Gynecological Maligancies: Contouring Guidelines

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Why is contouring necessary?

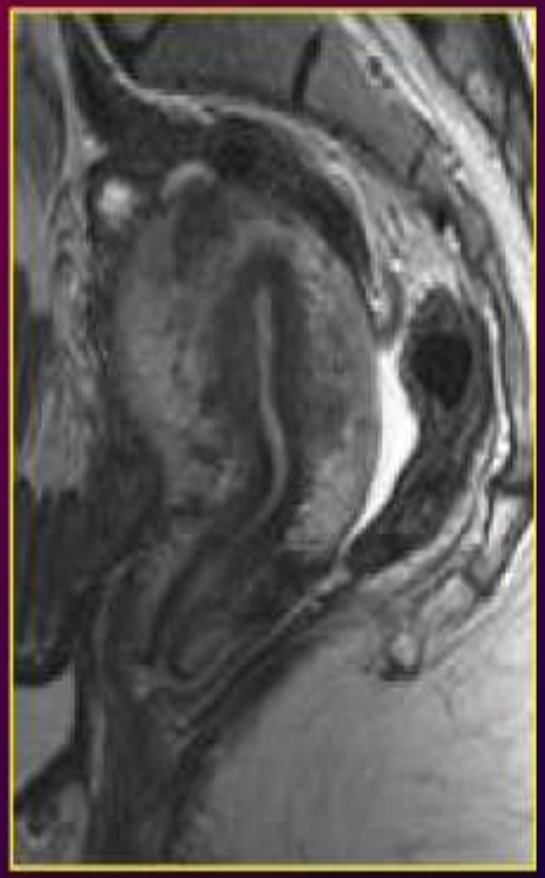
- For image-based conformal planning, targets and OARs have to be delineated for optimal treatment
- As we move from 4-field box arrangements and point A-based dose prescriptions, good imaging modalities and protocols become necessary
- Even though most guidelines are based on MR, in practice, it is prohibitively expensive to do routine MR-based planning
- TPSs too, have only recently become capable of dose calculation on MR & even now, there is no commercially available MR-based TPS

Problems with contouring for gynaec cancer on CT images

- The GTV itself may/ may not be well seen
- The parametrial disease is usually not visualised
- MR-based guidelines for parametrial contouring are confusing
- Though pelvic nodal contouring is systematic, but we still tend to end up replicating the traditional cranio-caudal boundaries of a 4-field box

Uterus (corpus and cervix) - CT:

- Isointense to muscle
- Endometrium indistinguishable from myometrium on unenhanced CT scan
- Cervix in general less enhancing than corpus

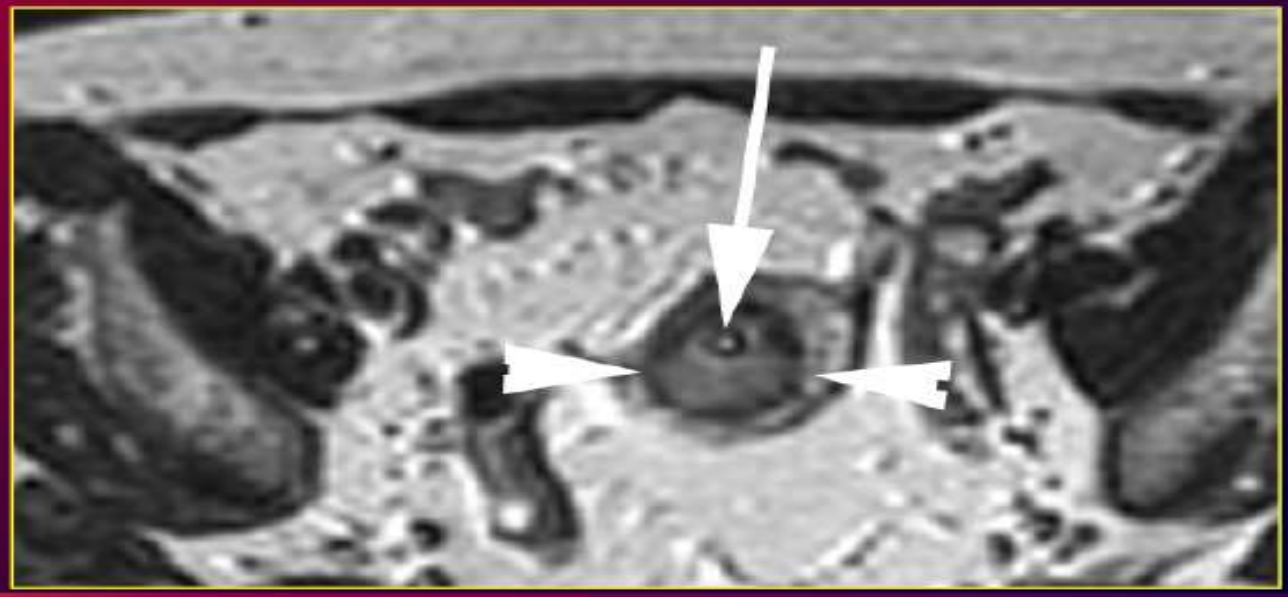


Uterus (corpus and cervix) - MR:

- Zonal anatomy on T 2-weighted MR scans
- Age-related changes of cervix and myometrium
- Enhancement variable

TUMOUR – EXTENSION – PARAMETRIUM (1)

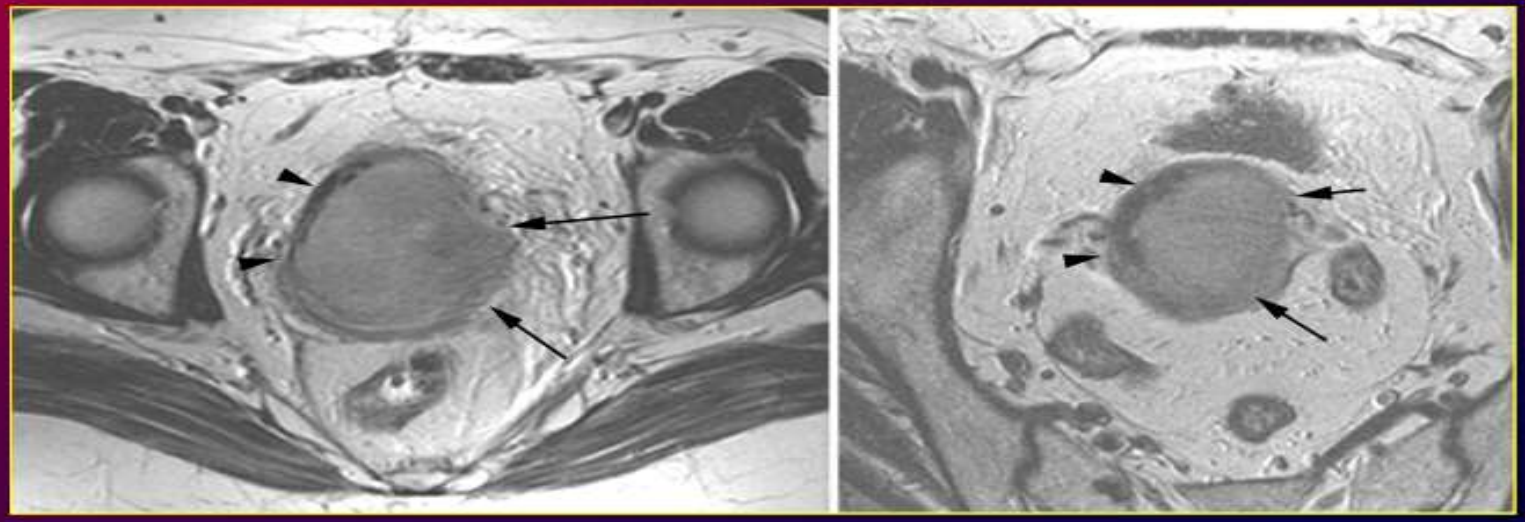
INTACT



FIGO IB

TUMOUR – EXTENSION – PARAMETRIUM (2)

