

INDICAZIONI NELLA CONTORNAZIONE DEI VOLUMI DI INTERESSE

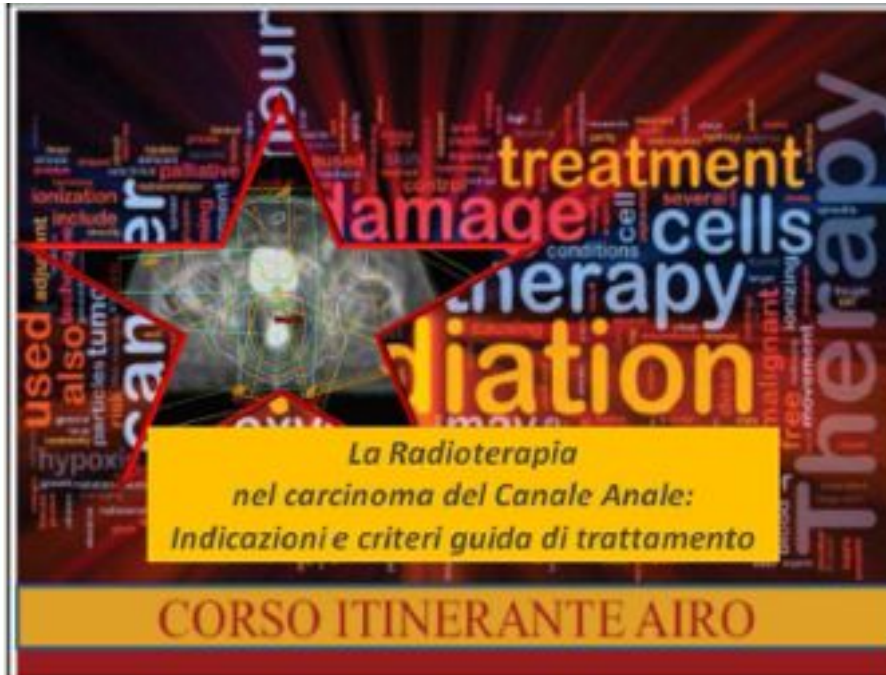
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U.O. Radioterapia sperimentale

Presidio Ospedaliero Oncologico "A. Businco",

ASLCagliari 
SISTEMA SANITARIO DELLA SARDEGNA



Coordinatori:
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Marco Lupattelli, *Vincenzo Fusco*

Sede del corso
- PAVIA: 13 GIUGNO 2014
- PERUGIA: 18 SETTEMBRE 2014
- **RIONERO IN VULTURE : 31 OTTOBRE 2014**





Radiotherapy and Oncology
June 2014 111(3):330–339,

clinical practice guidelines

Anal cancer: ESMO-ESSO-ESTRO Clinical Practice Guidelines for diagnosis, treatment and follow-up†

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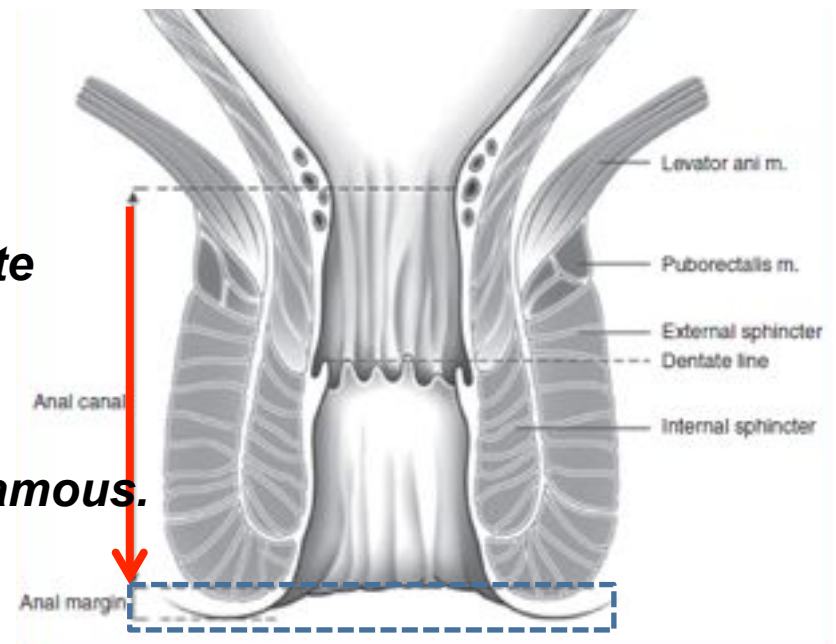
Annals of Oncology 00: 1–11, 2014
doi:10.1093/annonc/ndu159



The anal canal extends from the anorectal junction to the anal margin

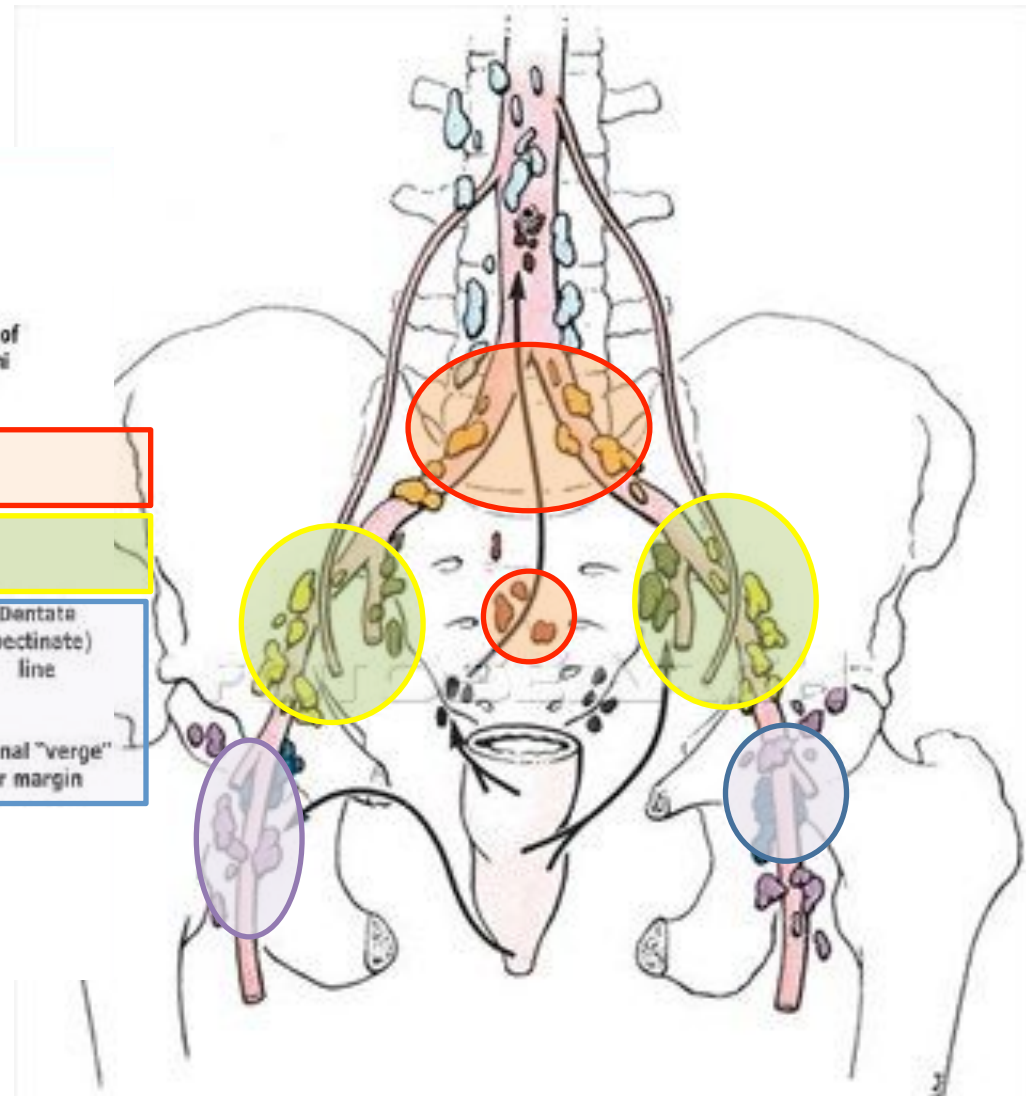
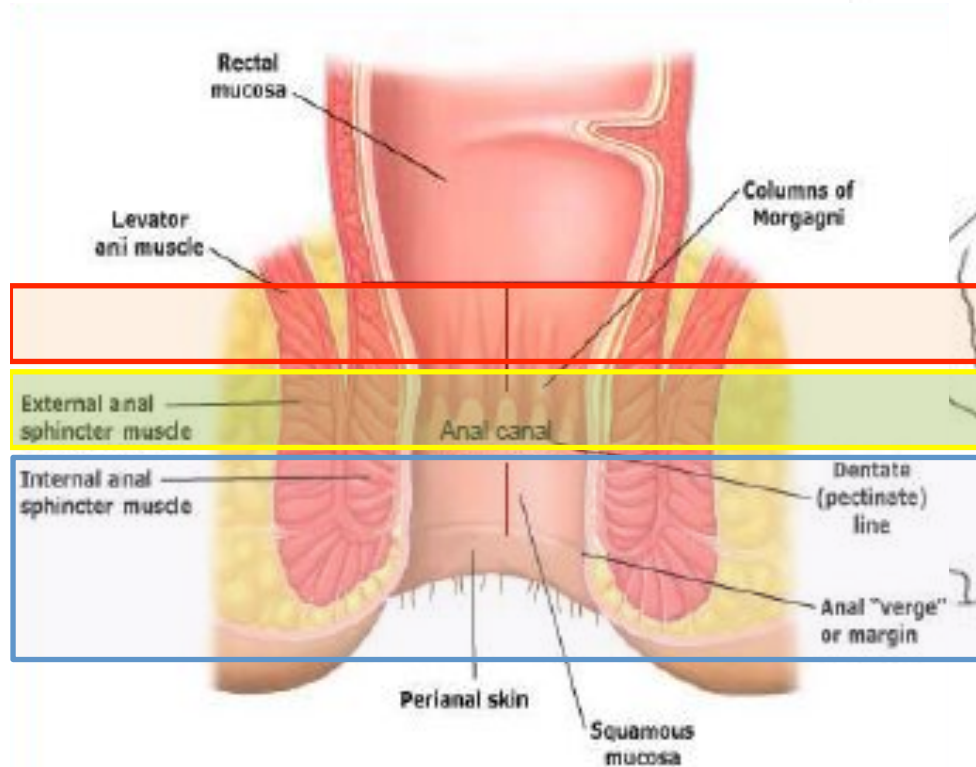
The columnar, or cylindric, epithelium of the rectum extends to about 1 cm above the dentate line where the anal transitional zone begins.

Below the dentate line the epithelium is all squamous.



The anal margin is the pigmented skin immediately surrounding the anal orifice, extending laterally to a radius of approximately 5 cm.

LYMPHATIC PATHWAYS

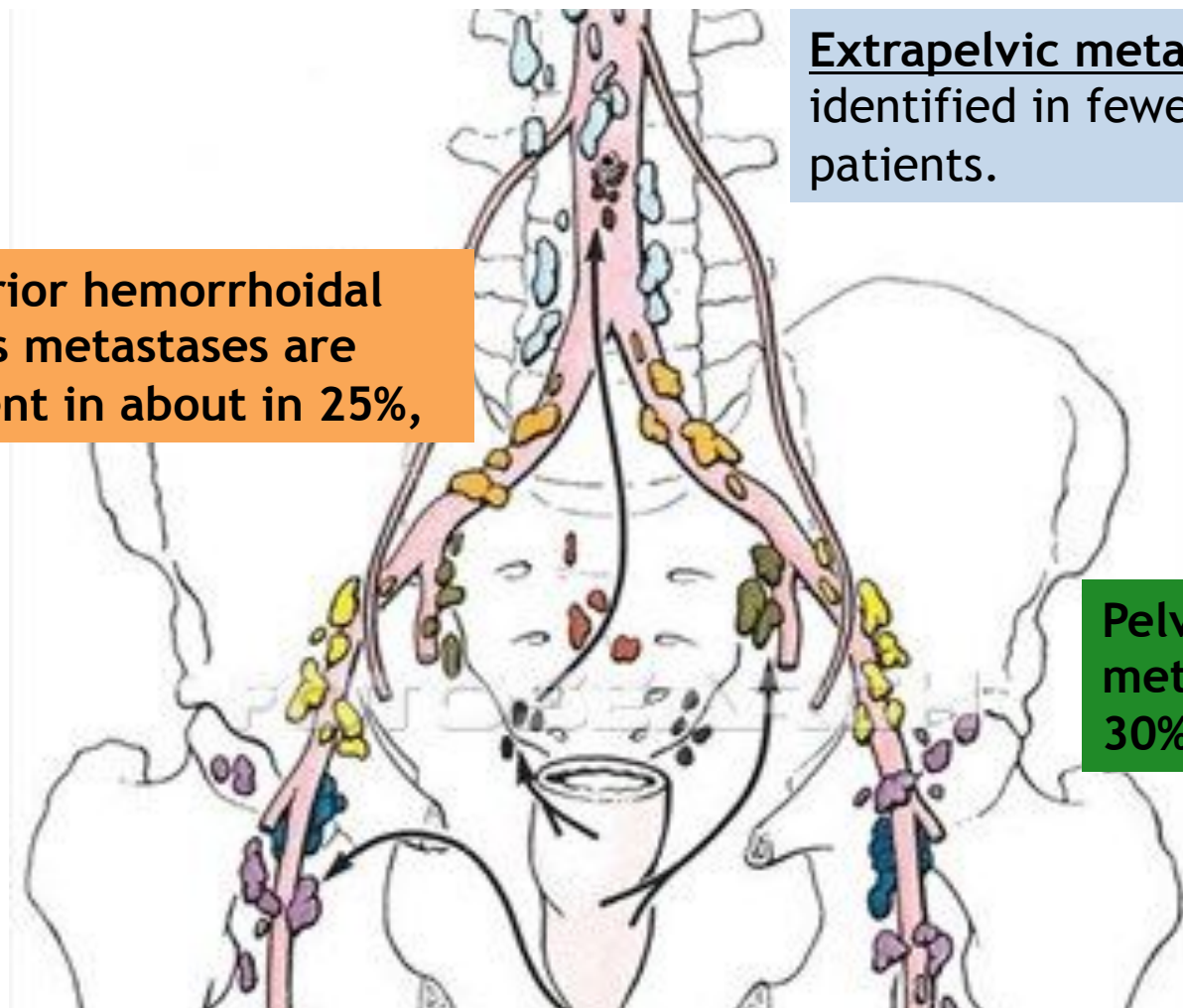


Perirectal, superior hemorrhoidal and inferior mesenteric nodes

Internal pudendal, hypogastric and obturator nodes

Inguinal, femoral and external iliac nodes

The overall risk of regional nodal involvement at diagnosis is about 25%. Pelvic lymph node metastases have been found in as many as 30% of patients treated by abdominoperineal resection.



Extrapelvic metastases are identified in fewer than 10% of patients.

Superior hemorrhoidal nodes metastases are present in about 25%,

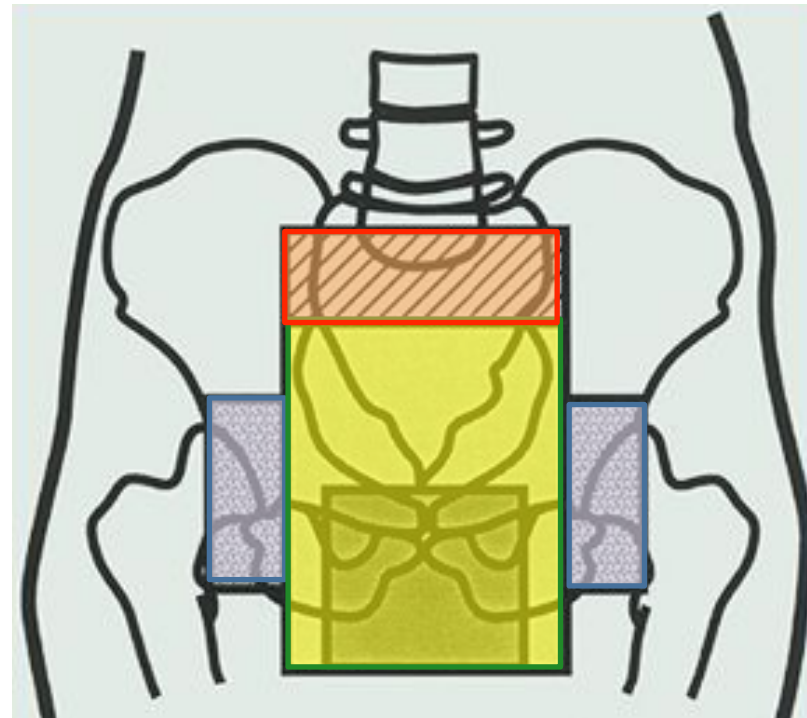
Pelvic nodes metastases in 30%

Inguinal metastases are clinically detectable in up to 20% of patients at initial diagnosis and are present subclinically in a further 10% to 20%.

