

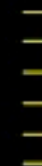
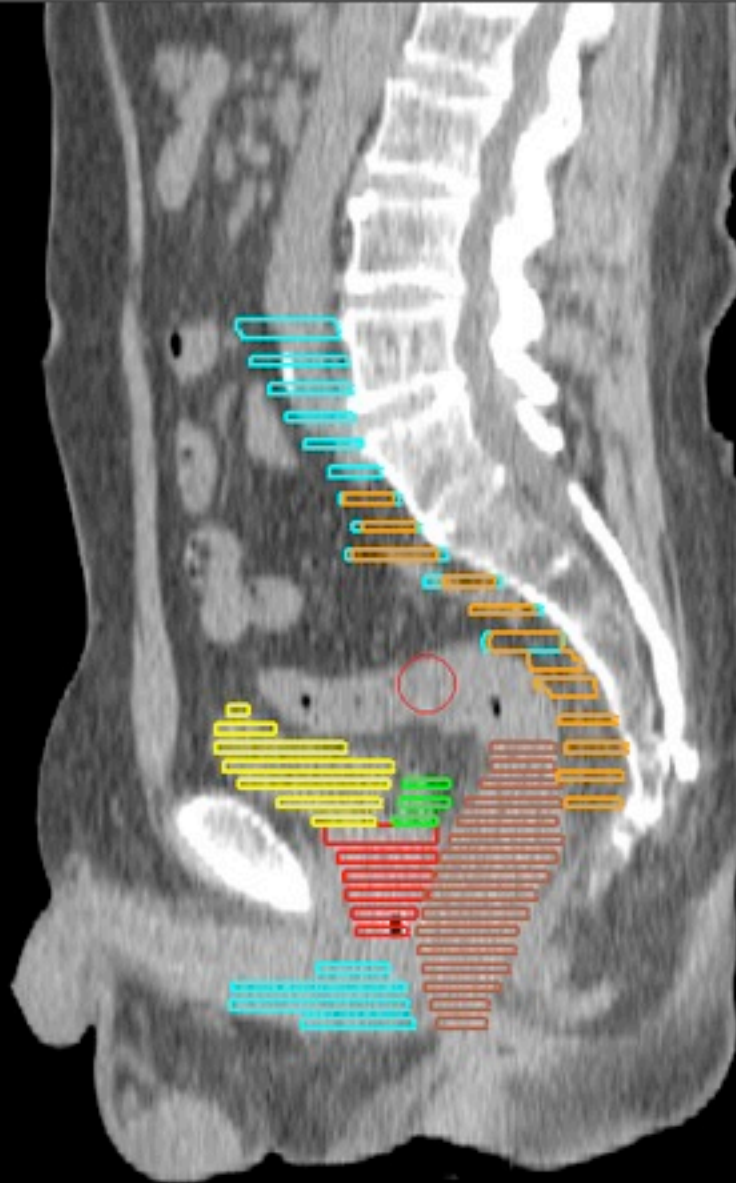
Prostate and Pelvic Lymph Node Anatomy for Contouring

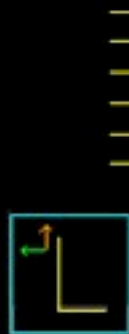
2012 AAPM
July 20-August 2
Charlotte, North Carolina

I-Chow Joe Hsu, MD

University of California San Francisco

Prostate Anatomy



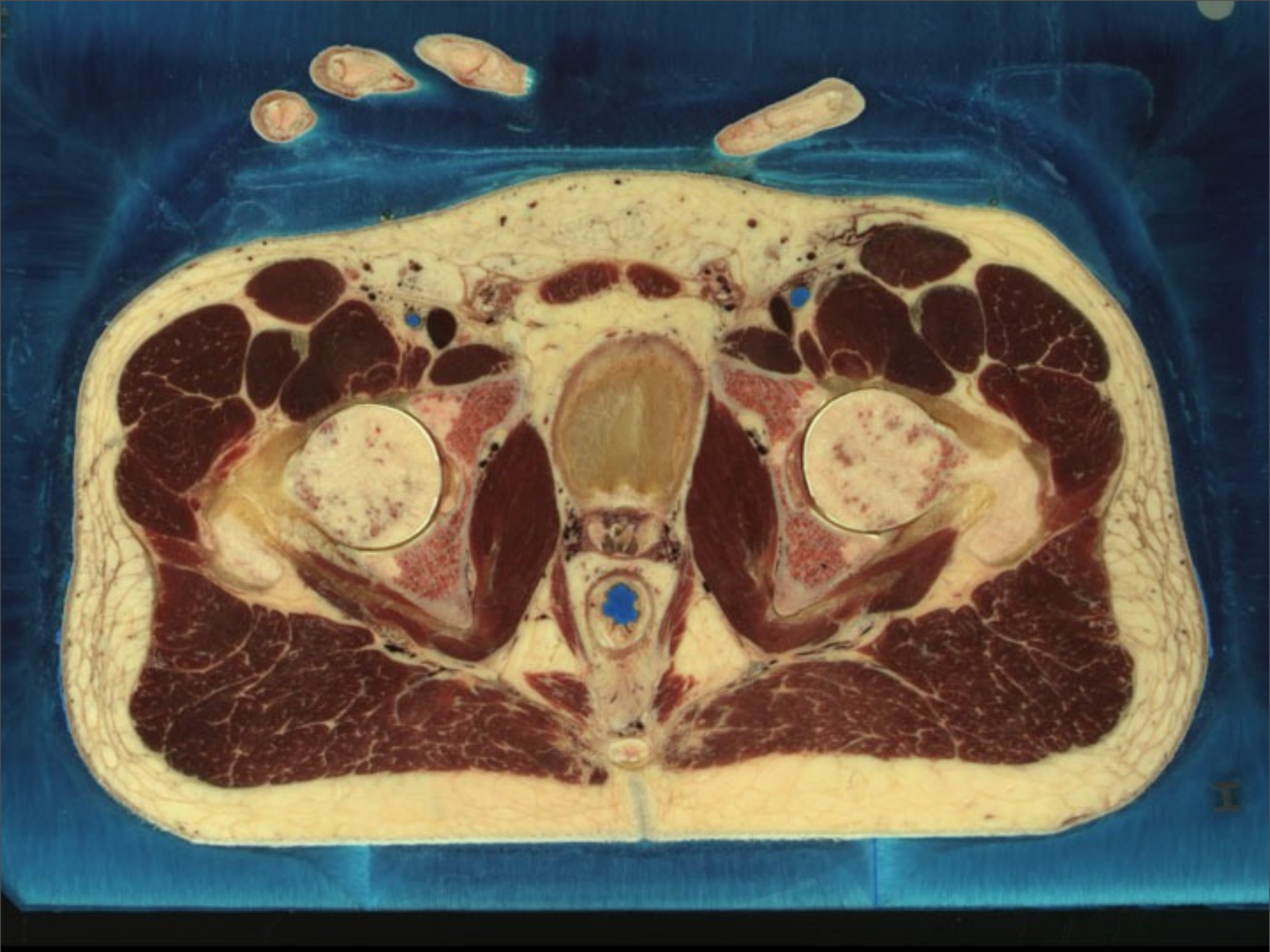


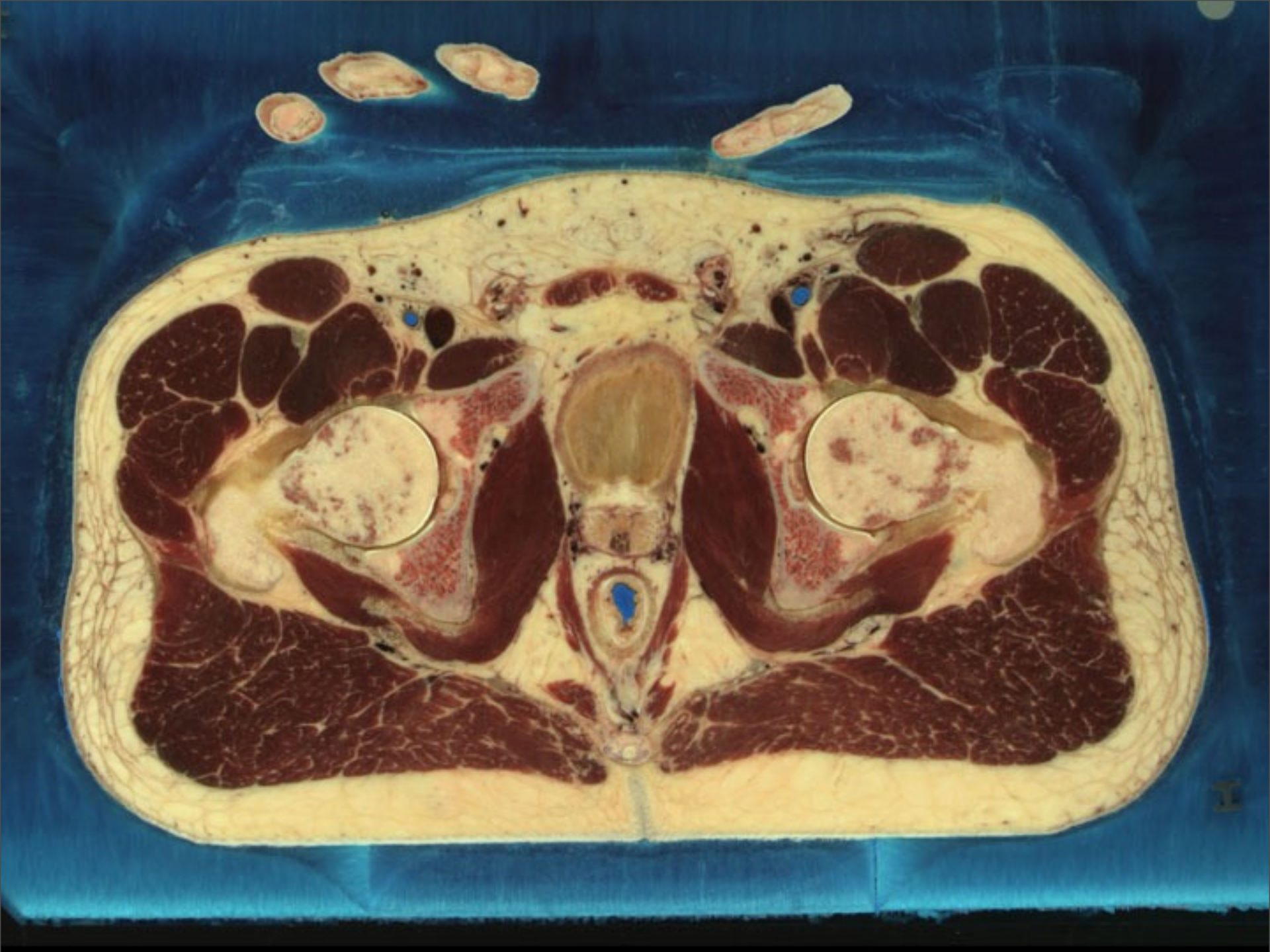
Visible Human Project

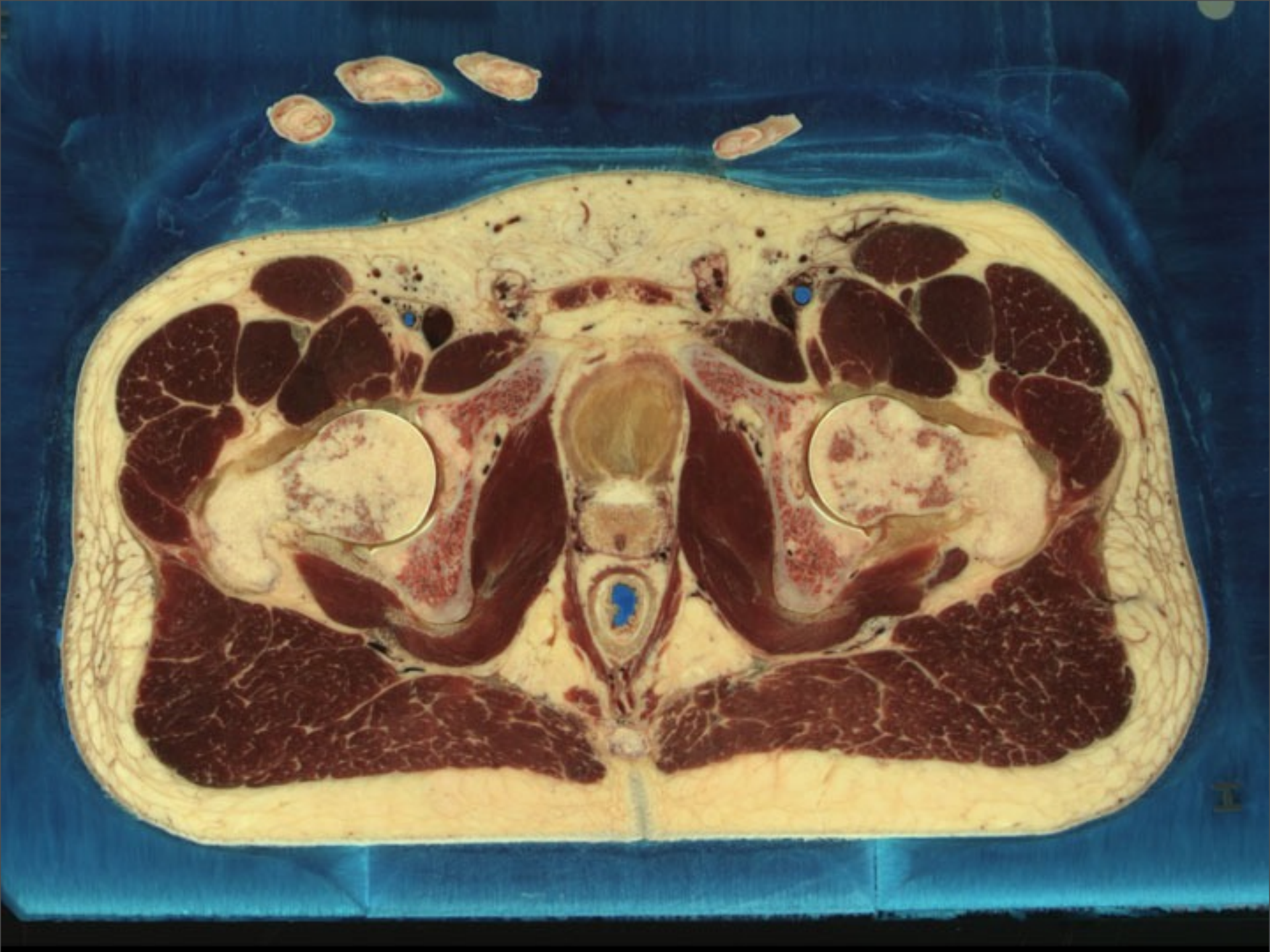


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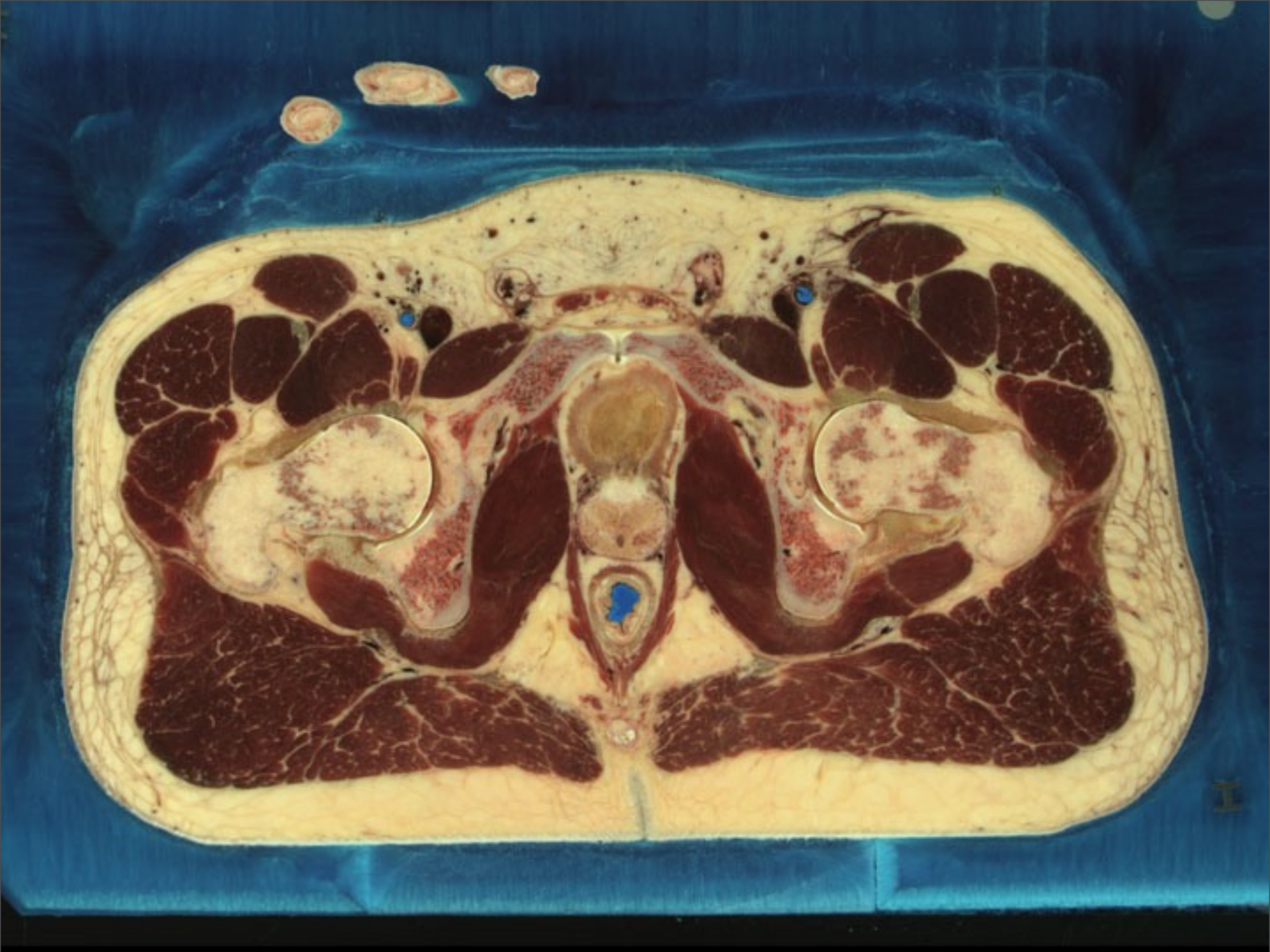


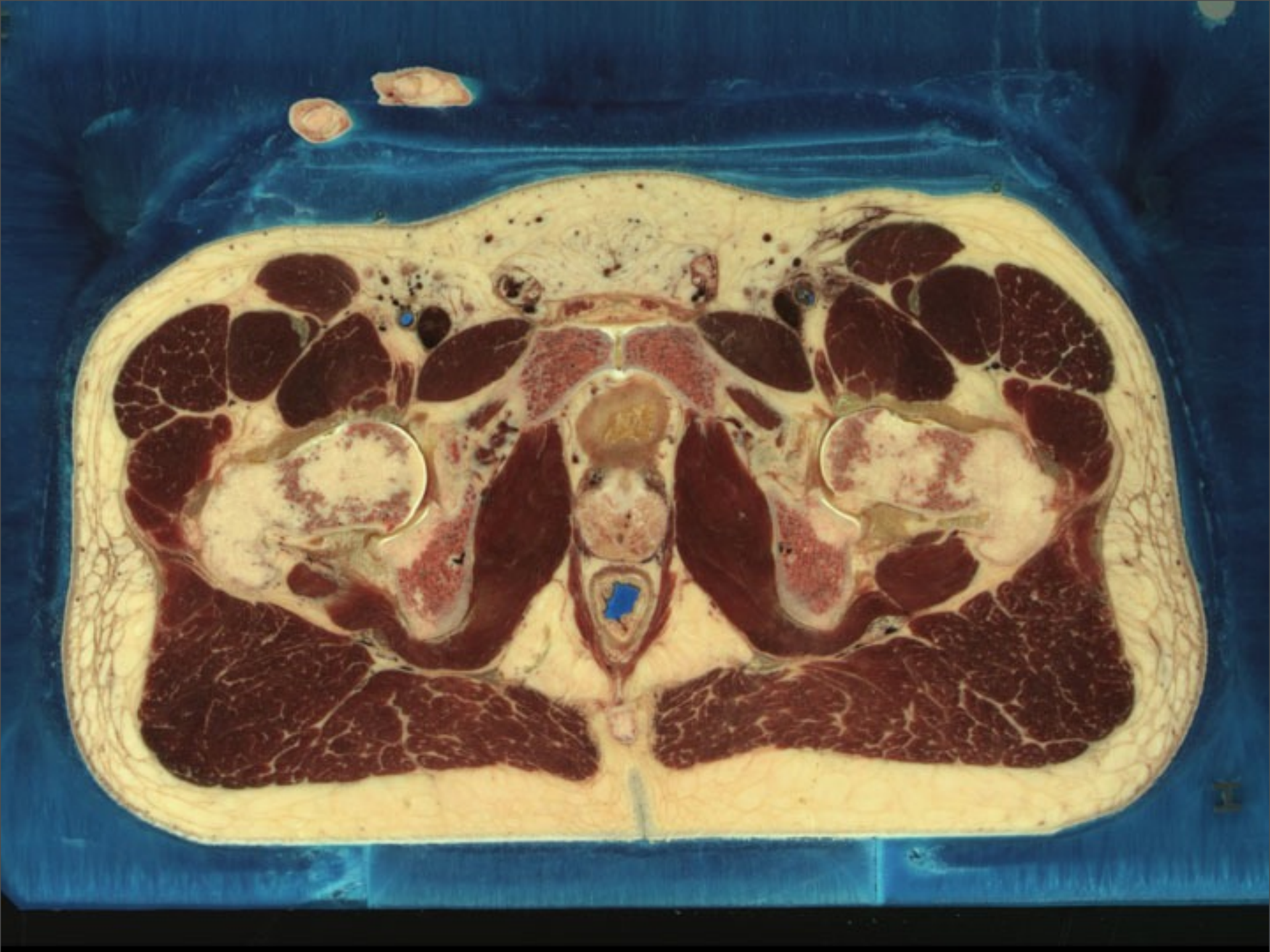




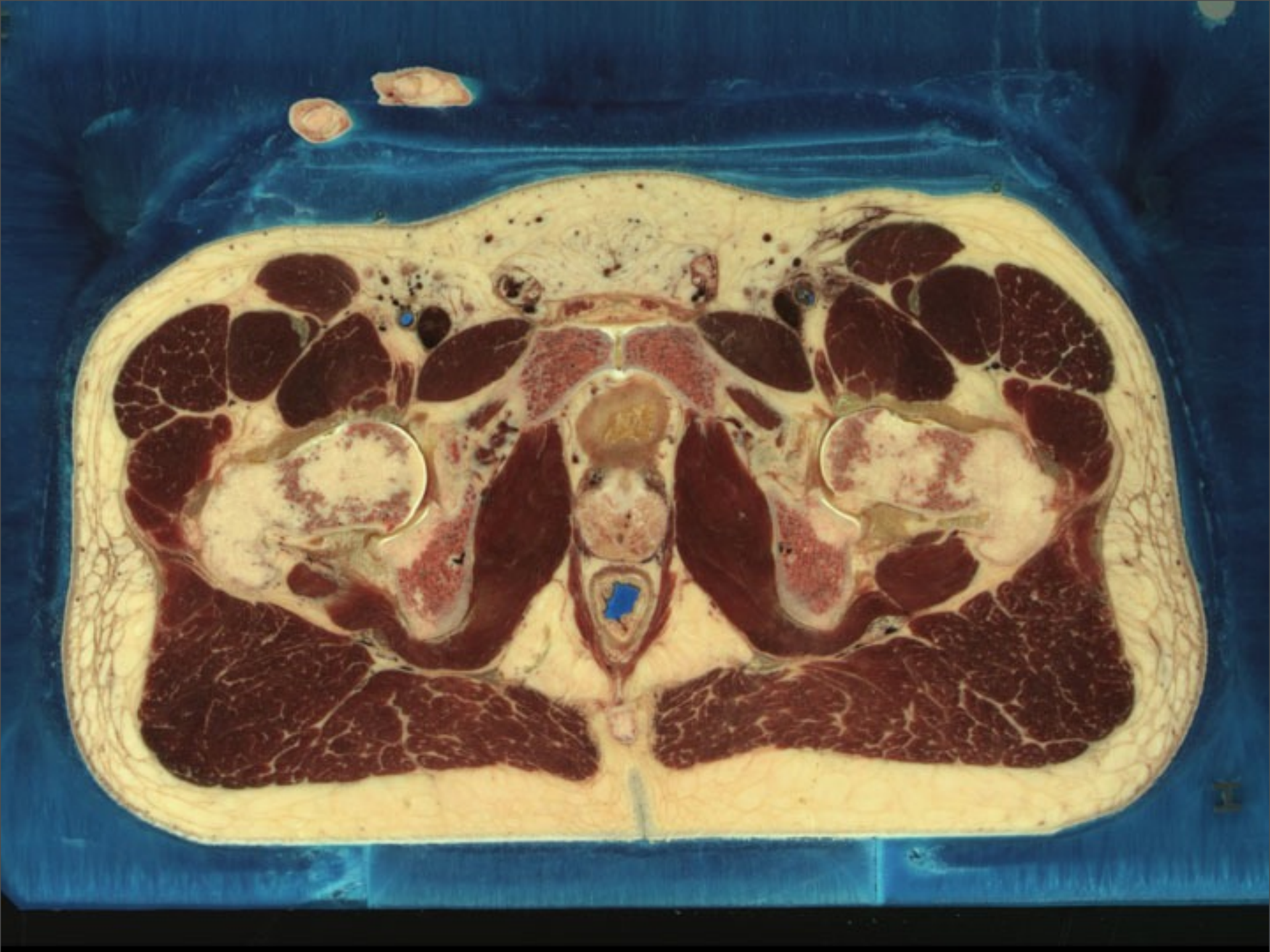


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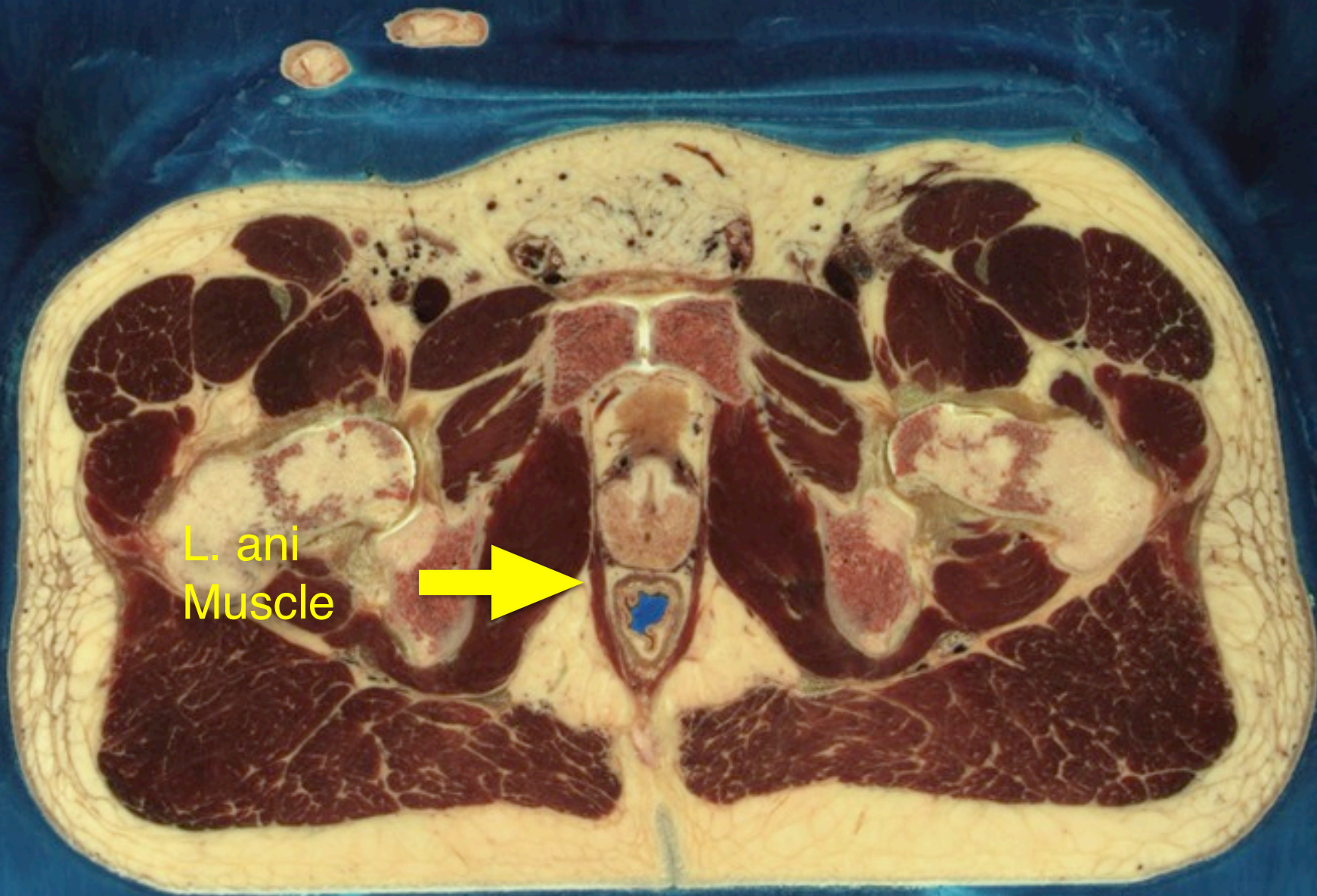




