Prostate Brachytherapy Support Group

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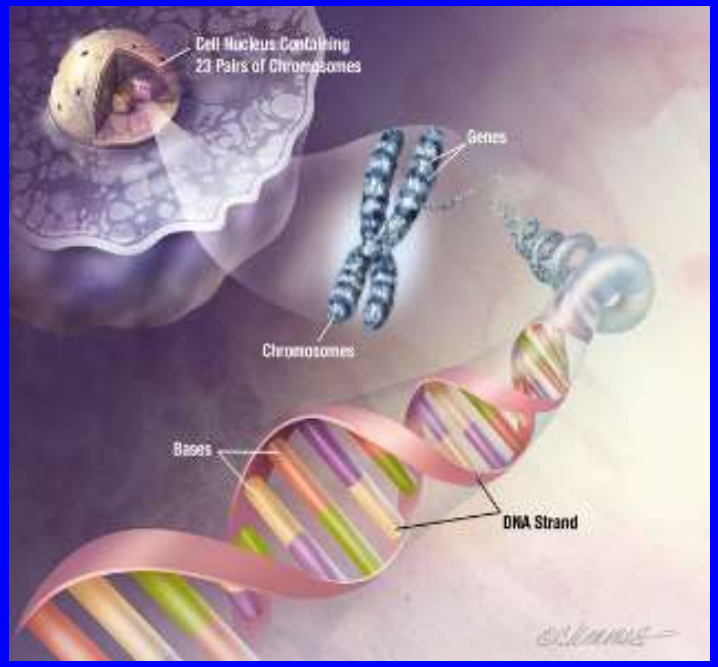
Outline

- Cells
- Radiation
  & what it does to cells
- Clinical uses of radiation
  (Radiotherapy)
- Prostate brachytherapy

Cells



- Water
  - approx 60% of male body weight (40 litres)
  - intracellular fluid - incorporated into cells (25 litres)
  - extracellular fluid - plasma & tissue fluid (15 litres)
- DNA
  - genetic code
- Other things

Different types of Radiation

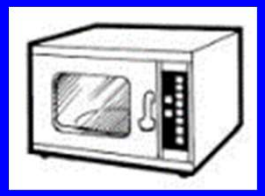
Radiowaves

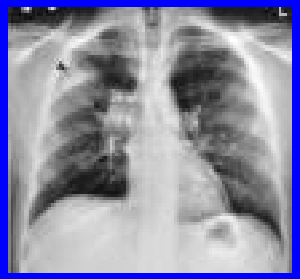
Infrared (IR)

Ultraviolet (UV)

Visible

Microwaves



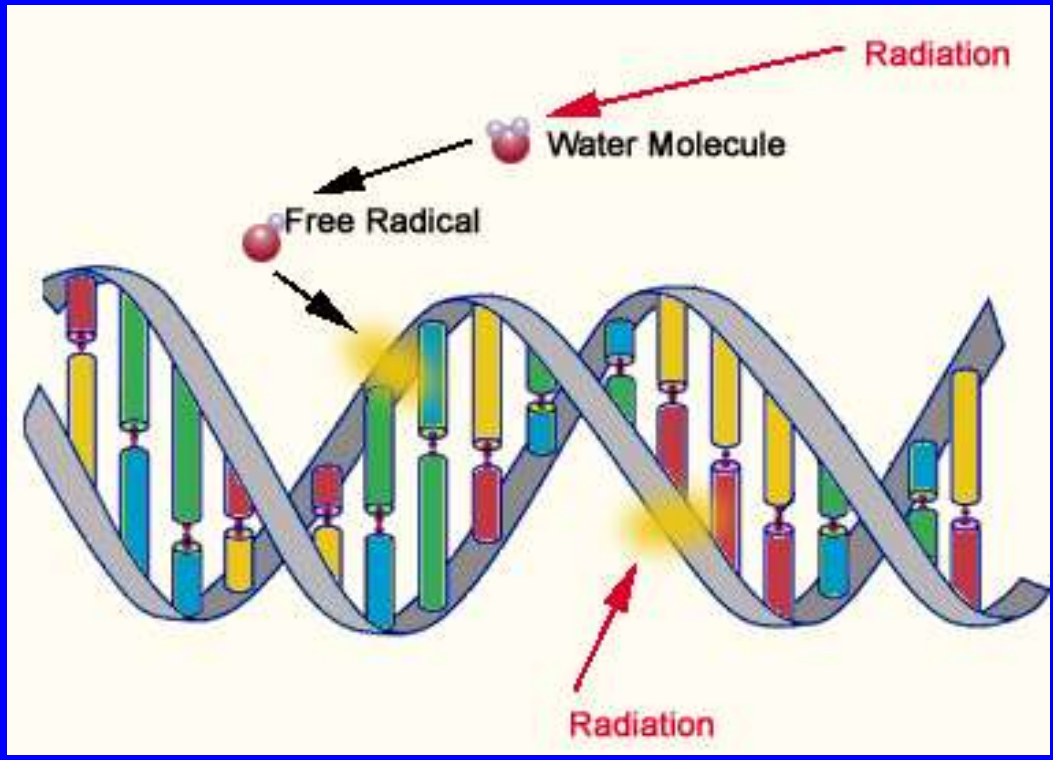


X rays (Ionising Radiation)

Some types of radiation kill cells

- X rays kill cells
- DNA breaks
- Cell cannot reproduce
- Cell dies
- Tumour cells more sensitive to radiation
- Tumour eventually dies

Some types of radiation kill cells



Wilhelm Conrad Roentgen

Clinical use of radiation

(Radiotherapy)

Marie Curie

Teletherapy

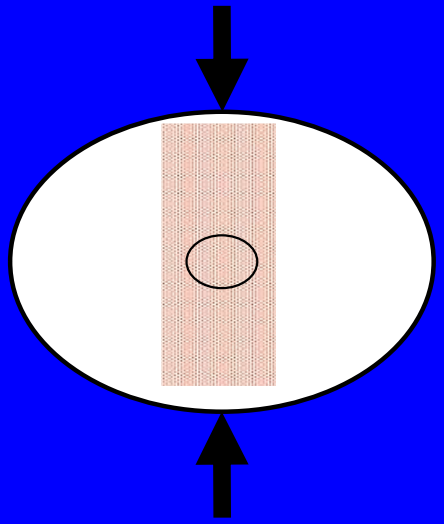
- tele = long (Greek)
- radiotherapy at a long distance
- source of radiation is placed a large distance from tumour tissue (~80-100cm)
- original type of radiotherapy and now most common

Brachytherapy

- brachy = short (Greek)
- radiotherapy at a short distance
- source of radiation is placed close to / inside tumour tissue
- rivalled teletherapy in early to mid-20th century

Teletherapy

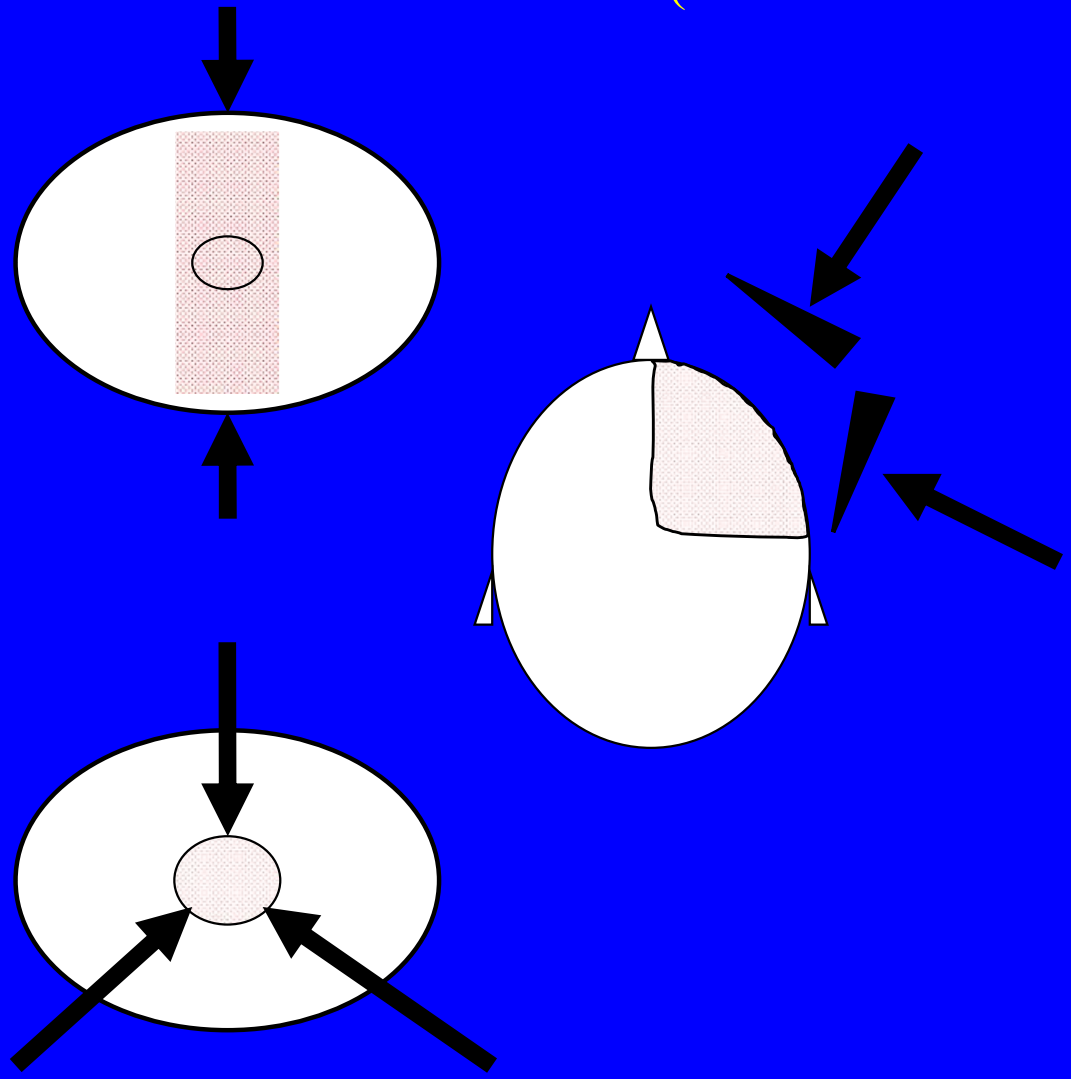
(External Beam Therapy)



- Linac (Linear accelerator)
- principally produces x-rays
- patient irradiated @ different angles
- total dose given to patient over a series of “fractions”
- eg 5 days/wk for 2-5 wk

Teletherapy

(External Beam Therapy)

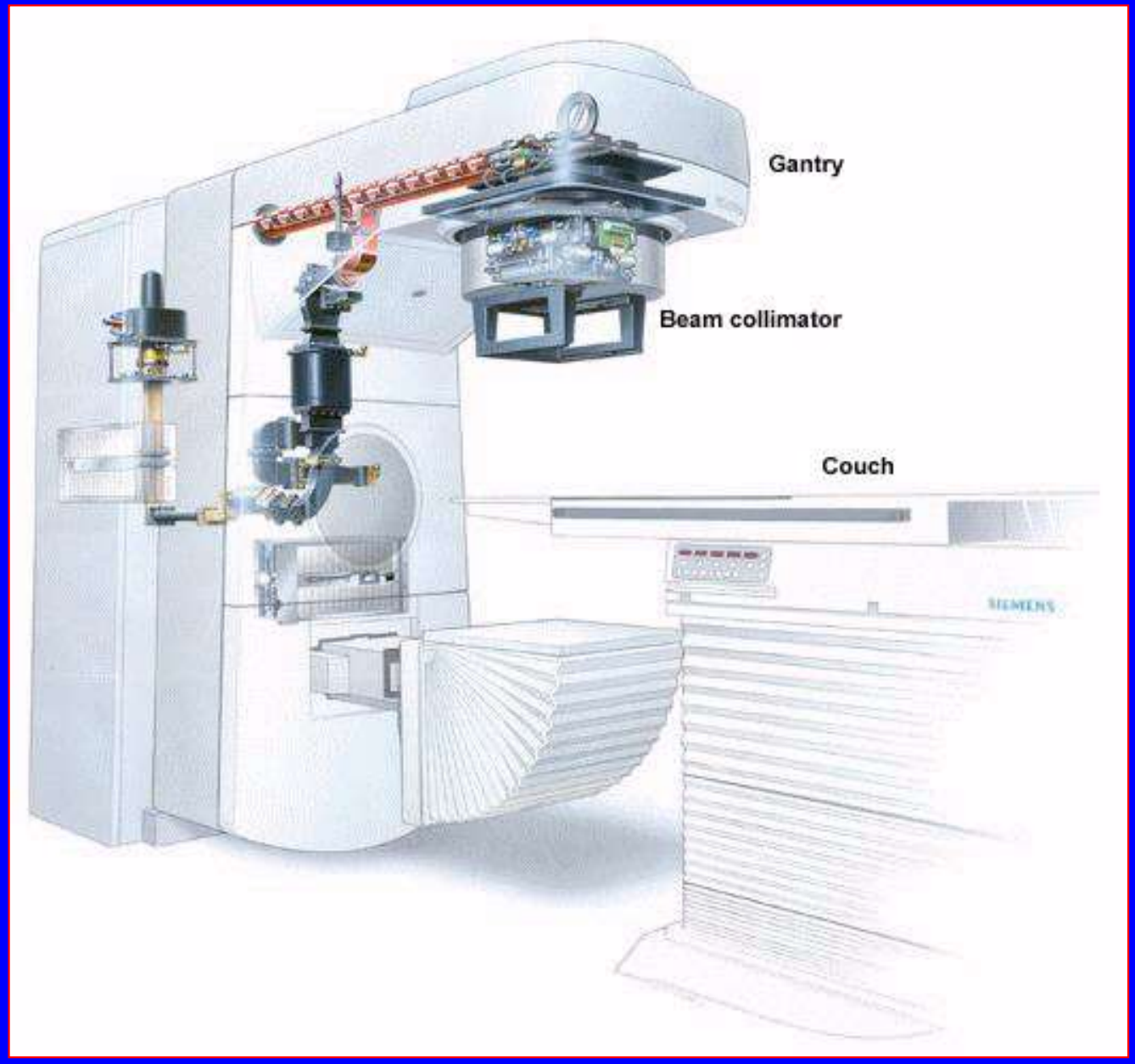


- irradiating patient from outside in
- various field arrangements
- irradiating healthy tissue
- aim is to give a maximum dose to tumour tissue and minimise dose to healthy tissue
- complex - not as simple as it sounds!!

