

Emerging trends in Cancer Treatment

18 Dec 2013

Miracle Grand Hotel BKK

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Wattanosoth Hospital

Cancer Treatment

- ▶ Surgery
- ▶ Radiation Therapy
- ▶ Systemic Treatment
- ▶ Palliative Care

Emerging trends in Radiotherapy

รองศาสตราจารย์นายแพทย์ประเสริฐ เลิศสงวนสินชัย
นายกสมาคมรังสีรักษาและมะเร็งวิทยาแห่งประเทศไทย

Radiation Therapy (I)

Machine

- Deep x-ray
- Co-60 Teletherapy
- Linear accelerator
- Particle beam :
 - Proton
 - Carbon-Ion

Radiation Therapy (II)

Technique

- 2D
- 3DCRT
- 4DRT
- VMAT
- SRS/SRT
- SBRT

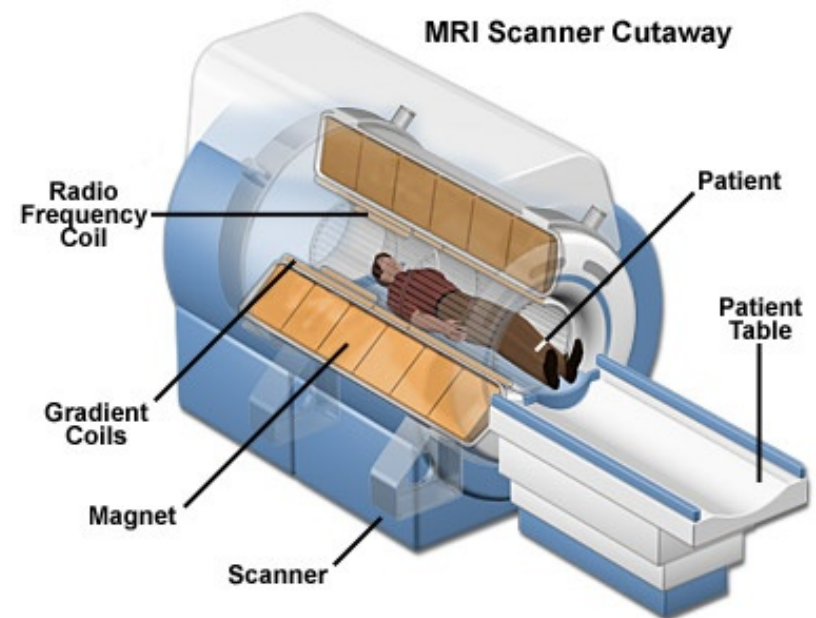
Advance in Radiation Oncology

- Needs** :-
- Good quality and accurate imaging system.
 - Modern radiation treatment planning.
 - Sophisticated radiation treatment machine.
 - Experience/ expert team.

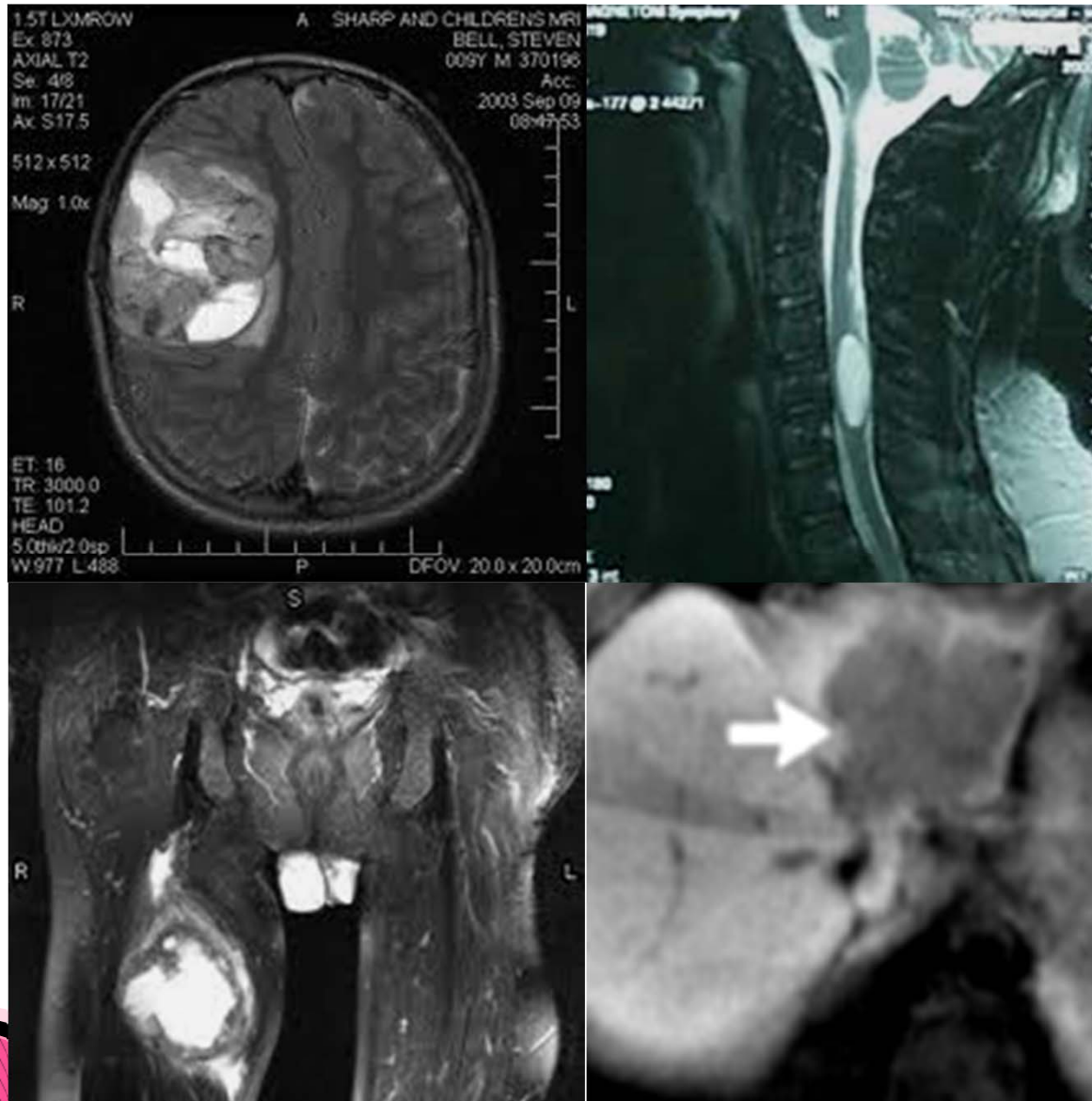
CT scan



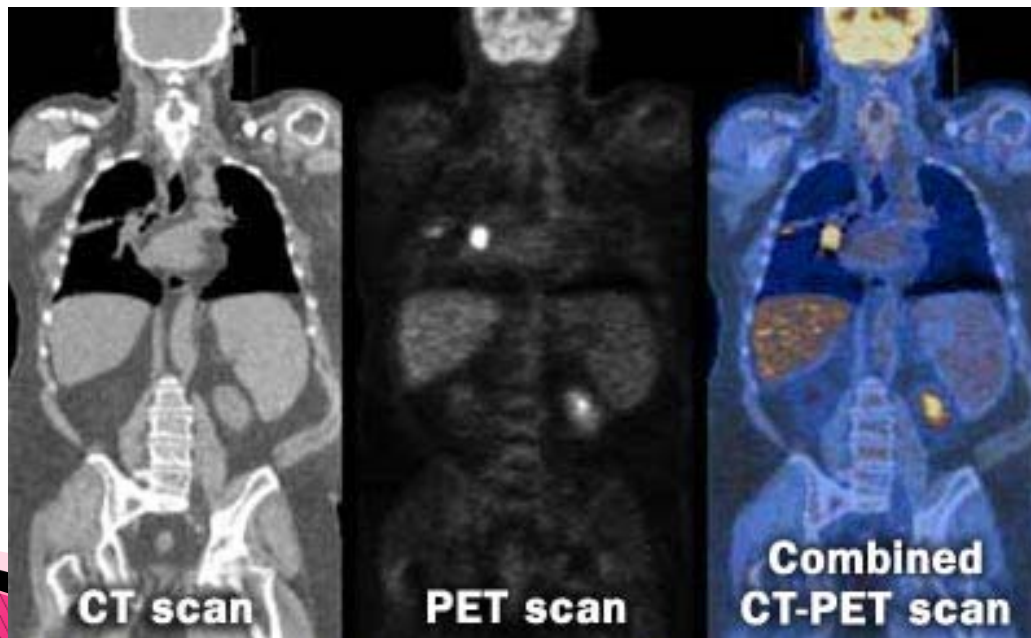
MRI



MRI Images



PET/CT scan (Functional Imaging)



PET / CT change in clinical stage (%)

Lung cancer	> 40 %
Colorectal cancer	42 %
Lymphoma	44 %
Breast cancer	31 %

J Nucl Med 2002 ; 43 ; 752 – 75

J Nucl Med 2001 ; 42 ; 586 – 59

J Nucl Med 2001 ; 42 ; 1139

J Nucl Med 2001 ; 42 ; 1334 – 1337



โรงพยาบาลวชิรเมธี
WATTANOSOTH HOSPITAL

IMAGE FUSION

CT-CT FUSION

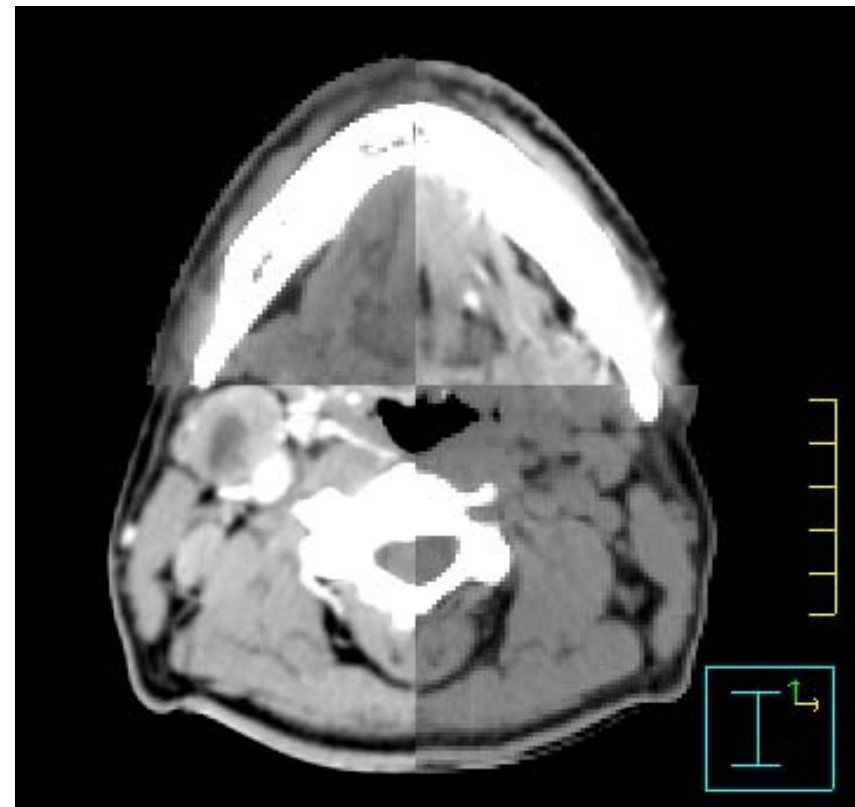
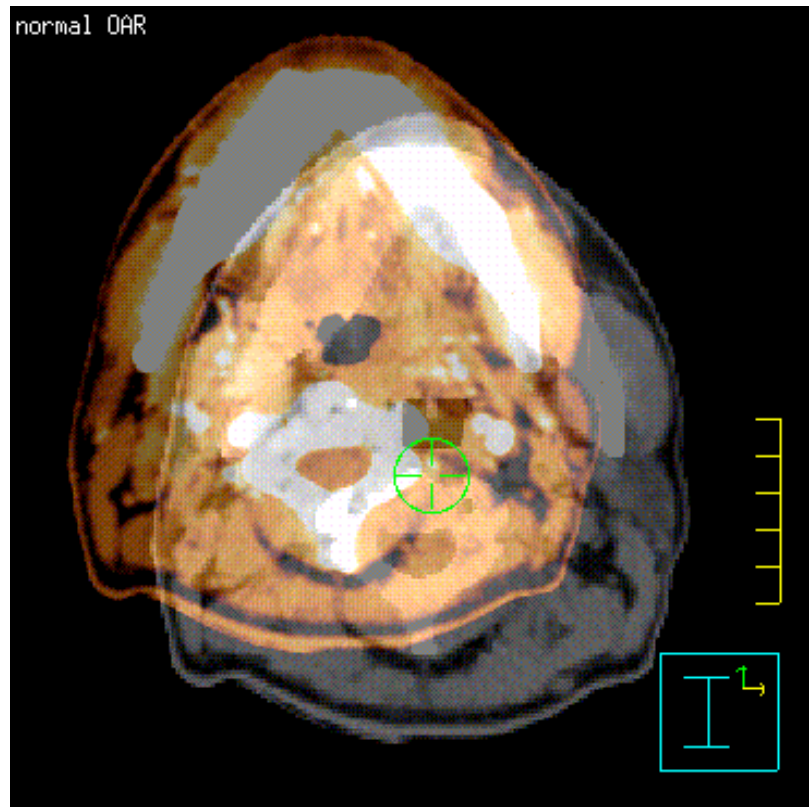
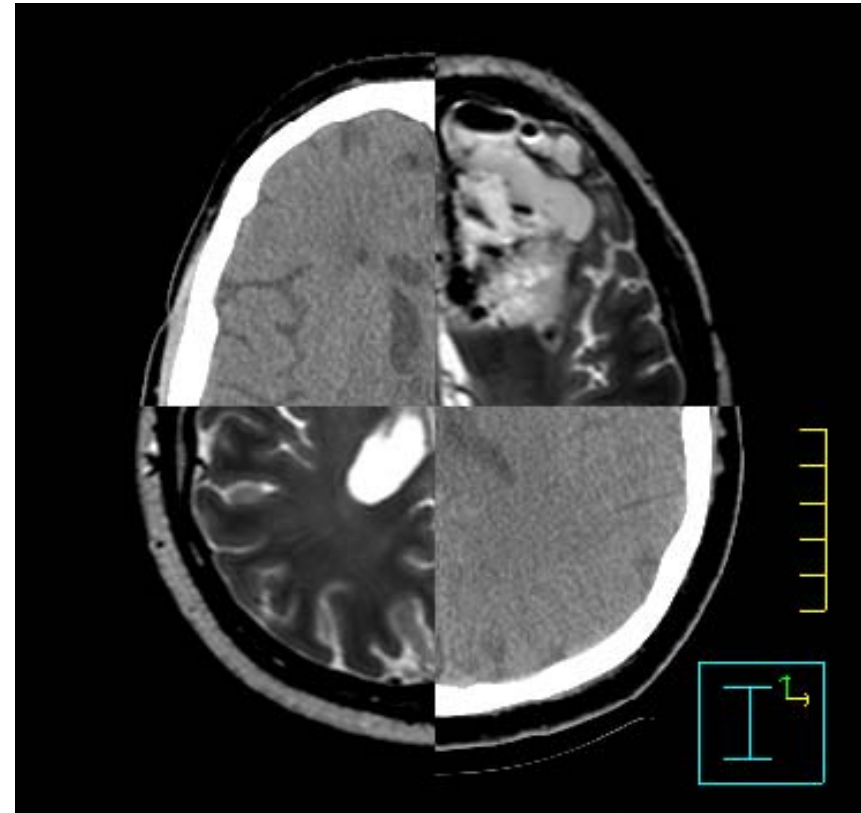
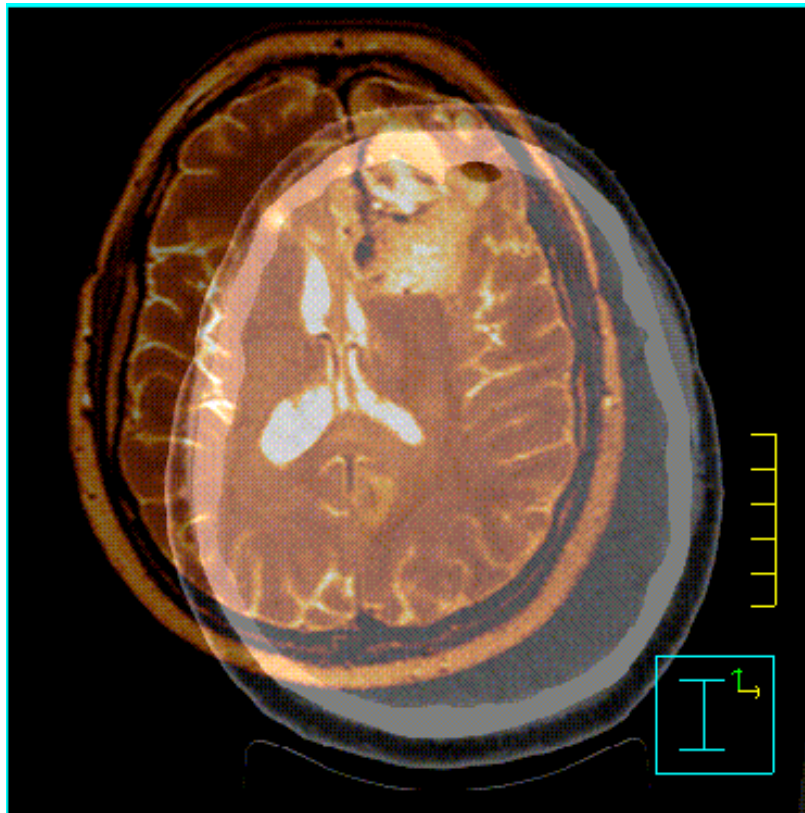