Only well-differentiated squamous cell cancers ≤ 2 cm in size situated in the distal canal appear to have a risk of nodal metastases $< 5\%$.

The finding in surgical series of histopathologically verified metastases in the **pararectal and internal iliac nodes in up to 30%** and in **inguinal nodes in up to 20%** has encouraged most centers to irradiate these node groups electively.

**As a result,
planning target volumes
may be extensive.**



PATTERNS OF RECURRENCE

LRF:

78% occurring locally in the primary site

44% within the pelvis or inguinal nodes

56% had local-only failure,

22% had both local and regional failure,

22% had regional-only failure.

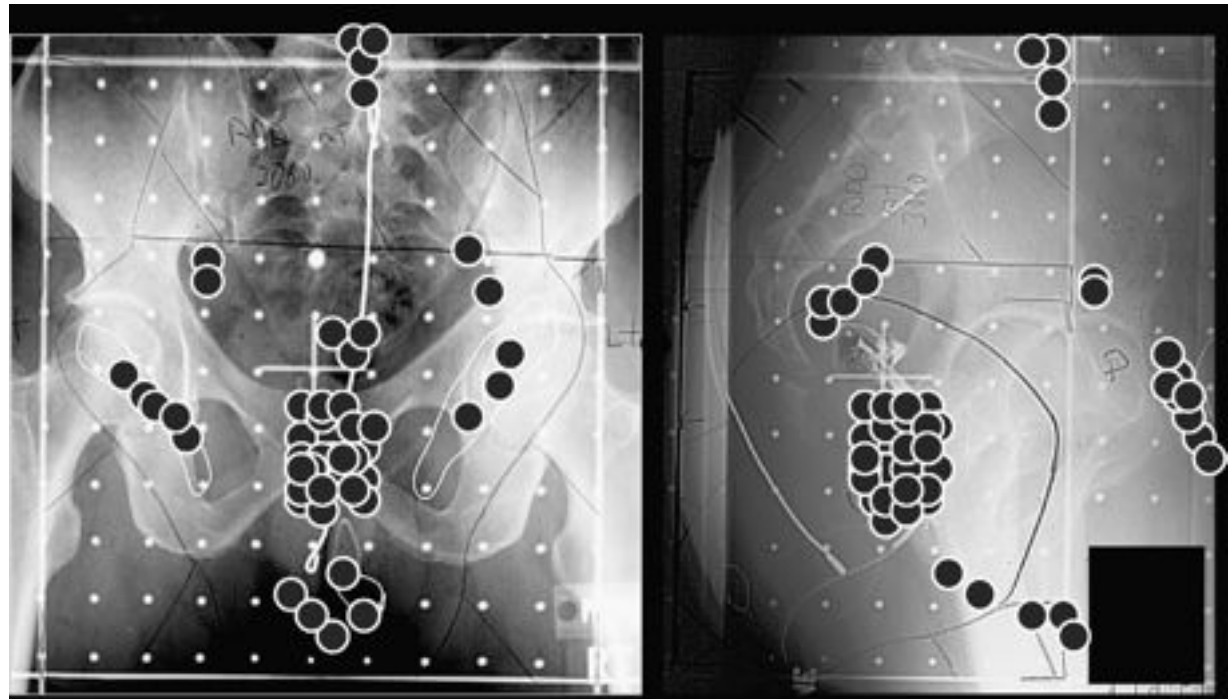
180 SCCAC patients, retrospectively reviewed
(173 patients mitomycin-based CHT-RT)

January 1990 - March 2007

Memorial Sloan-Kettering Cancer Center

Median primary tumor dose = 45 Gy

3-year LRF = 23%.

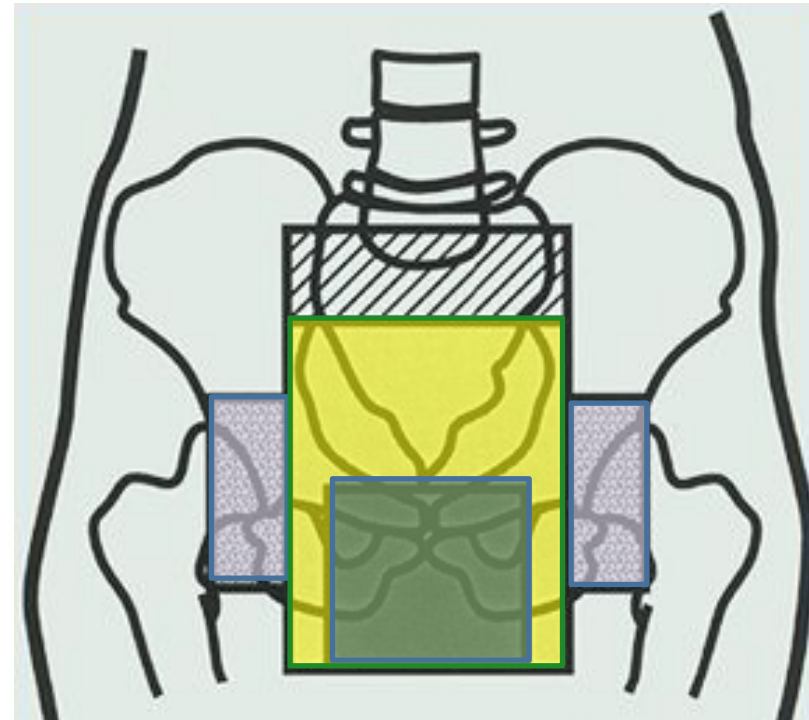


PATTERNS OF RECURRENCE

167 SCCAC patients CHT-RT

September 1992 and August 2004
M. D. Anderson Cancer Center

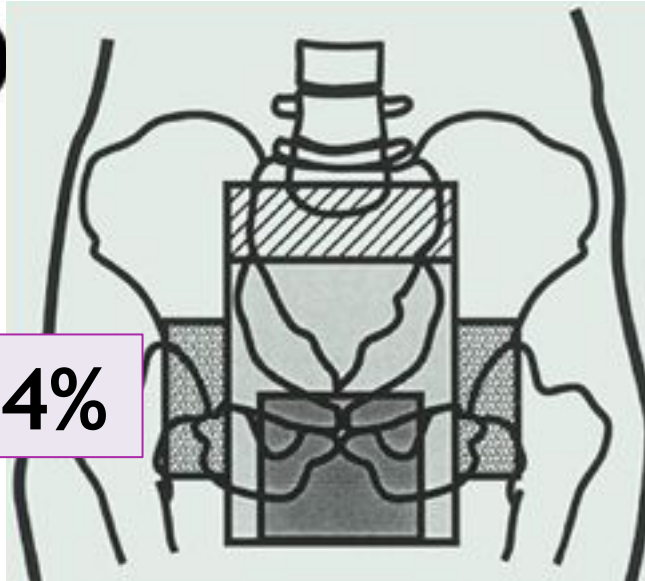
Median primary tumor dose = 55 Gy
LRF=14%
estimated 3-year LRC = 81%.



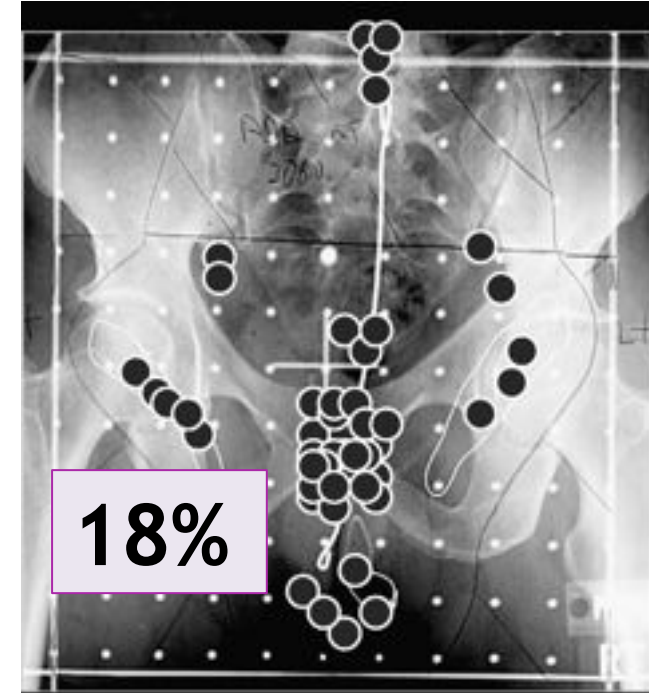
Site	Number of failures (%)
Anus/rectum	18 (75)
Presacral/iliac	5 (21)
Inguinal	1 (4)



Critical issues



4%



18%

This difference may be related to the higher dose delivered to involved inguinal nodes in study of Das P. et al (55 Gy) vs the prescribed dose to the inguinal nodes in all inguinal failures in the study of Wright et al. was 45 Gy.

J. L. Wright et al, Int. J. Radiation Oncology Biol. Phys. 2010

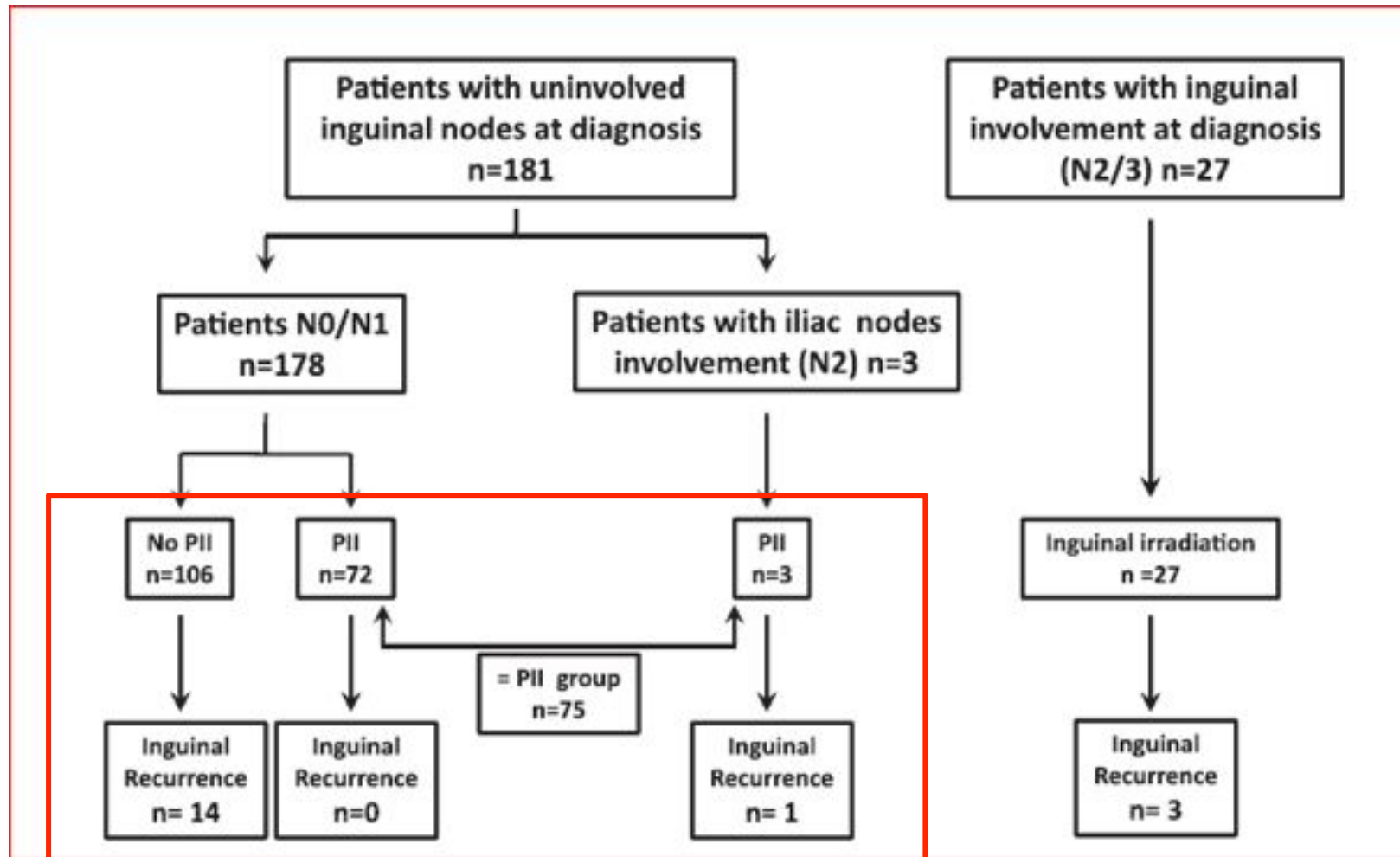
P. Das et al, Int. J. Radiation Oncology Biol. Phys. 2007

PROPHYLACTIC INGUINAL IRRADIATION

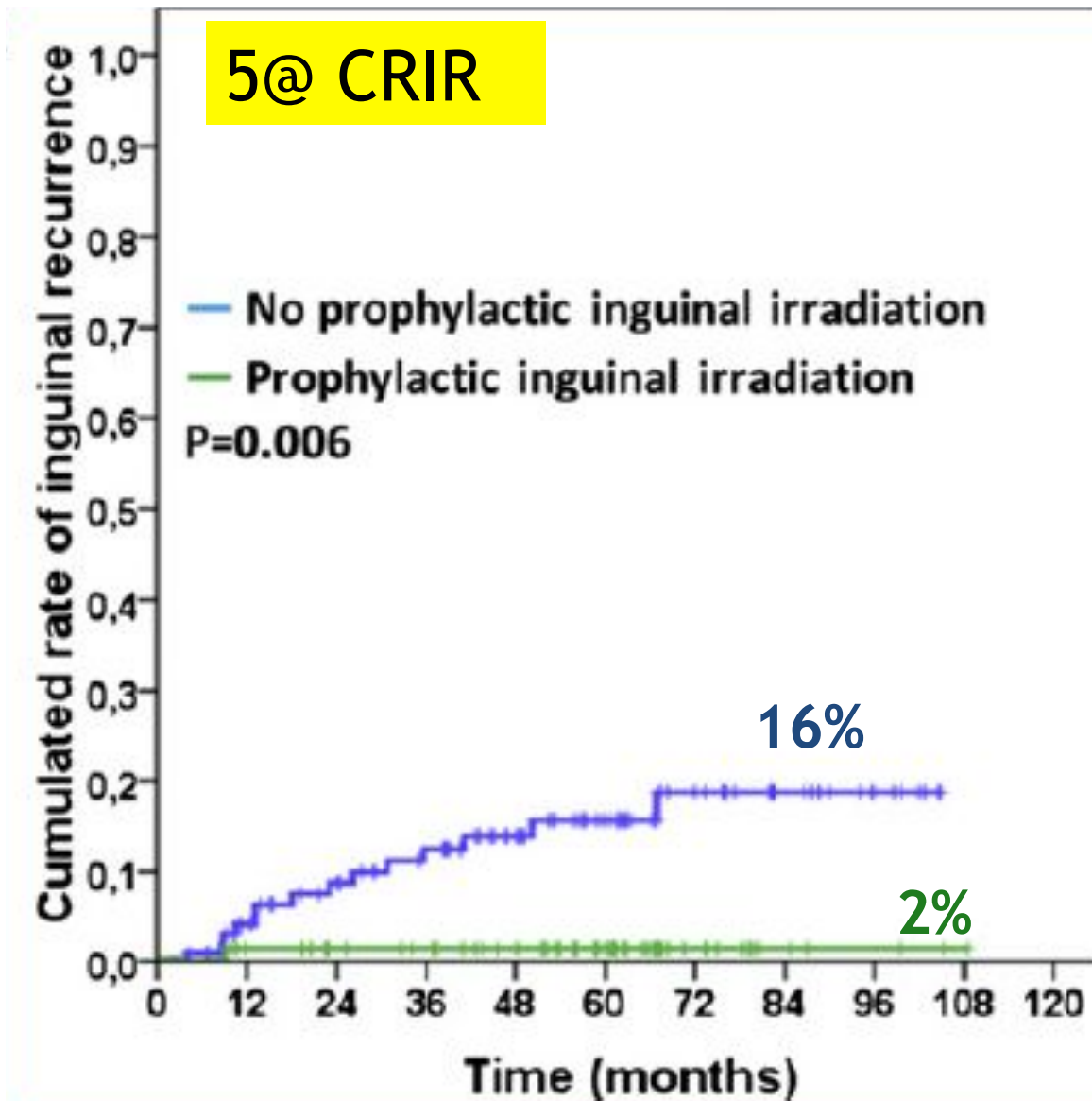
retrospective study of 208 SCCAC patients

