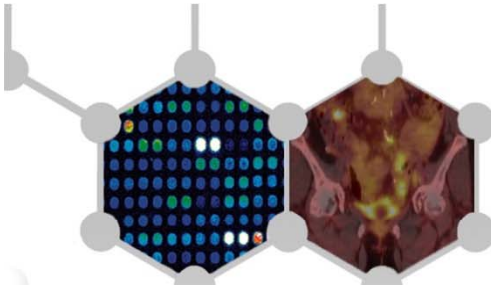

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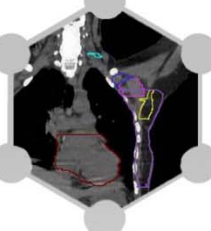

International Consensus Contouring Guidelines for Adjuvant Radiation after Radical Cystectomy for Bladder Cancer

Brian C. Baumann, Walter R. Bosch, Amit Bahl, Alison J. Birtle, Rodney H. Breau, Amarnath Challapalli, Albert J. Chang, Ananya Choudhury, Sia Daneshmand, Ali El-Gayed, Adam Feldman, Steven E. Finkelstein, Thomas J. Guzzo, Serena Hilman, Ashesh Jani, S. Bruce Malkowicz, Constantine A. Mantz, Viraj Master, Anita V. Mitra, Vedang Murthy, Sima P. Porten, Pierre M. Richaud, Paul Sargos, Jason A. Efstathiou, Libni J. Eapen, John P. Christodouleas

Contours adopted for the NRG-GU001 trial

Contributors

Brian C. Baumann MD[1], Walter R. Bosch DSc[2], Amit Bahl MBBS, MD, DNB, FRCP, FRCR, FFRRCSI[3], Alison J. Birtle MBBS, MRCP, FRCR, MD[4], Rodney H. Breau MD[5], Amarnath Challapalli MBBS, MD, MRCP-UK, FRCR, PhD[3], Albert J. Chang MD[6], Ananya Choudhury MA, PhD, MRCP, FRCR[7, 8], Sia Daneshmand MD[9], Ali El-Gayed MD[10], Adam Feldman MD, MPH[11], Steven E. Finkelstein MD[12], Thomas J. Guzzo MD, MPH[1], Serena Hilman MBChB, BSc (Hons), MRCP, FRCR[3], Ashesh Jani MD, MSEE[13], S. Bruce Malkowicz MD[1], Constantine A. Mantz MD[14], Viraj Master MD, PhD, FACS[13], Anita V. Mitra MBBS, BSc, MRCP, FRCR, MD[15], Vedang Murthy MD, DNB, DipEpp[16], Sima P. Porten MD, MPH[6], Pierre M. Richaud MD[17], Paul Sargos MD[17], Jason A. Efstathiou MD, Dphil[11], Libni J. Eapen MD[5], John P. Christodouleas MD, MPH[1]

[1]Hospital of the University of Pennsylvania, Philadelphia, PA, [2]Washington University in St. Louis, St. Louis, MO, [3]University Hospitals Bristol NHS Foundation Trust, Bristol, UK, [4] Royal Preston Hospital, Preston, UK, [5]University of Ottawa, Ottawa, Canada, [6]University of California San Francisco, San Francisco, CA, [7]Department of Clinical Oncology, The Christie NHS Foundation Trust, Manchester, UK, [8]The University of Manchester, Manchester Academic Heath Science Centre, Manchester, UK, [9]University of Southern California, Los Angeles, CA, [10]Saskatoon Cancer Centre, Saskatoon, Canada, [11]Massachusetts General Hospital, Boston, MA, [12]Cancer Treatment Centers of America, Tulsa, OK, [13]Emory University, Atlanta, GA, [14]21st Century Oncology, Scottsdale, AZ and Fort Myers, FL,[15]University College London Hospital, London, UK, [16]Tata Memorial Center, Mumbai, India, [17]Institut Bergonié, Bordeaux, France

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Developing consensus contouring guidelines for post-op RT