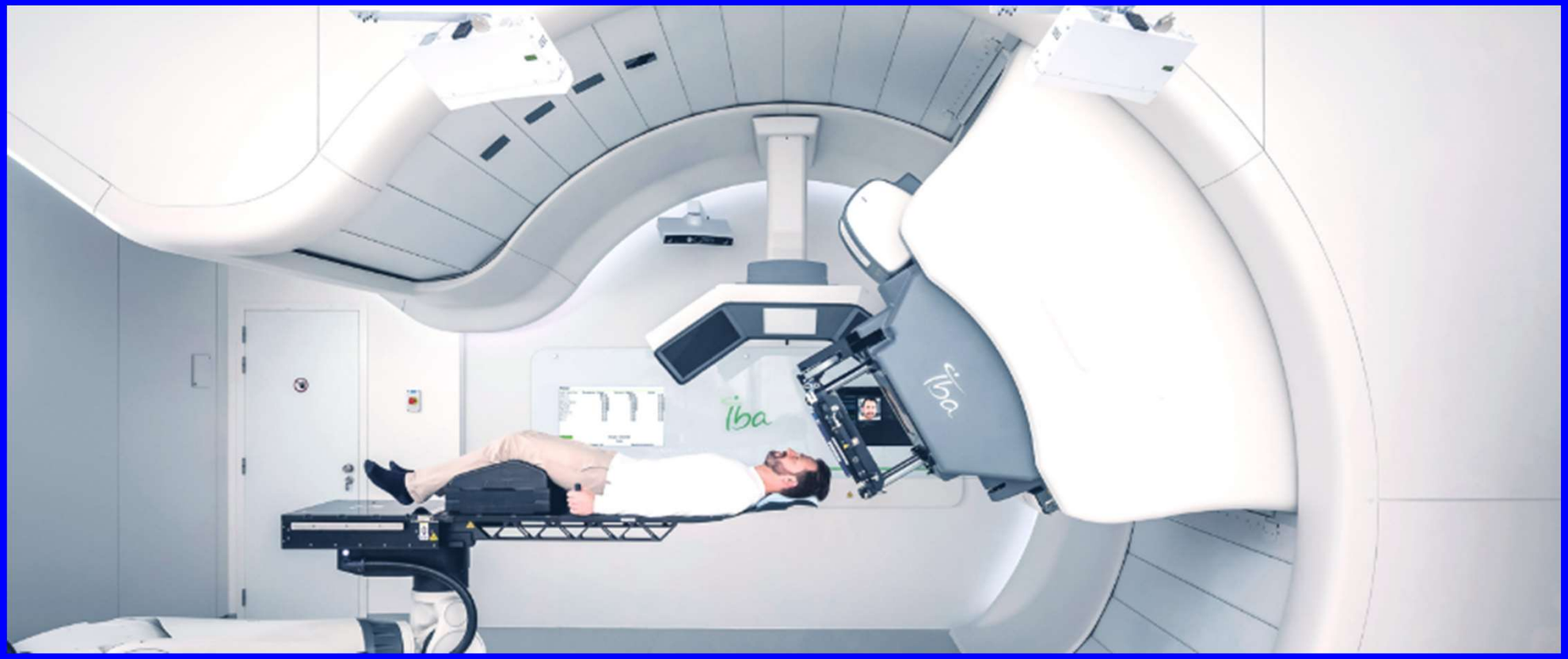
Linacs

- Particle accelerators
- Approx £1.5m plus (unit only)
  - Specialised installation facilities
- Highly complex machines
- Require stable support systems
- Require a comprehensive quality assurance programme


VARIAN


Gantry
Beam collimator
Couch
SIEMENS

Proton therapy units



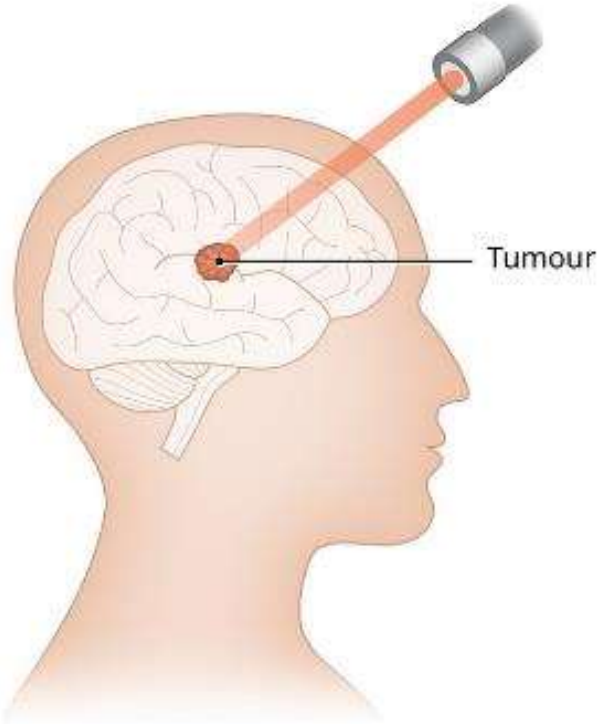
TARGETED PROTON THERAPY:

Deposits most energy on target

CONVENTIONAL RADIATION THERAPY:

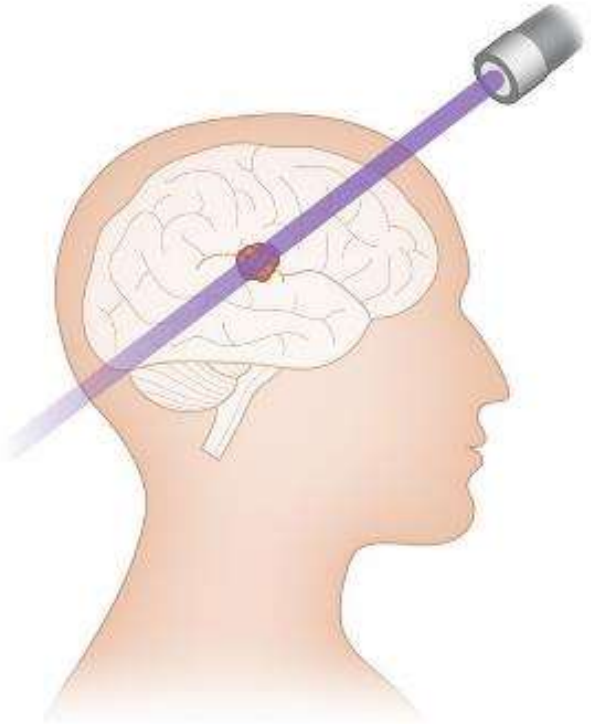
Deposits most energy before target

Proton Beam Therapy

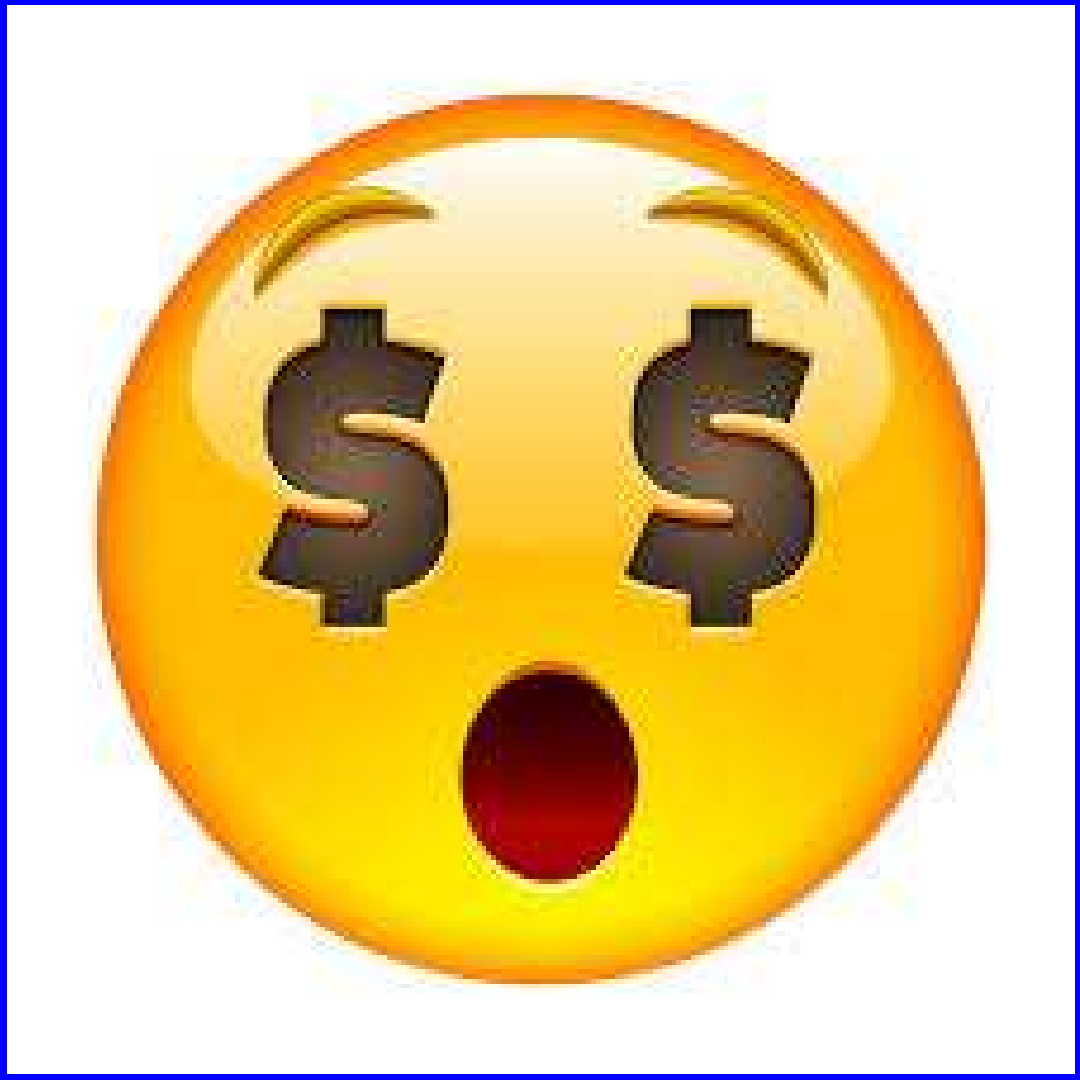


Proton beam releases energy
at a single point and disappears,
sparing nearby organs and tissues

Radiotherapy



X-ray deposits energy along its path,
potentially harming nearby organs and tissues



£250 million for 2 NHS proton therapy facilities in the UK

1500 patients per year

“Crazy medicine and unsustainable public policy”

Prof Ezekiel Emmanuel, University of Pennsylvania 2012

Wilhelm Conrad Roentgen

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(Radiotherapy)

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Brachytherapy

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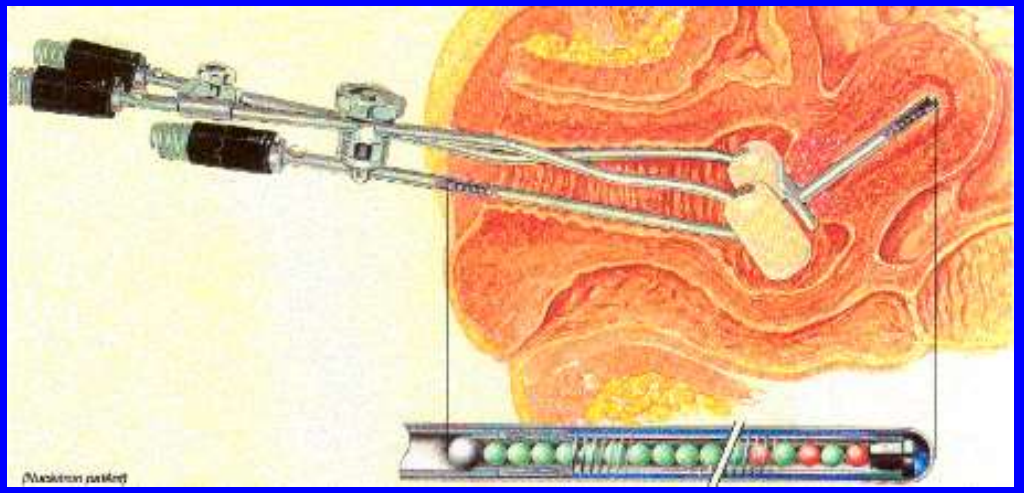
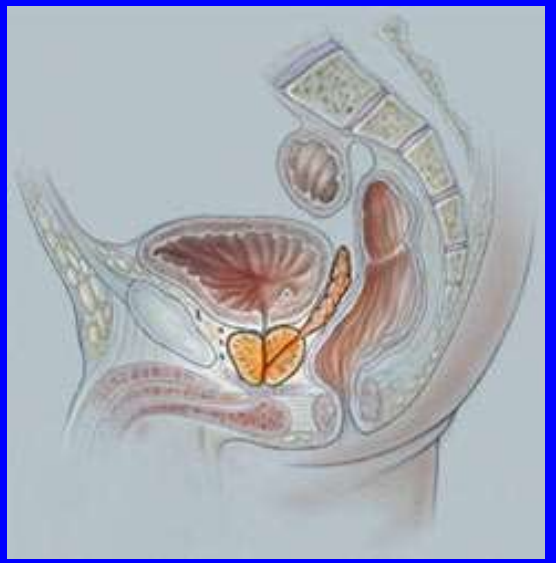
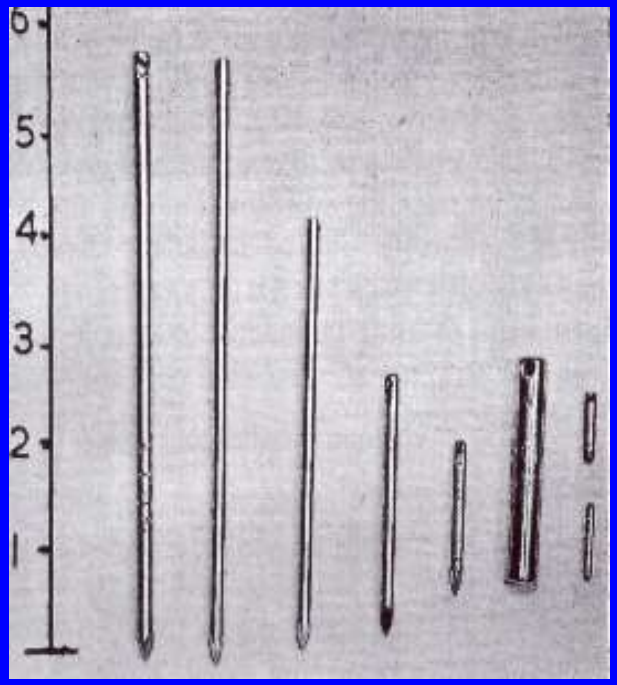
- source of radiation is placed close to / inside tumour tissue
- rivalled teletherapy in early to mid-20th century