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Friday, April 6, 12



L. ani
Muscle





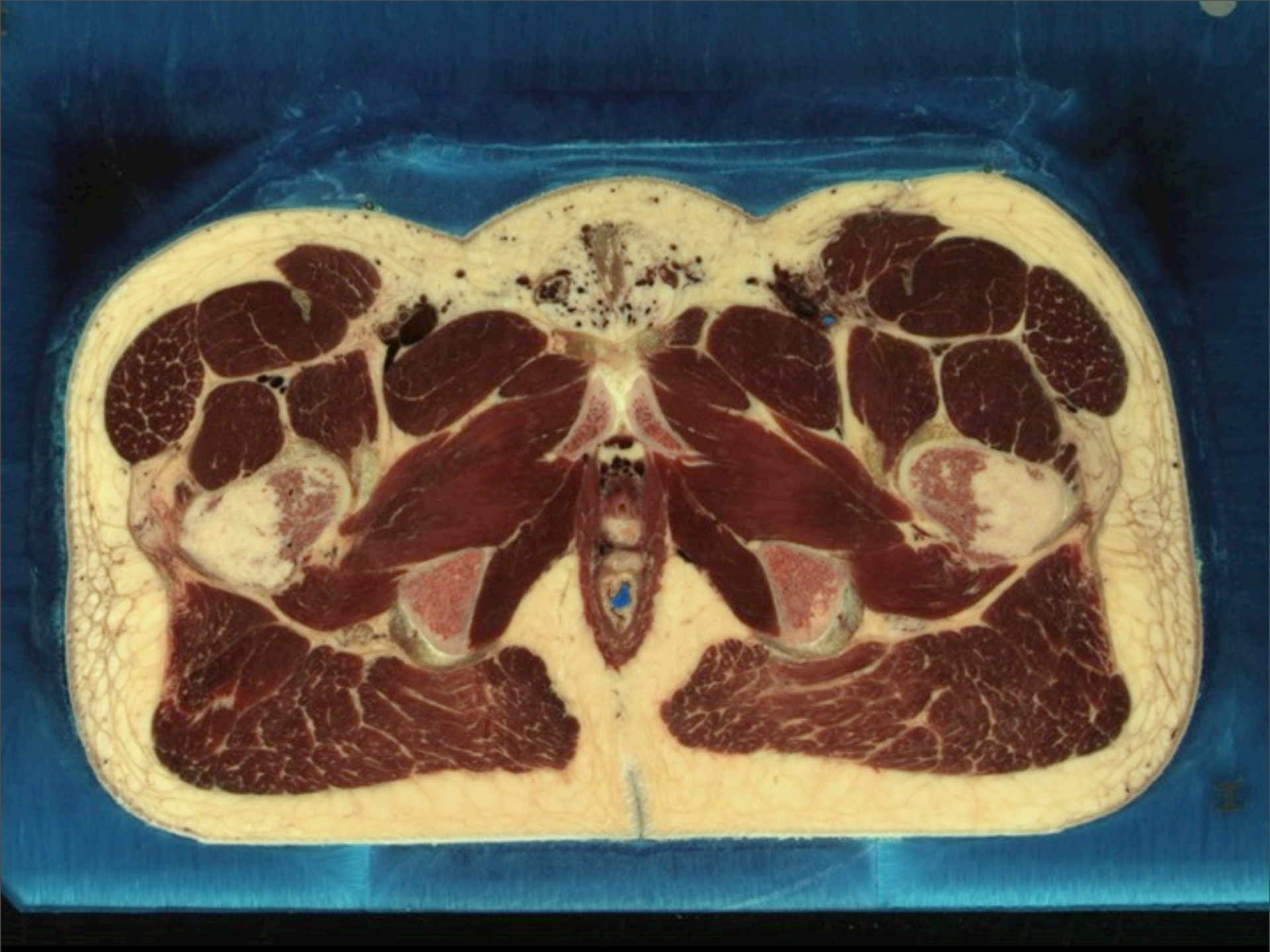




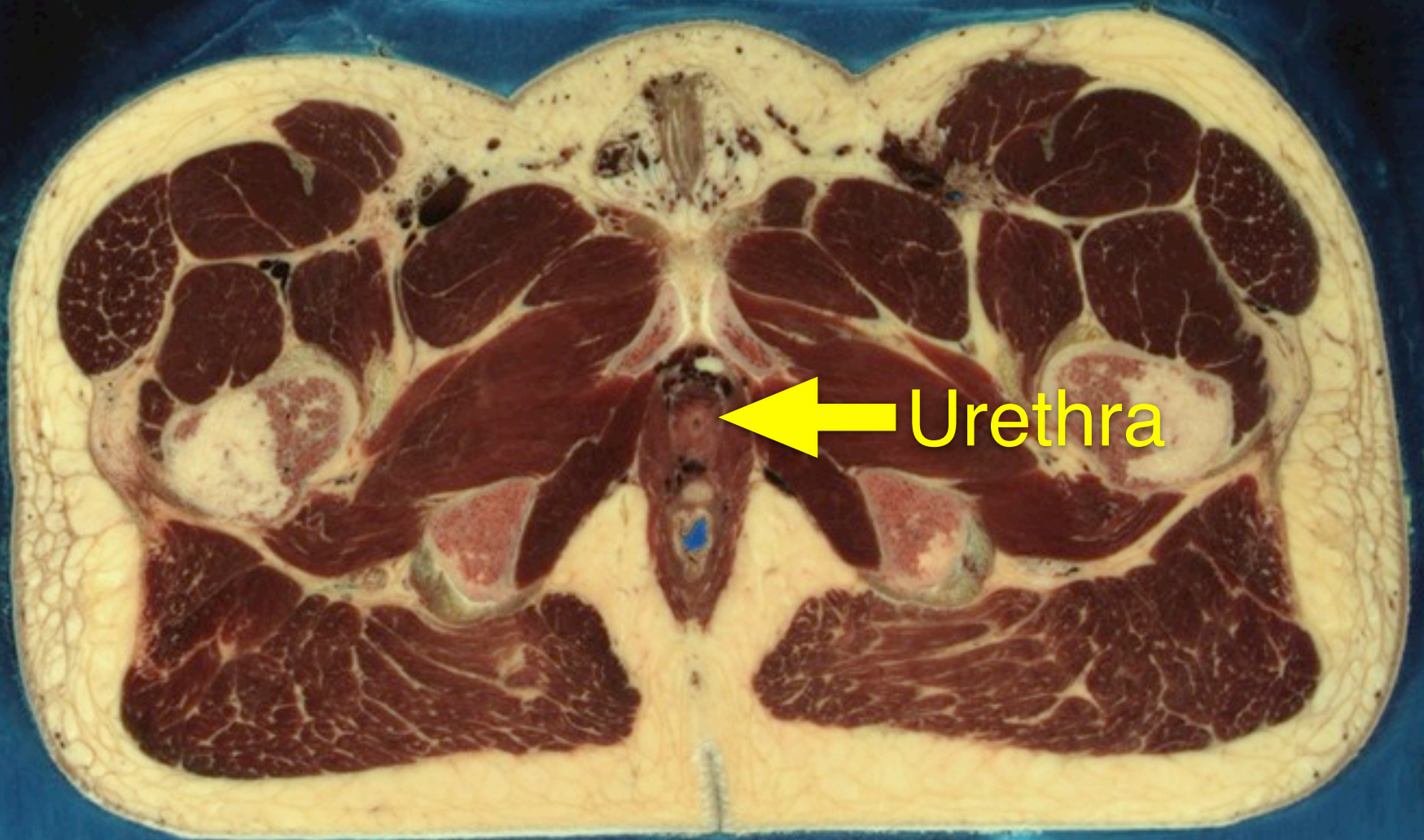




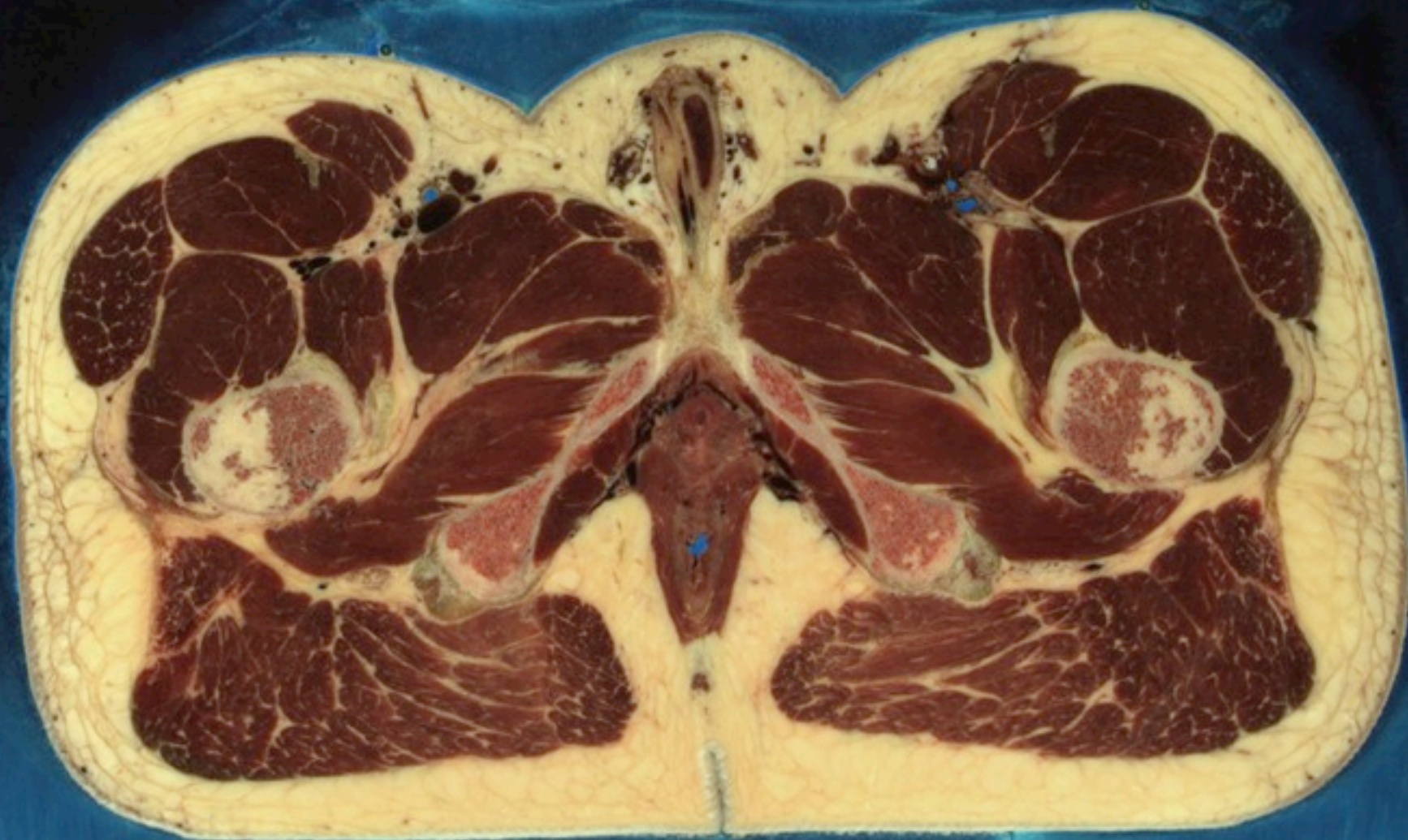




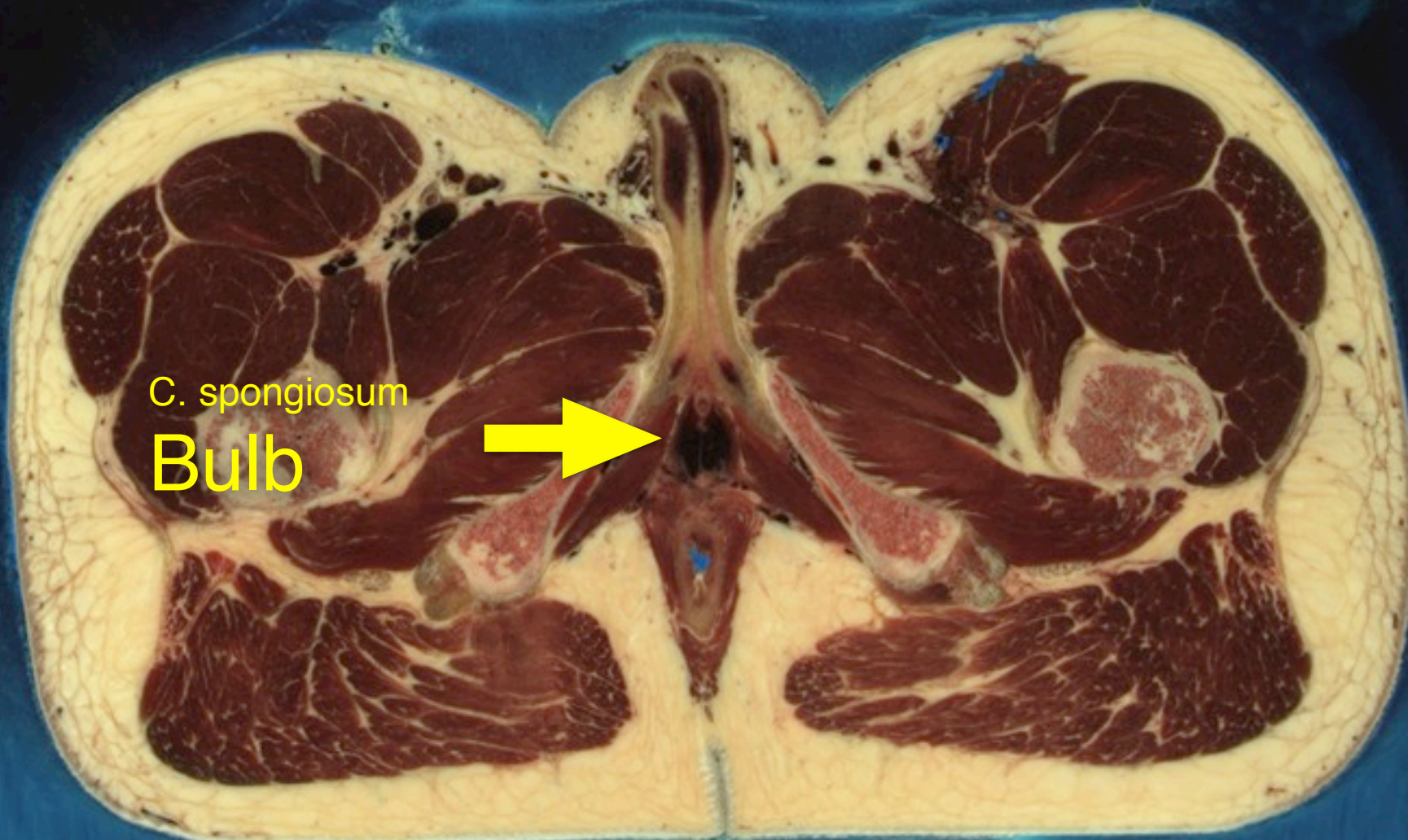
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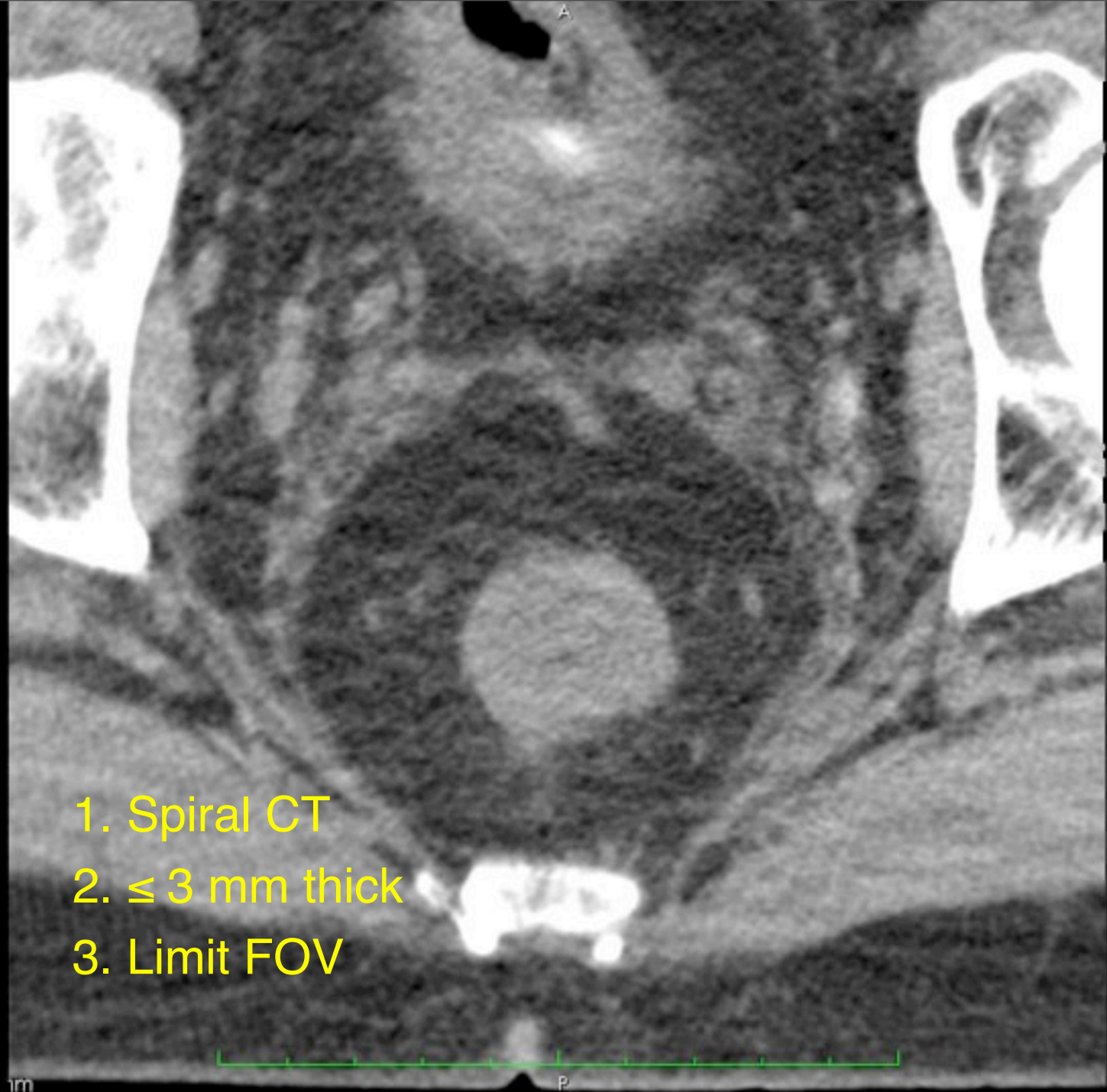


C. spongiosum
Bulb



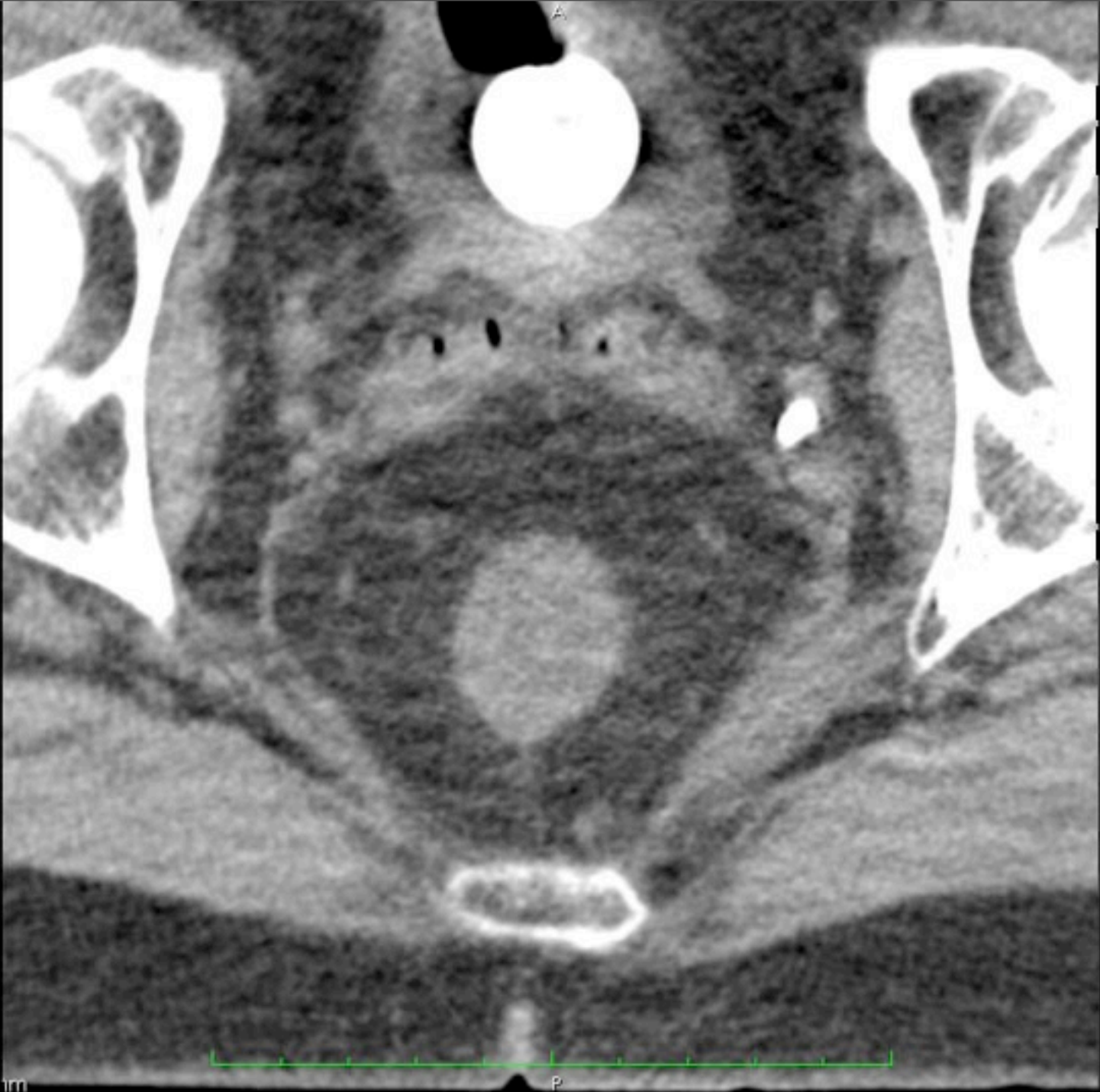


CT Contouring





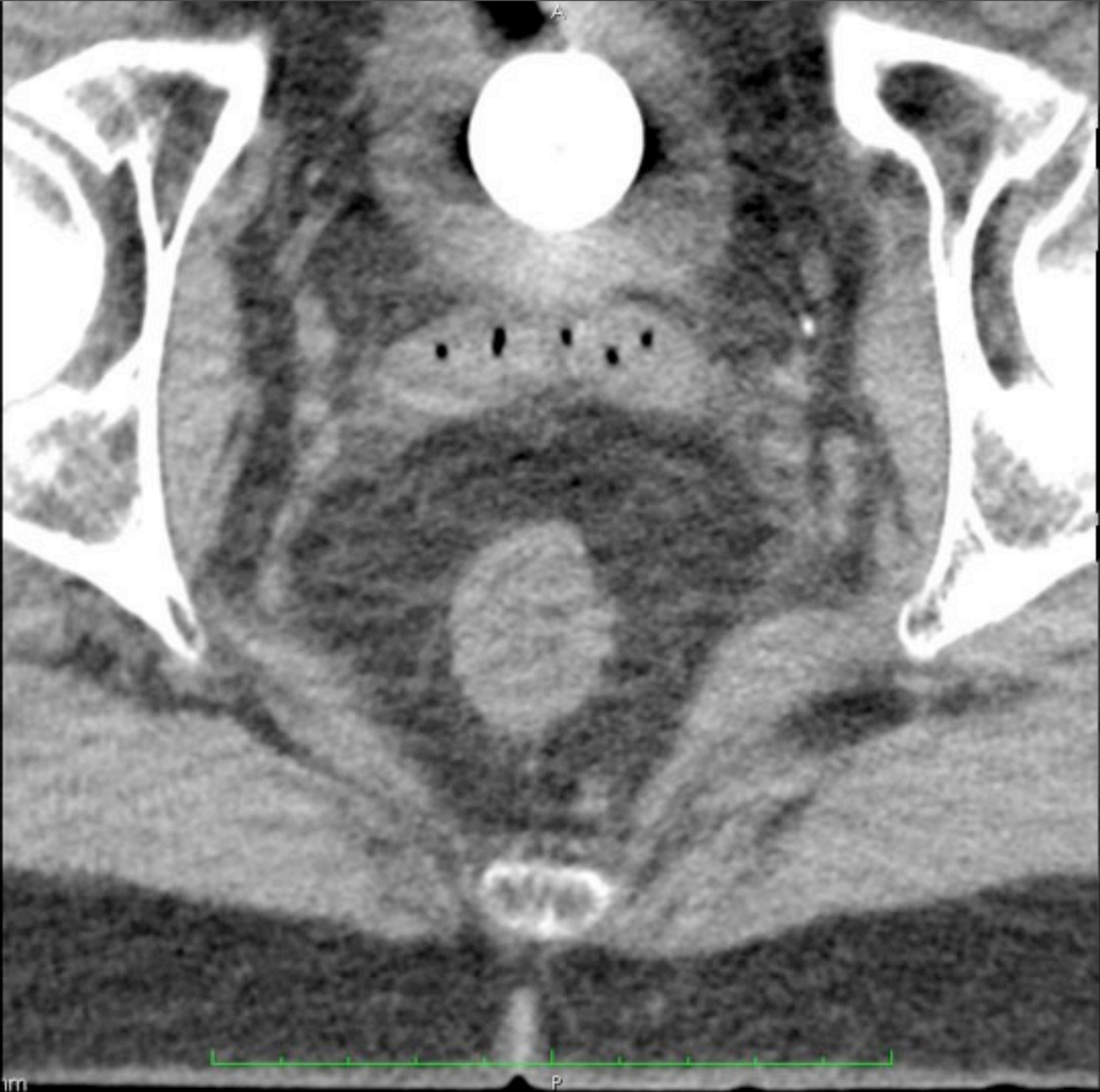


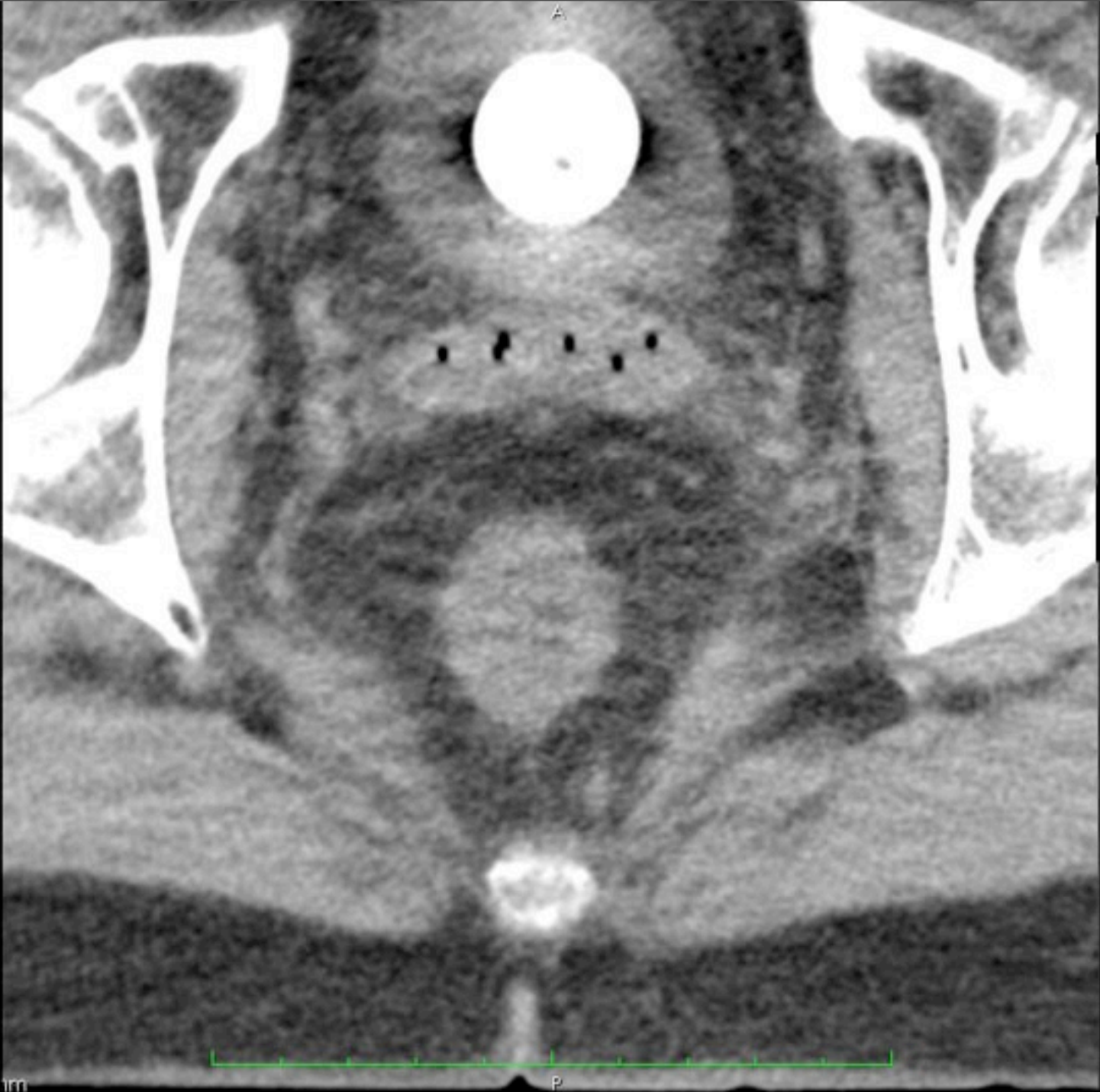




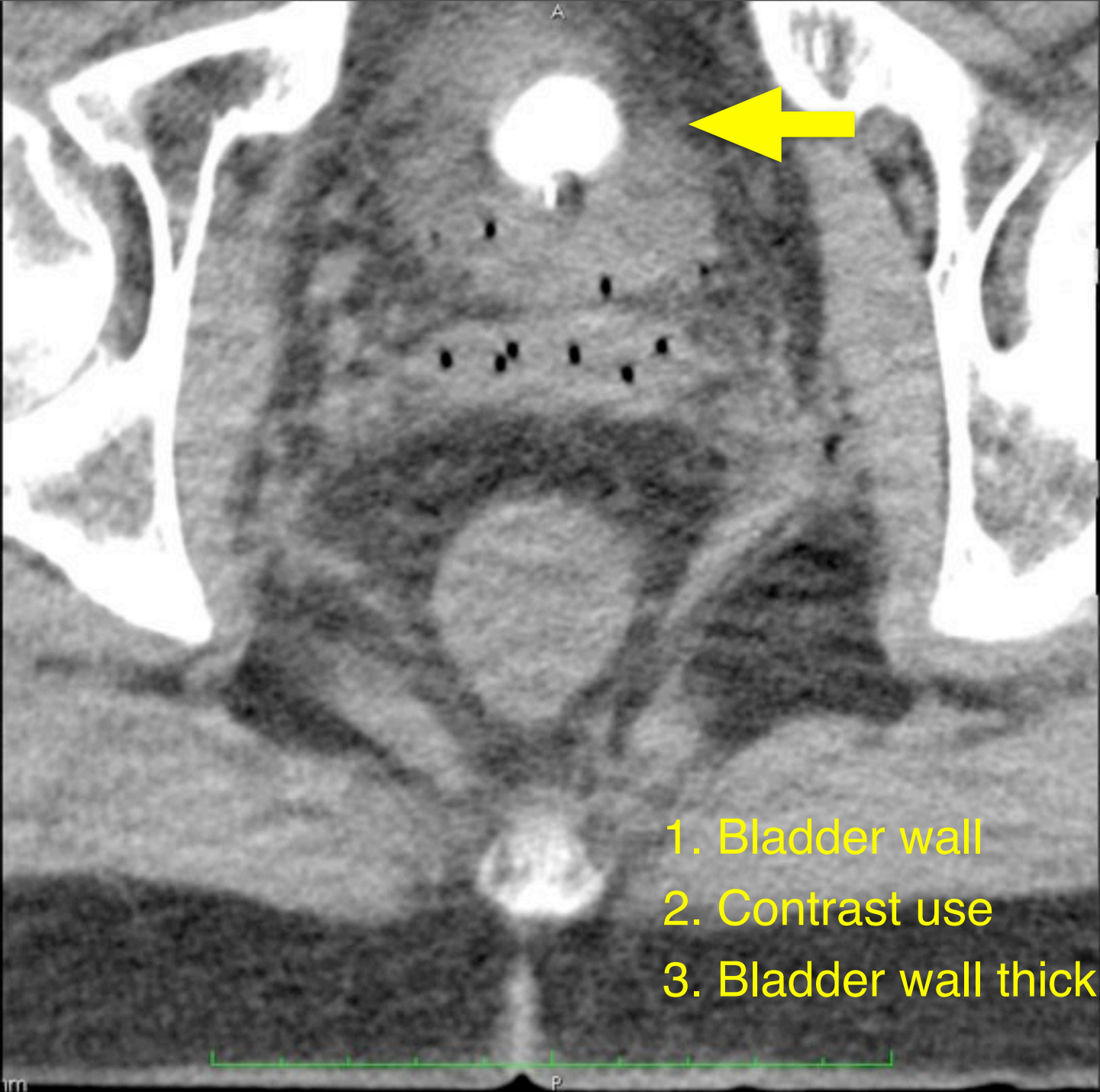
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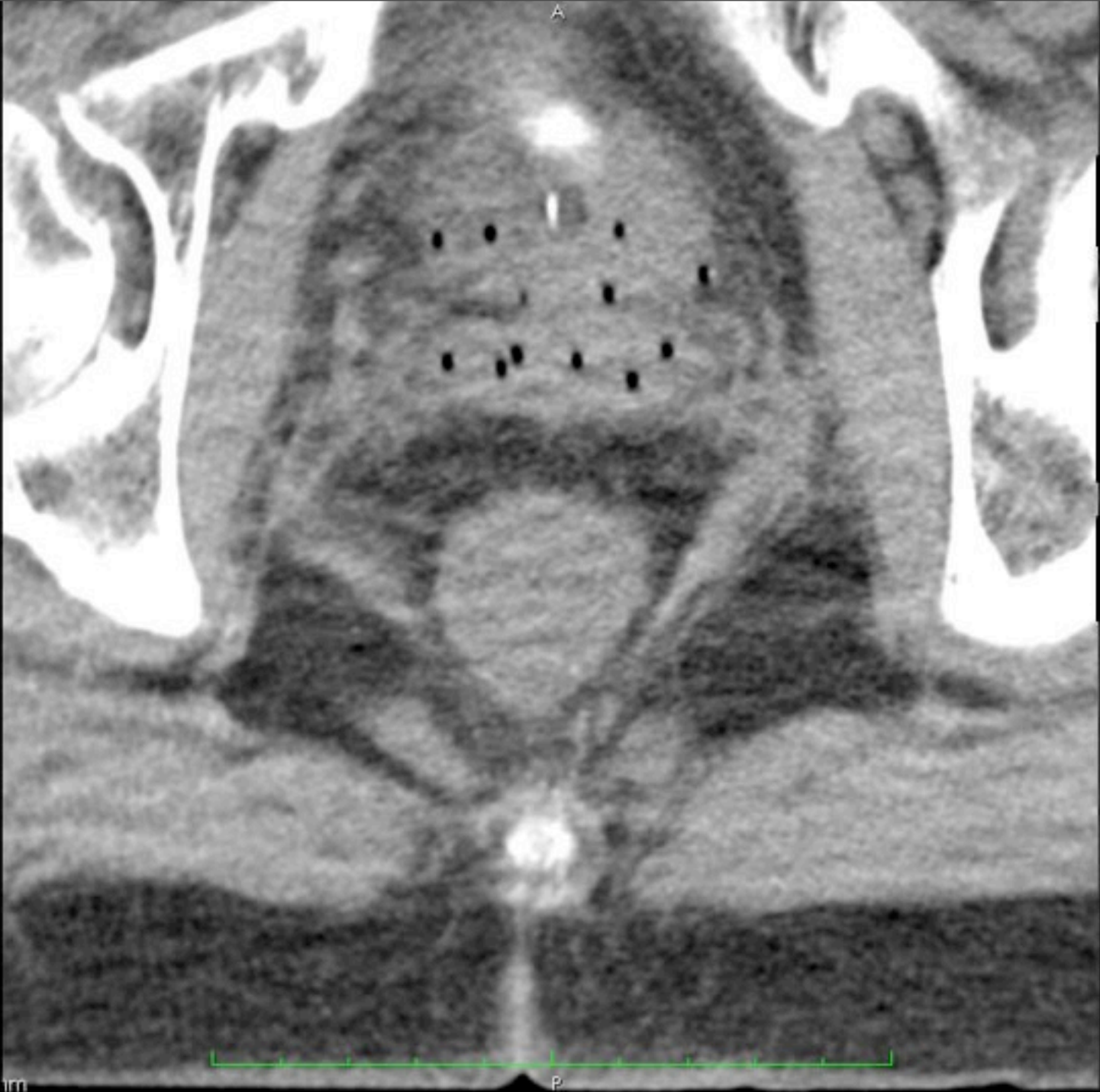