Purpose: Achieve a multi-institutional, international consensus defining target volumes and organs-at-risk for bladder cancer patients undergoing adjuvant RT in clinical trials based on patterns of failure after cystectomy

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Baumann et al., *IJROBP*, 2016

Methods

- Convened a multidisciplinary group of bladder cancer specialists from 5 countries and 15 institutions
- Six radiation oncologists & 7 urologists participated in the development of the initial contours
- The group proposed initial language for the CTVs and OARs, and each radiation oncologist contoured them on CT scans of male & female cystectomy patients

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Methods

- Group updated its CTV and OAR descriptions
- The cystectomy bed, the area of greatest controversy, was contoured by another 6 radiation oncologists & the language was again updated
- To test the revised language, CTVs & OARs were drawn by 6 additional rad onc's
- Contours were evaluated for level of agreement using the Landis-Koch κ statistic

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Results

- Group adopted our proposal for target coverage based on a prior patterns of failure analysis (Baumann et al., *IJROBP*, 2013)

Surgical Margin Status	Recommended CTV coverage
Negative margins	**Pelvic Lymph nodes alone** (distal common iliac, internal iliac, external iliac, and obturator nodes)
Positive margins	**Pelvic Lymph nodes + presacral nodes + cystectomy bed**

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Results

- Consensus language describing CTVs and OARs was developed and externally validated and the revised instructions were found to produce consistent contours

K Statistic	Cystectomy bed	Pelvic nodes	Bowel space	Rectum	Bone marrow	Urinary diversion
MALE	0.51	0.56	0.63	0.72	0.72	0.48
FEMALE	0.58	0.56	0.68	0.70	0.72	0.41

K statistic value	Level of Agreement
$0.2 < K \leq 0.4$	Fair
$0.4 < K \leq 0.6$	Moderate
$0.6 < K \leq 0.8$	Substantial
$0.8 < K \leq 1.0$	Almost perfect

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Consensus CTV Cystectomy Bed

Anatomical borders of the cystectomy bed clinical target volume	
Superior	The contour will extend 2 cm superior to the superior aspect of the pubic symphysis.
Anterior	The contour will extend to the posterior aspect of the pubic rami/symphysis. Above and below the pubic symphysis, the contour will stop anteriorly at the planes defined by extending lines superiorly (Plane 1 in Fig) and inferiorly (Plane 2 in Fig) from the posterior aspect of the symphysis.
Posterior	The contours will abut the anterior one-third of the external ano-rectal circumference without extending into the ano-rectum. Above the level of the rectum, the contour will stop posteriorly at the plane defined by extending a line superior from the anterior border of the rectum (Plane 3 in Fig).
Lateral	The contour will extend to the medial border of the obturator internus muscles bilaterally. Inferior to the obturator internus muscles, the lateral border of the contour will extend to the vaginal wall or the prostate bed.
Inferior	The contour will stop 2-3 mm (1 axial CT slice) above the penile bulb for males and 1 cm below the lower pole of the obturator foramen for females.