2000-2004

PII dose = 45 -50 Gy



PROPHYLACTIC INGUINAL IRRADIATION



In the PII group, no Grade >2 toxicity of the lower extremity was observed

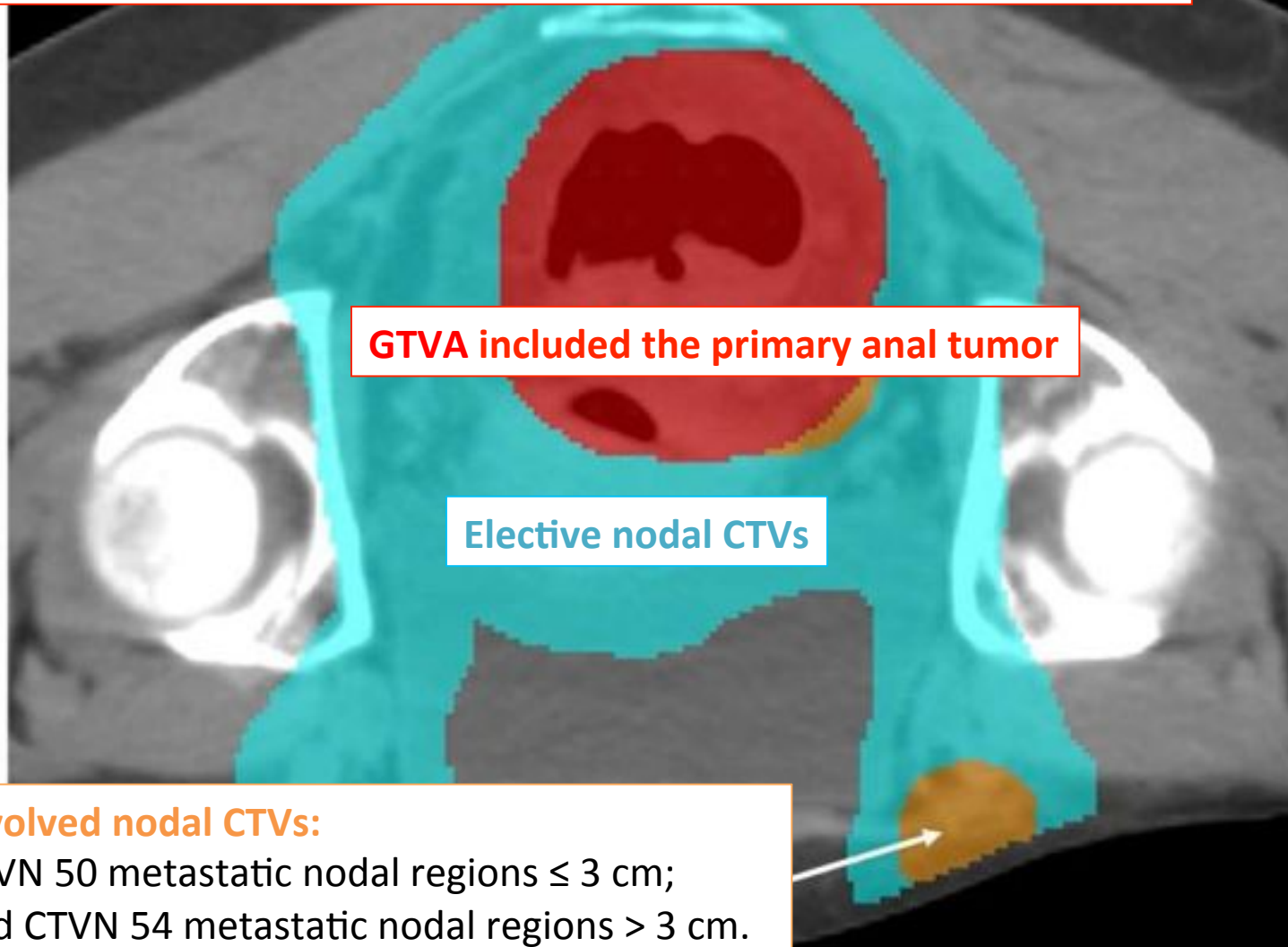
In the no PII group, the 5-year CRIR was 12% and 30% for T1-T2 and T3-T4 respectively ($p = 0.02$).

Clinical Investigation: Gastrointestinal Cancer

RTOG 0529: A Phase 2 Evaluation of Dose-Painted Intensity Modulated Radiation Therapy in Combination With 5-Fluorouracil and Mitomycin-C for the Reduction of Acute Morbidity in Carcinoma of the Anal Canal



Kachnic LA, Winter K, Myerson RJ, et al. Int J Radiat Oncol Biol Phys. 2013



GTVA included the primary anal tumor

Elective nodal CTVs

Involved nodal CTVs:

CTVN 50 metastatic nodal regions ≤ 3 cm;
and CTVN 54 metastatic nodal regions > 3 cm.

Clinical Investigation: Gastrointestinal Cancer

RTOG 0529: A Phase 2 Evaluation of Dose-Painted Intensity Modulated Radiation Therapy in Combination With 5-Fluorouracil and Mitomycin-C for the Reduction of Acute Morbidity in Carcinoma of the Anal Canal



Kachnic LA, Winter K, Myerson RJ, et al. Int J Radiat Oncol Biol Phys. 2013

Radiation Planning Quality Assurance

Of the 52 DP-IMRT cases, 81% required planning revisions pre-treatment on initial submission, 46% required multiple re-submissions, of which 4 cases never passed. Incorrect investigator contouring included inaccurate delineation of gross tumor (21%), miscontouring of elective nodal volumes (mesorectum 55%, presacrum 43%, inguinal fossa 33%, iliac nodal groups 31%), and/or misidentification of normal structures (small bowel 60%, large bowel 45%). Each DP-IMRT treatment was reviewed for target dose prescription and normal tissue constraint compliance, Table 3. Minor deviations were infrequent for tumor dosing, and 39% experienced minor deviations for small bowel and 22% for femoral head coverage. On final pre-treatment review, there were no major deviations concerning target dosing, and only three cases with normal tissue major deviations (two from investigators who did not attain final pre-treatment plan approval). As such, DP-IMRT was considered reproducible in a cooperative group setting.

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

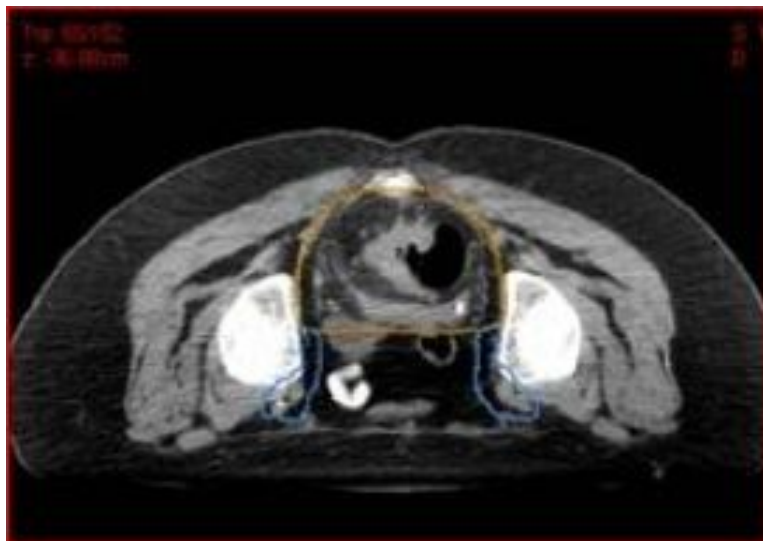


Elective nodal CTVs

CTVA: internal iliac, pre-sacral, peri-rectal.

CTVB: external iliac nodal region

CTVC: inguinal nodal region



LIMITATIONS:

- no clear definition of the different anatomical boundaries

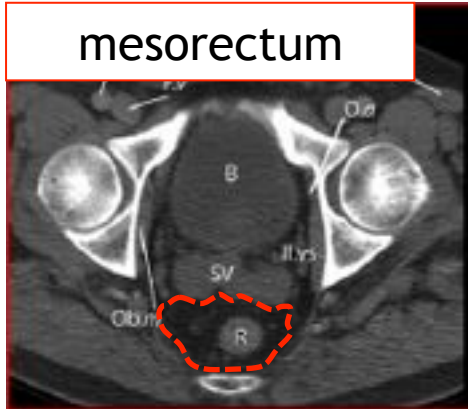
Australasian Gastrointestinal Trials Group (AGITG) Contouring Atlas and Planning Guidelines for Intensity-Modulated Radiotherapy in Anal Cancer



M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

ELECTIVE NODAL VOLUMES

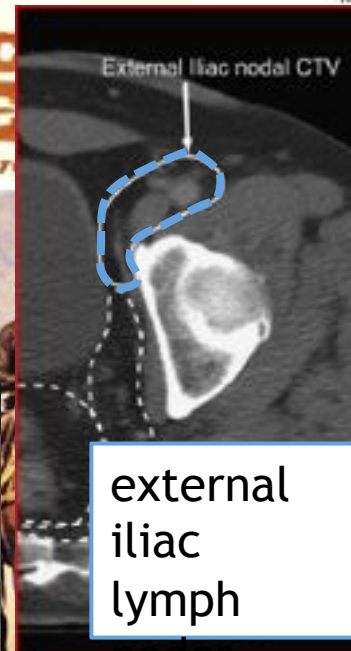
mesorectum



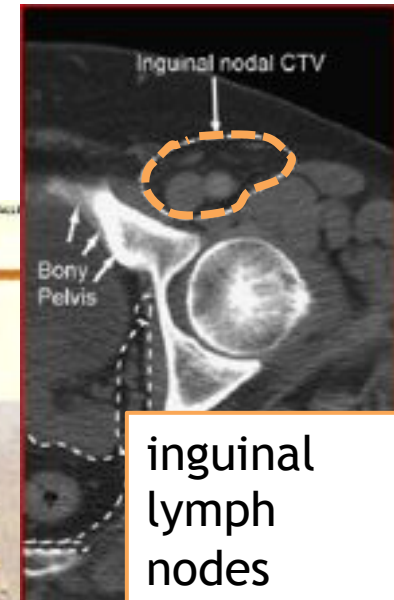
presacral space



External Iliac nodal CTV

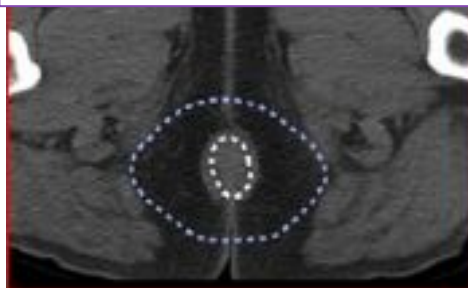


Inguinal nodal CTV

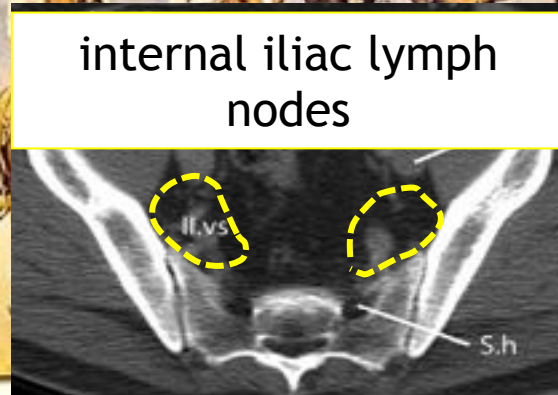


inguinal lymph nodes

ischiorectal fossa



internal iliac lymph nodes



external iliac lymph nodes

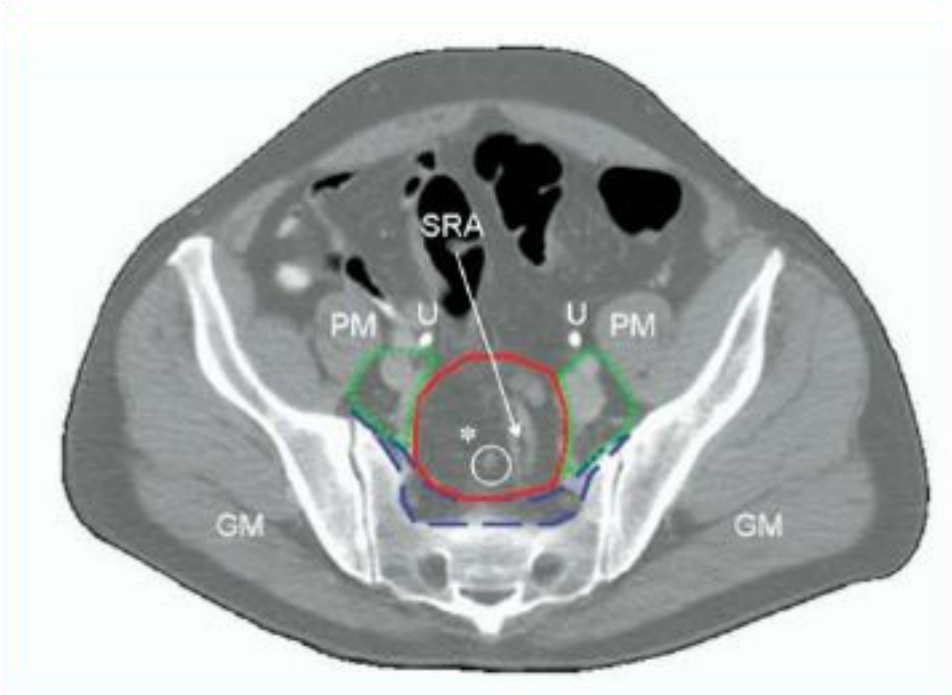
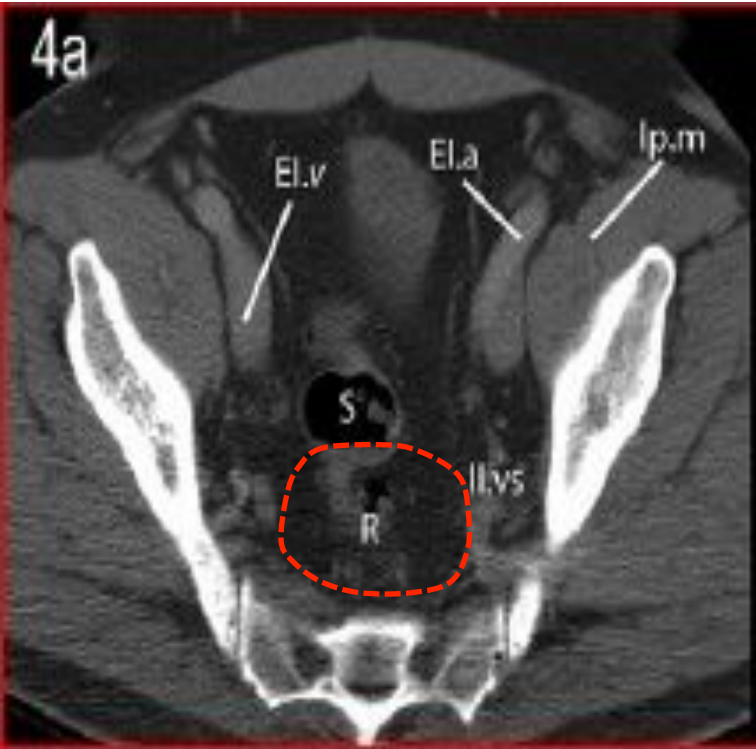


obturator lymph nodes

CTV borders for individual nodal groups

MESORECTUM

Cranial =the recto-sigmoid junction

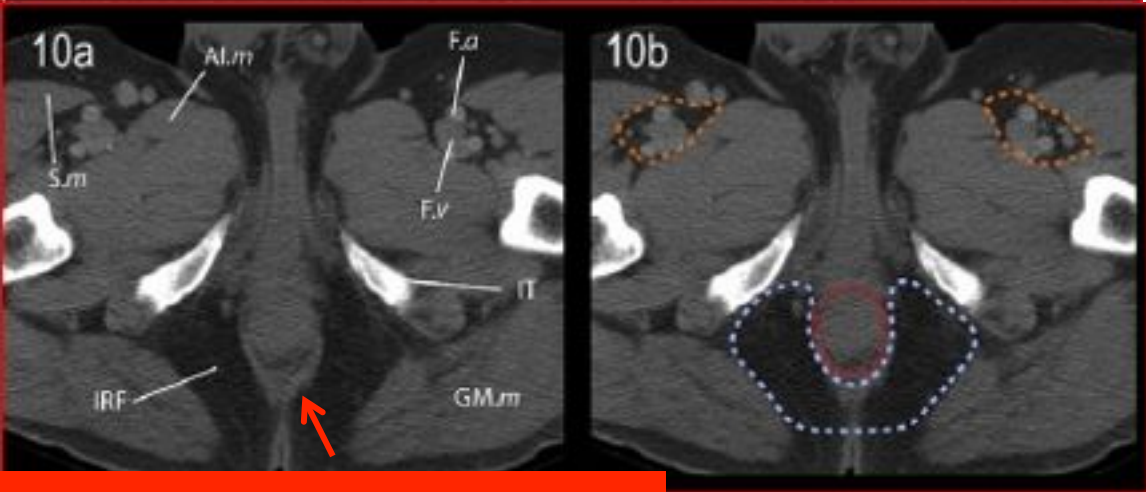
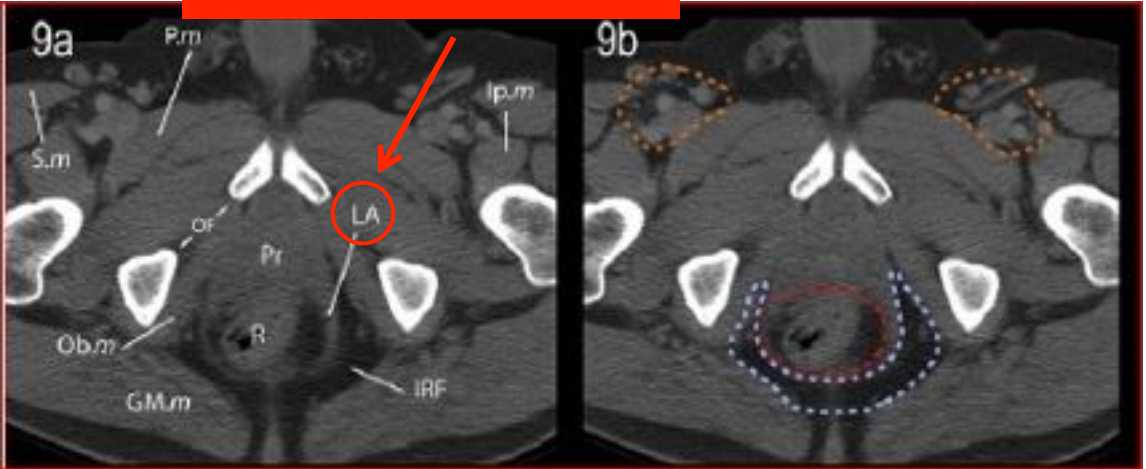