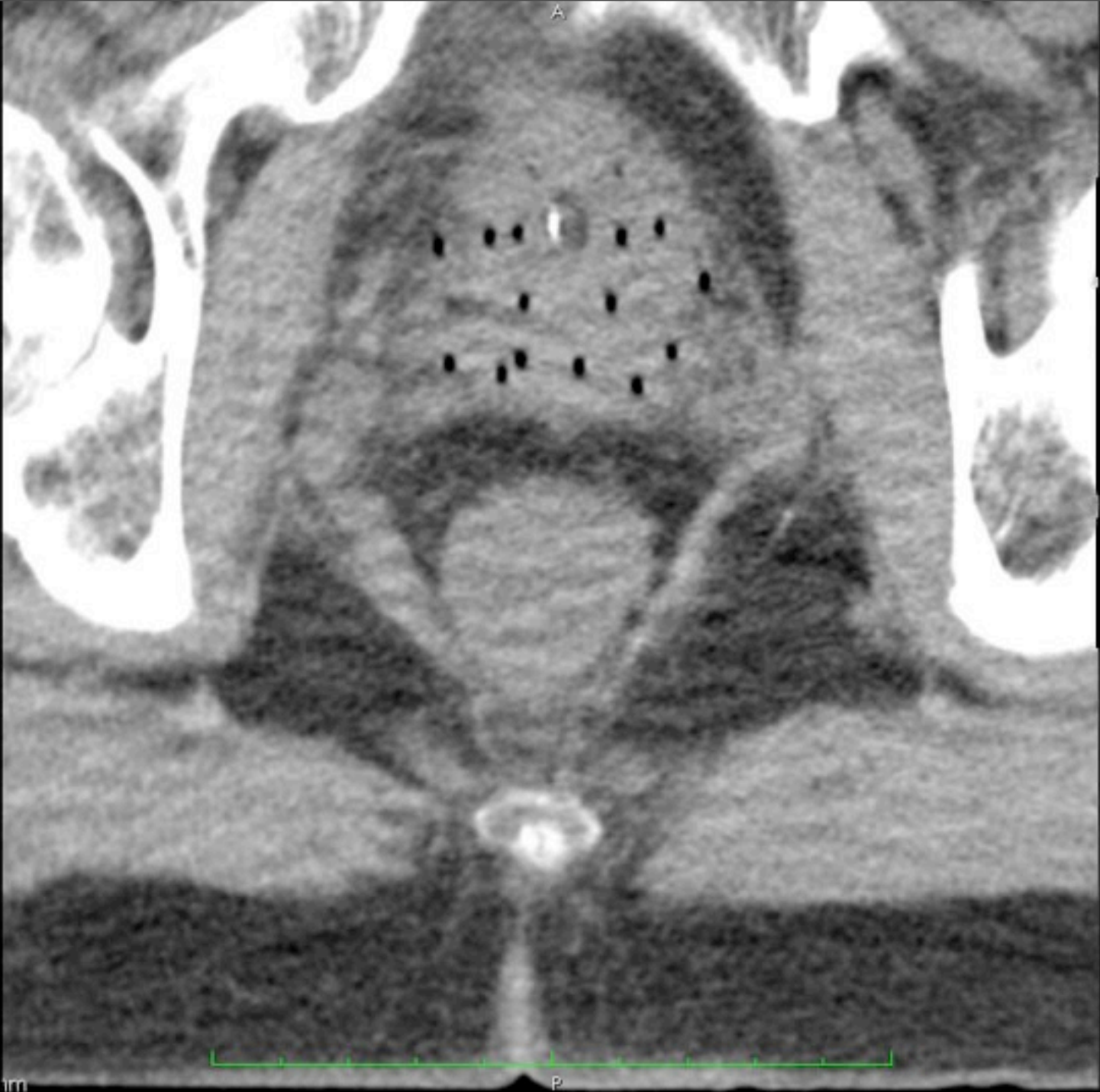


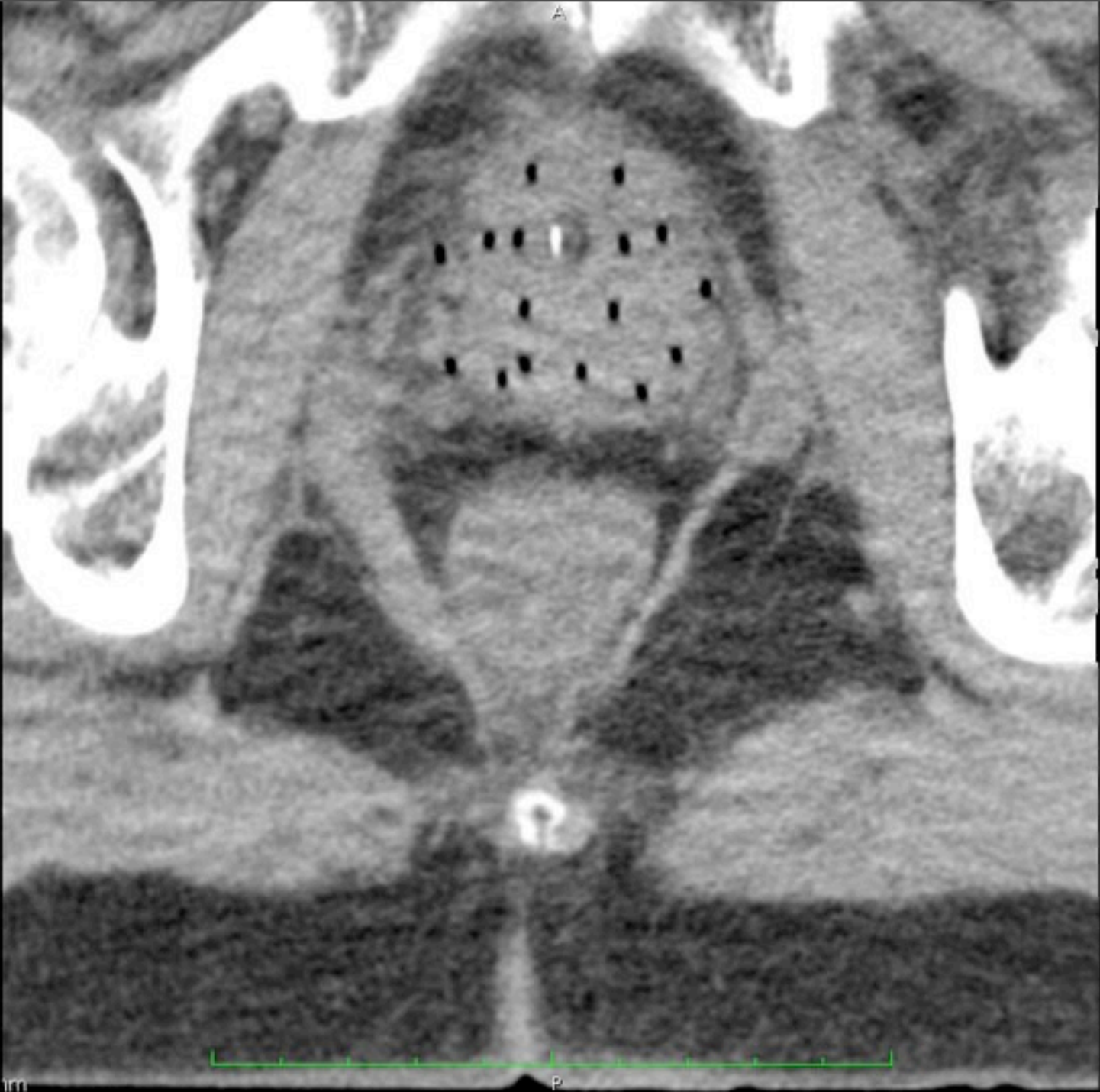


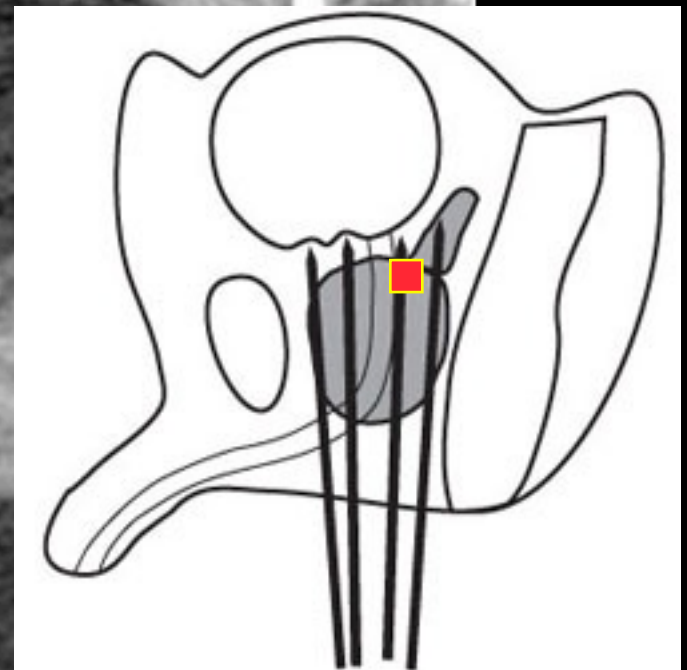
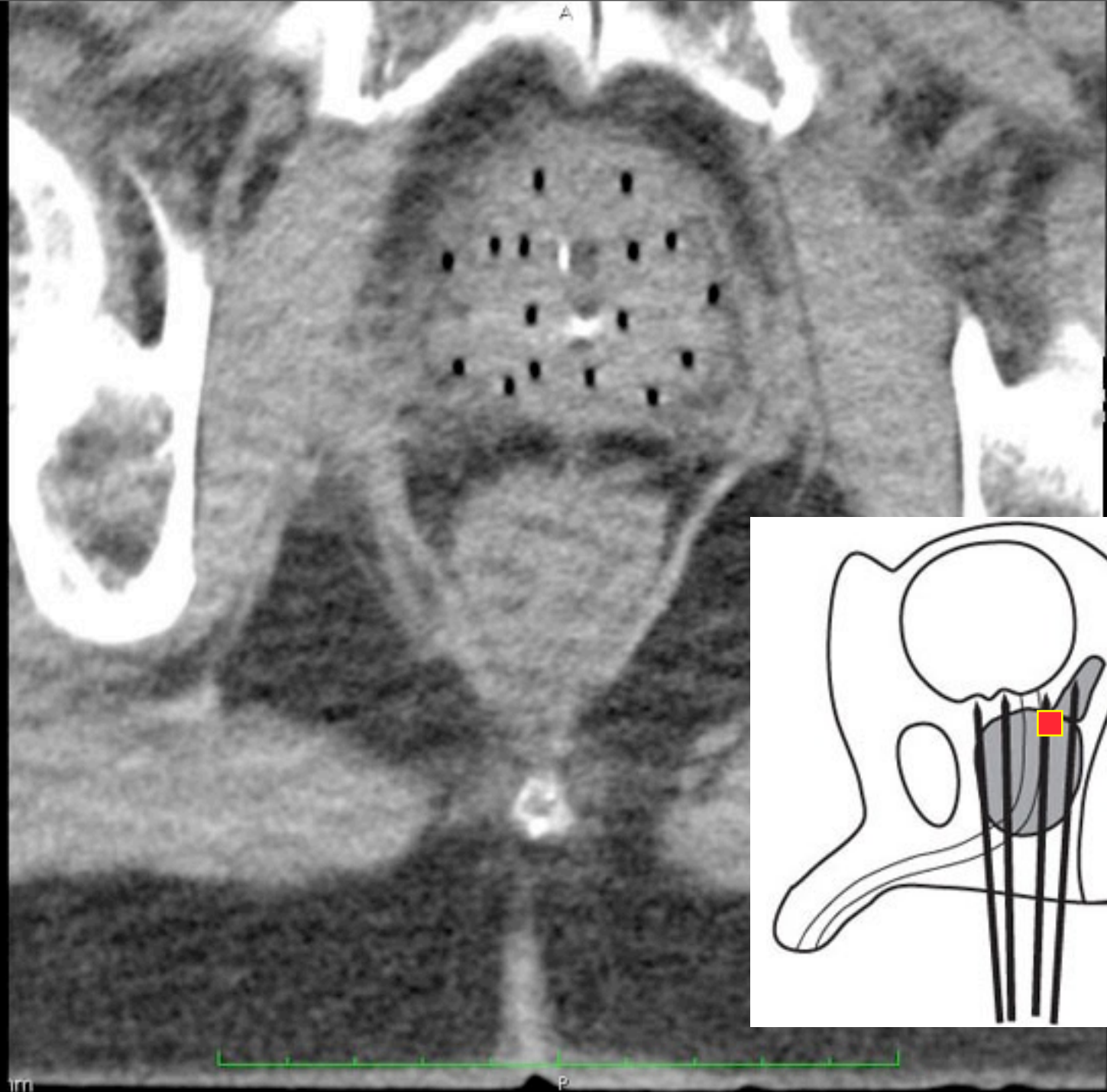


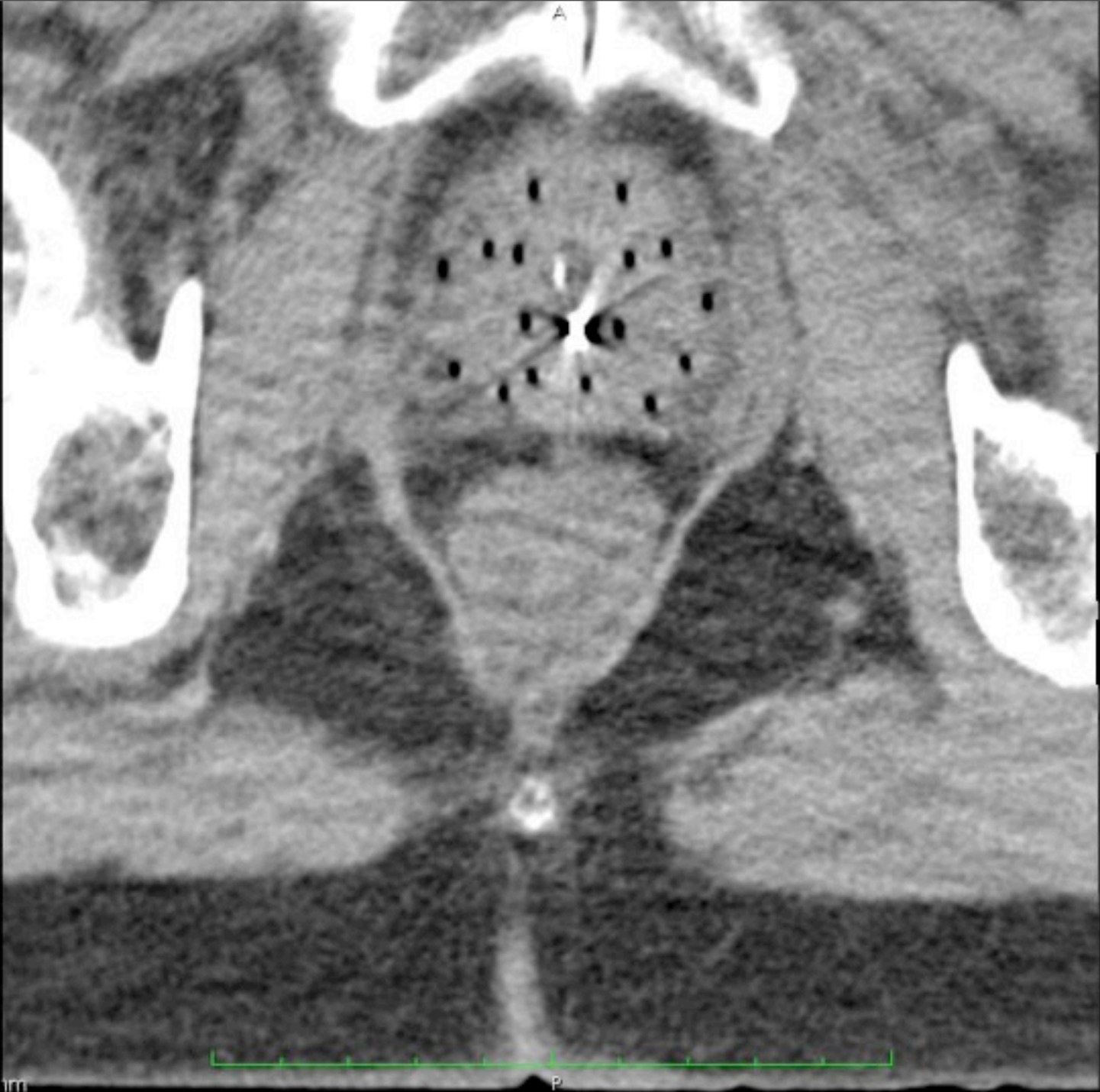
- 1. Bladder wall
- 2. Contrast use
- 3. Bladder wall thickness











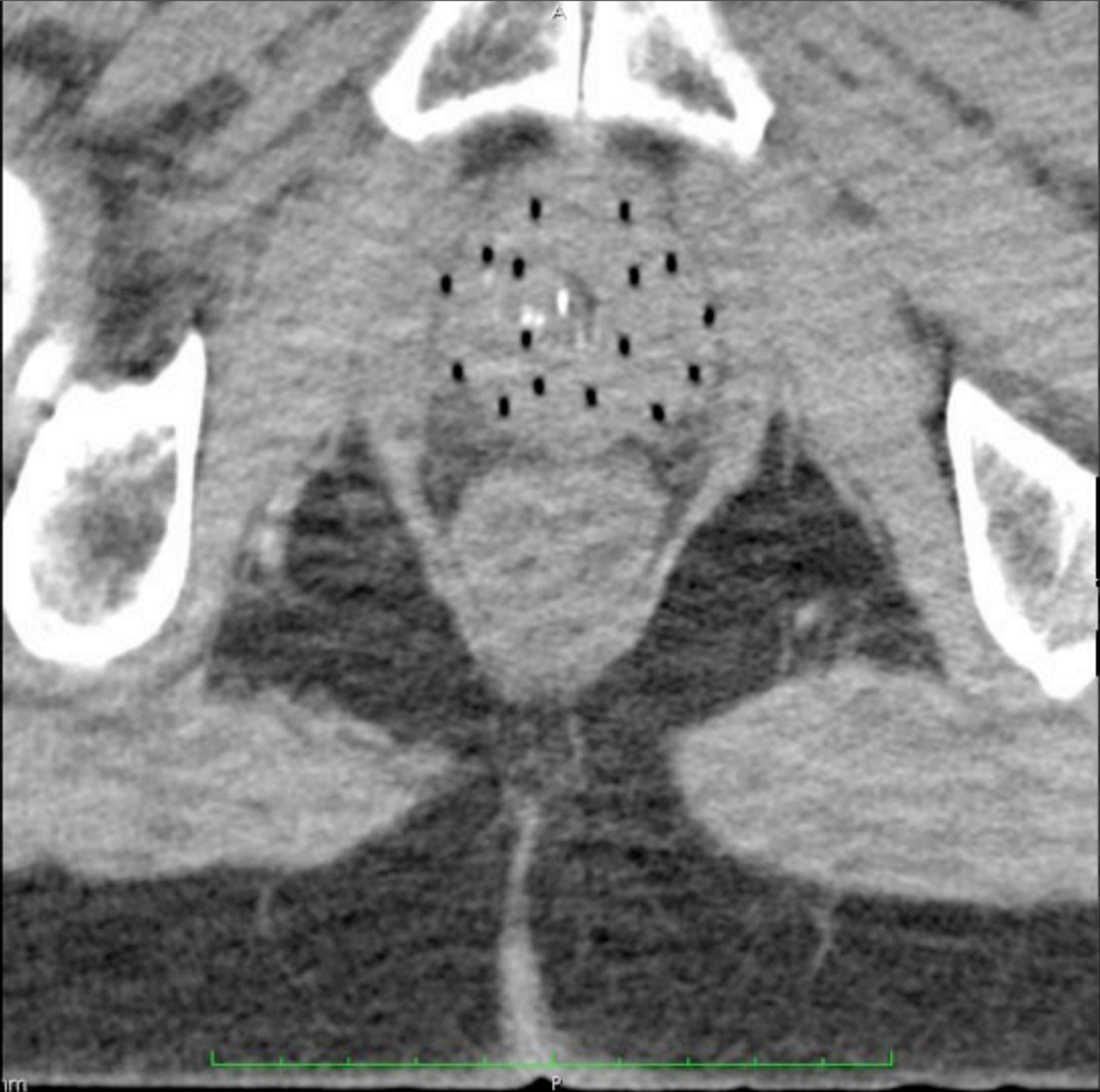
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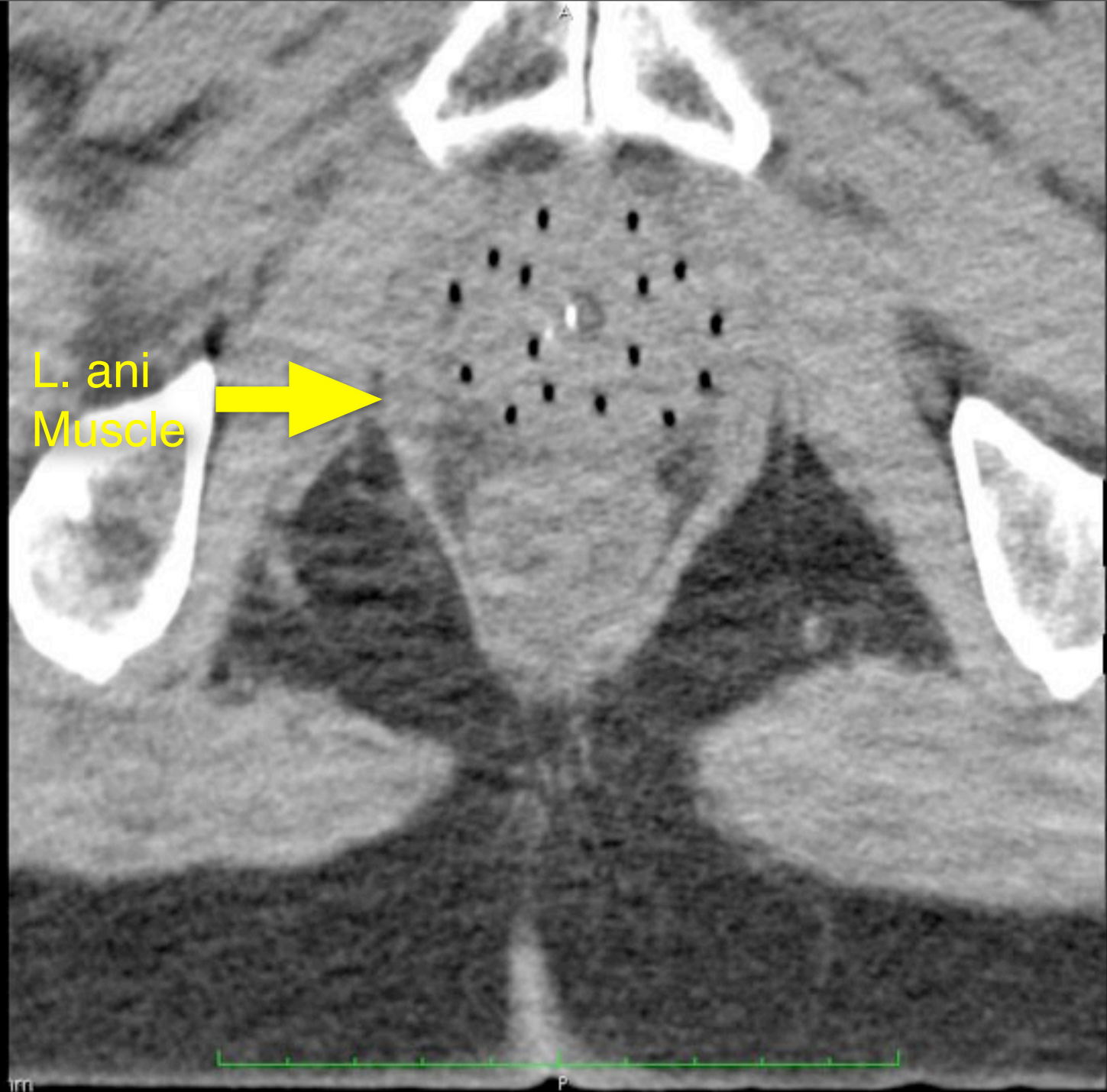
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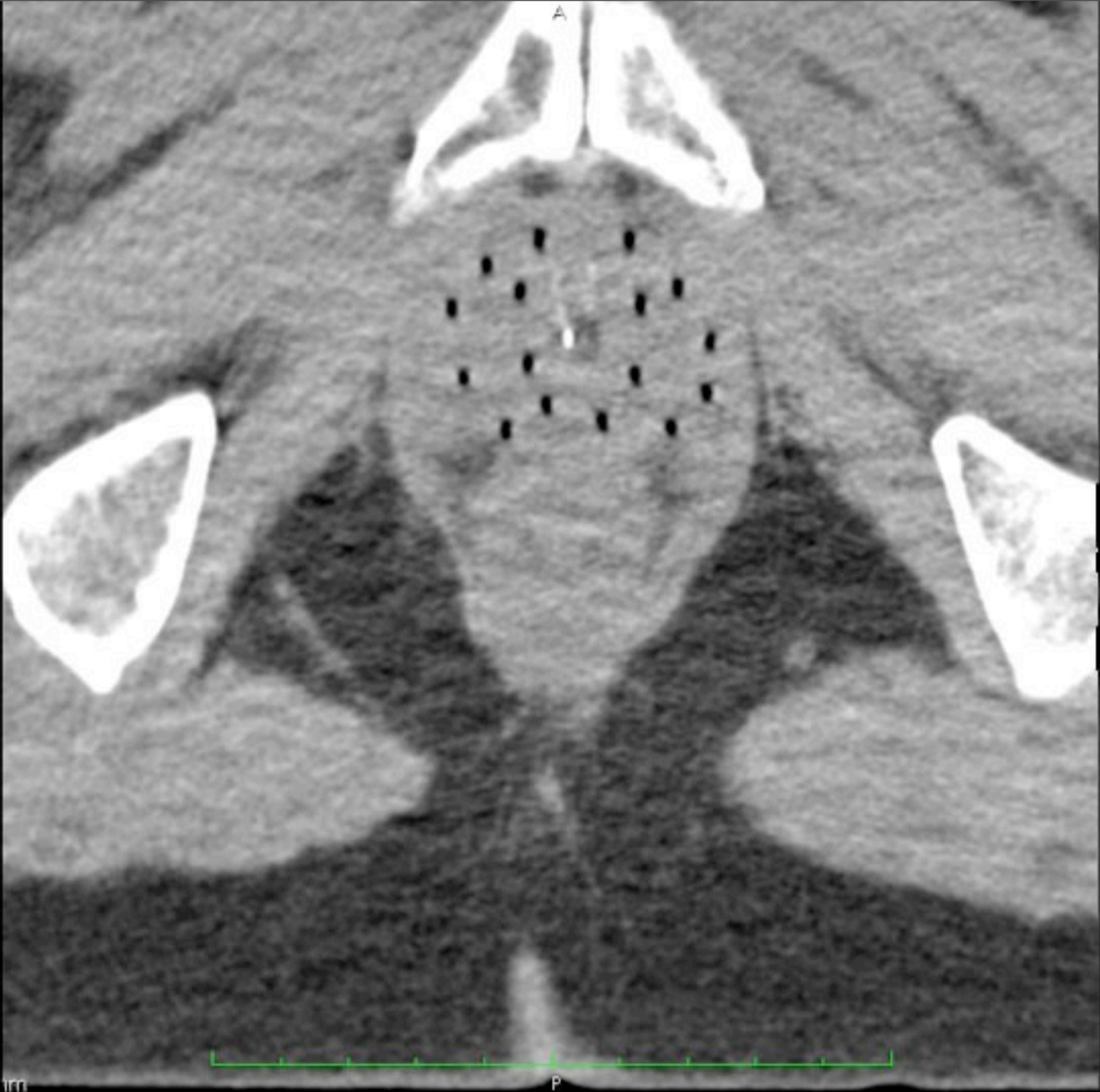






