



# Intra-operative planning: The gold standard of care in LDR ?

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St James's  
Institute  
of  
Oncology

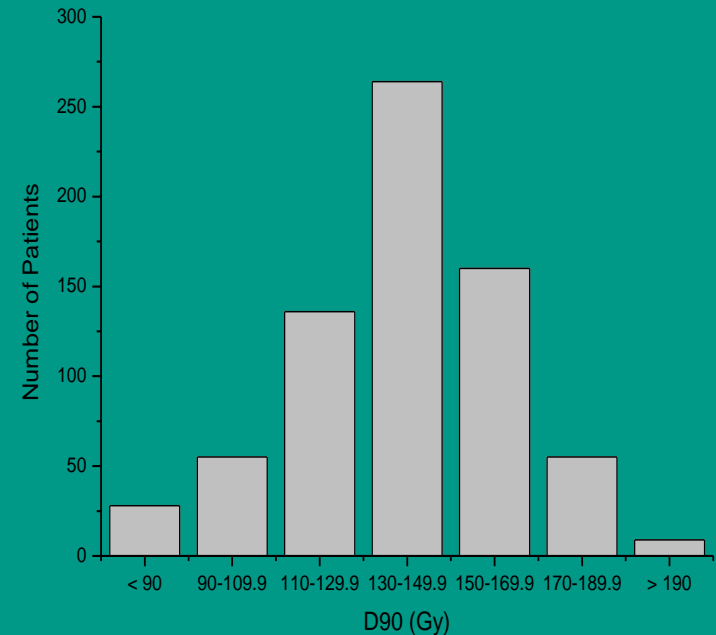
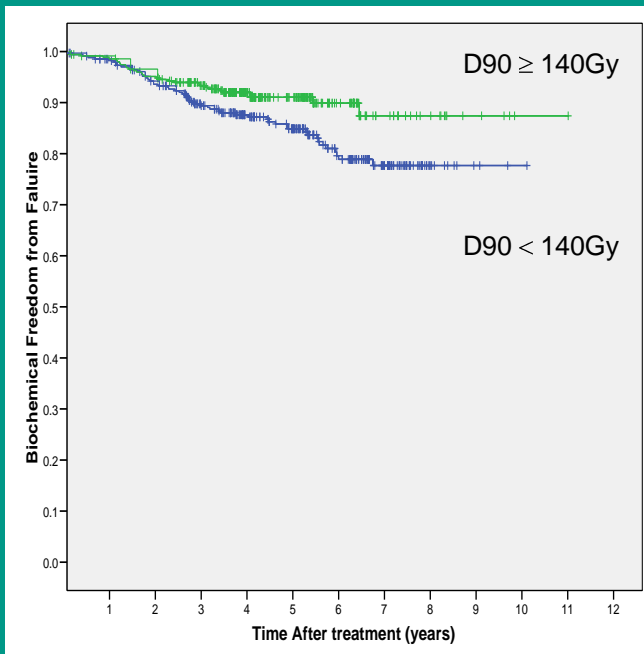
The Leeds Teaching Hospitals **NHS**  
NHS Trust

# Prostate Brachytherapy in Leeds

- 1995: I-125 implants as two step pre-plan commenced at Cookridge
- 1999: Move to 'all-in-one' pre-plan procedure
- 2001: 90% patients done as 'all-in-one'
- 2009: Move to St. James's site
  - 141 patients 'all-in-one'
  - 16 'two-step'
- Present: over 2,500 patients treated and commencing interactive treatments



# Post-implant dosimetry correlates with outcome: Leeds biochemical control (N=1298)



NADIR +2 Definition

Log rank = 0.01

Normal distribution: patients at lower end may have poorer cancer control and those at higher end more toxicity