INVASION



FIGO IIB

EBRT contouring CTV nodes

- The RTOG guidelines for pelvic LN contouring are well-described
- CTV nodes should include the common iliac, external iliac, internal iliac, obturator and presacral groups
- Key points are:

(1) Draw the pelvic vessels (tightly) and grow 7mm-1cm margins around them=nodal CTV. **

**Based on Taylor et al's work with USPIO:7mm margins around the pelvic vessels were found to encompass 95% of the nodes.

Int J Radiat Oncol Biol Phys 2005;63:1604–1612.

(2) Do not include the ilio-psoas & piriformis muscle bellies within the CTV.

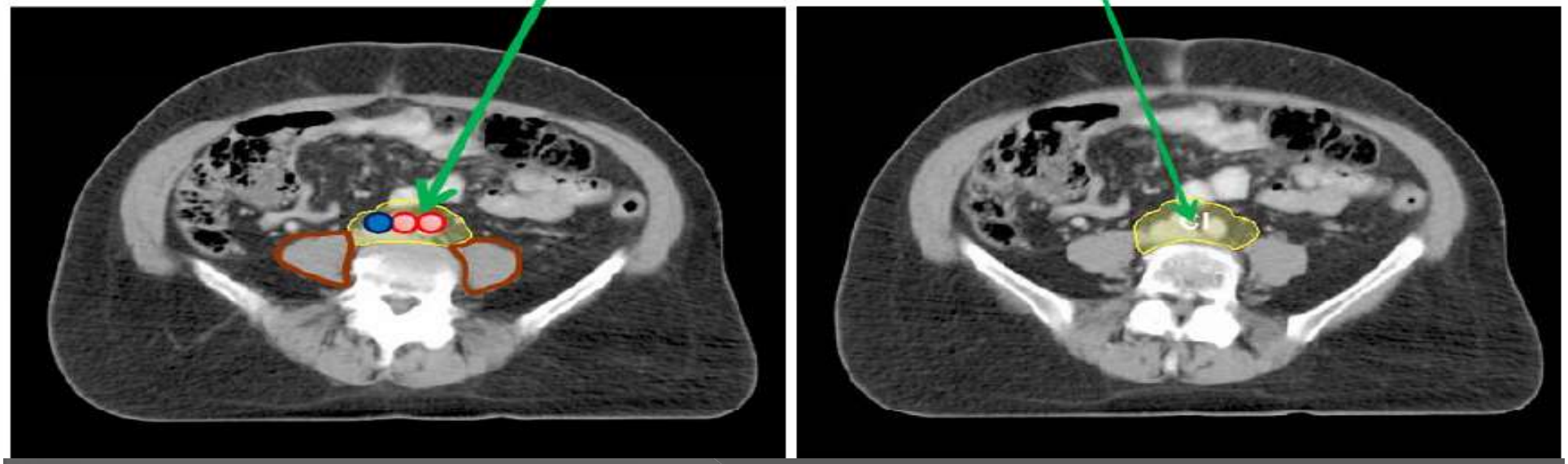
(3) The nodal CTV upper border should reach upto 7mm-1cm caudal to the L4-L5 junction

(4) The presacral space coverage is crucial, at least upto the S2-S3 junction. The thickness of the CTV should be at least 1-1.4cm in the midline. Normally this part of the CTV is taken till the cranial-most slice in which the rectum becomes visible

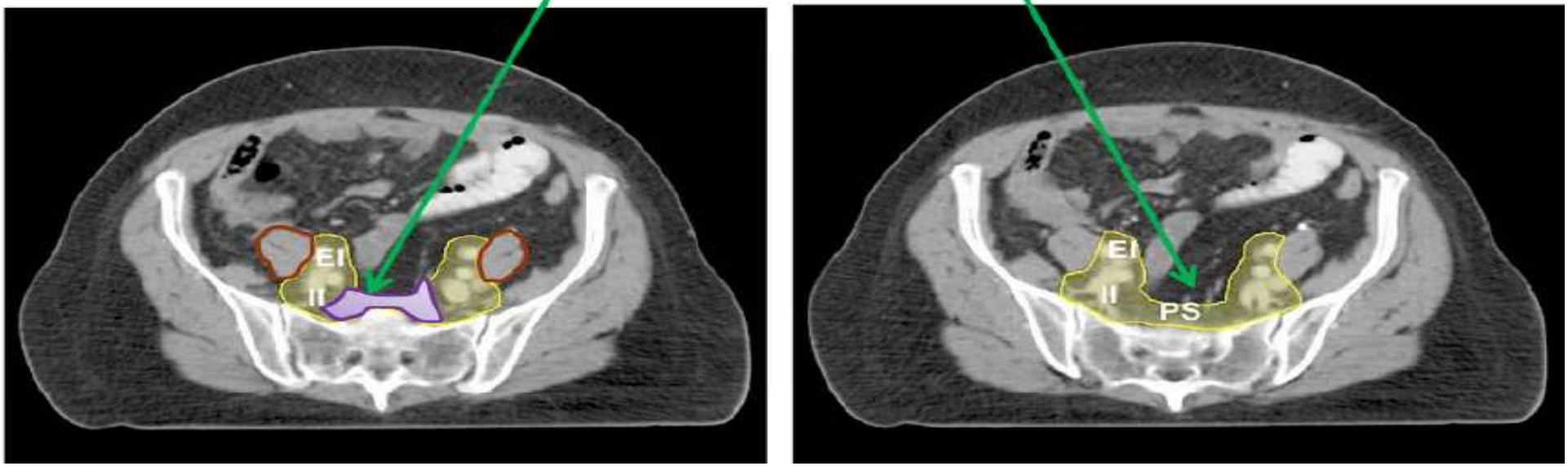
(5) The external iliac nodes should be drawn till the slice where the heads of the femurs become visible