M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012
S. Roels Int. J. Radiation Oncology Biol. Phys., 2006

MESORECTUM

Caudal =the ano-rectal junction

levator ani muscles

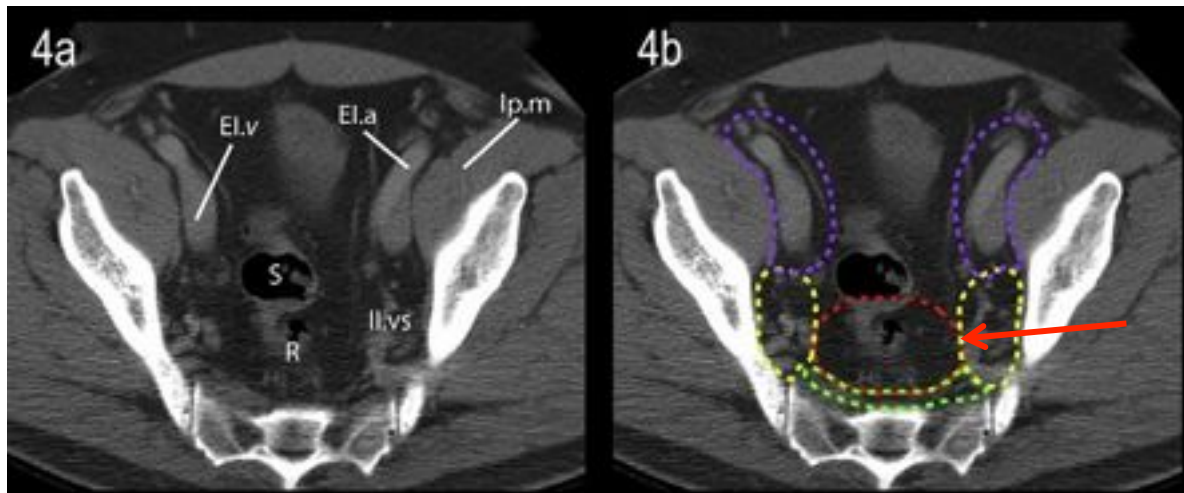


external sphincter muscles

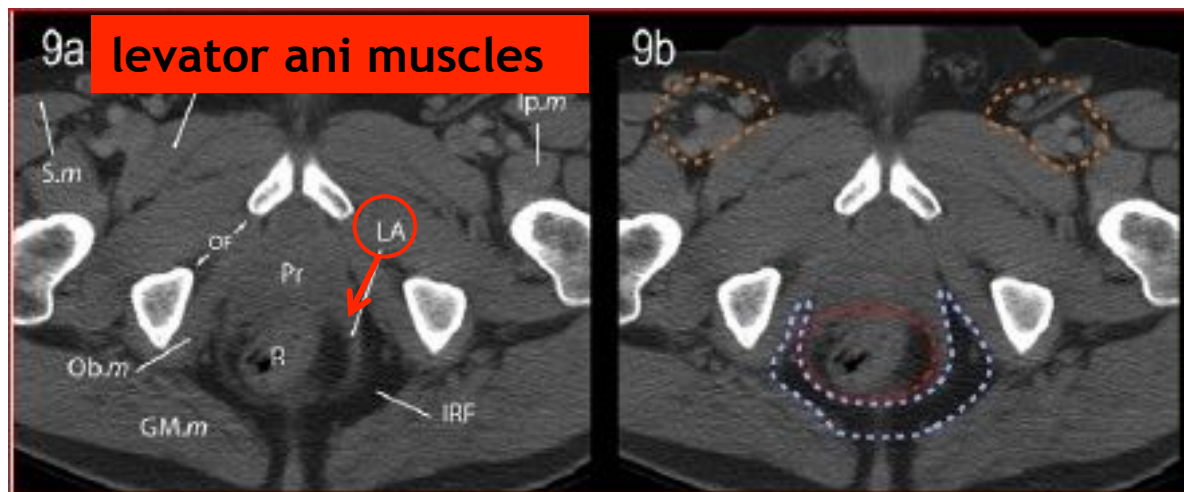


MESORECTUM

Lateral, in the upper pelvis = internal iliac lymph node group

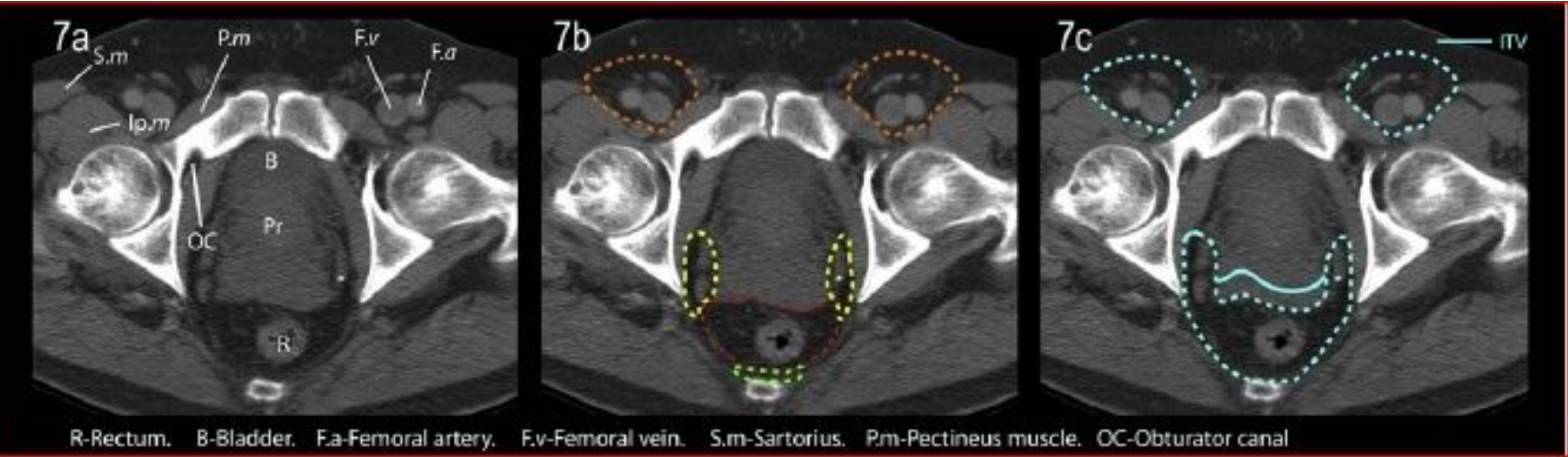


Lateral, in the lower pelvis = the border is the medial edge of the levator ani.



MESORECTUM

Anterior =For males, the penile bulb and prostate in the lower pelvis, and by the posterior edge of the seminal vesicles (SV) and bladder in the mid pelvis.
In females, the boundary is formed by the bladder, vagina, cervix, and uterus.

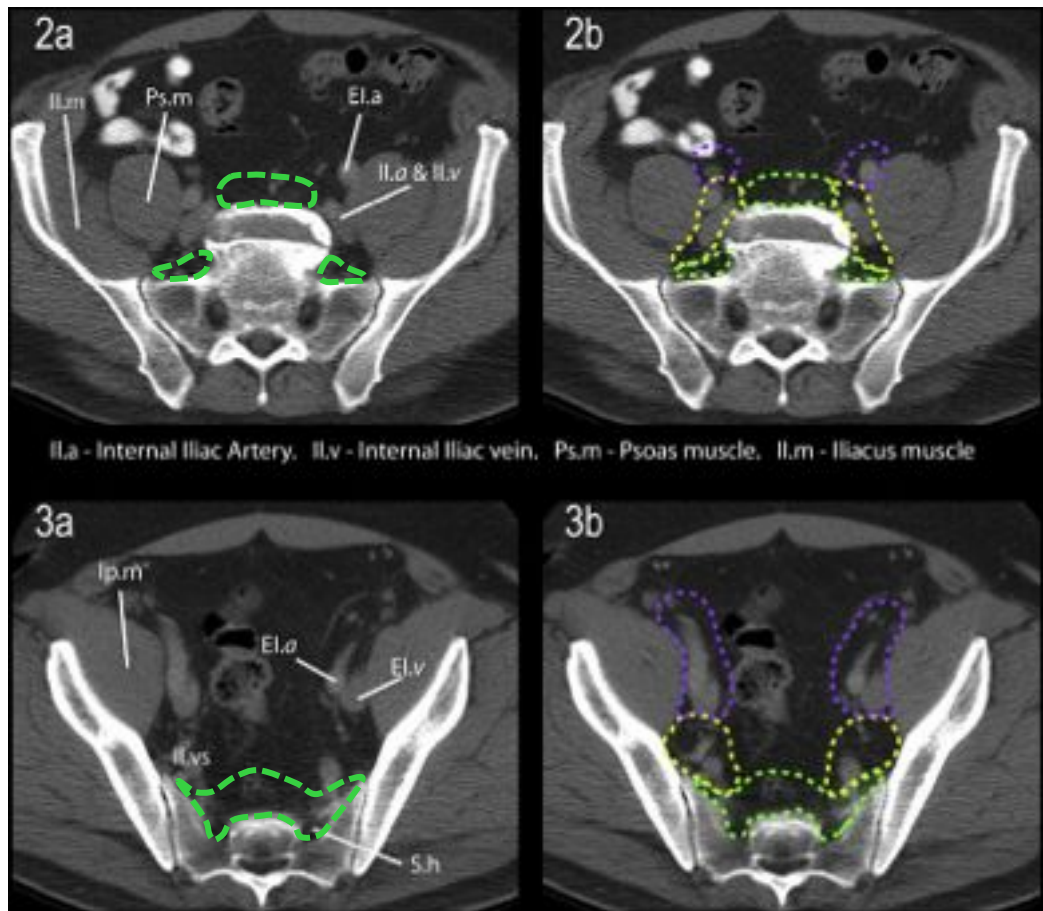
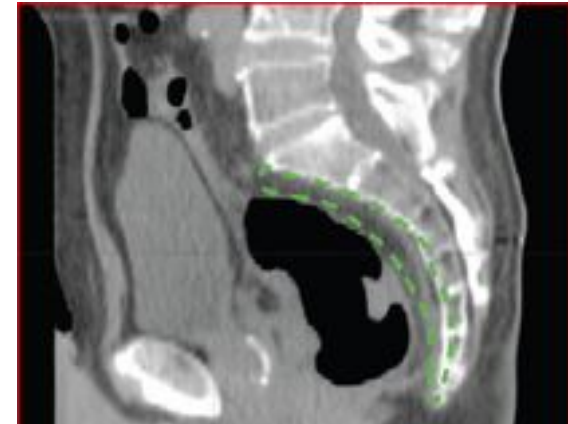


Posterior =The presacral space

PRESACRAL SPACE

Cranial: The sacral promontory.

Caudal: The inferior edge of the coccyx



Il.a - Internal Iliac Artery. Il.v - Internal Iliac vein. Ps.m - Psoas muscle. Il.m - Iliacus muscle

Lateral: The sacro-iliac joints.

Anterior: 10 mm anterior to the anterior sacral border.

Posterior: The anterior border of the sacral bone.

Taylor A et al. Clin Oncol (R Coll Radiol). 2007

M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

ISCHIORECTAL FOSSA

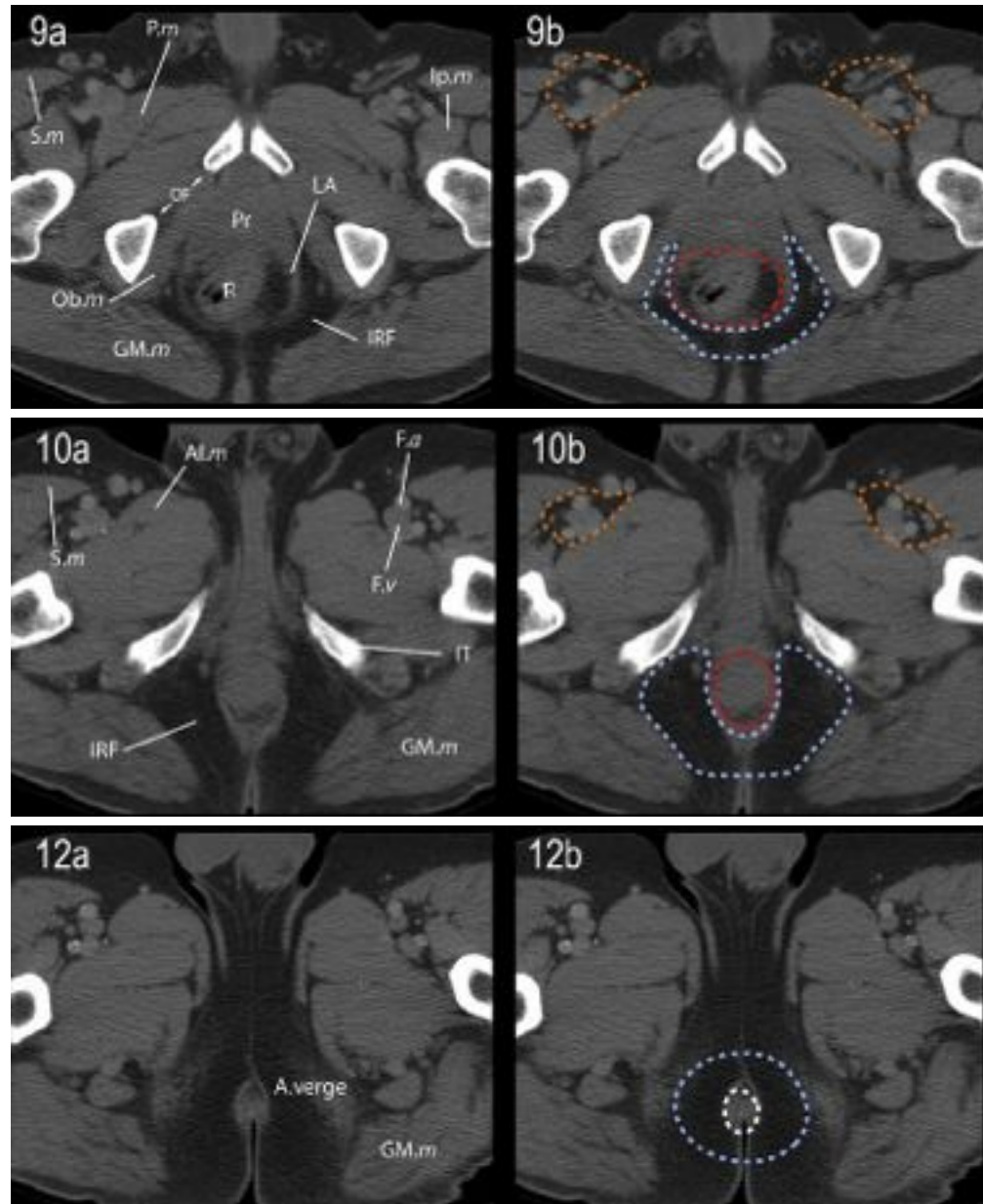
Cranial = levator ani, gluteus maximus, and obturator internus

Anterior = at the level where the obturator internus muscle, levator ani, and anal sphincter muscles fuse. Inferiorly, at least 10- to 20-mm anterior to the sphincter muscles.

Posterior = a transverse plane joining the anterior edge of the medial walls of the gluteus maximus muscle.

