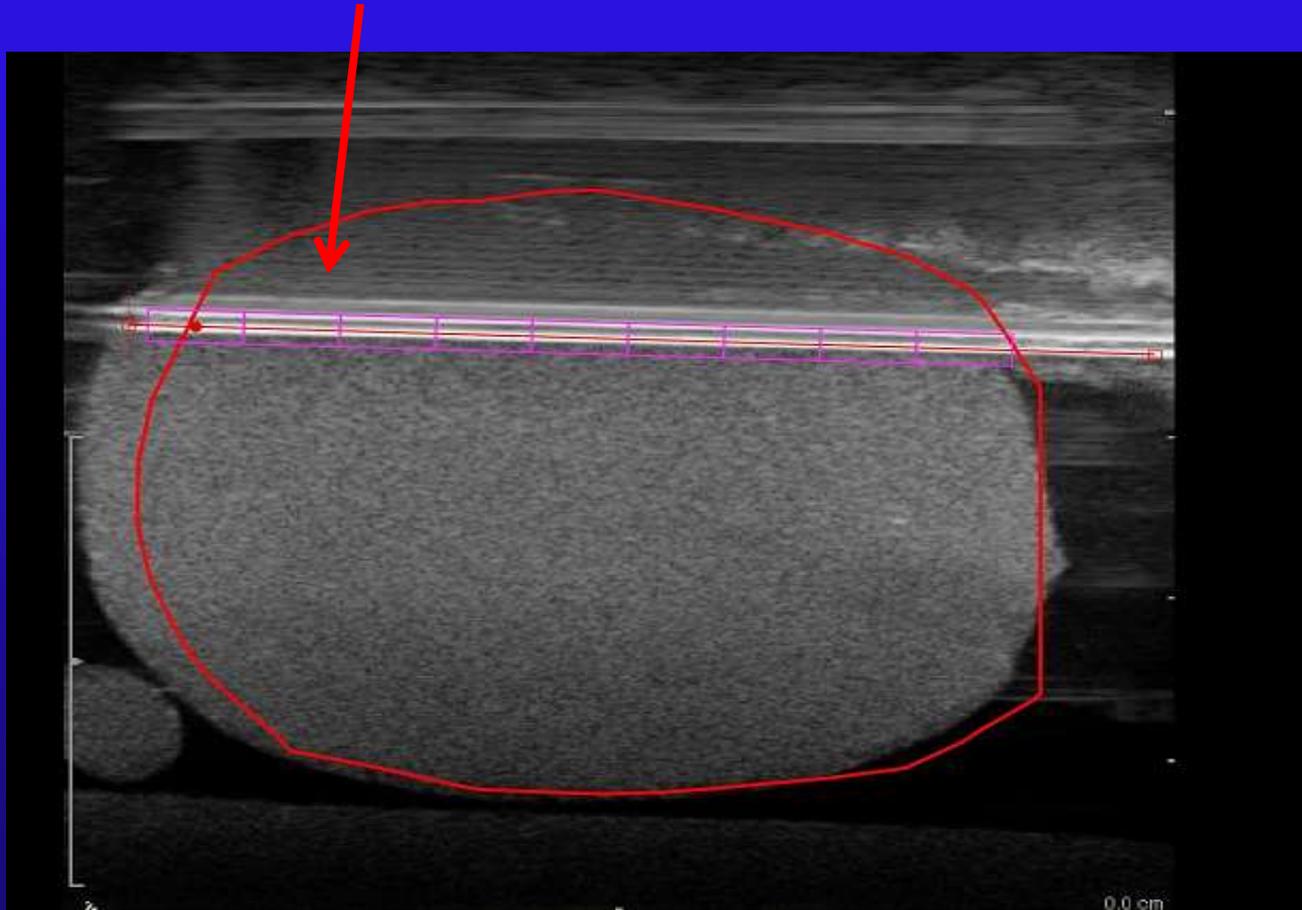
inserted



planned



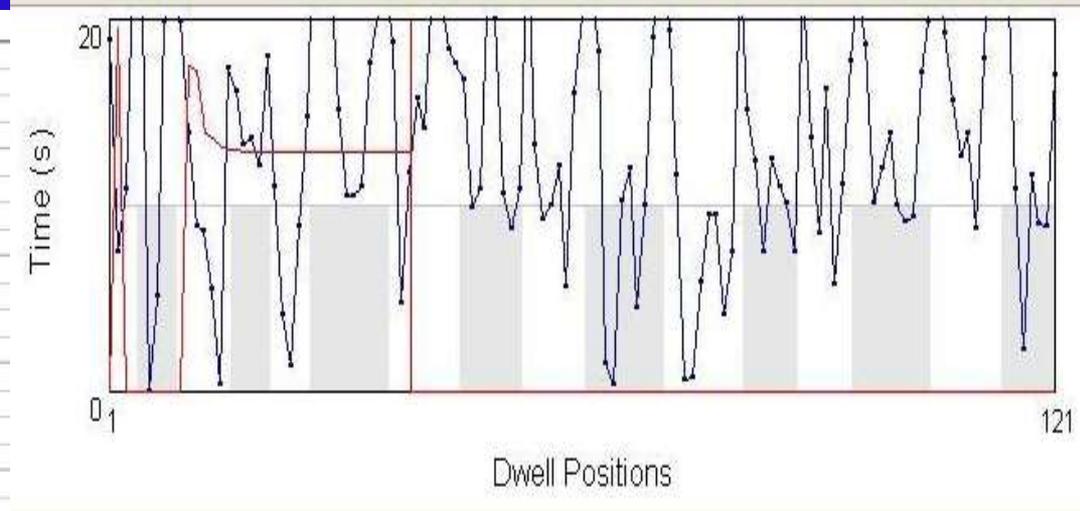