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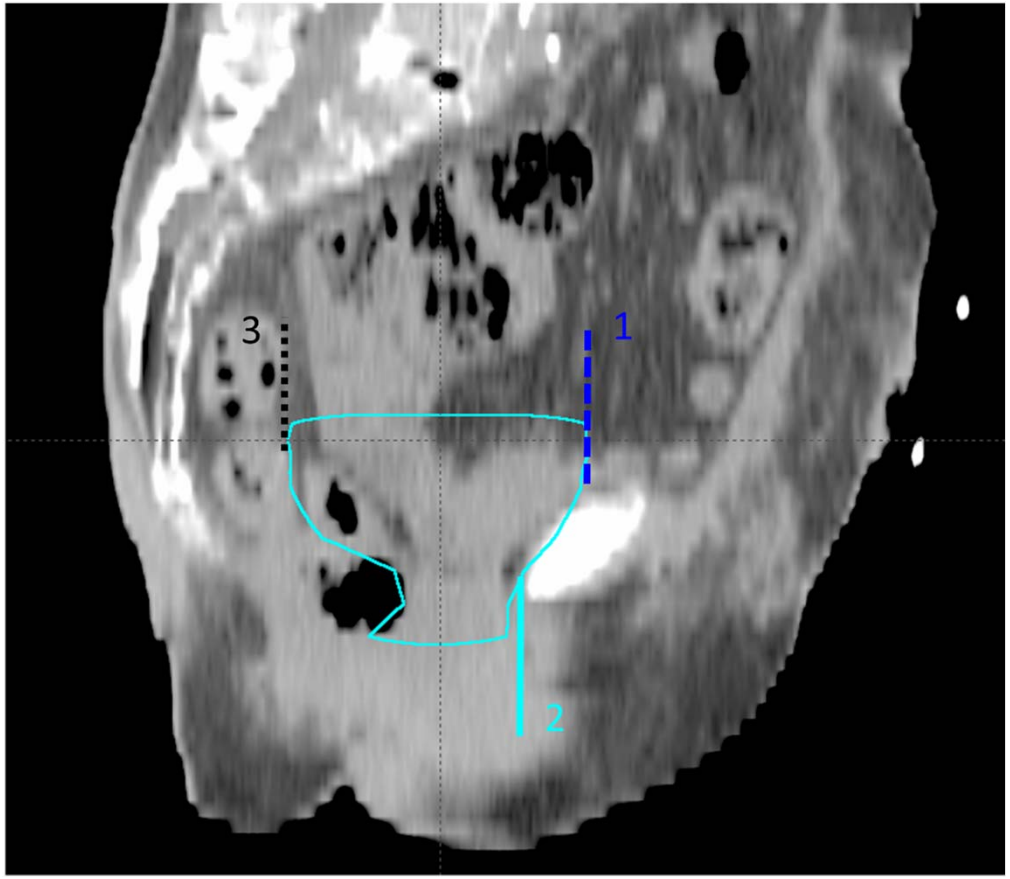
Consensus CTV Cystectomy Bed



Above and below the pubic symphysis, the cystectomy bed contour will stop anteriorly at the planes defined by extending lines superiorly (plane 1) and inferiorly from the anterior border (plane 2). Above the rectum, the contour will stop posteriorly at the plane defined by extending a line superiorly from the anterior border of the rectum (plane 3).