IMAGE FUSION

CT-MRI FUSION



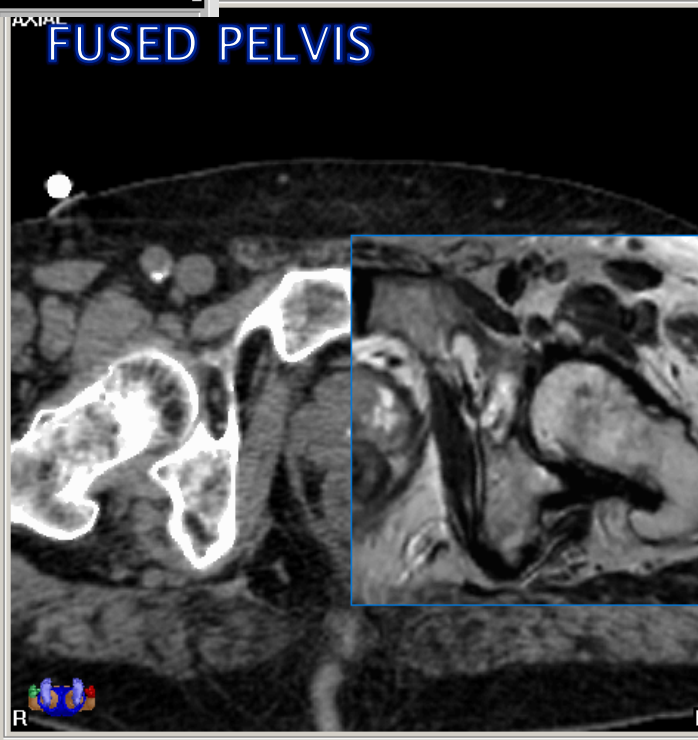
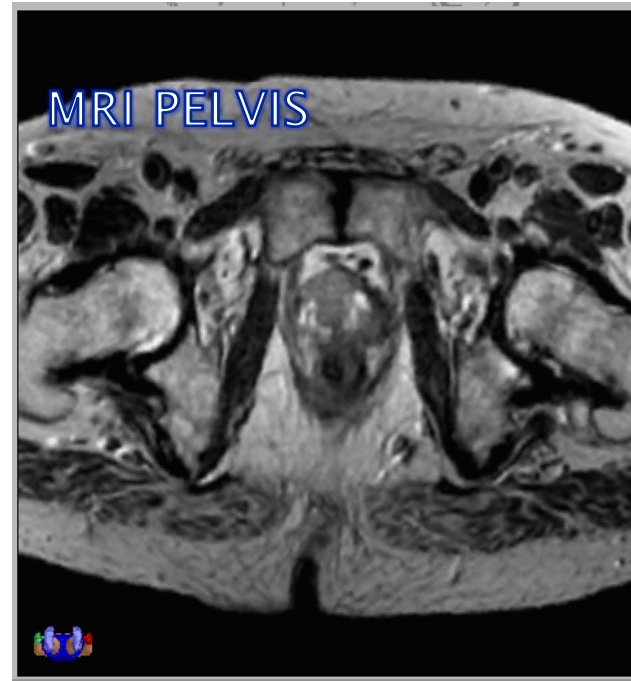
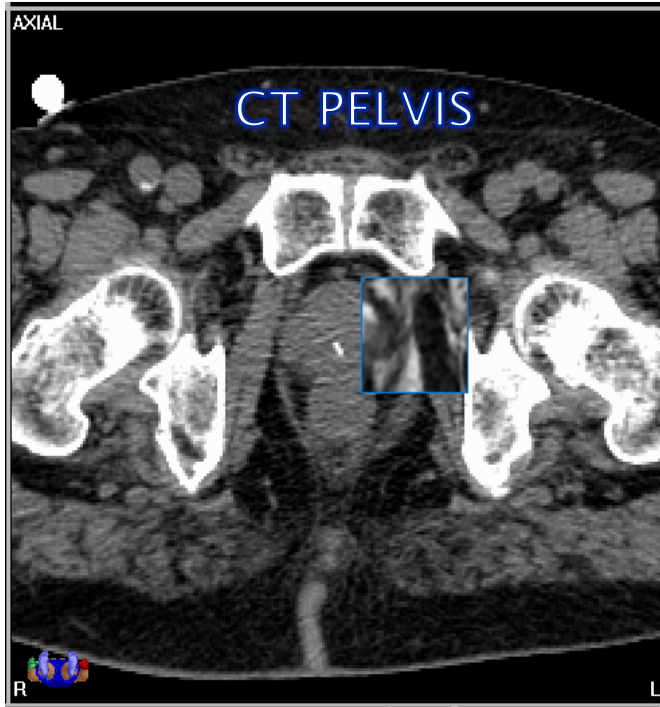
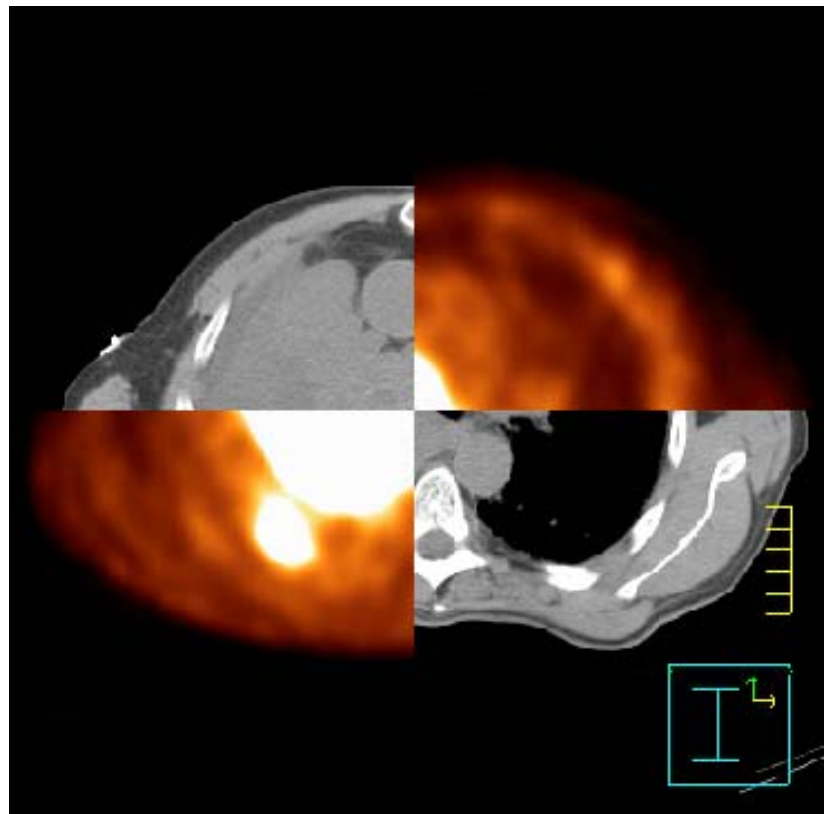
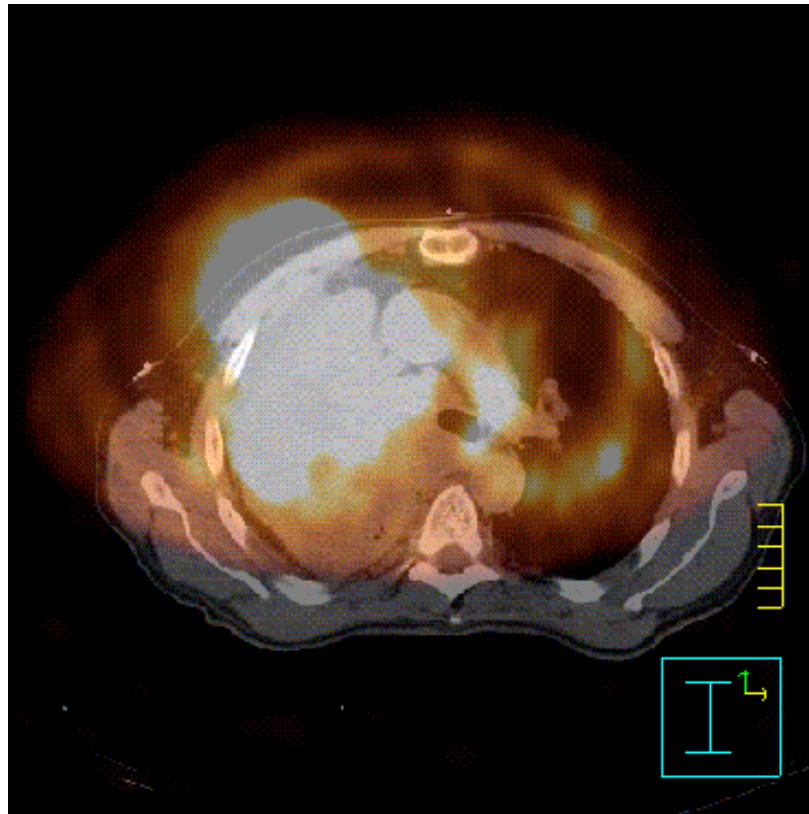
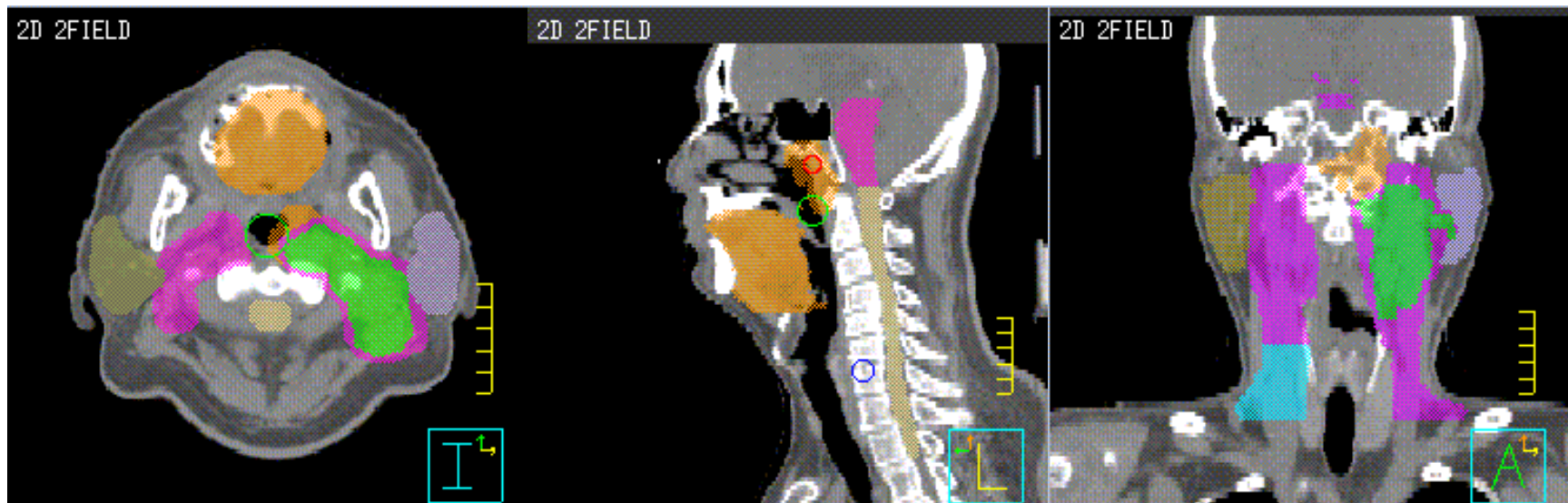


IMAGE FUSION

CT-PET FUSION

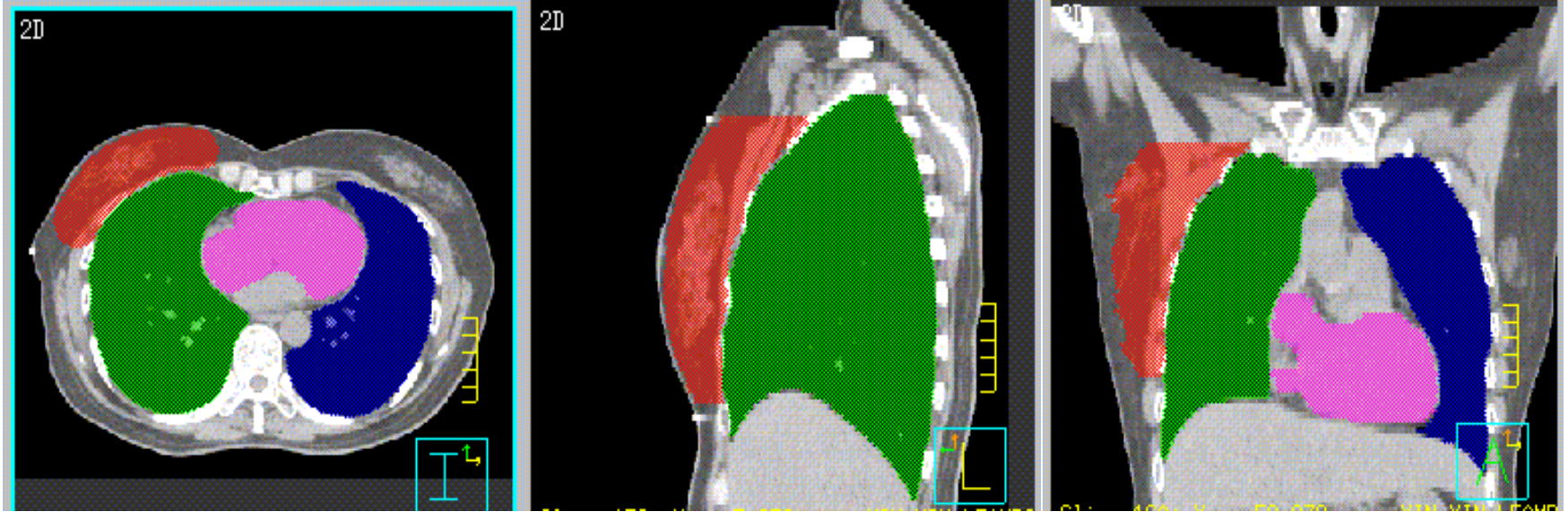


Nasopharynx organ delineation

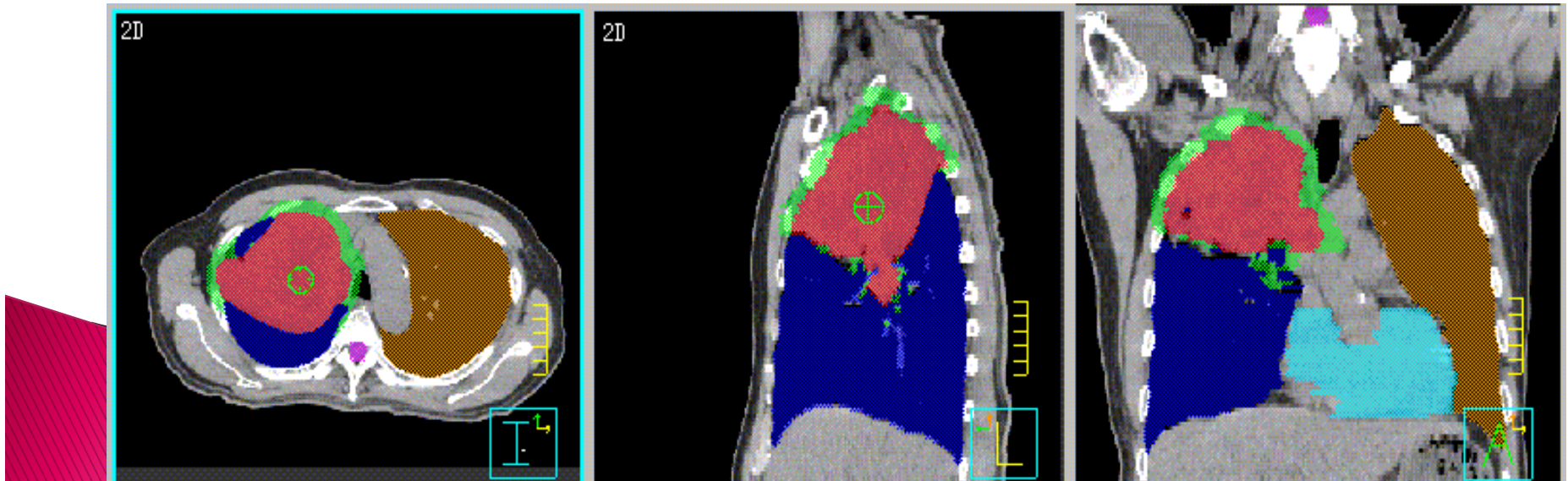


organ delineation

Breast

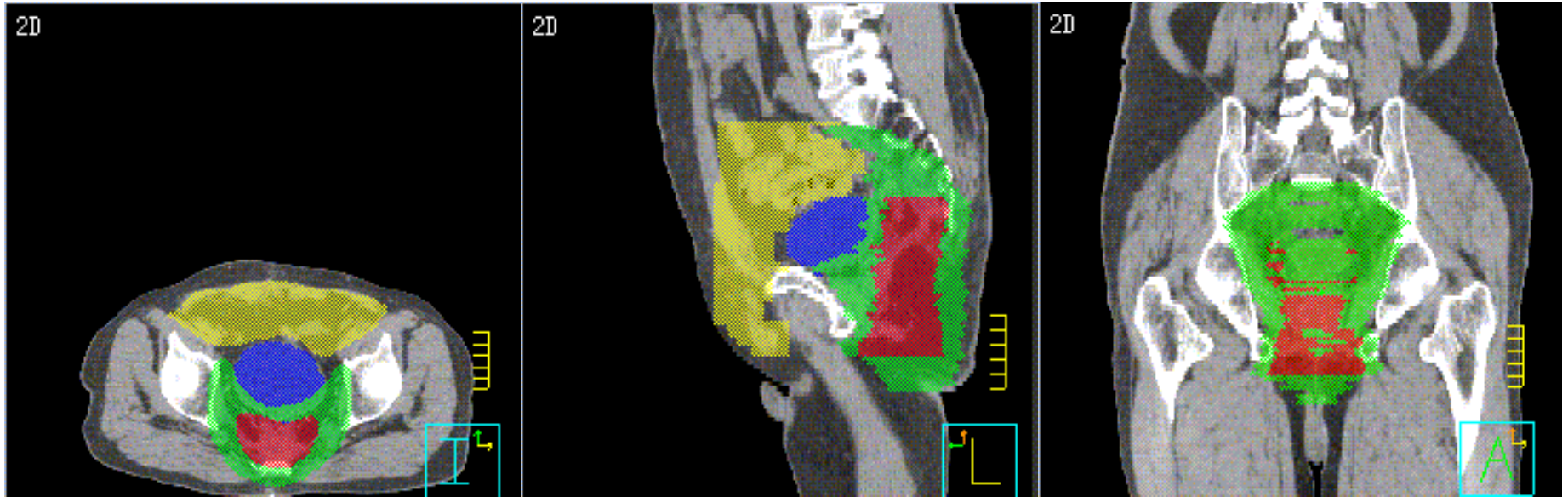


Lung

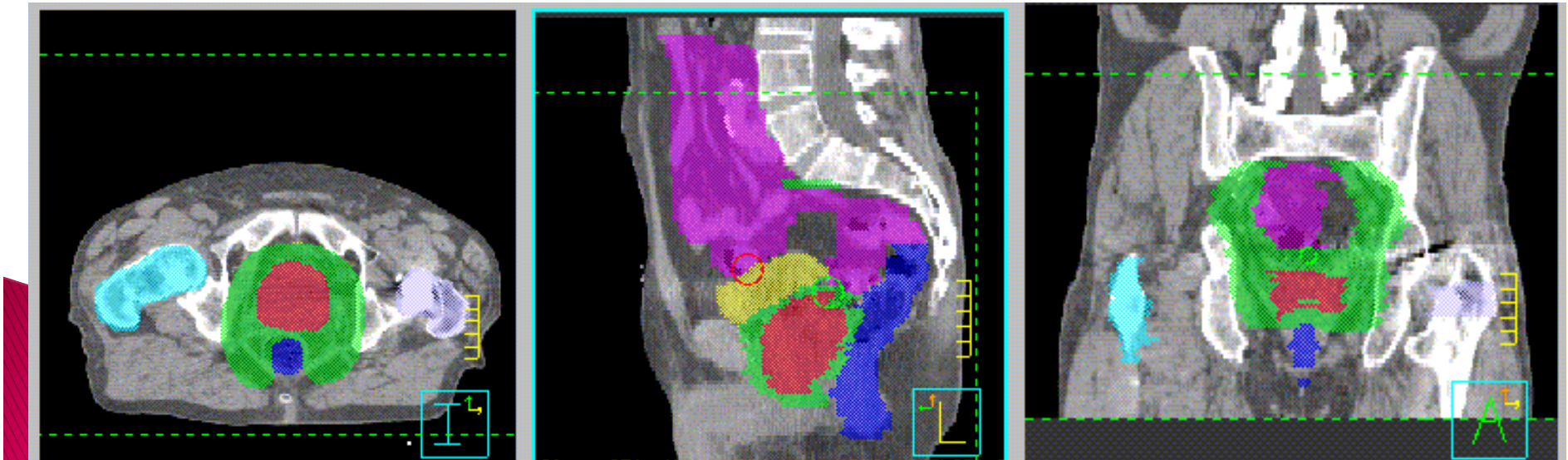


organ delineation

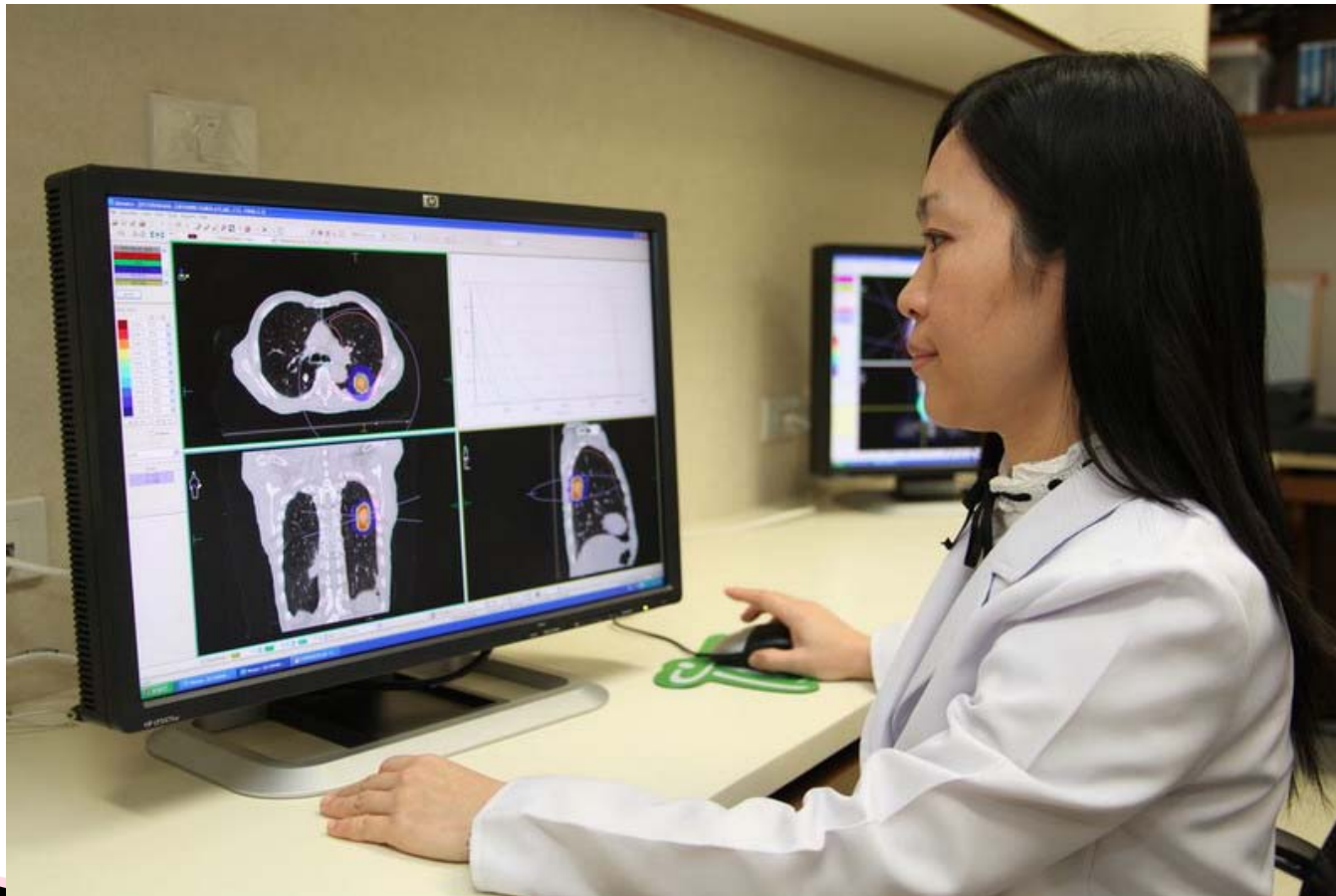
Rectum



Prostate



RADIATION TREATMENT PLANNING (RTP)

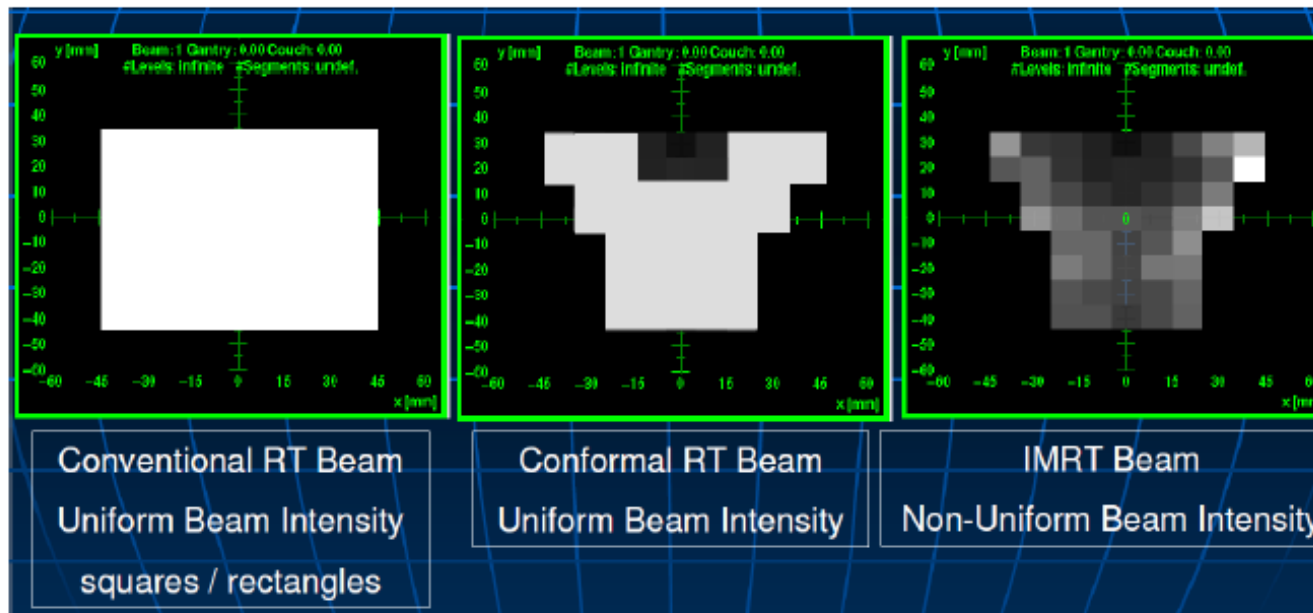


RT treatment

- ▶ The highest probability of cure with the least morbidity
- ▶ 2D 3D IMRT/IGRT
 - Biologic variables
 - Set up error/ organ movement
- ▶ The abilities to identify the cancer cells and target them with radiation

Intensity Modulated Radiotherapy

2D-RT → 3D-CRT → IMRT



Goal: Delivery of higher dose to the tumour and a lower dose to the OAR

Two-Dimensional Radiation Therapy (2D RT) or Conventional Radiation Therapy

- Is a simple standard radiation treatment
- Dose of radiation distribution is equally to tumor and normal tissue

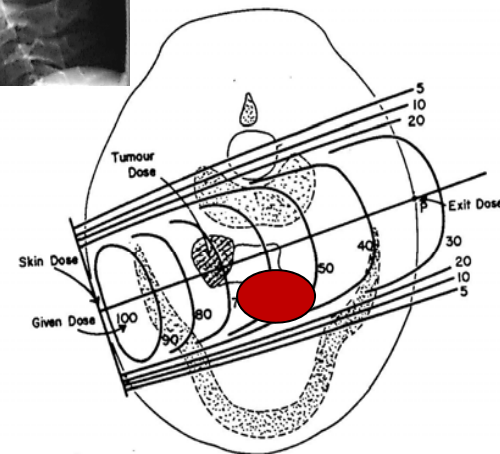
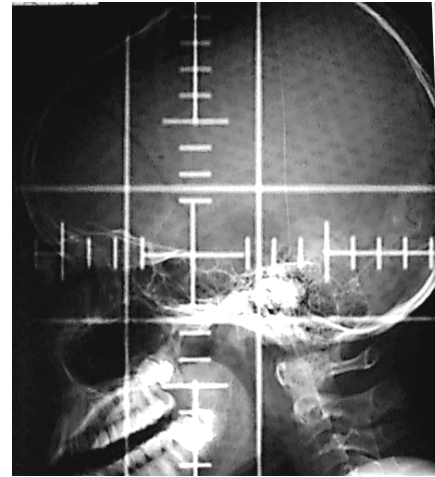


FIGURE XI-1. Diagram showing a cobalt 60 field superimposed on the cross-sectional diagram of the head at the level of the tonsil.