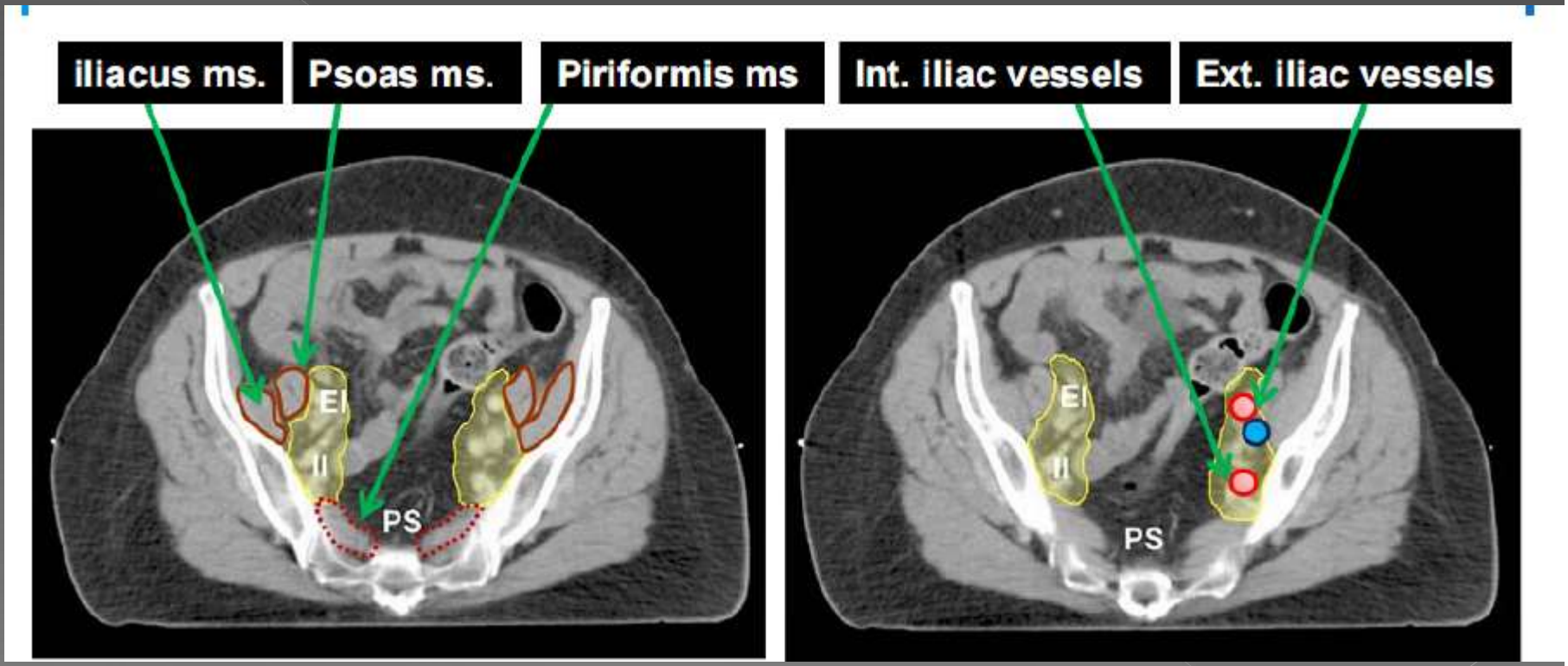
(6) The internal iliac nodes should be included below this level till the uppermost slice where the symphysis pubis becomes visible

Aortic Bifurcation = Common iliacs



Pre sacral Lymph nodes




iliacus ms.
Psoas ms.
Piriformis ms
Int. iliac vessels
Ext. iliac vessels
EI
II
PS
EI
II
PS

EBRT contouring CTV primary

TMH protocol:

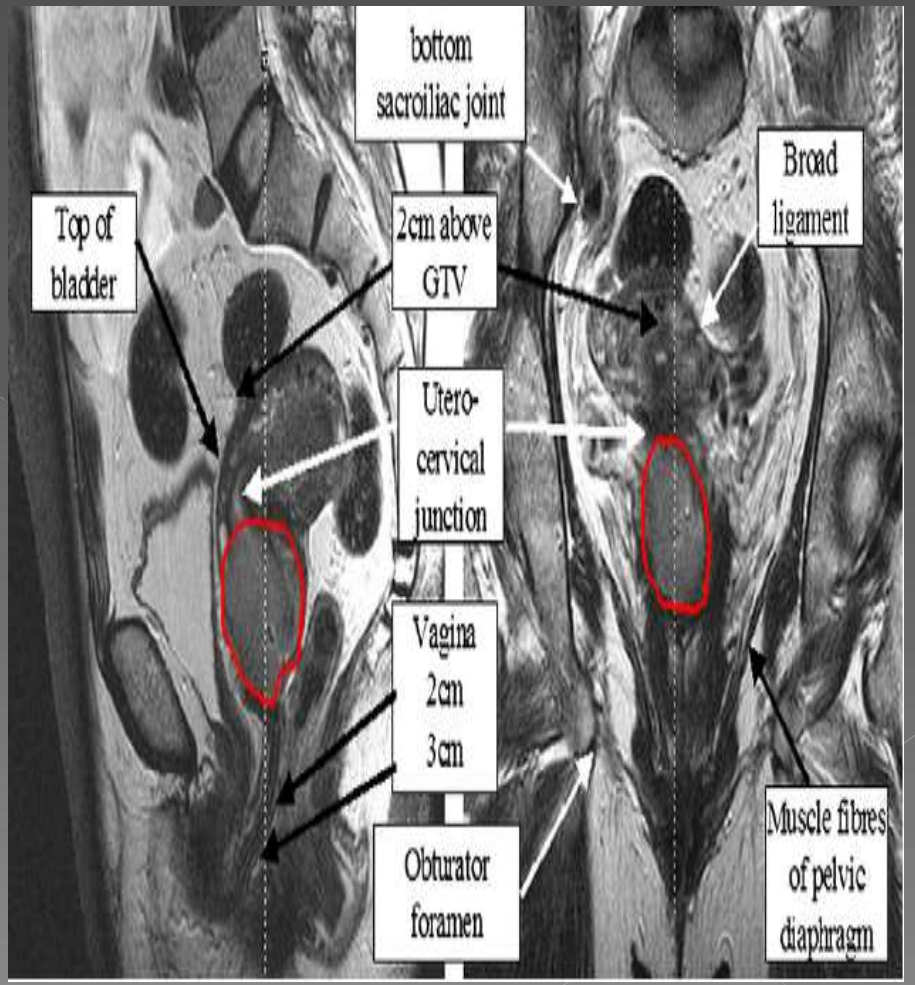
- Draw the GTV (based on clinical and imaging findings).
- Grow margin of 0.5-1cm all around (edited from rectum and bladder).
- Join with the vagina & uterine body (without margin)
- Vagina should be included at least till the bottom of the ischial tuberosity. If there was lower vaginal disease, it is best to include up till the introitus.
- The weakness of this protocol is that the parametrium disease may not be adequately covered, especially in IIIB disease.