Lateral = ischial tuberosity, obturator internus, and gluteus maximus muscles

Caudal = at the level of the anal verge



An Atlas of the Pelvic Lymph Node Regions to Aid Radiotherapy Target Volume Definition

A. Taylor*, A. G. Rockall†, M. E. B. Powell*

*Department of Radiotherapy, St Bartholomew's Hospital, London, UK; †Department of Radiology, St Bartholomew's Hospital, London, UK

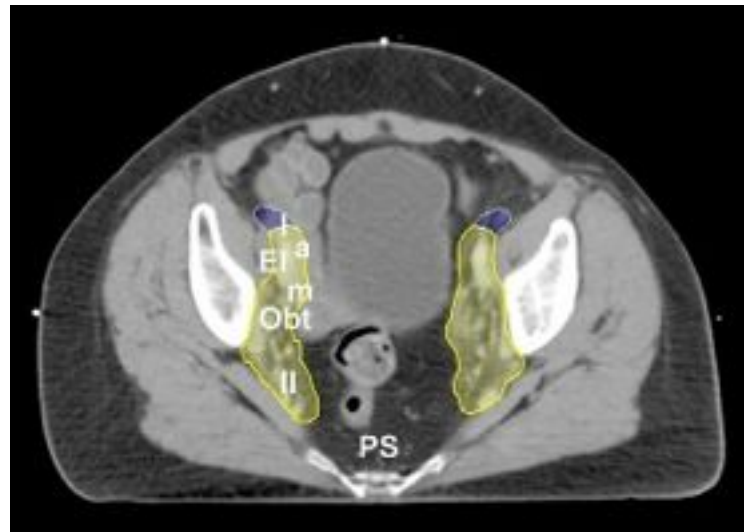


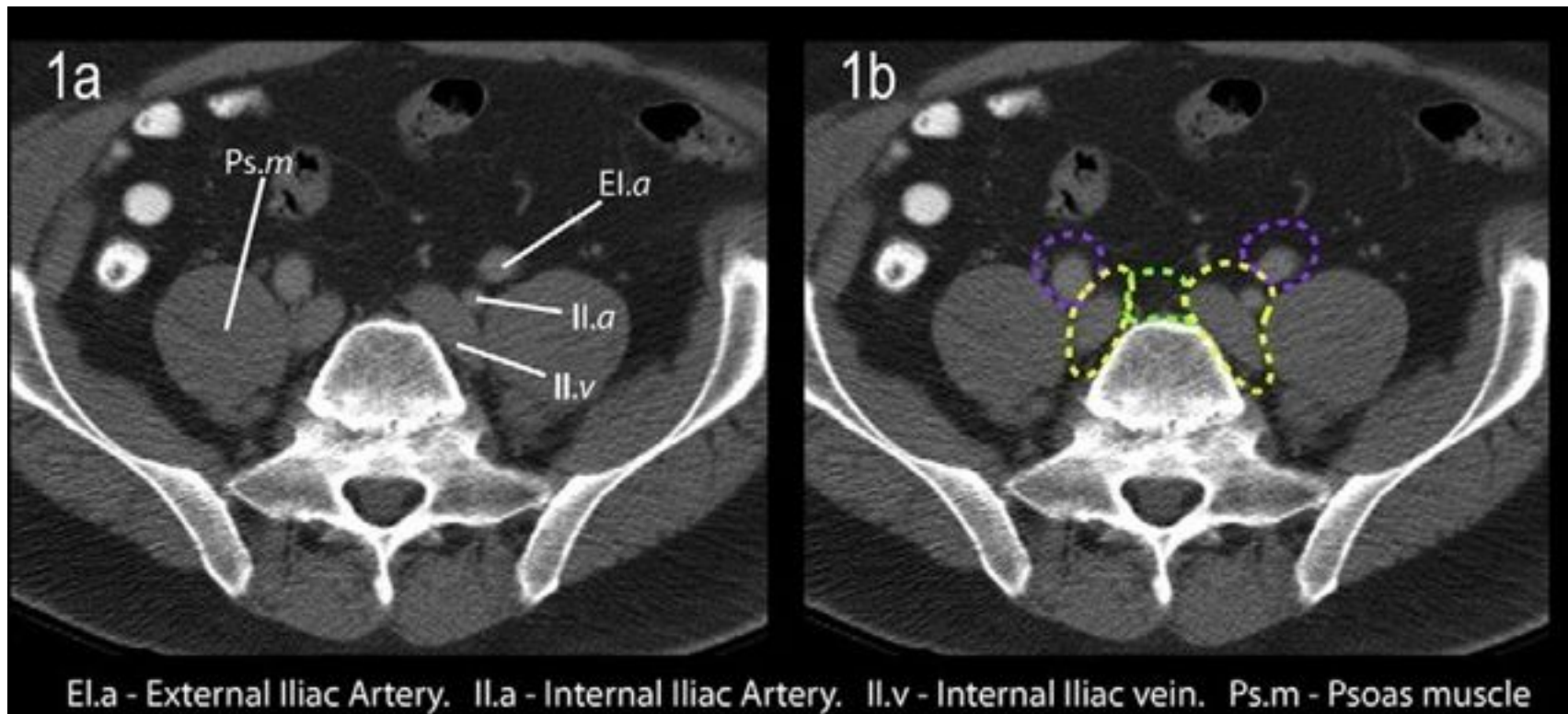
Table 1 – Summary of the guidelines for delineating nodal regions

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

*Also include any visible nodes.

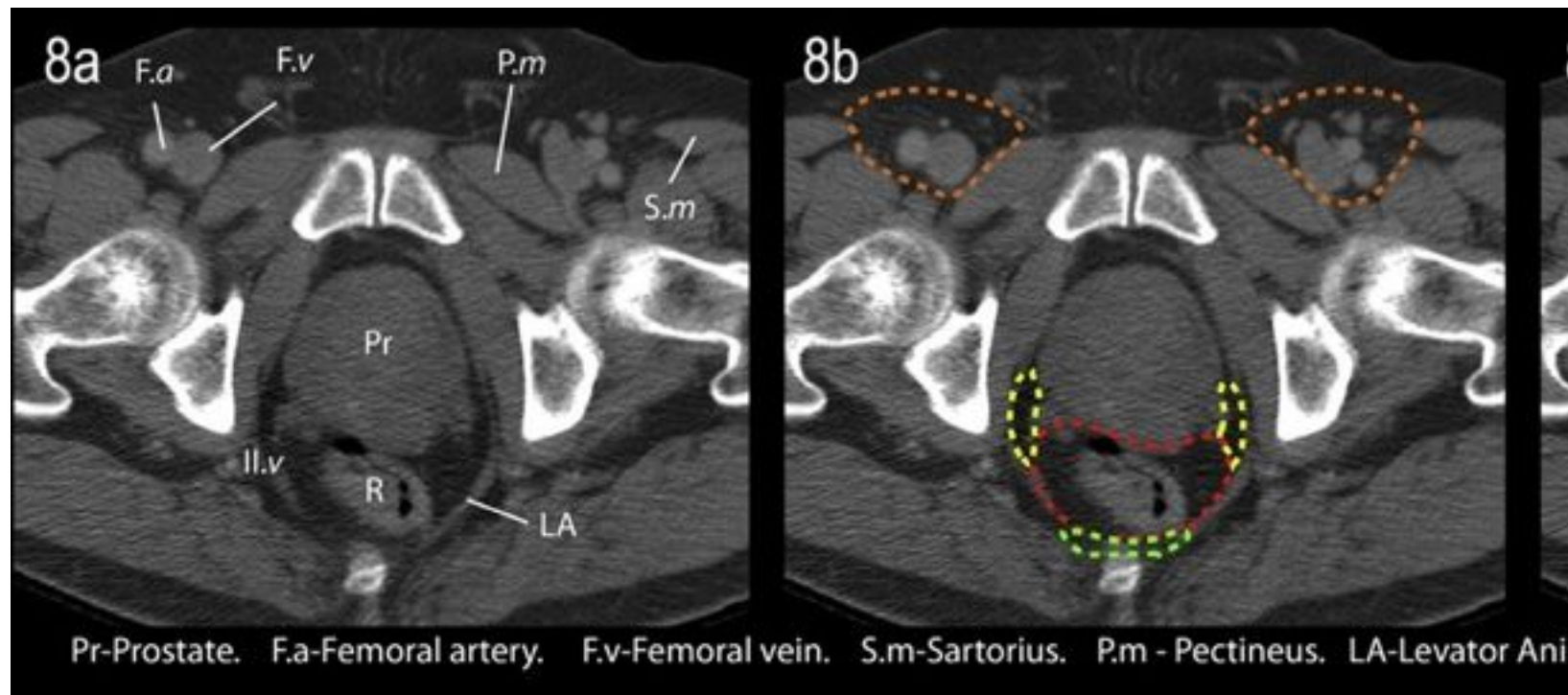
INTERNAL ILIAC LYMPH NODES

Cranial = Bifurcation of the common iliac artery into the external and internal iliac arteries (usually corresponds to the L5-S1 interspace level).



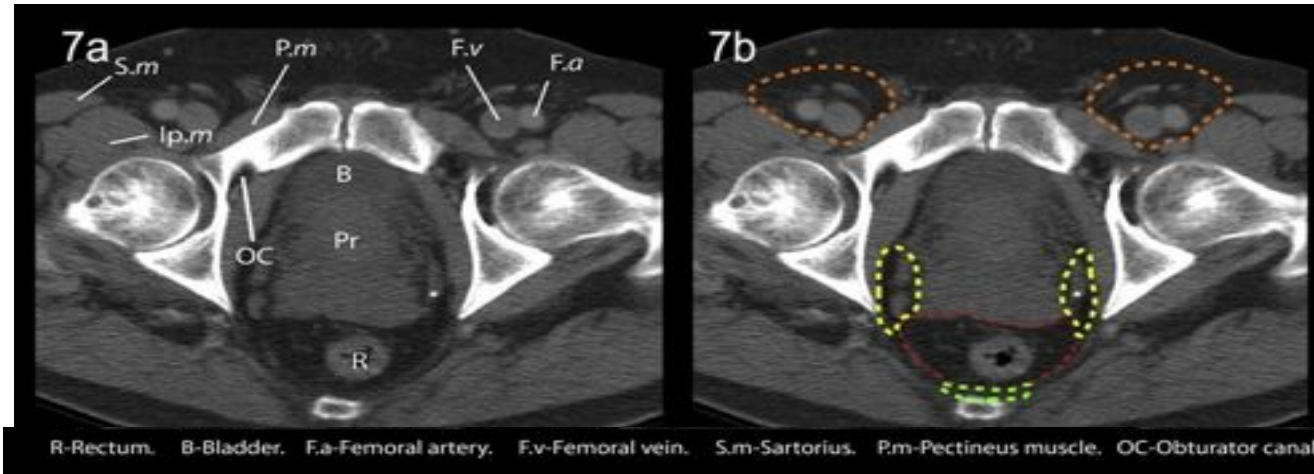
INTERNAL ILIAC LYMPH NODES

Caudal = where the fibers of the levator ani insert into the obturator fascia and obturator internus muscle, at the level of the obturator canal, or at the level where there is no space between the obturator internus muscle and the midline organs (bladder, SV)

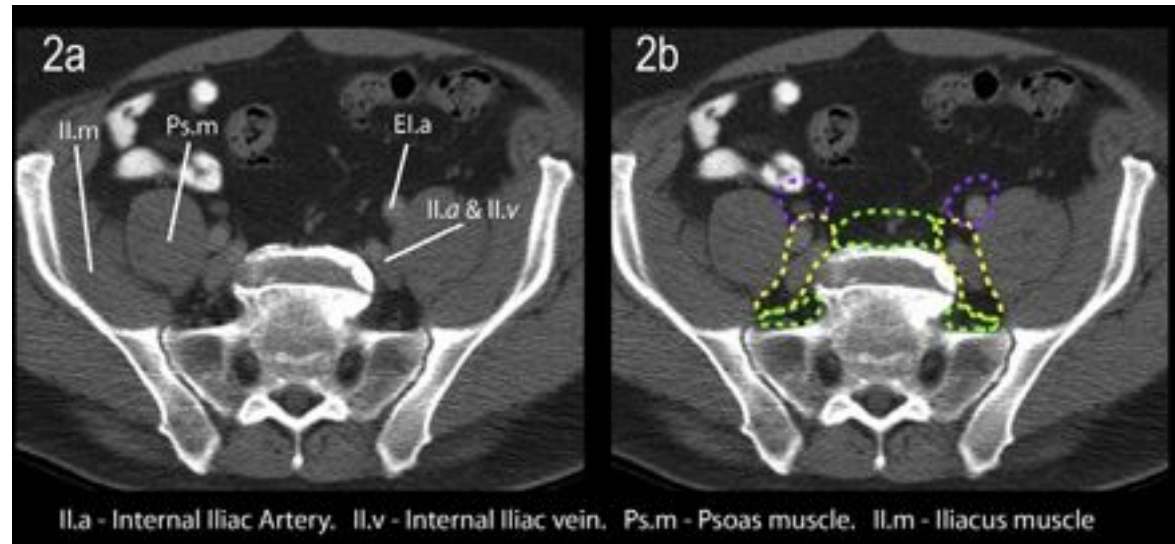


INTERNAL ILIAC LYMPH NODES

Lateral in the lower pelvis = The medial edge of the obturator internus muscle (or bone where the obturator internus is not present)



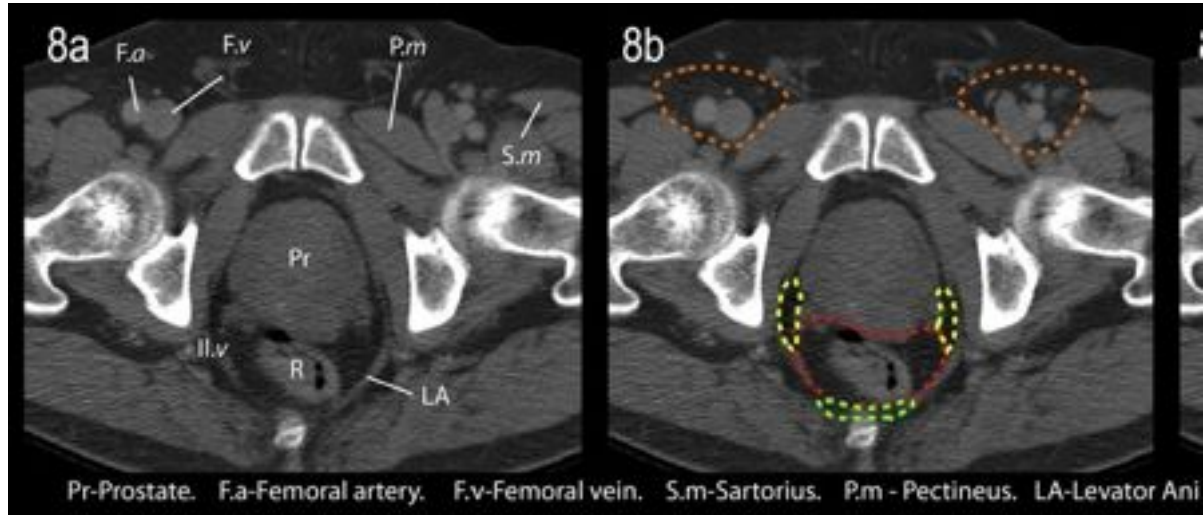
Lateral in the upper pelvis = the iliopsoas muscle in.



INTERNAL ILIAC LYMPH NODES

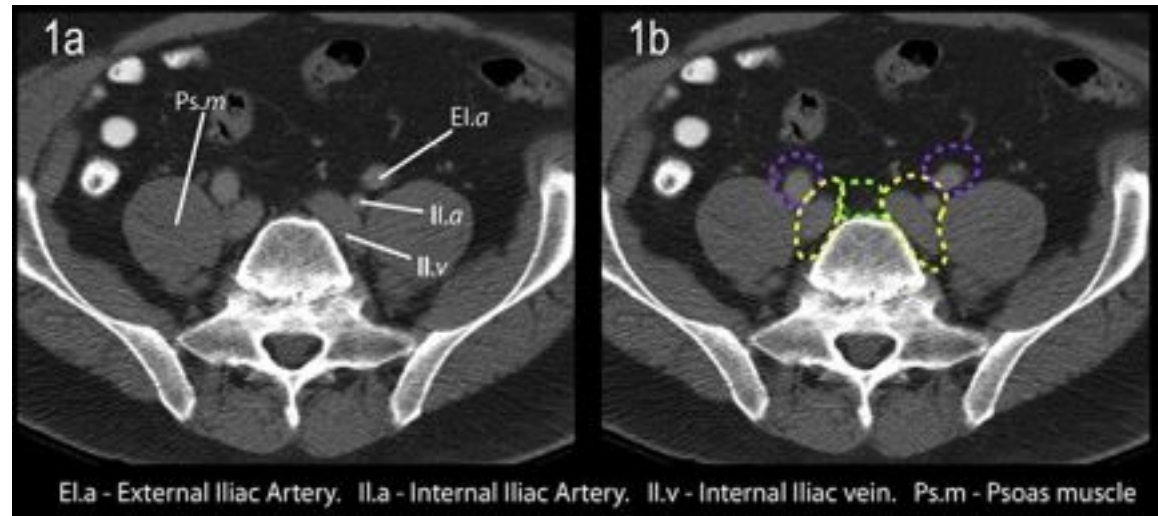
Medial in the lower pelvis = the mesorectum and the presacral space.