Types of Brachytherapy



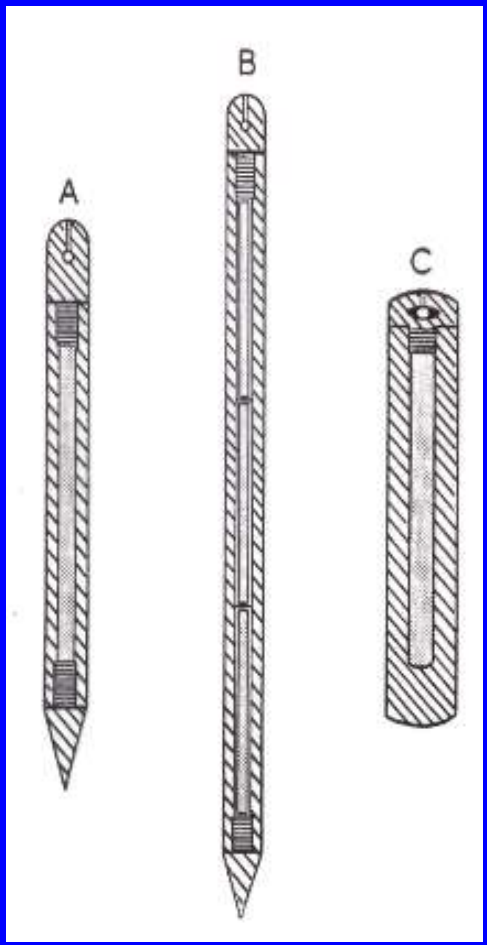


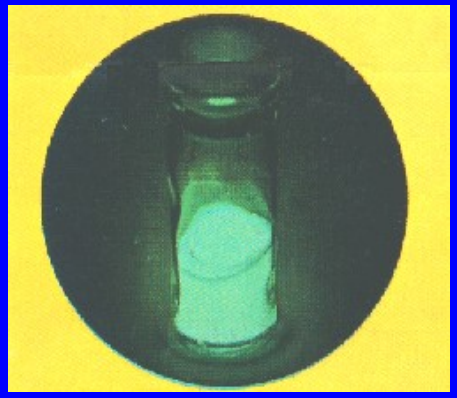
Brachytherapy Radiation Sources



Examples

- Sources contain radioactive material
- needles / tubes / seeds
- Selection of sizes / strengths
- Low to high hazard depending on material





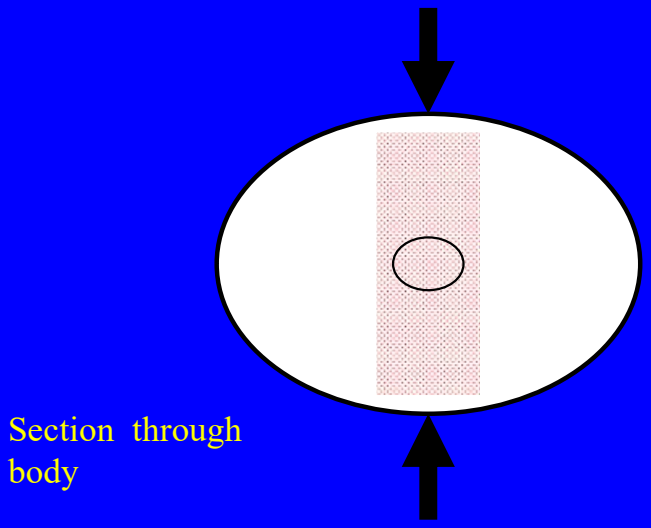
Radioactive material

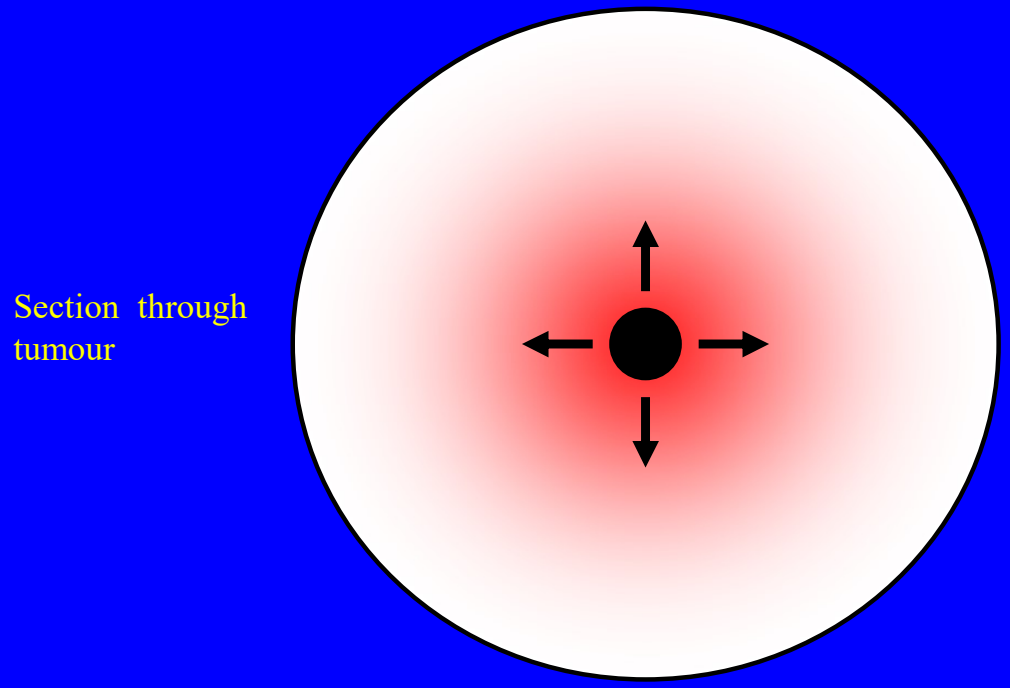
Why do Brachytherapy?

Principal reason

Improved dose distribution to tumour

Brachytherapy Dose Distribution





External

- irradiates tumour
- irradiates healthy tissue

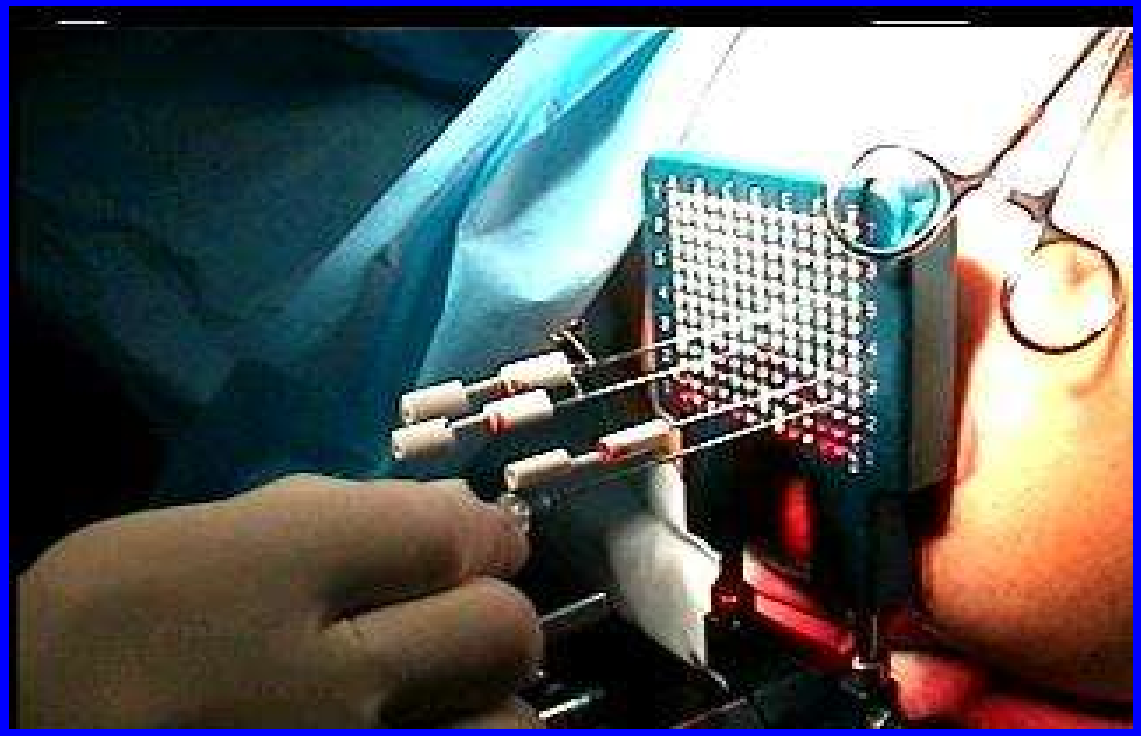
Internal / Brachytherapy

- rapid fall-off
- highly localised dose
- spares surrounding tissue

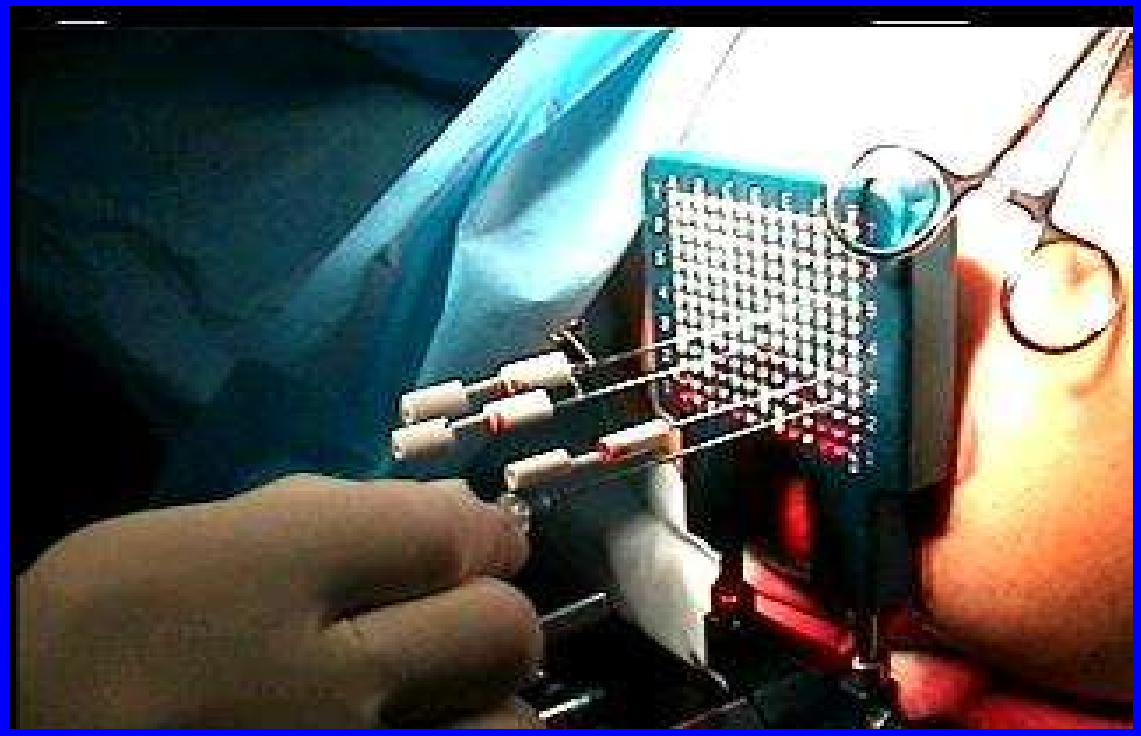
Treatment of prostate using Brachytherapy

- So we've got a prostate
- How do we treat it using iodine seeds?

We stick needles into it !!



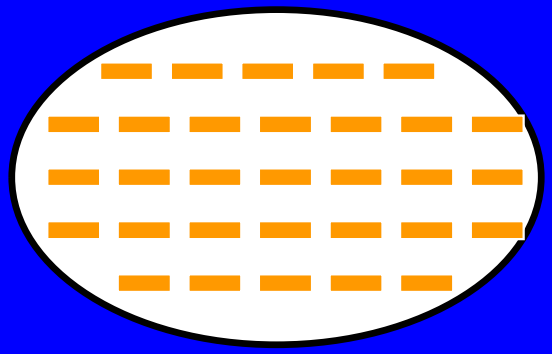
We stick needles into it !!