- Most clinicians agree on including the entire corpus uteri in the CTV primary
- At least the upper ½ of the vagina needs to be included in the CTV primary (in the absence of vaginal involvement)
- In case of vaginal involvement, upper 2/3 of vagina needs to be included
- Entire vagina should be included for extensive vaginal involvement

Parametrial contouring guidelines (Lim et al)

Table 3. Anatomical boundaries of parametria

Location	Anatomic structures
Anteriorly	Posterior wall of bladder or posterior border of external iliac vessel
Posteriorly	Uterosacral ligaments and mesorectal fascia
Laterally	Medial edge of internal obturator muscle/ ischial ramus bilaterally
Superiorly	Top of fallopian tube/ broad ligament. Depending on degree of uterus flexion, this may also form the anterior boundary of parametrial tissue.
Inferiorly	Urogenital diaphragm



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Controversy!

Care must be

taken to include the entire uterosacral ligaments if they are either clinically or radiologically involved with disease. If this is the case, an argument can be made to include the entire mesorectum as pararectal lymph nodes would also be at risk. In that case, parametrial volumes would extend up to the rectal contour (Fig. 5). Patients with Federation Internationale de Gynecologie et d'Obstetrique (FIGO) stage 3B or greater disease and those with extensive nodal involvement should also have the entire mesorectum included in the parametrial volumes, which extend to the pelvic sidewall (excluding bone and muscle), and ex-

CTV pelvis

- Join the CTV nodes & CTV primary by Boolean function=CTV pelvis
- Now apply a margin of 0.7-1.5cm (cranio-caudal) and 0.7-1cm (radial) over CTV pelvis= PTV pelvis

Brachytherapy contouring: GEC-ESTRO guidelines GTVD

- Hypointense areas on T2 weighted MRI +
- Entire cervix +/-
- Parametrial/vaginal disease (if present)

Radiotherapy and Oncology 78 (2006) 67-77

GTVB

- Hypointense areas on T2-weighted MRI +
- Entire cervix +/-
- Parametrial/vaginal disease (if present)

HR-CTV

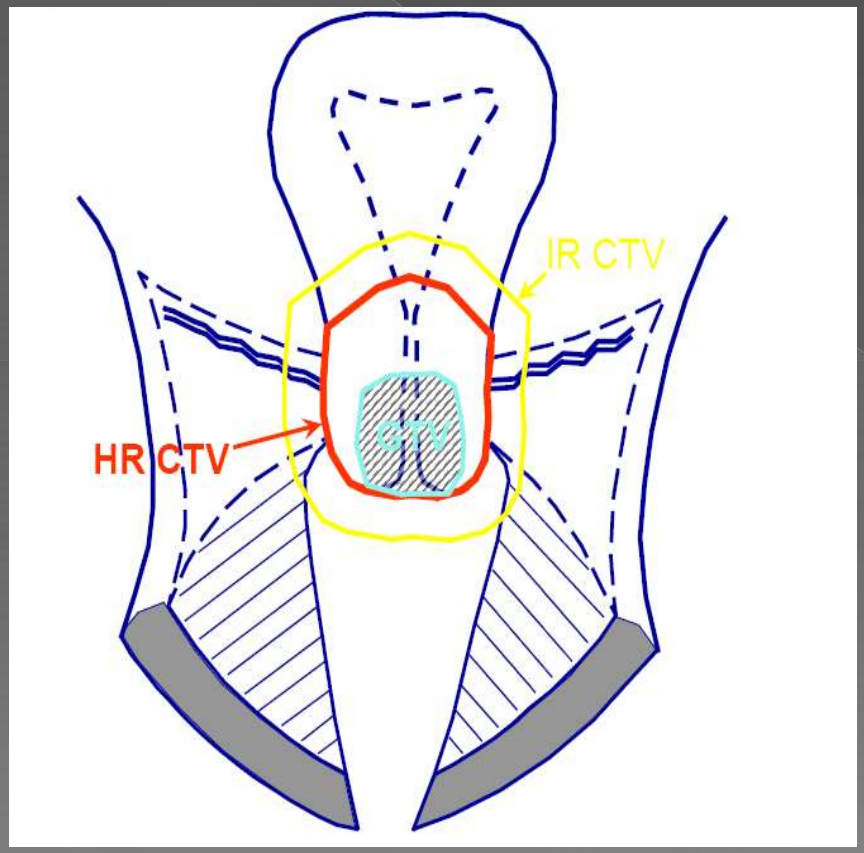
Includes:

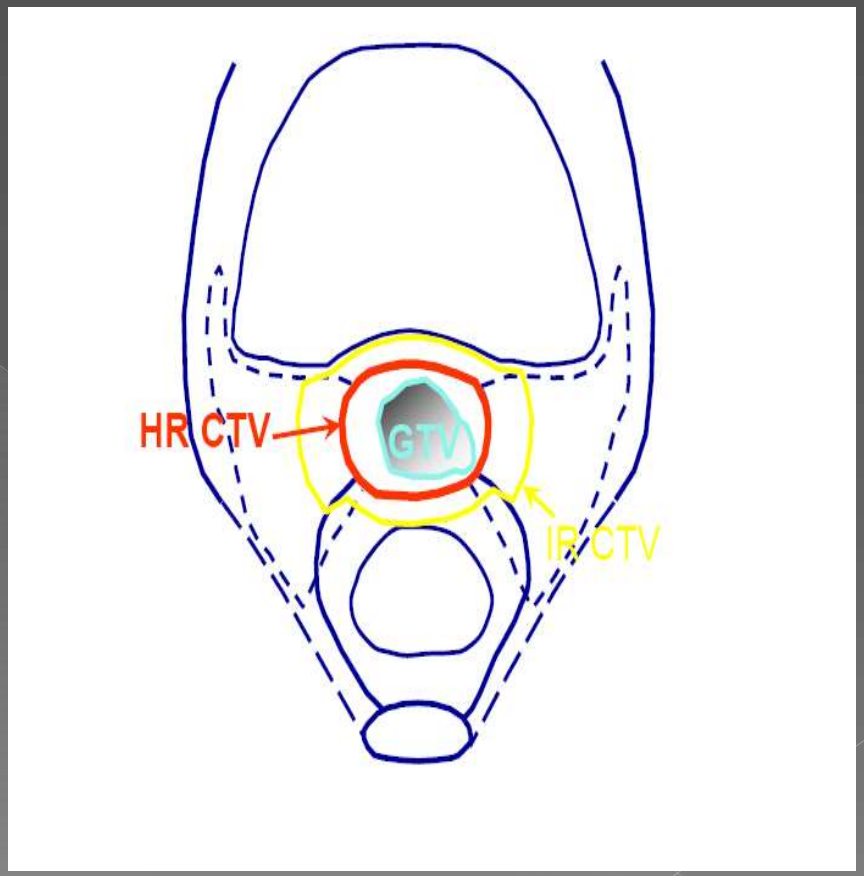
- GTVB +
- All gray zones (areas of high-signal intensity on MR)