Medial in the upper pelvis = the internal iliac vessels + 7 mm medial margin



Anterior in the lower pelvis = the obturator internus muscle or bone.

Anterior in the upper pelvis = the internal iliac vessels + 7 mm medial margin

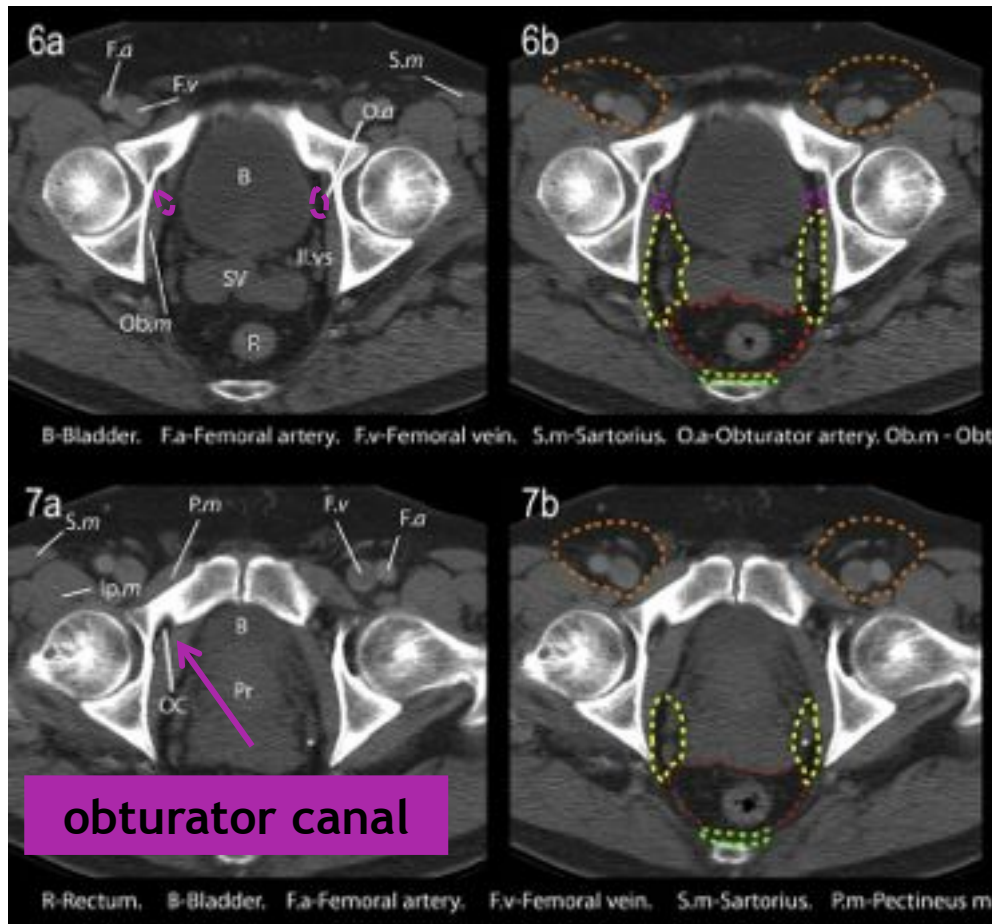


Taylor A et al. Clin Oncol (R Coll Radiol). 2007

M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

OBTURATOR LYMPH NODES

Along the obturator artery, a branch of the internal iliac artery that usually starts at the level of the acetabulum, and exits via the obturator canal.



Cranial = 3 to 5 mm cranial to the obturator ca where the obturator artery is sometimes visible.

Caudal = The obturator canal, where the obturator artery has exited the pelvis.

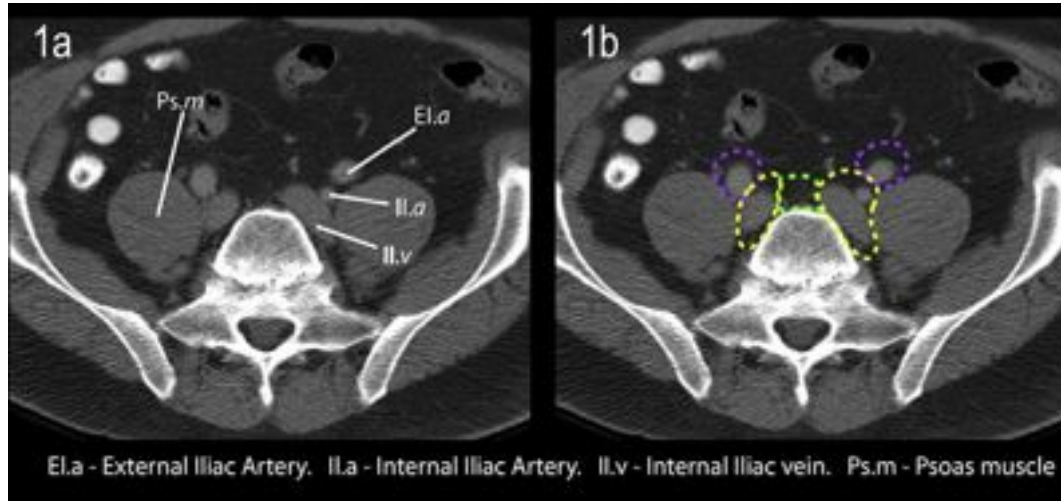
Anterior = The anterior extent of the obturator internus muscle.

Posterior = The internal iliac lymph node group

Lateral = The obturator internus muscle.

Medial = The bladder.

EXTERNAL ILIAC LYMPH NODES



Cranial = Bifurcation of the common iliac artery into the external and internal iliac arteries.

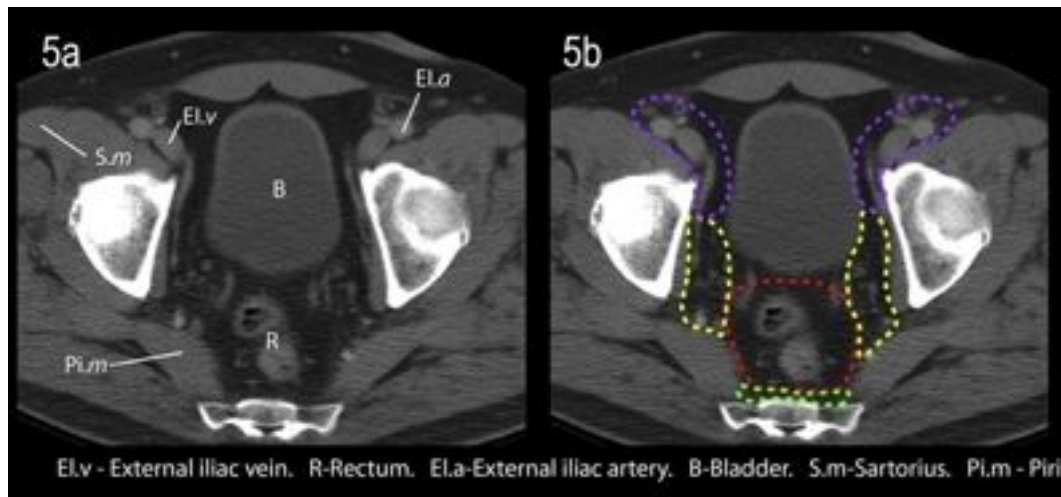
Lateral = The iliopsoas muscle

Medially = the bladder or a 7-mm margin around the vessels

Anterior = A 7-mm margin anterior to the external iliac vessels

Posterior = The internal iliac lymph node group

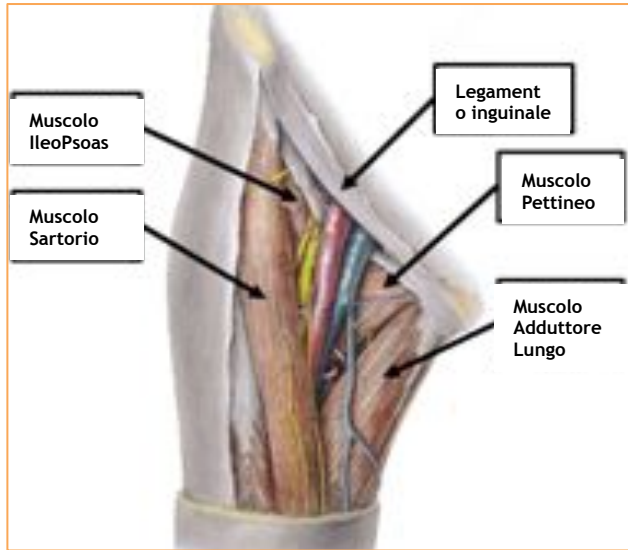
Caudal = The level where the external iliac vessels are still located within the bony pelvis before continuing as the femoral. This transition usually occurs between the acetabulum's roof and the superior pubic rami



Taylor A et al. Clin Oncol (R Coll Radiol). 2007

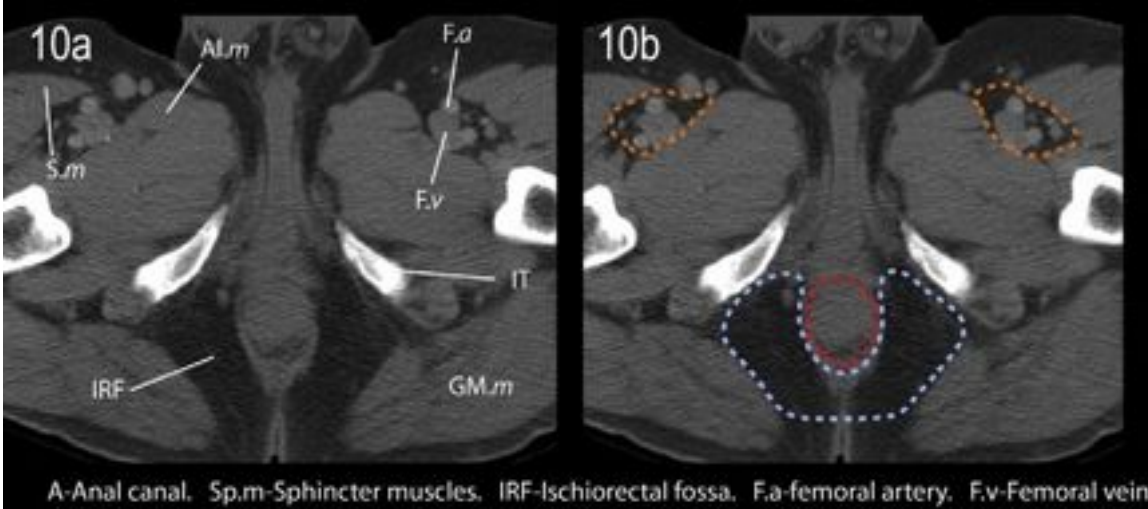
M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

INGUINAL LYMPH NODES



Caudal = lower edge of the ischial tuberosities

Cranial =The level where the external iliac artery leaves the bony pelvis to become the femoral artery.



Taylor A et al. Clin Oncol (R Coll Radiol). 2007
M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

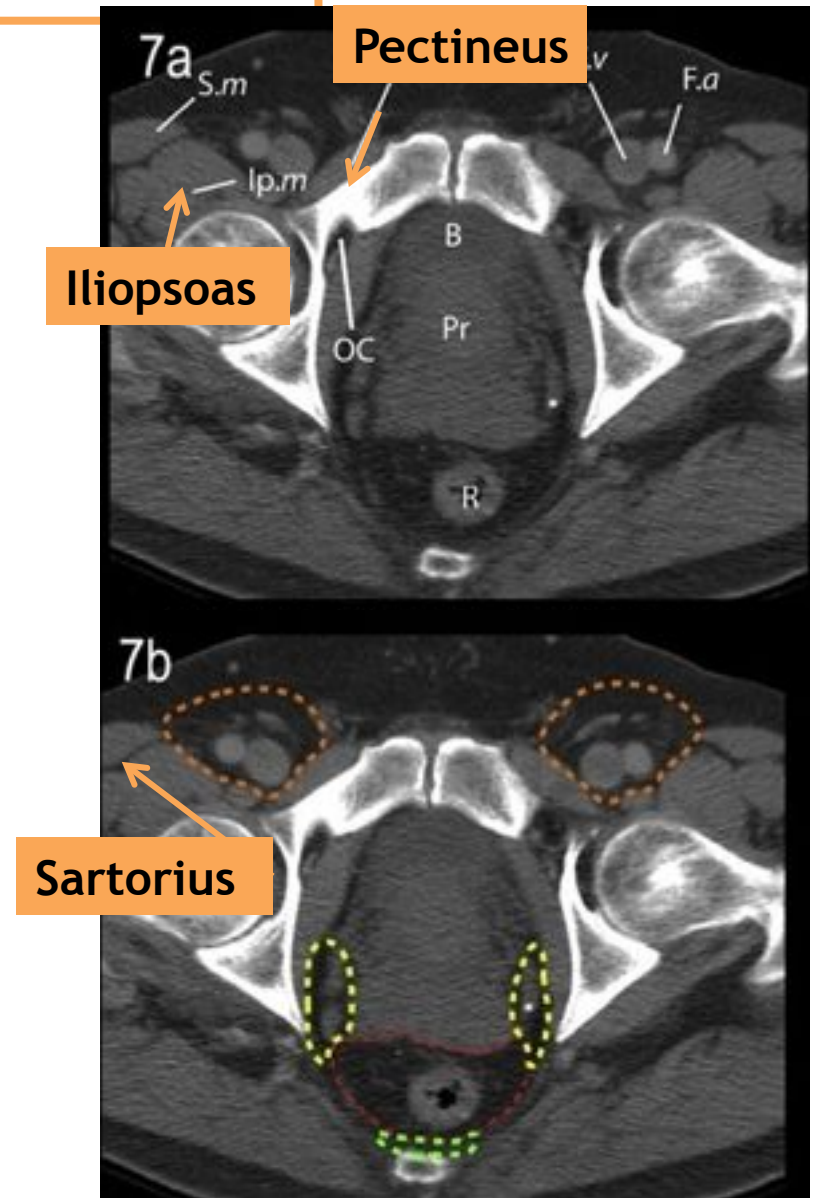
INGUINAL LYMPH NODES

Posterior = The bed of the femoral triangle is formed by the iliopsoas, pectineus, and adductor longus muscles.

Anterior = on the inguinal vessels + 20 mm, inclusive of any visible lymph nodes or lymphocoeles

Lateral = The medial edge of sartorius or iliopsoas

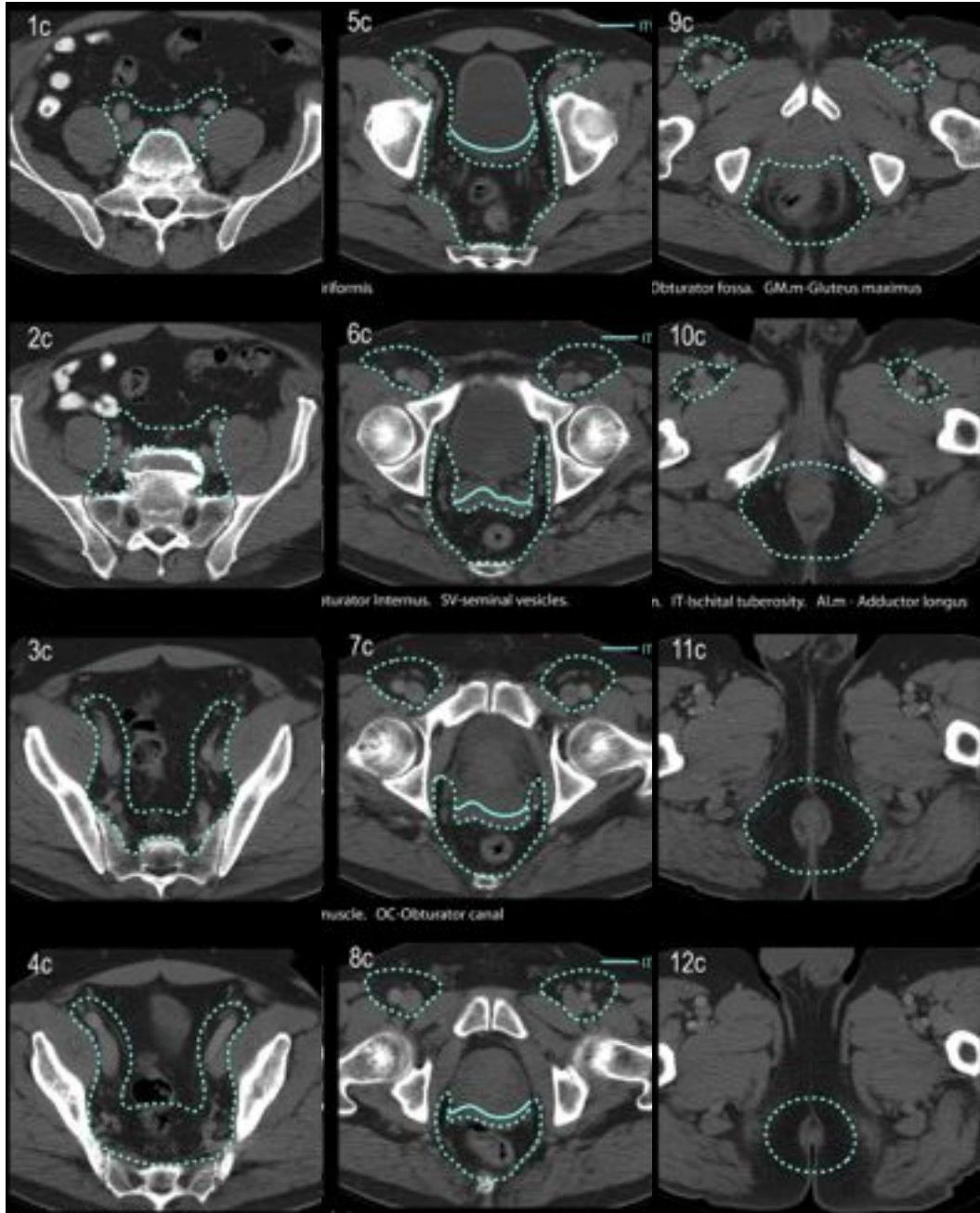
Medial = A 10- to 20-mm margin around the femoral vessels. The medial third to half of the pectineus or adductor longus muscle serves as an approximate border.