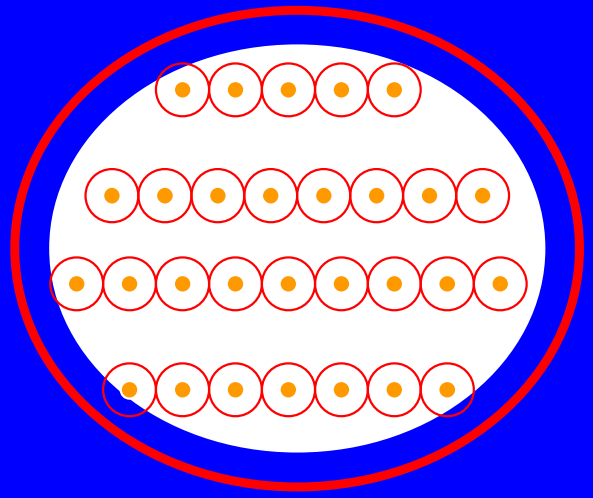
And then put radioactive seeds in through the needles

Brachytherapy Prostate Implants

Broad concept



Sagittal view

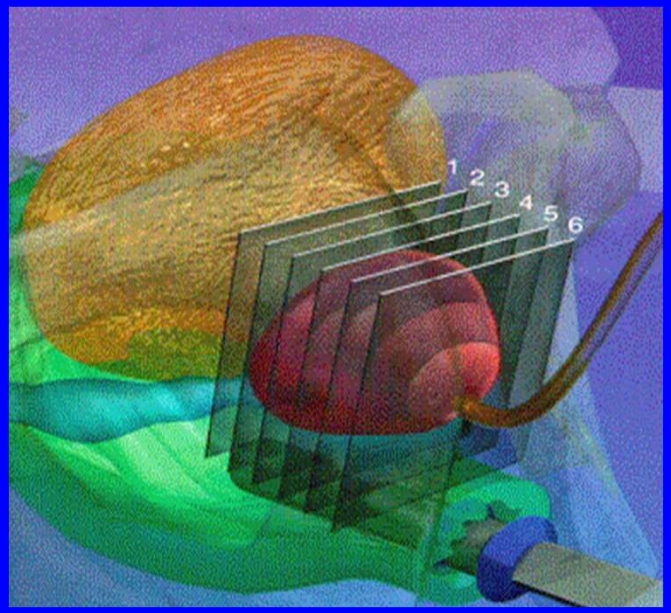


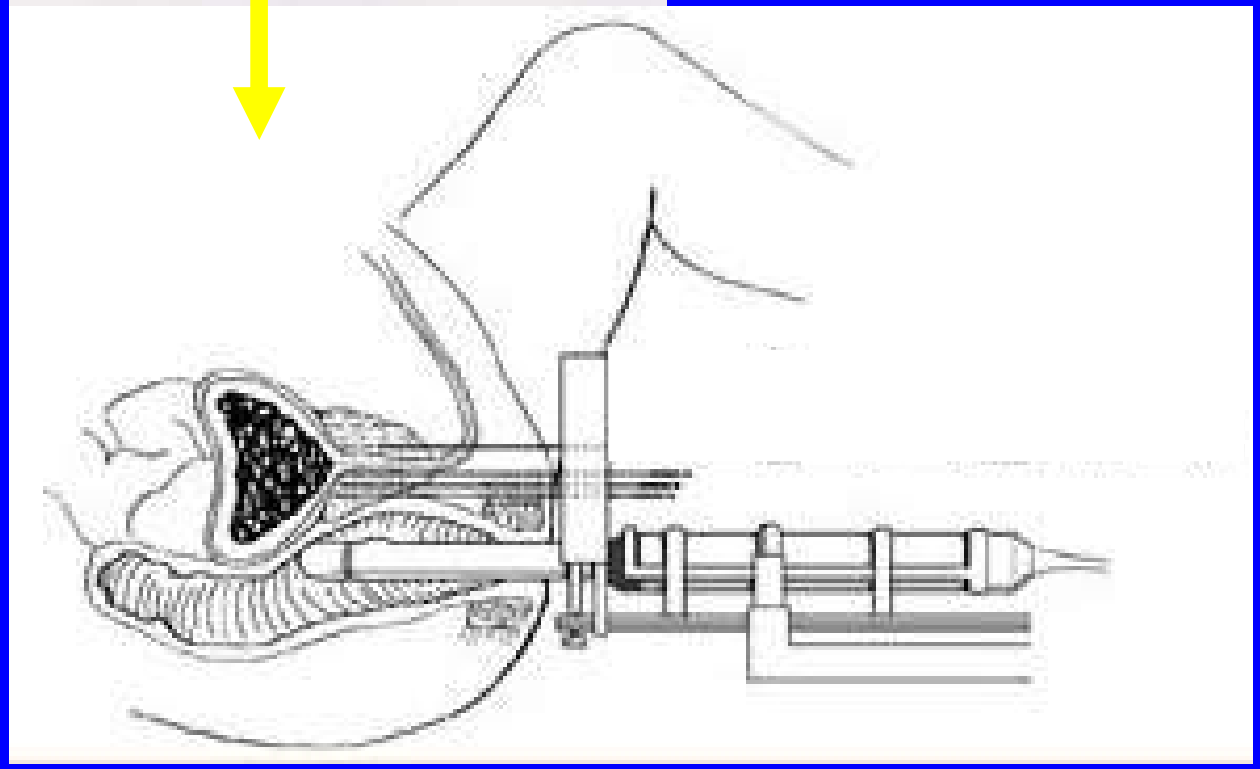
Transverse view

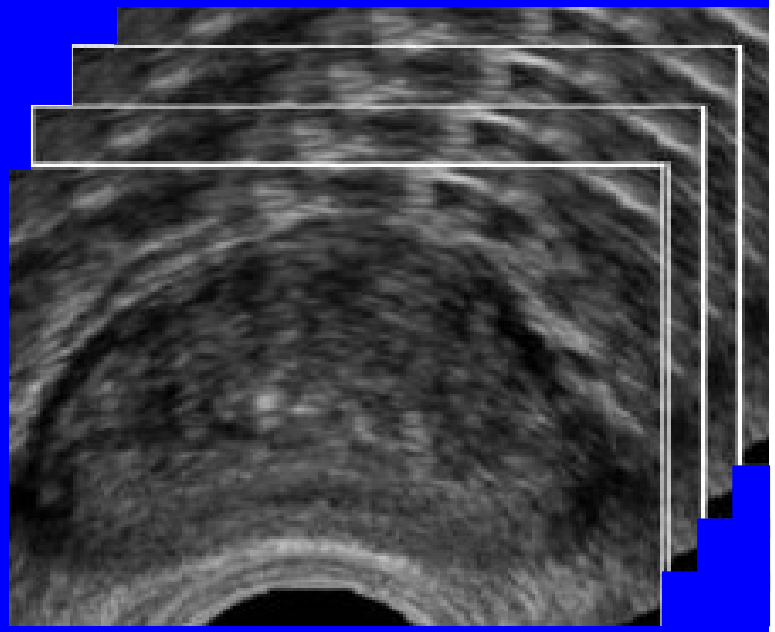
- visualise the prostate
- place seeds in prostate
- each seed gives off radiation to very localized area
- combined effect is a dose to whole prostate
- position of seeds tailored to size / shape of prostate
- ensure whole prostate is adequately covered
- 50-100 seeds placed
- permanent implant