# Intra-operative planning: Terminology

Planning modality	Description
Intra-operative planning	Creation of a plan on the OR just before the implant procedure, with immediate execution of the plan
Interactive planning	Stepwise refinement of the treatment plan using computerised dose calculations derived from image-based needle position feedback
Dynamic dose distribution	Constant updating of calculations of dose distribution, using continuous deposited seed position feedback

# Intra-operative vs. two step pre-plan technique

- Advantages:
  - Reduces risk of introducing systematic error between pre-plan and implant
  - More convenient for patient
  - Overall time in OR less
- Disadvantages:
  - Risk of seed wastage/over-ordering
  - Risk of being unable to implant if gland larger than expected
  - Plans need to be produced quickly
  - Resources: multiple physics staff need to be available

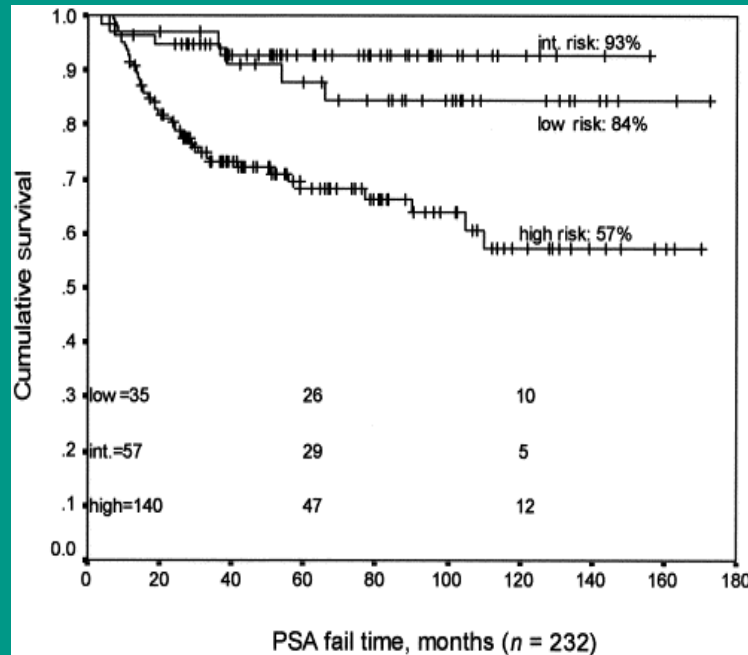
# Studies of intra-operative vs. two step pre-plan techniques

- Retrospective and prospective studies
  - A number of studies show significant improvement in dosimetry using intra-operative vs. 2 step
- Impact on clinical outcomes
  - Shah et al. Cancer J. 2006;12:289-97
  - 42 patients 2 step, 93 intra-op pre-plan between 1996-2001, not randomised
  - Improved biochemical control and disease free survival (87% vs. 99%) at 4 yrs with intra-op pre-plan technique

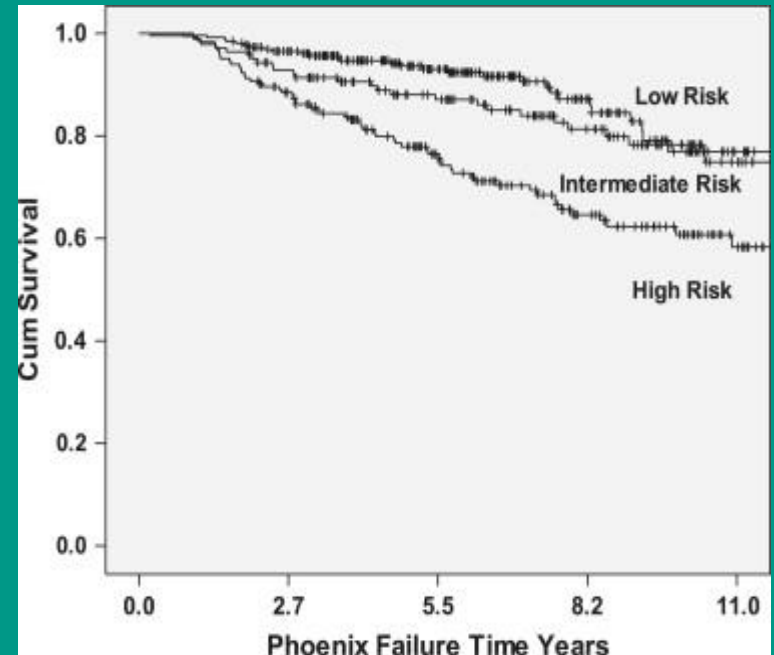
# Intra-op pre-plan vs. interactive planning