2D RT

Both tumor and normal tissue receive the same radiation dose

Novalis Treatment Planning 5.31 © 1989/2004 by BrainLAB AG
File Edit Calculations AutoContour Settings Therapy Info

Isocenter
Store Select
Add Remove
Pos. Isoc O. Coll.
X: 288.69
Y: -227.63
Z: -113.50
Dose: 2.86
Margin: 0.0

Beam
Select
Add Remove
Pos. Beam
Pos. Leaf O. Coll.
O. Leaf O. Shape
Table: 0
Gantry: 0
Coll.: 90
Dose: 1.43
Margin: 0.0

Dose Display
 Isodoses
 Dose Wash
 Thresh. Dose

Dosimetry
Normal. Point
Parameters...
 Pencil Beam

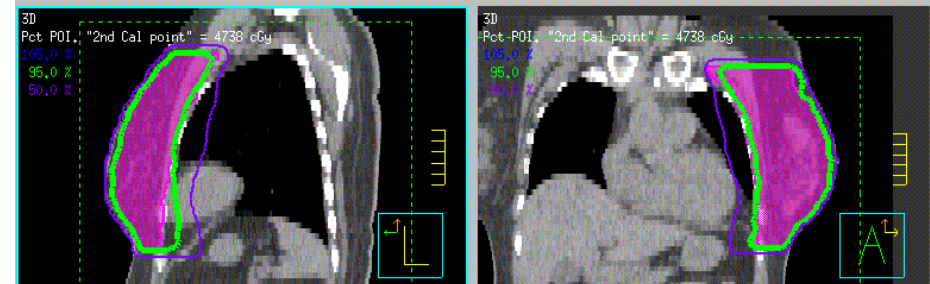
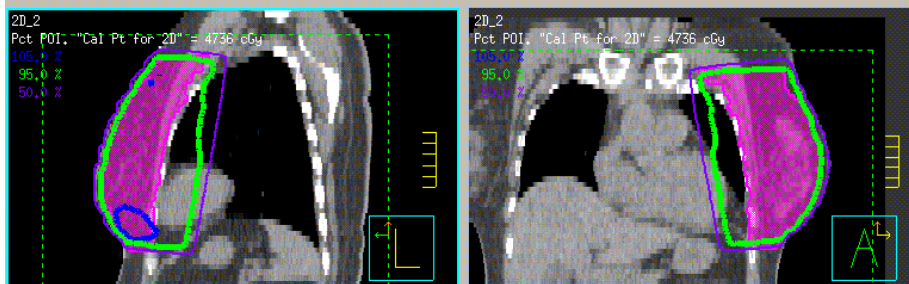
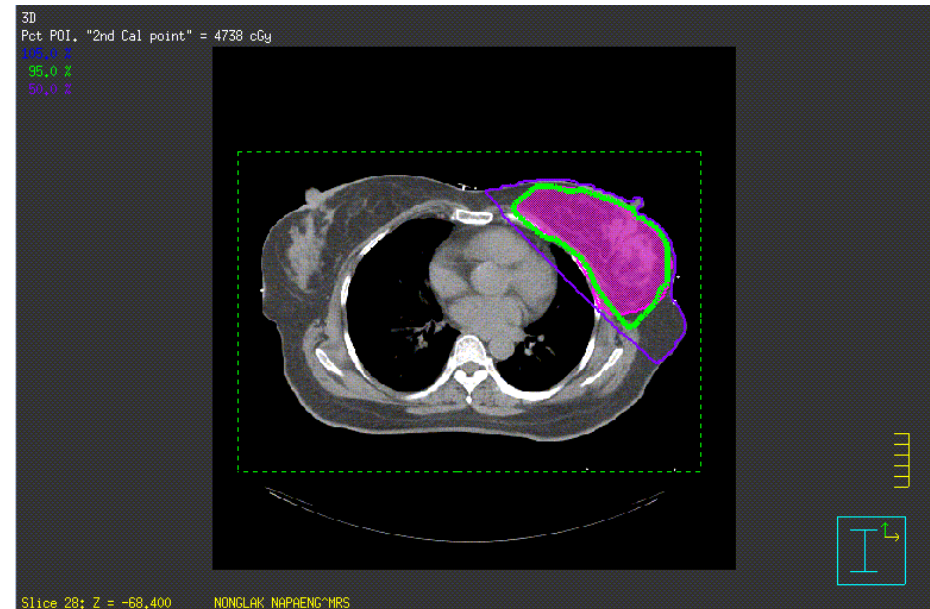
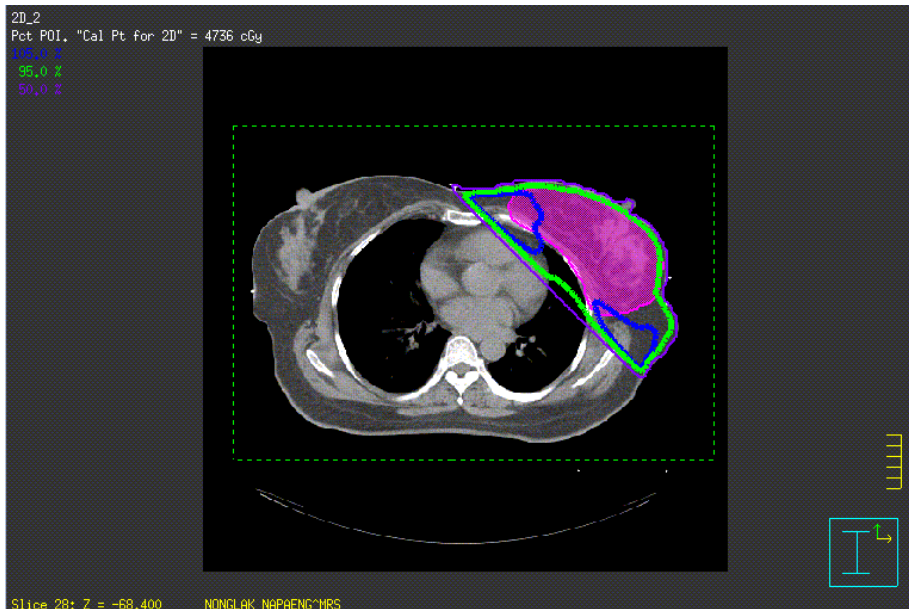
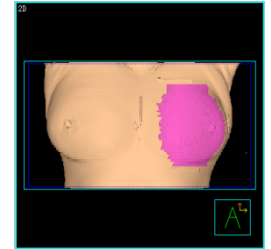
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Copy Delete
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 4 Images
 9 Images
 16 Images
 3D Display
 Beam's Eye
 Field Proj.
 Tissue
 Split Screen
In Out
CT set #1
Prior Next
Options
 Reconstruct.
 Multipanar
 Multiple Sets
 Other Views
 Catalog
 Sketches
 3D Overview
 Room's Eye
In Out

Slice no. 46 / Z = -114.0
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163 MU
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CORONAL
SAGITTAL
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PATIENT: 0106001197 UMPOL LIKITANASOMBAT MR. 0 0 6 15.02.2006 - 13:01:4

2D-Tangential beams

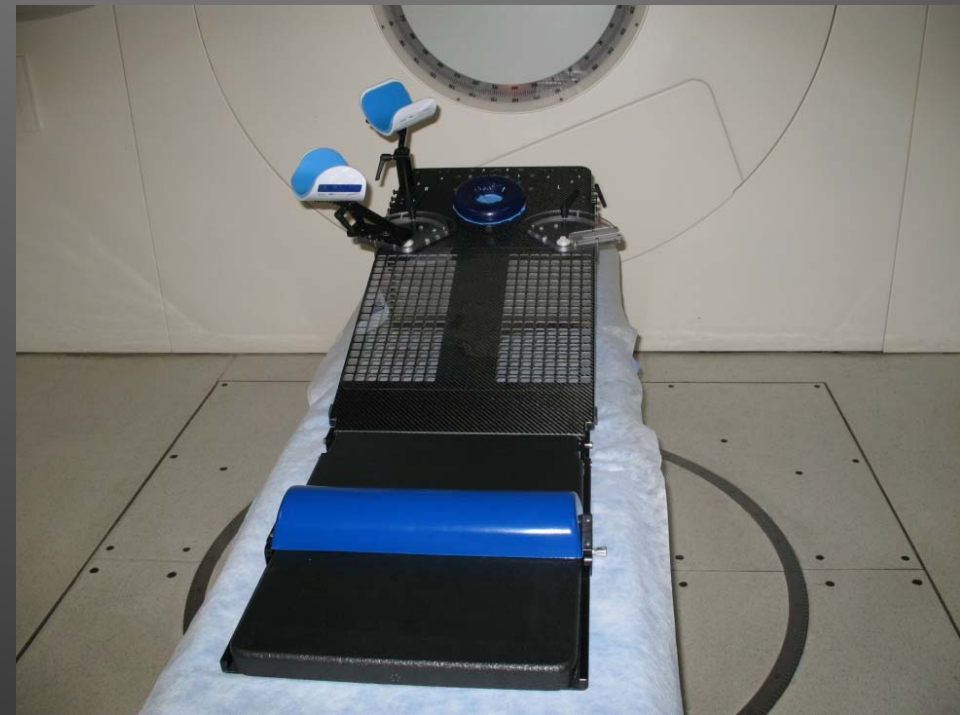
3D-CRT



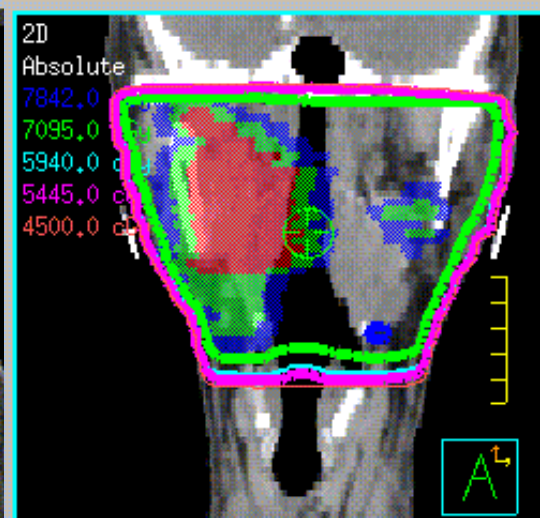
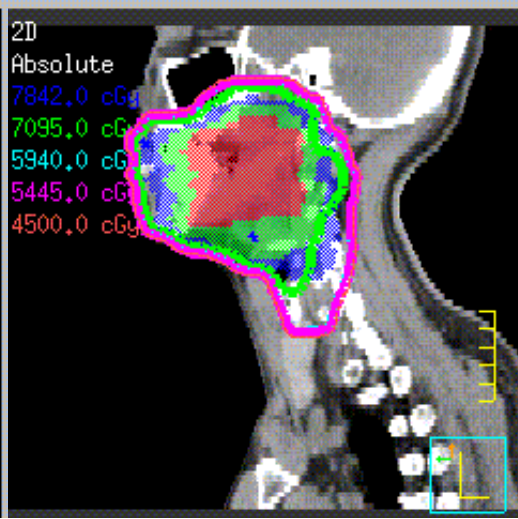
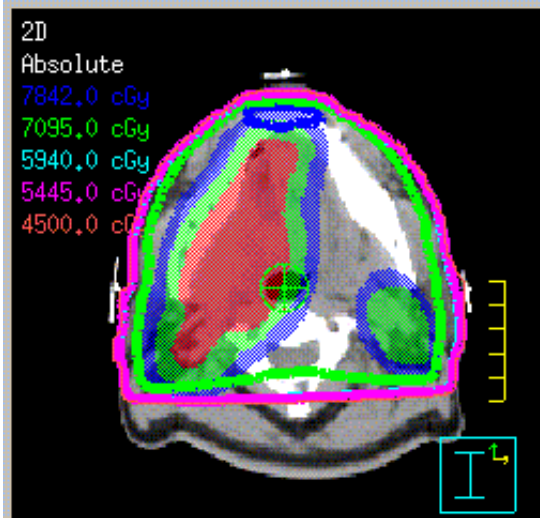
- High exposure dose to lung and heart also hot spot at periphery area

- Better precise beam to target with dose homogeneity

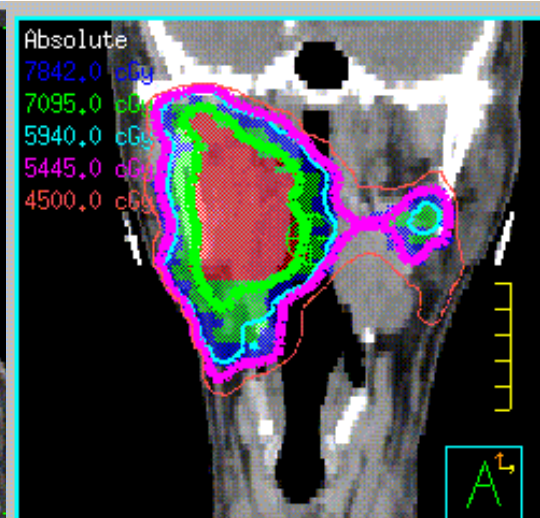
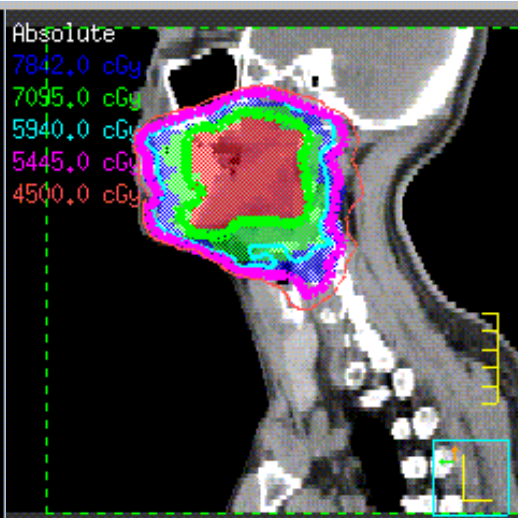
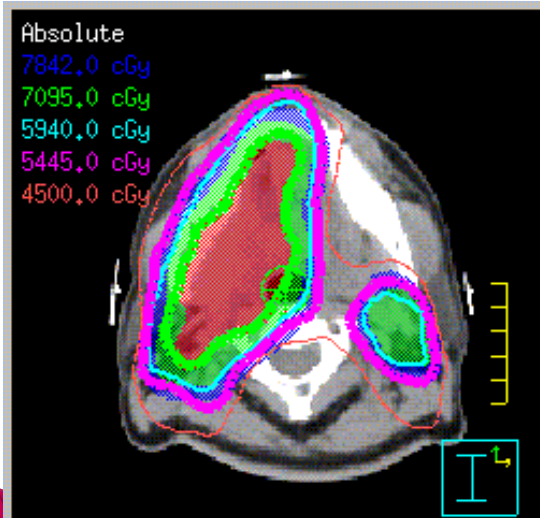
Breast Board



Radiation planning: Oropharynx



2D

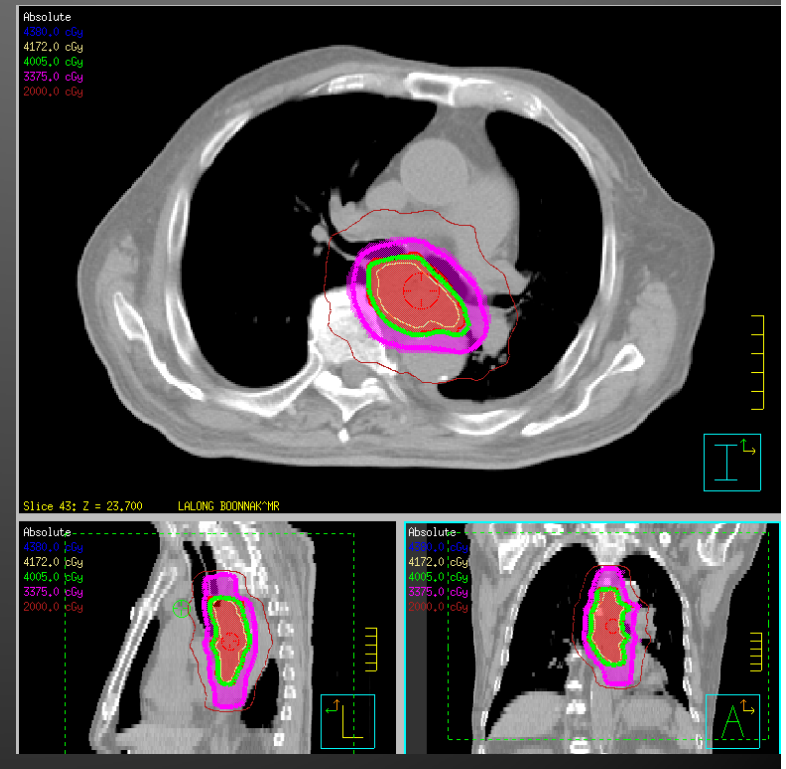


IMRT

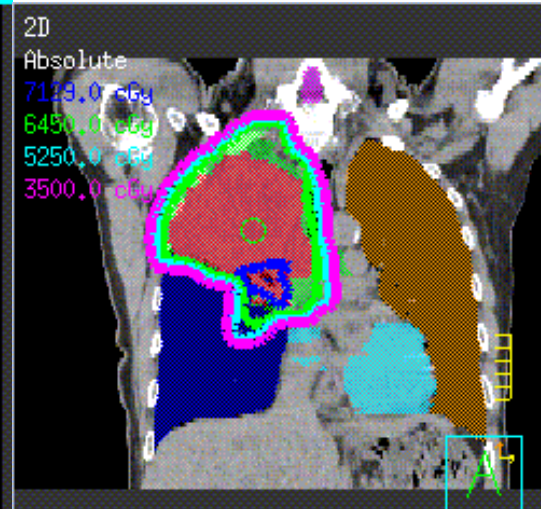
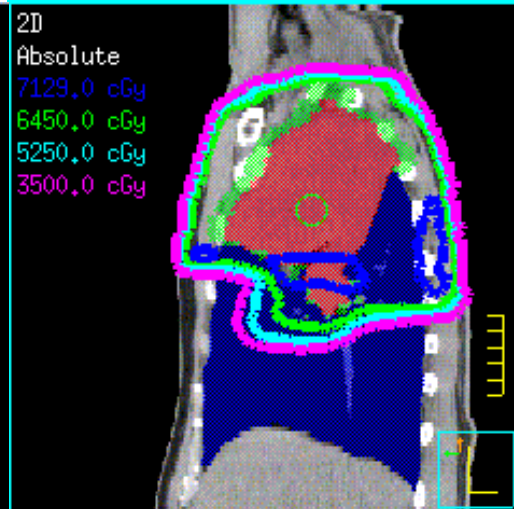
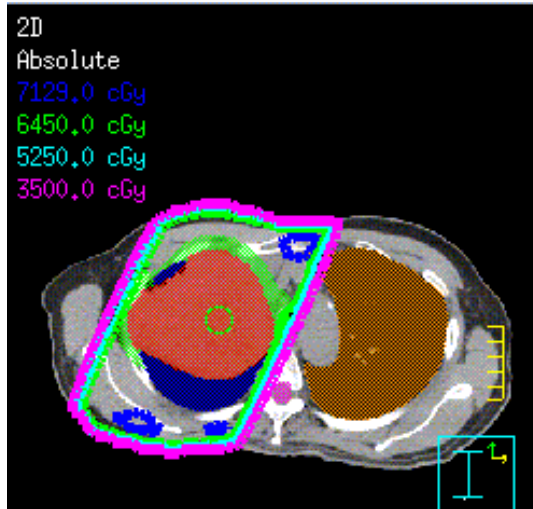
Esophageal cancer