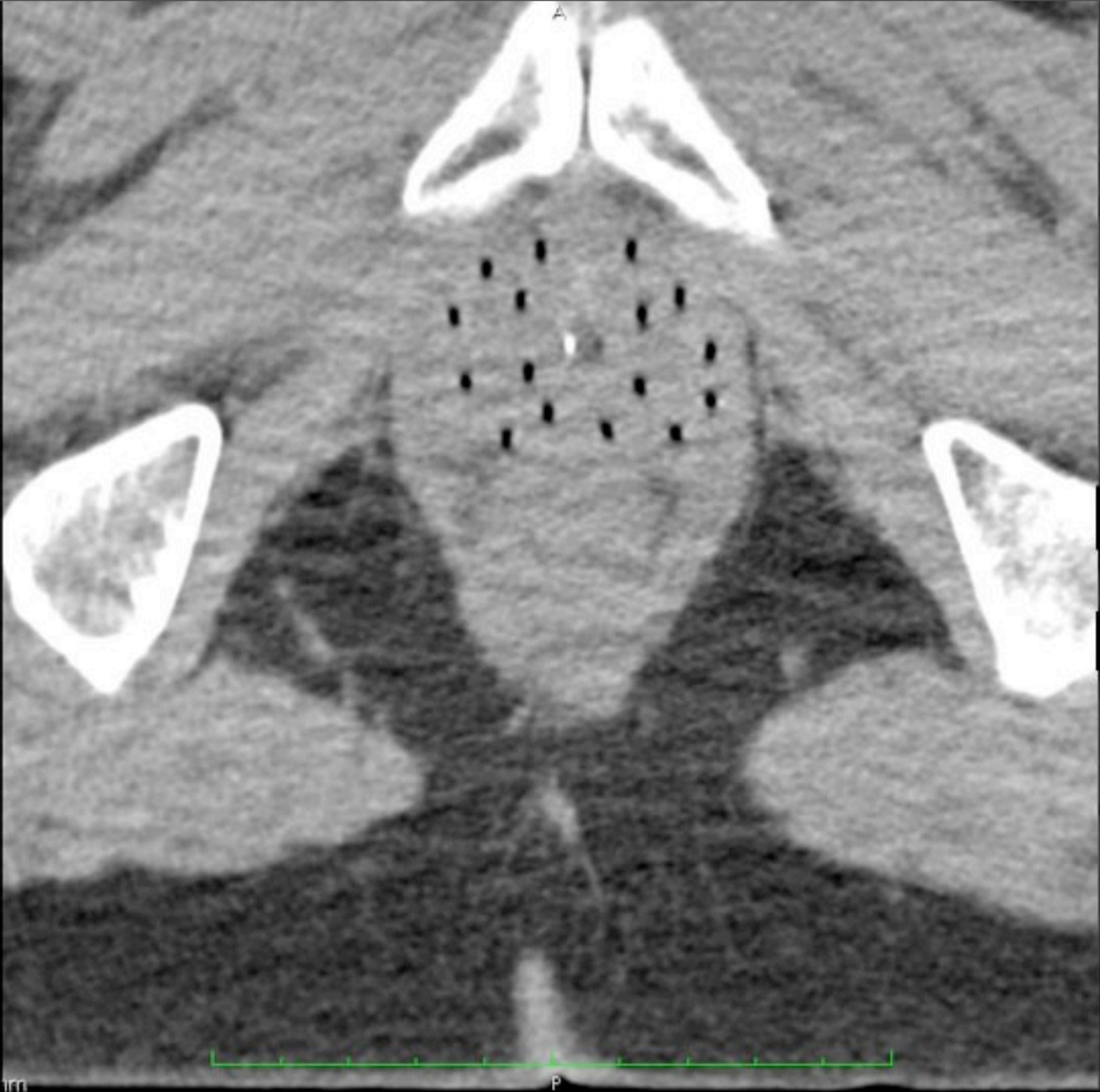
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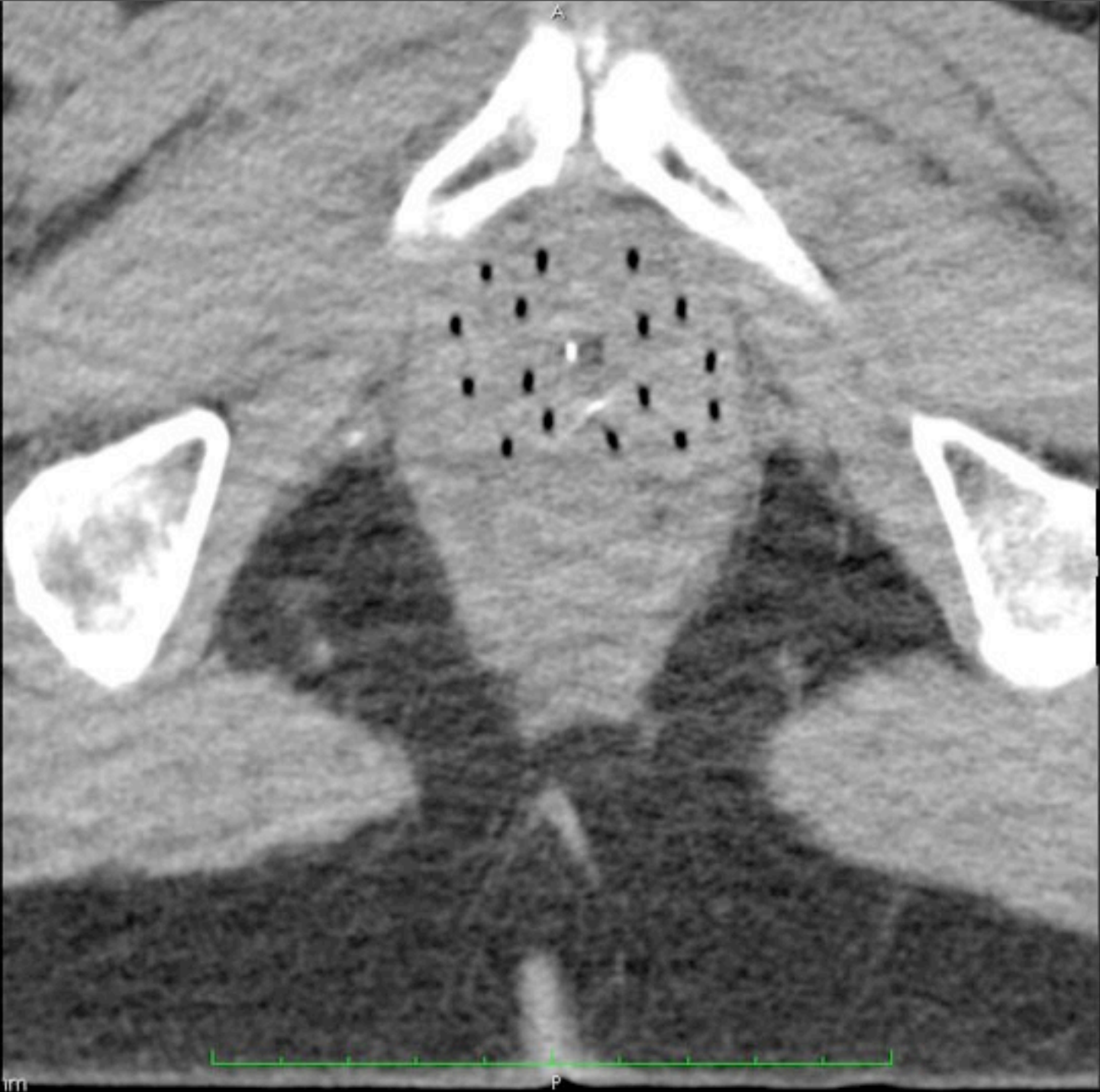
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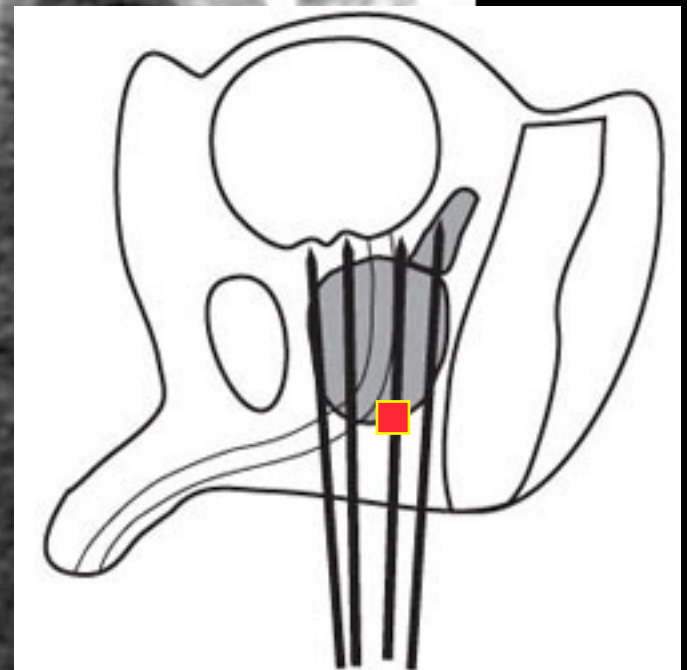
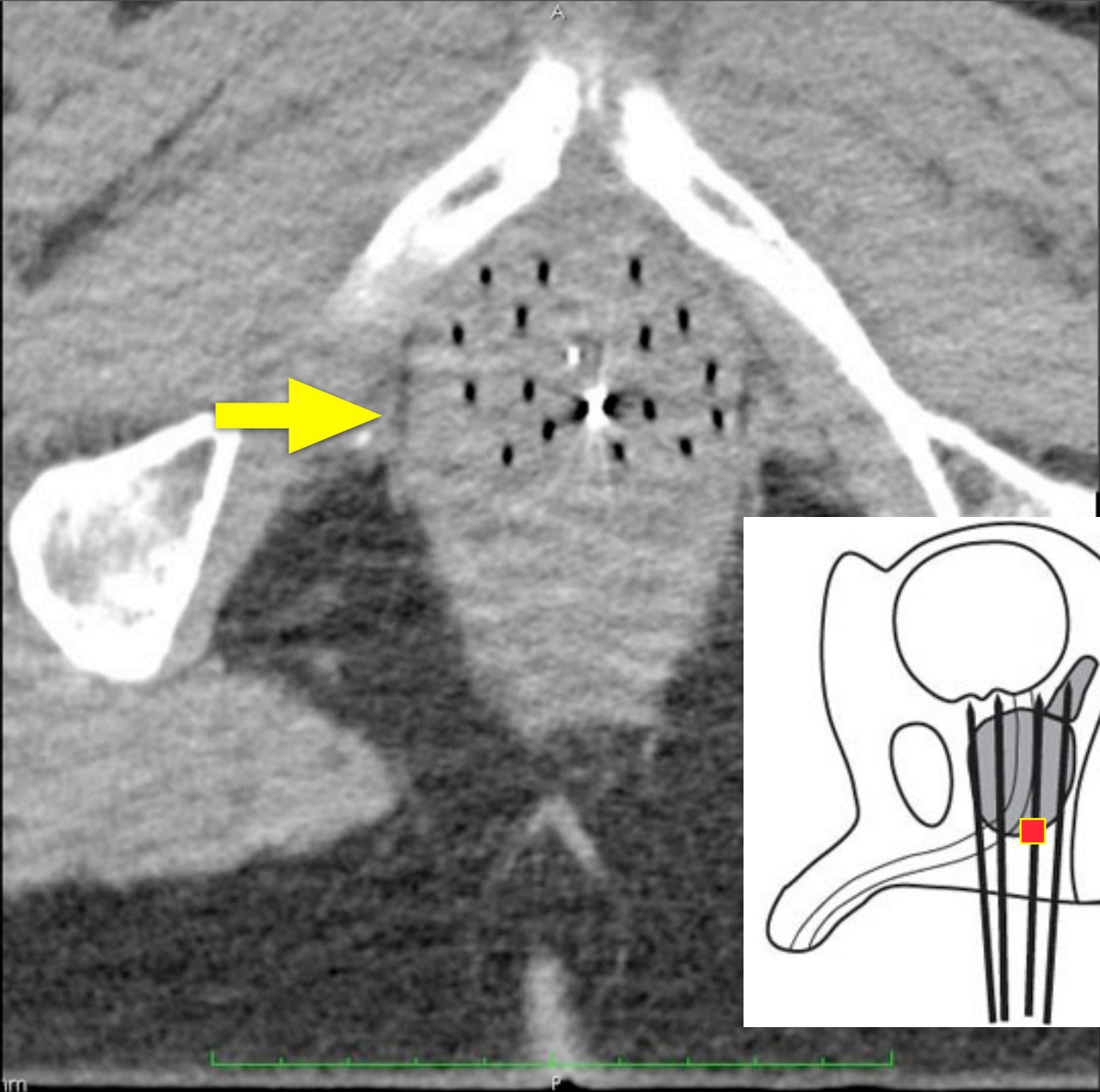
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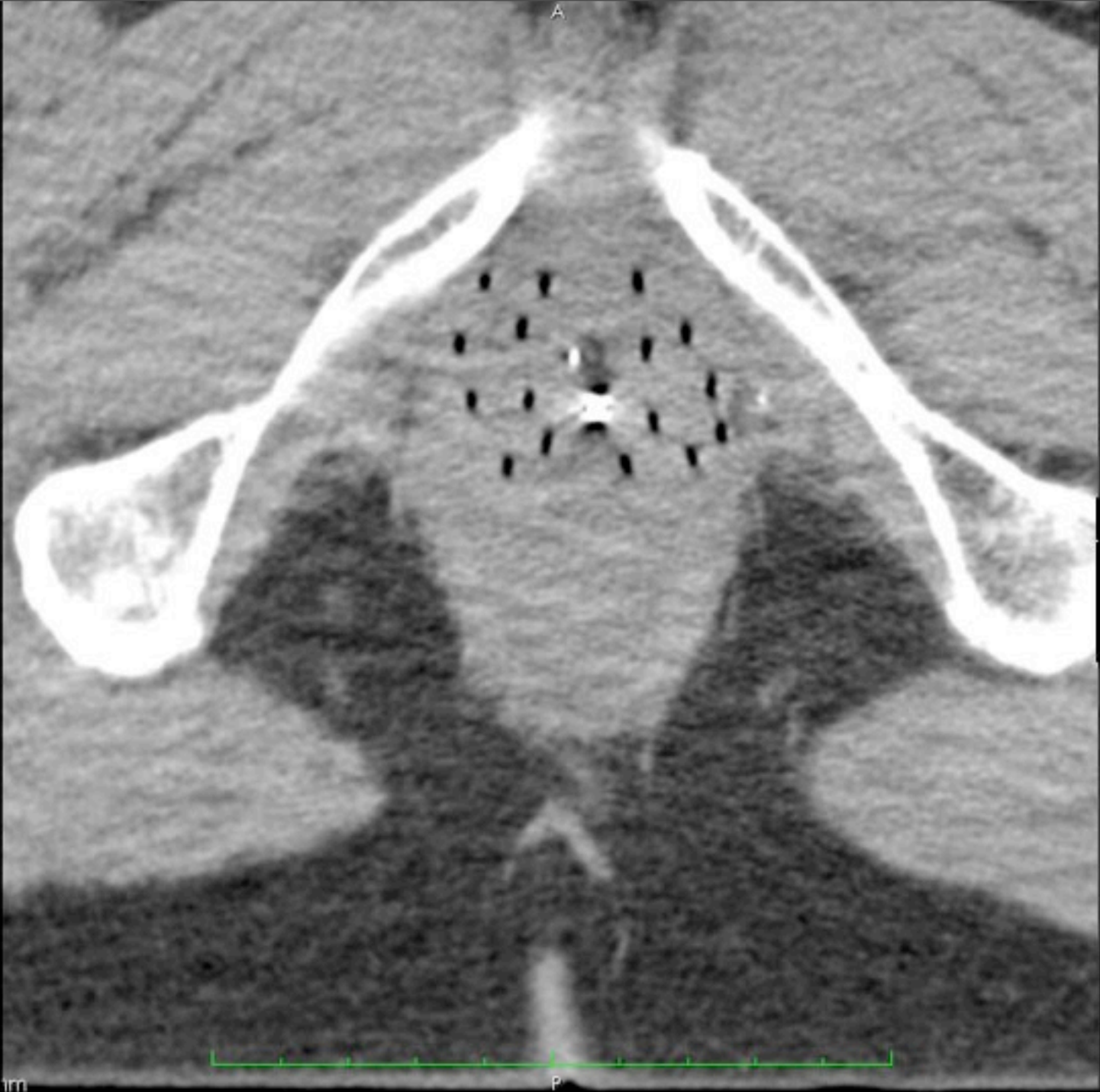


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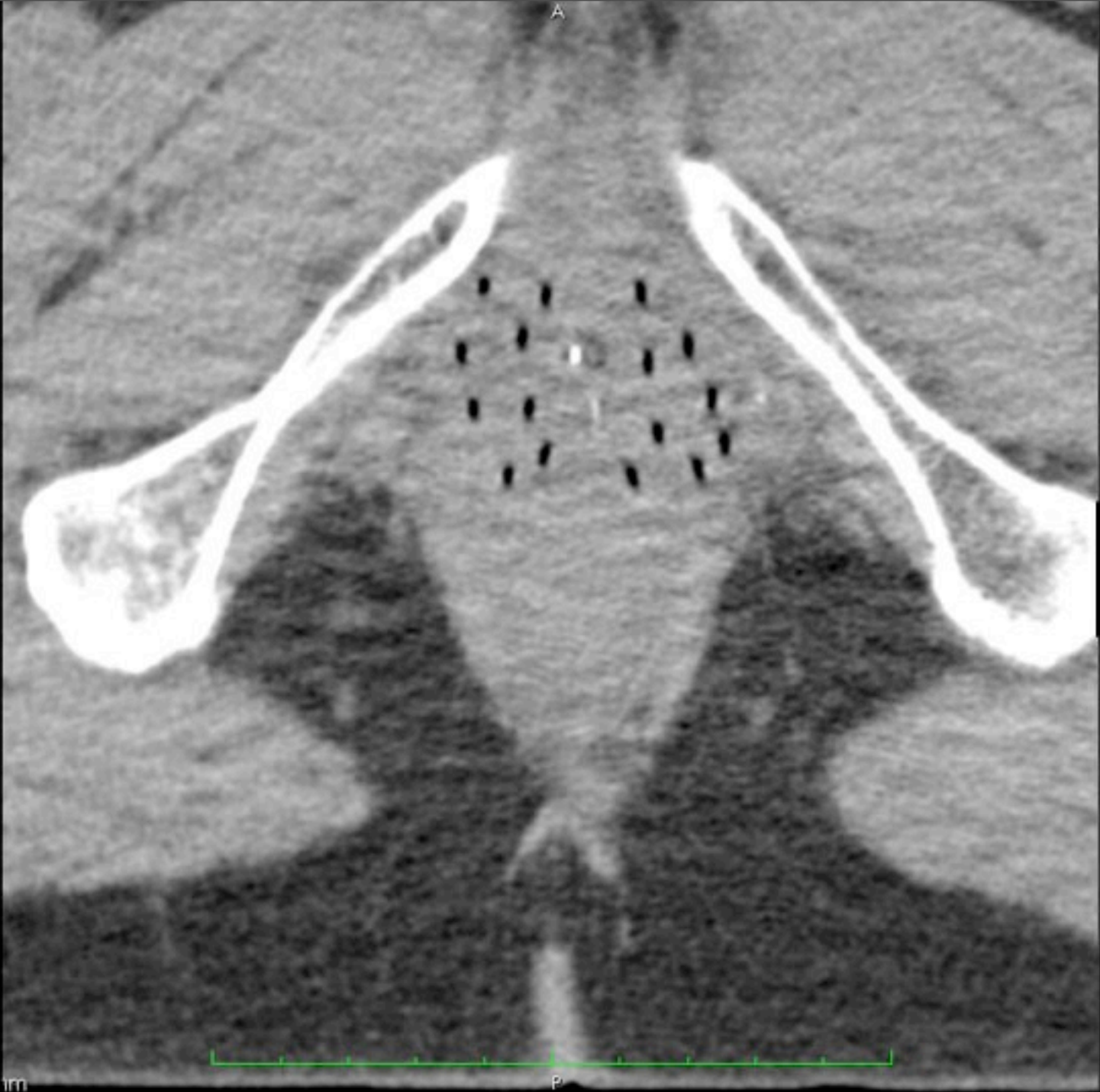




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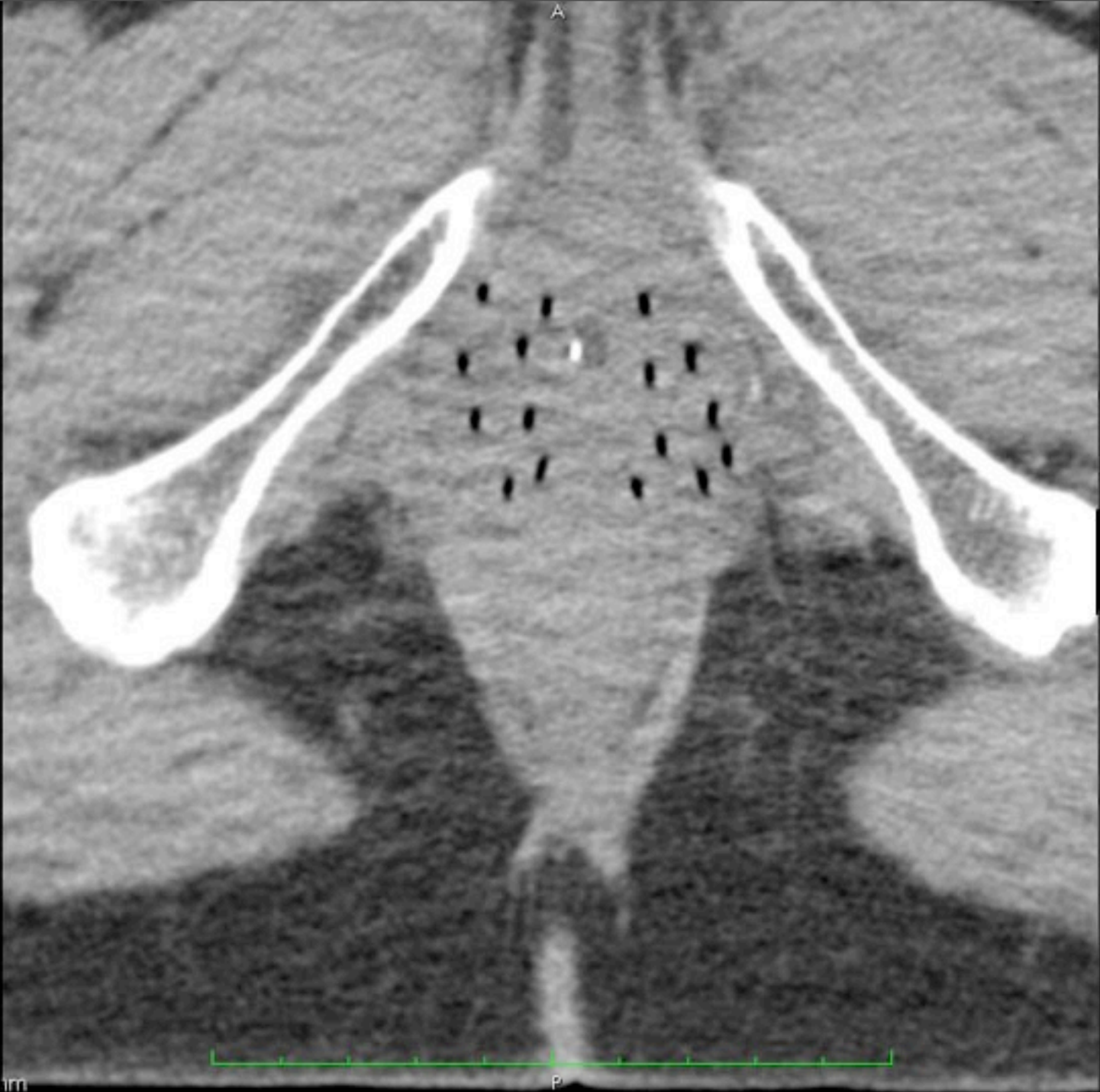
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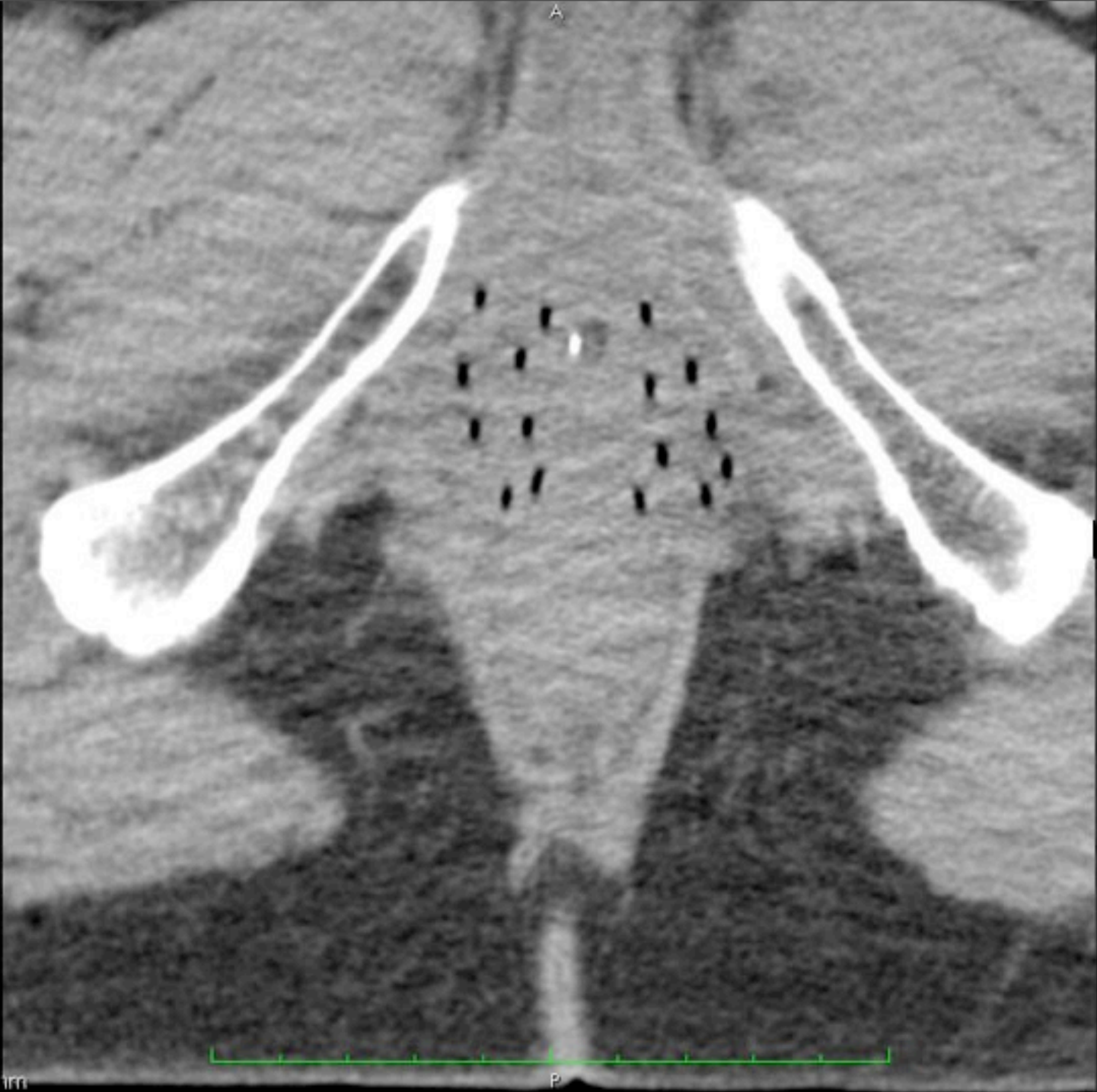
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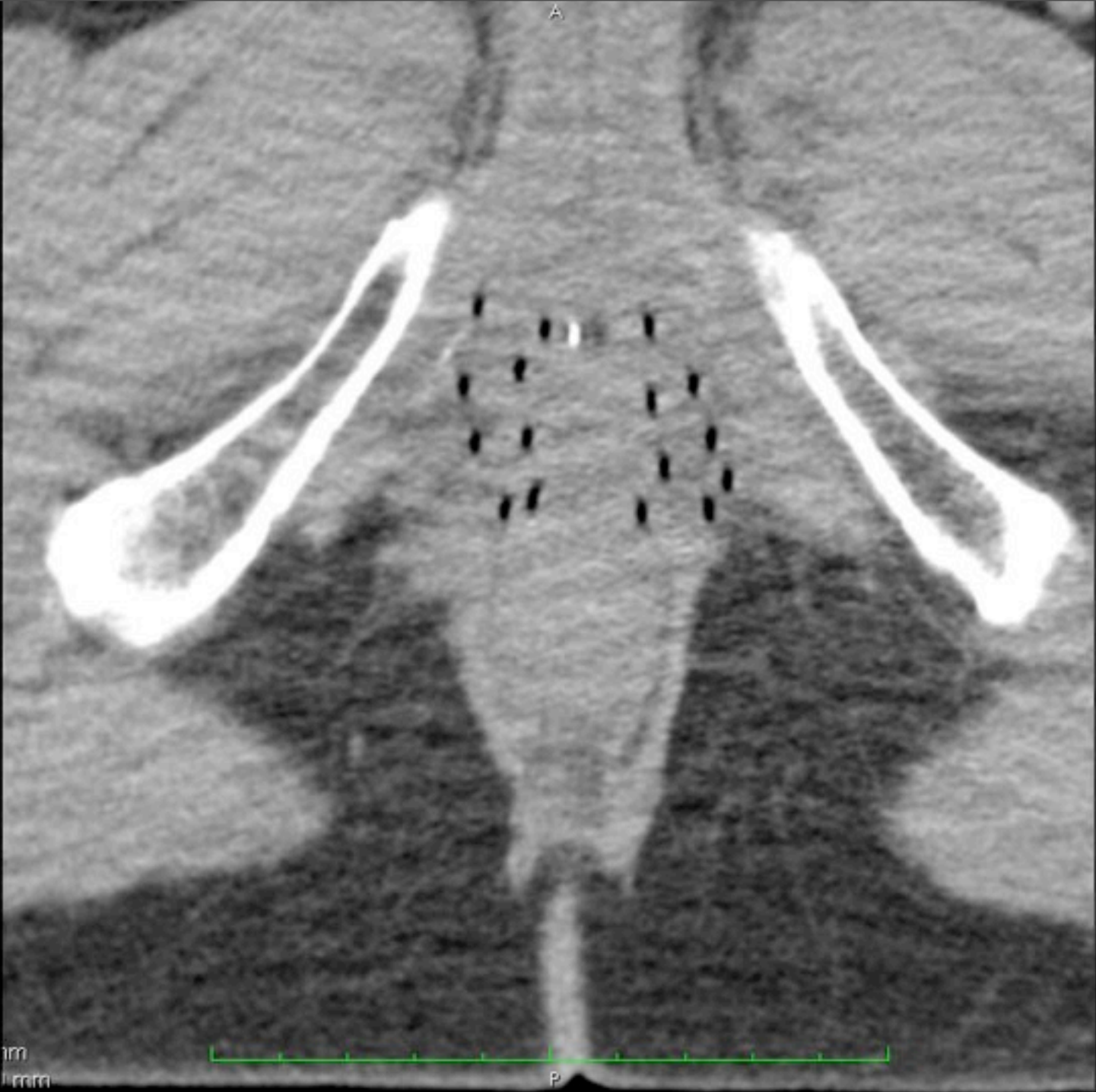


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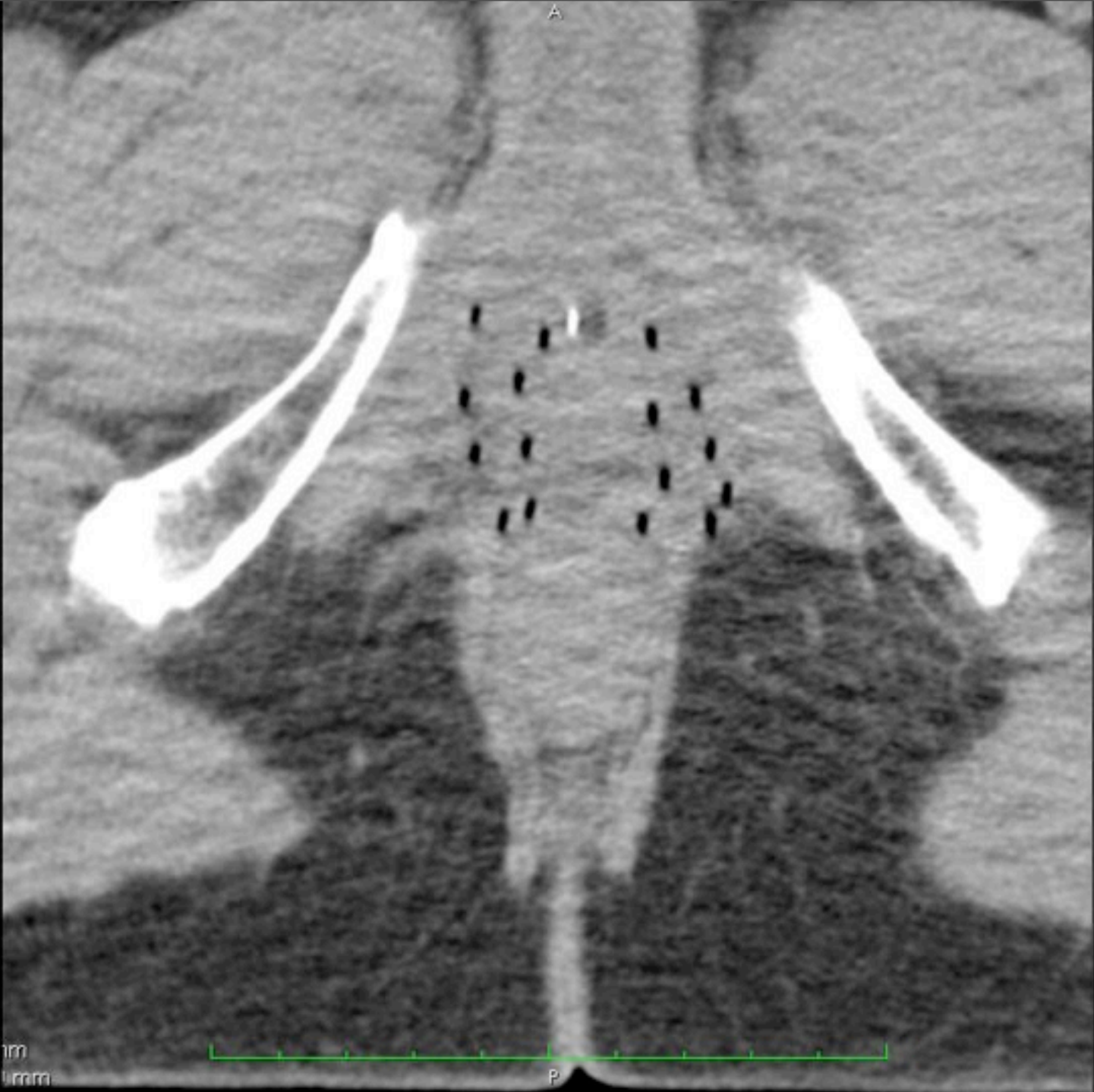