- No direct randomised comparisons
- Interactive generally compared with historical series which introduces bias
- Interactive may result in improved dosimetry but ? Clinical impact
- Interactive has limitations
  - Interactive planning based on needle position may not replicate actual seed position
  - Changes in prostate volume are not accounted for by TPS
  - Loose seeds may move and strands may retract after deposition and over time

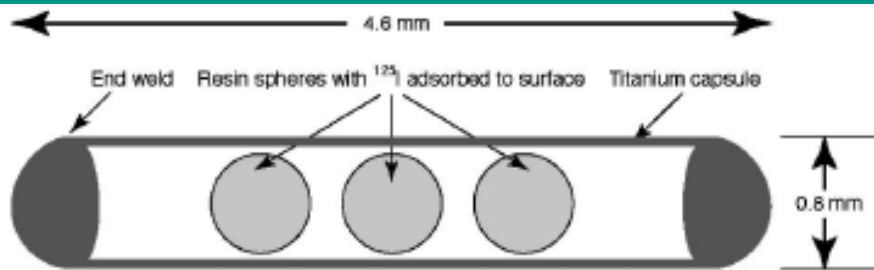
# Equivalent long term outcomes: Seattle vs. Mount Sinai



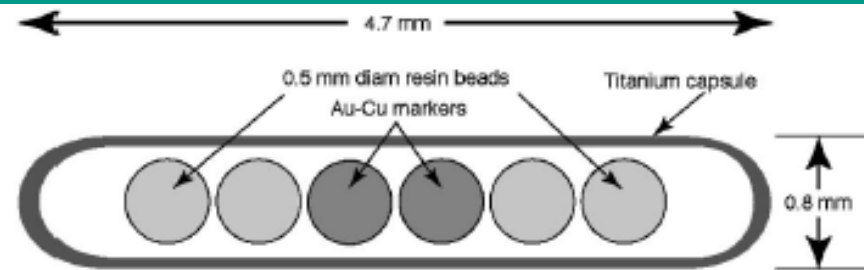
Seattle: Pre-plan 2 step  
technique



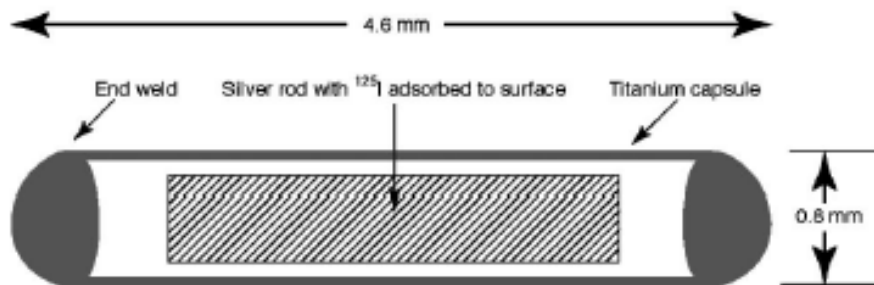
Mount Sinai: Interactive  
technique



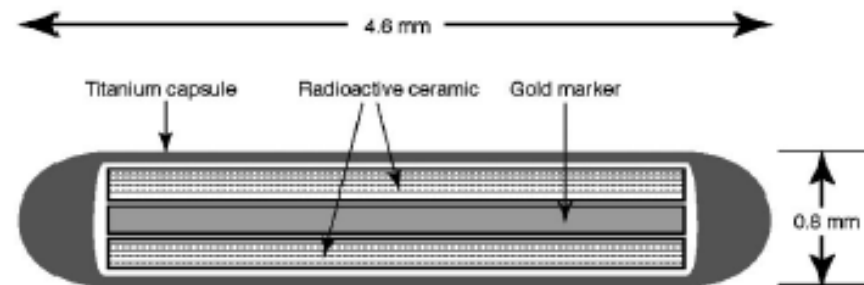
Amersham Health model 6702 source



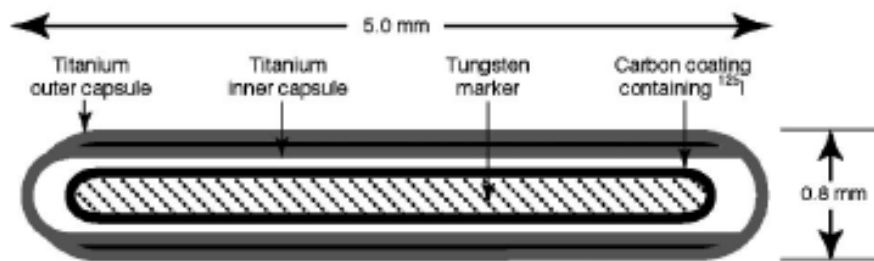
NASI model MED3631-A/M or MED3633 source



