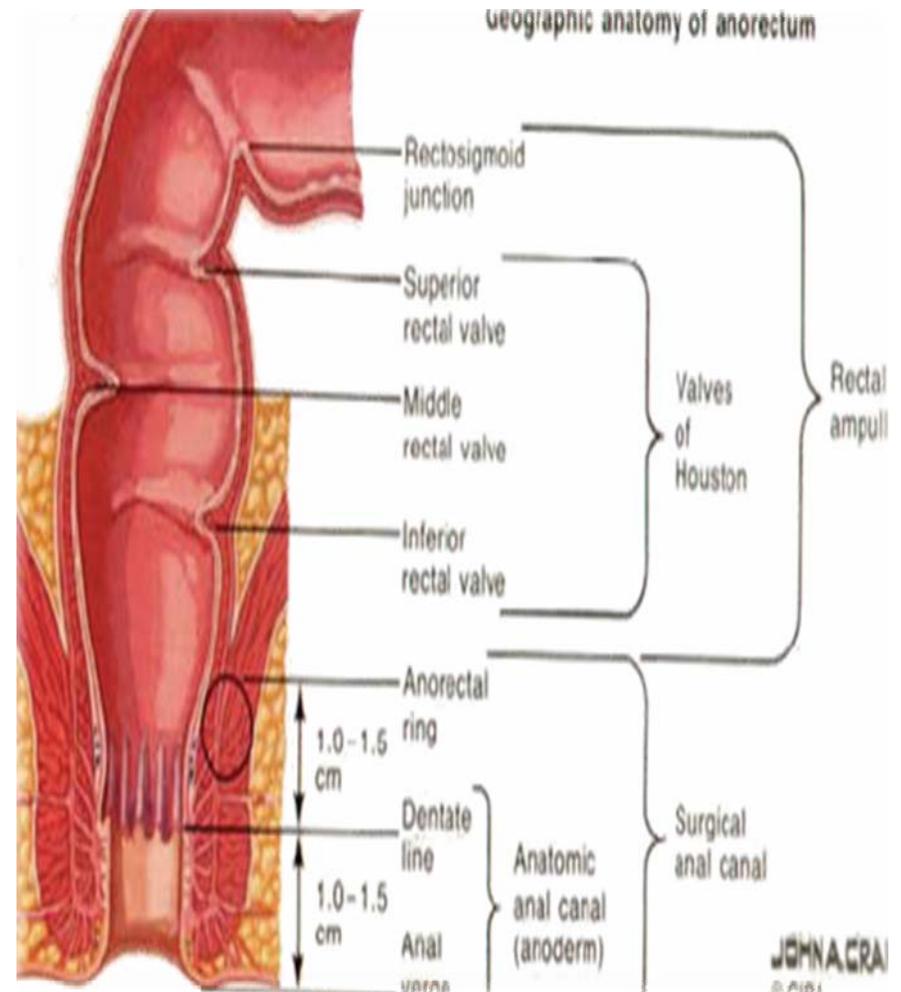


Target Volume Delineation in Carcinoma Anal Canal

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Learning Objectives

- Anatomy of Anal canal
- Lymphatic drainage and vascular supply
- Delineation of GTV and CTV
- Anatomical bony landmarks assisting delineation

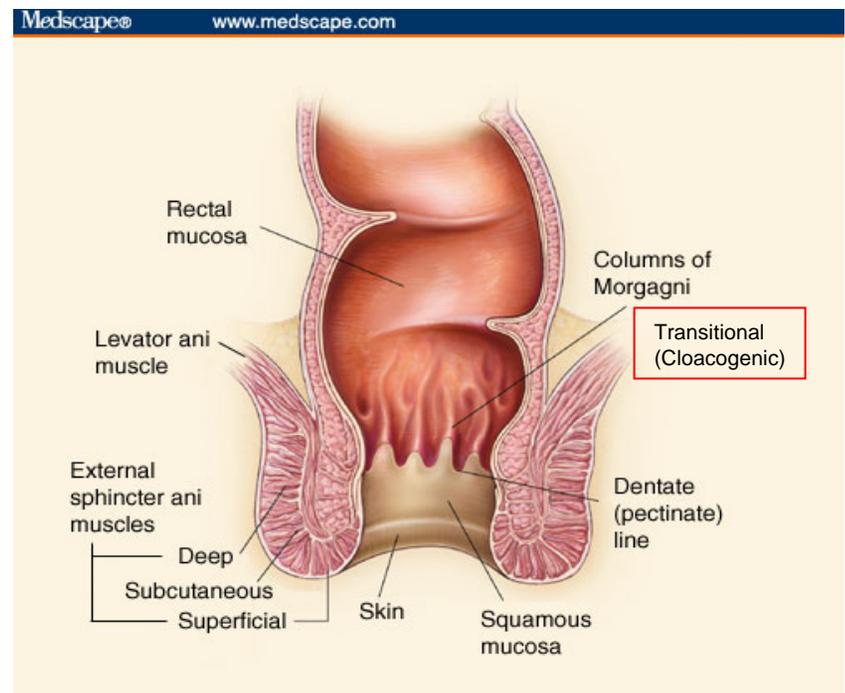


Anatomy of Anal canal

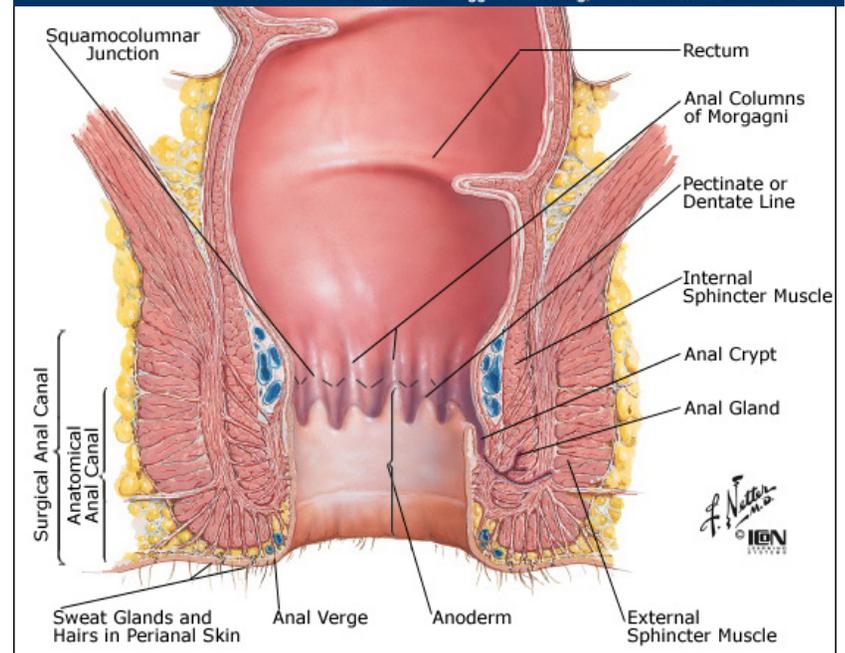
- Anal canal extends from anorectal junction i.e. tip of coccyx (puborectalis/ levator ani muscle forms a sling) to anal verge.