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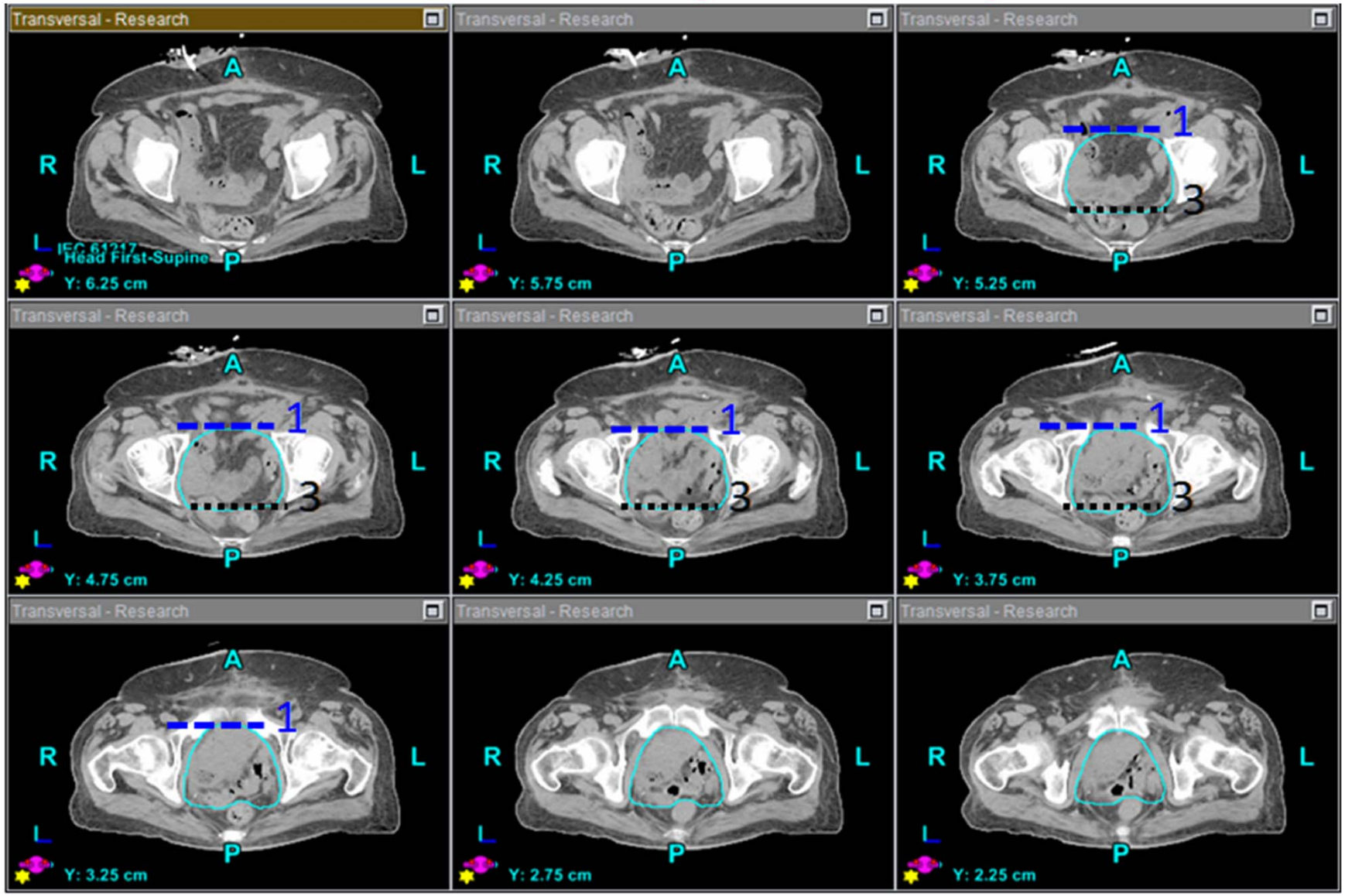
Consensus CTV Cystectomy Bed