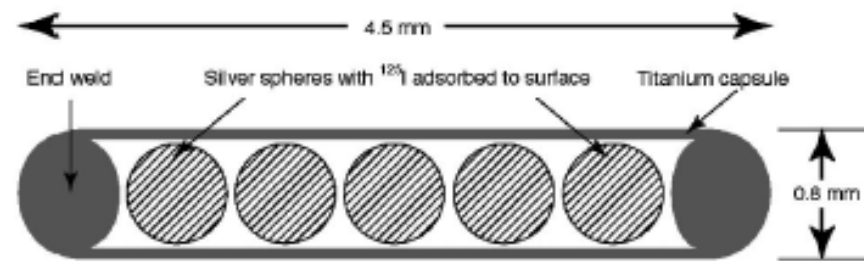
Amersham Health model 6711 source



Bebig model I25.S06 source

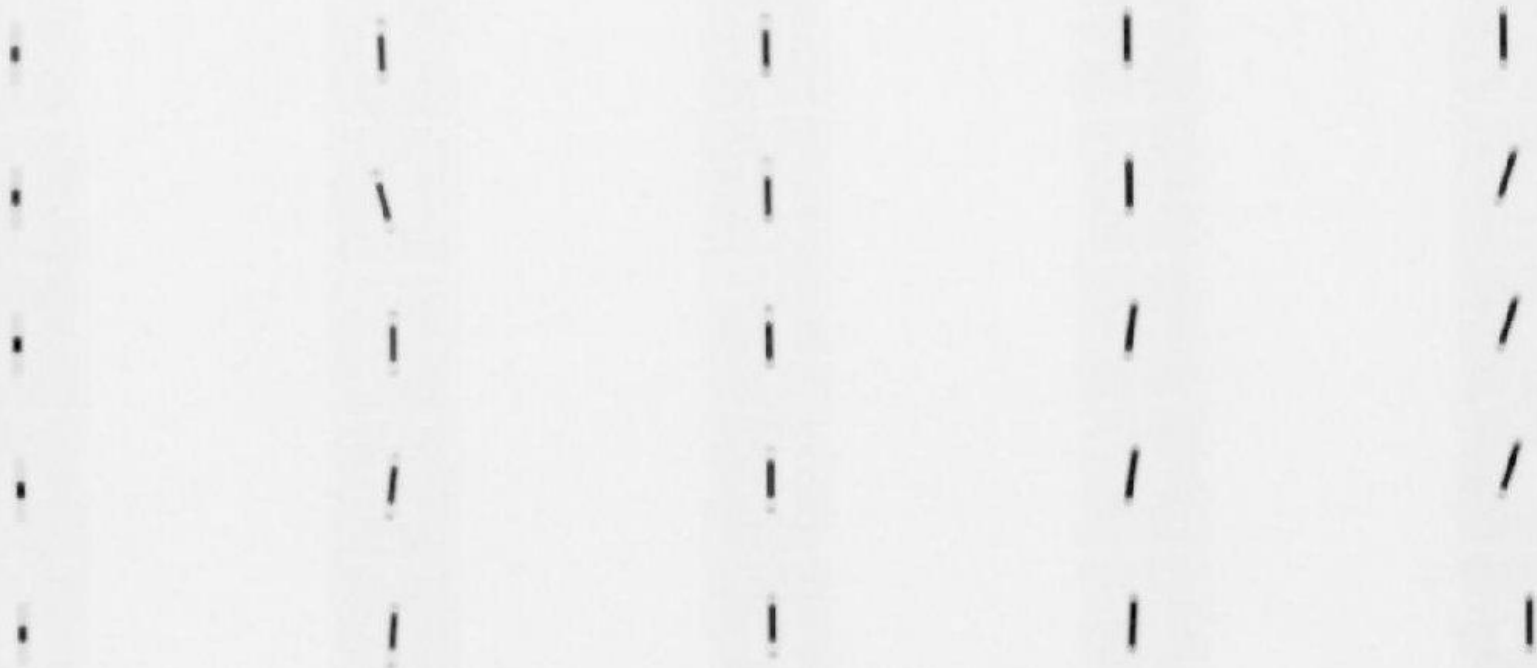


Best model 2301 source



Imagyn model IS-I2501 source

# Visibility on X-Ray



lBt

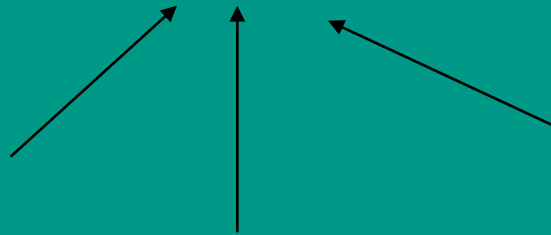
Echo

RS

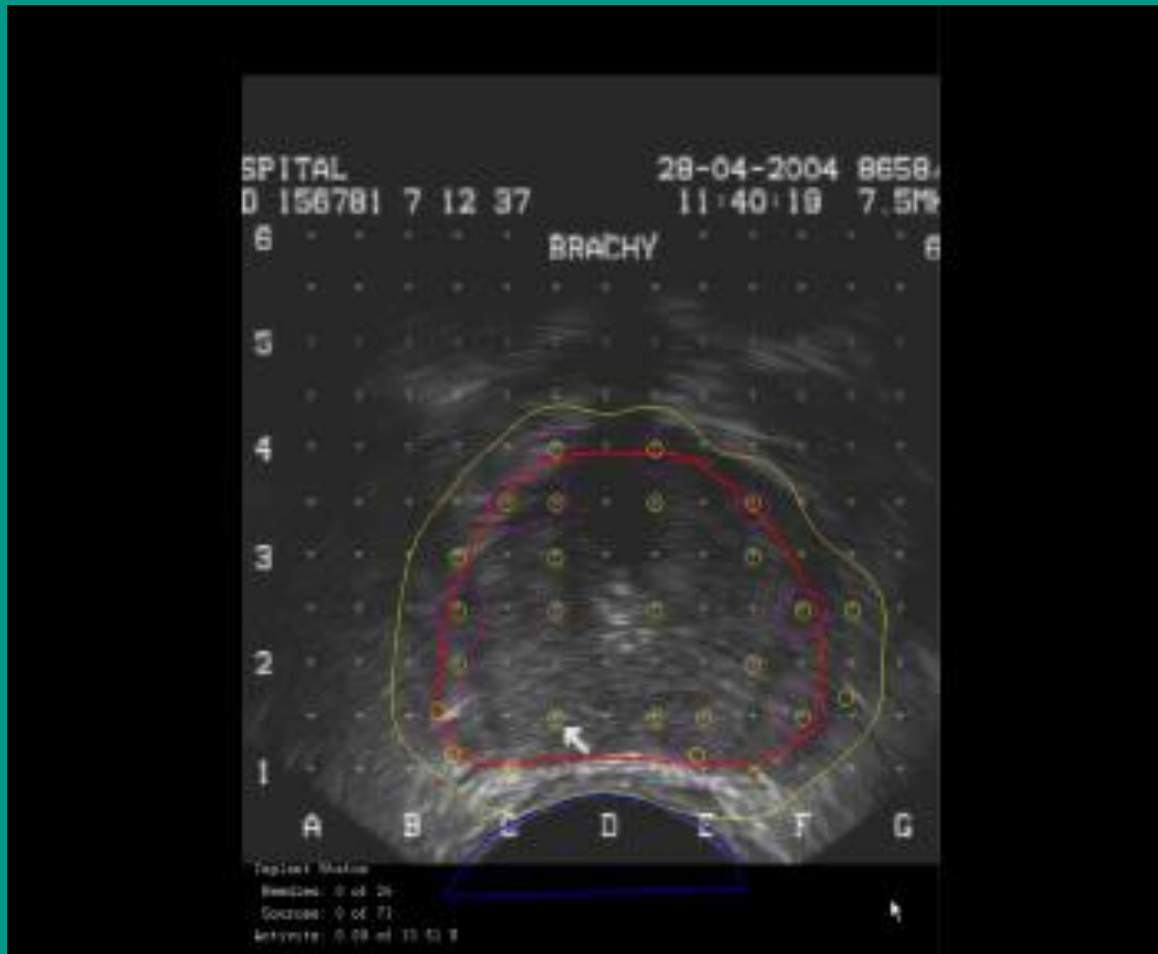
Bebig

Nucl

# TPS



# Theatre planning and implantation



# Theatre Dosimetry Planning

File View Variations Configuration Help

UltraSave Id Acquisition Template Registration Contour Source Placement Implant 2D View 3D View DVH CVA

BRACHY 6.3

6  
5 Prescribed Dose  
4  
3  
2  
1  
A B C D E F G

Real-time updated dosimetry

Transverse  
Position: 2.13 cm

Longitudinal

Coronal

Prescription Dose/Isodose Levels

145.0 Gy Modify...

Dose (Gy)	Dose (%)	Color
<input checked="" type="checkbox"/> 290.0	200 %	
<input checked="" type="checkbox"/> 217.5	150 %	
<input type="checkbox"/> 181.2	125 %	
<input checked="" type="checkbox"/> 174.0	120 %	
<input type="checkbox"/> 145.0	100 %	

Activity: 0.448 U

Longitudinal Transverse

2.13 cm [Zero Probe Depth]