Length = 3.8 - 4 cm

- Perianal skin= 5 cm radius around anal verge



Source: AIDS Read © 2004 Cliggett Publishing, Division of SCP Communications



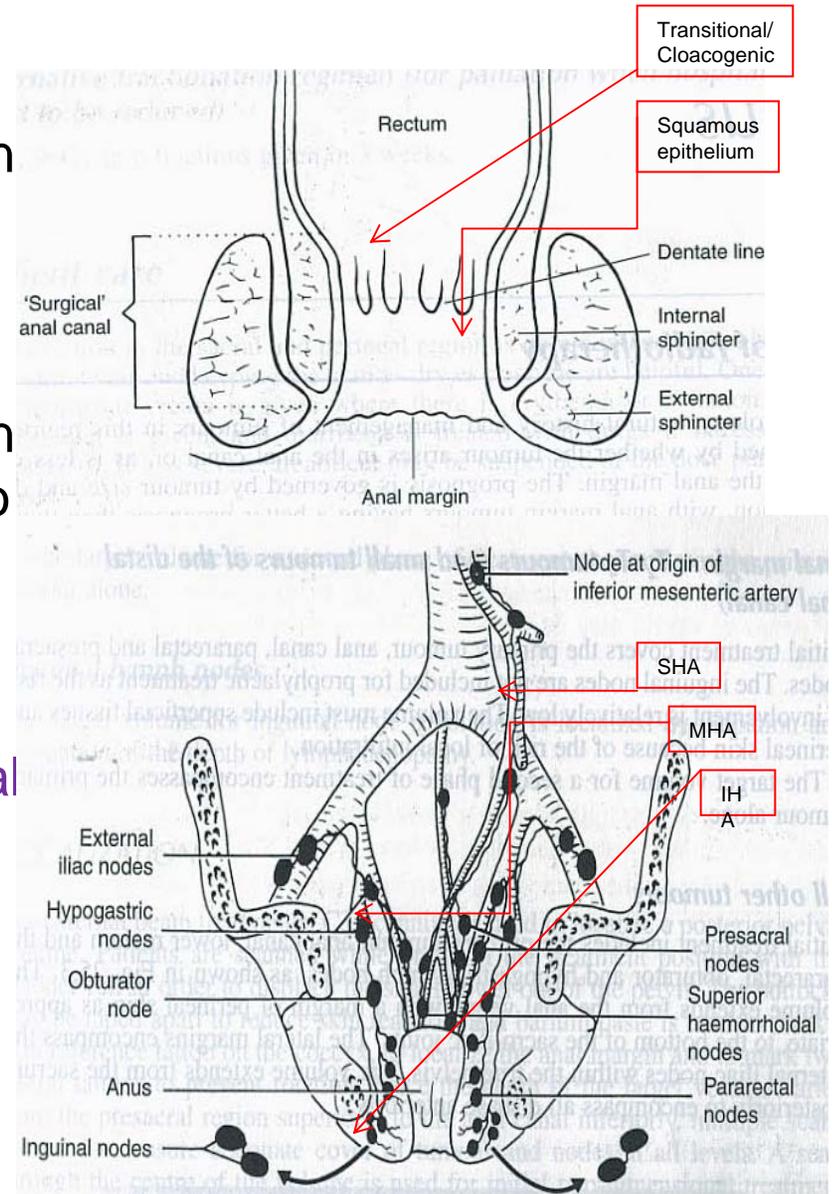
Lymphatics of Anal Canal

3 pathways

- Anal canal sup to dentate line → along sup. hemorrhoidal vessel (SHA) to **perirectal, presacral nodes**
- Anal canal sup to dentate line → along middle hemorrhoidal vessel (MHA) to **Internal iliac nodes (pudendal, hypogastric)**
- Anal canal inf. to dentate line (& Anal verge and anal margin) → along inf. hemorrhoidal vessel to med. Supf. **Inguinal nodes & External iliac (obt.)**

Nodes at presentation :

- Pelvic LN = 30%
- Inguinal LN = 20-35%



AJCC Staging in Anal Caners

- T1: Tumor **2 cm** or less in greatest dimension
- T2: Tumor **>2 cm but less < 5 cm** in greatest dimension
- T3: Tumor **> 5 cm** in greatest dimension
- T4: Tumor of any size invades adjacent organ(s), e.g., vagina, urethra, bladder (involvement of the sphincter muscle(s) *alone* is not classified as T4
- N1: Metastasis in **perirectal lymph nodes**(s)
- N2: Metastasis in **unilateral internal iliac** and/or **unilateral inguinal** lymph node(s)
- N3: Metastasis in **perirectal and inguinal** lymph nodes and/or **bilateral internal iliac** and/or **bilateral inguinal** lymph nodes
- **Stage 0:** Tis N0 M0 **Stage I:** T1 N0 M0
- **Stage II:** T2 N0 M0 T3 N0 M0
- **Stage IIIA:** T1, T2, T3 N1 M0 T4 N0 M0
- **Stage IIIB:** T4 N1 M0 Any T N2, N3 M0
- **Stage IV:** Any T Any N M1

Sites of local recurrence

- Primary tumour bed
- Perineum
- Lymph nodal area
 - Mesorectum including the presacral space – includes perirectal and presacral nodes
 - Other lymph nodal area - internal iliac, external iliac and inguinal

Conventional Radiation Fields

Uninvolved inguinal nodes

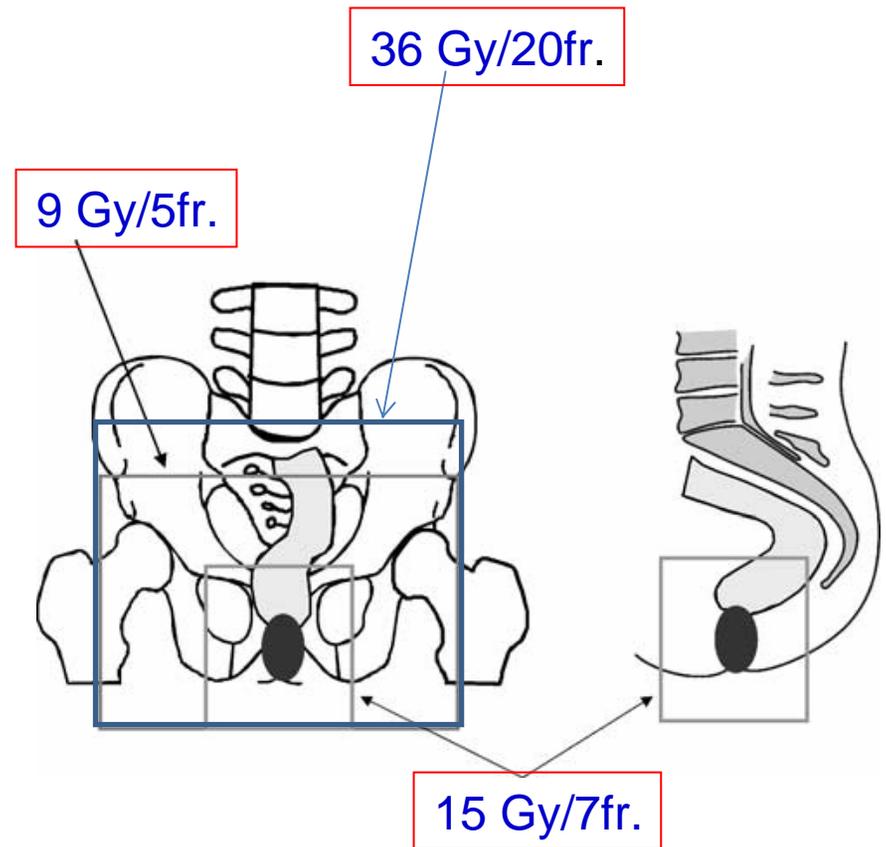
- Phase I: AP & PA field, 36Gy/20#

Sup- L5-S1 junction

Inf- 2 cm below anal verge or growth

Lat- most lateral part acetabulum

- Phase II : AP-PA field, 9Gy/5# , with sup margins lowered up to inferior level of SI joint
- Phase III: 15Gy/7# to area of gross disease with margin i.e. PTV by 3 fields (2 lat. & 1 post.) or 2 post ob. fields



If involved inguinal nodes

Why to Treat Inguinal nodes ?

- In inguinal node positive disease : 5 yr survival rate 20% lower than node negative

Two situations:

1. Clinically Uninvolved inguinal nodes

- If not prophylactically treated: Rate of failure is 20-25%
- About half of nodal failures are uncontrollable
- If prophylactically treated: Rate of failure is 5%
- Elective lymphadenectomy is not recommended

2. Clinically Involved inguinal nodes

- 80% control rate by CTRT or surgery+RT if nodes are not fixed

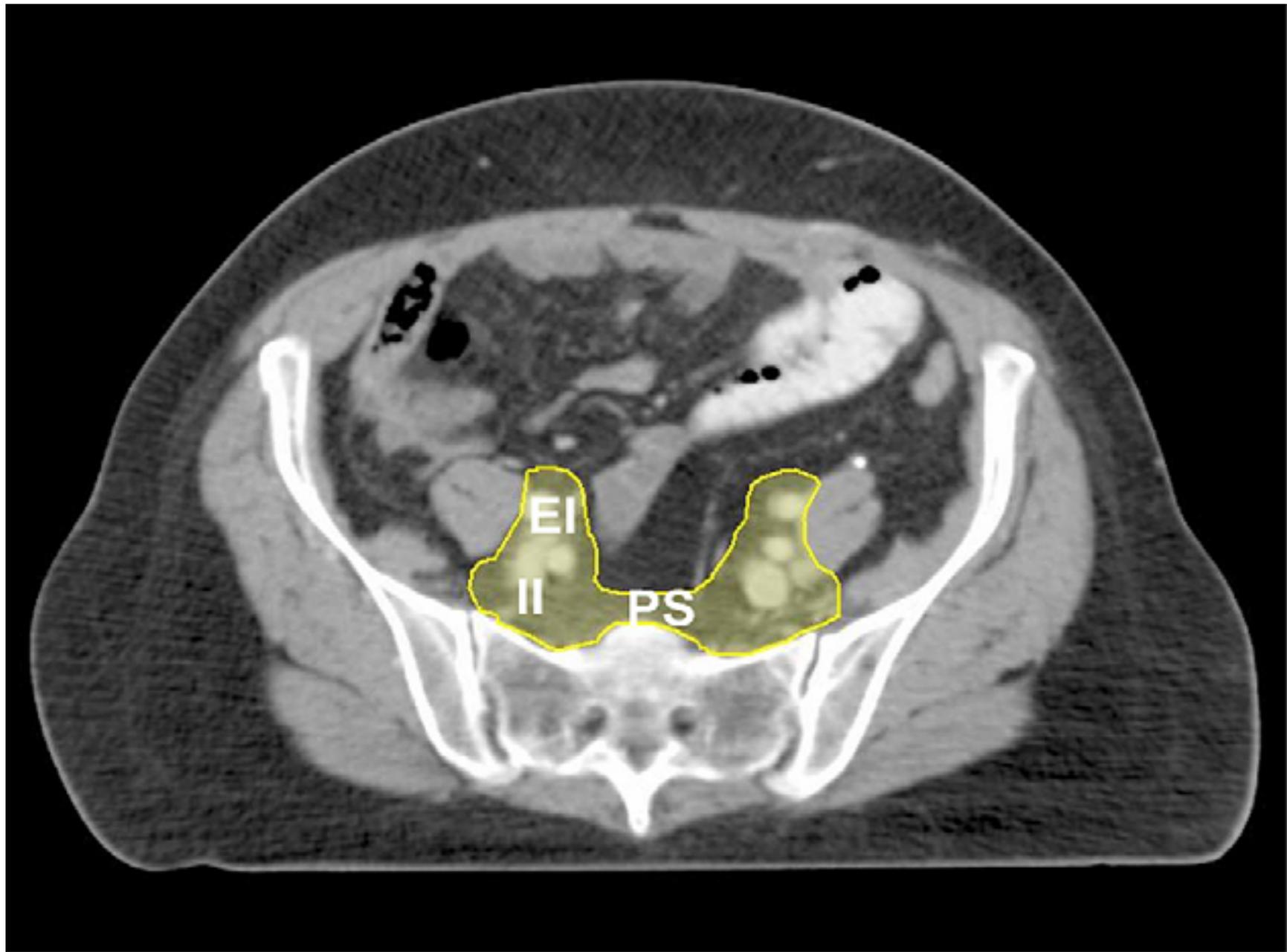
Pelvic lymph nodes : Anatomical Locations