PET/CT SCAN

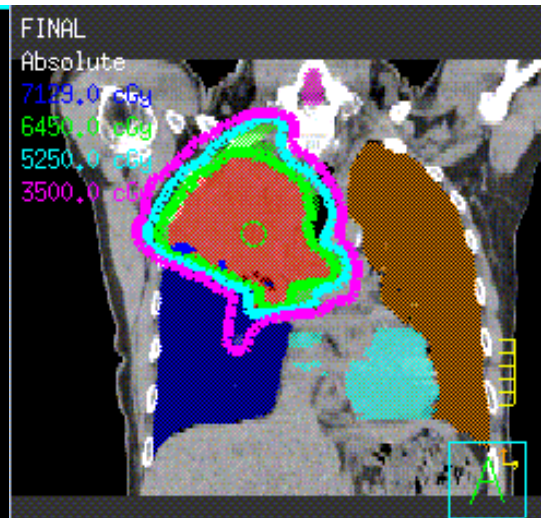
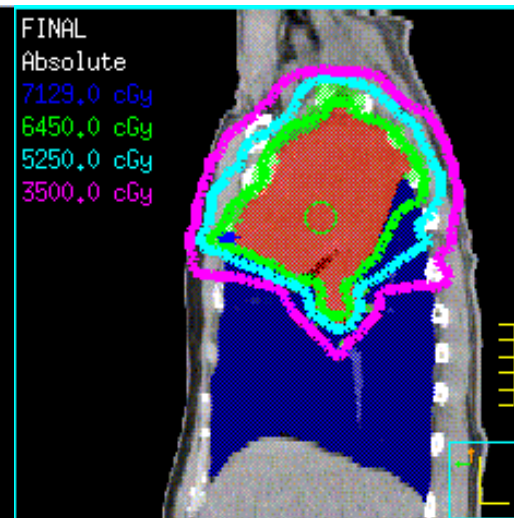
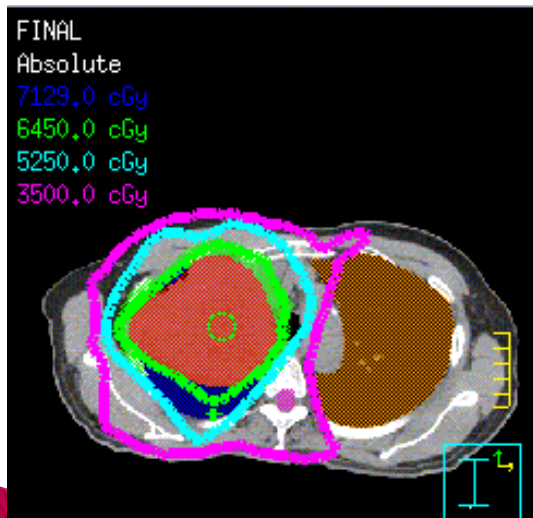
IMRT Planning



Radiation planning: Lung

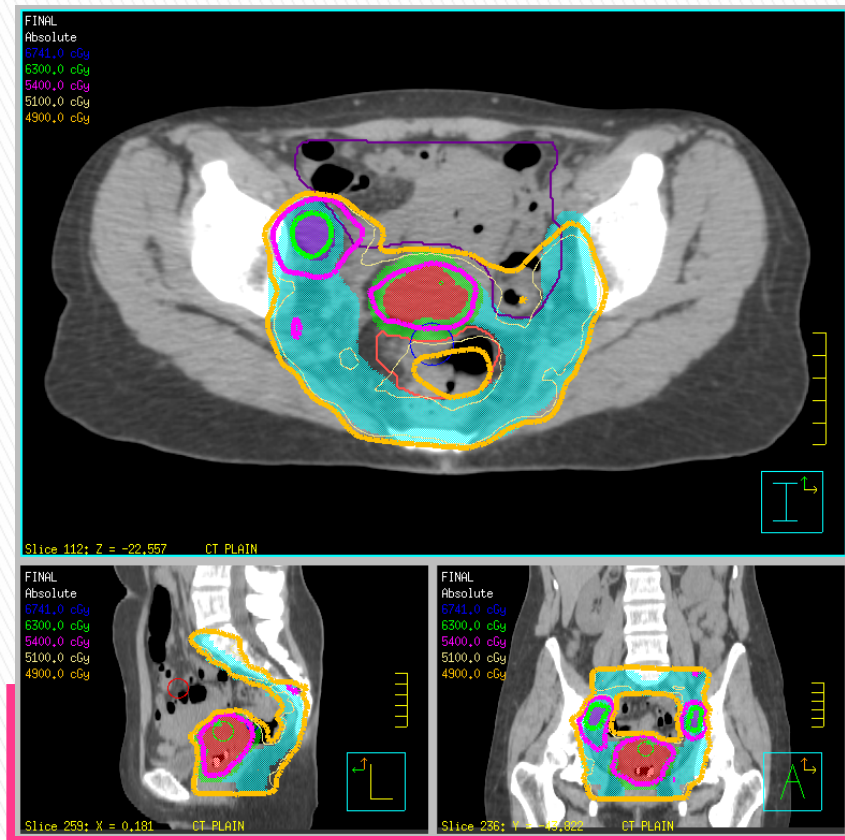
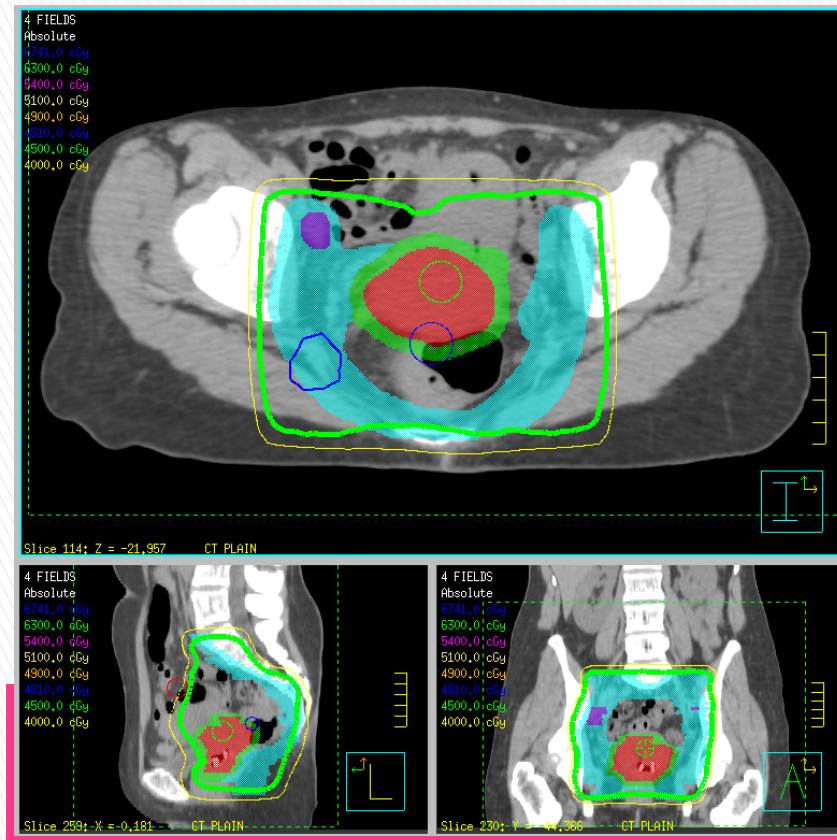


2D



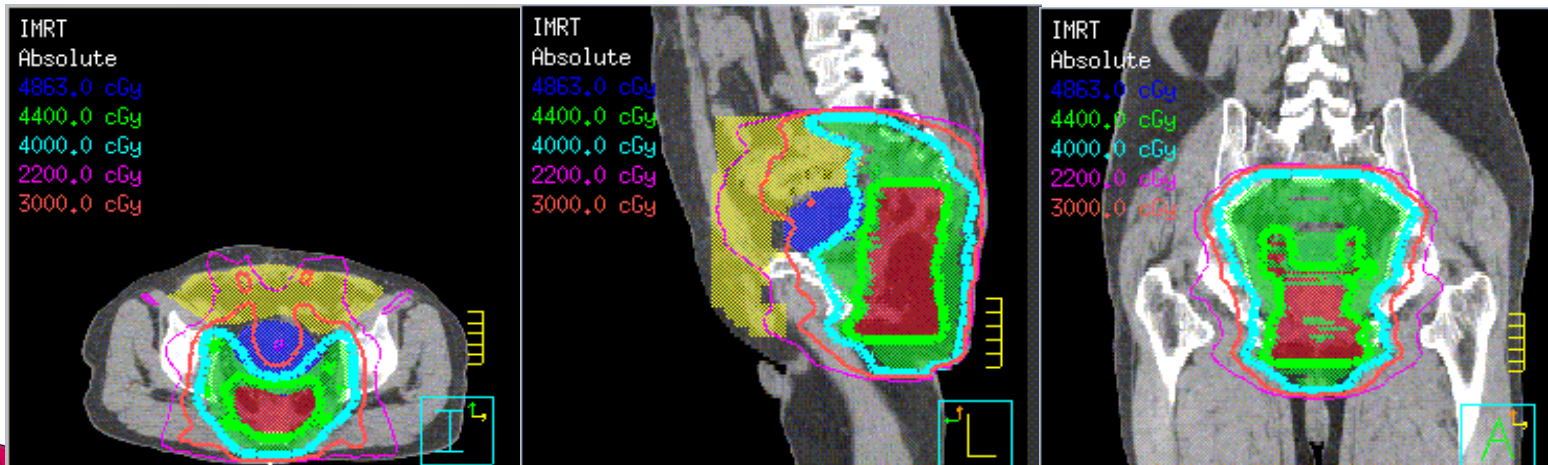
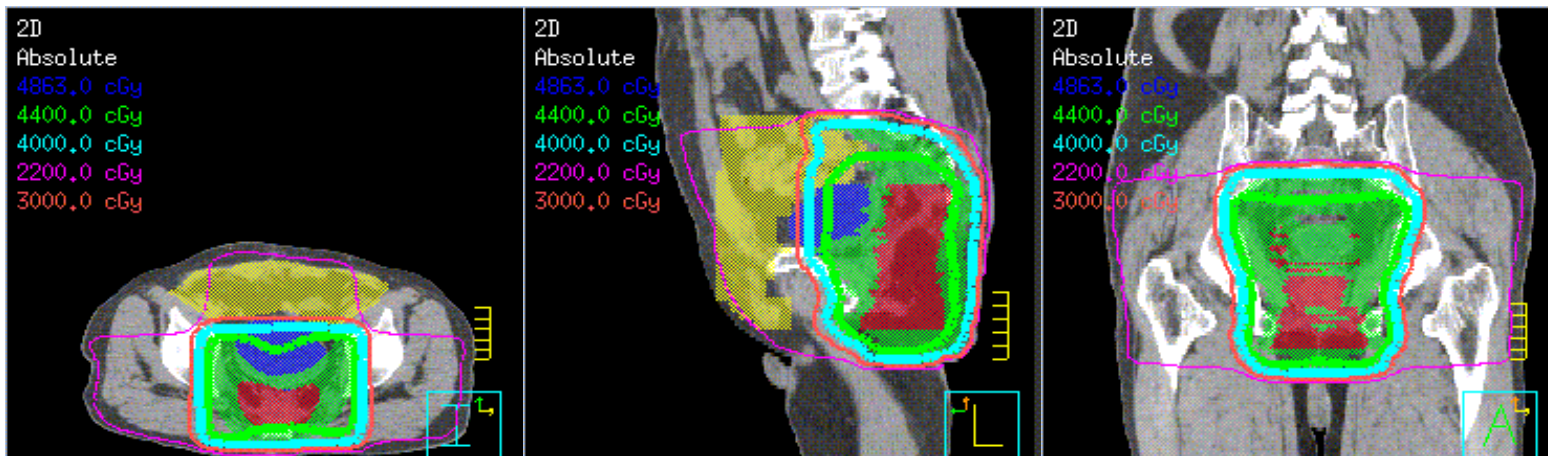
IMRT

2D VS 3D / IMRT Technique

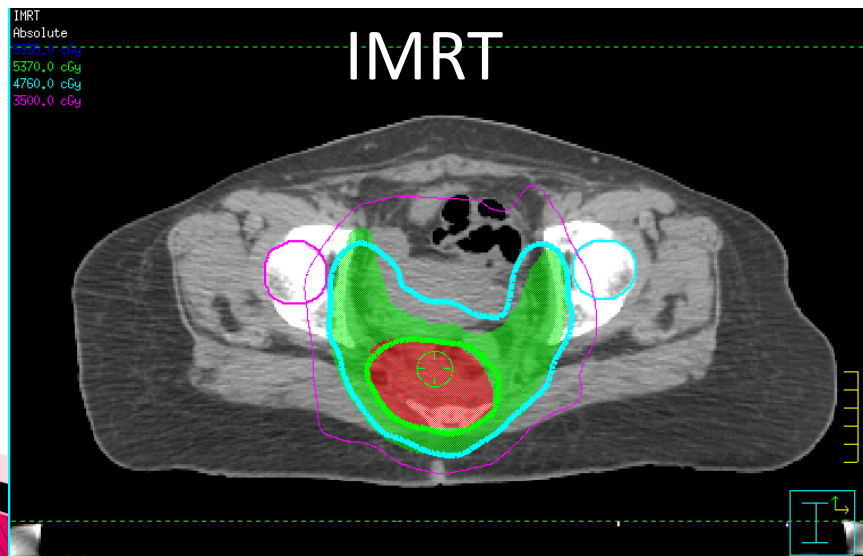
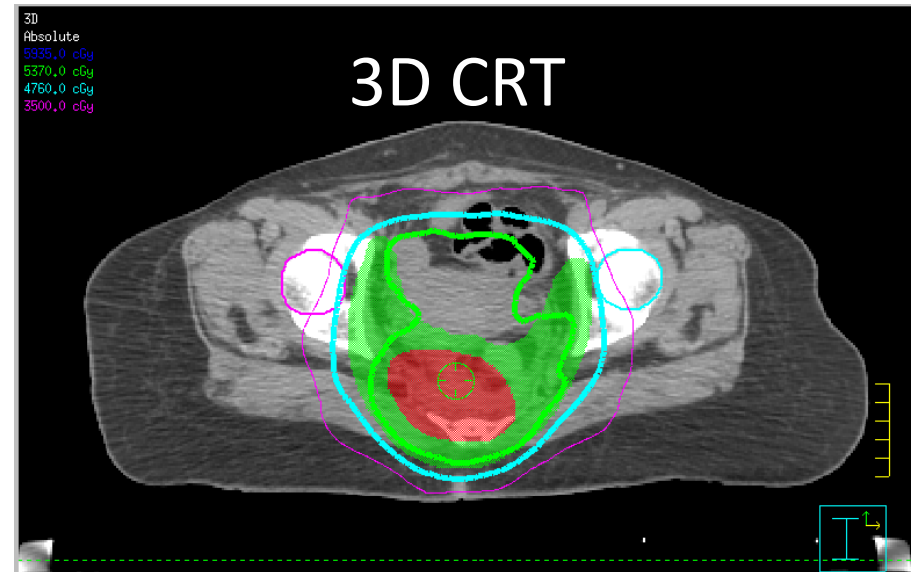
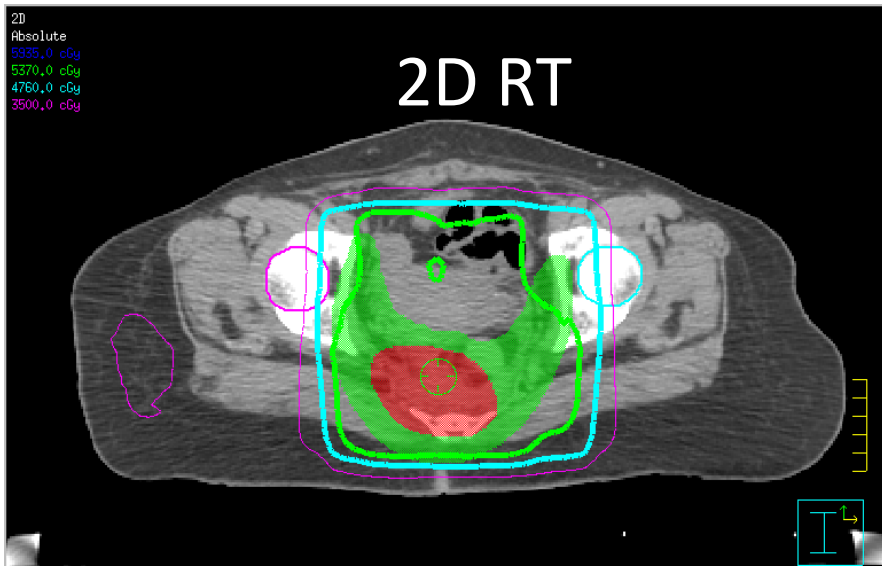


CA Cervix

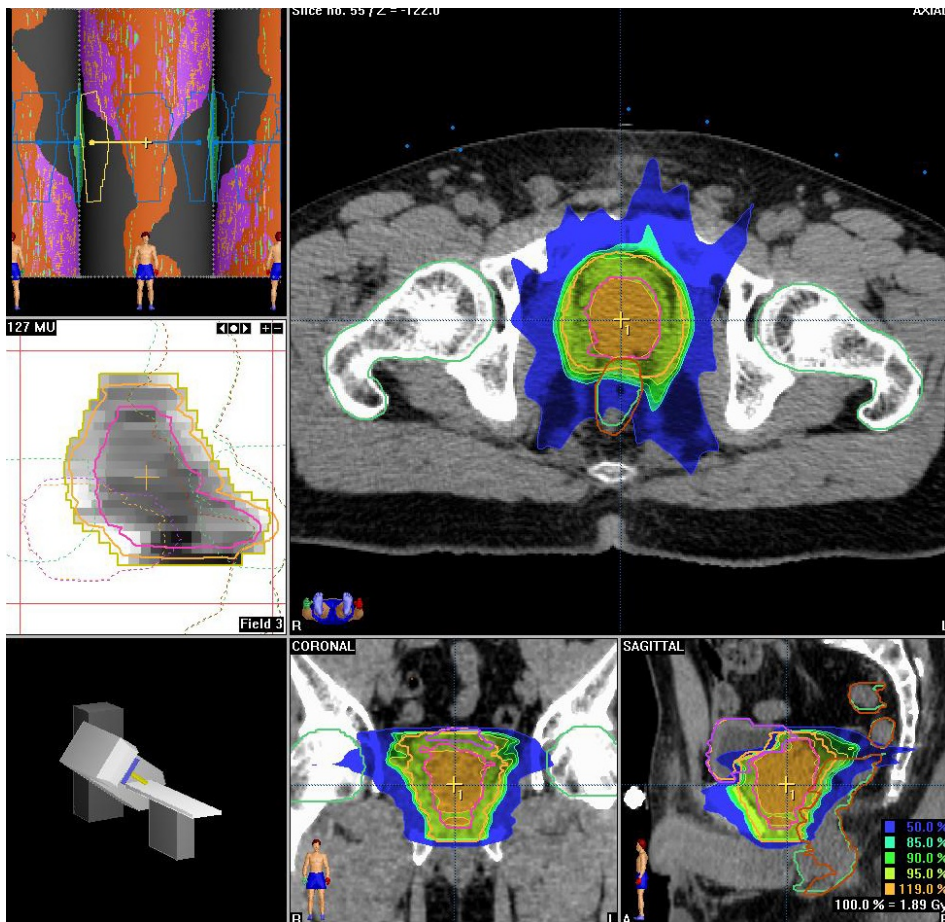
Radiation planning: Rectum



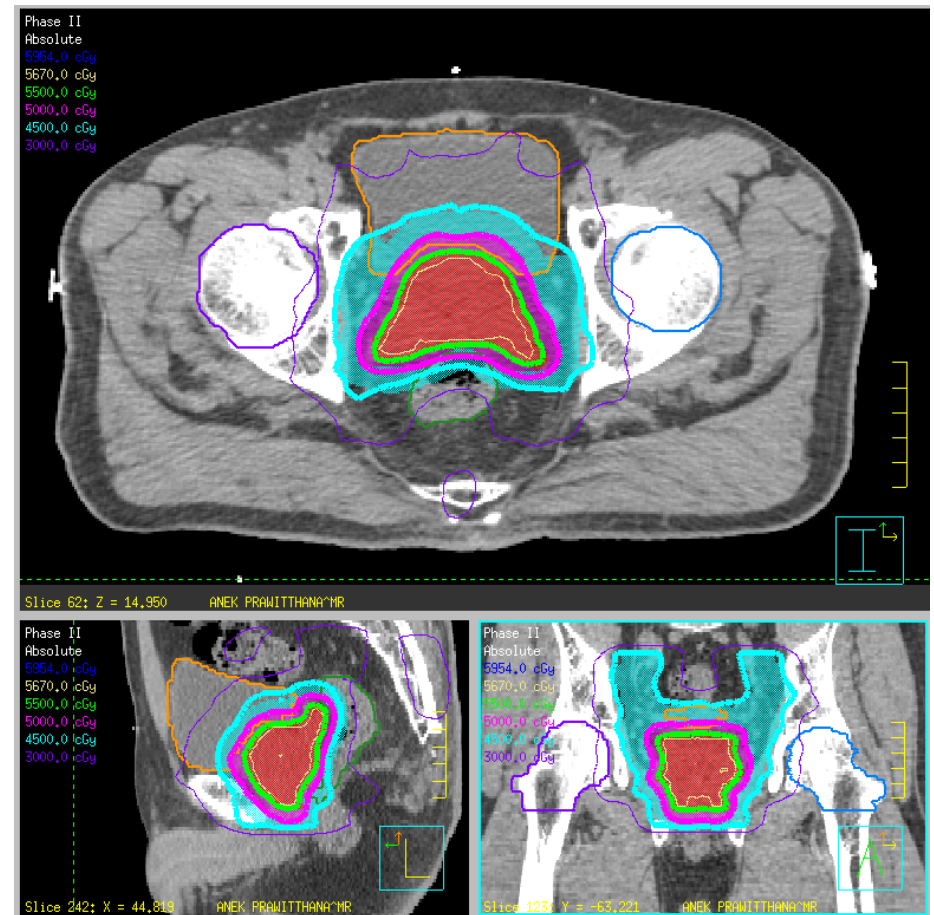
RT TECHNIQUE: RECTAL CANCER



CA PROSTATE (IMRT Technique)