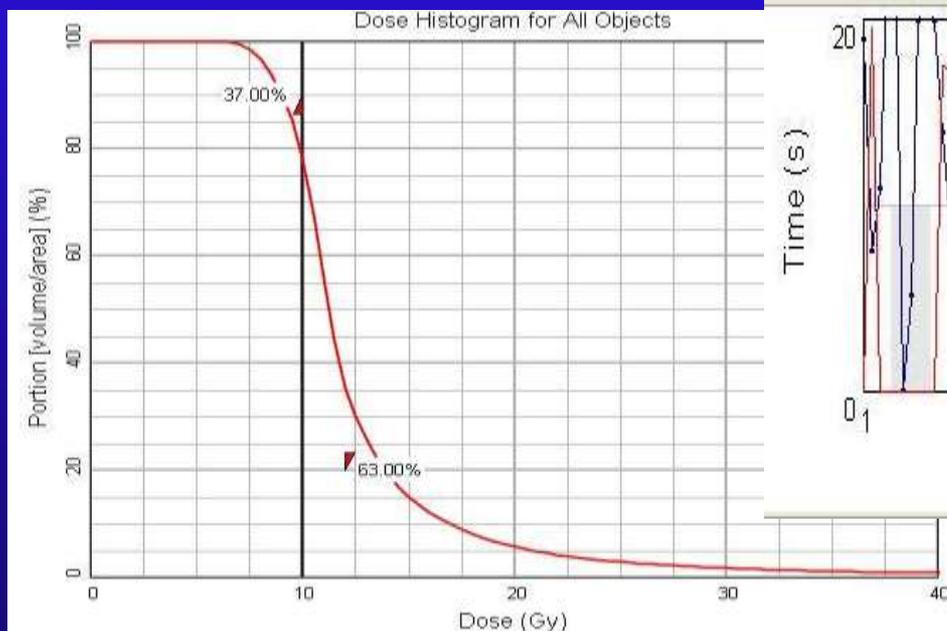
adjust the planned position (can be done with bent needles as well)