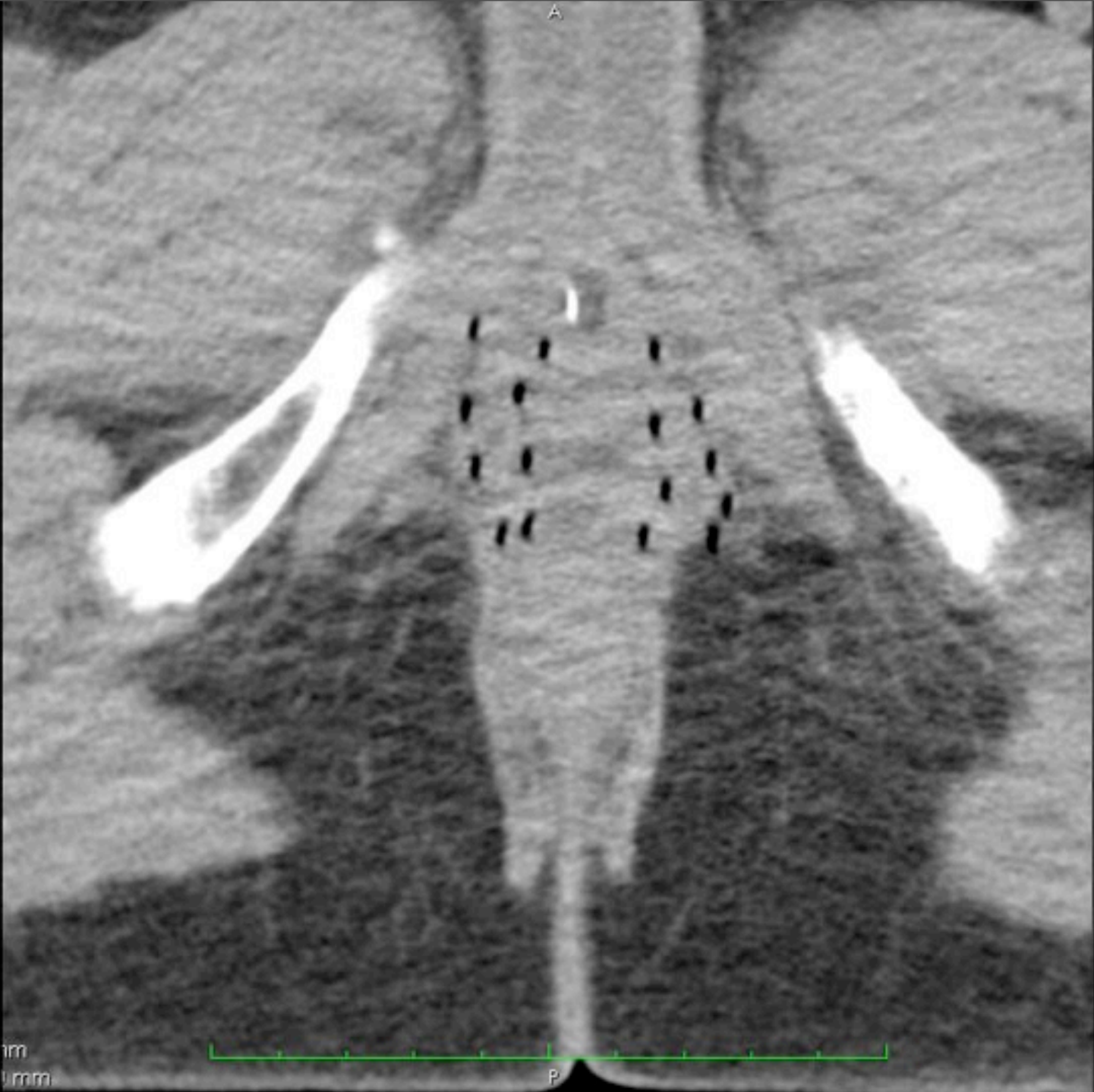


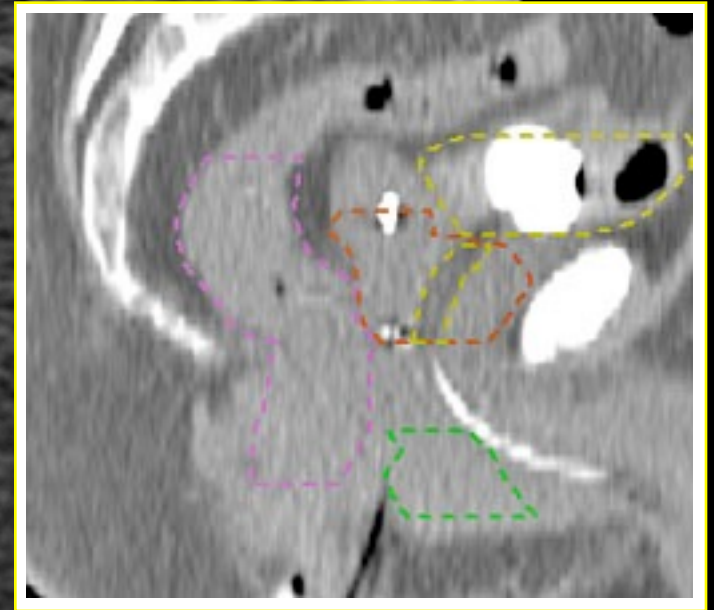
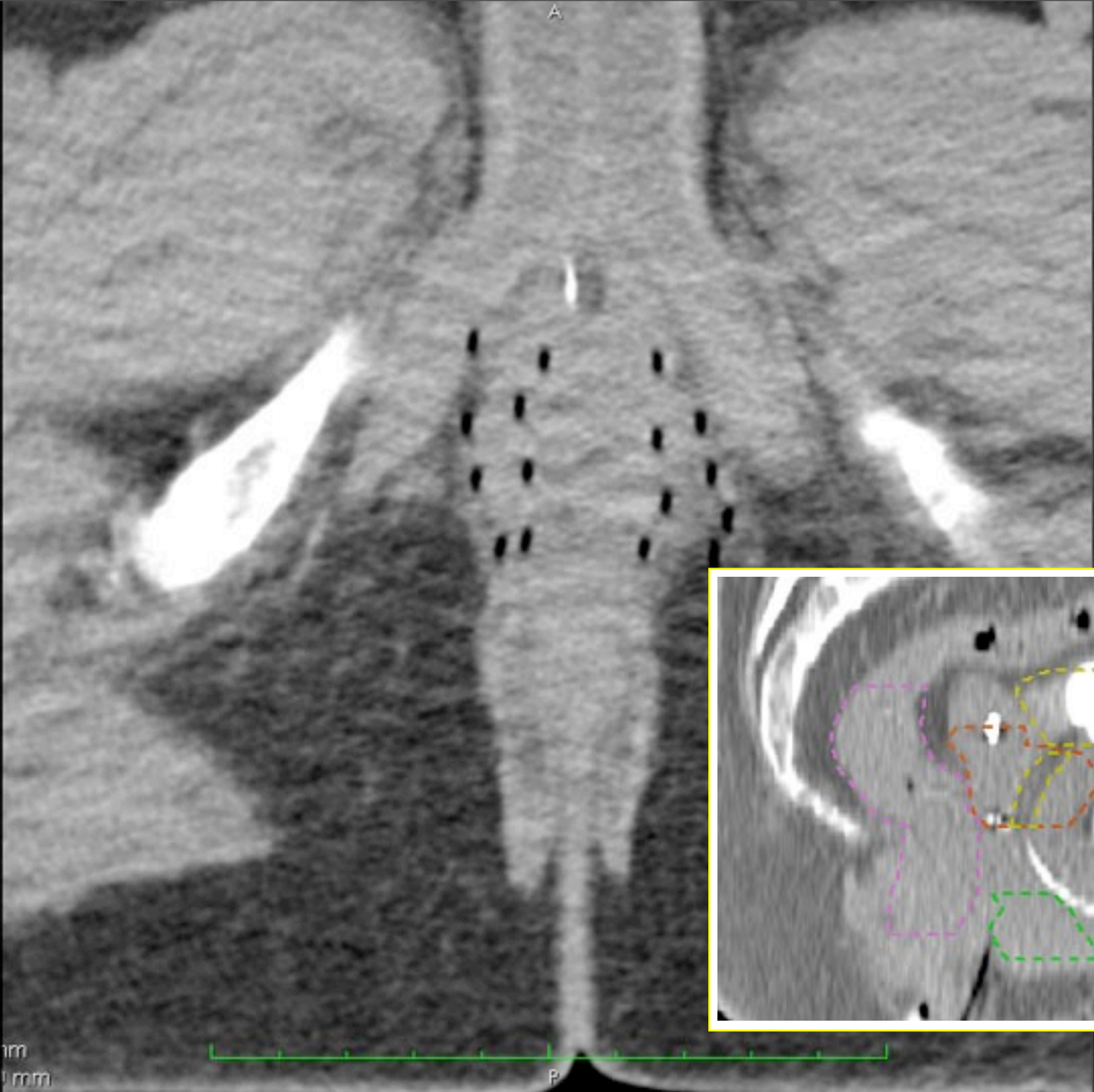


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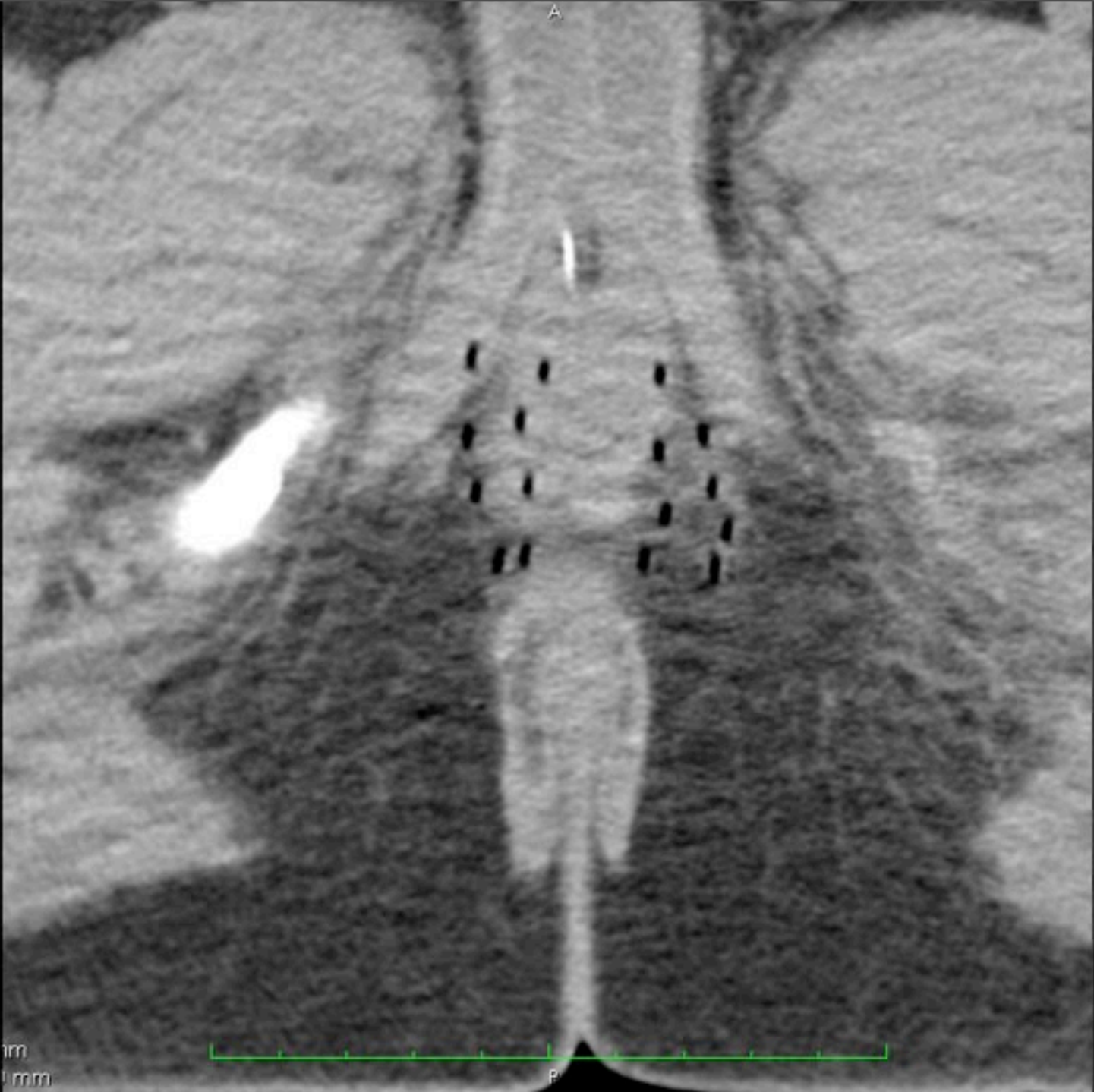






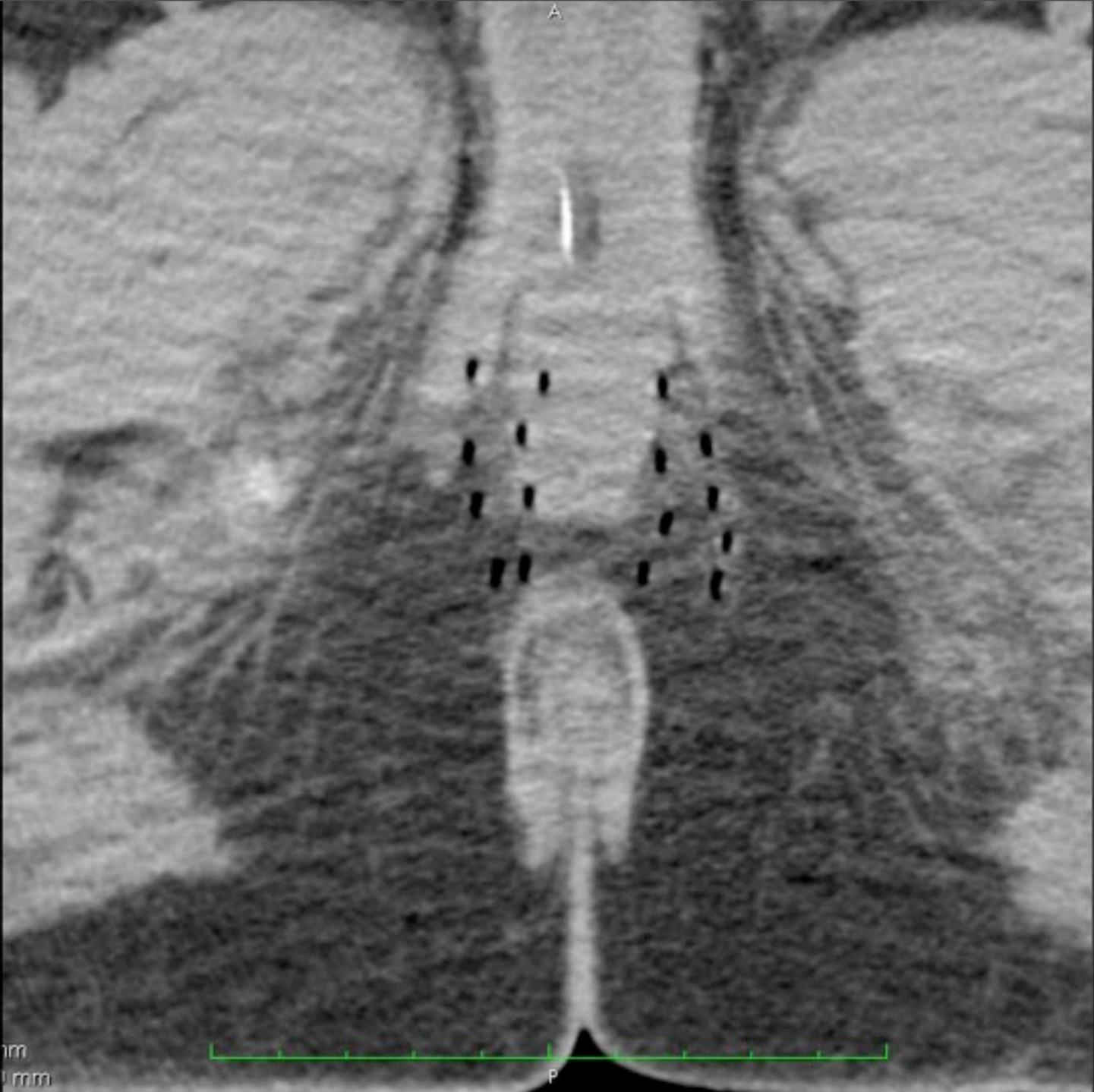
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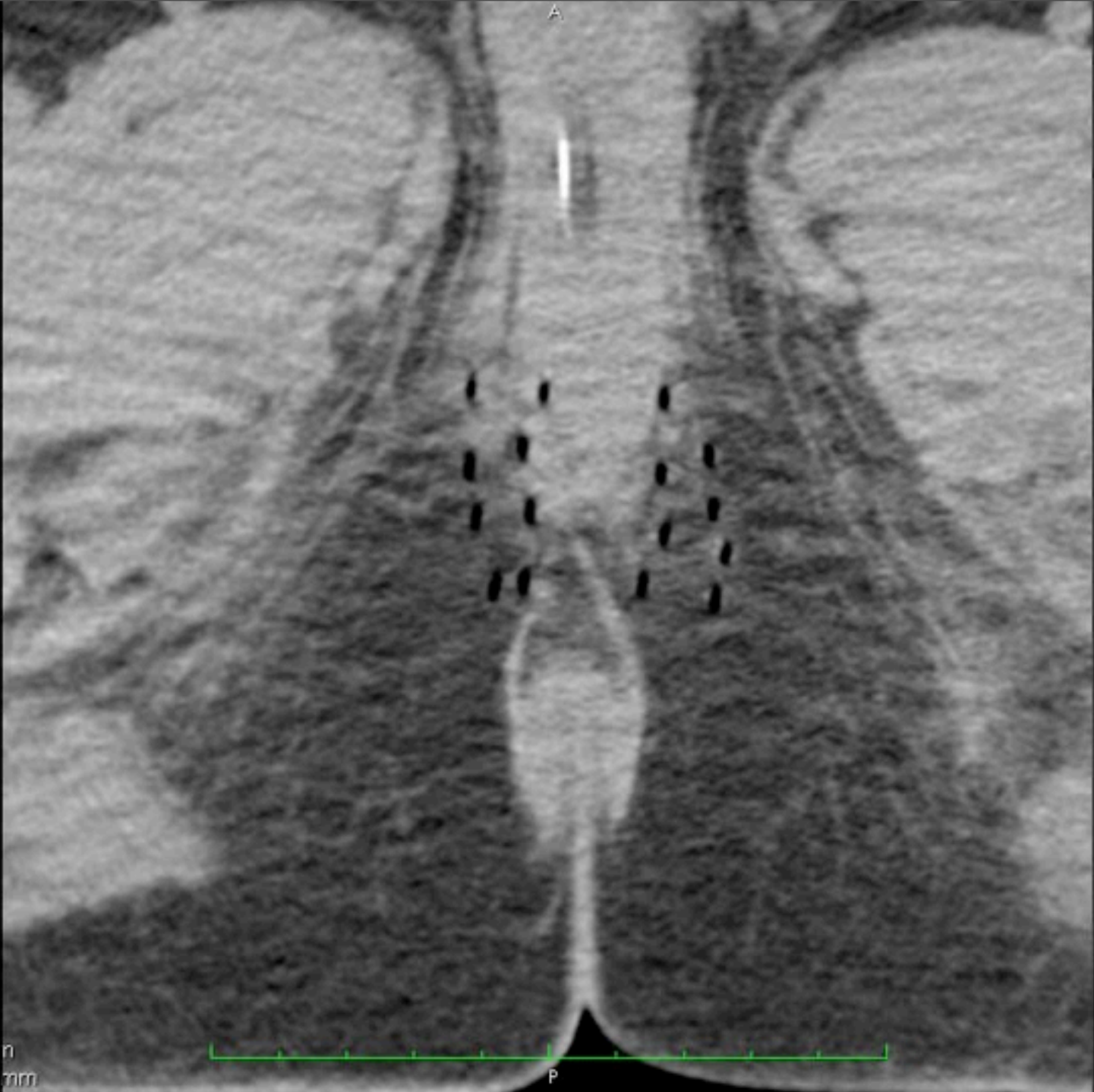
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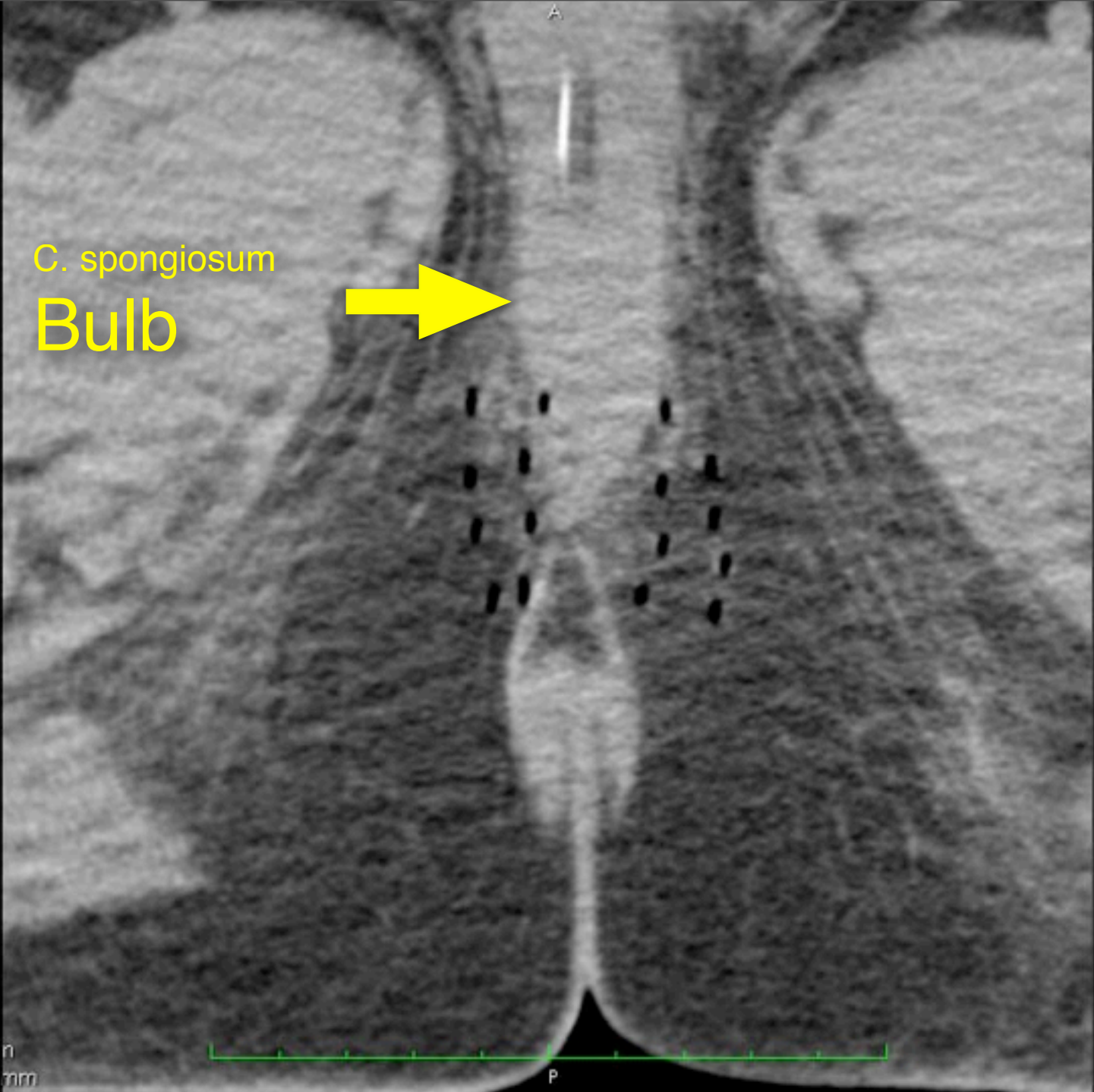
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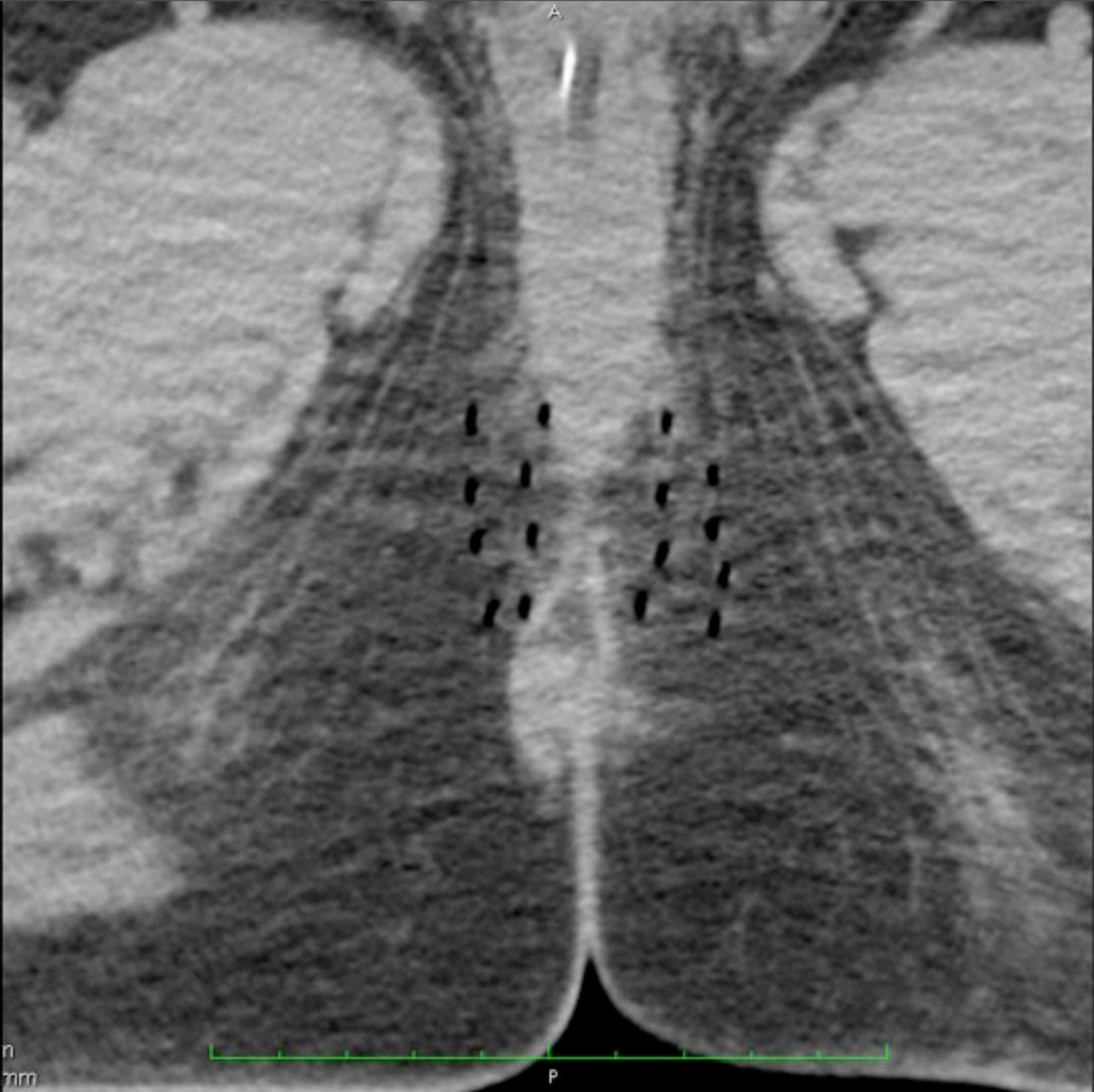


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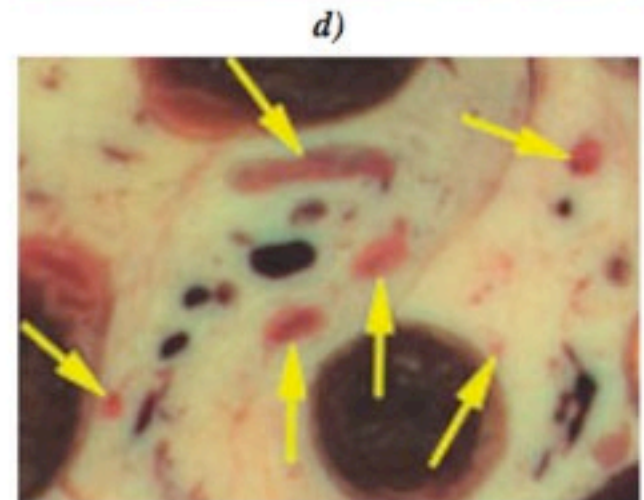
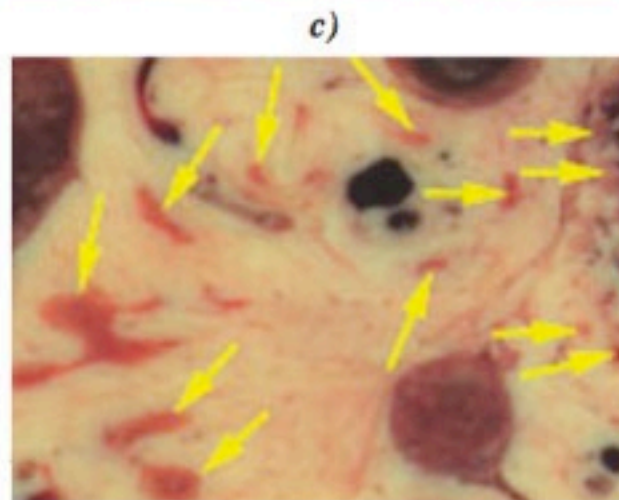
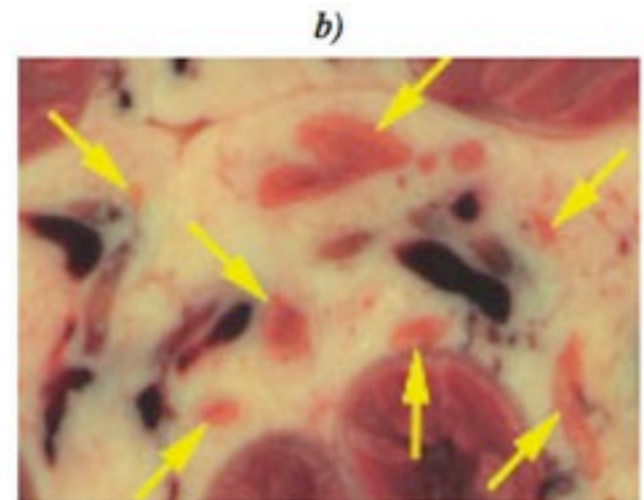
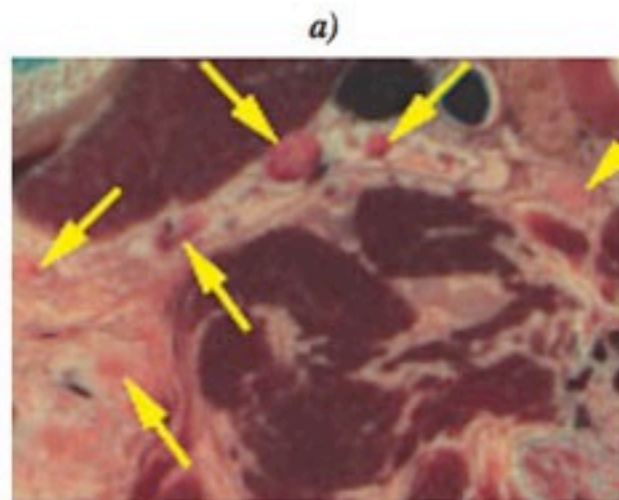