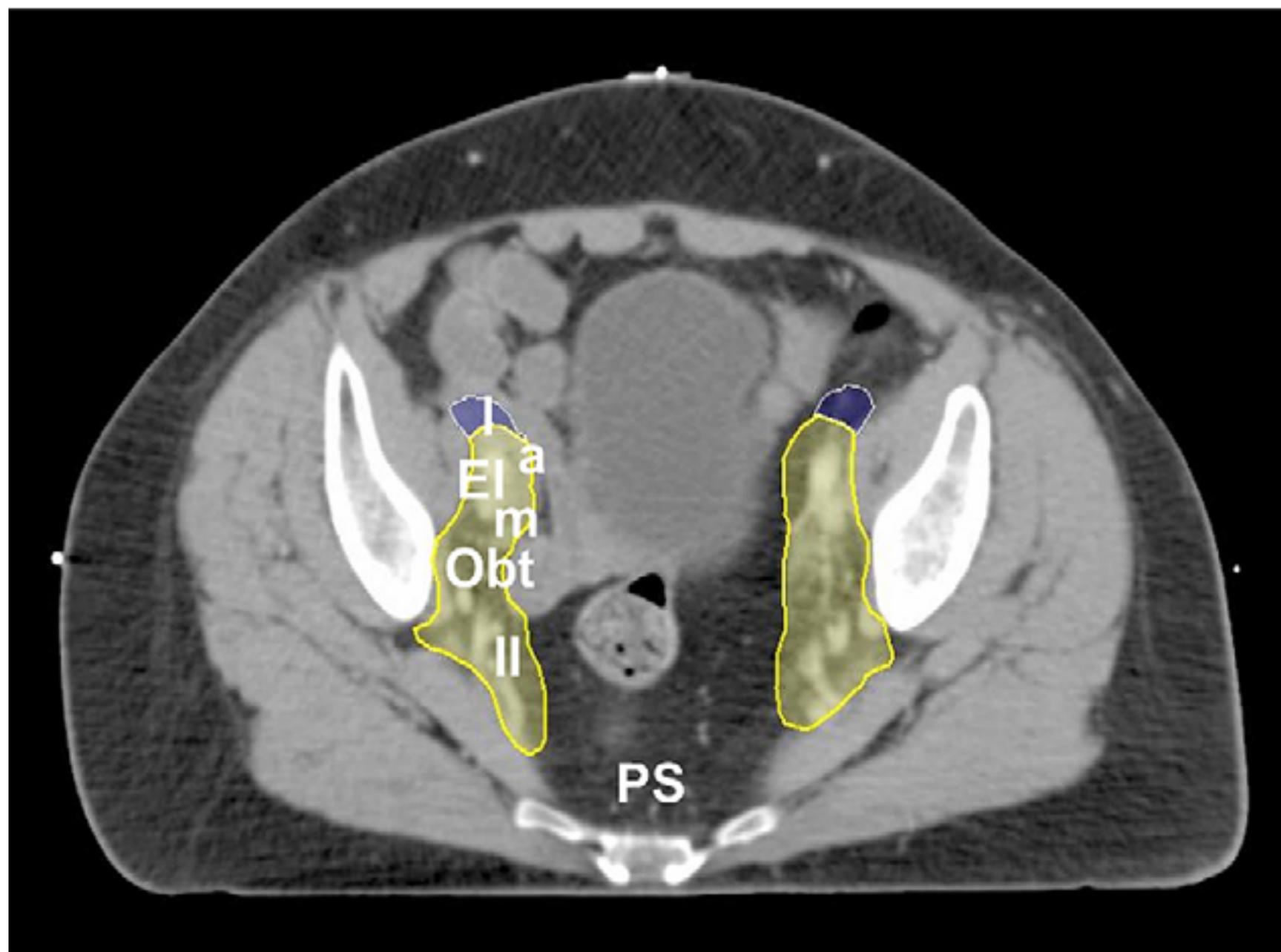
- Maximum short axis diameter (MSAD)
 - 10 mm for common and ext. iliac LN & inguinal nodes
 - 8 mm for internal iliac nodes
- Common iliac - located lat.and post. to vessels
- External iliac - between med border of psoas/lat. border of pelvic cavity and vessel.
 - 3 groups-lateral, middle, and medial (obturator)
- Internal iliac - post. in pelvis, ant. to piriformis along middle rectal and internal pudendal artery
- Inguinal - in fat ant. and medial to femoral vessels

CT defined lymph node levels

Lymph node group	Recommended margins*
Common iliac	7 mm margin around vessels. Extend posterior and lateral borders to psoas and vertebral body
External iliac	7 mm margin around vessels. Extend anterior border by a further 10 mm anterolaterally along the iliopsoas muscle to include the lateral external iliac nodes
Internal iliac	7 mm margin around vessels. Extend lateral borders to pelvic side wall
Obturator	Join external and internal iliac regions with a 17 mm wide strip along the pelvic side wall
Pre-sacral	Subaortic: 10 mm strip over anterior sacrum Mesorectal: cover entire mesorectal space

Taylor, A. et al (2007) Clinical Oncology 19, 542-55







Ing

Radiotherapy Planning CT Simulation

- Prone/supine with full/semi-filled bladder
- Use immobilisation techniques (alpha cradle) \pm bowel displacement maneuvers/ knee rest
- A radio-opaque marker placed at the anal verge or at the distal edge of palpable disease
- Oral and IV contrast
- Arms over chest or above head
- 5mm CT sections from L5 to 3-4 cm below anal verge

What is the target ?

- GTV +CTVA– Primary tumour, enlarged LN, mesorectal fat (Perirectal tissue & presacral space)
- CTVN –B/L Internal Iliac LN, external iliac LN, inguinal

Upper pelvis – ant wall of sacrum (Post.), sacral promontory (cephalad), presacral tissue up to iliopsoas laterally

Mid pelvis – perirectal fat(Ant.), 1-2 cm of bladder/uterus

Lower pelvis – perirectal fat and presacral tissue up to levator ani and inguinal nodes

CLINICAL INVESTIGATION

ELECTIVE CLINICAL TARGET VOLUMES FOR CONFORMAL THERAPY IN ANORECTAL CANCER: AN RADIATION THERAPY ONCOLOGY GROUP CONSENSUS PANEL CONTOURING ATLAS

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LEONARD L. GUNDERSON, M.D.,|| THEODORE S. HONG, M.D.,¶ J. J. JOHN KIM, M.D.,#
CHRISTOPHER G. WILLETT, M.D.,** AND LISA A. KACHNIC, M.D.††

RTOG Anorectal Target Volumes Consensus Guidelines – 2008 (RTOG 0529 Protocol)

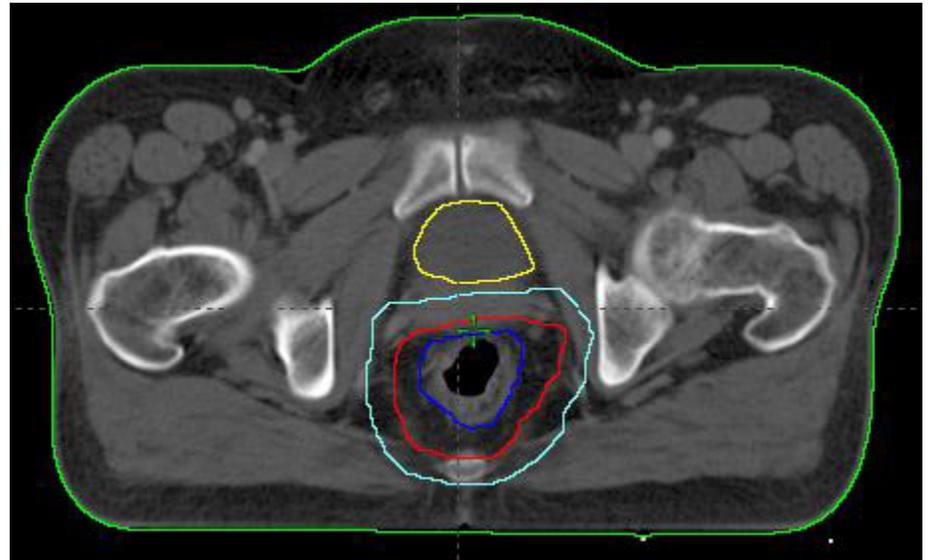
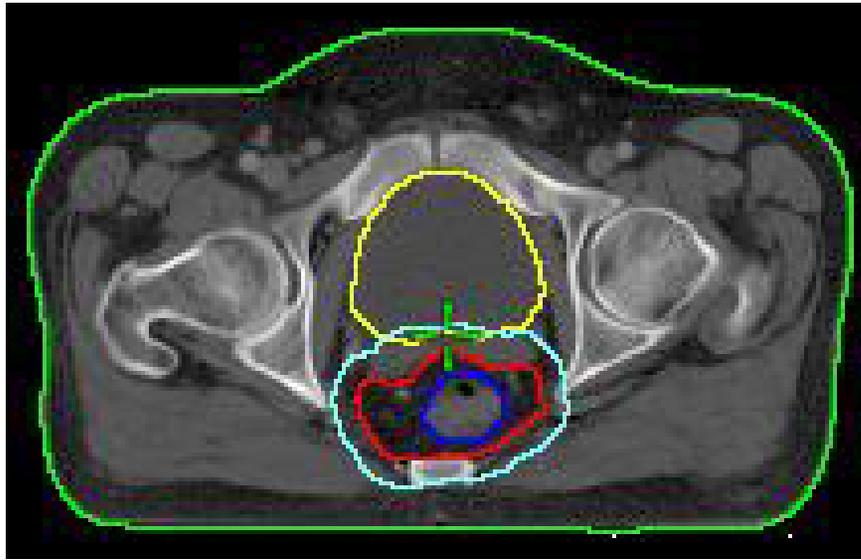
- **For Anal canal : Primary Tumour**