Prostate with seminal vesicle

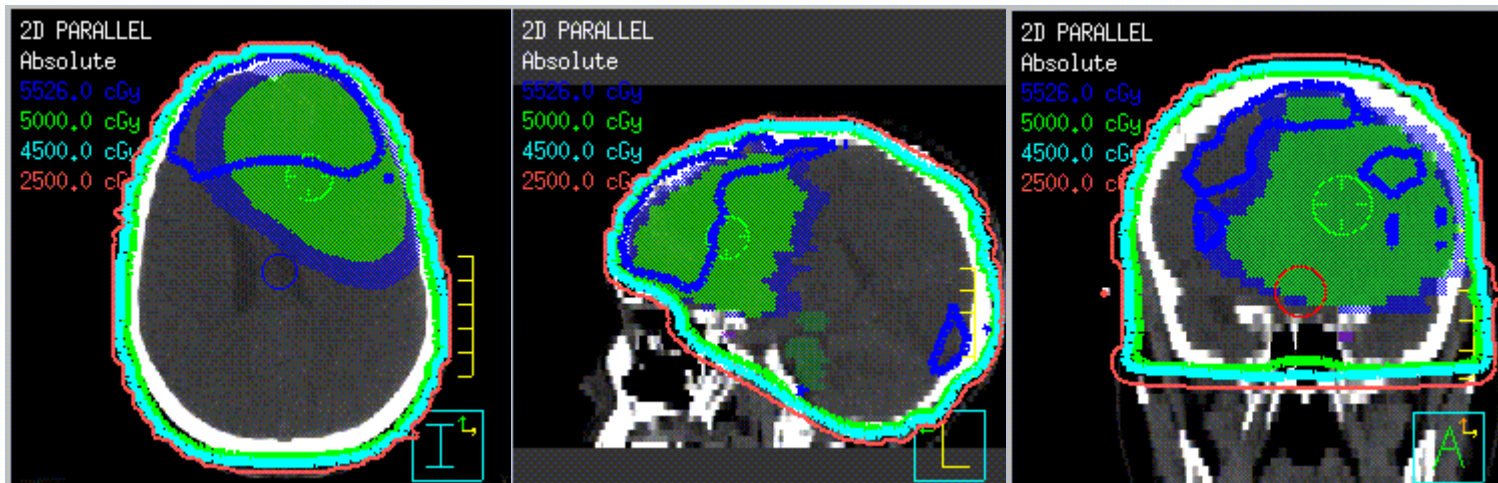


Prostate with seminal vesicle and pelvic lymphnode

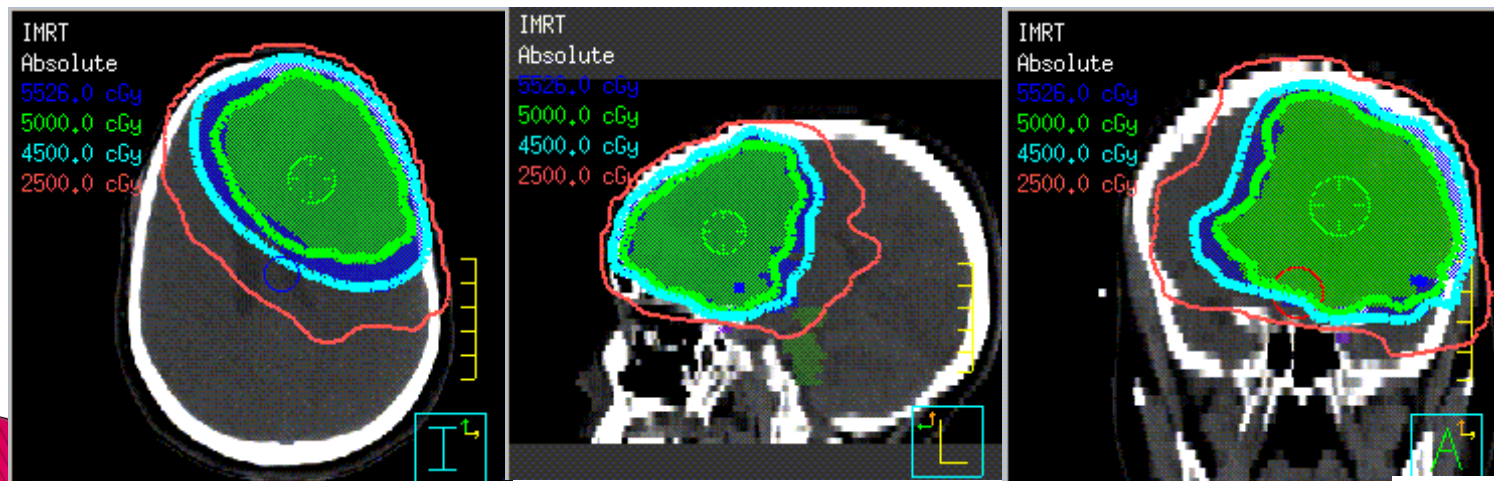
Body Immobilization Devices (Vac-loc)



Radiation planning: Brain

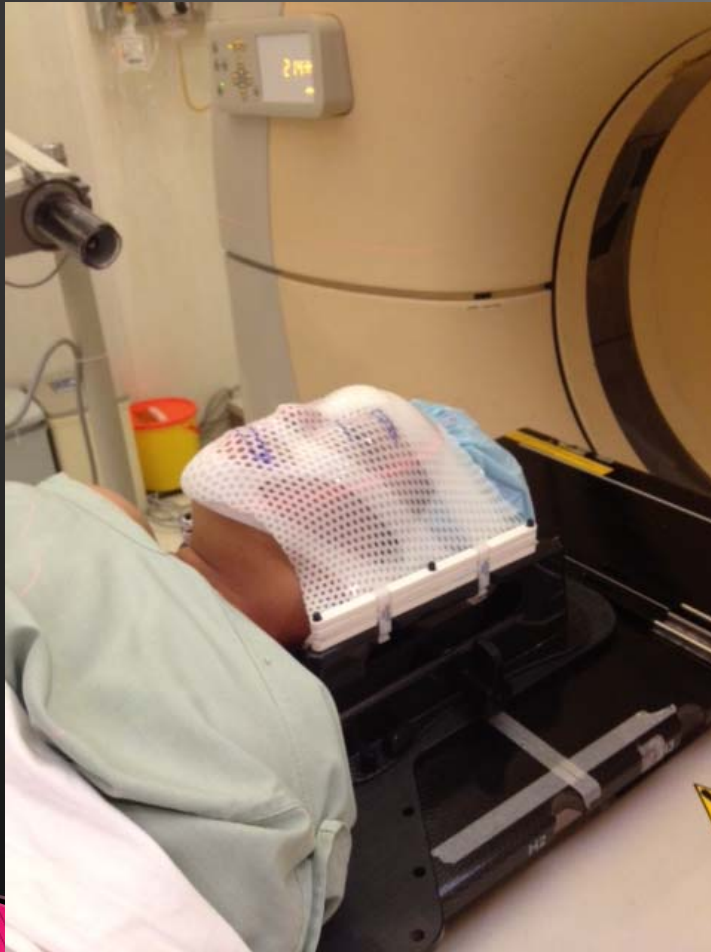


2D

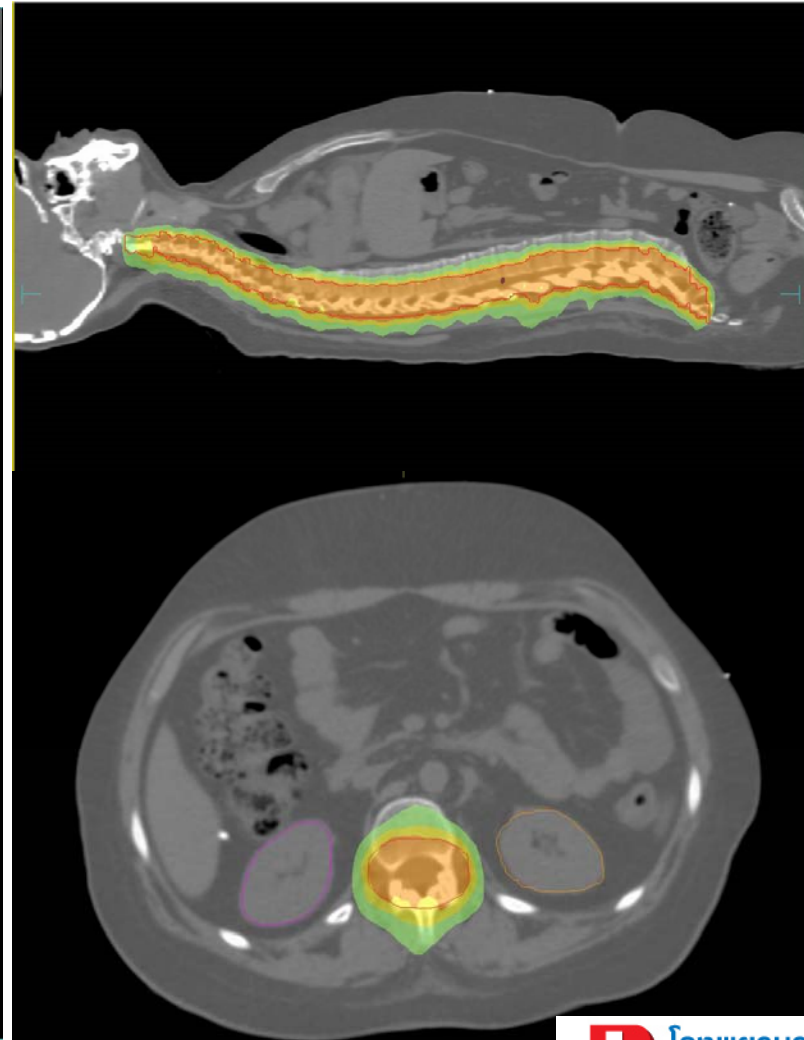
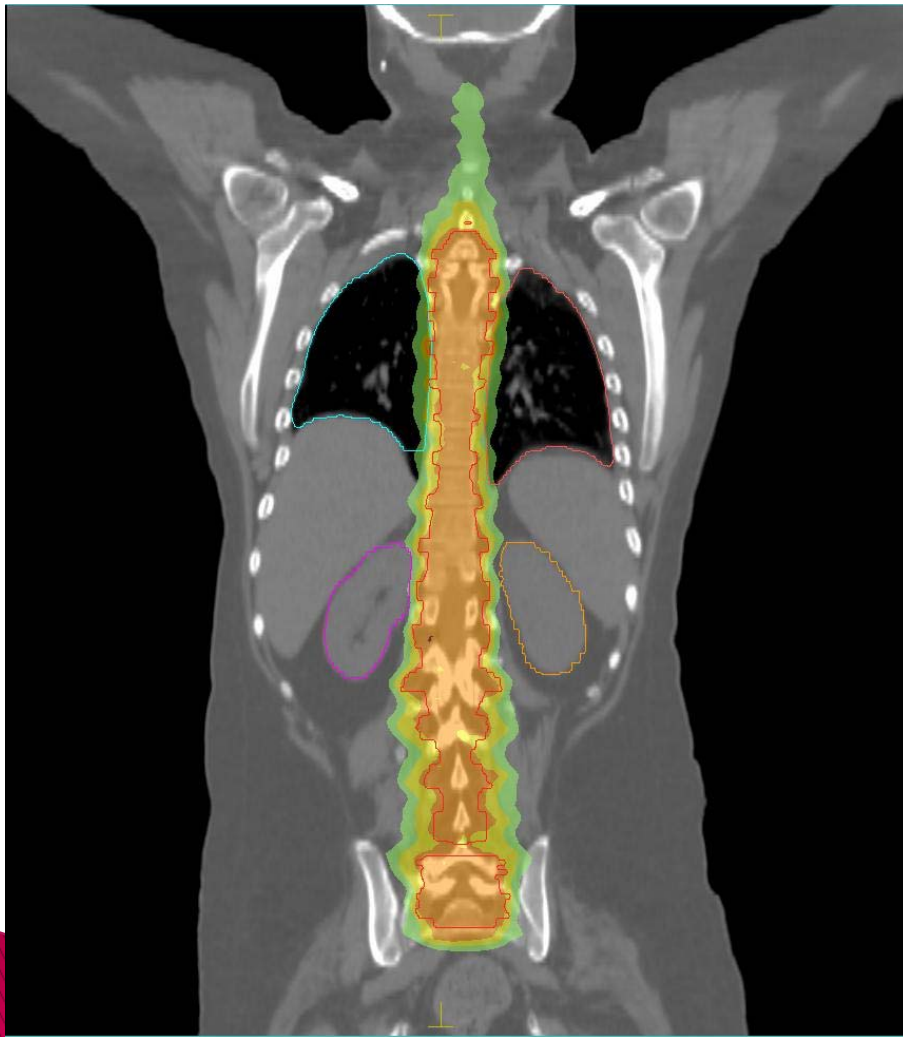


IMRT

Cranial Immobilization with Localizing box



IMRT whole spine radiation



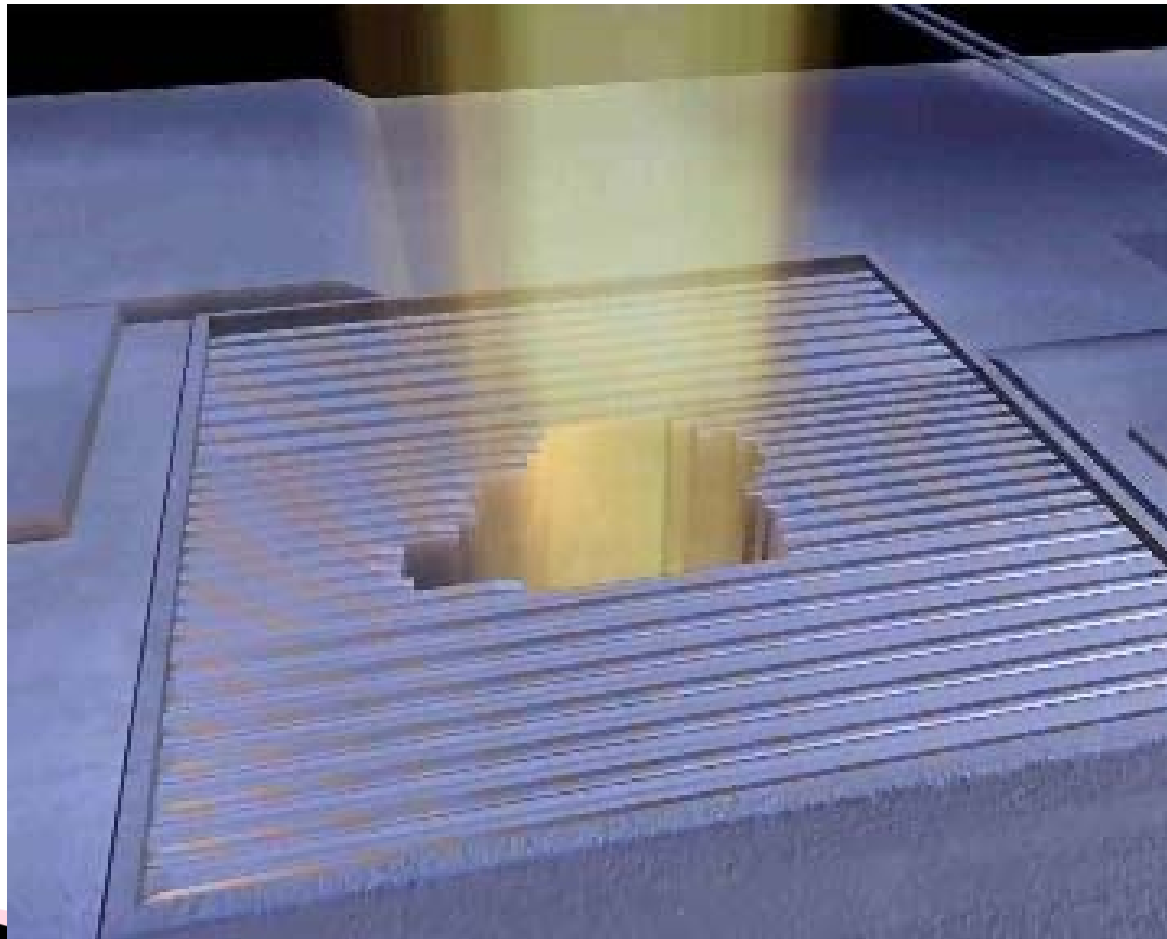
Radiation Treatment Machines



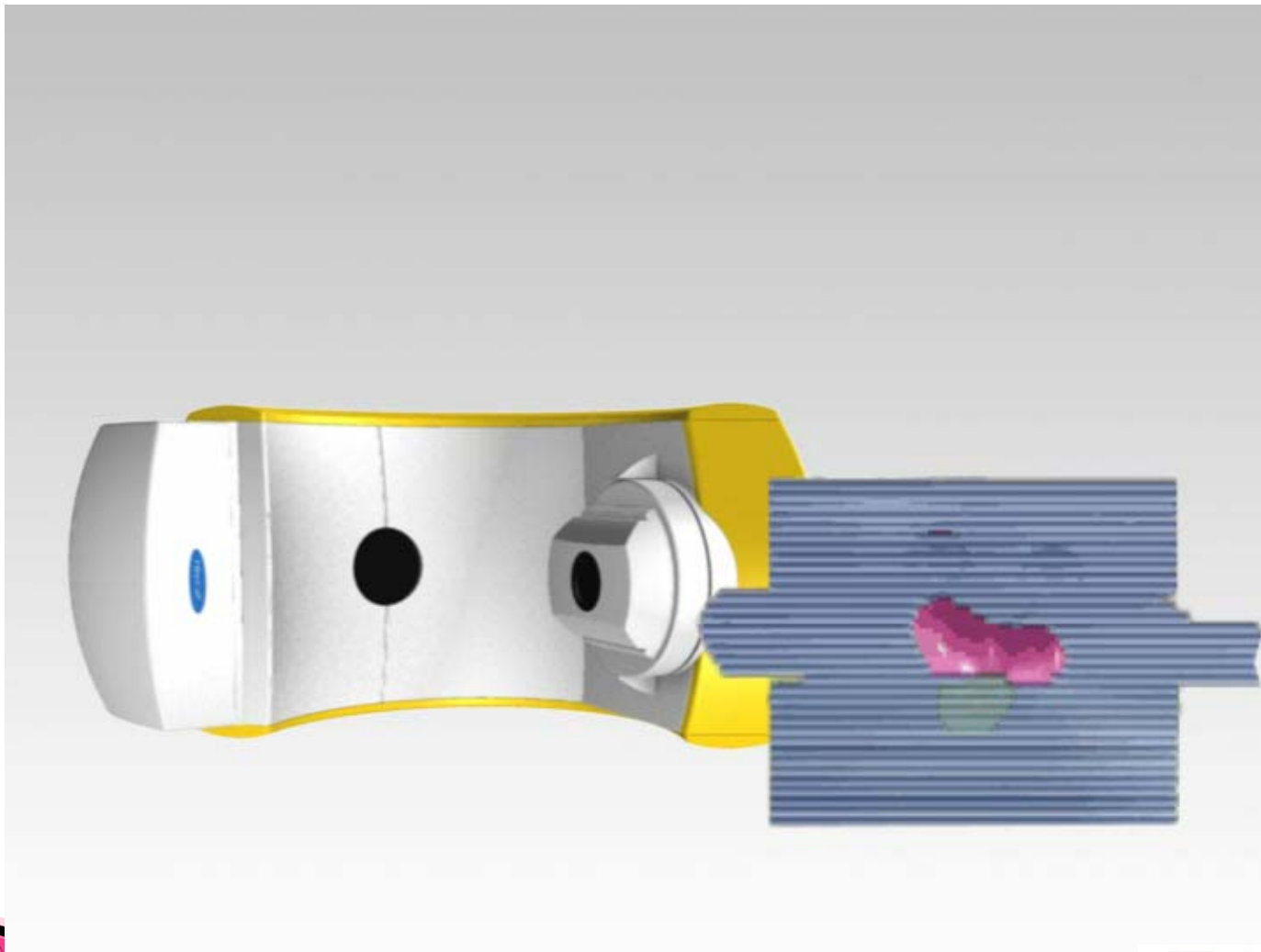
LINAC with MLC



MULTILEAF COLLIMATOR (MLC)



Novalis



Four Dimension Radiation Therapy (4D RT)



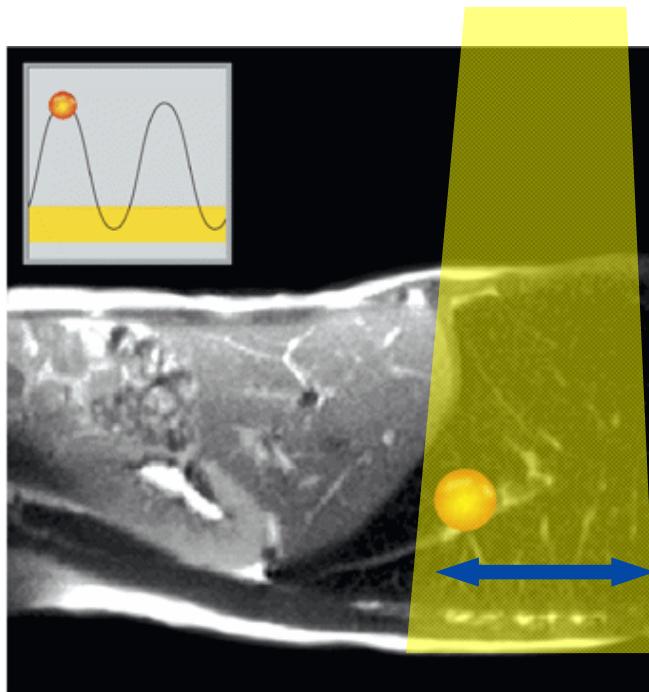
Four Dimension Radiation Therapy (4D RT)

Novalis Adaptive Gating

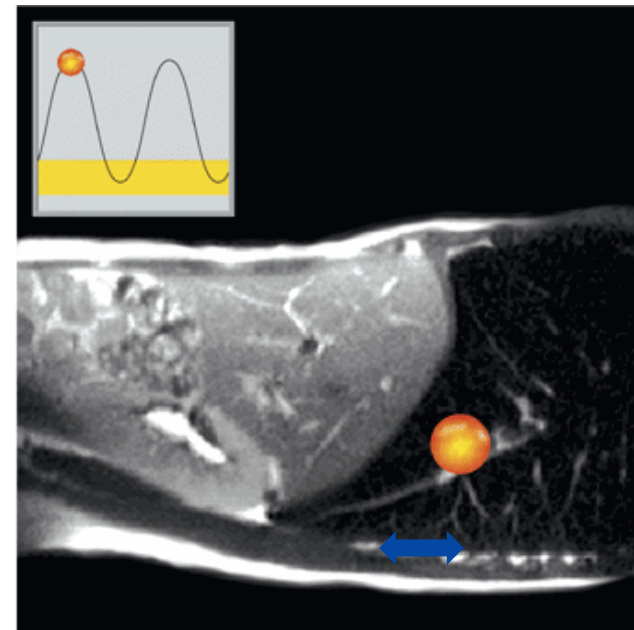


Four Dimension Radiation Therapy (4D RT) Adaptive Gating

Large margins are traditionally required to compensate for respiration induced organ motion



Treatment Margin



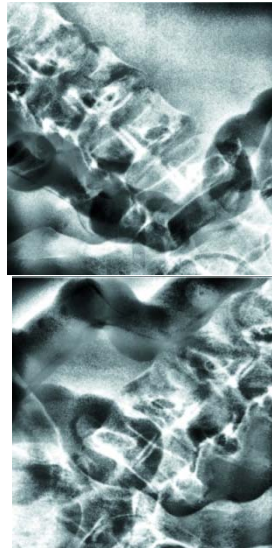
Reduced
Treatment
Margin

IGRT (Image-Guided Radiation Therapy)

ExacTrac X-Ray 6D

Stereoscopic Imaging

- Acquisition of first X-ray image
- Acquisition of second X-ray image





ภาพวิดีโอแสดงเทคนิคการฉายรังสีแบบระบบนำวิถี
(Image Guided Radiation Therapy, IGRT)