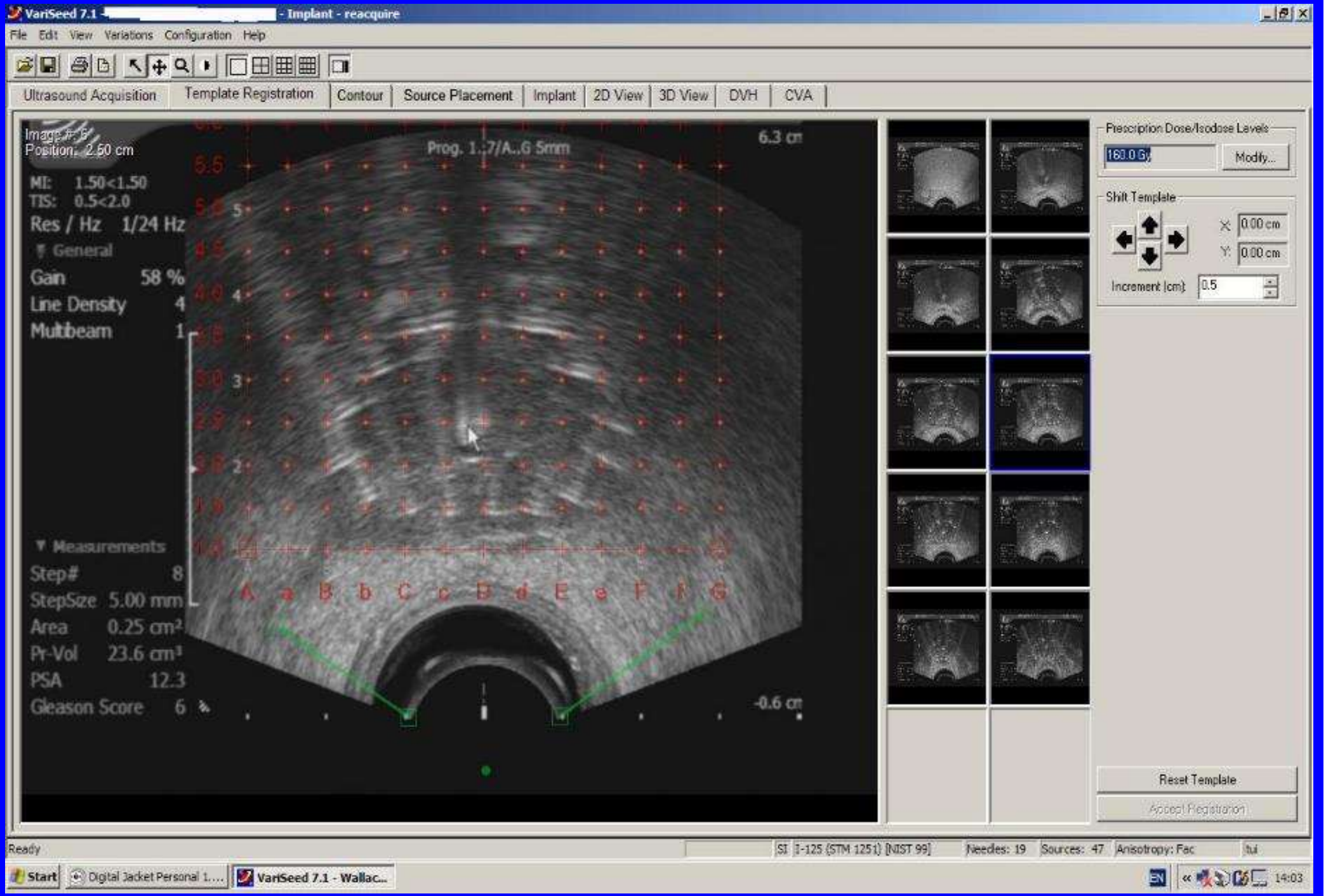
The procedure

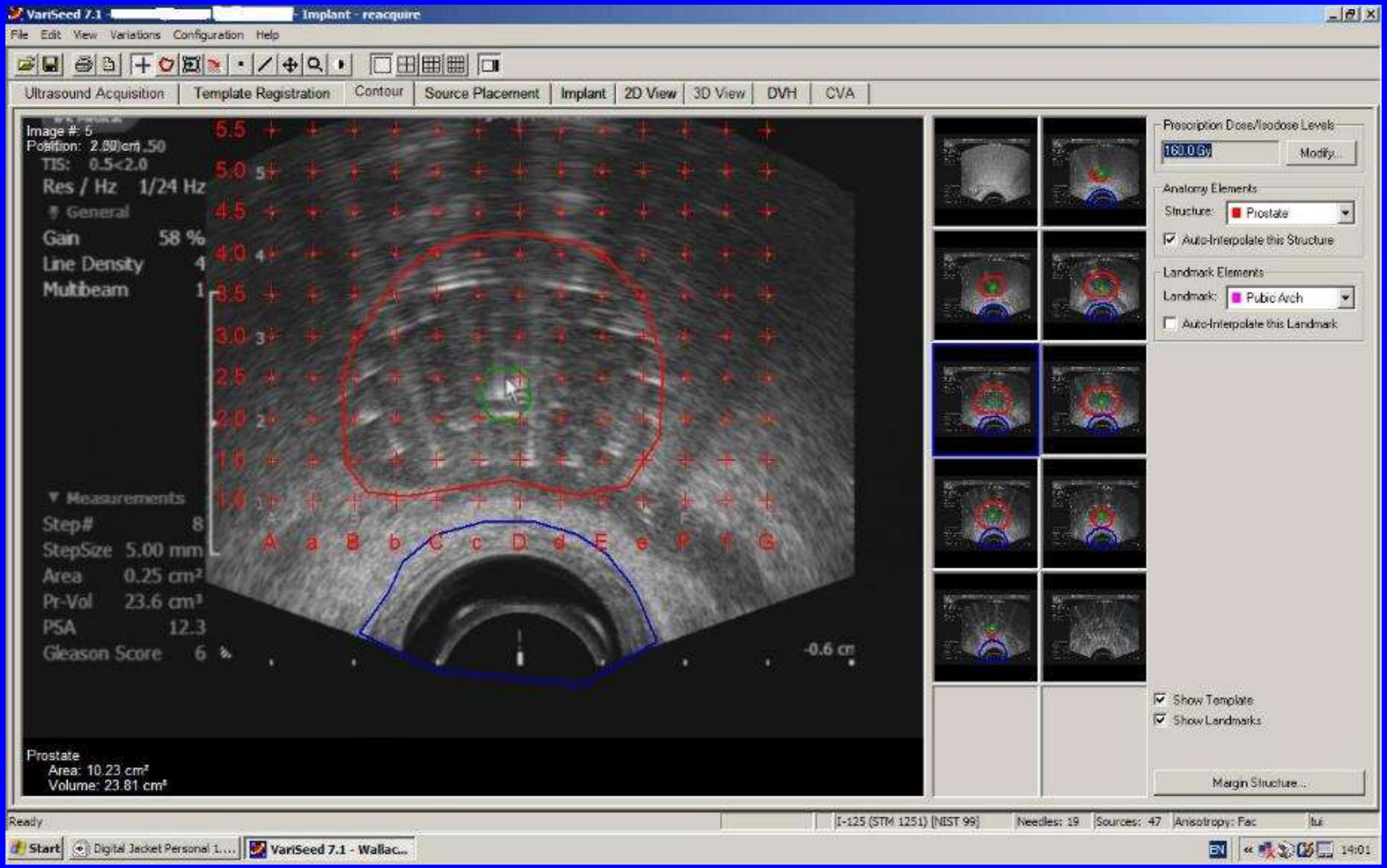
The procedure

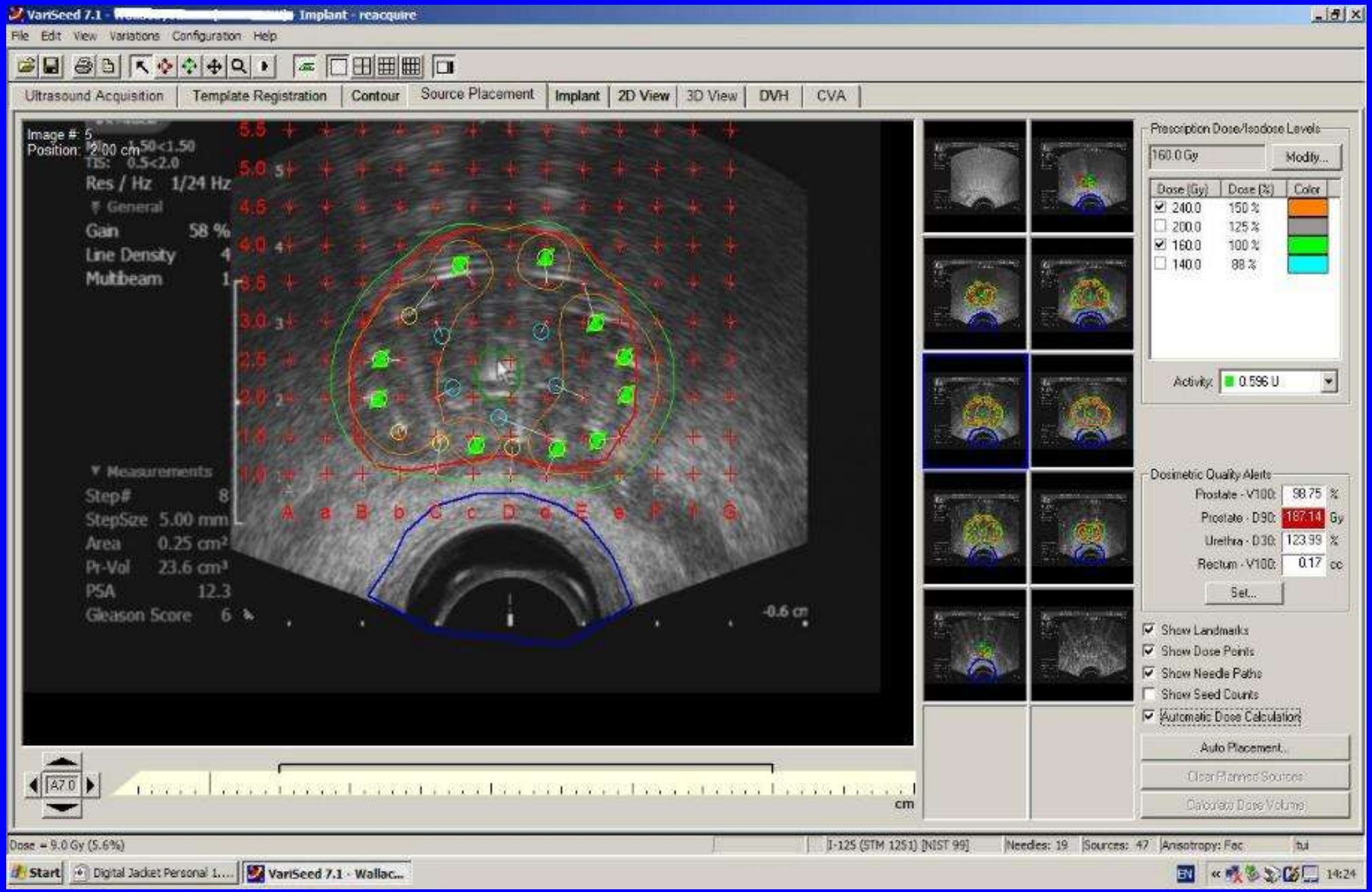

1
2
3
4
5
6

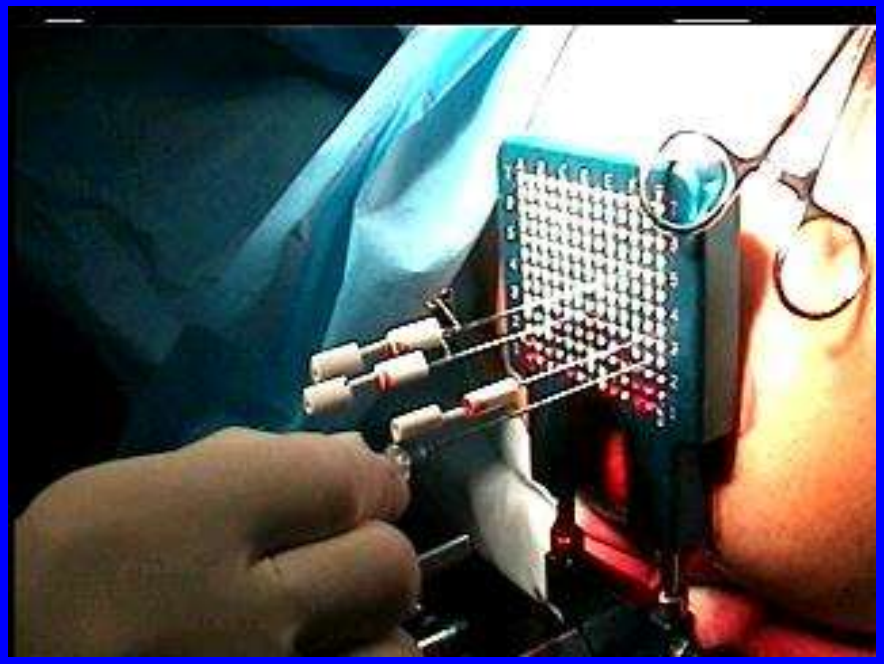





VariSeed 7.1
- Implant - reacquire
File Edit View Variations Configuration Help
Ultrasound Acquisition
Template Registration
Contour
Source Placement
Implant
2D View
3D View
DVH
CVA
Image #: 6
Position: 2.50 cm
Prog. 1..7/A..G 5mm
6.3 cm
-0.6 cm
MI: 1.50<1.50
TIS: 0.5<2.0
Res / Hz 1/24 Hz
General
Gain 58 %
Line Density 4
Multibeam 1
Measurements
Step# 8
StepSize 5.00 mm
Area 0.25 cm²
Pr-Vol 23.6 cm³
PSA 12.3
Gleason Score 6
Prescription Dose/Isodose Levels
160.0 Gy
Modify...
Shift Template
X: 0.00 cm
Y: 0.00 cm
Increment (cm) 0.5
Reset Template
Accept Registration
Ready
SI I-125 (STM 1251) [NIST 99]
Needles: 19
Sources: 47
Anisotropy: Fac
Start
Digital Jacket Personal 1....
VariSeed 7.1 - Wallac...
14:03


VariSeed 7.1 - Implant - reacquire
File Edit View Variations Configuration Help
Ultrasound Acquisition
Template Registration
Contour
Source Placement
Implant
2D View
3D View
DVH
CVA
Image #: 5
Position: 2.80 cm .50
TIS: 0.5<2.0
Res / Hz 1/24 Hz
General
Gain 58 %
Line Density 4
Multibeam 1
Measurements
Step# 8
StepSize 5.00 mm
Area 0.25 cm²
Pr-Vol 23.6 cm³
PSA 12.3
Gleason Score 6
-0.6 cm
Prostate
Area: 10.23 cm²
Volume: 23.81 cm²
Prescription Dose/Isodose Levels
160.0 Gy
Modify...
Anatomy Elements
Structure: Prostate
Auto-Interpolate this Structure
Landmark Elements
Landmark: Pubic Arch
Auto-Interpolate this Landmark
Show Template
Show Landmarks
Margin Structure...
Ready
I-125 (STM 1251) [NIST 99]
Needles: 19
Sources: 47
Anisotropy: Fac
Start
Digital Jacket Personal 1....
VariSeed 7.1 - Wallac...
14:01

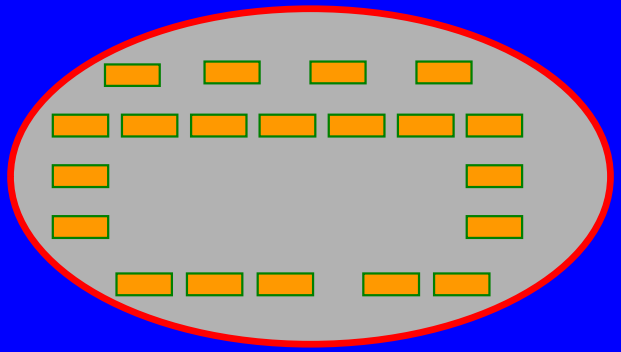

VariSeed 7.1 - Implant - reacquire
File Edit View Variations Configuration Help
Ultrasound Acquisition
Template Registration
Contour
Source Placement
Implant
2D View
3D View
DVH
CVA
Image # 5
Position: 2.00 cm
Res / Hz 1/24 Hz
General
Gain 58 %
Line Density 4
Multibeam 1
Measurements
Step# 8
StepSize 5.00 mm
Area 0.25 cm²
Pr-Vol 23.6 cm³
PSA 12.3
Gleason Score 6
-0.6 cm
cm
Prescription Dose/Isodose Levels
160.0 Gy
Modify...
Dose (Gy) Dose (%) Color
240.0 150 %
200.0 125 %
160.0 100 %
140.0 88 %
Activity: 0.596 U
Dosimetric Quality Alerts
Prostate - V100: 98.75 %
Prostate - D90: 187.14 Gy
Urethra - D30: 123.99 %
Rectum - V100: 0.17 cc
Set...
Show Landmarks
Show Dose Points
Show Needle Paths
Show Seed Counts
Automatic Dose Calculation
Auto Placement...
Clear Planned Sources
Calculate Dose Volume
Dose = 9.0 Gy (5.6%)
I-125 (STM 1251) [NIST 99]
Needles: 19
Sources: 47
Anisotropy: Fac
Start
Digital Jacket Personal 1....
VariSeed 7.1 - Wallac...
14:24

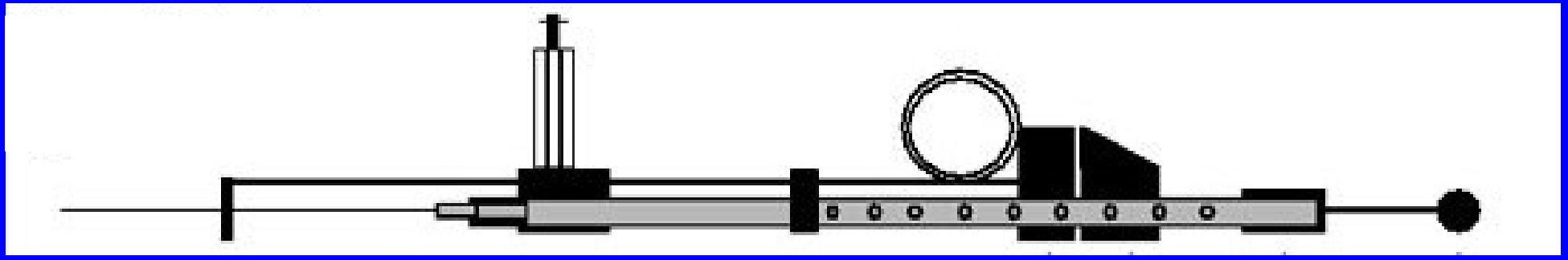


Insert peripheral needles

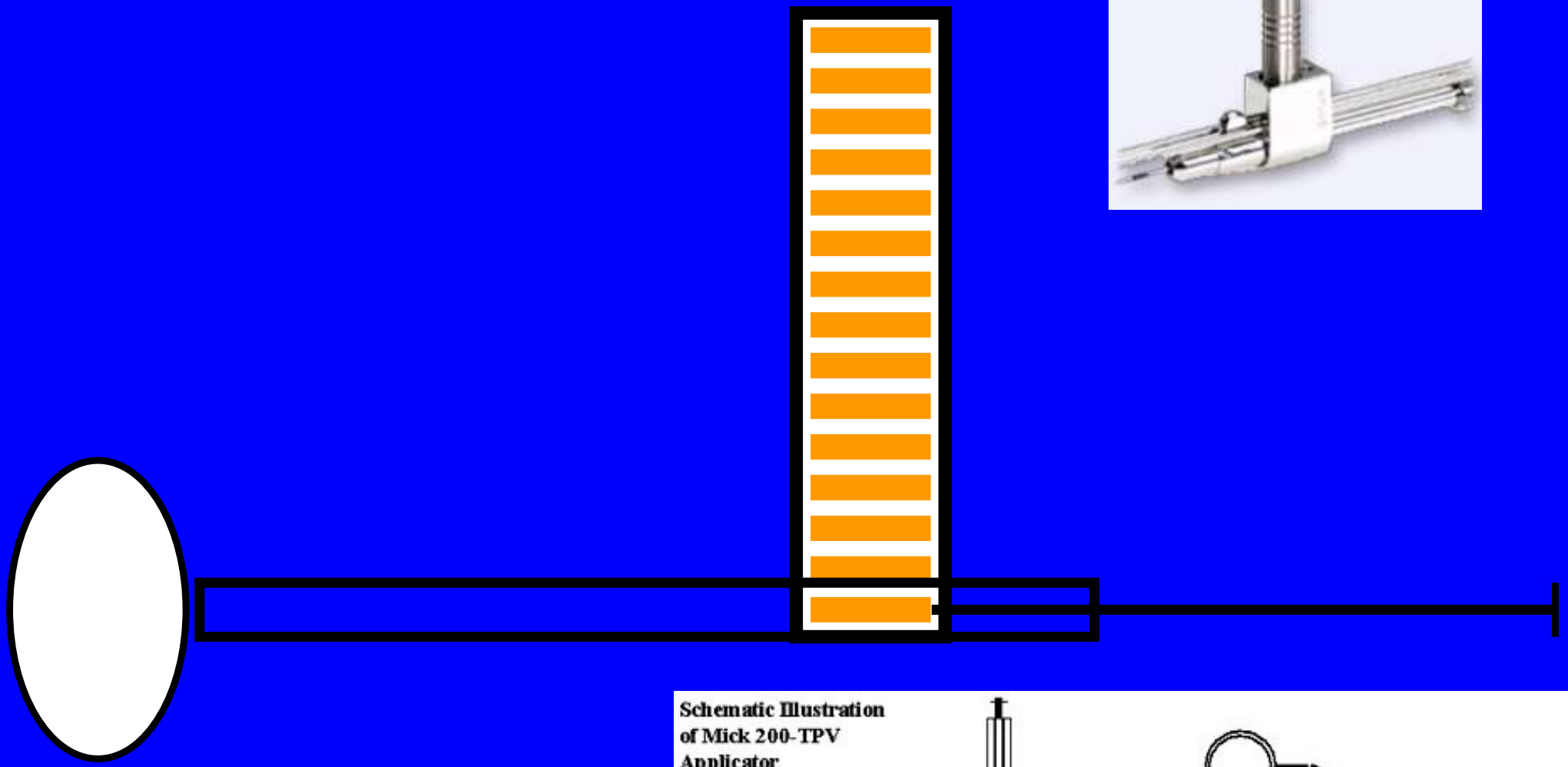
Insert seeds through needles in sagittal view using