# Optimization

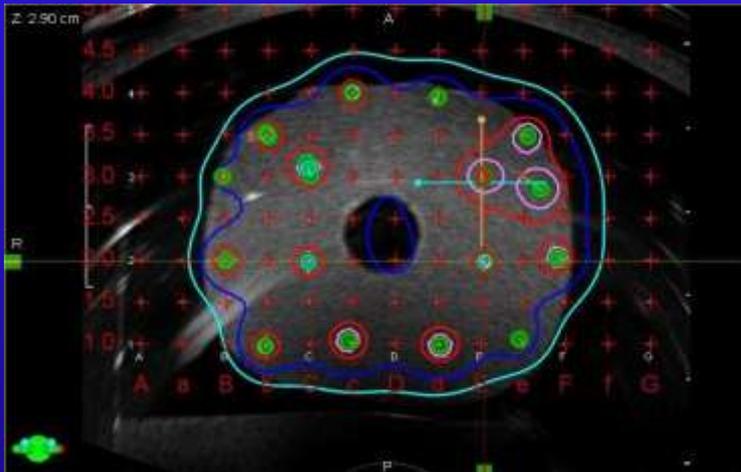
Optimization Parameters similar to BrachyVision

	Region	Coverage	Priority	Portion	< > =	Dose
<input checked="" type="checkbox"/>	Prostate	Volume	1.00	90.00	% >	100.00 %
<input checked="" type="checkbox"/>	Prostate	Volume	1.00	20.00	% <	120.00 %

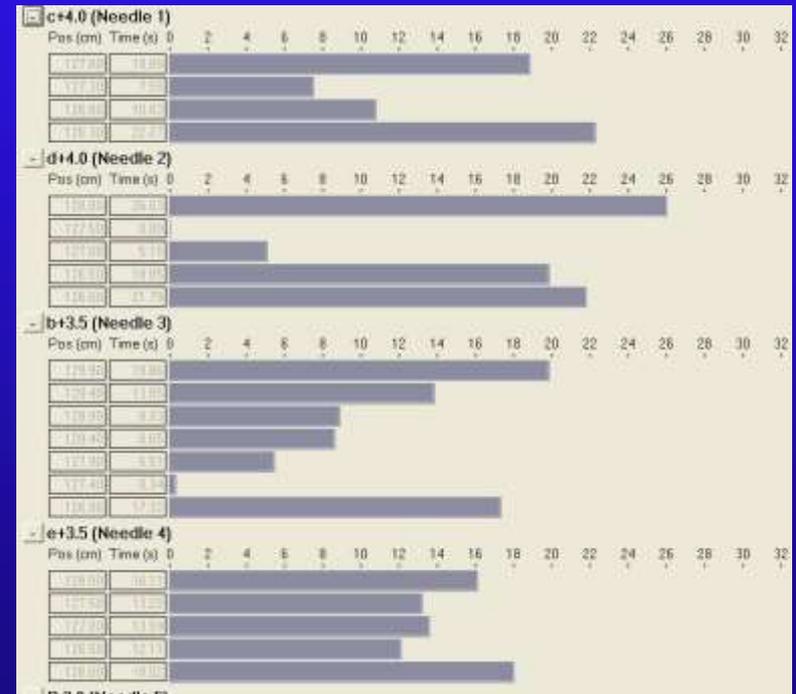


Live DVH and dwell time display

# Isodose and Dwell Control Window



Variseed-like



BrachyVision-like

# QA

- Ensure proper transfer guide tube placement
- Measure needle + transfer tube lengths
- Dose second check
- Transfer plan to HDR Treatment Console
- Check treatment parameters

# Dose second check

## Second Check

Make sure the macro is enabled on your Excel 2003 : Tools-->macro-->security level-->medium; in Excel 2007 after get the security warning, enable it in the options