IR-CTV

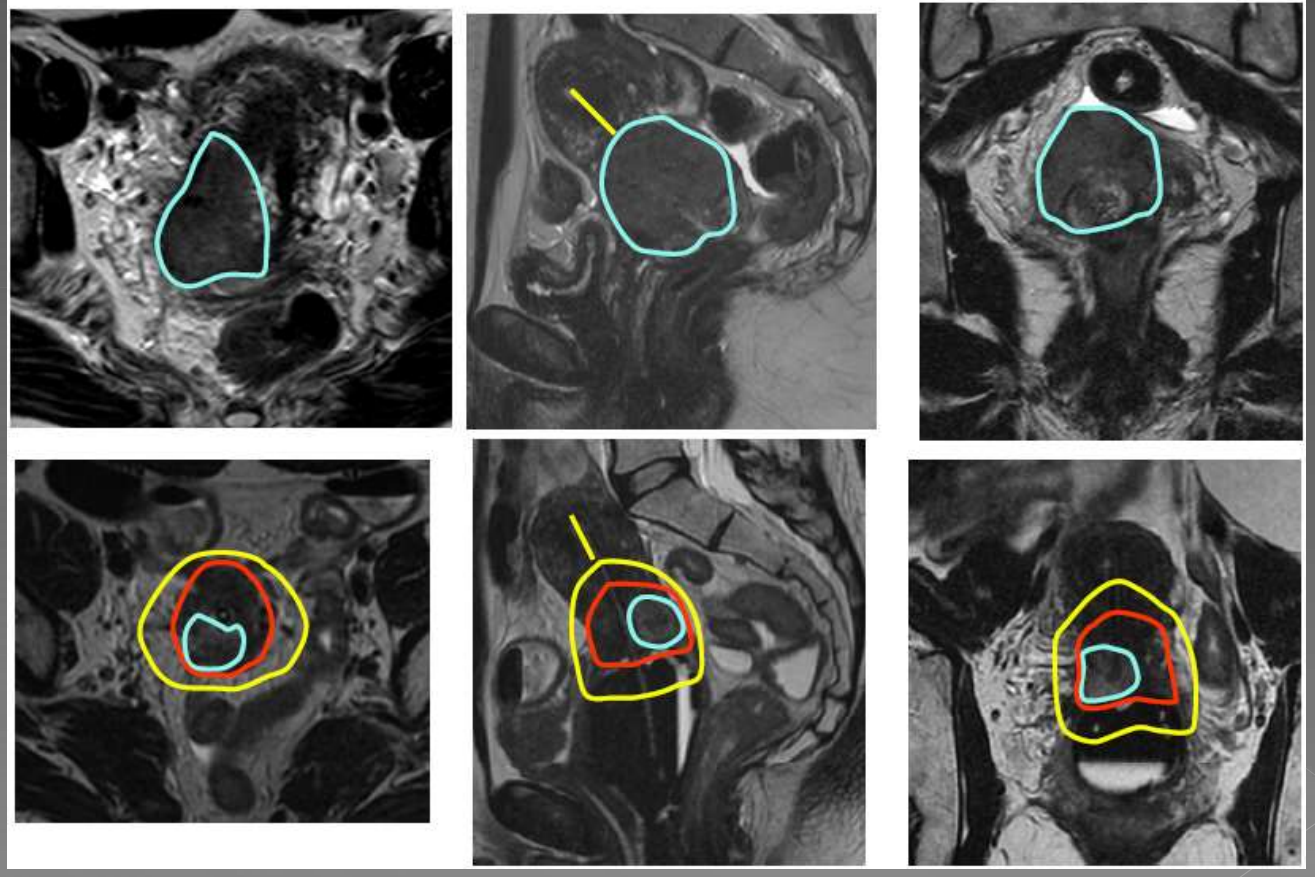
Includes:

- GTVD +
- 1cm margin craniocaudal & lateral, 5mm AP(edited from bladder and rectum)


IR CTV
HR CTV
GTV

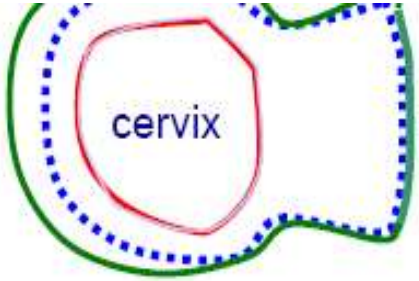

HR CTV
GTV
IR CTV

Stage IB2

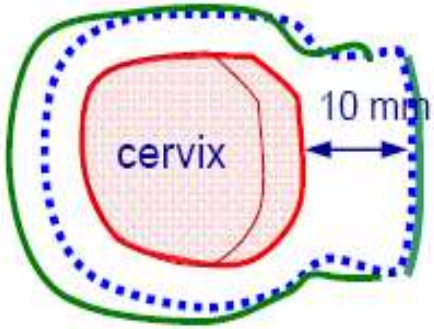


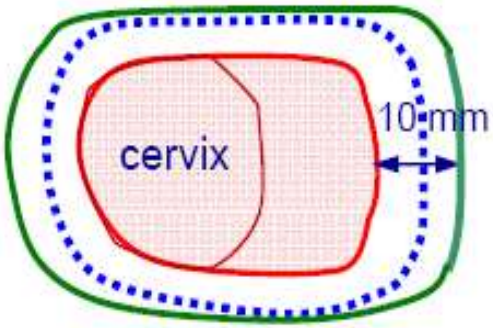
CTV BT

Complete remission

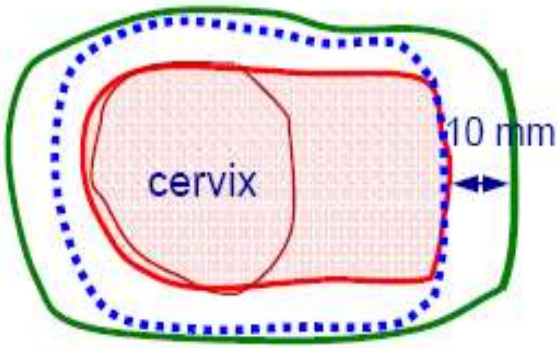


Partial remission





Stable disease



Legend

HR-CTV

IR-CTV

Initial tumour extension (at diagnosis)

Residual disease

Remember….

- Summing dose distributions between EBRT and brachytherapy is not possible with most TPS (as the data sets are different: patient positioning demands this)
- MR-CT fusion on the TPS for such mobile structures will also have an inherent error
- The BEST fusion is the one in your head: clinical findings, teletherapy & brachytherapy contours and distributions are most meaningful this way!
- This is why, for brachytherapy, post-insertion MR and MR-compatible applicators are not compulsory
- A pre-EBRT and pre-BT MR can be sufficient→ the data is extrapolated on the CT scans