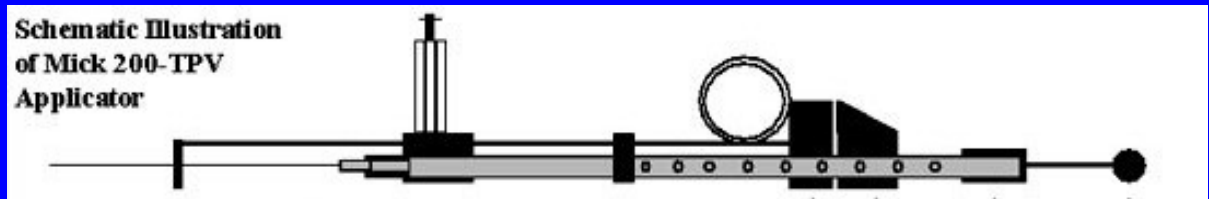
Mick Applicator





Seed Insertion device (Mick Applicator)





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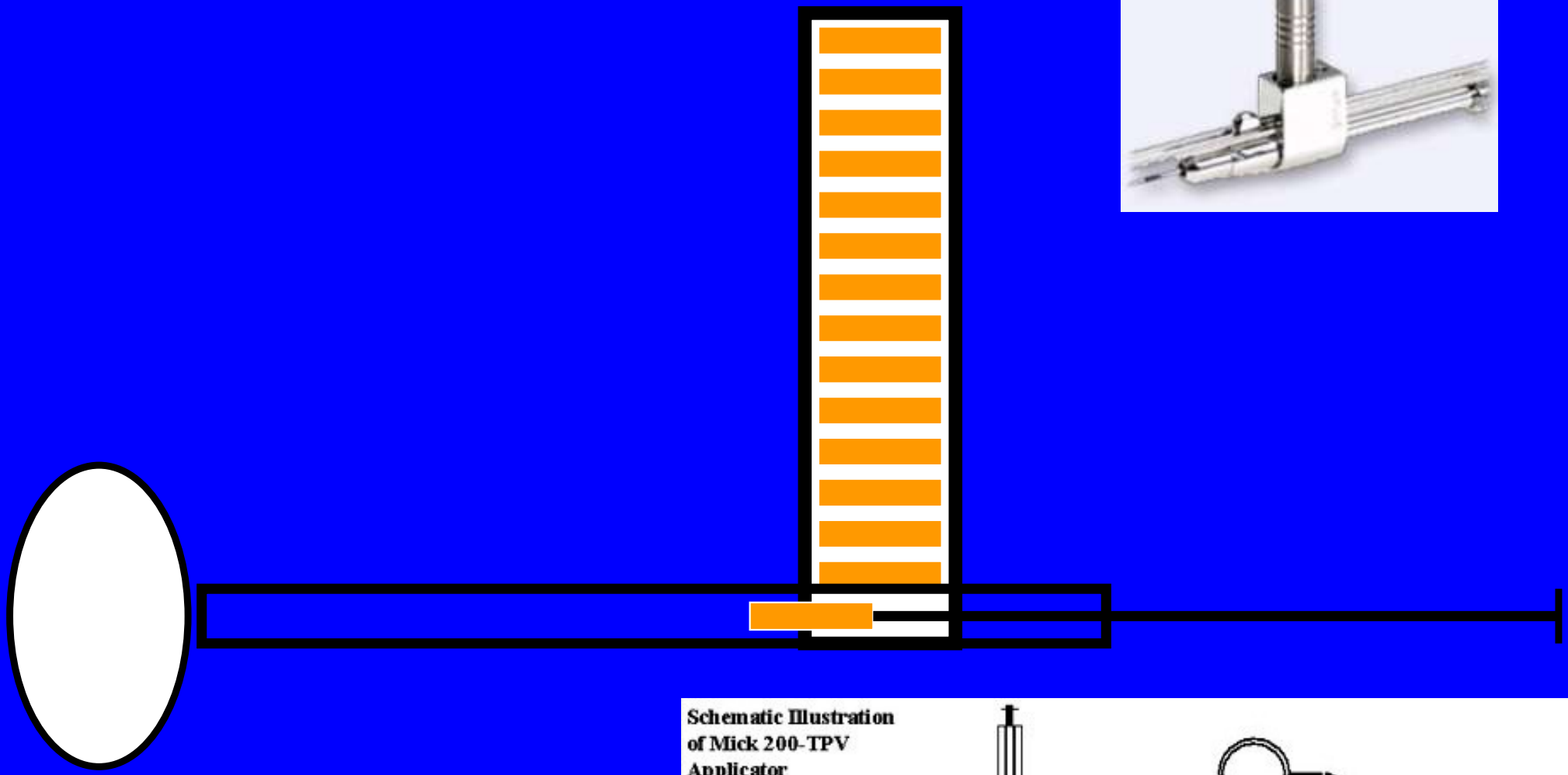

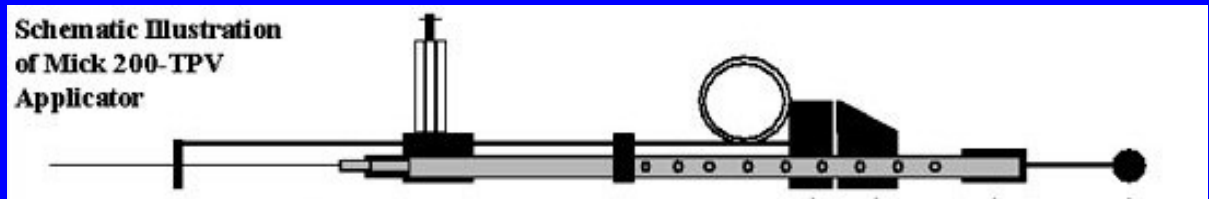

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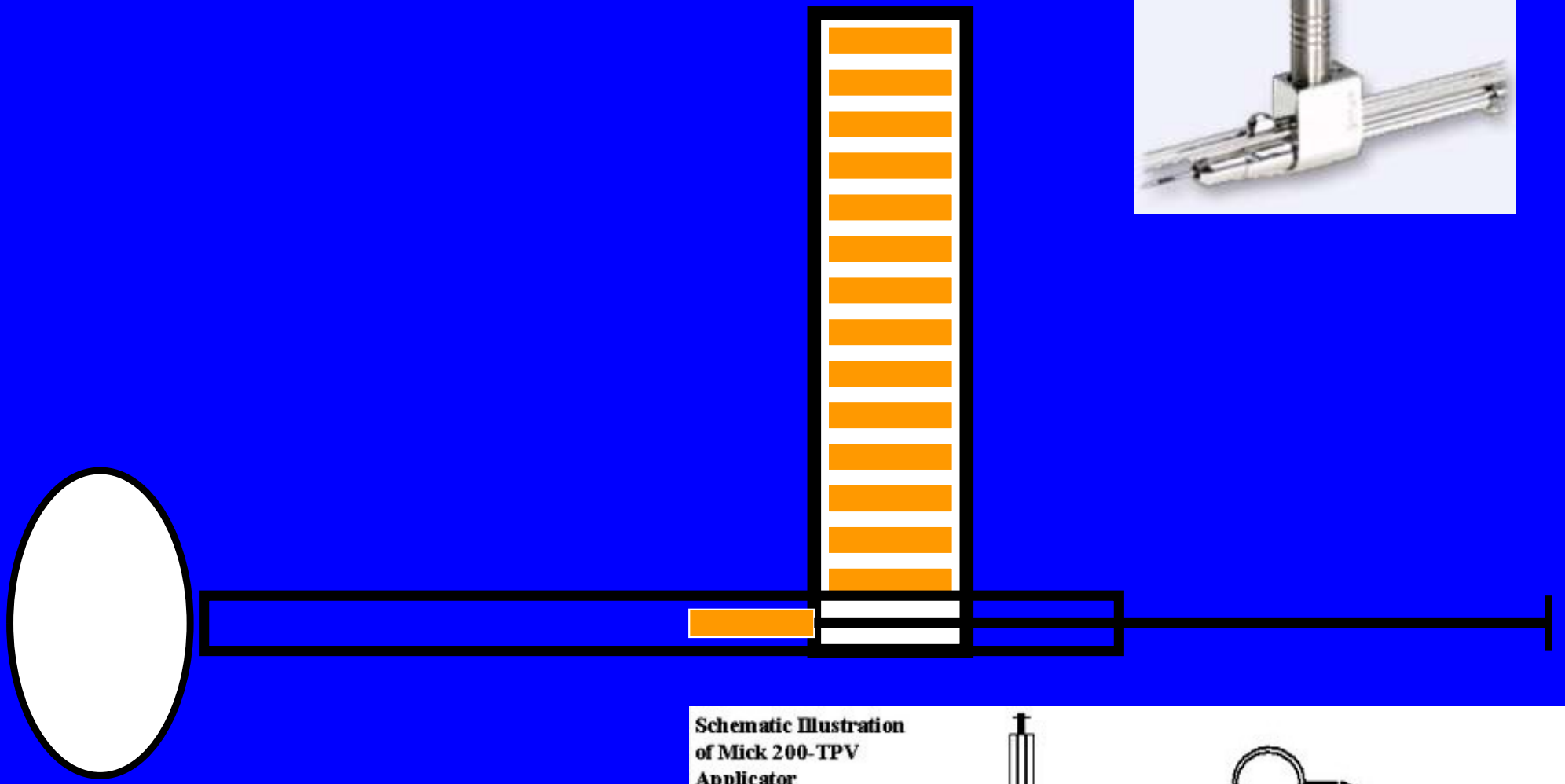

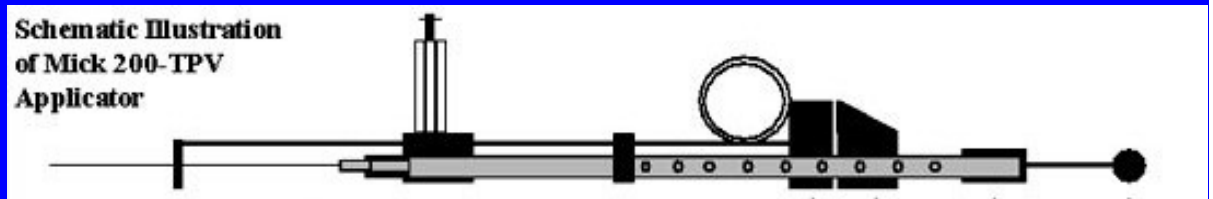

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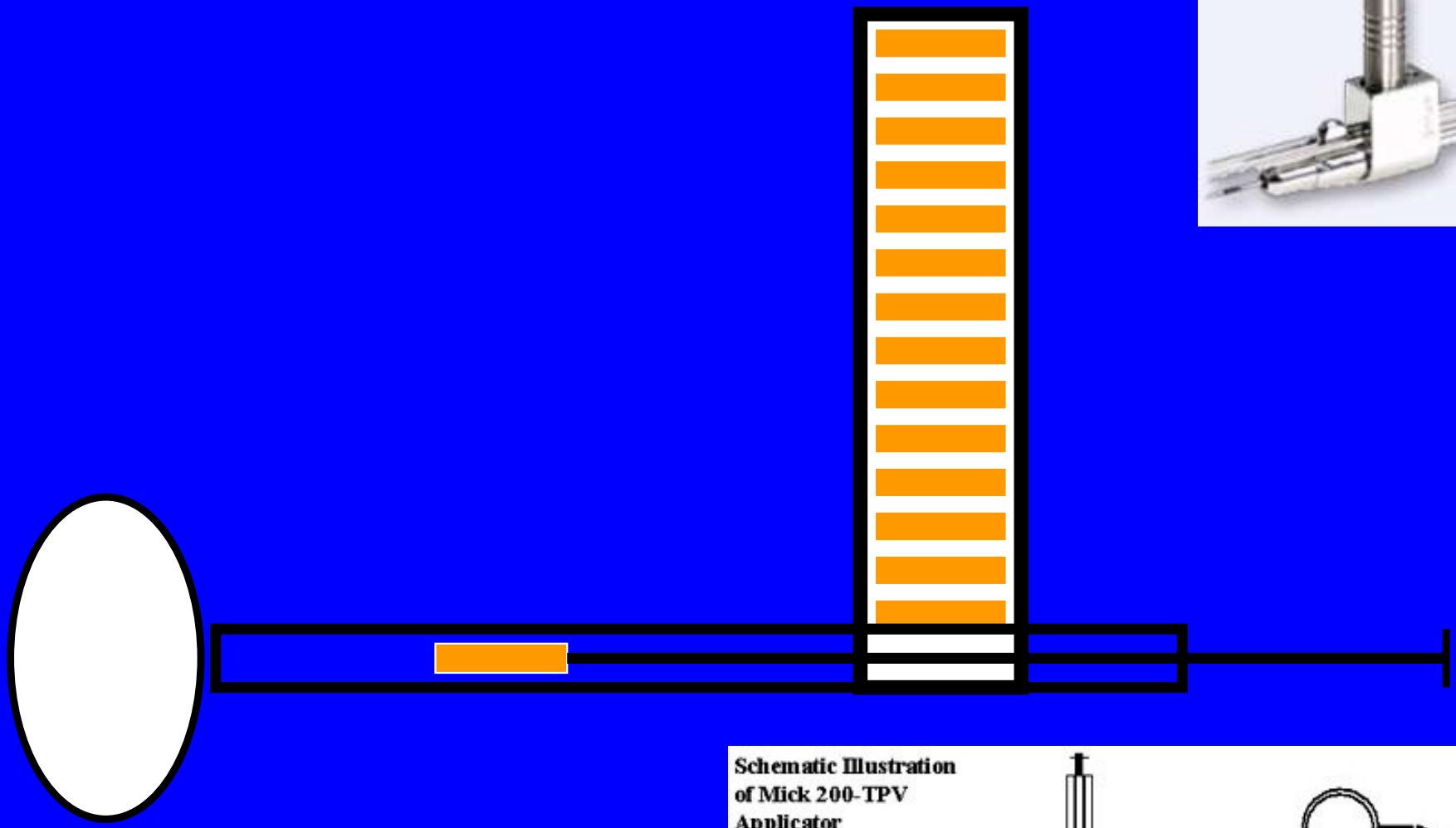