- GTV = All gross tumour + involved nodes (clinical & radiological)
- CTVA = 2 cm proximal and caudad to gross disease . It should include 2 -2.5 cm normal perianal skin around the anal verge.

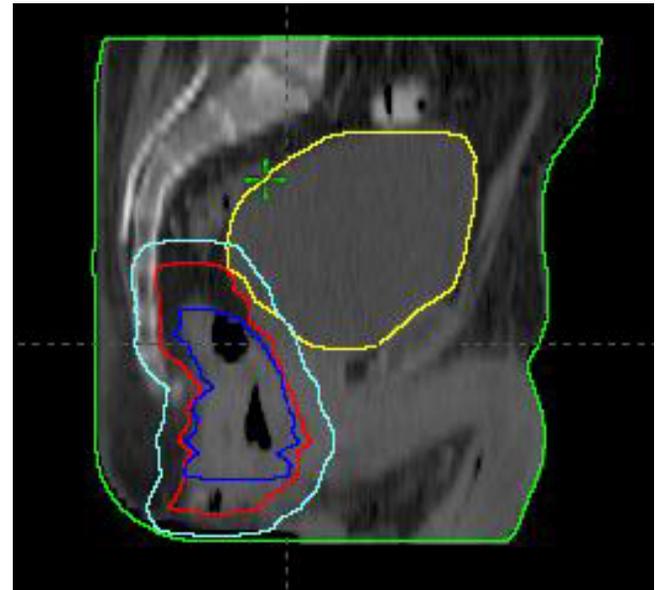
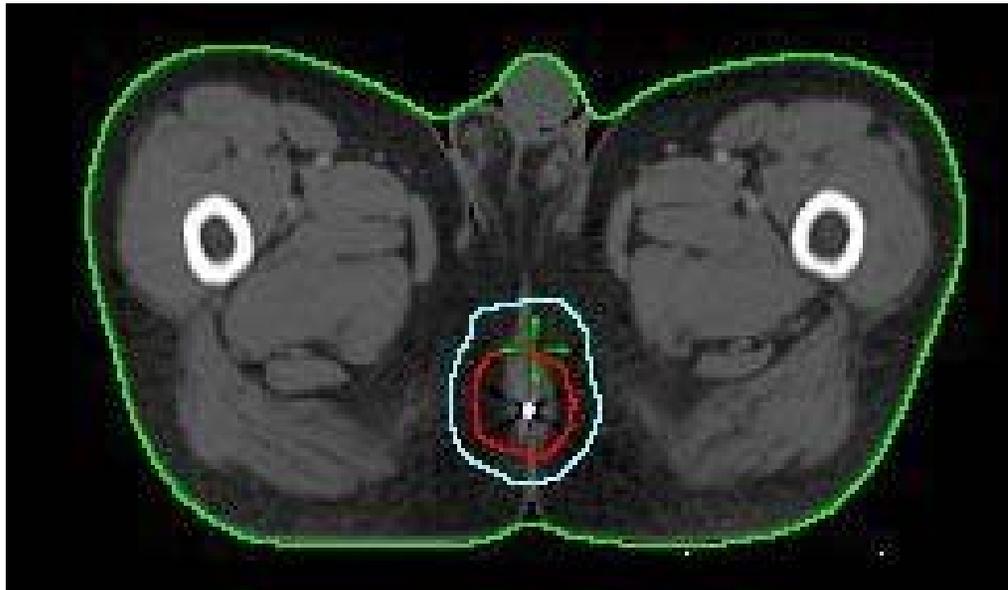
It should include mesorectum, prescra and perianorectal tissue 2 cm cephalad and caudad to gross disease.

1 cm of posterior bladder/ prostate/uterus/

- PTVA = 1 cm expansion from CTVA in all directions (trimmed to 3-5 mm to spare non target skin surface). CTVN(nodal) should not overlap with PTVA
- **Dose to PTVA = 54-59.4Gy**