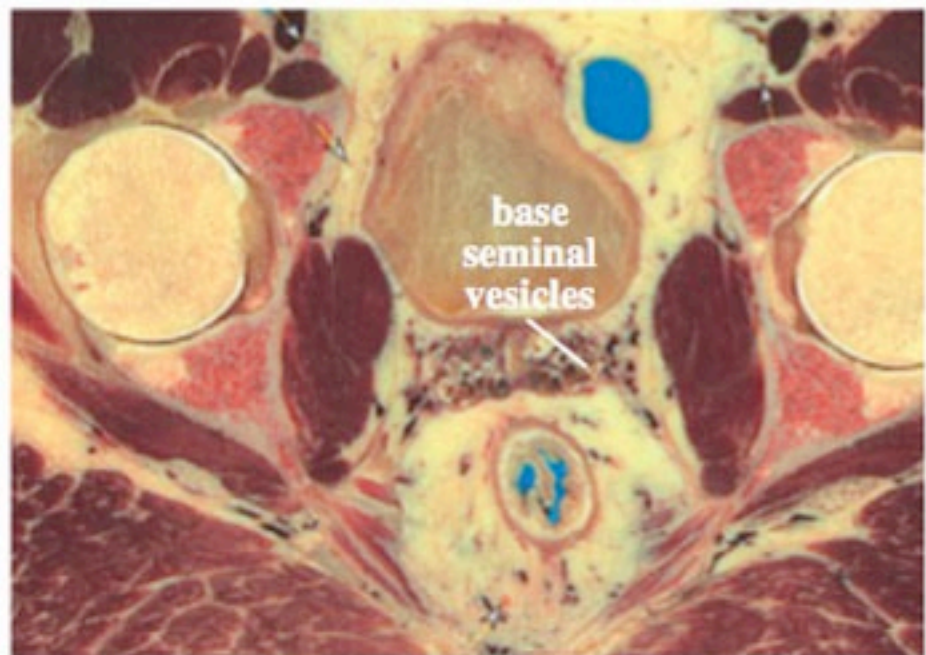
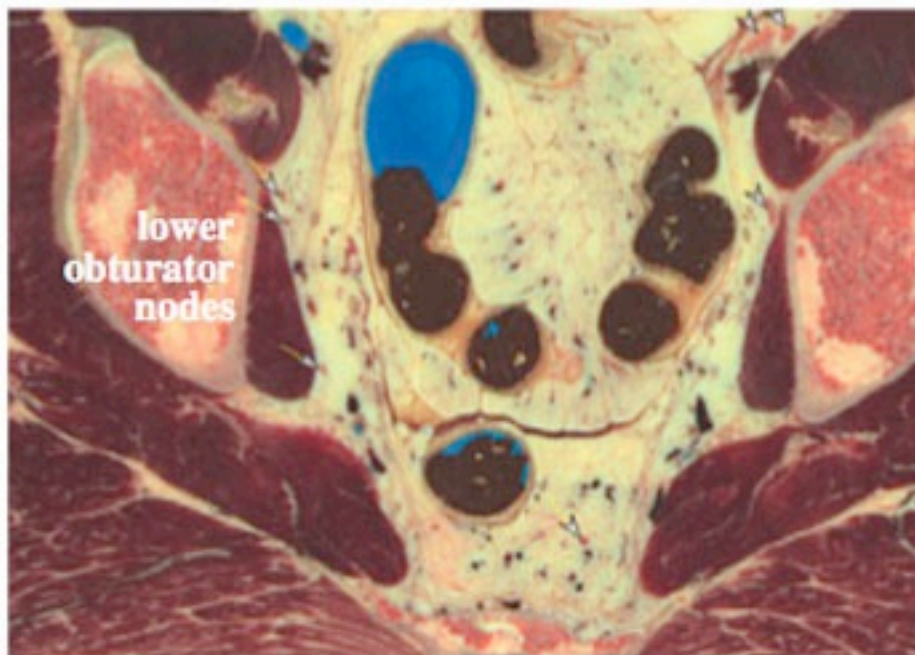
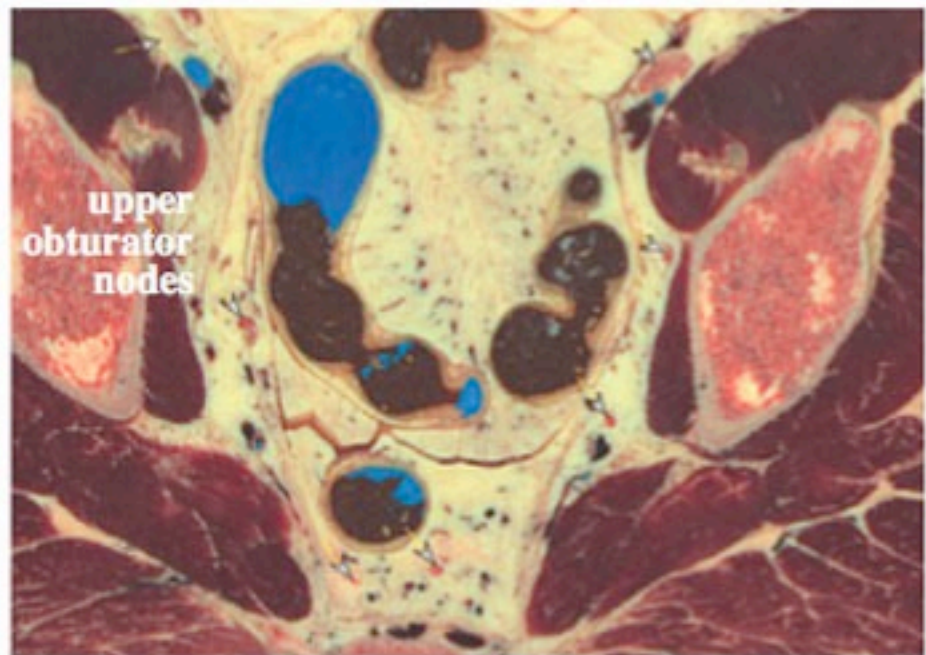
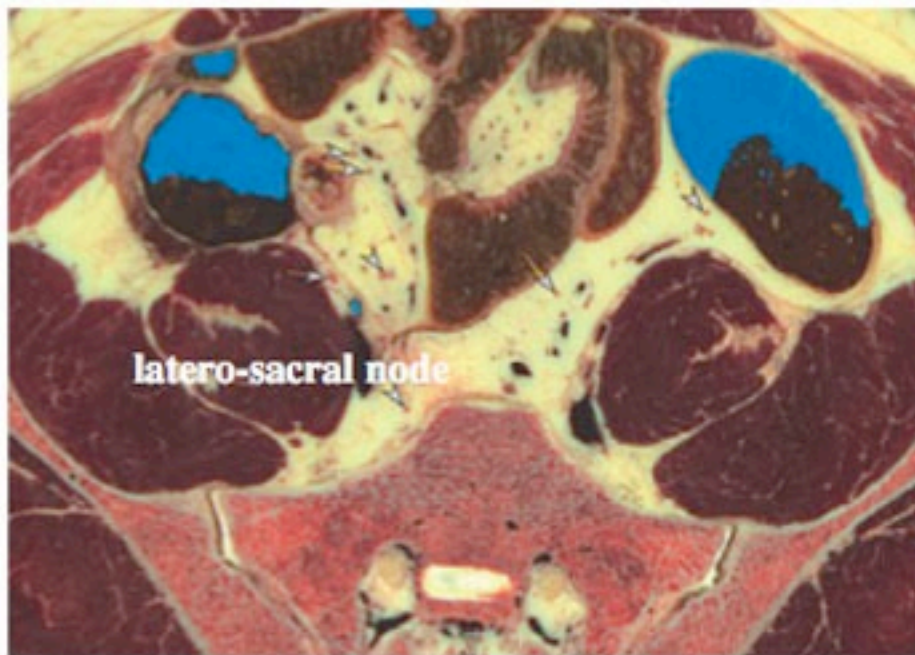
C. spongiosum
Bulb

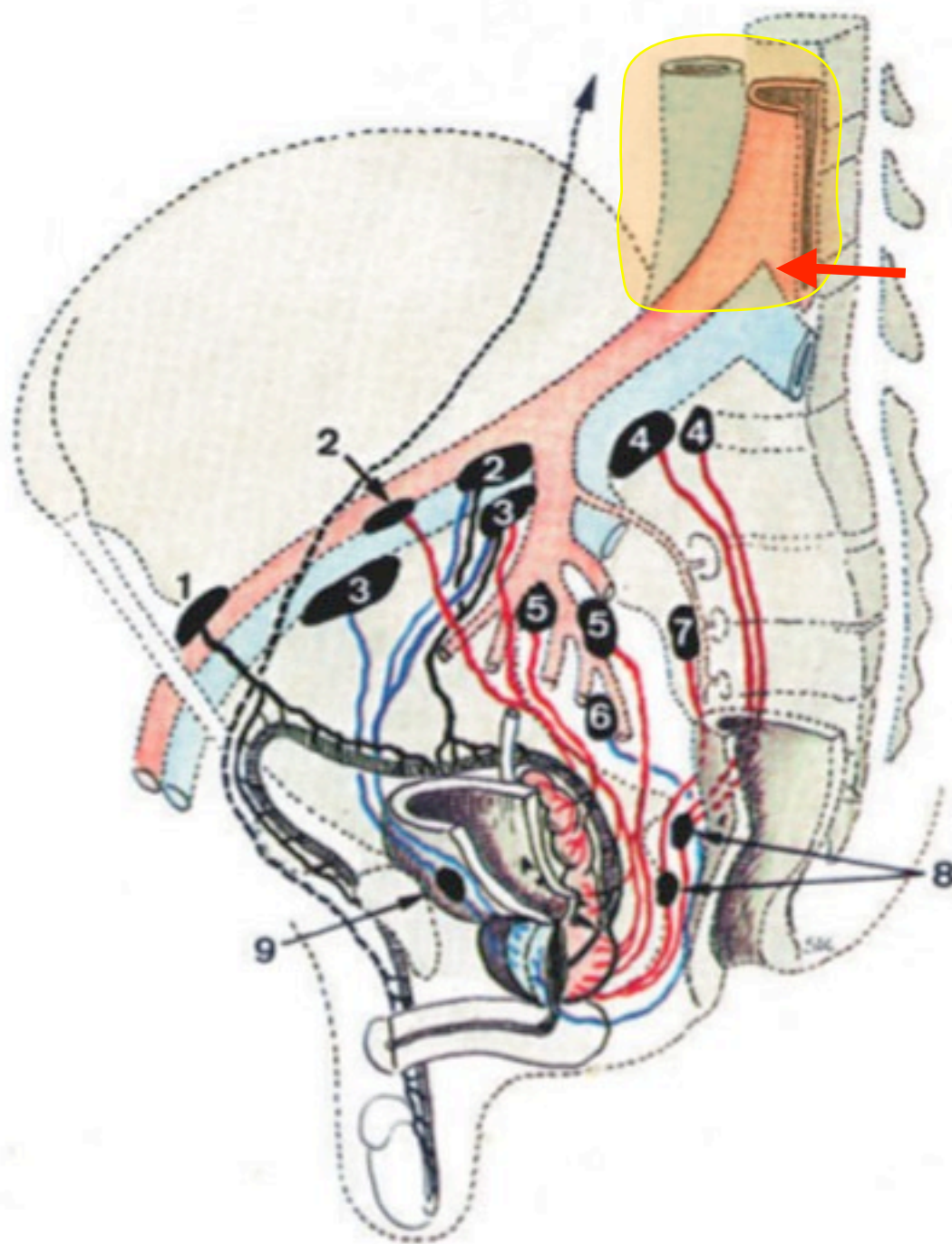


Pelvic Lymph Node Anatomy

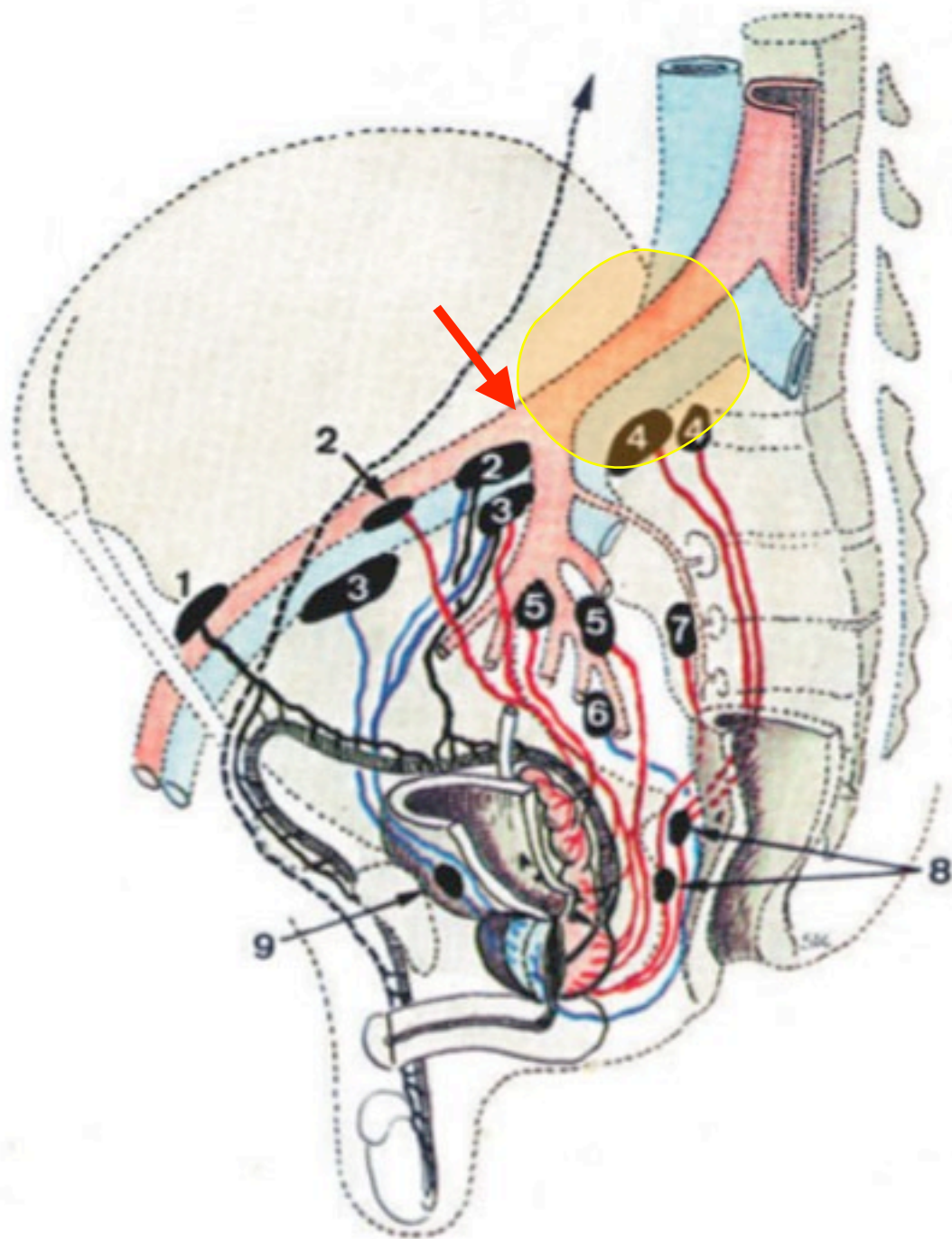
Figure 4. Different characteristics, of size, shape and color intensity of various normal lymph nodes in different body regions; **a)** Head and Neck **b)** Presacral and **c)** and **d)** Mesenteric lymph nodes as identified on the VHMO dataset.



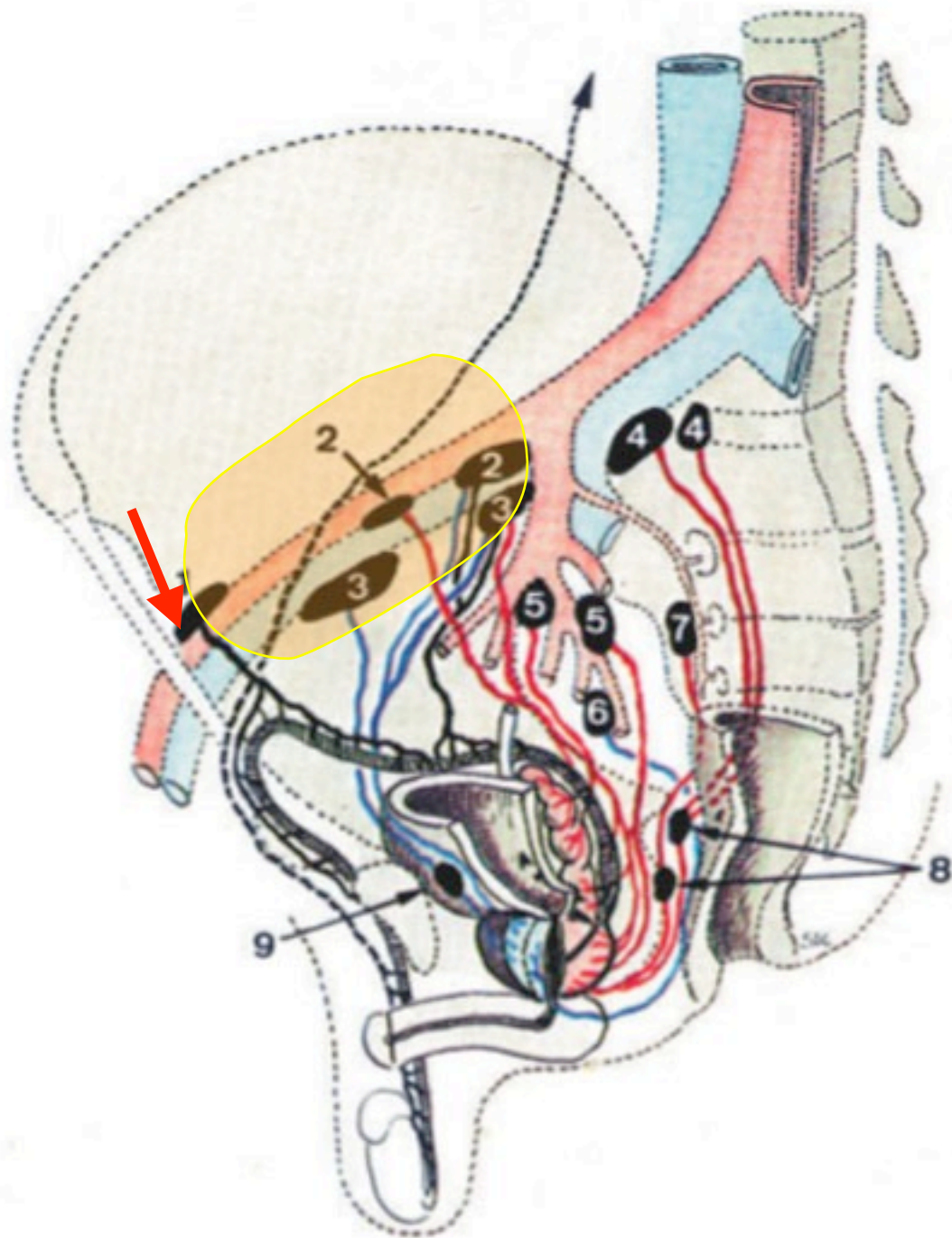




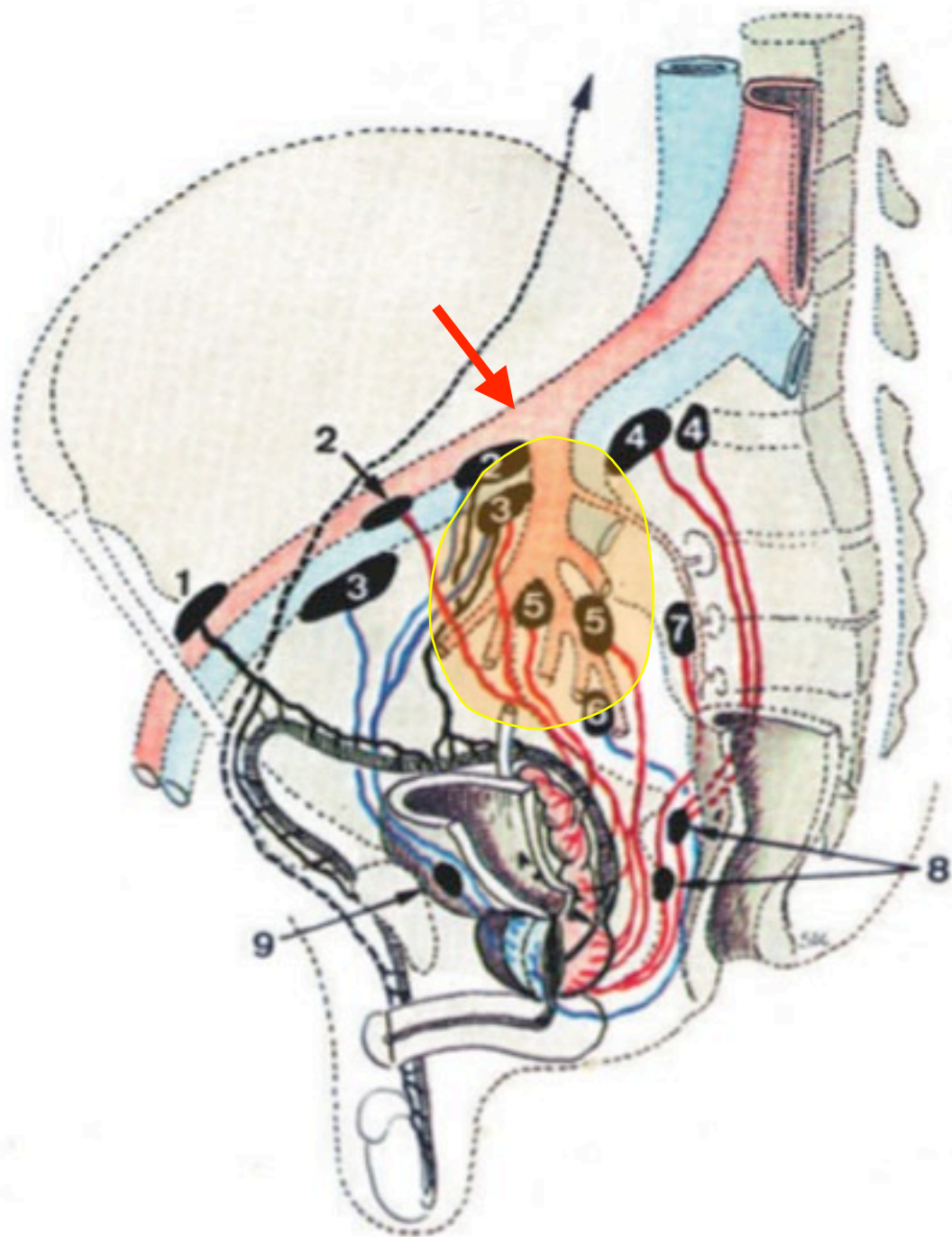
- 1 lateral lacunar node
- 2 intermediate external nodes
- 3 medial external nodes
- 4 promontorial nodes
- 5 internal iliac nodes
- 6 inferior gluteal nodes
- 7 lateral sacral nodes
- 8 intermediary lymph nodes
- 9 intermediate and prevesical nodes



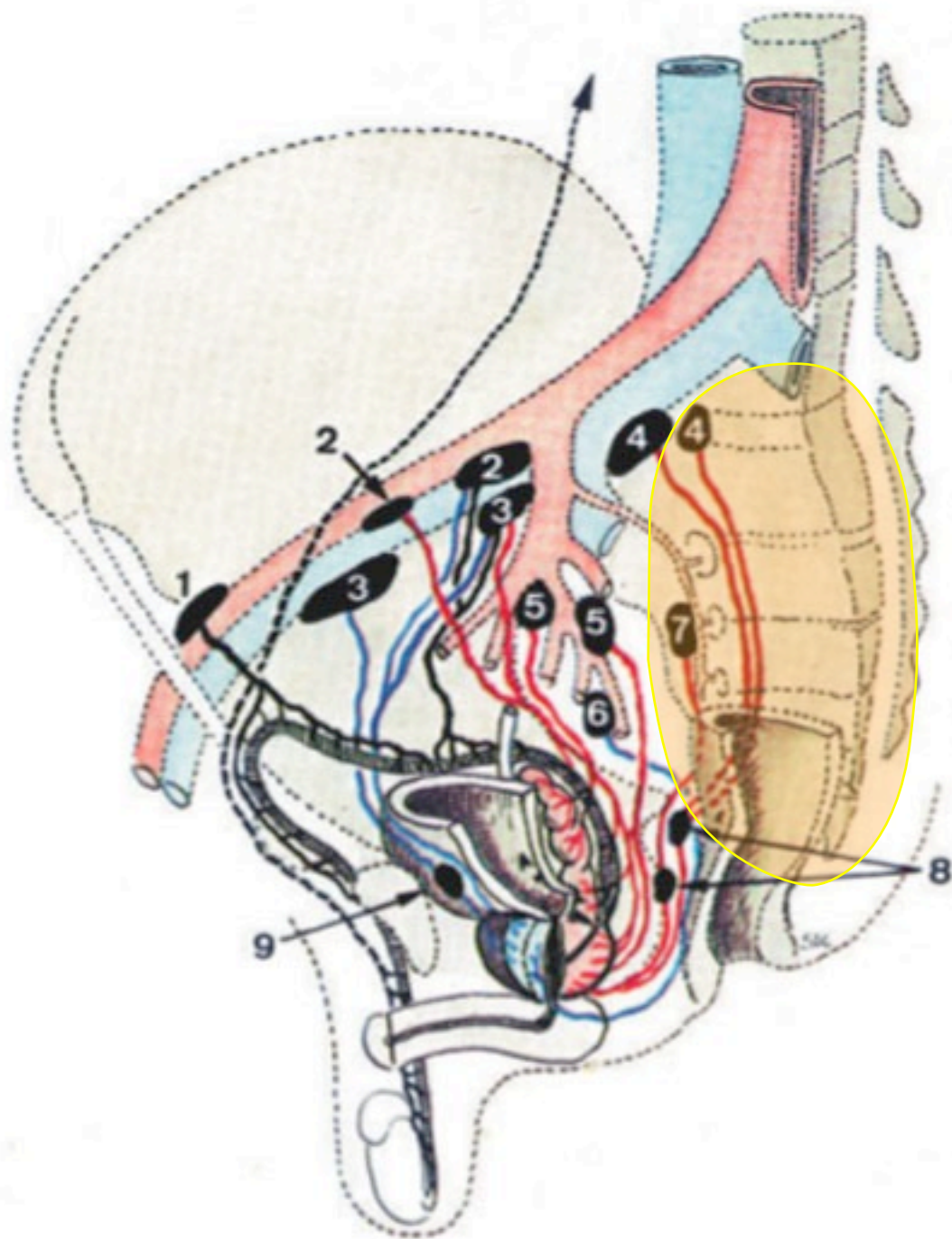
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- 7 lateral sacral nodes
- 8 intermediary lymph nodes
- 9 intermediate and prevesical nodes

MAPPING PELVIC LYMPH NODES: GUIDELINES FOR DELINEATION IN INTENSITY-MODULATED RADIOTHERAPY

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Purpose: To establish guidelines for delineating the clinical target volume for pelvic nodal irradiation by mapping the location of lymph nodes in relation to the pelvic anatomy.

Methods and Materials: Twenty patients with gynecologic malignancies underwent magnetic resonance imaging with administration of iron oxide particles. All visible lymph nodes were outlined. Five clinical target volumes were generated for each patient using modified margins of 3, 5, 7, 10, and 15 mm around the iliac vessels. The nodal contours were then overlaid and individual nodes analyzed for coverage. The volume of normal tissue within each clinical target volume and planning target volume was also measured to aid selection of the margin that could provide maximal nodal, but minimal normal tissue, coverage.

Results: In total, 1216 nodal contours were evaluated. The nodal coverage was 56%, 76%, 88%, 94%, and 99% using vessel margins of 3, 5, 7, 10, and 15 mm, respectively. The mean volume of bowel within the planning target volume was 146.9 cm³ with a 7-mm margin, 190 cm³ with a 10-mm margin, and 266 cm³ with a 15-mm margin. Minor modification to the 7-mm margin ensured 99% coverage of the pelvic nodes.

Conclusion: Blood vessels with a modified 7-mm margin offer a good surrogate target for pelvic lymph nodes. By making appropriate adjustments, coverage of specific nodal groups may be increased and the volume of normal tissue irradiated decreased. On the basis of these findings, recommended guidelines for outlining pelvic nodes have been produced. © 2005 Elsevier Inc.

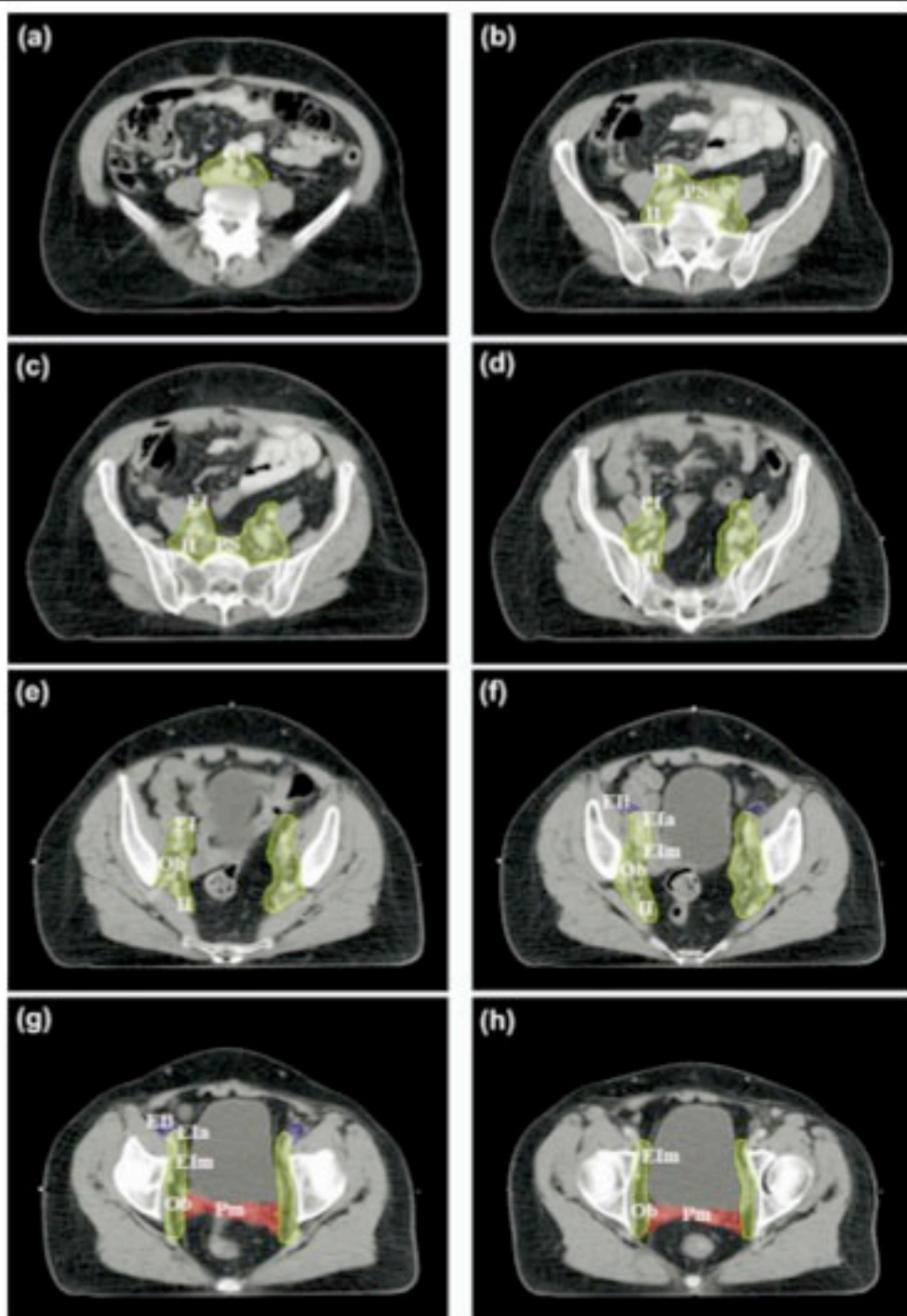
Int. J. Radiation Oncology Biol. Phys., Vol. 63, No. 5, pp. 1604–1612, 2005

Pelvic lymph nodes, Clinical target volume, Intensity-modulated radiotherapy, Iron oxide particles.

Table 4. Recommend modifications to margins

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 additional 10-mm anterolaterally along iliopsoas muscle to include lateral external iliac nodes
Obturator	Join external and internal iliac regions with 18-mm-wide strip along pelvic sidewall
Internal iliac	7-mm margin around vessels; extend lateral borders to pelvic sidewall
Presacral	10-mm strip over anterior sacrum

* Also include any visible nodes.



A verification study of proposed pelvic lymph node localisation guidelines using nanoparticle-enhanced magnetic resonance imaging[☆]

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Andrea G. Rockall^b, Rodney H. Reznek^b, Melanie E.B. Powell^a

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Abstract

Background and purpose: Normal sized pelvic lymph nodes are not easily identifiable on conventional imaging, but can be visualised with contrast-enhanced magnetic resonance imaging (MRI) using intravenous ultra-small particles of iron-oxide (USPIO). We have previously reported pelvic node clinical target volume (CTV) delineation guidelines for use with conventional imaging, derived from nodal mapping studies using USPIO. This study aims to verify these guidelines using an independent observer in a further patient cohort.

Materials and methods: Ten patients with gynaecological cancer underwent MRI with and without intravenous USPIO. The guidelines were used to outline a pelvic node CTV on pre-contrast T2-weighted images. On post-contrast T2*-weighted images the pelvic nodes were identified and outlined. The pre- and post-contrast images were co-registered and CTV examined for node coverage.

Results: By applying the guidelines, full coverage of 737 of 741 node outlines was achieved (>99%). Four nodes were not completely encompassed, two anterior external iliac nodes and two lateral external iliac nodes.

Conclusions: MRI with USPIO contrast enabled the production of guidelines for localising a pelvic node CTV with conventional imaging. Application of these guidelines to a further patient cohort resulted in coverage of 99.5% node outlines demonstrating the reliability of this technique.

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Keywords: Pelvic lymph node delineation; Intensity-modulated radiotherapy (IMRT); Ultra-small iron oxide particles (USPIO)

CONSENSUS GUIDELINES FOR DELINEATION OF CLINICAL TARGET VOLUME FOR INTENSITY-MODULATED PELVIC RADIOTHERAPY IN POSTOPERATIVE TREATMENT OF ENDOMETRIAL AND CERVICAL CANCER

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CARIEN CREUTZBERG, M.D.,§ JENNIFER DE LOS SANTOS, M.D.,¶ DAVID GAFFNEY, M.D., Ph.D.,||
ANUJA JHINGRAN, M.D.,# LORRAINE PORTELANCE, M.D.,** TRACEY SCHEFTER, M.D.,††
REVATHY IYER, M.D.,‡‡ MAHESH VARIA, M.D.,§§ KATHRYN WINTER, M.S.,¶¶ AND ARNO J. MUNDT, M.D.,|||

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Purpose: To develop an atlas of the clinical target volume (CTV) definitions for postoperative radiotherapy of endometrial and cervical cancer to be used for planning pelvic intensity-modulated radiotherapy.

Methods and Materials: The Radiation Therapy Oncology Group led an international collaboration of cooperative groups in the development of the atlas. The groups included the Radiation Therapy Oncology Group, Gynecologic Oncology Group, National Cancer Institute of Canada, European Society of Therapeutic Radiology and Oncology, and American College of Radiology Imaging Network. The members of the group were asked by questionnaire to define the areas that were to be included in the CTV and to outline these areas on individual computed tomography images. The initial formulation of the group began in late 2004 and culminated with a formal consensus conference in June 2005.

Results: The committee achieved a consensus CTV definition for postoperative therapy for endometrial and cervical cancer. The CTV should include the common, external, and internal iliac lymph node regions. The upper 3.0 cm of the vagina and paravaginal soft tissue lateral to the vagina should also be included. For patients with cervical cancer, or endometrial cancer with cervical stromal invasion, it is also recommended that the CTV include the presacral lymph node region.