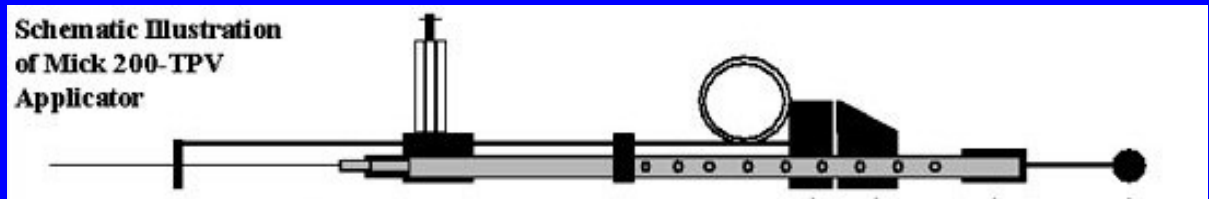

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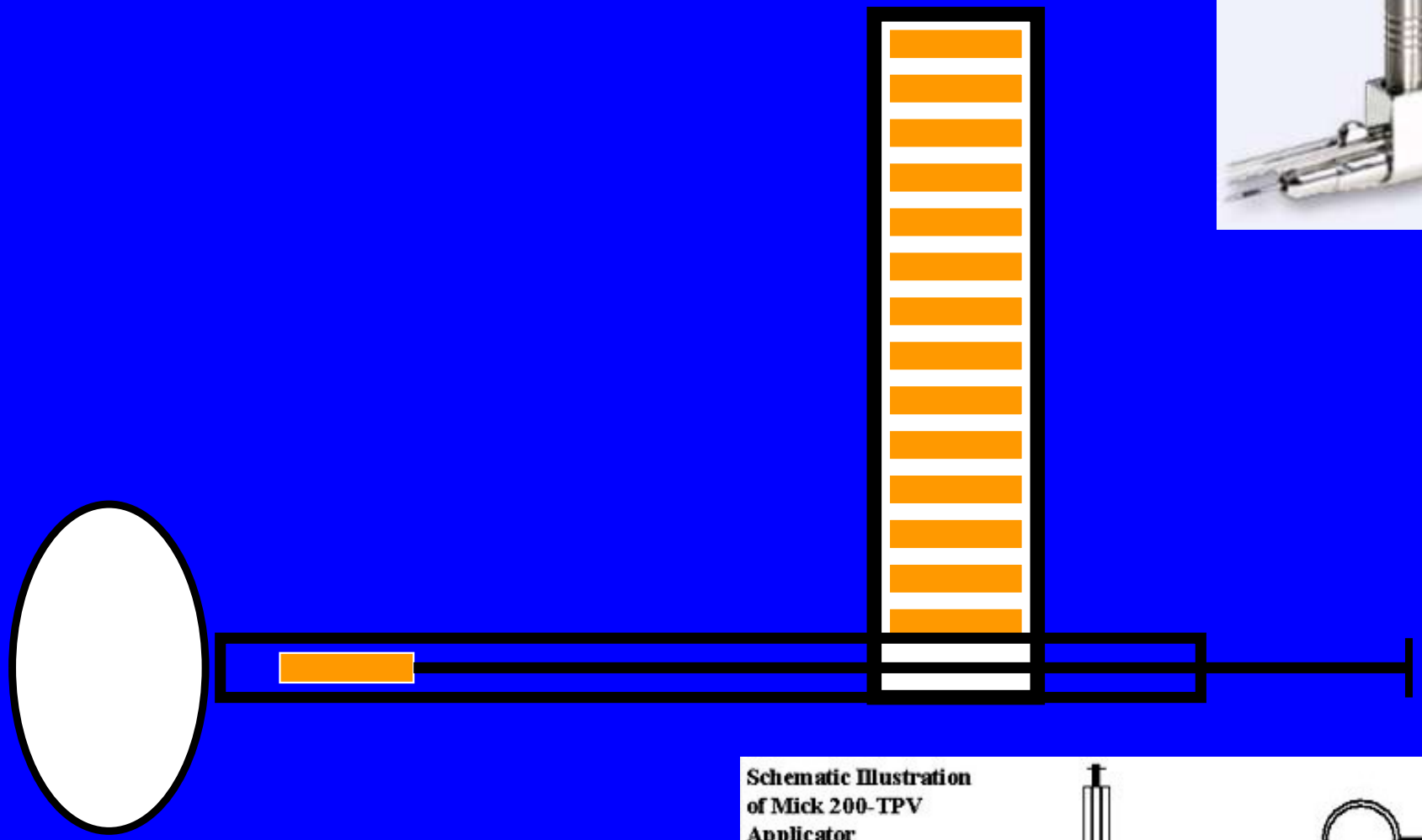

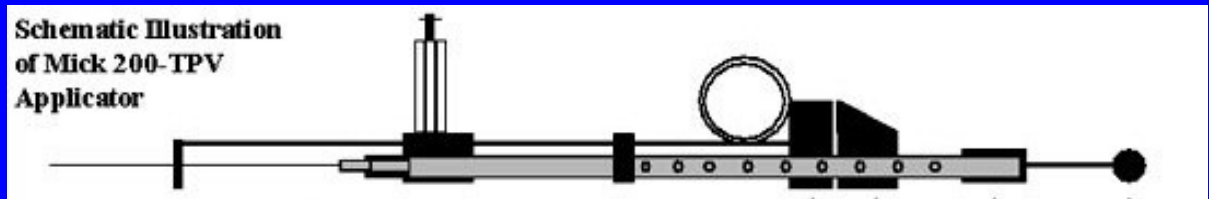

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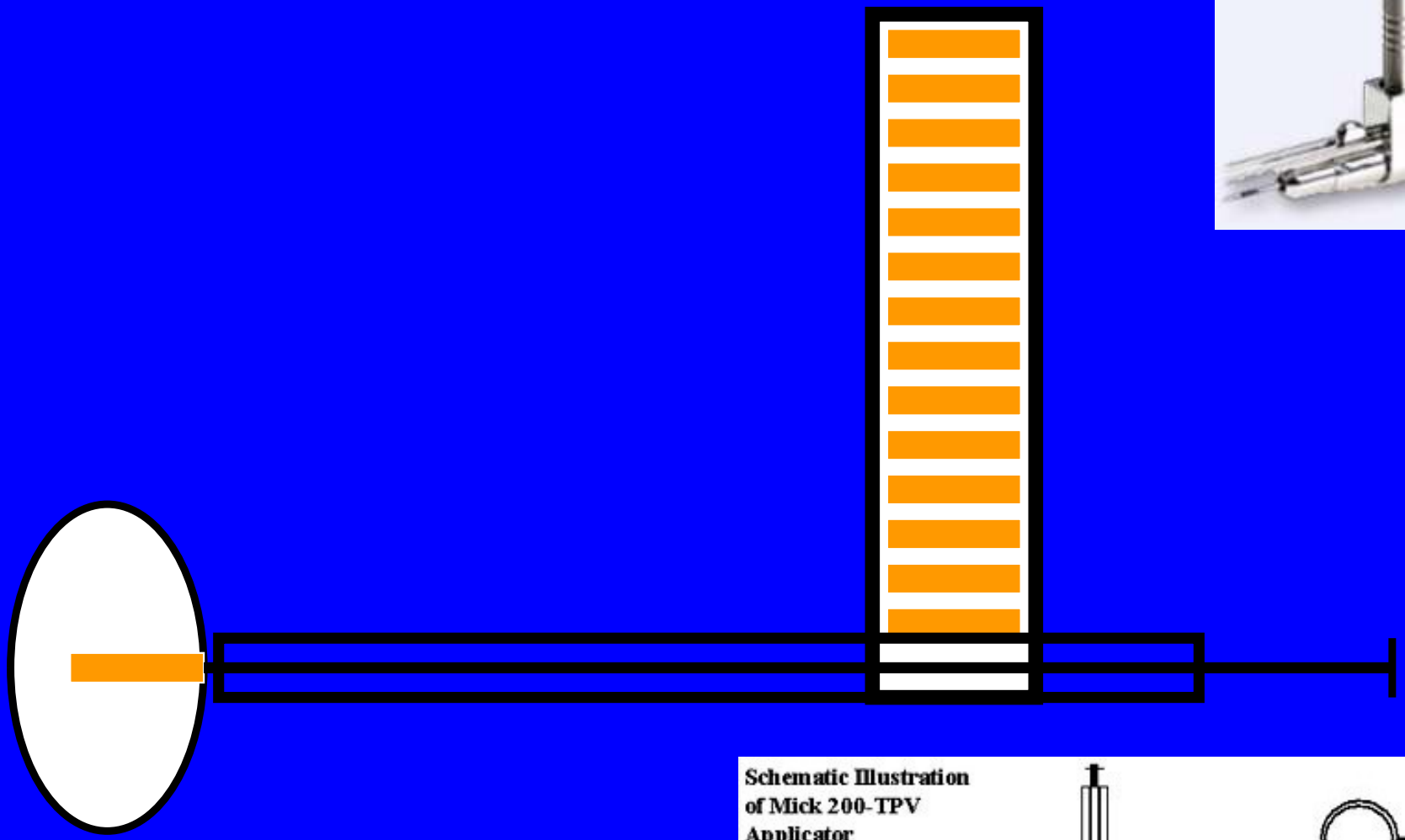
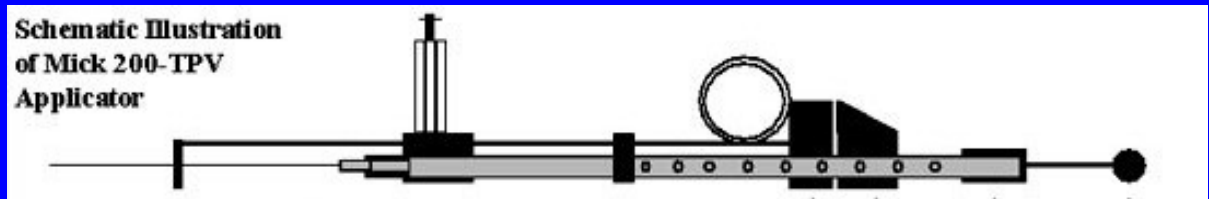
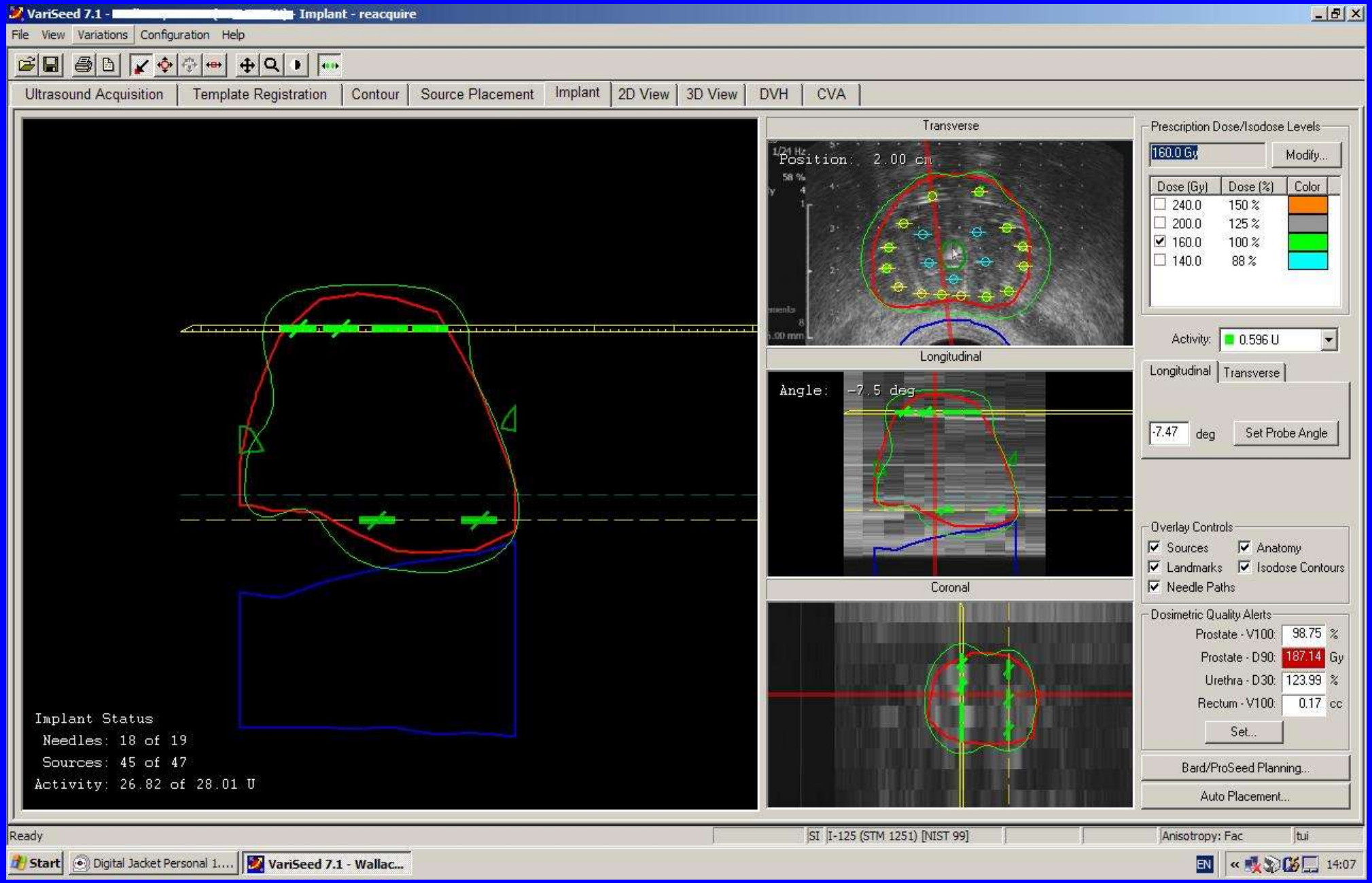