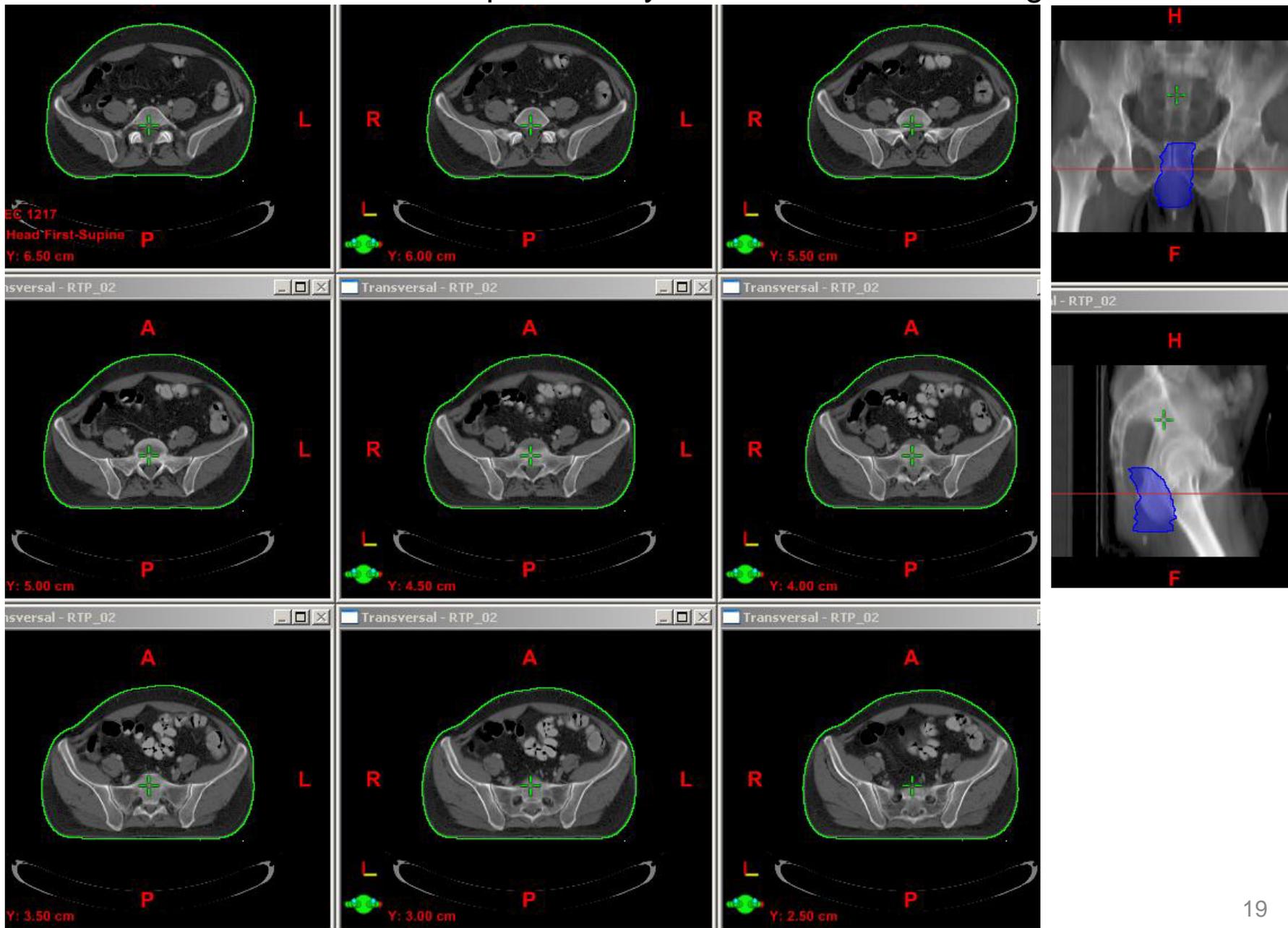


Bladder- yellow line, GTV – Blue line, CTVA- Red line, PTVA- cyan line

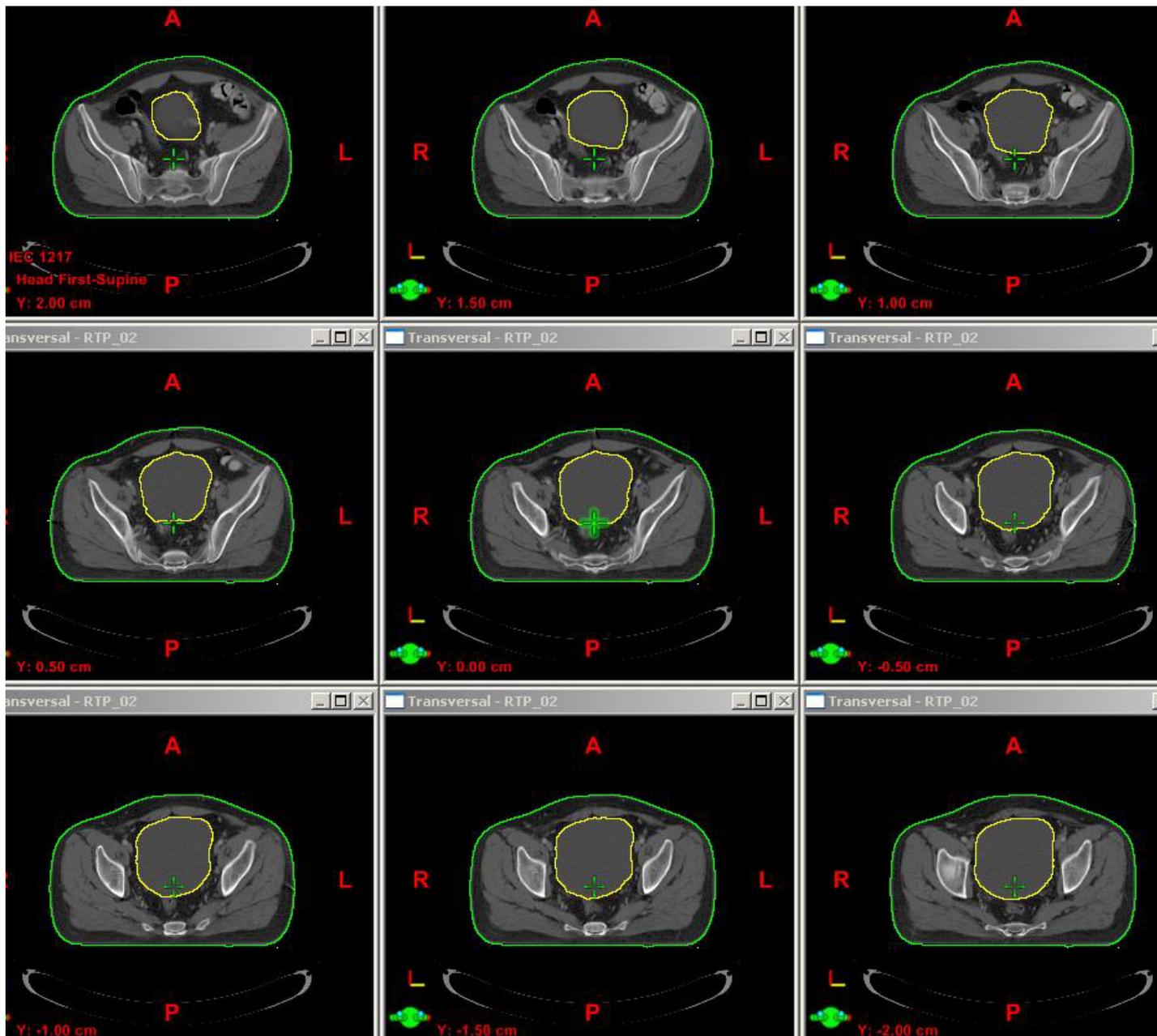


Anal verge with 2 cm normal perianal skin

5 mm CT sections from sacral promontory to 2 cm below anal verge

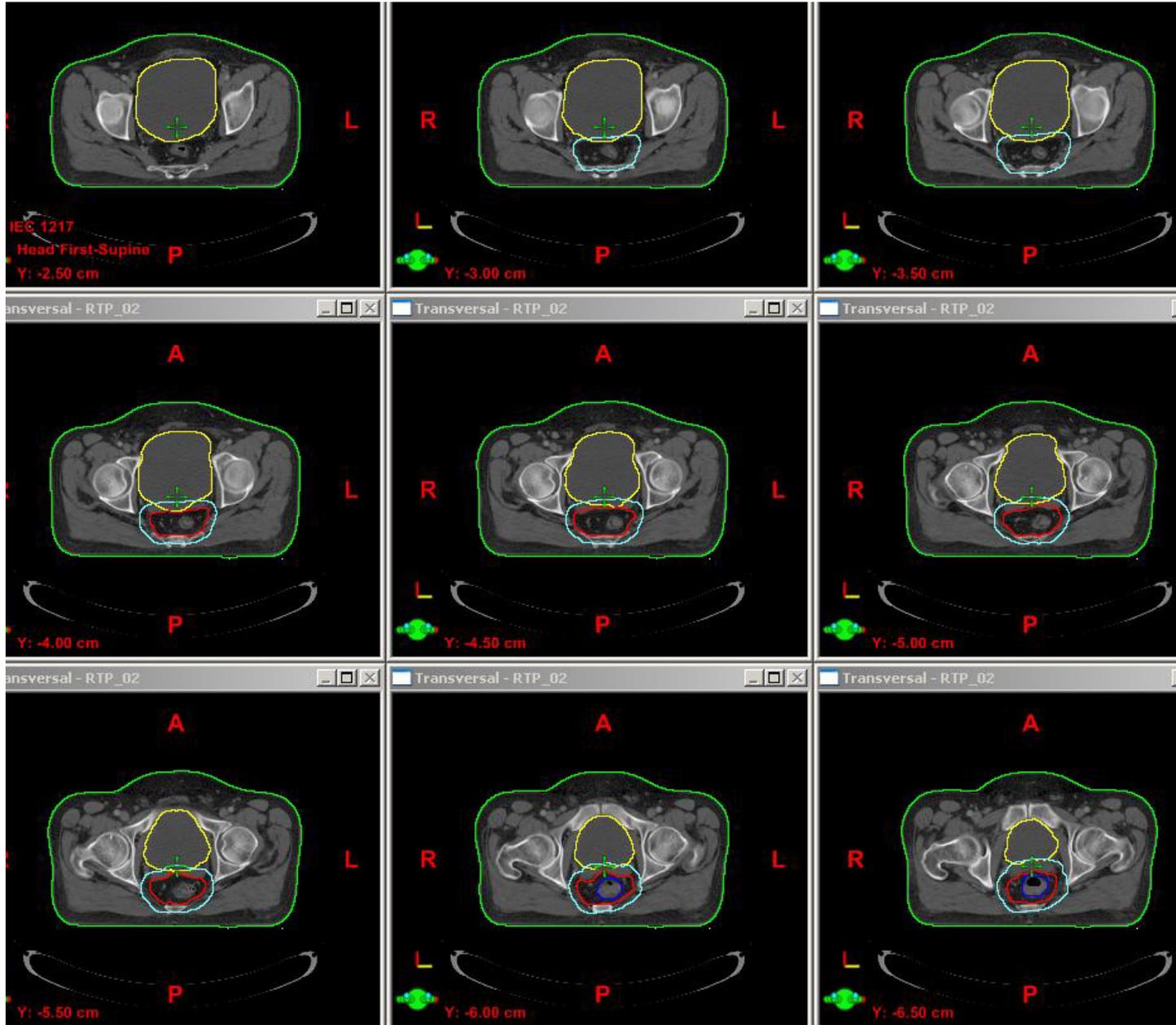


5 mm CT sections from sacral promontory to 2 cm below anal verge



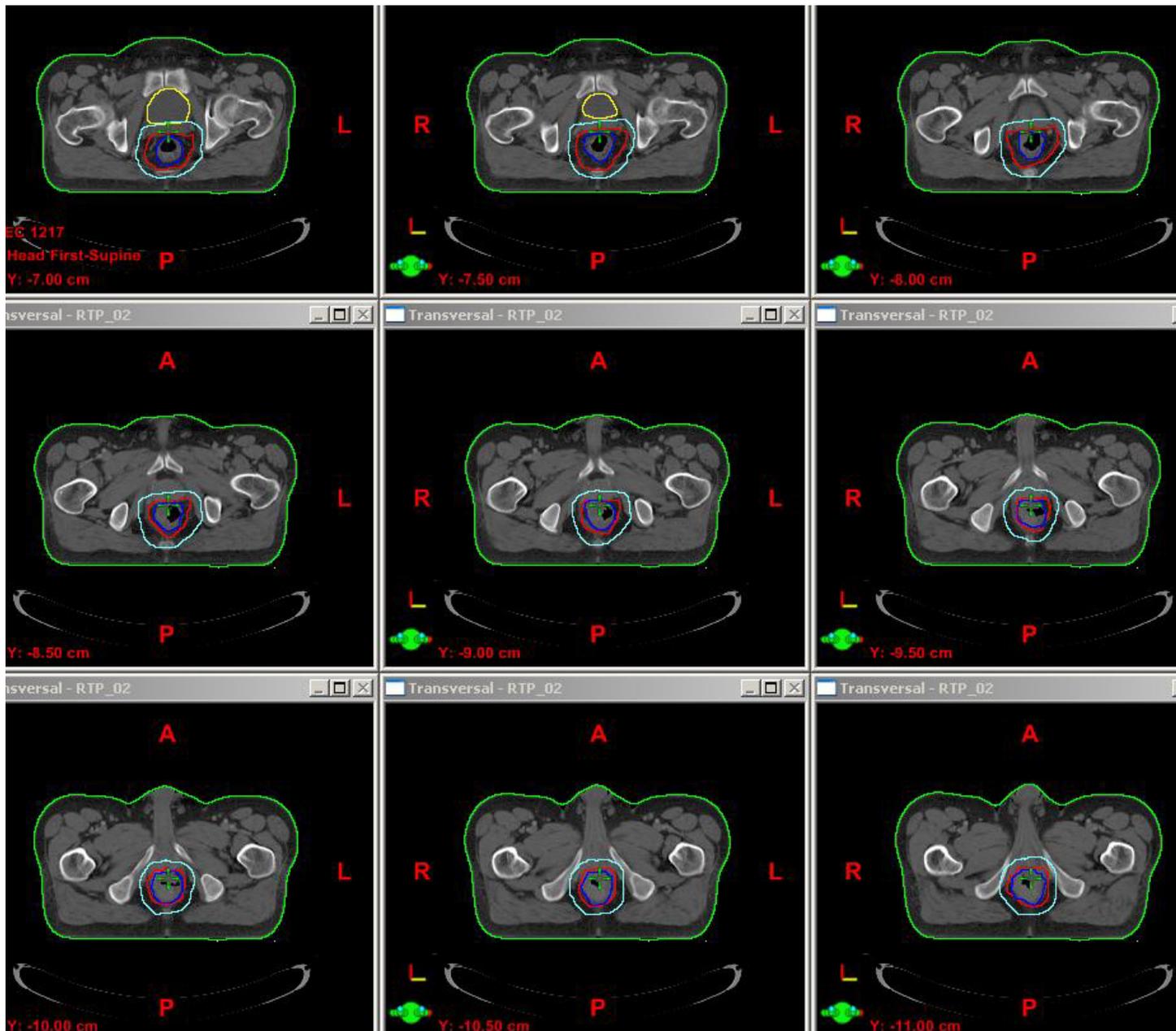