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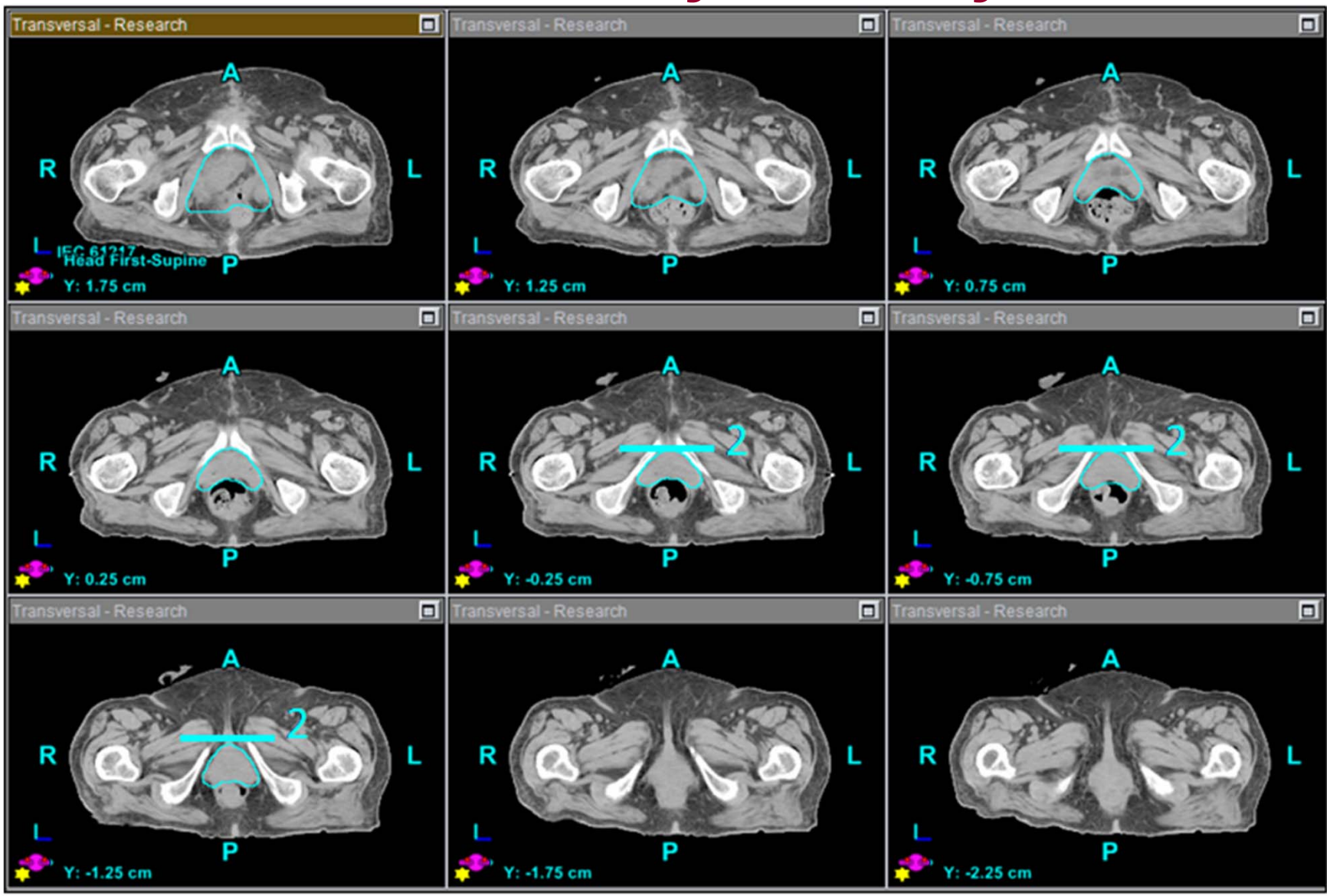
Consensus CTV Cystectomy Bed



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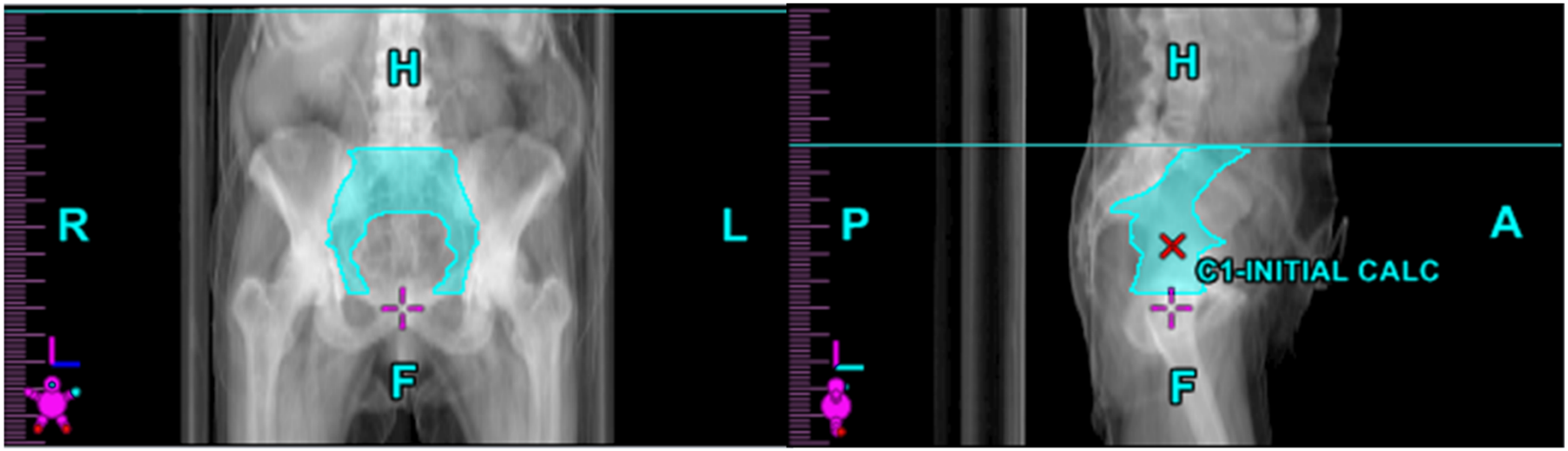
Nodal CTV