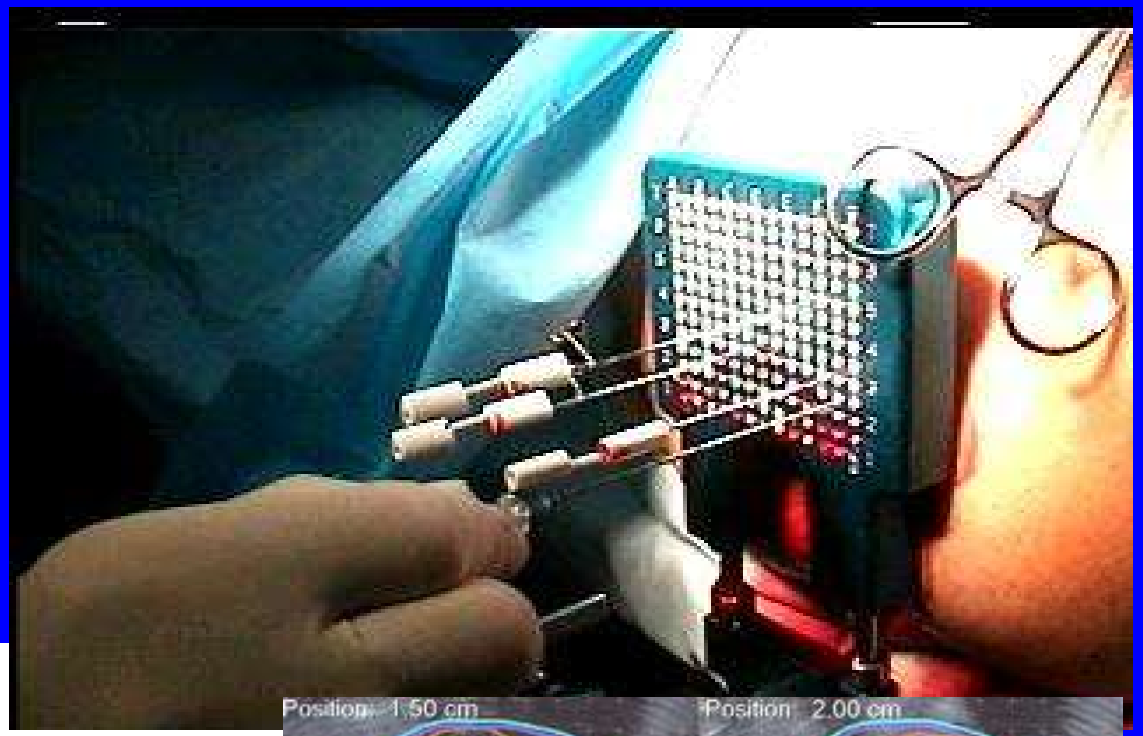


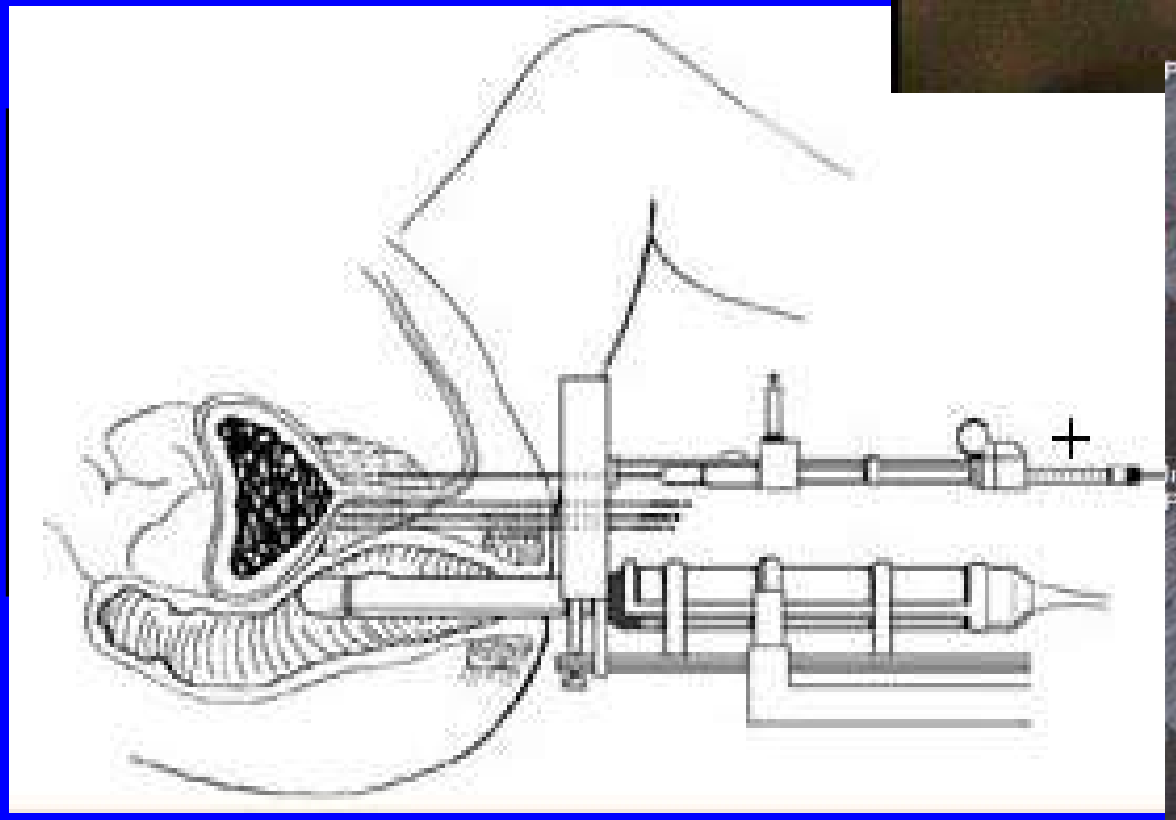

VariSeed 7.1 - Implant - reacquire
File View Variations Configuration Help
Ultrasound Acquisition
Template Registration
Contour
Source Placement
Implant
2D View
3D View
DVH
CVA
Implant Status
Needles: 18 of 19
Sources: 45 of 47
Activity: 26.82 of 28.01 U
Transverse
Position: 2.00 cm
Longitudinal
Angle: -7.5 deg
Coronal
Prescription Dose/Isodose Levels
160.0 Gy
Modify...
Dose (Gy)
Dose (%)
Color
240.0 150 %
200.0 125 %
160.0 100 %
140.0 88 %
Activity: 0.596 U
Longitudinal
Transverse
-7.47 deg
Set Probe Angle
Overlay Controls
Sources
Anatomy
Landmarks
Isodose Contours
Needle Paths
Dosimetric Quality Alerts
Prostate - V100: 98.75 %
Prostate - D90: 187.14 Gy
Urethra - D30: 123.99 %
Rectum - V100: 0.17 cc
Set...
Bard/ProSeed Planning...
Auto Placement...
Ready
SI I-125 (STM 1251) [NIST 99]
Anisotropy: Fac
tui
Start
Digital Jacket Personal 1....
VariSeed 7.1 - Wallac...
EN
14:07

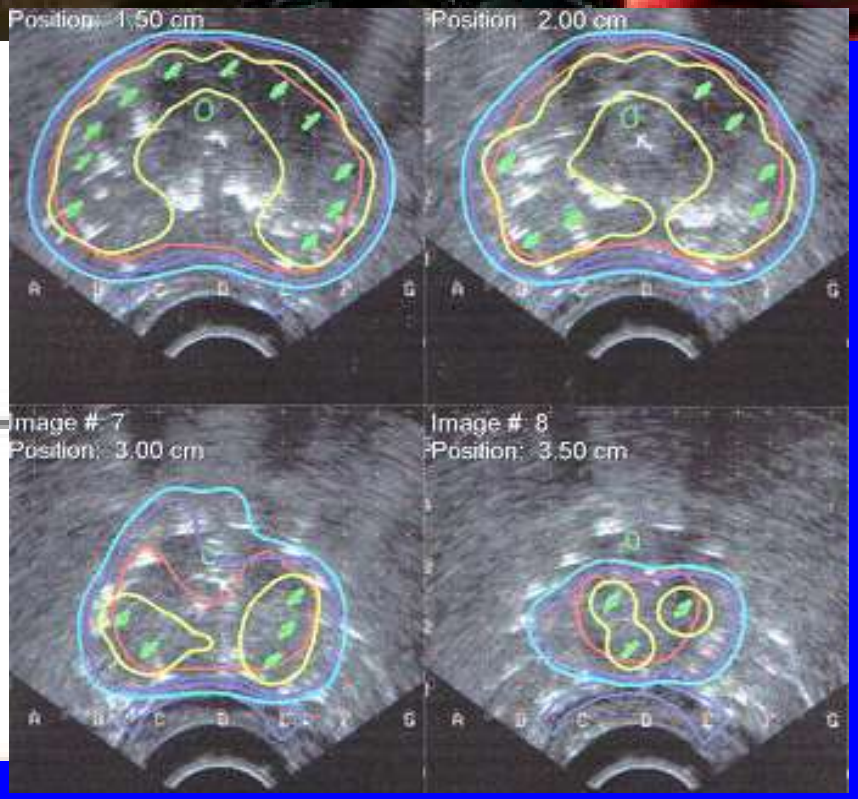
Interior

needles and seeds

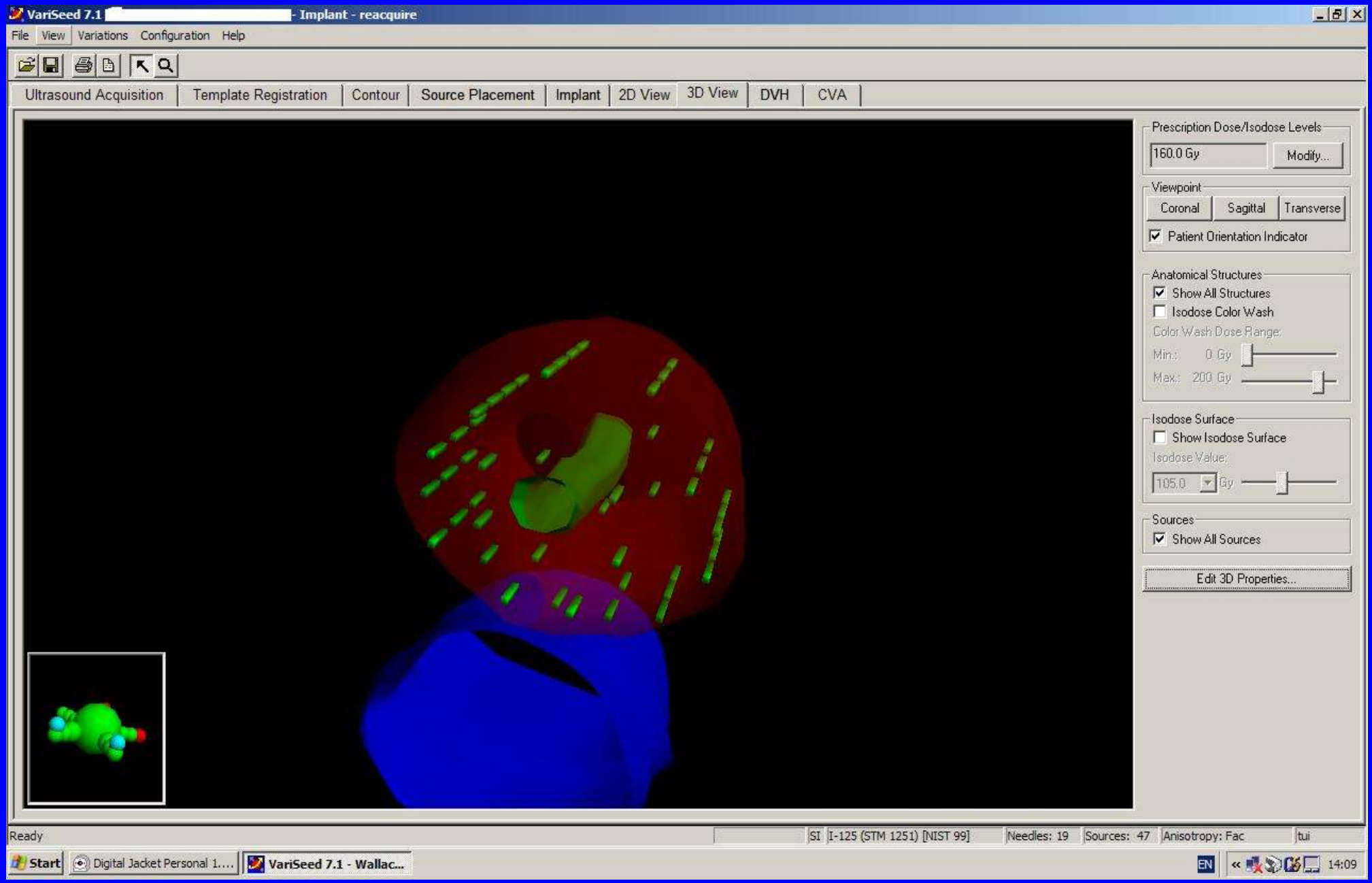
follow







The finished prostate



The finished prostate