Patient: HS

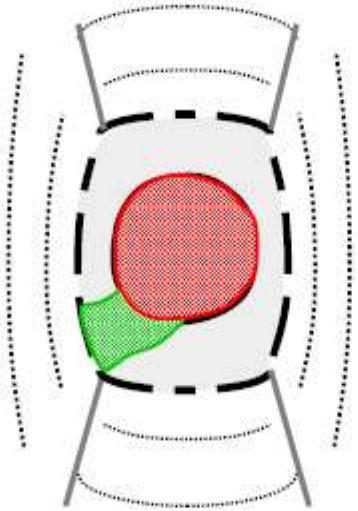
Clinical Drawing

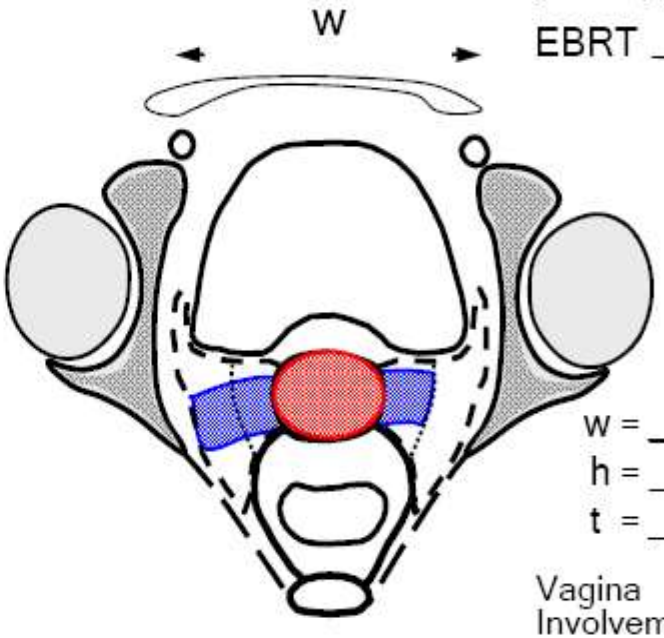
At Diagnosis [X]

At Brachytherapy [ ]

EBRT ___ Gy

	Infiltrative	Exophytic
Cervix		
Vagina		
Parametria		
Rectum or Bladder		



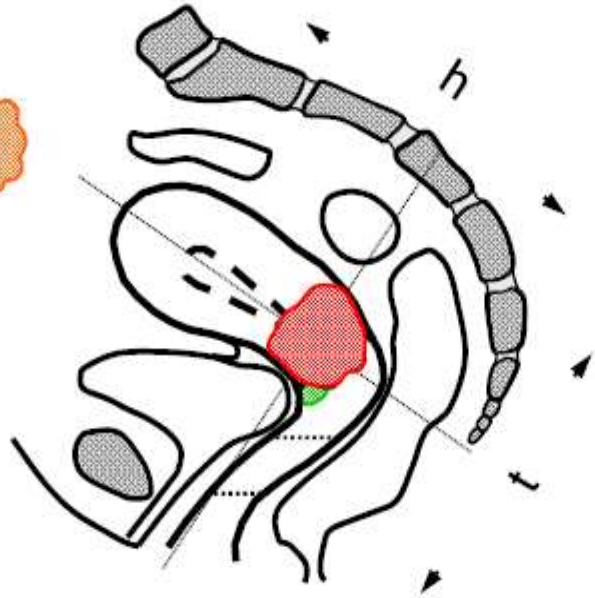


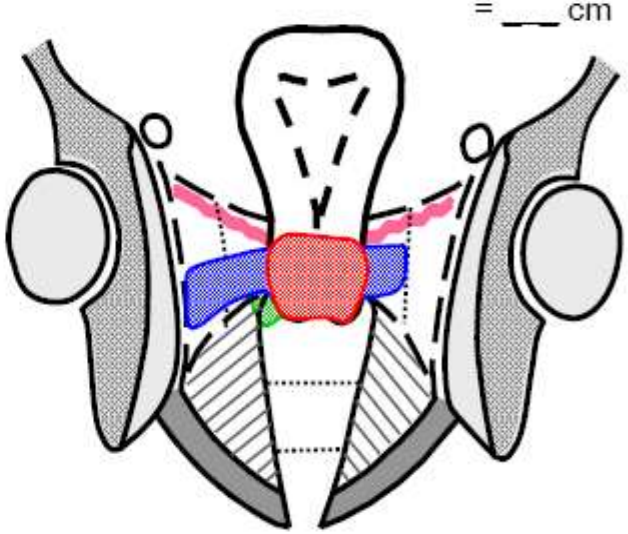
w = ___ cm

h = ___ cm

t = ___ cm

Vagina Involvement = ___ cm





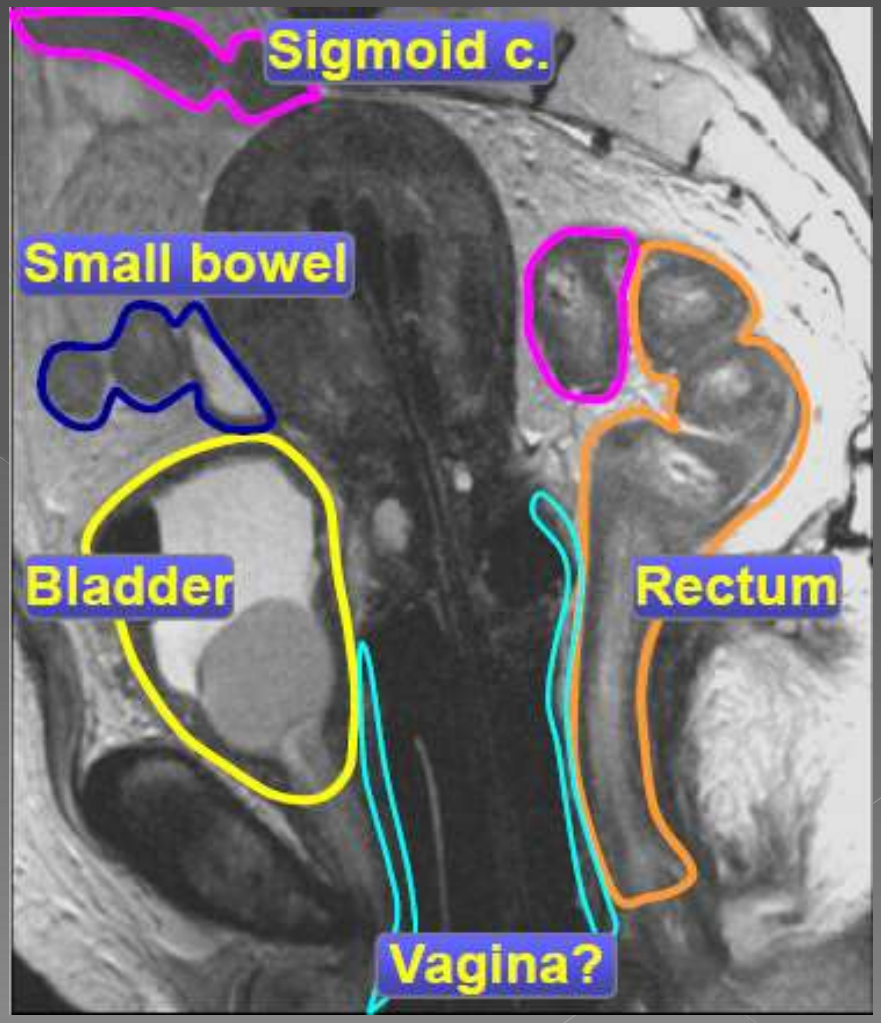
dd/mm/yy

___/___/___

Signature

Organs at Risk

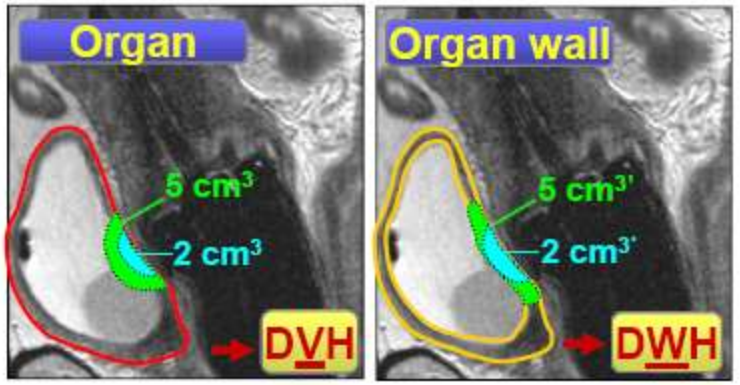
- Urinary bladder
- Rectum (rectosigmoid junction to anus)
- Sigmoid colon
- Small bowel (loops vs space)
- Femoral heads