Conclusion: This report serves as an international template for the definition of the CTV for postoperative intensity-modulated radiotherapy for endometrial and cervical cancer. © 2007 Elsevier Inc.

Intensity-modulated radiotherapy, Adjuvant therapy, Pelvic radiotherapy, Endometrial cancer, Cervical cancer.

RTOG GU RADIATION ONCOLOGY SPECIALISTS REACH CONSENSUS ON PELVIC LYMPH NODE VOLUMES FOR HIGH-RISK PROSTATE CANCER

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ELIZABETH O'MEARA, M.D.,** SETH A. ROSENTHAL, M.D.,^{††} MARK RITTER, M.D.,^{‡‡}
AND MICHAEL SEIDER, M.D.^{§§}

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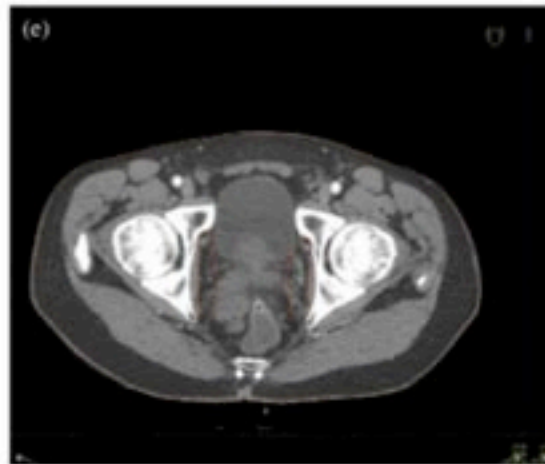
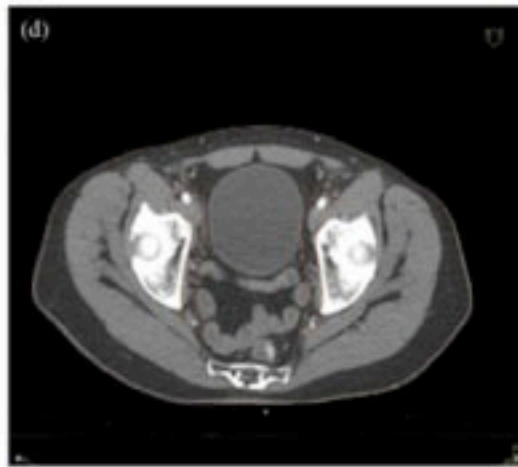
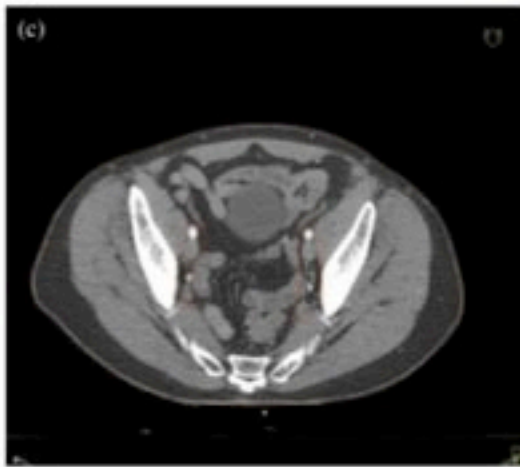
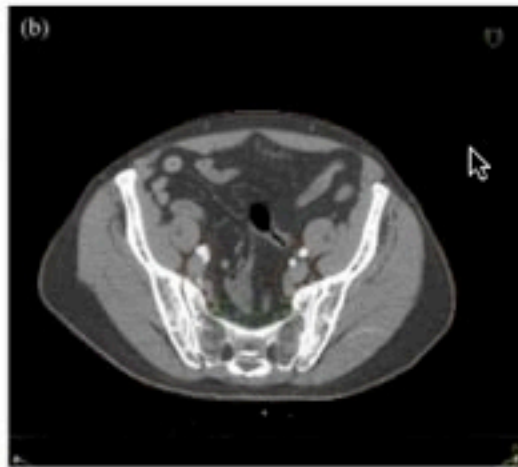
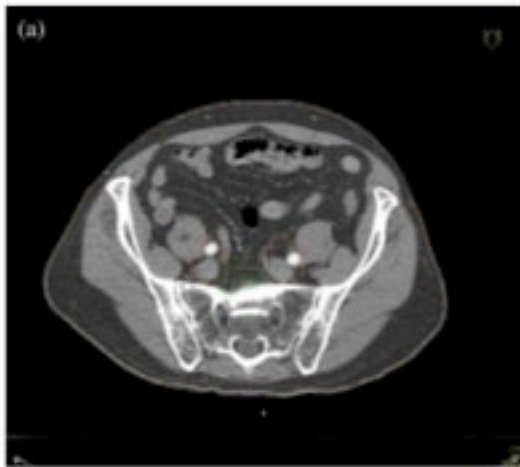
Purpose: Radiation therapy to the pelvic lymph nodes in high-risk prostate cancer is required on several Radiation Therapy Oncology Group (RTOG) clinical trials. Based on a prior lymph node contouring project, we have shown significant disagreement in the definition of pelvic lymph node volumes among genitourinary radiation oncology specialists involved in developing and executing current RTOG trials.

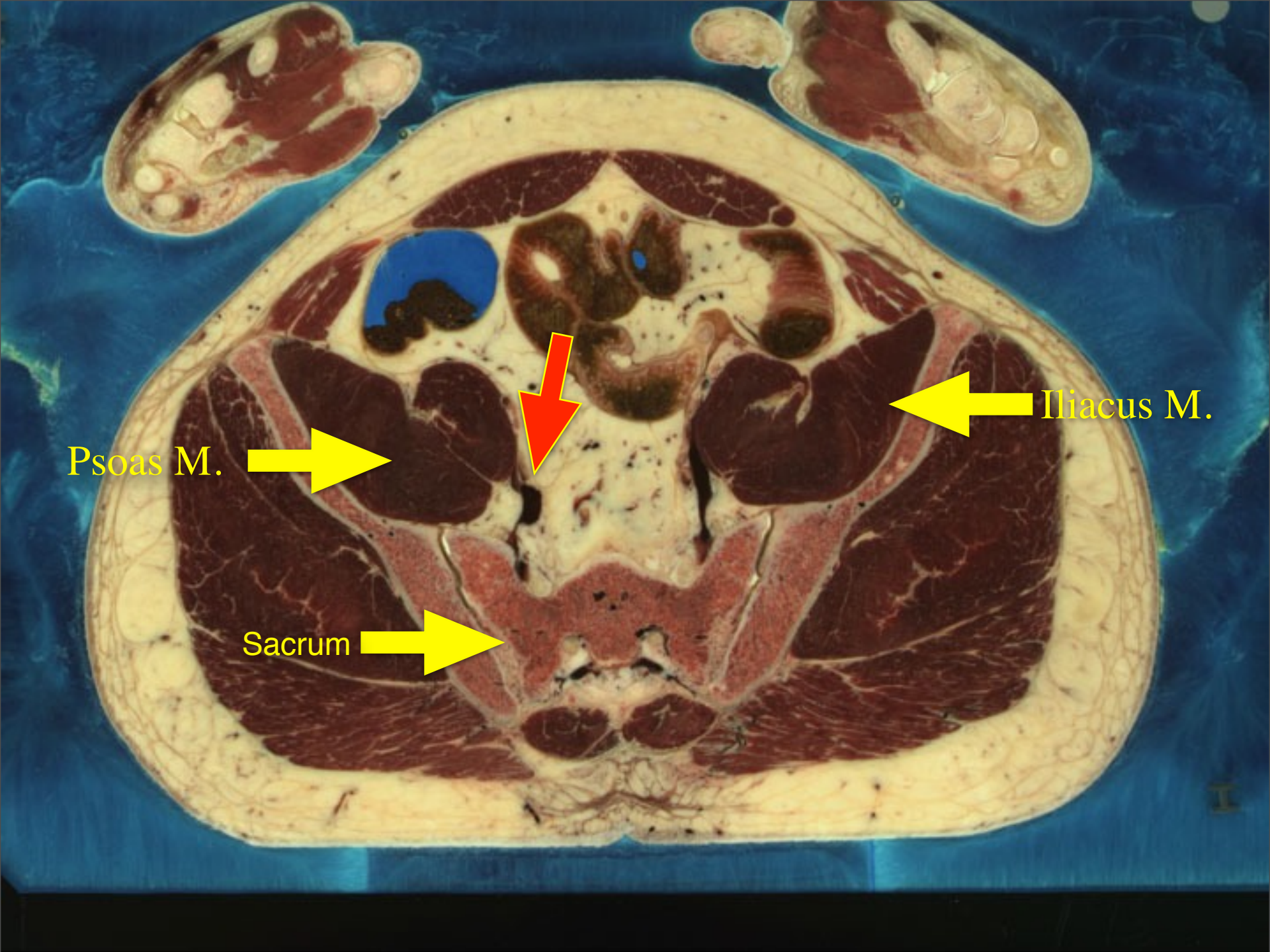
Materials and Methods: A consensus meeting was held on October 3, 2007, to reach agreement on pelvic lymph node volumes. Data were presented to address the lymph node drainage of the prostate. Extensive discussion ensued to develop clinical target volume (CTV) pelvic lymph node consensus.

Results: Consensus was obtained resulting in computed tomography image-based pelvic lymph node CTVs. Based on this consensus, the pelvic lymph node volumes to be irradiated include: distal common iliac, presacral lymph nodes (S₁-S₃), external iliac lymph nodes, internal iliac lymph nodes, and obturator lymph nodes. Lymph node CTVs include the vessels (artery and vein) and a 7-mm radial margin being careful to "carve out" bowel, bladder, bone, and muscle. Volumes begin at the L5/S1 interspace and end at the superior aspect of the pubic bone. Consensus on dose-volume histogram constraints for OARs was also attained.

Conclusions: Consensus on pelvic lymph node CTVs for radiation therapy to address high-risk prostate cancer was attained and is available as web-based computed tomography images as well as a descriptive format through the RTOG. This will allow for uniformity in evaluating the benefit and risk of such treatment. © 2008 Elsevier Inc.

Prostate cancer, Pelvic lymph nodes, Target volume, IMRT, Radiation oncology guidelines.