SYNERGY VMAT



Volumetric Modulated Arc Therapy (VMAT)

The radiation deliver with continuous varying

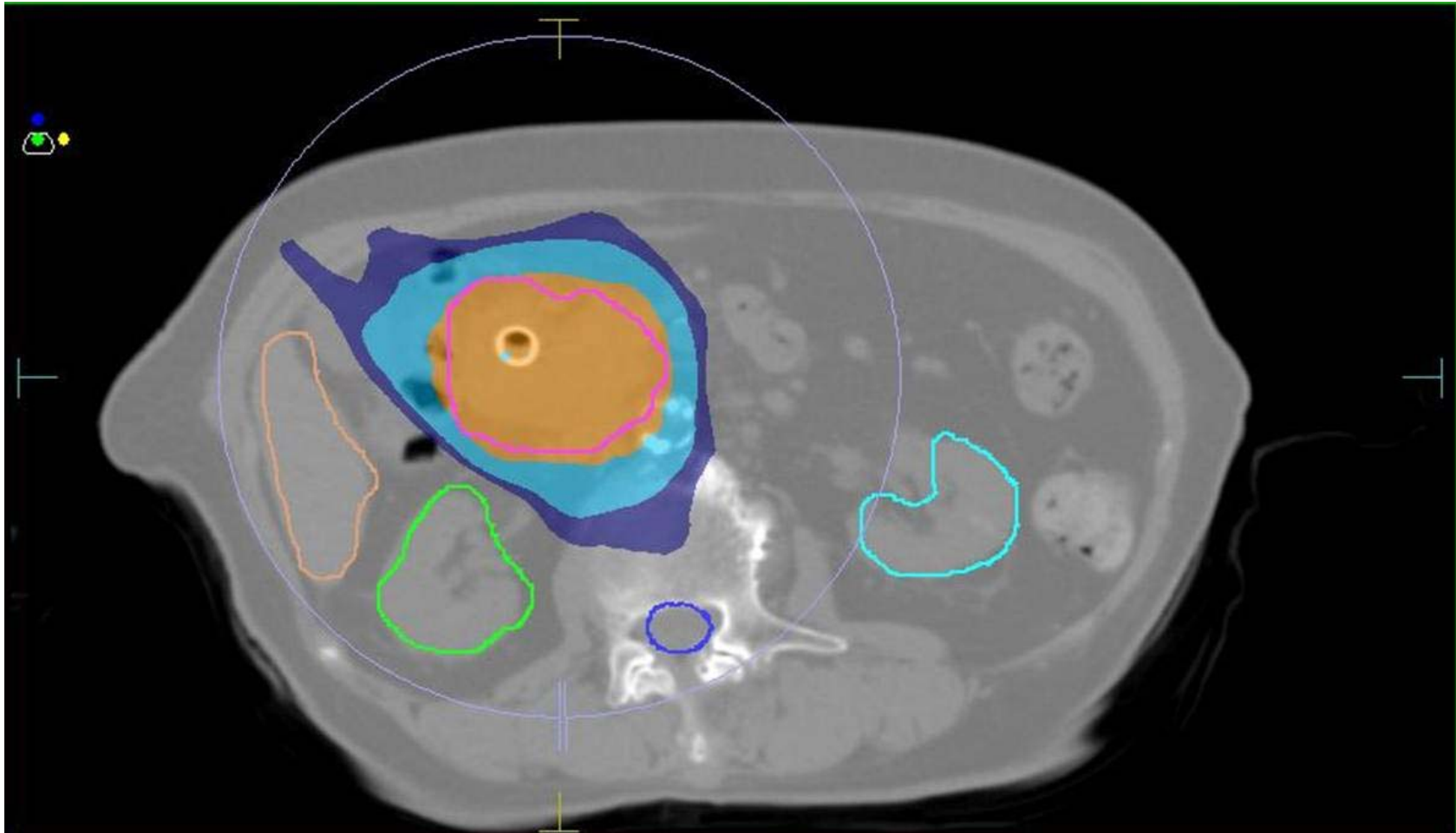
- Gantry rotation
- Gantry speed
- Multileaf Collimator (MLC)
- Collimator angle
- Dose rate



HIGHLY CONFORMAL PLANS CAN BE DELIVERED IN
SINGLE OR FEW ARC TREATMENTS IN **VERY SHORT**
TIMES

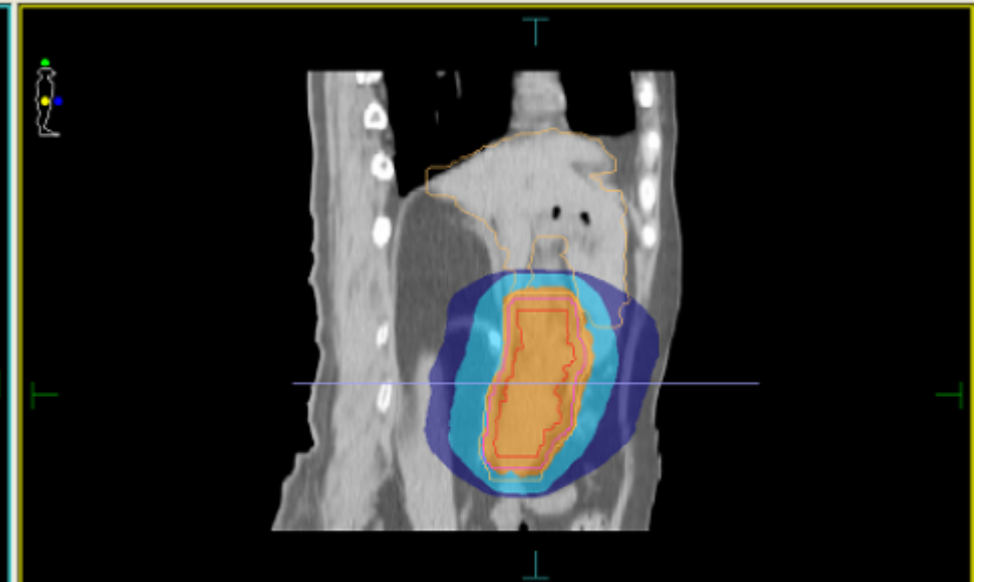
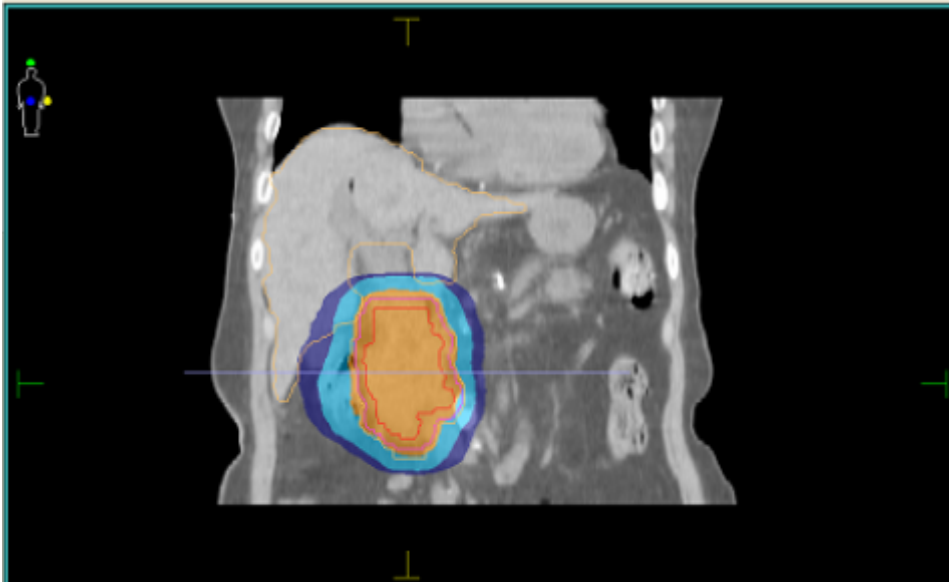
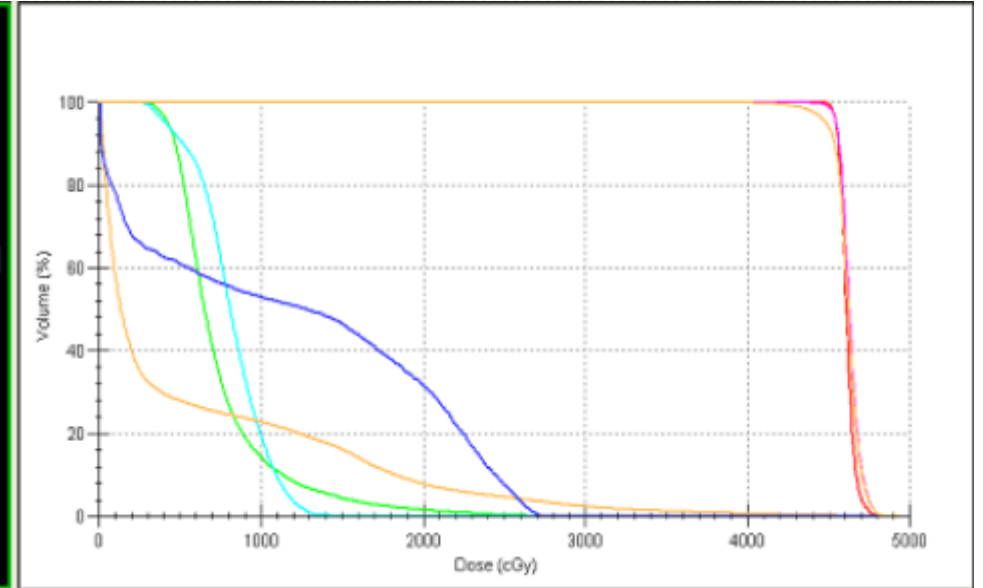
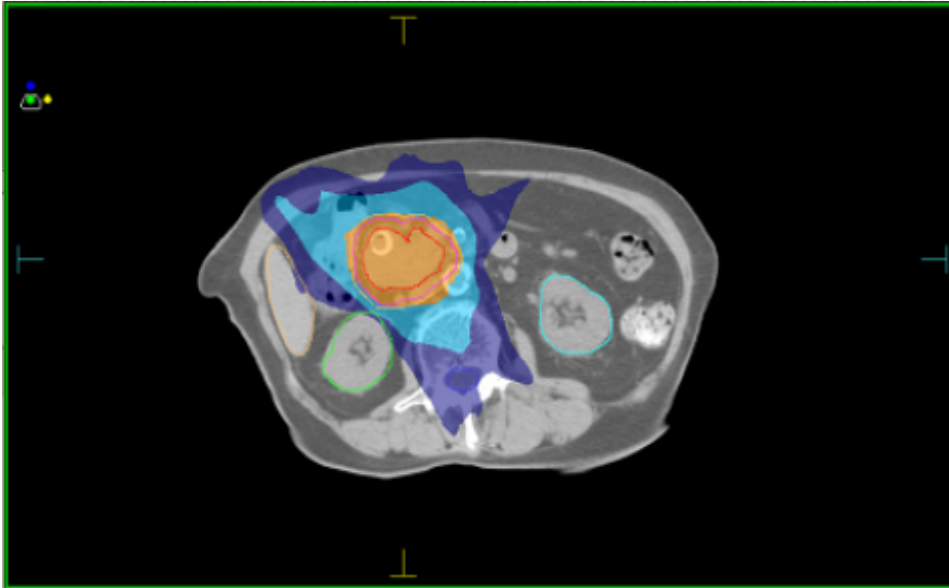
Volumetric Modulated Arc Therapy (VMAT)





ภาพแสดงการฉายรังสีของผู้ป่วยมะเร็งระดับอ่อน โดยใช้เทคนิคการฉายรังสีรอบตัวผู้ป่วยแบบปรับความเข้ม
(VMAT, Volumetric Modulated Arc Therapy)
สามารถหลีกเลี่ยงรังสีต่ออวัยวะสำคัญรอบข้าง เช่น ตับ ไต ลำไส้เล็ก และ ไชสันหลัง

Radiation planning: CBD cancer



Summary

1. The improvement of imaging in oncology

- More accurate staging
- Better localization / delineation target organ

2. Modern radiation treatment planning system (RTP)

: 3DCRT, IMRT, VMAT

3. The improvement in sophisticate radiation machine

4. Experience Team

Results in

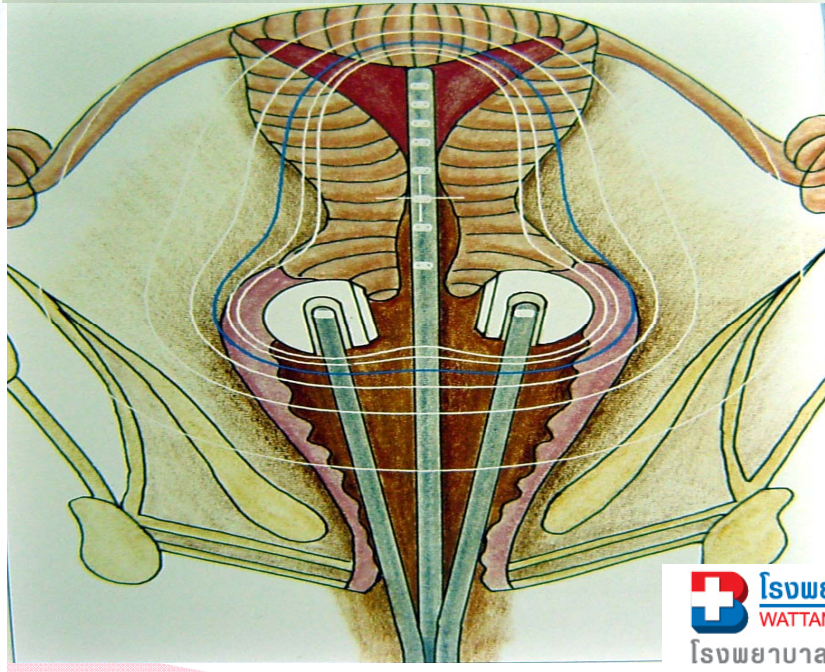
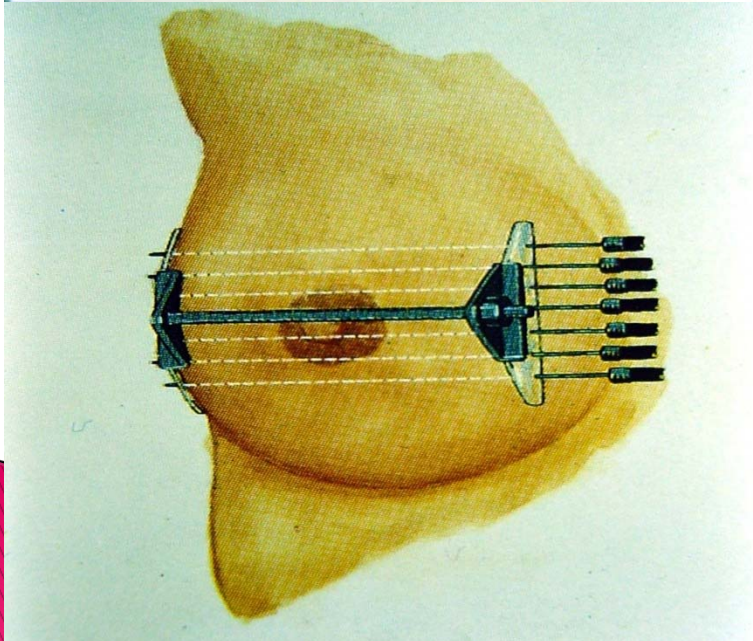
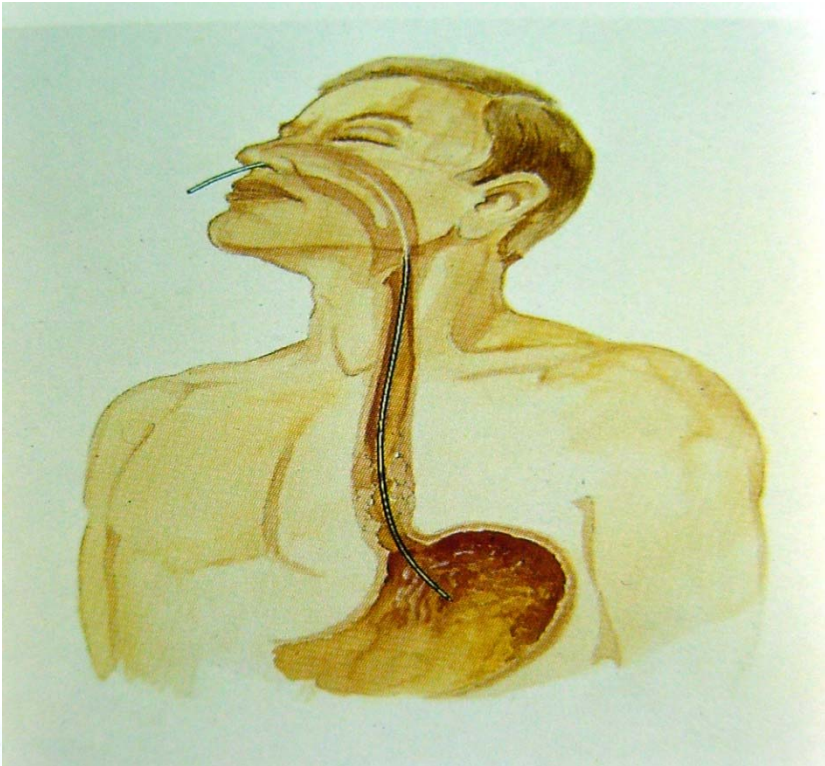
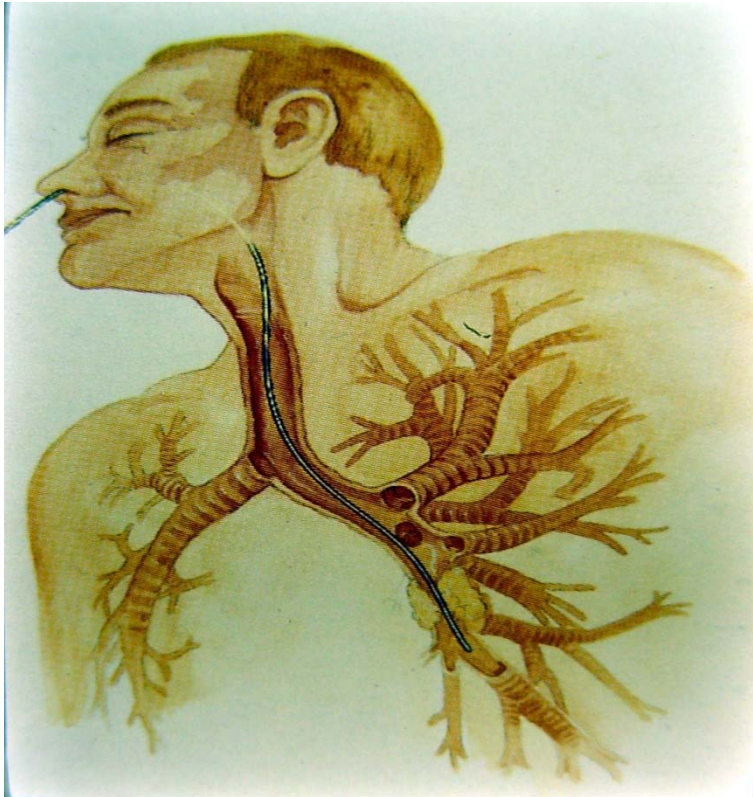
1. Accuracy and precision
2. Escalation (higher) radiation dose to target tissue
3. Lower/decrease radiation dose to non-target (organ at risk) tissue

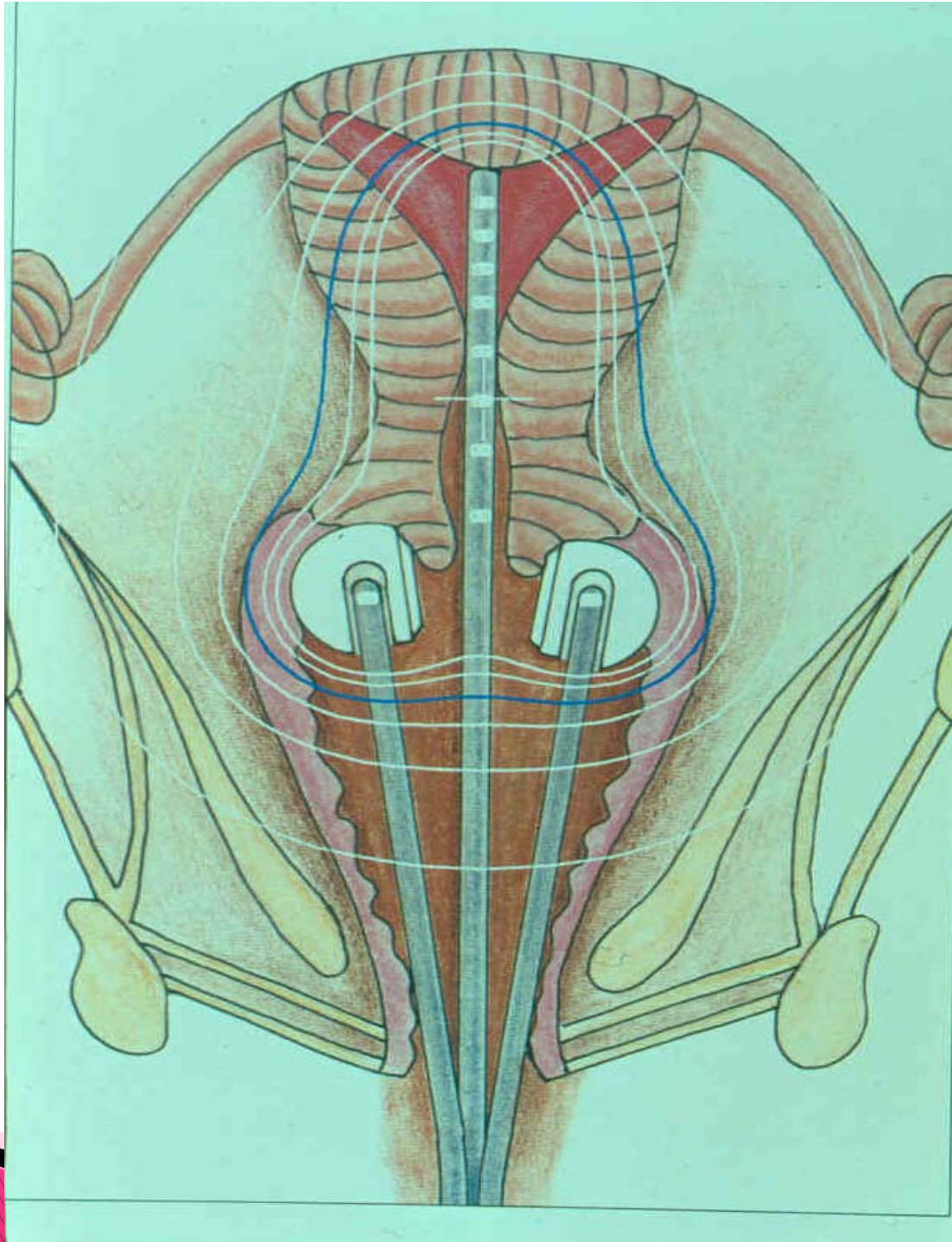
Higher tumor control
Decrease normal tissue complication
eg :- HNSCCA, Lung, Prostate