Contouring OARs for BT

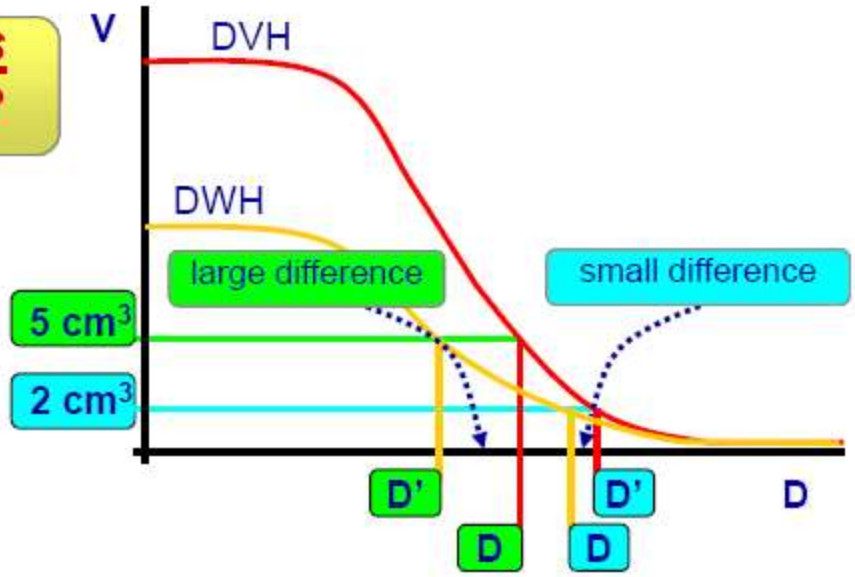
Delineation of OAR

- Modality: CT vs. MRI
- **Organ vs. organ wall**
- Interobserver variation



Can we contour *organs* instead of *organ walls*?

Yes, if doses to 2 cm³ are evaluated.



DVH – dose volume histogram
DWH – dose wall histogram

Wachter-Gerstner N. Radiother Oncol 2003;68:269-276

Post-operative CTV delineation (Small et al)

Target site	Definition
Common iliac lymph nodes	From 7 mm below L4–L5 interspace to level of bifurcation of common iliac arteries into external and internal iliac arteries
External iliac lymph nodes	From level of bifurcation of common iliac artery into external artery to level of superior aspect of femoral head where it becomes femoral artery
Internal iliac lymph nodes	From level of bifurcation of common iliac artery into internal artery, along its branches (obturator, hypogastric) terminating in paravaginal tissues at level of vaginal cuff
Upper vagina	Vaginal cuff and 3 cm of vagina inferior to cuff
Parametrial/paravaginal tissue	From vaginal cuff to medial edge of internal obturator muscle/ischial ramus on each side
Presacral lymph nodes*	Lymph node region anterior to S1and S2 region

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Fig. 1. Upper common iliac clinical target volume.

The CTV should be extended to include any adjacent visible or suspicious lymph nodes, lymphoceles, and pertinent surgical clips. The CTV should also include a minimum of 1.5 cm of soft tissue anterior to the vertebral body at the midline. The CTV should be modified to exclude the vertebral body, psoas muscle, and bowel.

Fig. 2. Mid-common iliac (red) and presacral clinical target volume (blue).

the presacral lymph node coverage should discontinue when the piriformis muscle is clearly visualized (approximately at the inferior border of S2).

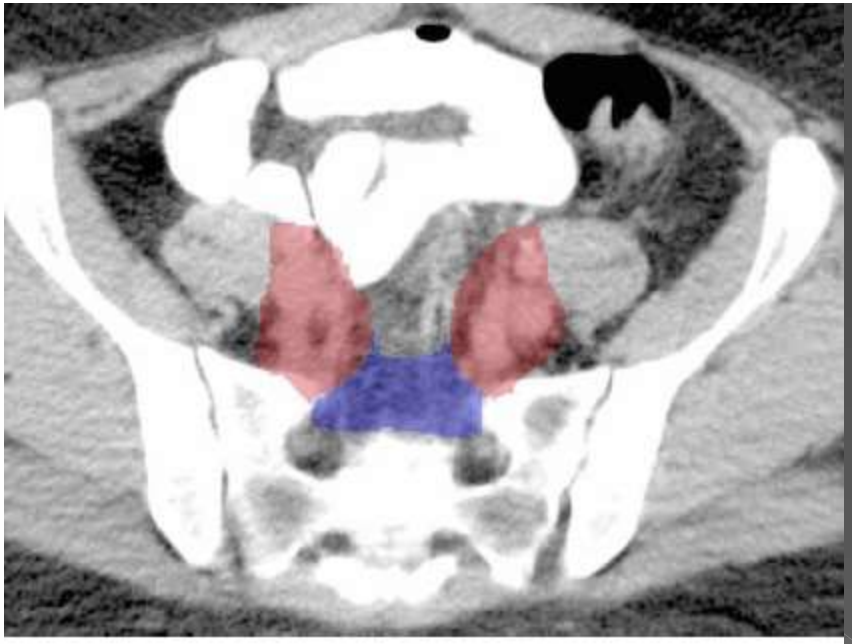

Fig. 3. Lower common iliac (red) and presacral clinical target volume (blue).

Fig. 5. External and internal iliac clinical target volume.

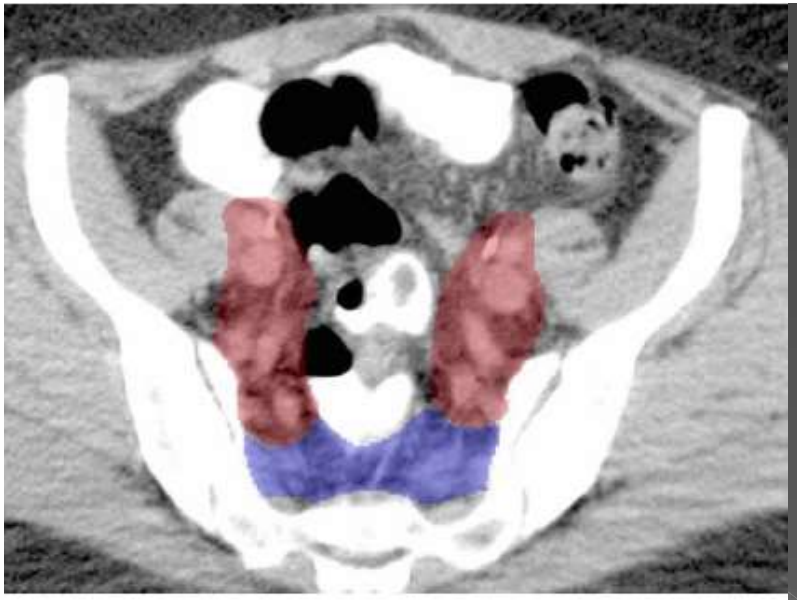

Fig. 4. Upper external and internal iliac (red) and presacral clinical target volume (blue).