1. At the Brachytherapy Planning server, Go to File-->Print-->Report-->choose the Generic/Text Only as the printer and QAExportPlain.tml as the layout (already set as default) -->OK-->name it as "c:\PATIENTNAME.txt"

Please specify the full path of it

2. Go to the desktop where the AUTO\_CAL.xls is at

3. Two ways to activate the macros: a. use short cut key: ctrl+shift+A or b. under excel go to tools -->macros-->macro-->Run the sheet1.Auto\_CAL

Dose Rate Constant for Source 1.1 cGy/hU

Activity to Kema Conversion 4.03 U/mCi

Source Treatment Activity 4213.27 mCi

Position [cm]	DwellTime [s]	X [cm]	Y [cm]	Z [cm]
120.3	5.5	2.07	-10.91	-42.88
120.1	0.5	2.07	-10.87	-42.68
119.3	0.1	2.07	-10.89	-41.9
119.1	0.7	2.07	-10.85	-41.71
118.9	1.9	2.06	-10.6	-41.51
118.7	2.8	2.06	-10.58	-41.32
118.5	2	2.06	-10.51	-41.12
118.3	0.5	2.06	-10.47	-40.92
118.1	0.1	2.06	-10.43	-40.73

## REFPOINT DATA

Id	X [cm]	Y [cm]	Z [cm]	TG43Dose	SecondCalcDose	Pct Error [%]
F1						
dose pt	4.9	-12.05	-42.4	463.9	456.40	-1.62
	X					

Approval \_\_\_\_\_ Date \_\_\_\_\_

Excel spreadsheet reads in dwell positions and times, recalculates dose to dose points

# Partial prostate HDR

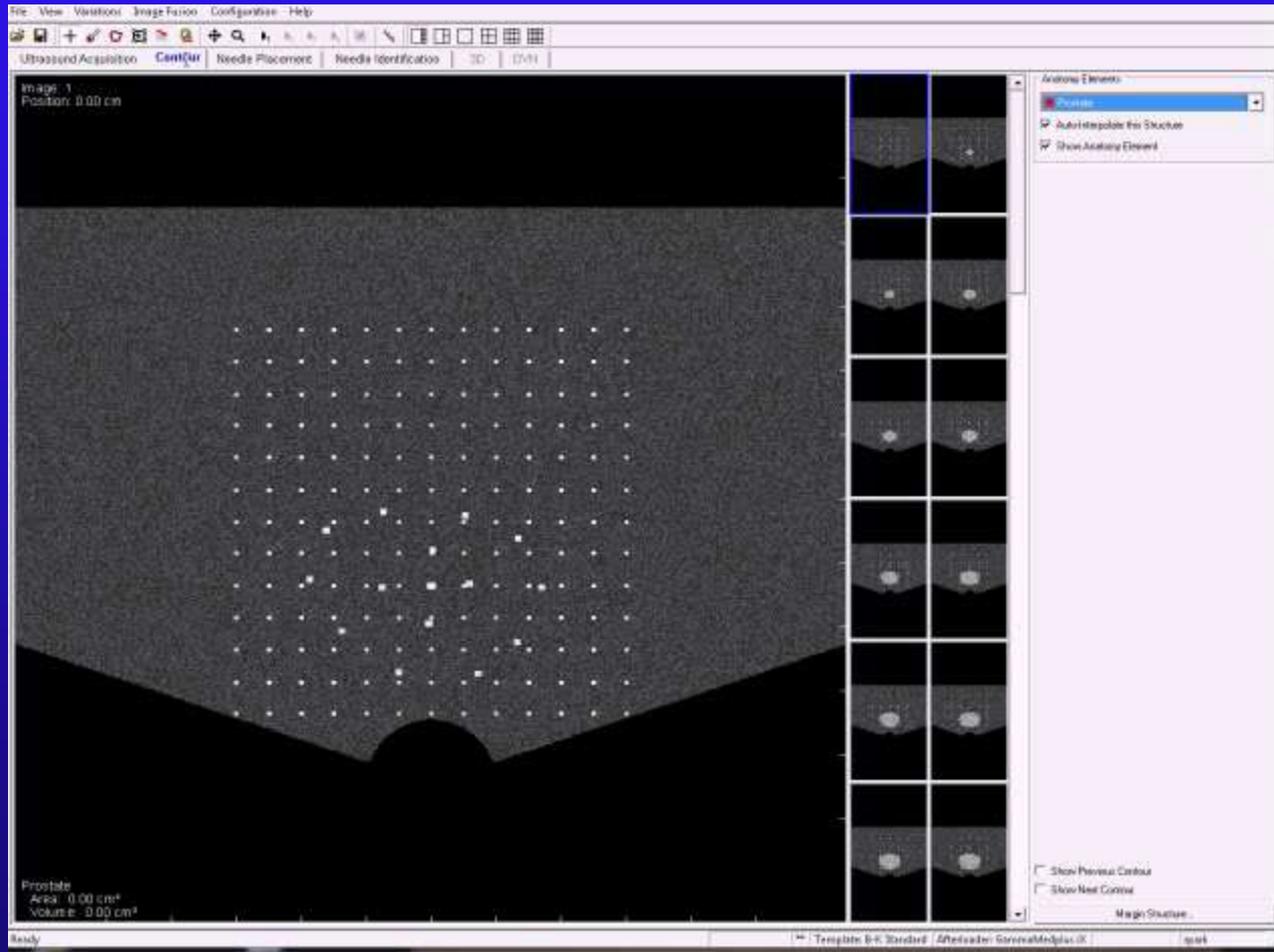
- used for low risk patients
- dosimetry can be optimized to spare adjacent structures
- CTV can be based on MRI
- US guided partial prostate HDR can be used to spare urethra, rectum