Taylor A et al. Clin Oncol (R Coll Radiol). 2007

M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

CTV COMBINED



Australasian Gastrointestinal Trials Group (AGITG) Contouring Atlas and Planning Guidelines for Intensity-Modulated Radiotherapy in Anal Cancer

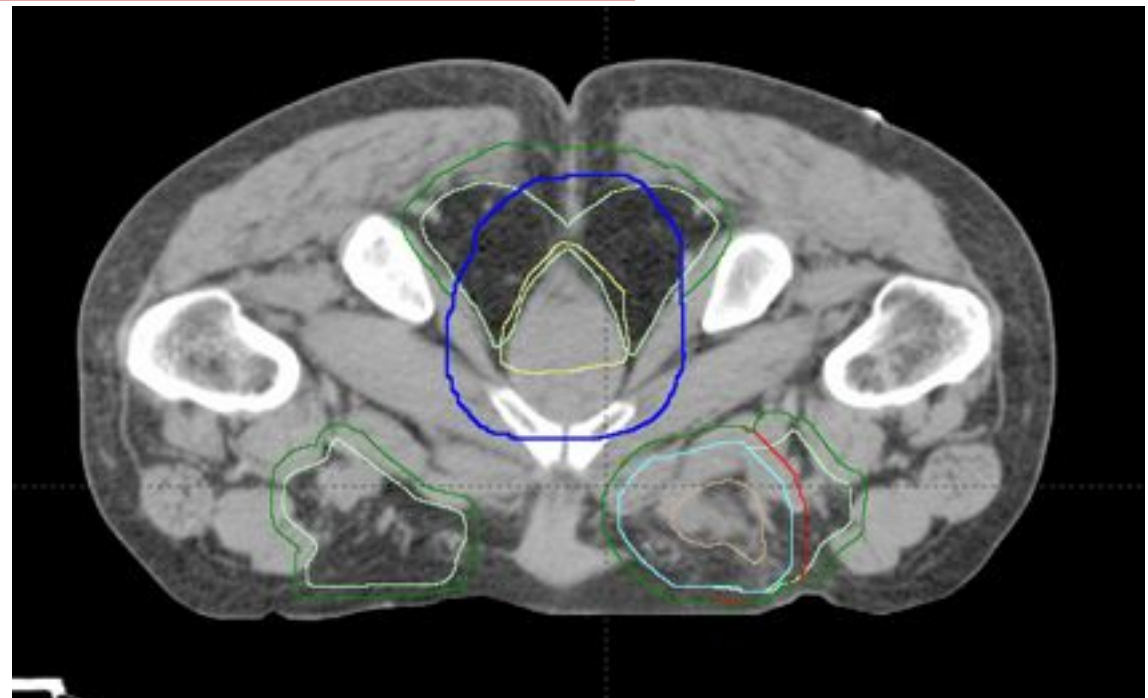


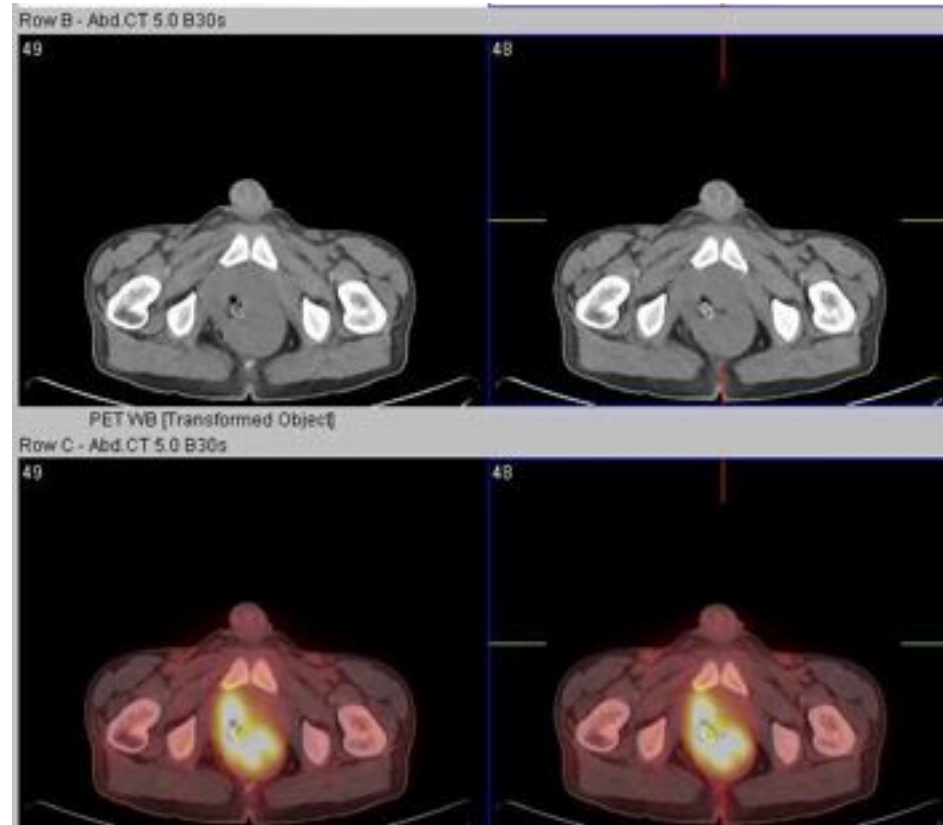
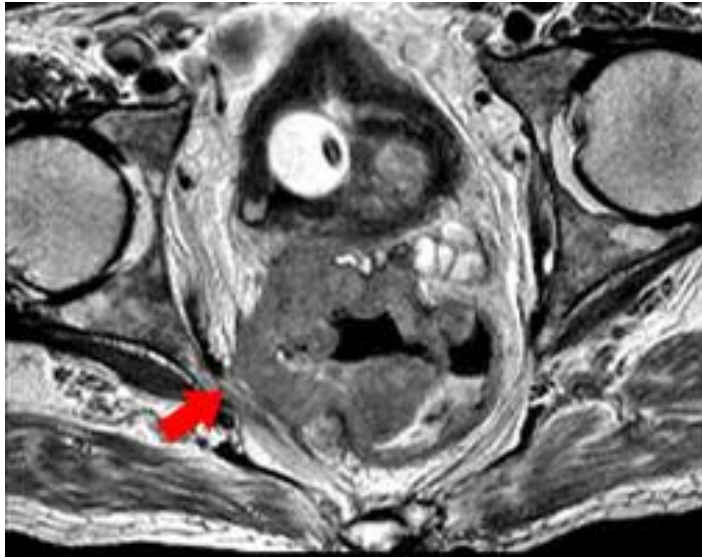
M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

CLINICAL TARGET VOLUME FOR GROSS DISEASE

PRIMARY TUMOR

CTV = **GTV** + entire
anal canal + internal
and external sphincter
+ 20 mm isotropic
margin





For very advanced anal or rectal cancers, extending through the mesorectum or the levators, the group's recommendation is to add ~2 cm margin up to bone wherever the cancer extends beyond the usual compartments.

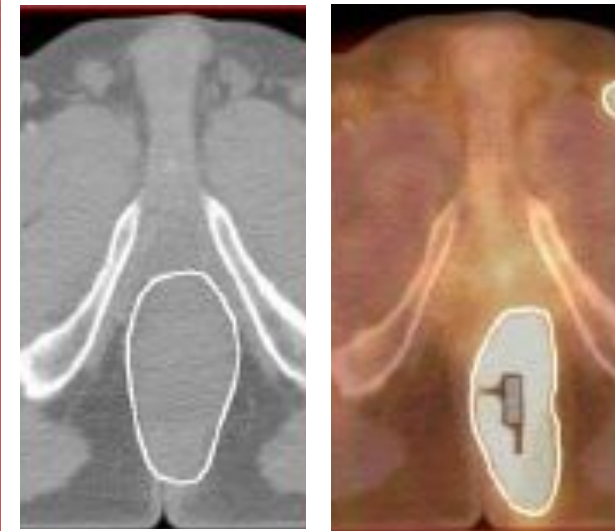
An MRI and/or PET/CT scan is strongly recommended in such cases.

RESEARCH

Open Access

FDG-PET/CT imaging for staging and target volume delineation in conformal radiotherapy of anal carcinoma

Marco Krengli^{1,2*}, Maria E Milia¹, Lucia Turri¹, Eleonora Mones³, Maria C Bassi³, Barbara Cannillo³, Letizia Deantonio¹, Gianmauro Sacchetti⁴, Marco Brambilla³, Eugenio Inglese⁴



For the T3-T4 cases CT images may be unable to clearly detect the tumor extension in relation with the close proximity of muscle structures especially at the level of the perineum. As a matter of fact, CT images may overestimate tumor volume in low rectal cancer compared to FDG-PET/CT or MR

The British Journal of Radiology, 82 (2009), 509–513

SHORT COMMUNICATION

 BIR
The British
Institute of
Radiology

MR vs CT imaging: low rectal cancer tumour delineation for three-dimensional conformal radiotherapy

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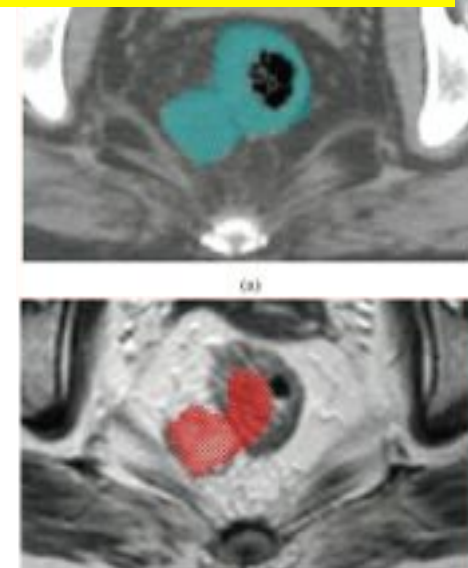


Figure 2. (a) Axial CT and (b) axial T_2 fast spin-echo (TR 3900, TE 120) MR images from the same patient, showing a T3 rectal adenocarcinoma. The shaded areas represent gross tumour volume delineation by the same radiologist. This overestimation of tumour volume on CT was consistent for all patients.

Australasian Gastrointestinal Trials Group (AGITG) Contouring Atlas and Planning Guidelines for Intensity-Modulated Radiotherapy in Anal Cancer

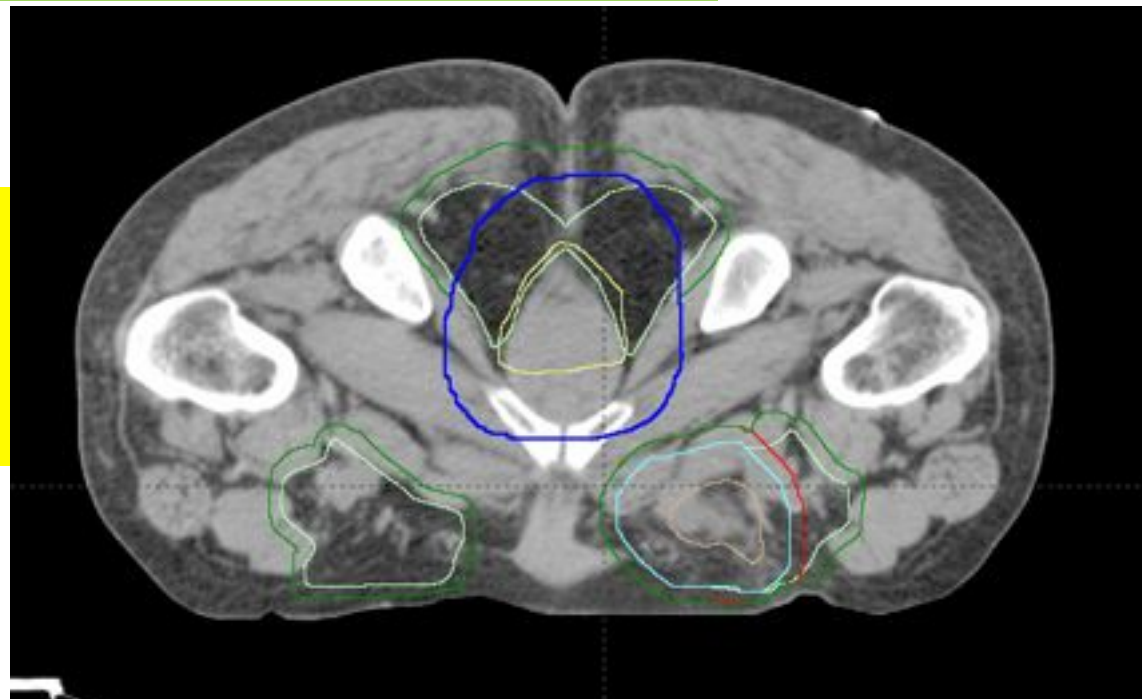


M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

CLINICAL TARGET VOLUME FOR GROSS DISEASE

INVOLVED NODE(S)

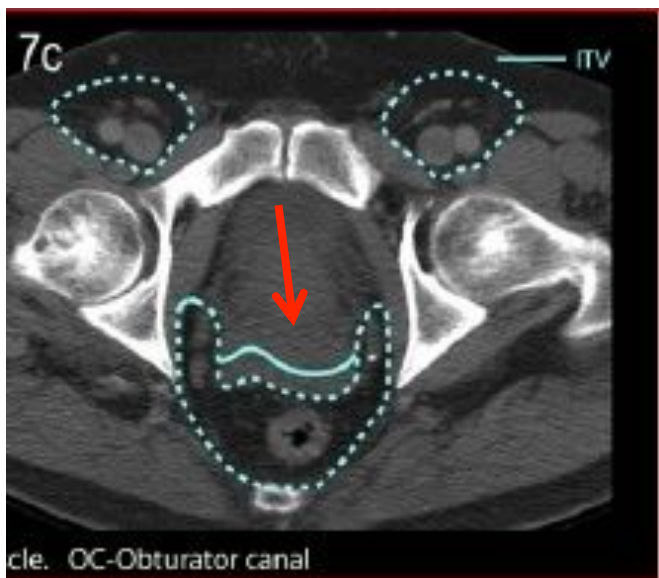
CTV = **Involved nodes** +
10-20 mm isotropic
margin, respecting
anatomical boundaries.





Critical issues

Anterior CTV border of the MESORECTUM.



AGITG atlas have addressed this issue by using ICRU63 definitions where we describe an internal margin of 10-mm to be added to the CTV at the levels of the bladder to form an internal target volume.