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Nodal CTV

- Union of 3 structures: iliac nodes, presacral nodes, and obturator nodes
- Nodal volumes should be trimmed to not extend outside the true pelvis or into muscle or bone
- Nodal volumes should not be cropped out of bowel to reduce the risk of a marginal miss because the primary site of failure is in the pelvic sidewall nodes
- Nodal CTV mirrors the pelvic nodal CTV in the RTOG atlas for high-risk prostate cancer

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Nodal CTV

- Presacral nodes: Extends from L5-S1 to the top of S3 and includes 1-1.5 cm of tissue anterior to the sacrum & between the vessel contours

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Nodal CTV

- Iliac nodes: Contour the common iliac and external and internal iliac vessels starting superiorly at L5-S1
  - External iliac vessels: Extend inferiorly to the top of the femoral heads
  - Internal iliac vessels: Extend inferiorly until they are no longer visible on CT scan or exit through the true pelvis via the greater sciatic notch

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Nodal CTV

- Iliac nodes: Generated by expanding the iliac vessel contours by 7 mm in the anterior, posterior, and lateral dimensions, but not the superior or inferior dimensions

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Nodal CTV

- Obturator nodes: Encompass 1 cm width of tissue medial to the obturator internus muscles extending from the anterior border of the ilium to the posterior border of the ilium
- Contoured starting superiorly at the inferior border of the iliac vessel contours and extending inferiorly to the top of the pubic symphysis