# Grant to be Submitted

## *Ultrasound*

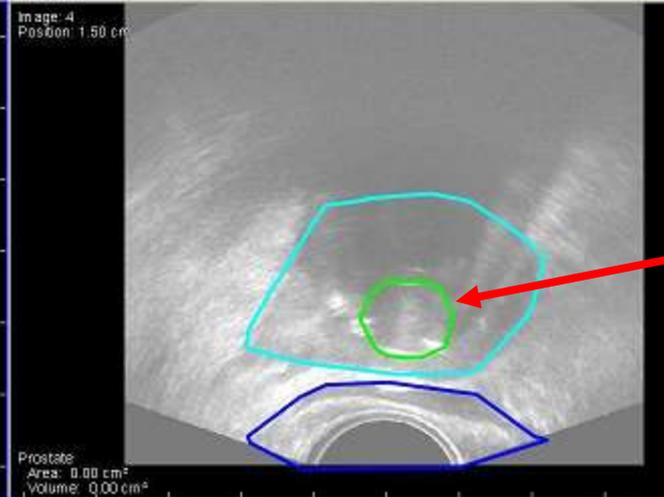
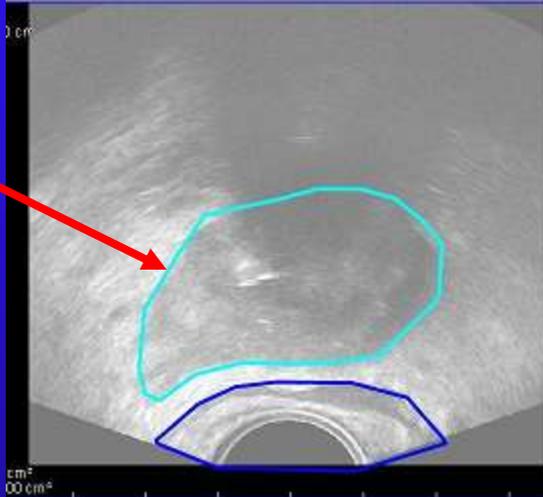
~~CT-on-Rails~~-Guided Partial Prostate HDR Brachytherapy:  
A Therapeutic Alternative to Reduce Morbidity and  
Overtreatment for Low-Risk Prostate Cancer  
**PI:** Timothy N. Showalter, MD (Department of Radiation  
Oncology)