Bladder- yellow line

5 mm CT sections from sacral promontory to 2 cm below anal verge (cont.)



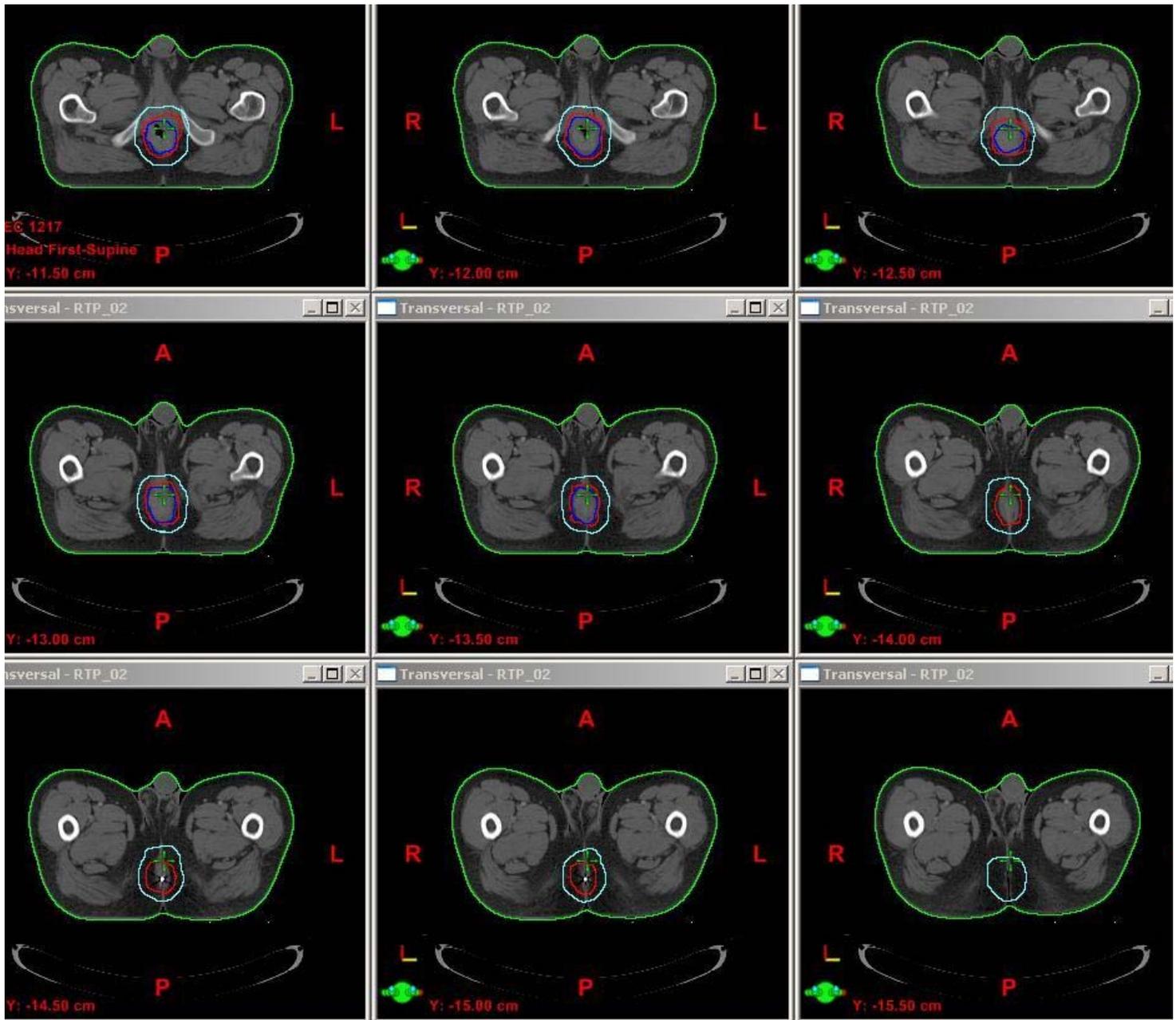
Bladder- yellow line
GTV – Blue line
CTVA- Red line
PTVA- cyan line

5 mm CT sections from sacral promontory to 2 cm below anal verge (cont.)

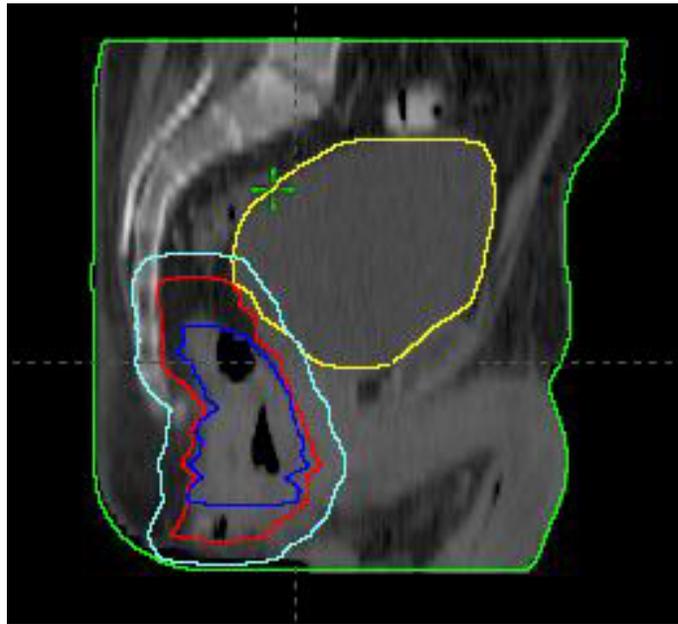
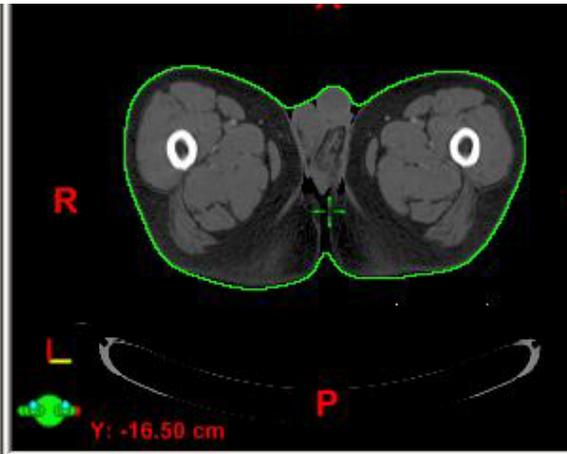
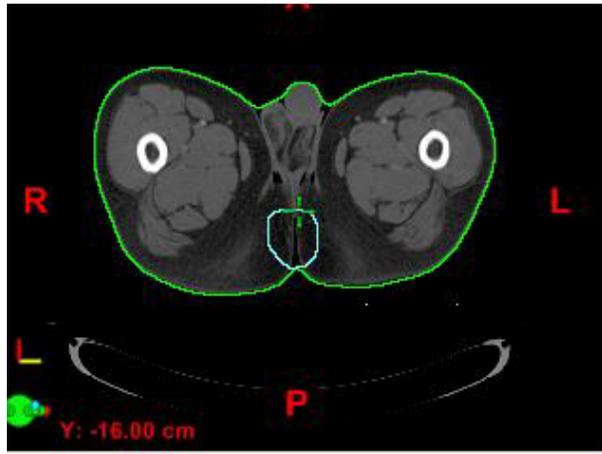