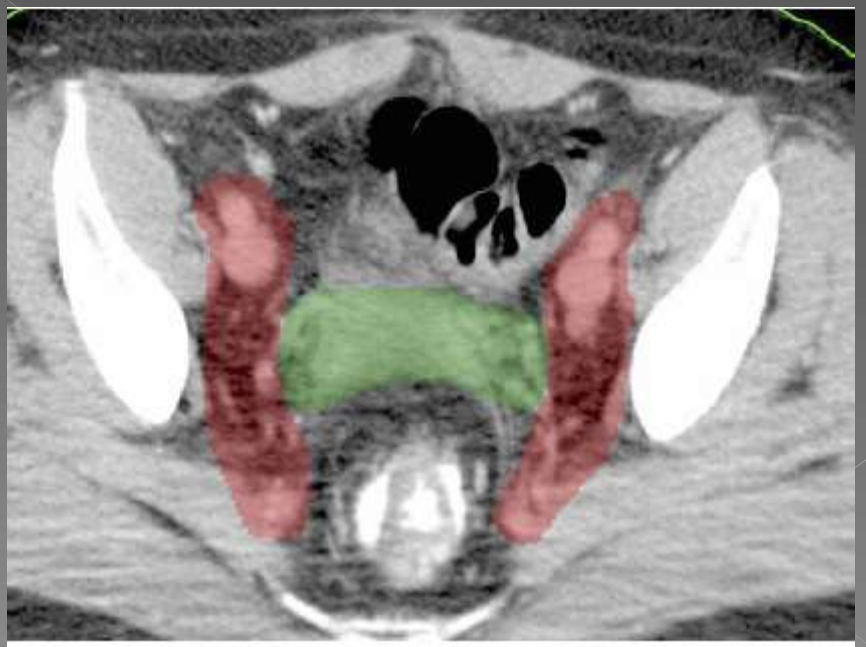

Fig. 6. External and internal iliac (red) and parametrial/vaginal (green) clinical target volume.

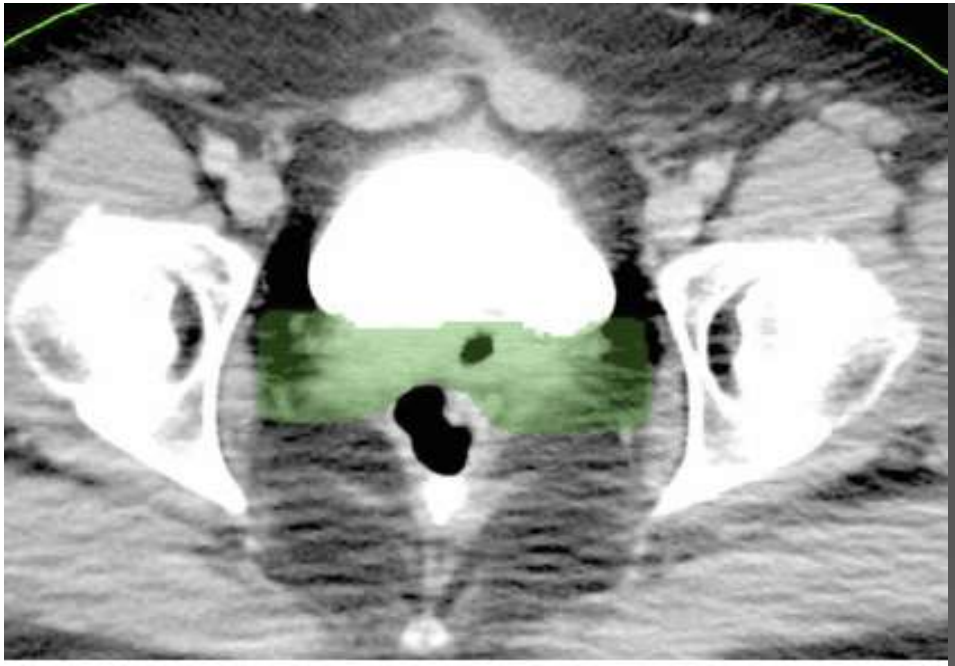

Fig. 7. Parametrial/vaginal clinical target volume.

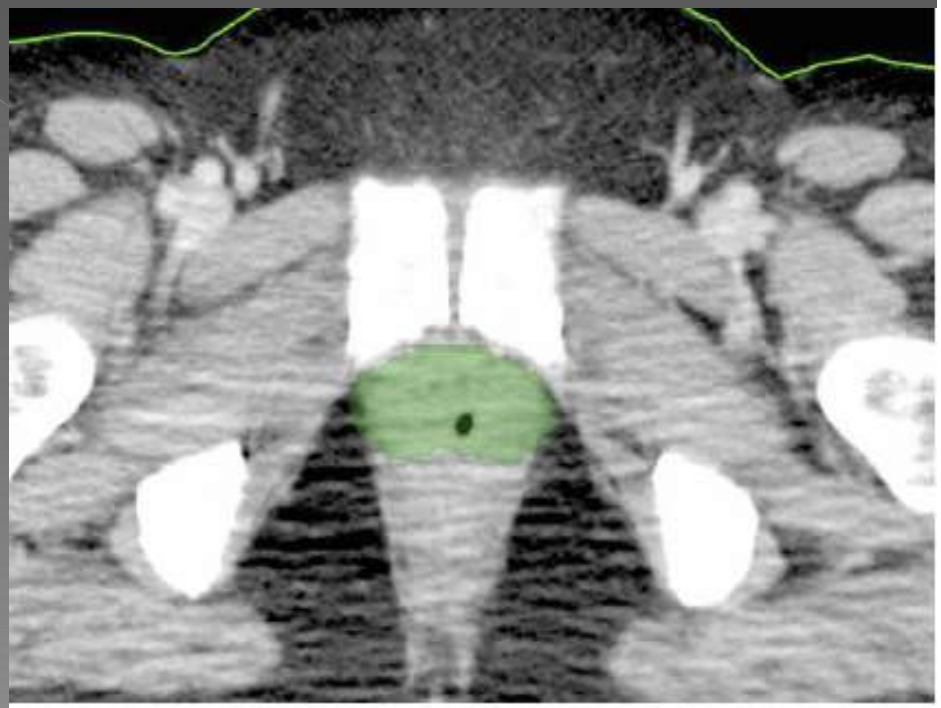

Fig. 8. Vaginal clinical target volume.