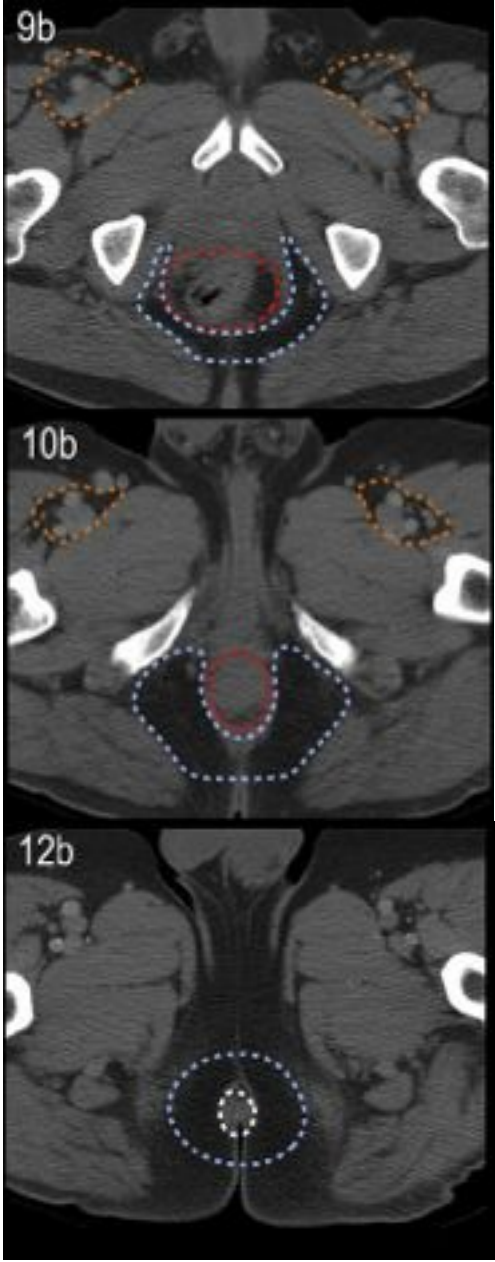
Nuyttens JJ, et al. Int J Radiat Oncol Biol Phys 2002

M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

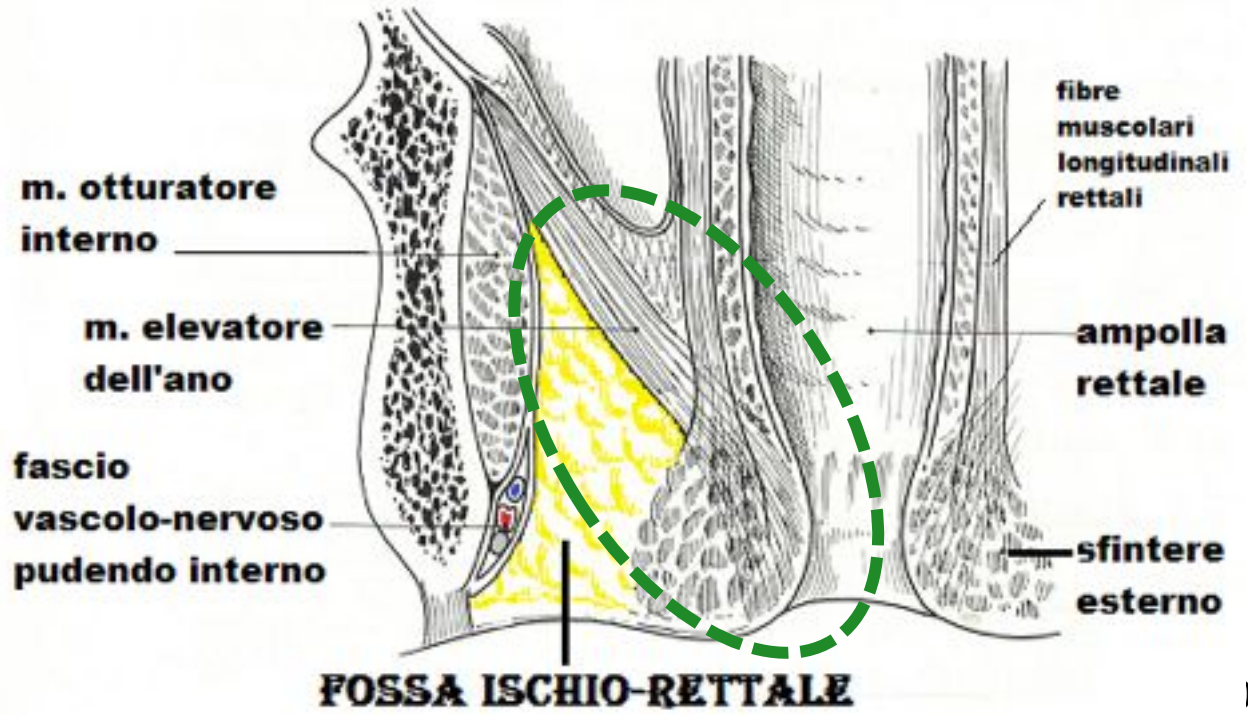


Critical issues

ISCHIORECTAL FOSSA



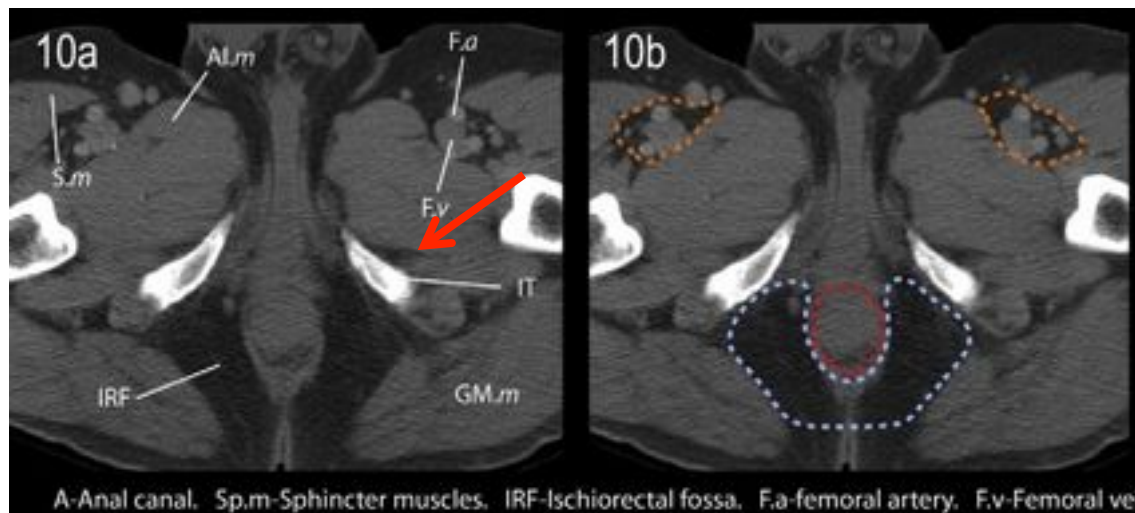
The RTOG guidelines do not consider the IRF to be an area at risk.





Critical issues

INGUINAL LYMPH NODES



The inguinal lymph node group: applying a “margin rules” for femoral vessels has its limitations, given that there is no clear anatomical compartment and that variation is seen with different body habitus.

A combination of landmark-based boundaries and margins when no anatomical boundaries exist was recommended.

The inferior edge of the ischial tuberosity was selected as the caudal level for contouring the inguinal fossa.



Critical issues

CLINICAL TARGET VOLUME FOR GROSS DISEASE

CTV for gross disease: 2D fields have recommended a 20- to 30-mm margin for the field edge around gross disease for the “boost” volume.

The consensus for this boost volume was to include the entire anal canal and sphincter muscles with a further margin.

There was variation in this expansion margin with a range of 10- to 20-mm.

Similarly, there was a variation of 10- to 20-mm for the CTV margin around involved nodes to account for extracapsular extension (ECE).

A minimum of 10-mm was based on pathological studies on ECE of metastatic lymph nodes in head-and-neck squamous cell carcinoma

Clinical Investigation: Gastrointestinal Cancer

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M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012



Clinical Investigation: Genitourinary Cancer

Organs at risk (OAR)

Pelvic Normal Tissue Contouring Guidelines for Radiation Therapy: A Radiation Therapy Oncology Group Consensus Panel Atlas

Gay HA et al. Int J Radiat Oncol Biol Phys. 2012

III Sessione: *La Pianificazione e la Delivery del Trattamento Radioterapico*

Moderatori: C. Aristei (Perugia) - G.C. Mattiucci (Roma) - P. Muto (Napoli)

14:00 Indicazioni nella Contornazione dei Volumi di interesse - L. Caravatta (Cagliari)

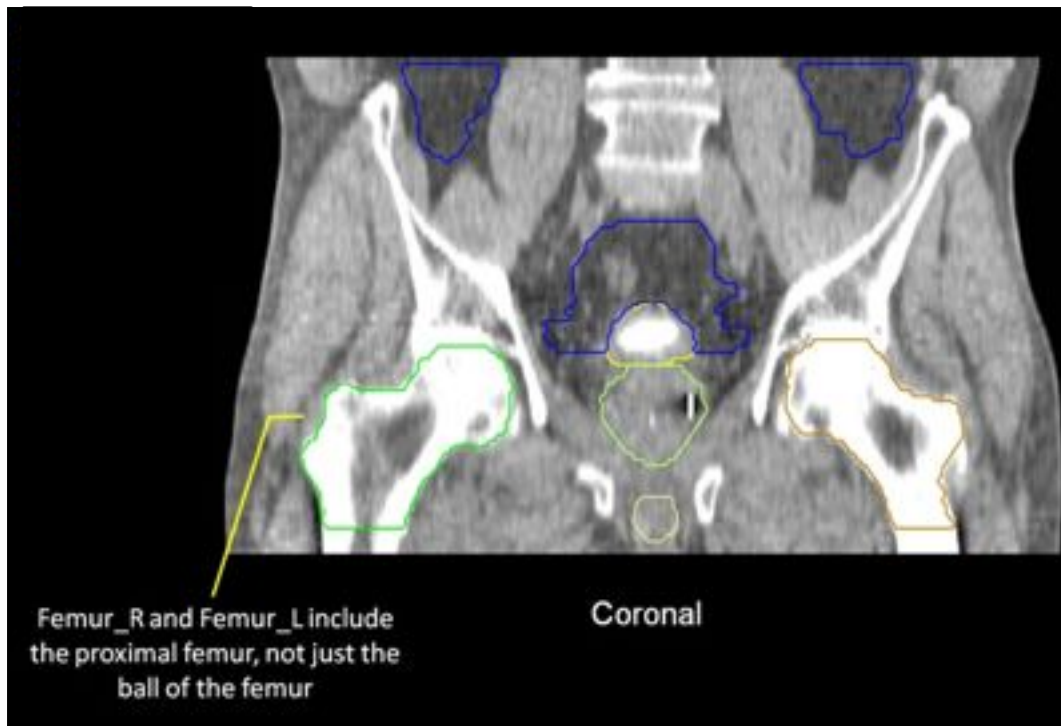
14:15 Dosi di tolleranza agli Organi Critici/tossicità attesa – M. E. Rosetto (Viterbo)

14:30 Tecniche di irradiazione (3D-CRT - IMRT - IGRT)

Aspetti tecnico-dosimetrici – S. Maggi (Ancona)

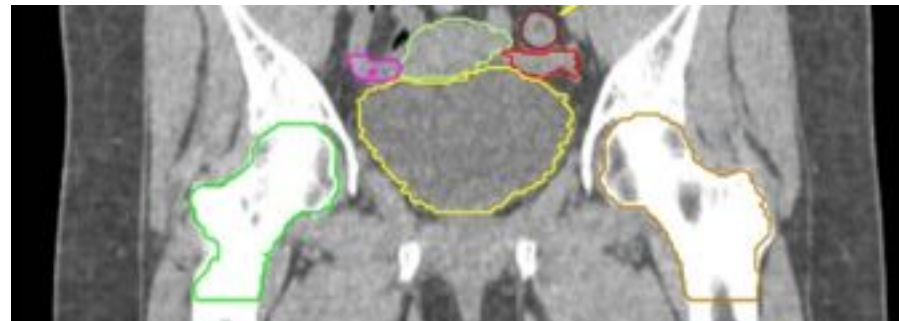
Risultati clinici - G. Macchia (Campobasso)

Organs at risk (OAR)



Femoral head and neck:
The entire femoral head and neck should be contoured.
The inferior extent is the cranial edge of the lesser trochanter.

Urinary bladder: The entire external outline of the bladder wall should be contoured.

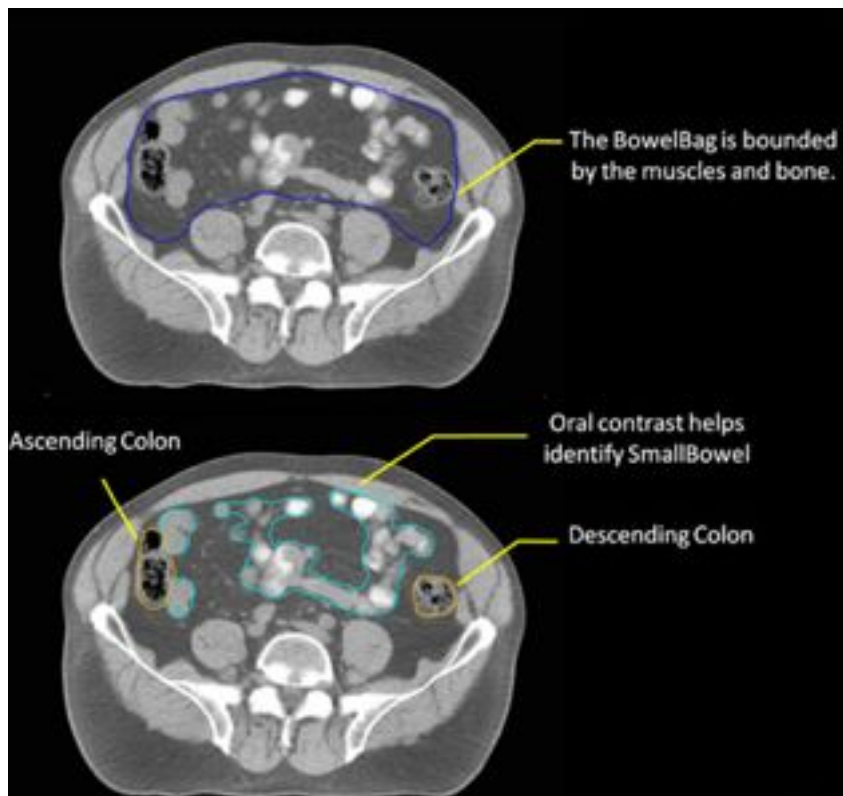


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M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

Organs at risk (OAR)



Bowel: Small bowel and large bowel, opacified or nonopacified, should be delineated from 15-mm superior to the cranial aspect of the PTV, extending inferiorly to the recto-sigmoid junction.

Devisetty K, et al. Radiother Oncol 2009

Bowel NOS: Peritoneal space occupied or potentially occupied by bowel, large or small.

Small bowel: To distinguish from large bowel, the use of o.c., administered 30 minutes before scanning, is encouraged. The small bowel can be outlined as loops containing contrast.

Large bowel: All intestine seen above the rectum; usually delineated as the bowel starting with noncircular or oval structures or above 15 cm.

Gay HA et al. Int J Radiat Oncol Biol Phys. 2012

M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

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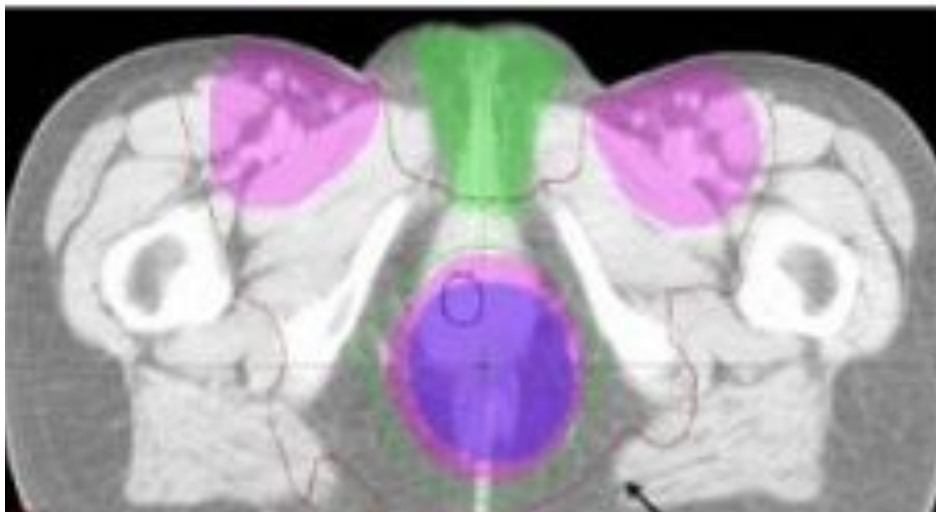


M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012

Organs at risk (OAR)

External genitalia and perineum.

In **MALES**: the bulb penis, scrotum, and area including skin and fat anterior to the pubic symphysis. In **FEMALES**: the clitoris, labia majora and minora, and area including skin and fat anterior to pubic symphysis. The cranial extent of this volume is the caudal edge of the pubic symphysis.



Bone marrow: Both iliac crests will be used to define “bone marrow.”

Delineation will extend cranially from the top of the iliac crests to the superior part of the acetabulum caudally. The left and right iliac crests are combined into one volume

Gay HA et al. Int J Radiat Oncol Biol Phys. 2012

M. Ng, et al. (AGITG) Int J Radiation Oncol Biol Phys, 2012



Coordinatori:
Francesca Valvo, Cynthia Aristei,
Marco Lupattelli, *Vincenzo Fusco*

Sede del corso
- PAVIA: 13 GIUGNO 2014
- PERUGIA: 18 SETTEMBRE 2014
- RIONERO IN VULTURE : 31 OTTOBRE 2014



INDICAZIONI NELLA CONTORNAZIONE DEI VOLUMI DI INTERESSE

Grazie per l'attenzione

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