Bladder- yellow line
GTV – Blue line
CTVA- Red line
PTVA- cyan line

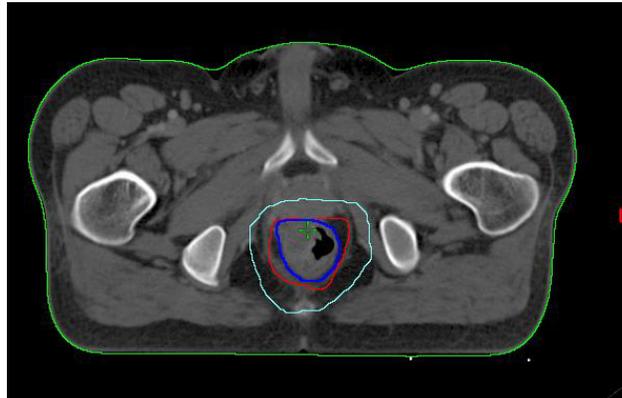
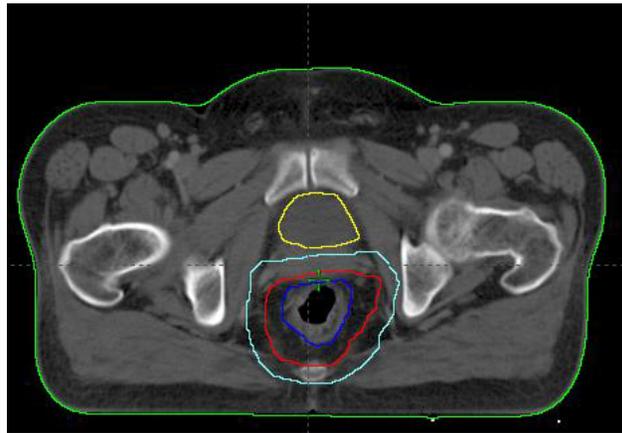
5 mm CT sections from sacral promontory to 2 cm below anal verge (cont.)



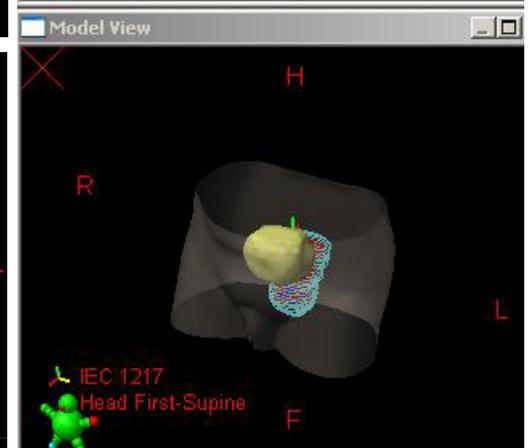
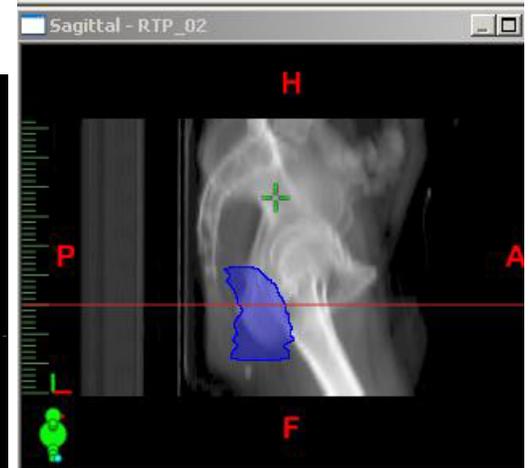
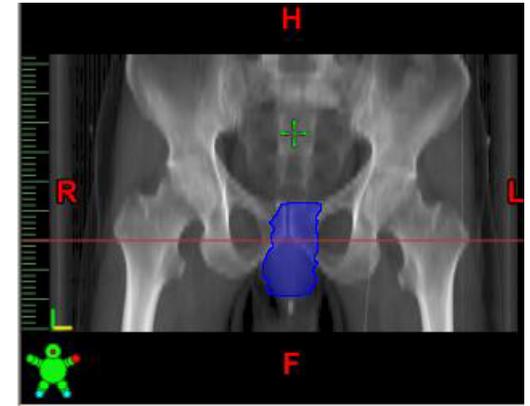
GTV – Blue line
CTVA- Red line
PTVA- cyan line



Sagittal Reconstruction
Showing tumour in anorectum



DRR



RTOG Anorectal Target Volumes Consensus Guidelines for nodes- 2008

- **For Anal canal : 3 elective nodal CTV**

For nodes 8mm- 1 cm expansion around vessels.(Ant.lat.=1cm)

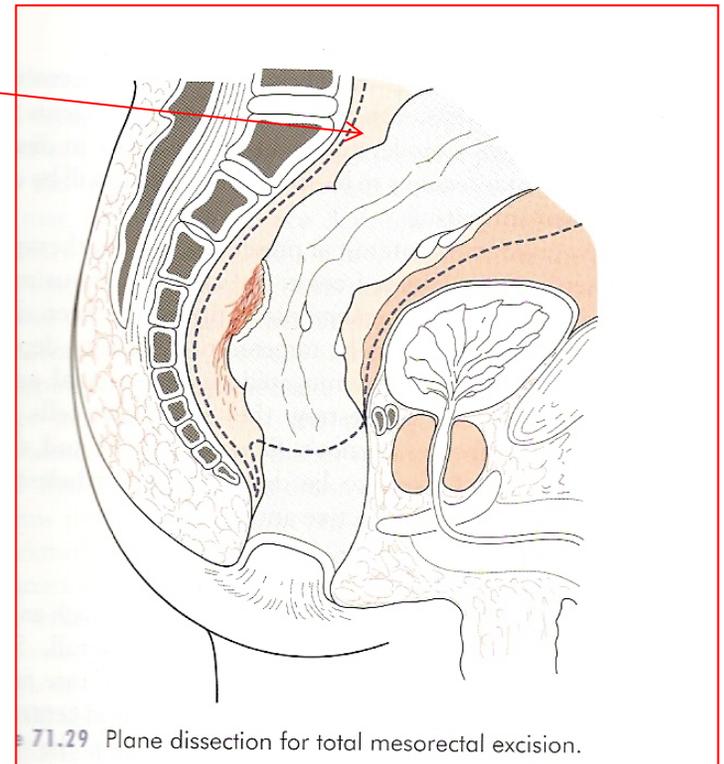
1. CTVa - Internal iliac, presacral & perirectal nodes
2. CTVb - External iliac nodes
3. CTVc - Inguinal nodes

- **Elective nodal CTV dose = 45GY**

CTVa (Internal iliac, presacral & perirectal nodal regions):

- Covers entire mesorectum sup. from sacral promontory to pelvic floor made by levator ani inferiorly. Anterior surface of sacrum posteriorly (presacral), iliopsoas /perirectal area laterally

Mesorectum -cylindrical, with cone-shaped tips in cranial and caudal direction
Starts at the level of the sacral promontory at the origin of the superior rectal artery and ending at the level where the levator ani muscle inserts into the rectal wall



71.29 Plane dissection for total mesorectal excision.

RTOG Anorectal Target Volumes Consensus Guidelines- 2008

•CTVb (For external iliac nodal regions) :

- Cephalad- Upper end of SI joint (division of common iliac artery)
- Caudad-Upper end of pubic rami(bottom of internal obturator artery)



RTOG Anorectal Target Volumes Consensus Guidelines- 2008

CTVc (For inguinal nodal regions):

- Cephalad : upper end of pubic ramus or at the inferior extent of internal obturator artery
- Caudad : 2 cm caudad to saphenous/femoral junction (SF junc. lies at 4cm down & 4 cm lat. to pubic tubercle, LN is med. to vessel)