Overlay Controls

Sources  Anatomy  
 Landmarks  Isodose Contours  
 Needle Paths

Dosimetric Quality Alerts

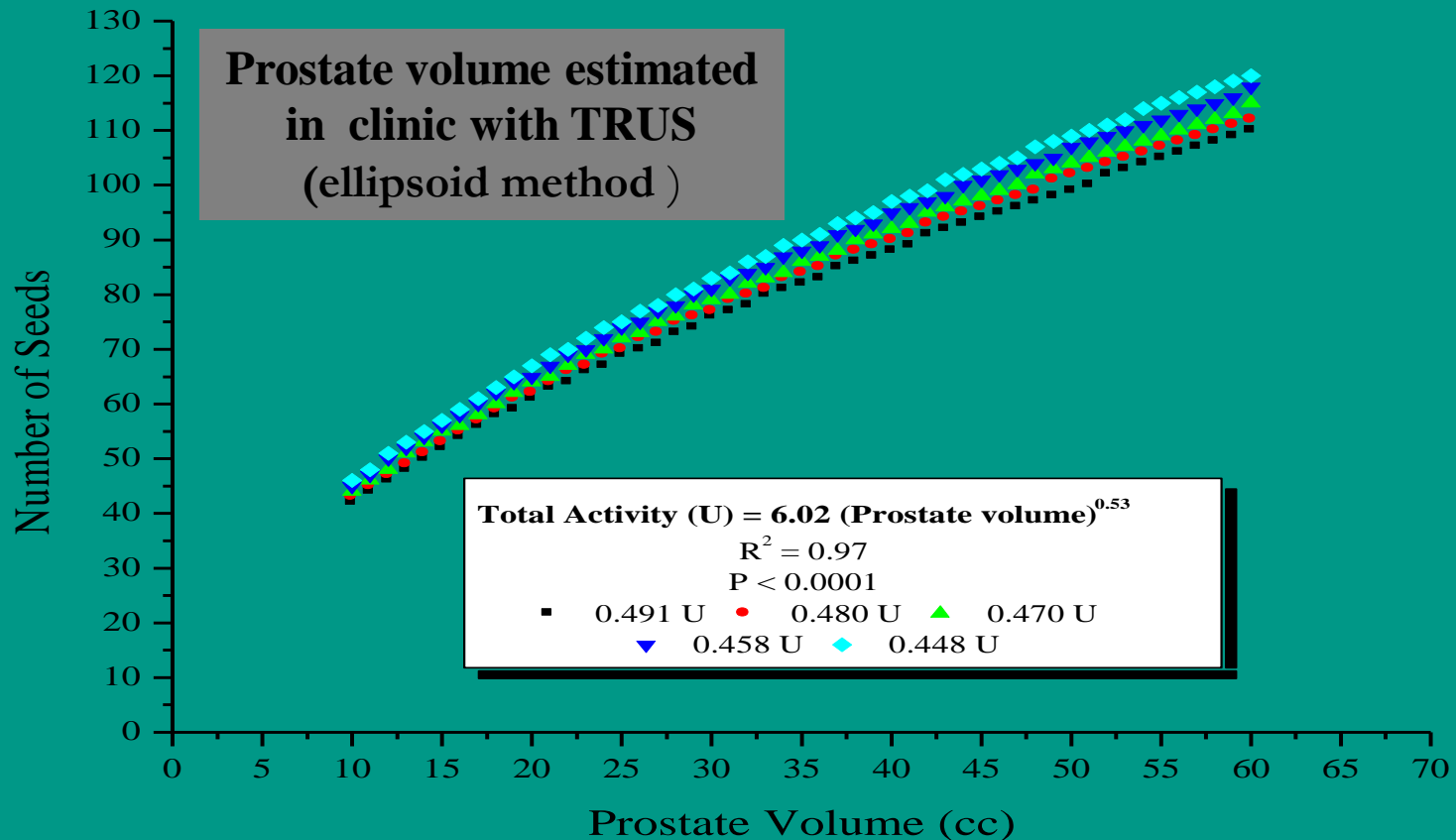
Prostate - V100: 100.0 %  
Prostate - V150: 62.4 %  
Prostate - V200: 22.5 %  
Prostate - D90: 190.0 Gy

Set ...

Auto Placement...

# Leeds Nomogram

*seed ordering: Al-Qaisieh et al,  
2006*



# Intra-operative pre-plan vs. interactive planning

- Advantages
  - Less complex, minor change to 2 step pre-plan technique
  - Requires less technology, equipment and physics input
  - No significant difference in clinical outcomes
- Disadvantages
  - In multi-operator teams interactive may produce more consistent dosimetry
  - For new operators there is still a learning curve