Improve quality of life and possible survival

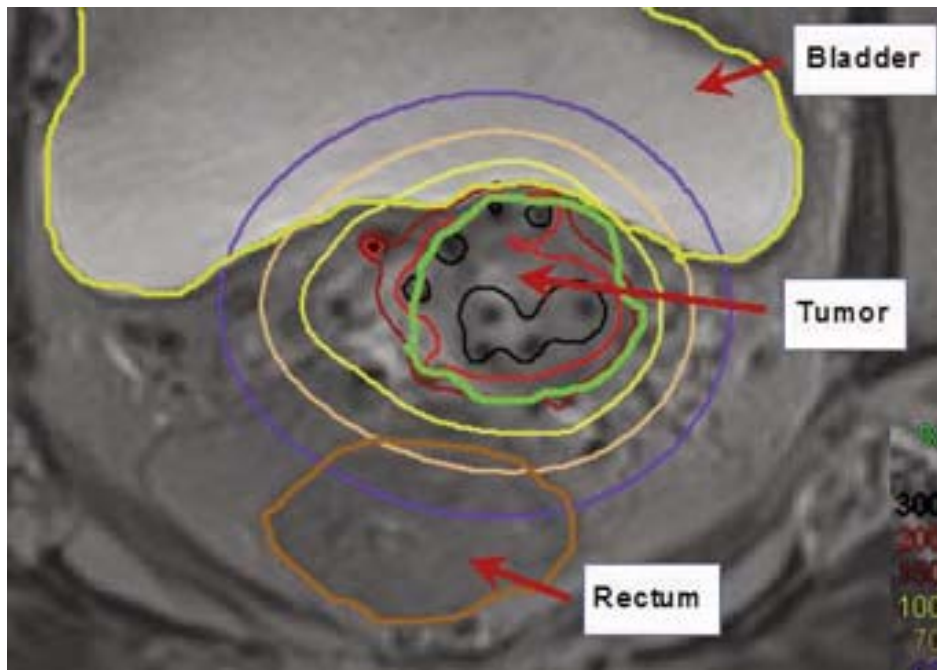
Brachytherapy



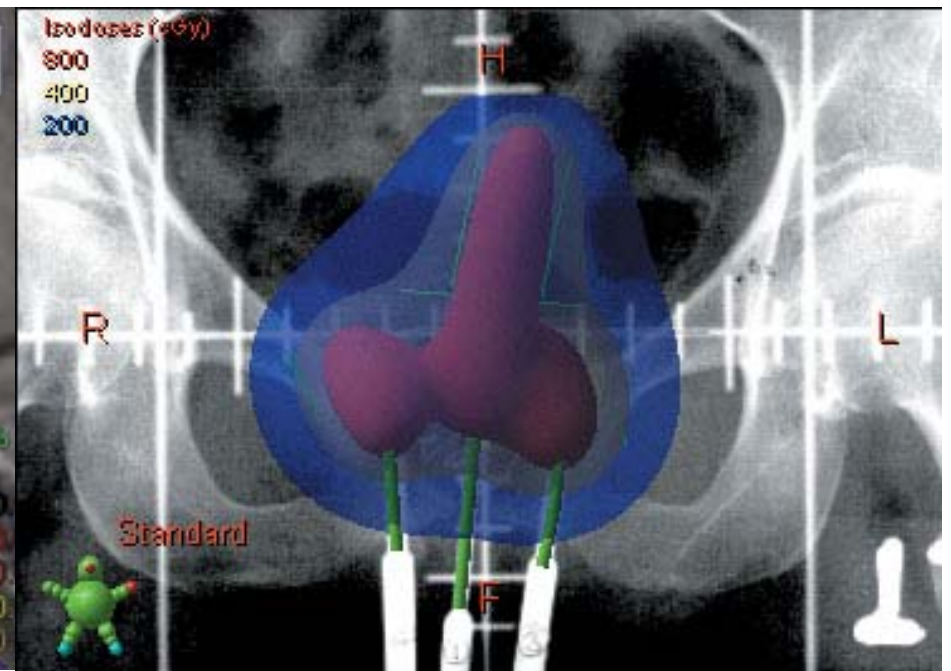




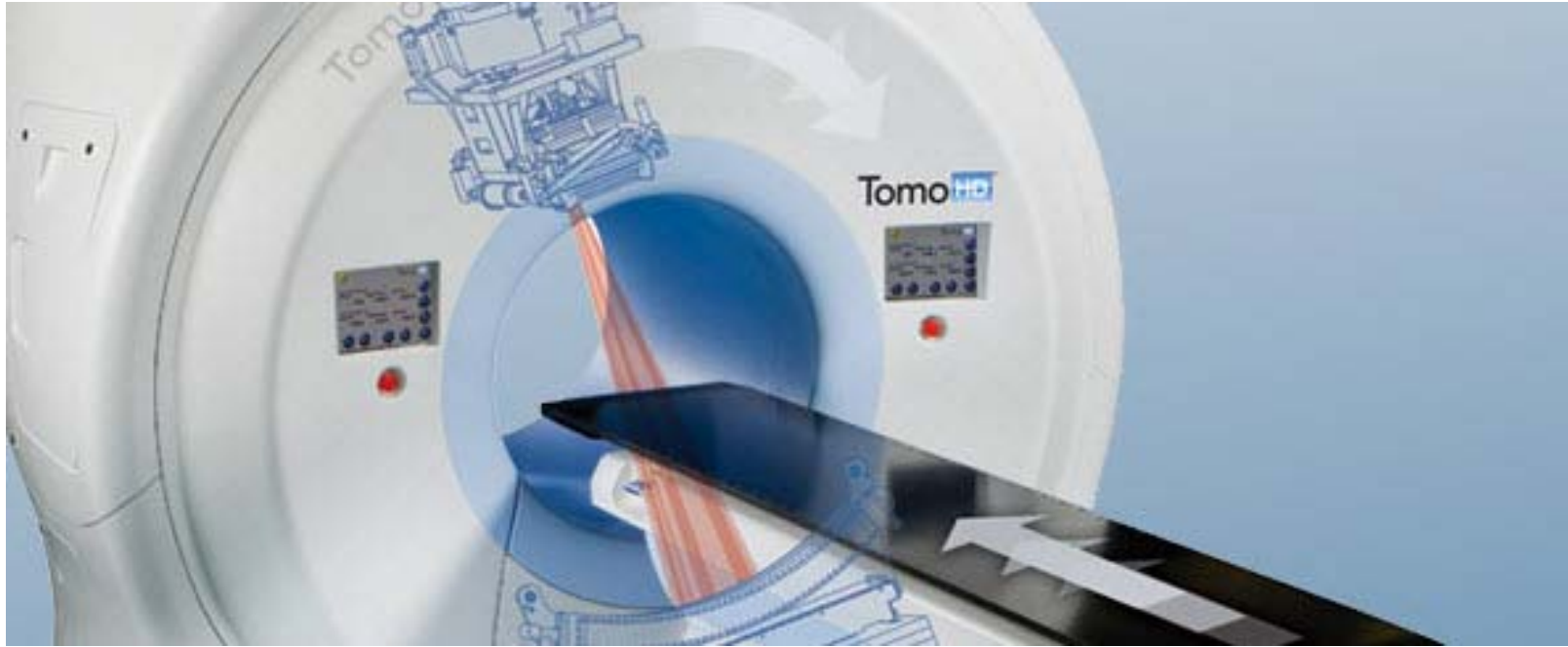
3D BRACHYTHERAPY DOSE DISTRIBUTION



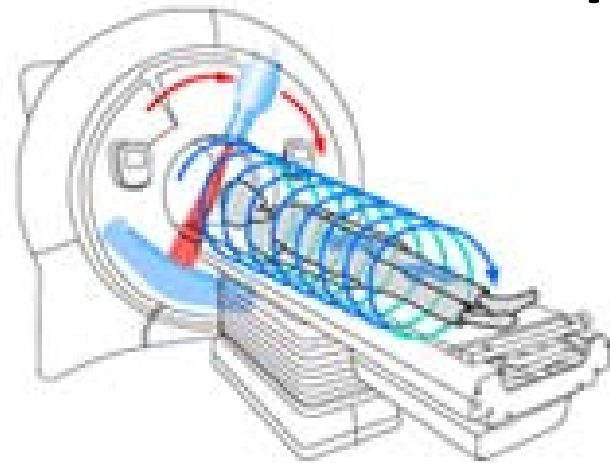
AXIAL VIEW



AP VIEW



Tomotherapy



TOMOTHERAPY PLANNING

ROIs Optimization Fractionation Delivery QA Setup Delivery QA Analysis

Fraction Count: 33
 The plan has 33 fractions defined for a planned delivery of 59.4 Gy.
 96.0% of the CTV-T volume receives at least 50.4 Gy for the current plan.
 Modulation factor for this tomotherapy IMRT plan is 2.277

Unlock All Fractions

Dose Display: Isodose
 56.43
 47.52
 41.58
 35.64
 29.7

Fraction	Locked	Fraction Date	Fraction	Locked	Fraction Date
1	<input type="checkbox"/>	April 01, 2010	16	<input type="checkbox"/>	April 22, 2010
2	<input type="checkbox"/>	April 02, 2010	17	<input type="checkbox"/>	April 23, 2010
3	<input type="checkbox"/>	April 05, 2010	18	<input type="checkbox"/>	April 26, 2010
4	<input type="checkbox"/>	April 06, 2010	19	<input type="checkbox"/>	April 27, 2010
5	<input type="checkbox"/>	April 07, 2010	20	<input type="checkbox"/>	April 28, 2010
6	<input type="checkbox"/>	April 08, 2010	21	<input type="checkbox"/>	April 29, 2010
7	<input type="checkbox"/>	April 09, 2010	22	<input type="checkbox"/>	April 30, 2010
8	<input type="checkbox"/>	April 12, 2010	23	<input type="checkbox"/>	May 03, 2010
9	<input type="checkbox"/>	April 13, 2010	24	<input type="checkbox"/>	May 04, 2010
10	<input type="checkbox"/>	April 14, 2010	25	<input type="checkbox"/>	May 05, 2010
11	<input type="checkbox"/>	April 15, 2010	26	<input type="checkbox"/>	May 06, 2010
12	<input type="checkbox"/>	April 16, 2010	27	<input type="checkbox"/>	May 07, 2010
13	<input type="checkbox"/>	April 19, 2010	28	<input type="checkbox"/>	May 10, 2010
14	<input type="checkbox"/>	April 20, 2010	29	<input type="checkbox"/>	May 11, 2010
15	<input type="checkbox"/>	April 21, 2010	30	<input type="checkbox"/>	May 12, 2010
	<input type="checkbox"/>		31	<input type="checkbox"/>	May 13, 2010
	<input type="checkbox"/>		32	<input type="checkbox"/>	May 14, 2010
	<input type="checkbox"/>		33	<input type="checkbox"/>	May 17, 2010

Finalize: Final Dose, Final Accept, Plan Report

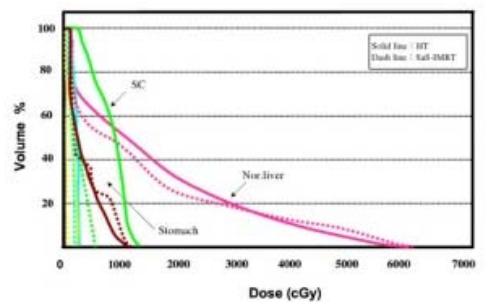
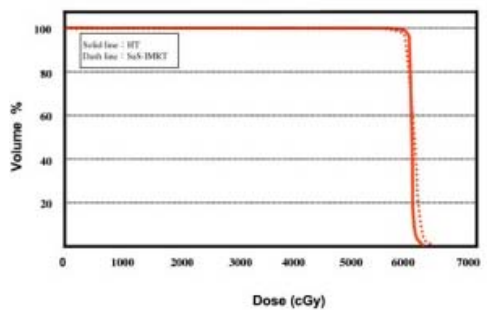
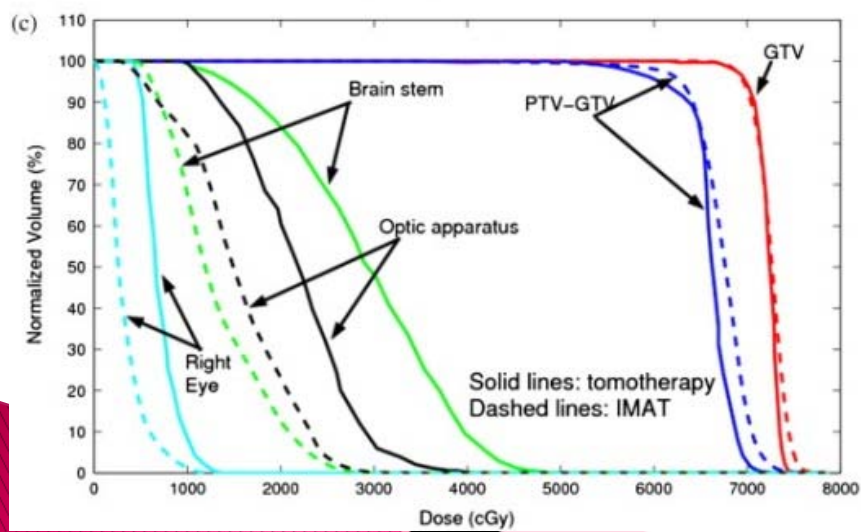
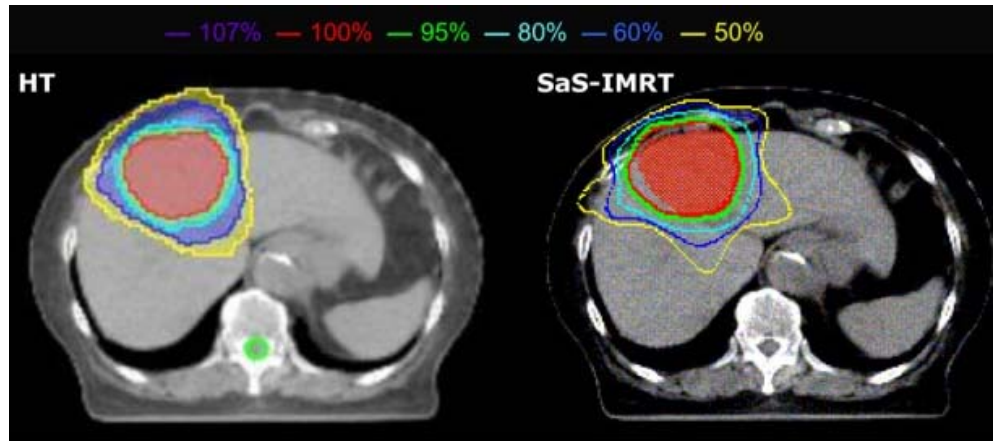
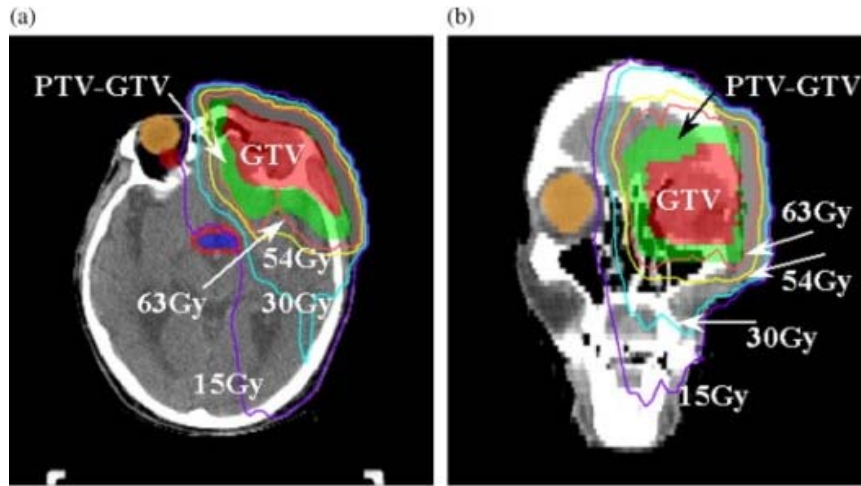
Tumor Settings: CTV-1, CTV-2, STV-L, STV-R

Sensitive Structure Settings: BODY, Brain Stem, Spc-L, Spc-R, Lungs-L, Lungs-R, M. submand., Oesophagus, Oesophagus, Oropharynx

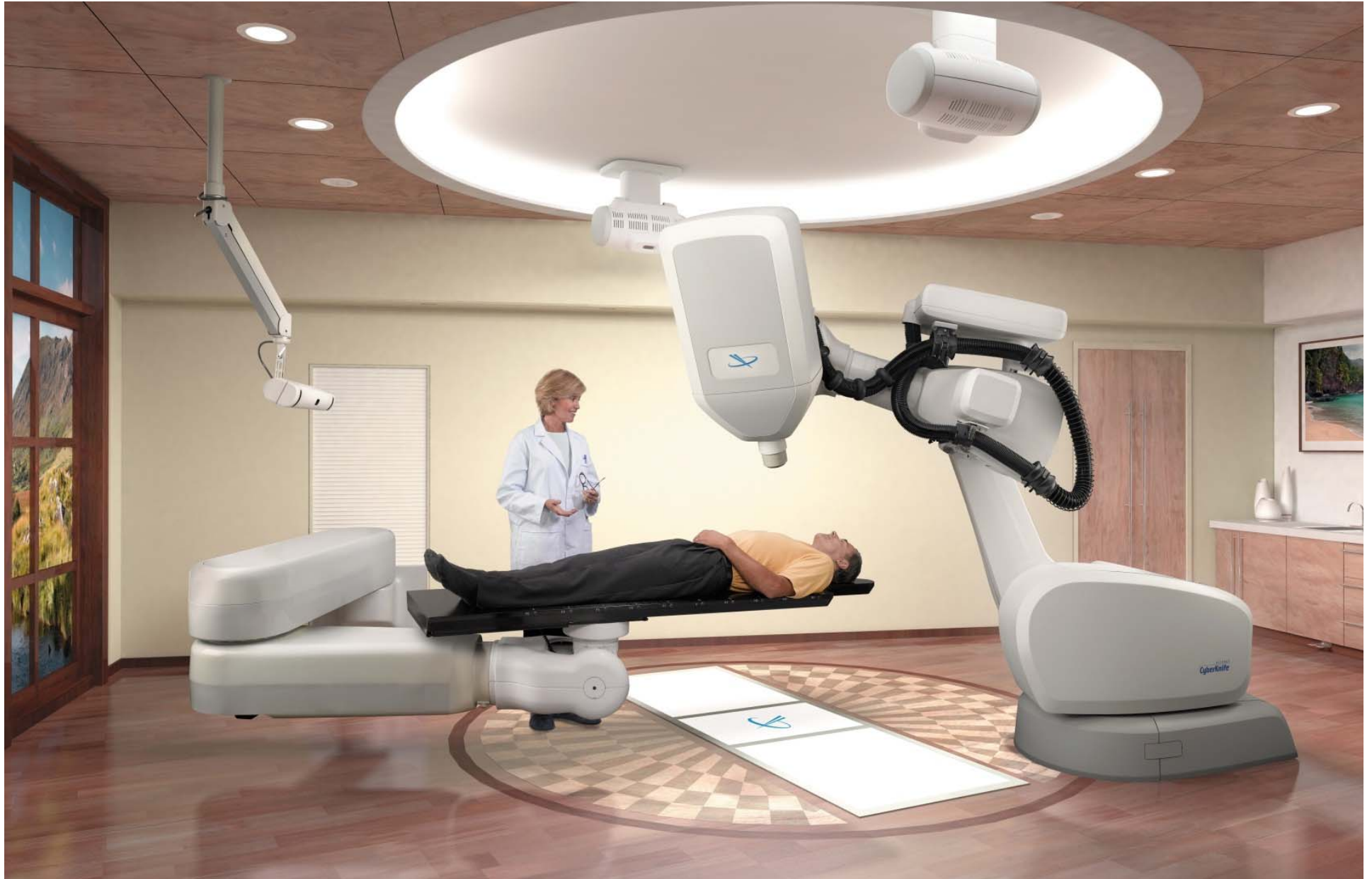
Dose-Volume Histogram - Cumulative Mode Relative
 Relative Volume (% Normalized) vs Dose (Gy)

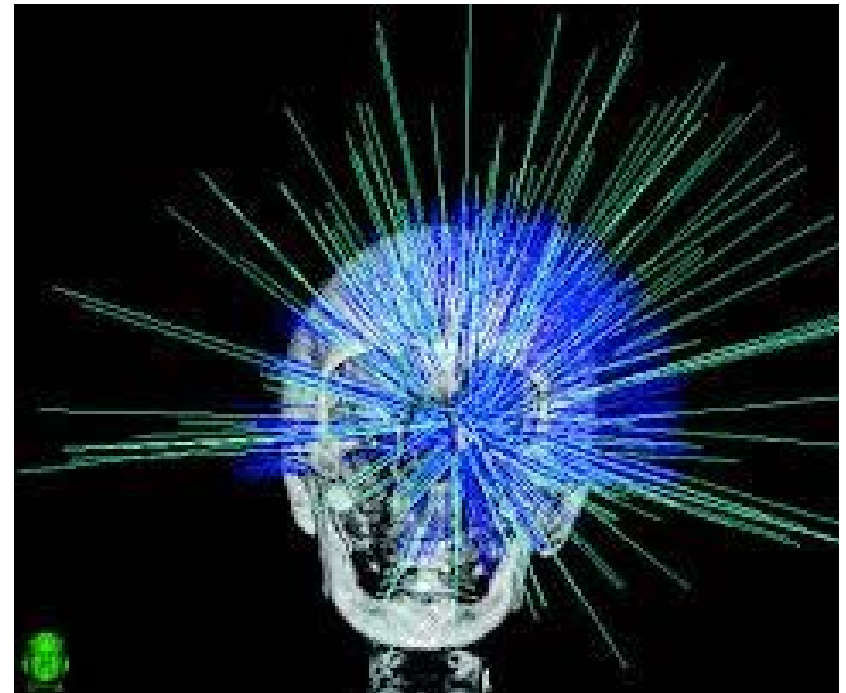
Patient Images: Axial, Coronal, Sagittal views with isodose overlays and anatomical markers (R, L, HFS, F, P).