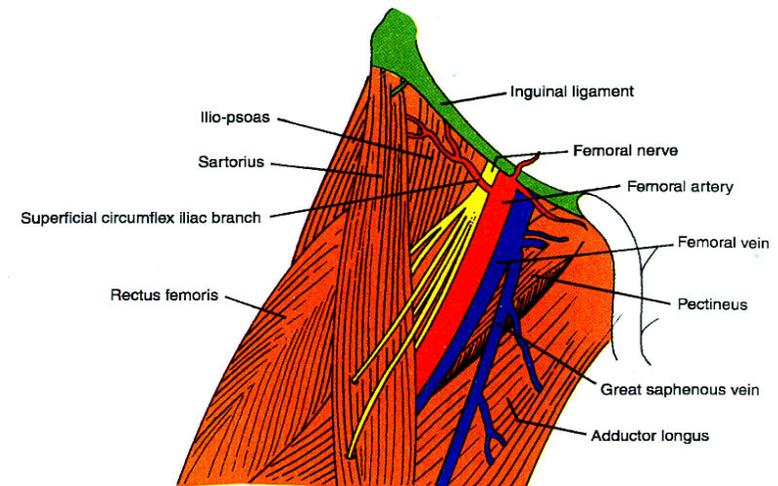
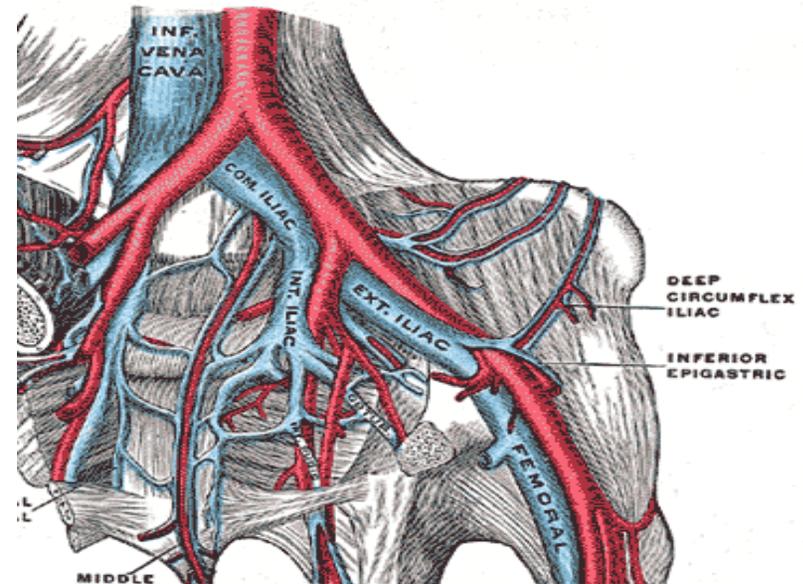
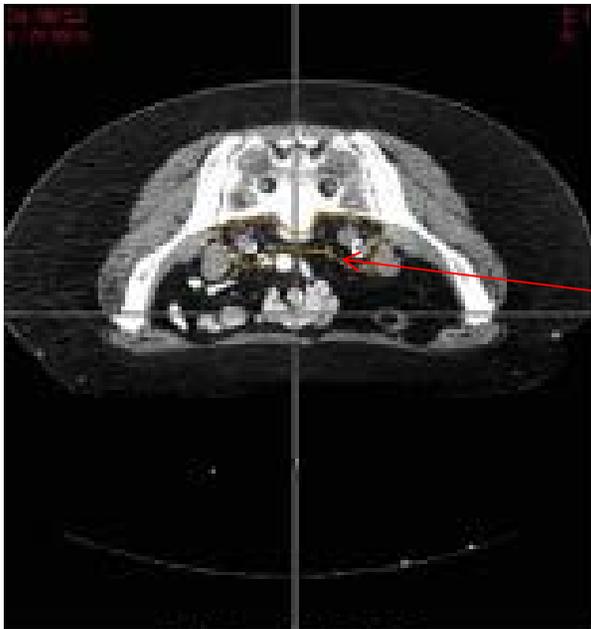
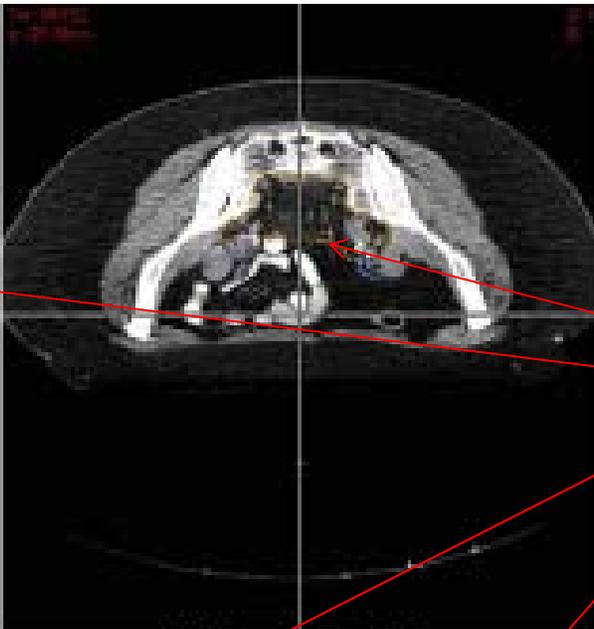


Fig. 3.14: Contents of the femoral triangle.

Upper Pelvis

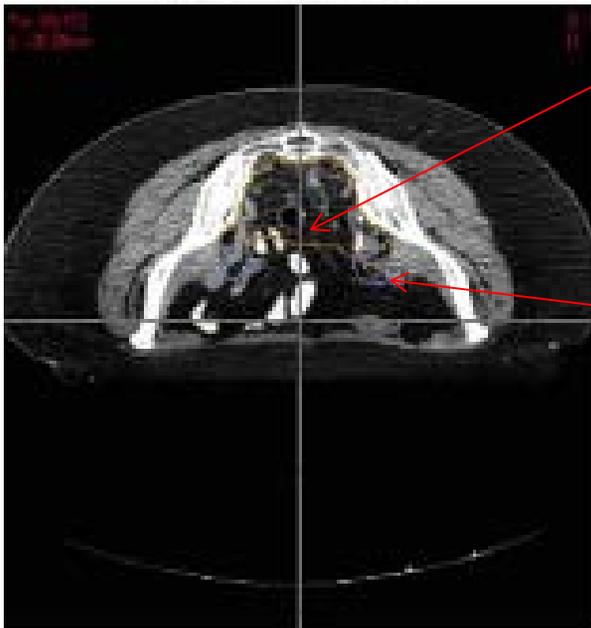


TP -29.38

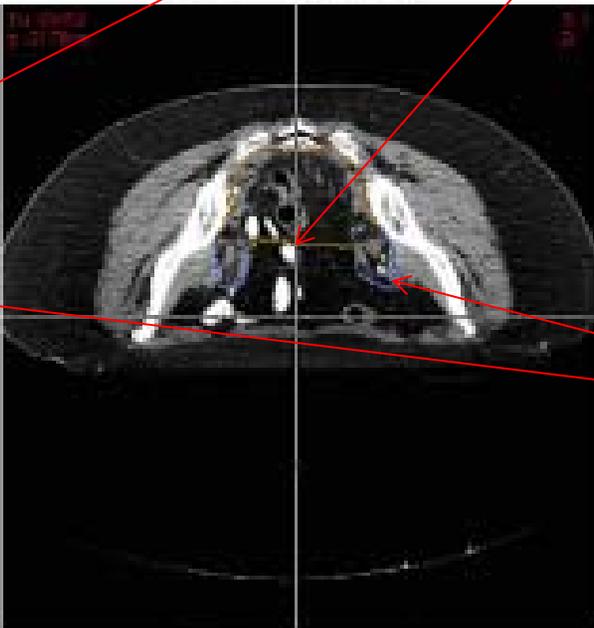


TP -29.98

CTVa
(Internal iliac,
presacral,
Perirectal)



TP -30.88



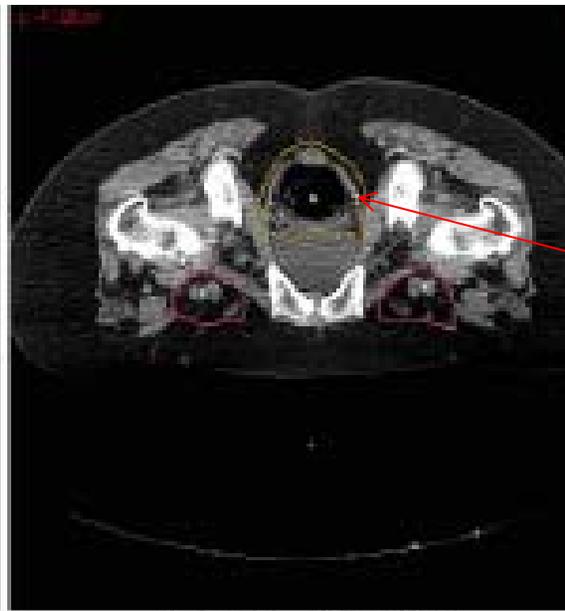
TP -31.78

CTVb
(external iliac)

Lower Pelvis



TP -39.88



TP -41.08

CTVa
(Internal iliac,
presacral,
Perirectal)



TP -42.58



TP -44.98

CTVc
(Inguinal)

Mid Pelvis



TP -34.18



TP -36.88

CTVa
(Internal iliac,
presacral,
Perirectal)

CTVb
(external iliac)



TP -37.18



TP -38.98

CTVc
(Inguinal)

Normal Tissue Contouring

No specific DVH recommendation for normal tissue by RTOG, still investigational but

- Femoral head, Iliac crest
- Small bowel up to 1 cm beyond PTVA
- large bowel including rectosigmoid
- Bladder
- External genitalia

Dose Prescription

- After target volume delineation, IMRT dose prescription as follows :
- PTV_A (Primary)= 54-59.4Gy
- CTV_{nodal}= 45-50 Gy (45Gy: uninvolved, 50 Gy: < 3 cm, 54 Gy: > 3 cm)

Dose constrains to normal tissue:

Bladder	35 Gy < 50% vol
Large bowel	30 Gy <200cc vol
Small bowel	30 Gy <200cc vol
Femoral head	30 Gy < 50% vol
Iliac crest	30 Gy < 50% vol
External genitalia	20 Gy < 50% vol

Suggested Reading

- *Myerson RJ et al, Sem Rad Oncol, 13: 433-440 2003*
- *Milano MT et al, Int J Radiat Oncol Biol Phys 63: 354-361, 2005*
- Taylor A et al. An Atlas of the Pelvic Lymph Node Regions to Aid Radiotherapy Target Volume Definition. *Clinical Oncology 19 : 542-550, 2007*
- *Salama JK et al, J Clin Oncol, 25: 4581-4586, 2007*
- *Myerson RJ et al. Elective Clinical Target Volumes For Conformal Therapy In Anorectal Cancer: An Radiation Therapy Oncology Group Consensus Panel Contouring Atlas. Int J Radiat Oncol Biol Phys 2008 (in press)*
- *www.rtog.org (see Anal canal protocol RTOG 0529)*