# Ultrasound/MR fusion

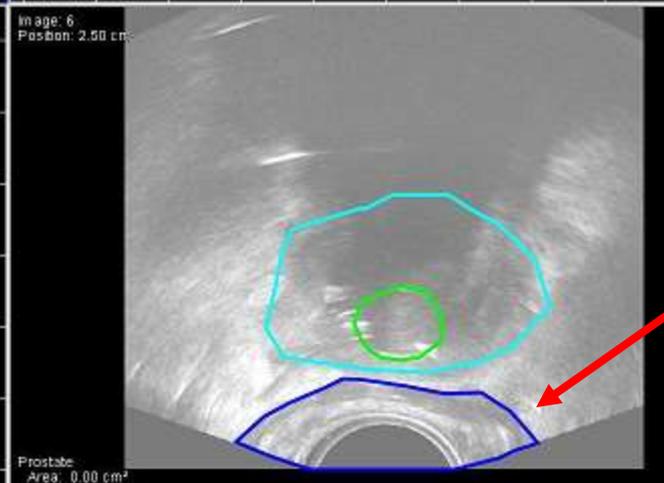
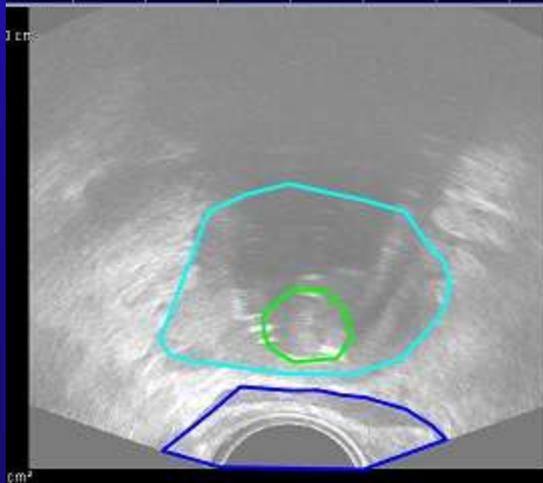


# Other Uses Syed Implant

Tumor

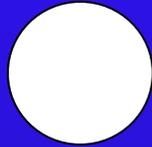


Vaginal Dilator



Rectum

# Points to Ponder



# Points to Ponder (cont'd)

- Patient Selection
- Ultrasound in place for treatment?
- Database Management

# Brachytherapy Planning Systems

BrachyVision

VariSeed

Vitesse

BeBig Eye Plaque





## Vitesse User's Guide:

“Vitesse is intended for use by an expert user....Besides having professional certification, users shall be fully trained in HDR brachytherapy procedures, transrectal ultrasound brachytherapy, and the Vitesse application”

# In case of problems...



do a CT scan and plan in BrachyVision

# Conclusions

- Vitesse 3.0 is a full treatment planning system for ultrasound guided prostate HDR
- optimized for use with existing equipment (B&K ultrasound, Civco tracked steppers)
- can be integrated into a scan-plan-treat IGBT workflow
- all caveats are presumed- correct source activity, acceptance testing, commissioning and training
- can fuse with MR for partial prostate HDR
- some utility for gynecological treatments (???)

# Acknowledgements

- Varian Brachytherapy- Wayne Lajoie, Karen Kigin, Rebecca Park, Sophie Weatherall
- Multiple Varian Webinars on MyVarian.com
- Paul Bagli- Civco
- Jerry Fiddes- B&K Medical



“A boy loves his dog”- Harlan Ellison