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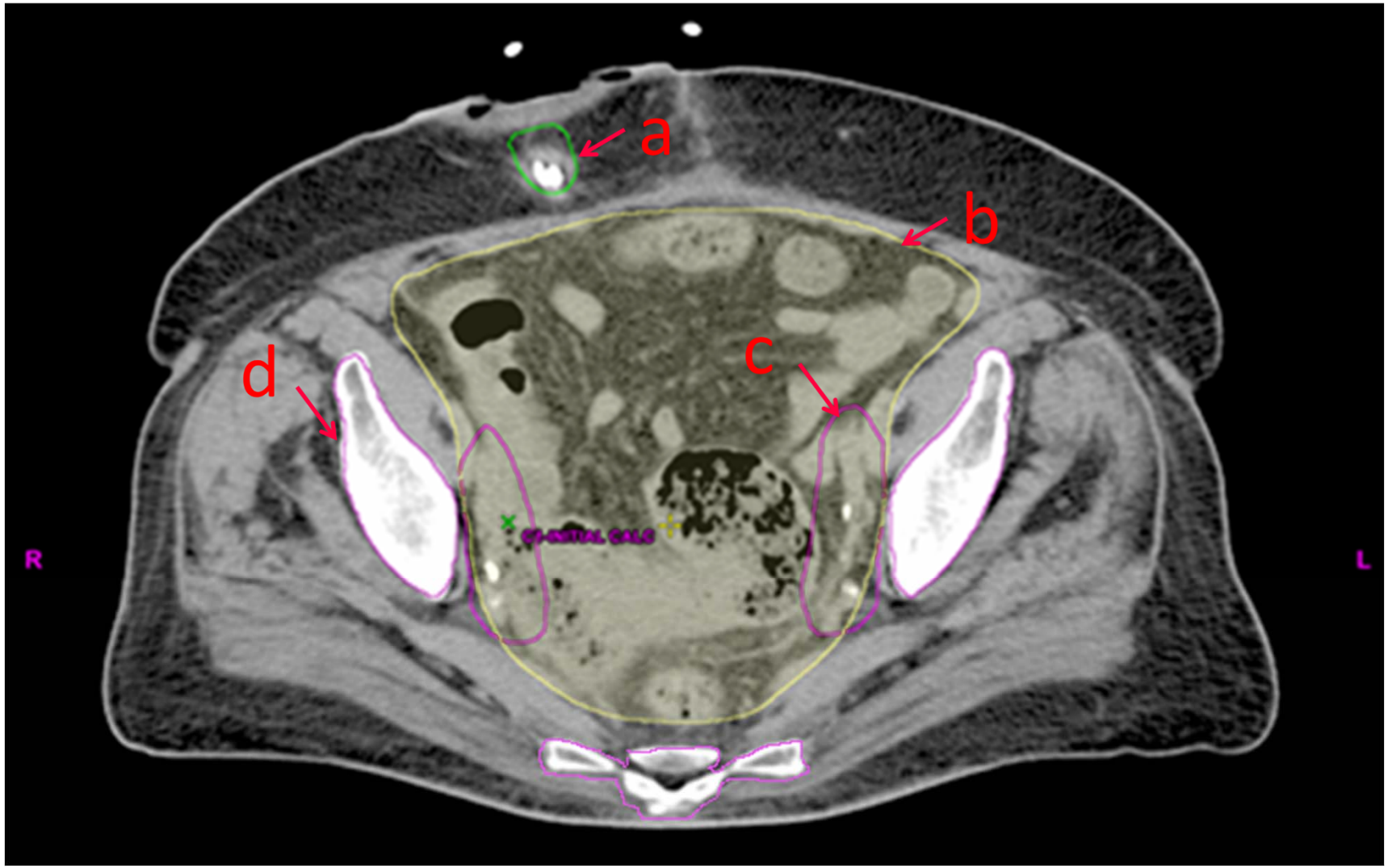
Organs at Risk



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Axial CT slice showing (a) urinary diversion, (b) bowel space, (c) nodal clinical target volume, (d) pelvic bone contours

Organs at Risk

- Urinary diversion: Contour as avoidance structure
- Non-continent diversion w/ bowel conduit (e.g. Ileal conduit): include the stoma & the visible portion of the bowel conduit
- Continent non-orthotopic catherizable diversion (e.g. Indiana pouch): include the stoma, bowel conduit, & internal urine reservoir
- Continent orthotopic diversion (Studer pouch): include the bowel reservoir

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Organs at Risk

- Ostomy bag: For patients with non-continent diversions, contour the ostomy bag to avoid bringing beams directly through this structure
- Simulate and treat with empty ostomy bag if possible

- Bowel contours: include the entire small bowel; cecum; and ascending, transverse, and sigmoid colon in one bowel bag contour beginning 3 cm above the superior extent of the nodal CTV

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Organs at Risk

- Rectum: Rectum and anal canal from the recto-sigmoid junction superiorly to the level of the ischial tuberosities inferiorly

- Pelvic bones: Contour starting superiorly 1 cm above the superior extent of the nodal CTV and extending 1 cm inferiorly to the inferior limit of the cystectomy bed CTV

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- Baumann BC, Bosch WR, Bahl A, et al., Development and validation of consensus contouring guidelines for adjuvant radiation therapy for bladder cancer after radical cystectomy. *Int J Radiat Oncol Biol Phys* 2016; 96(1):78-86.
- Lawton CA, Michalski J, El-Naqa I, et al., RTOG GU Radiation oncology specialists reach consensus on pelvic lymph node volumes for high-risk prostate cancer. *Int J Radiat Oncol Biol Phys* 2009; 74(2):383-387.

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