TOMOTHERAPY PLANNING

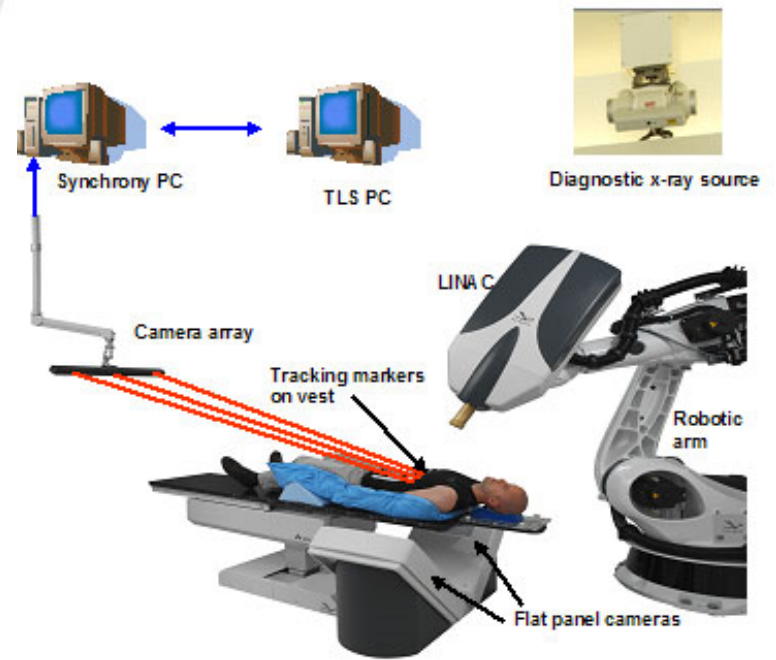


CYBERKNIFE



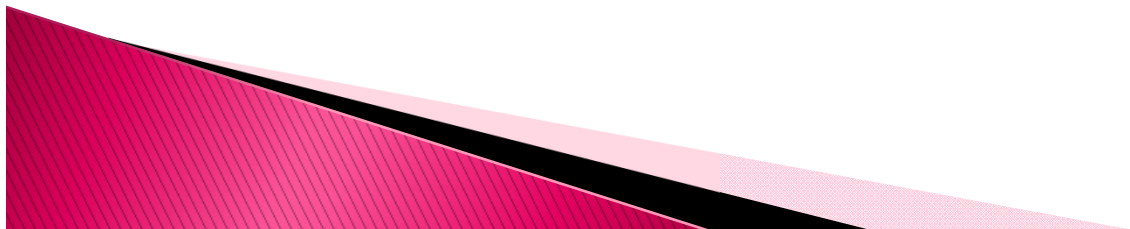


CyberKnife with Synchrony™

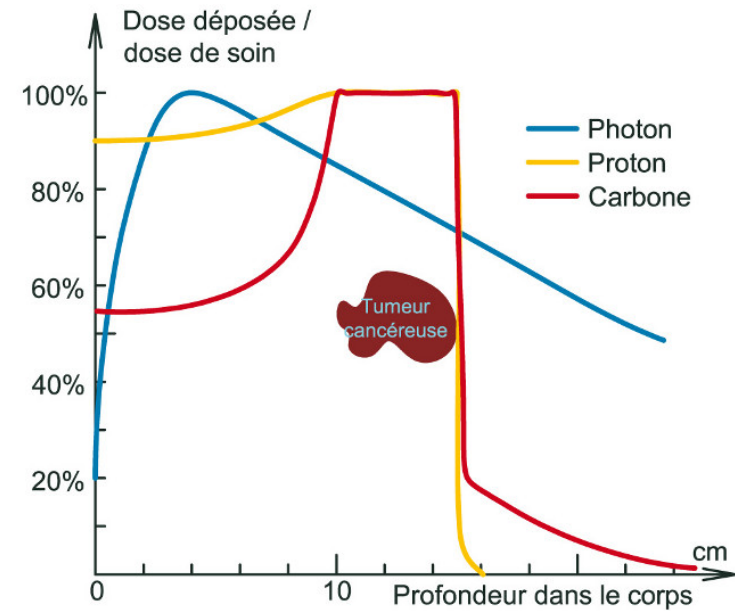
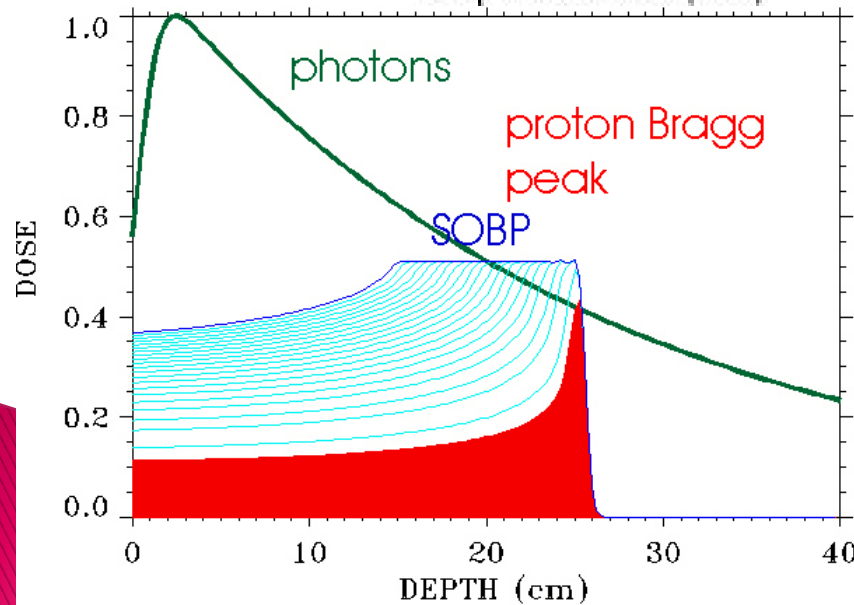
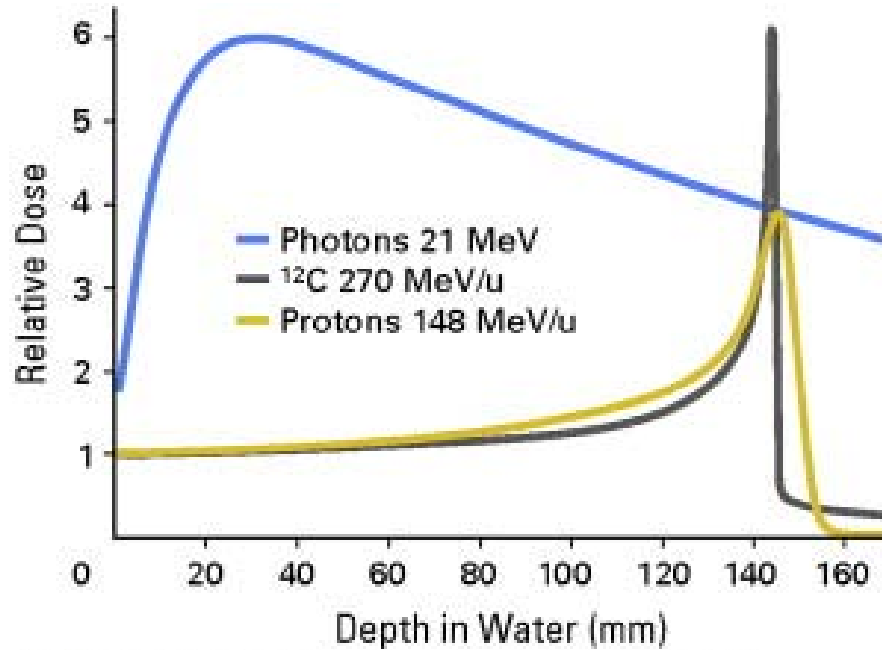


Cyberknife

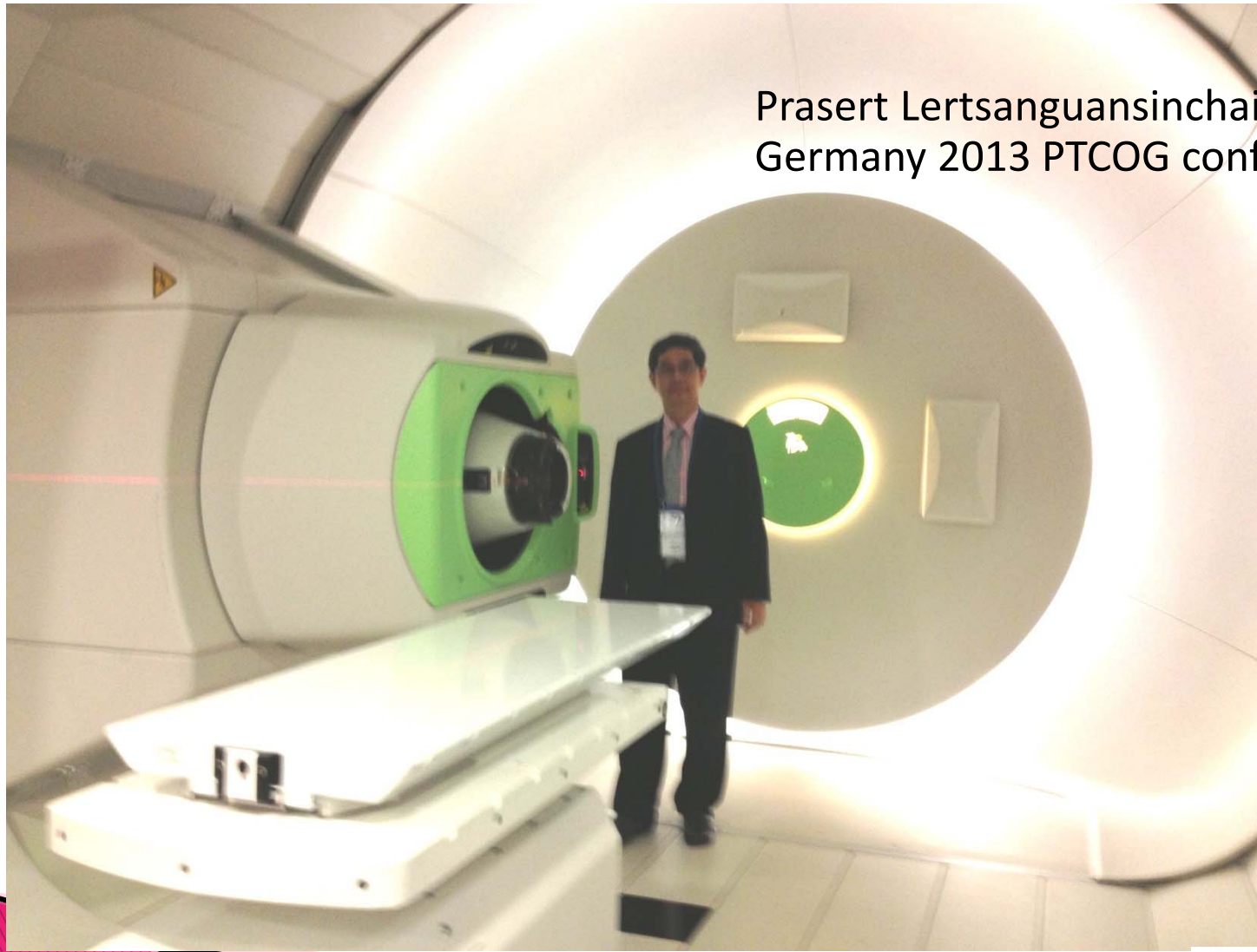
Particle beam in Cancer treatment



Particle beam therapy



Proton Therapy

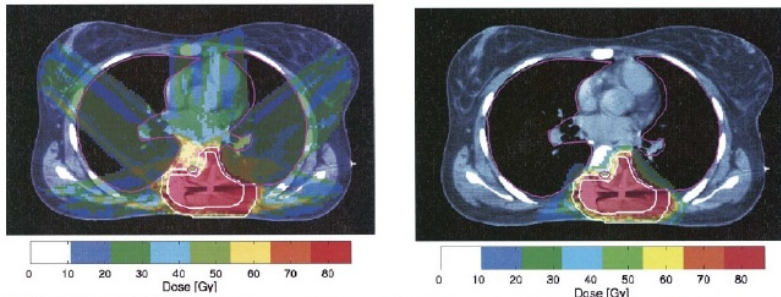


Prasert Lertsanguansinchai
Germany 2013 PTCOG conference

PROTON THERAPY

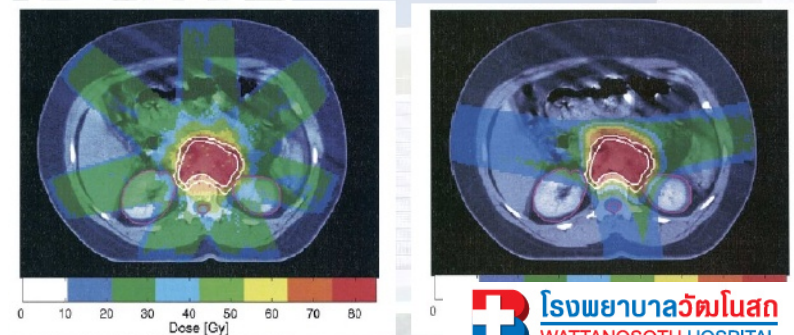


Paraspinal tumour treated with IXRT vs. IPRT



From Weber et al, Int. J. Radiation Oncology Biol. Phys., Vol. 58, No. 5, pp. 1596–1606, 2004

Paraspinal tumour treated with IXRT vs. IPRT



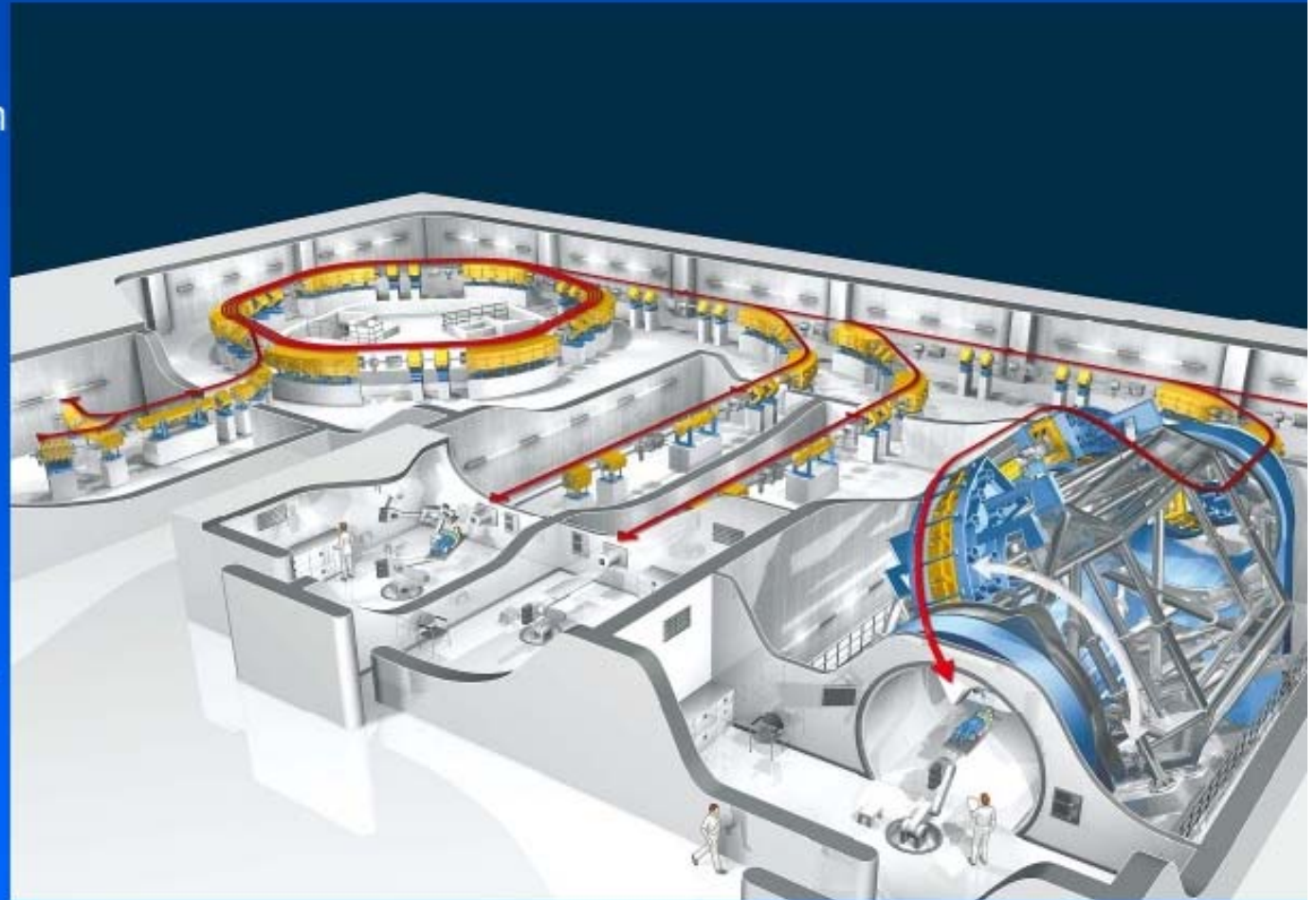
From Weber et al, Int. J. Radiation Oncology Biol. Phys

Carbon ion Therapy

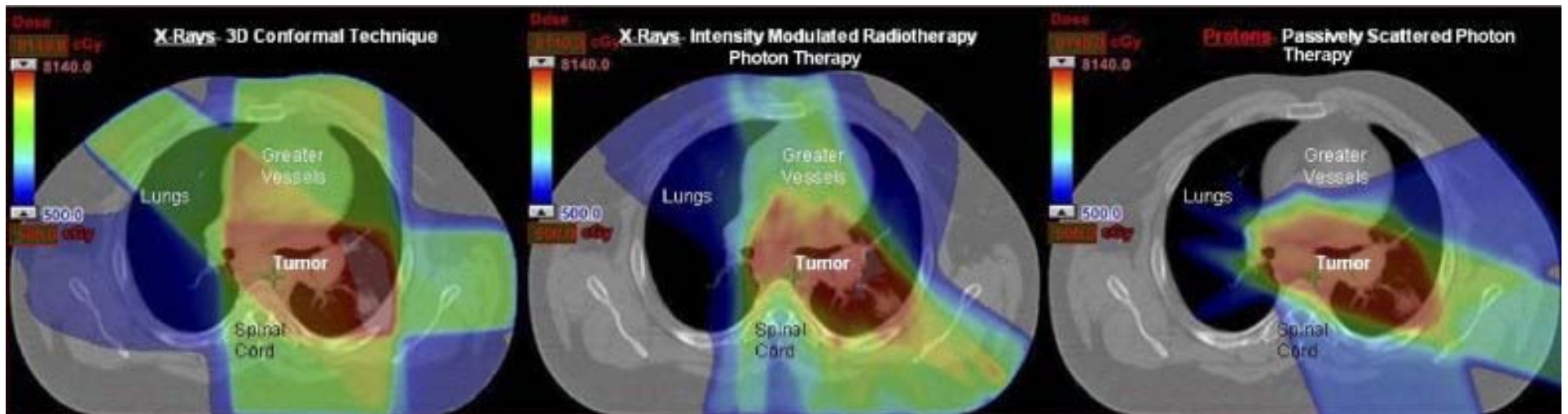


Heidelberg Ion Therapy Center

- compact design
- full clinical integration
- rasterscanning only
- low-LET modality: Protons (later He)
- high-LET modality: Carbon (Oxygen)
- ion selection within minutes
- world-wide first scanning ion gantry
- > 1000 patients/year
> 15.000 fractions/year

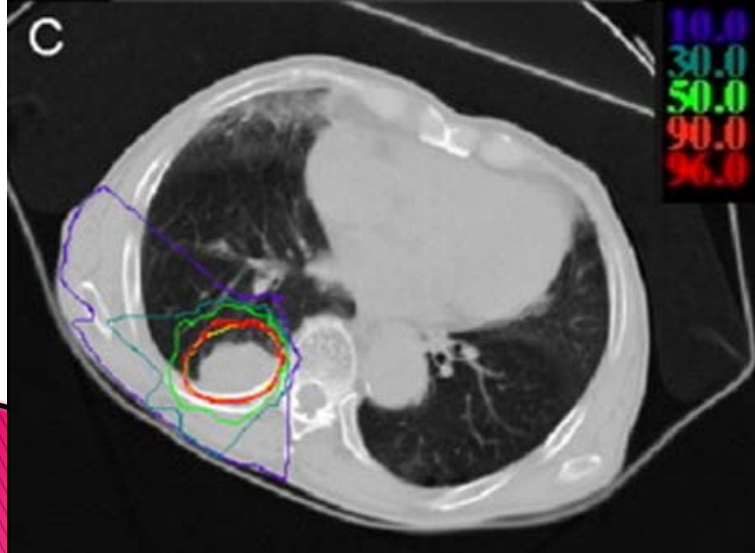
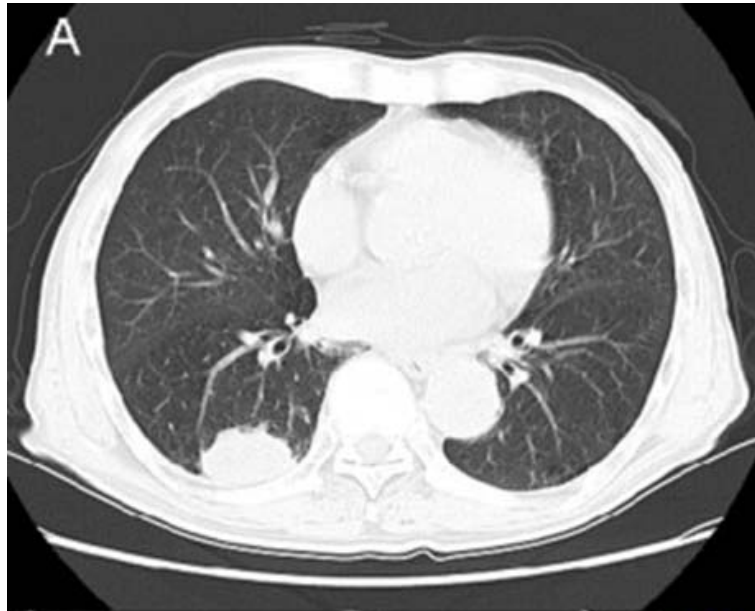


Particle Beam Therapy



Seminars in Radiation Oncology
Volume 23, Issue 2, April 2013, Pages 88-96
Controversies in Proton Therapy
Martijn Engelsman, PhD,

Carbon ion Therapy



- (A) Pre-CIRT
- (B) Six months after CIRT
- (C) Dose distribution for the tumor





THANK YOU