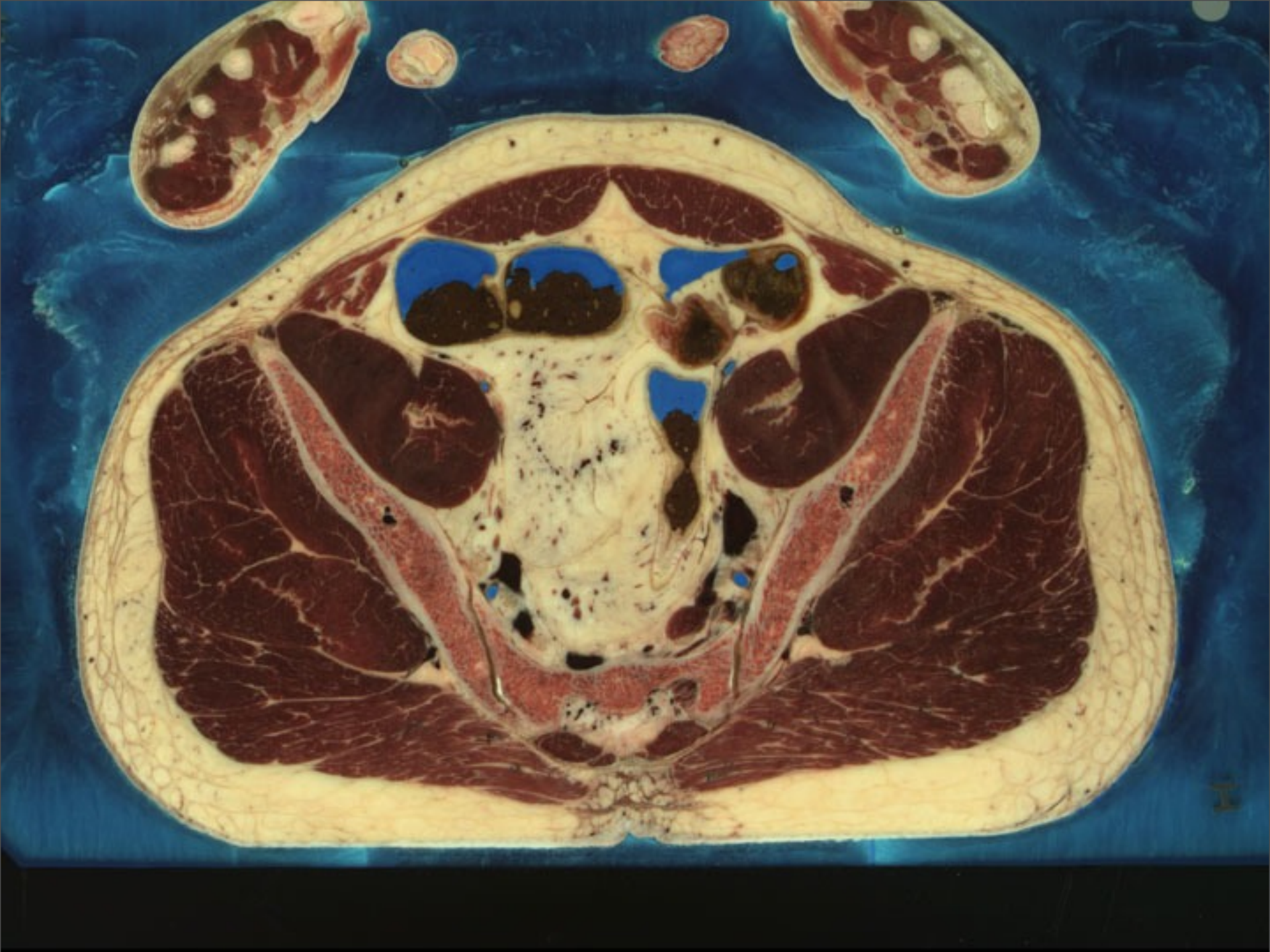


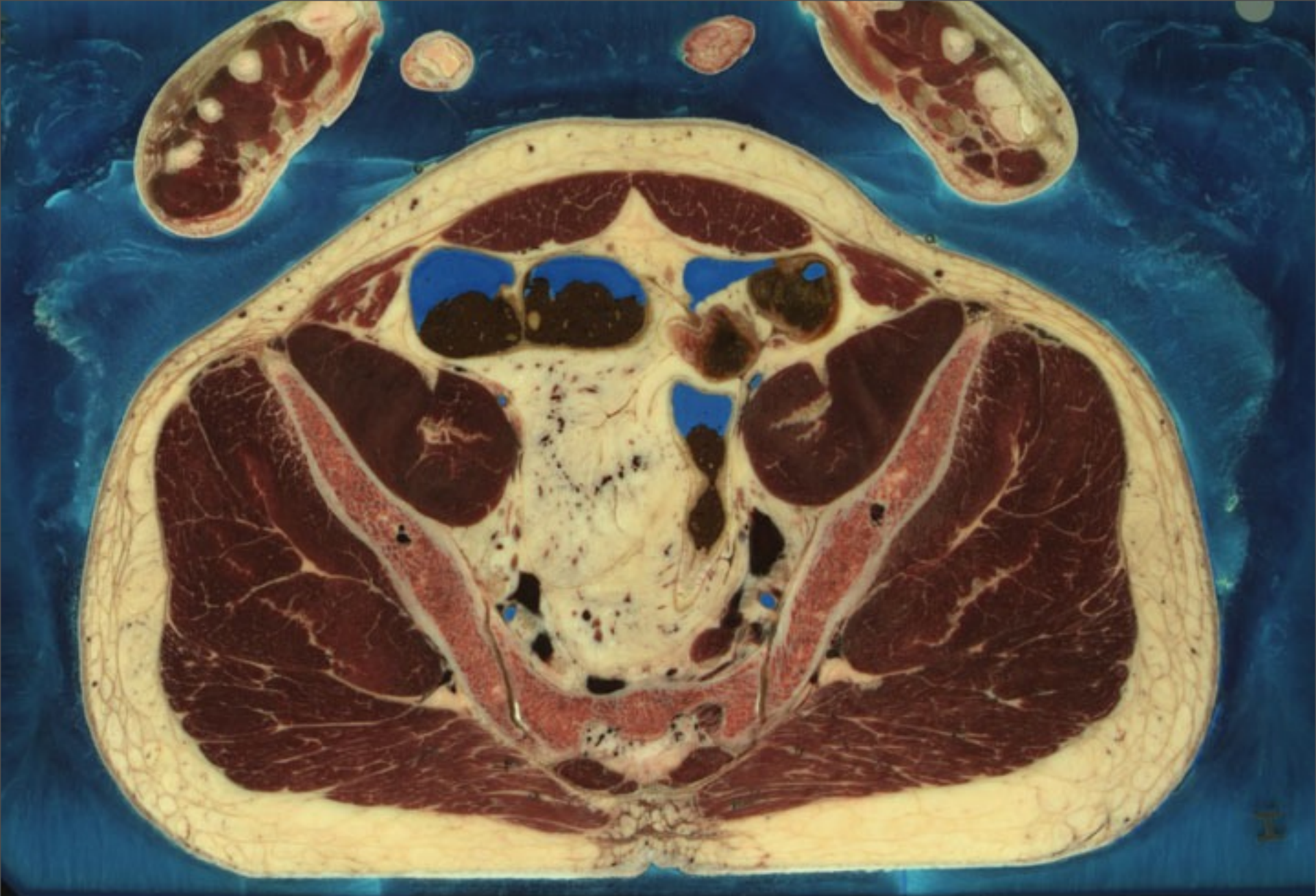


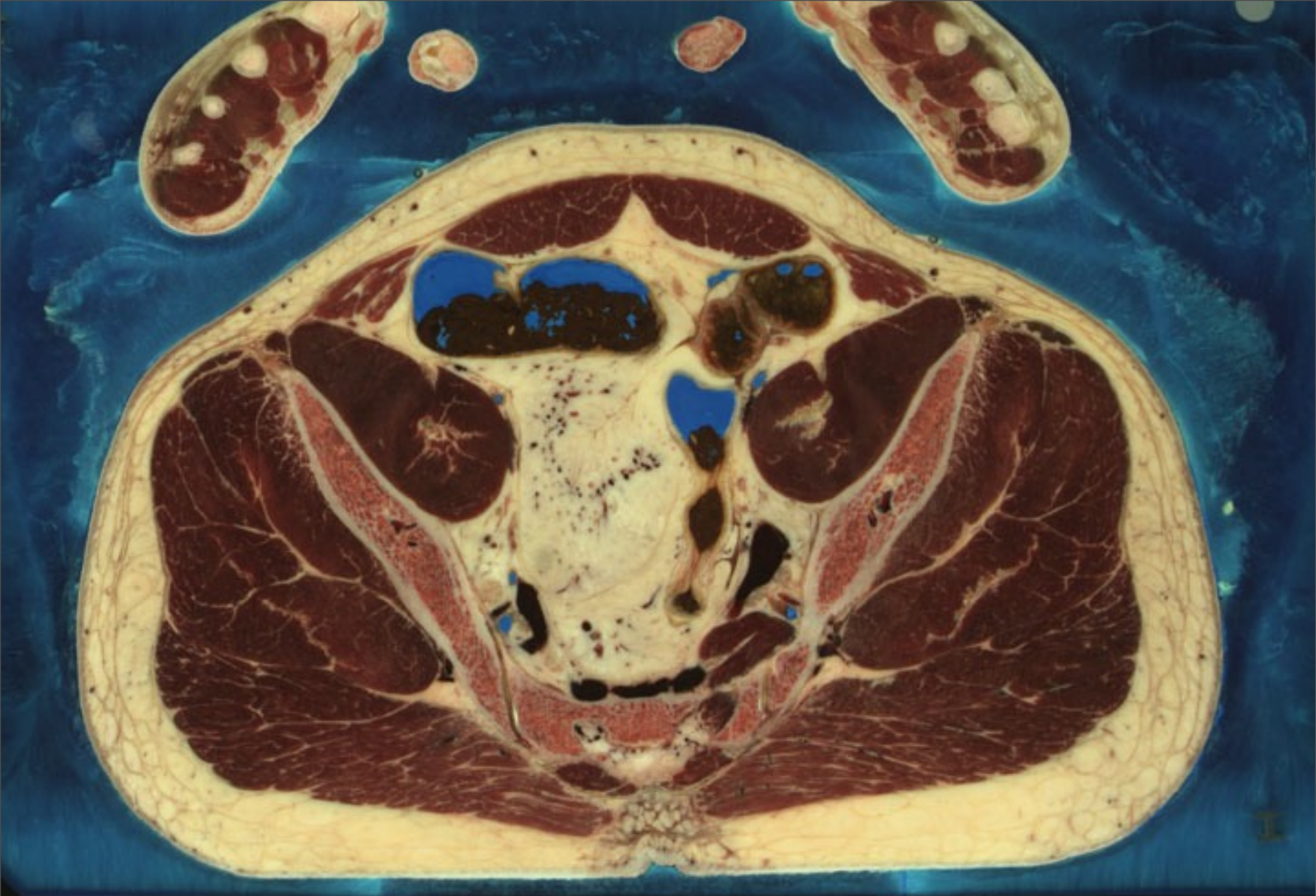


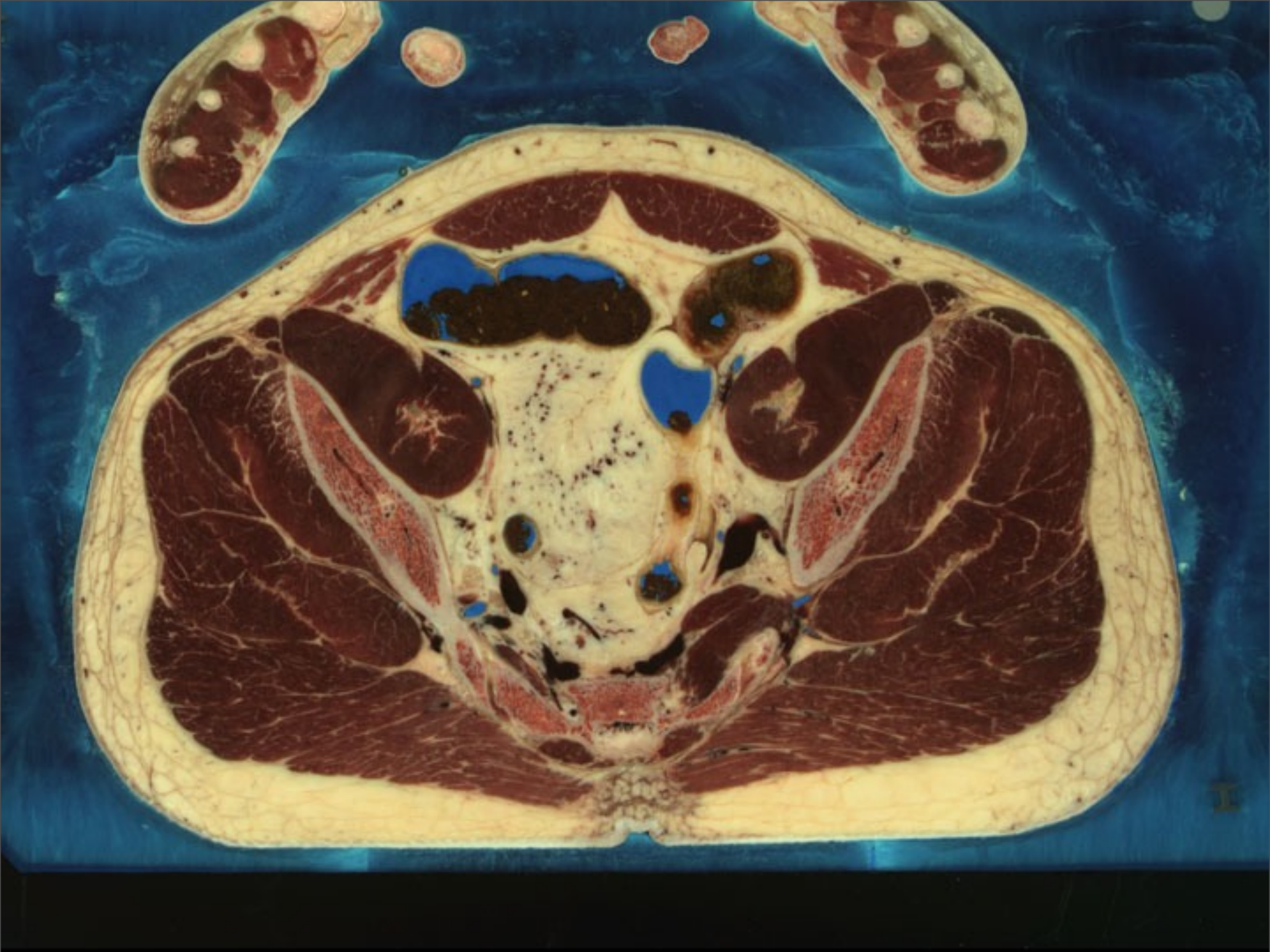




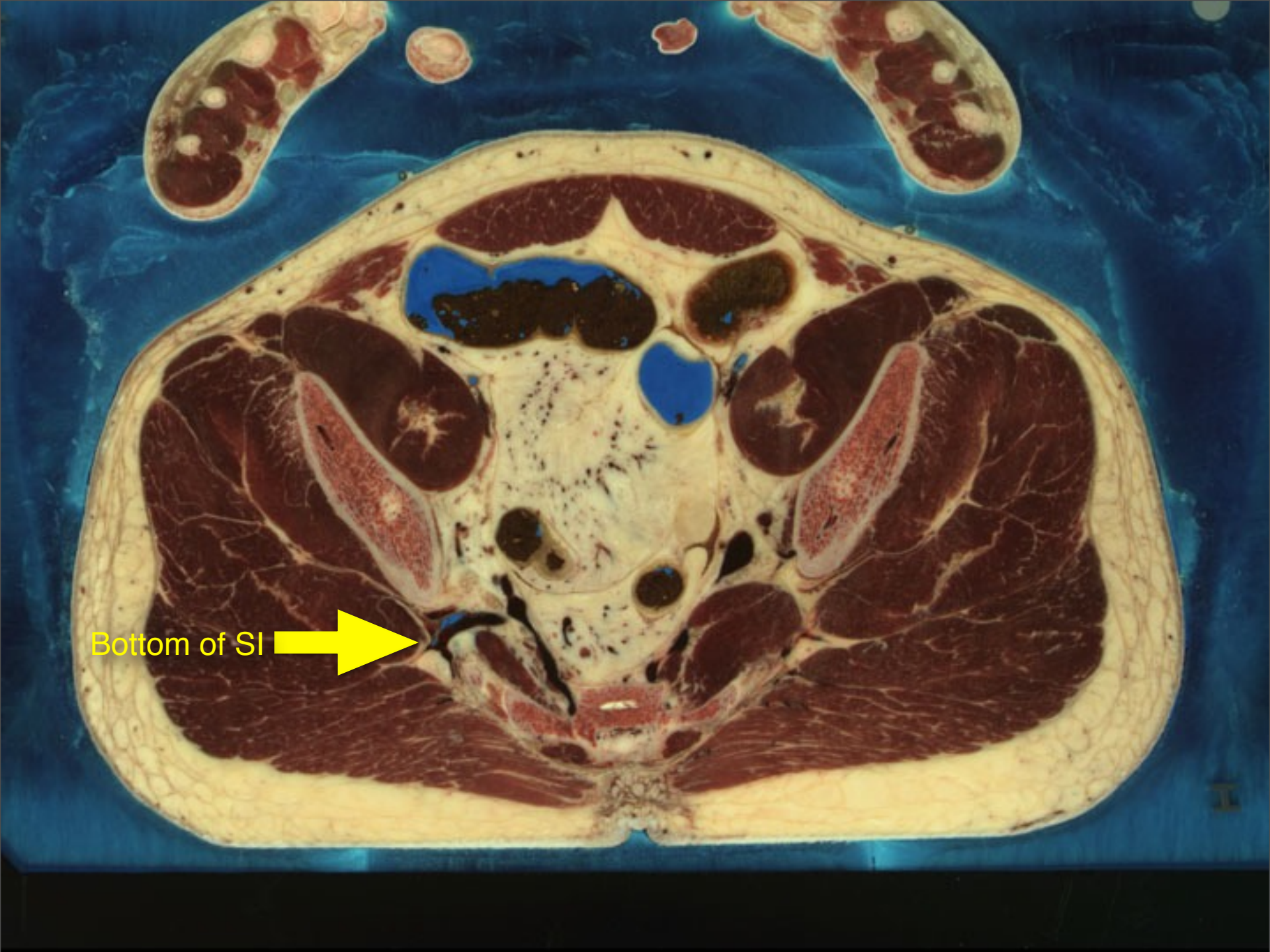


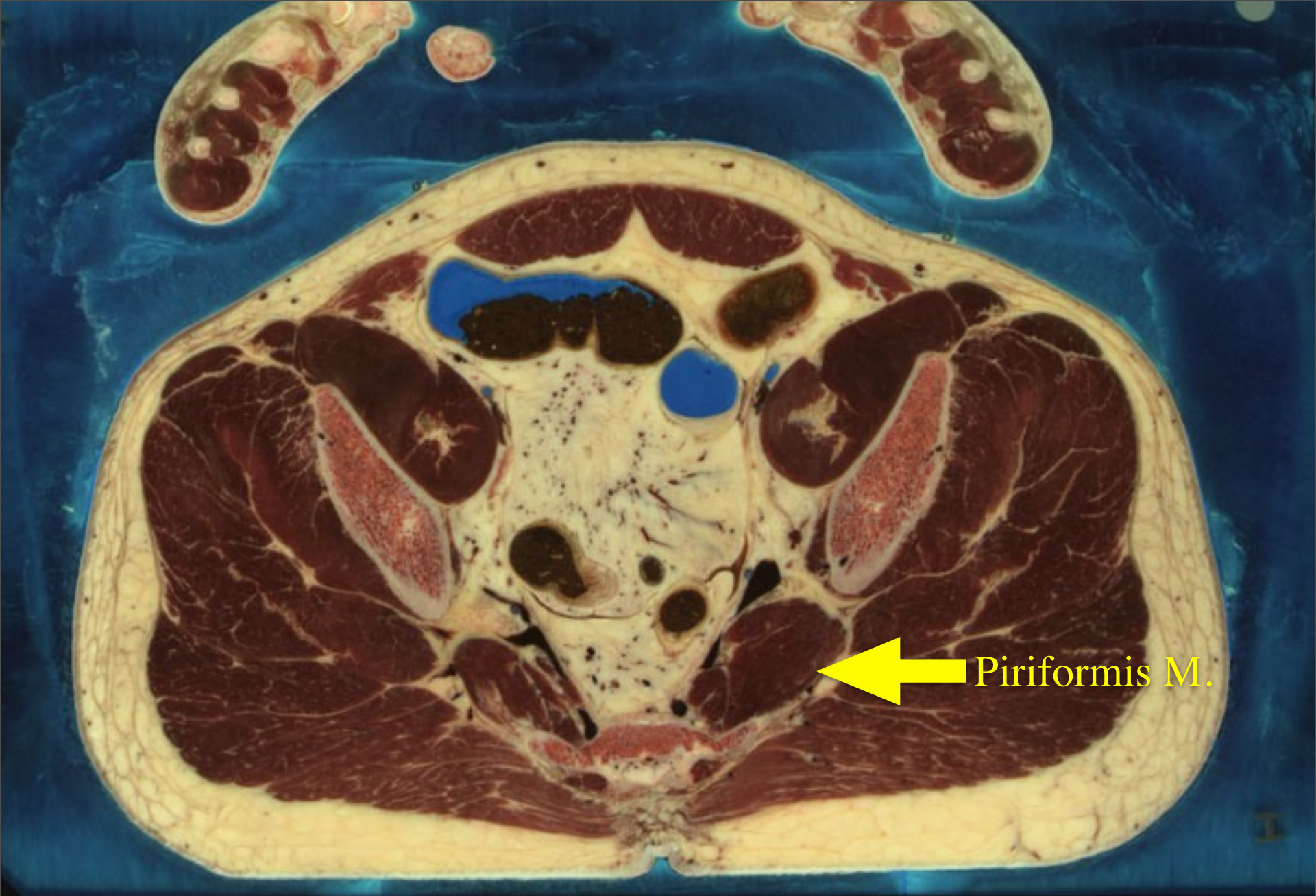




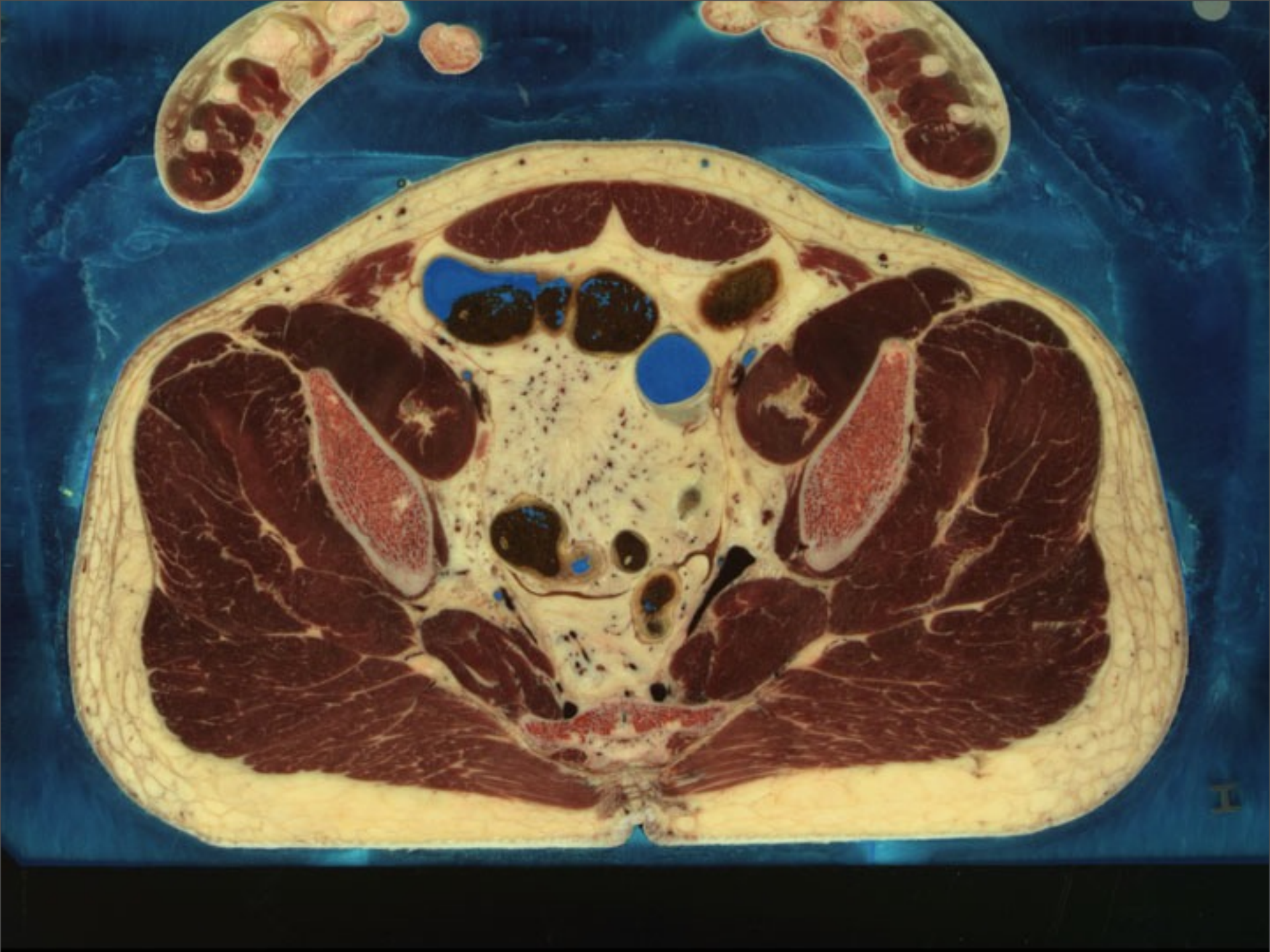


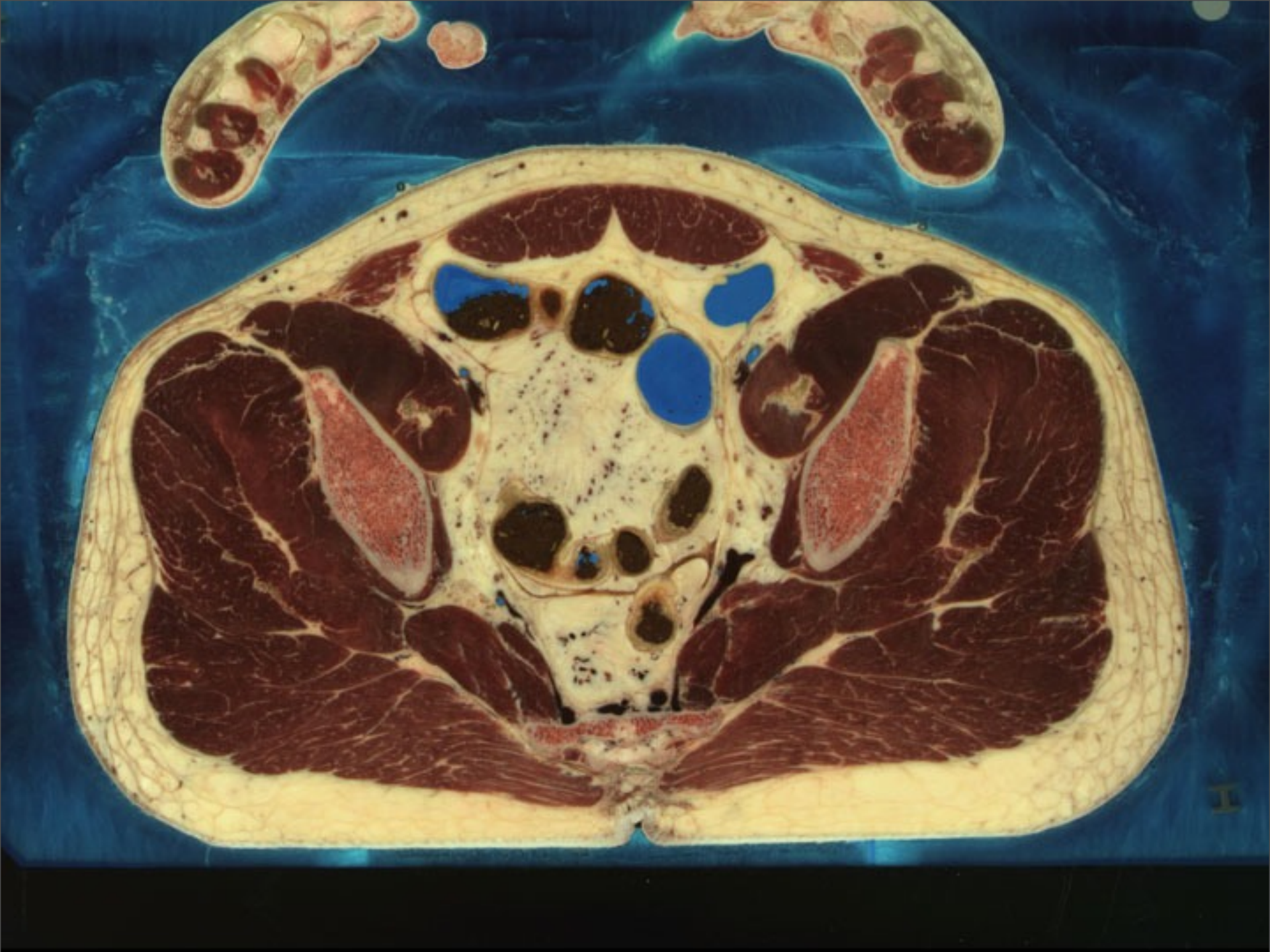
Bottom of SI →

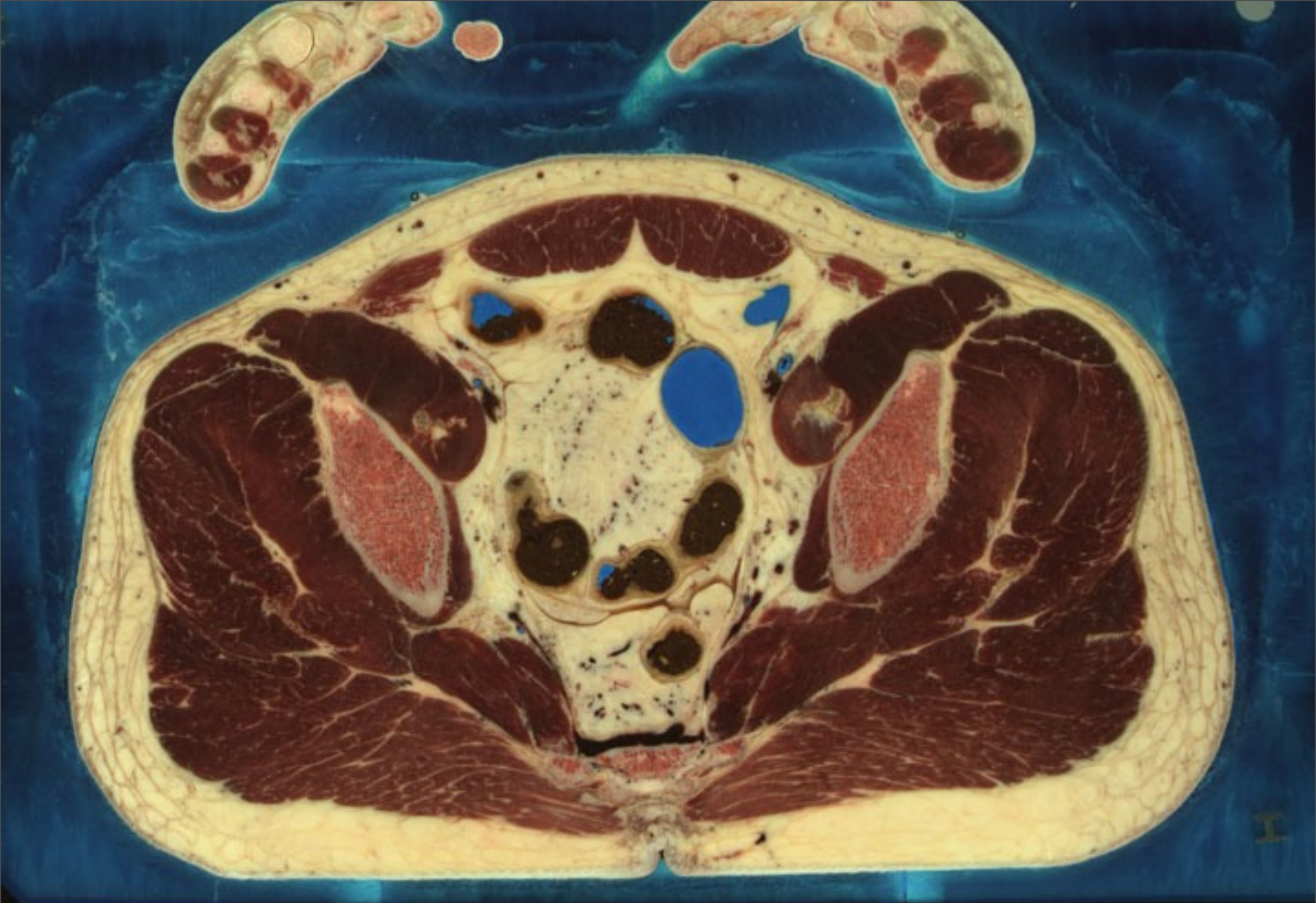


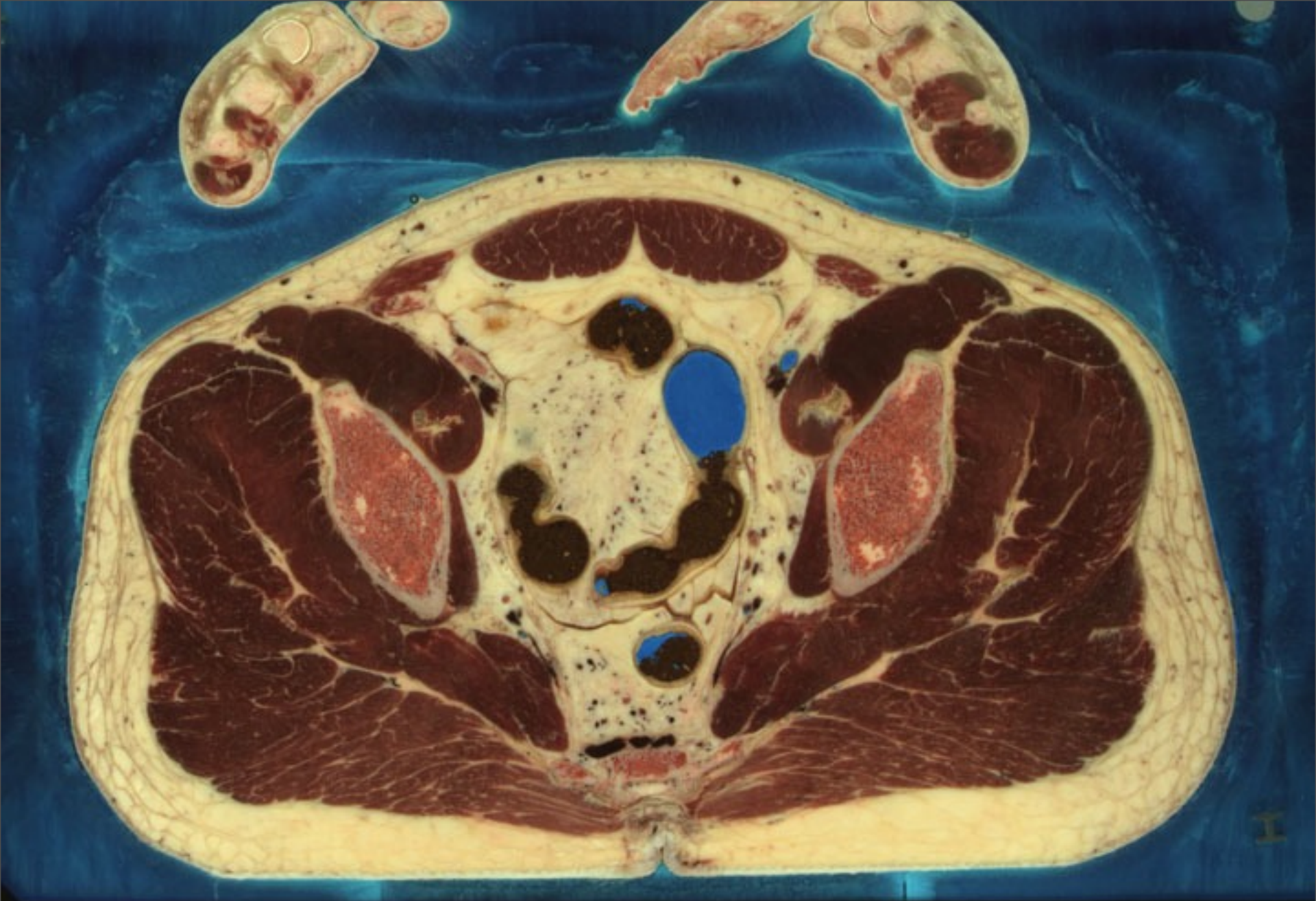


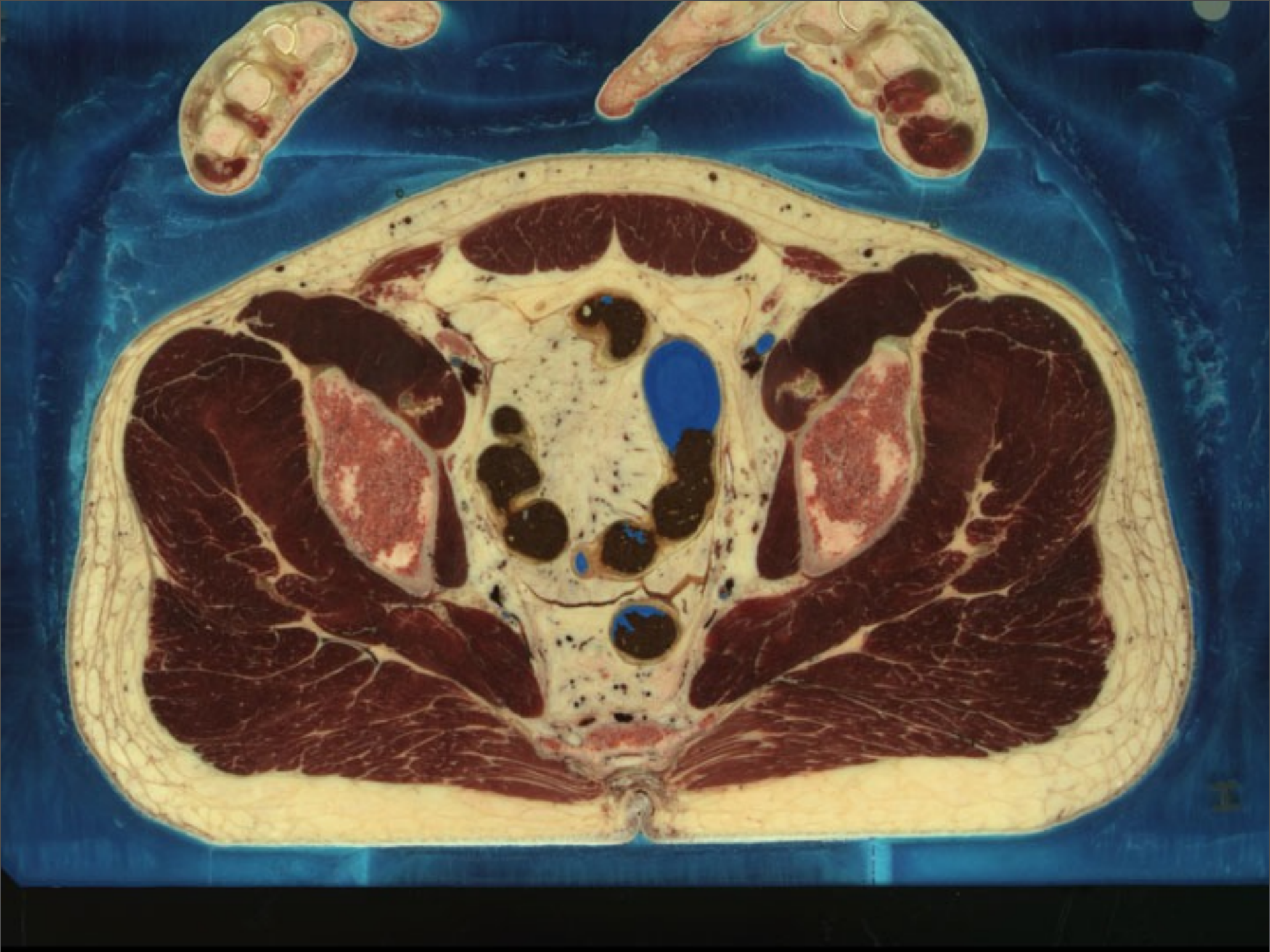
Piriformis M.

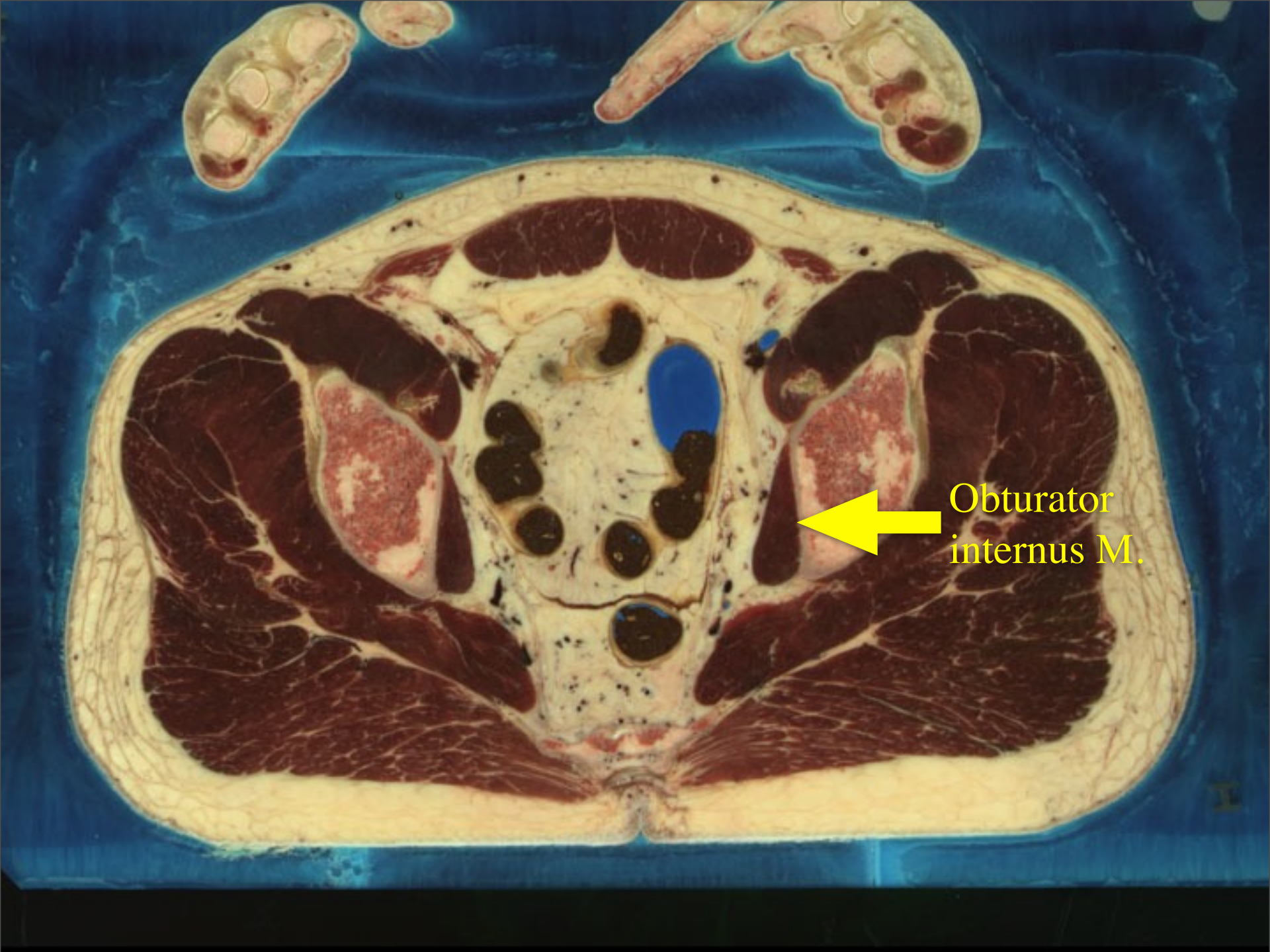






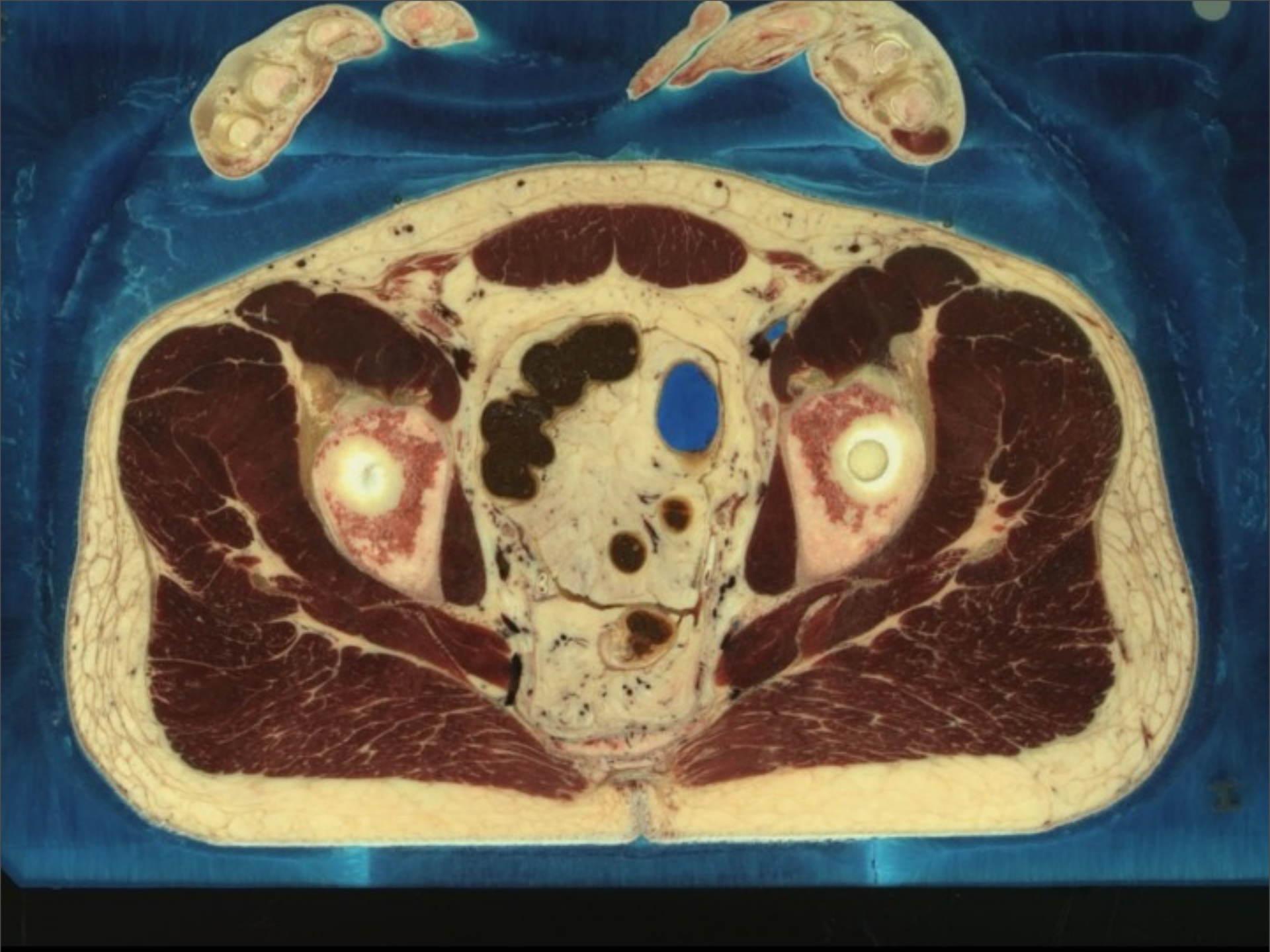




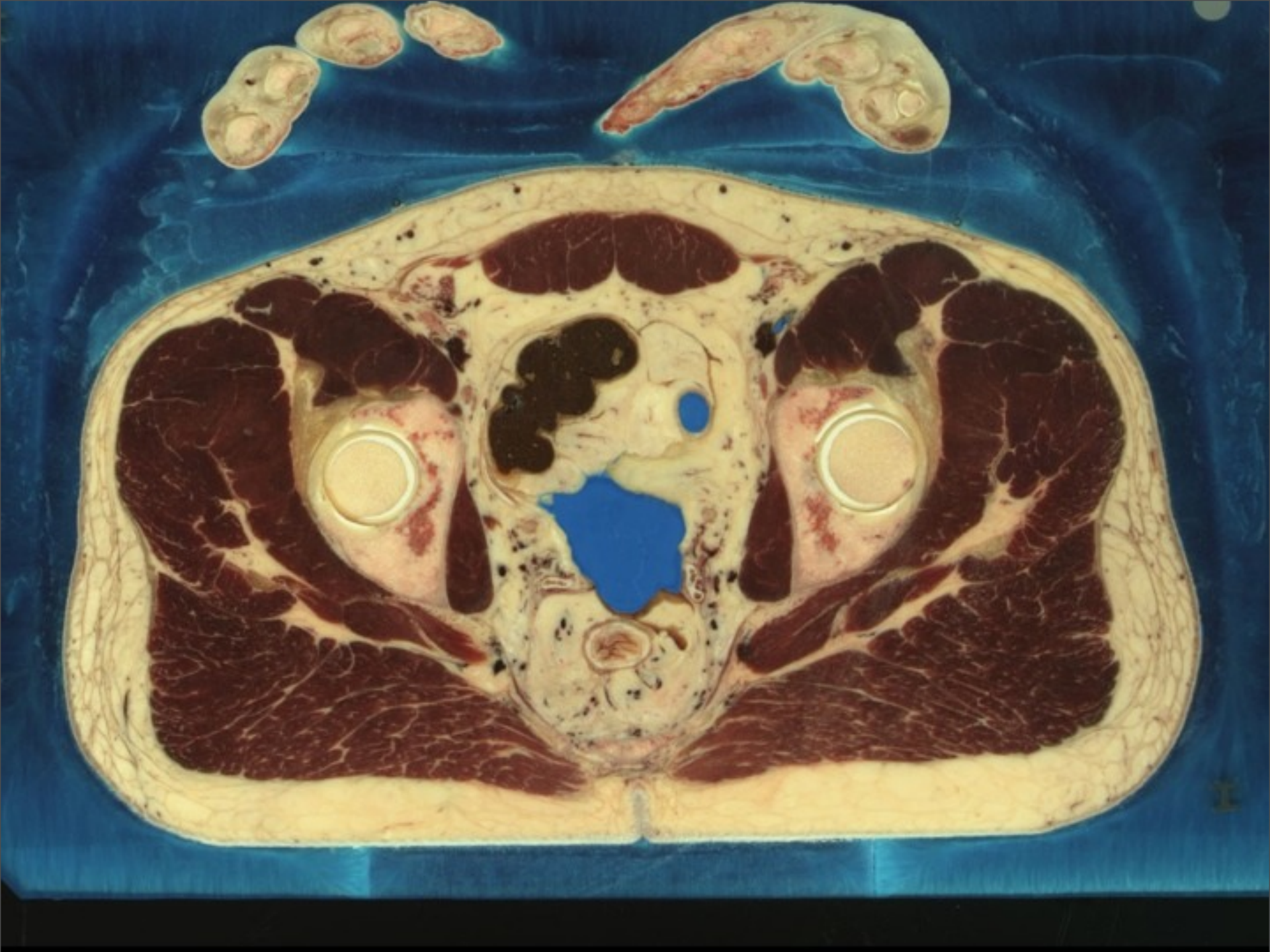


Obturator
internus M.



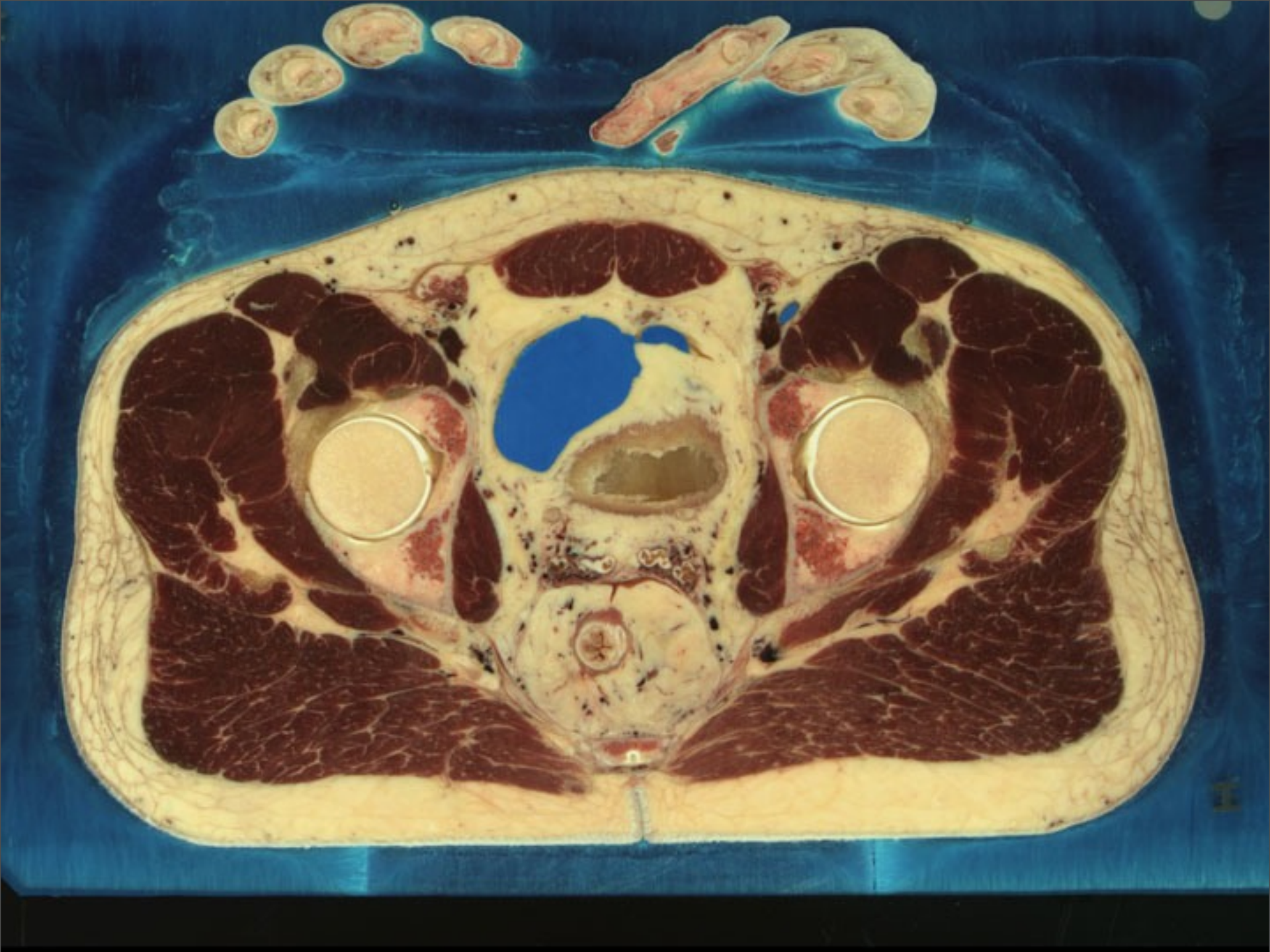


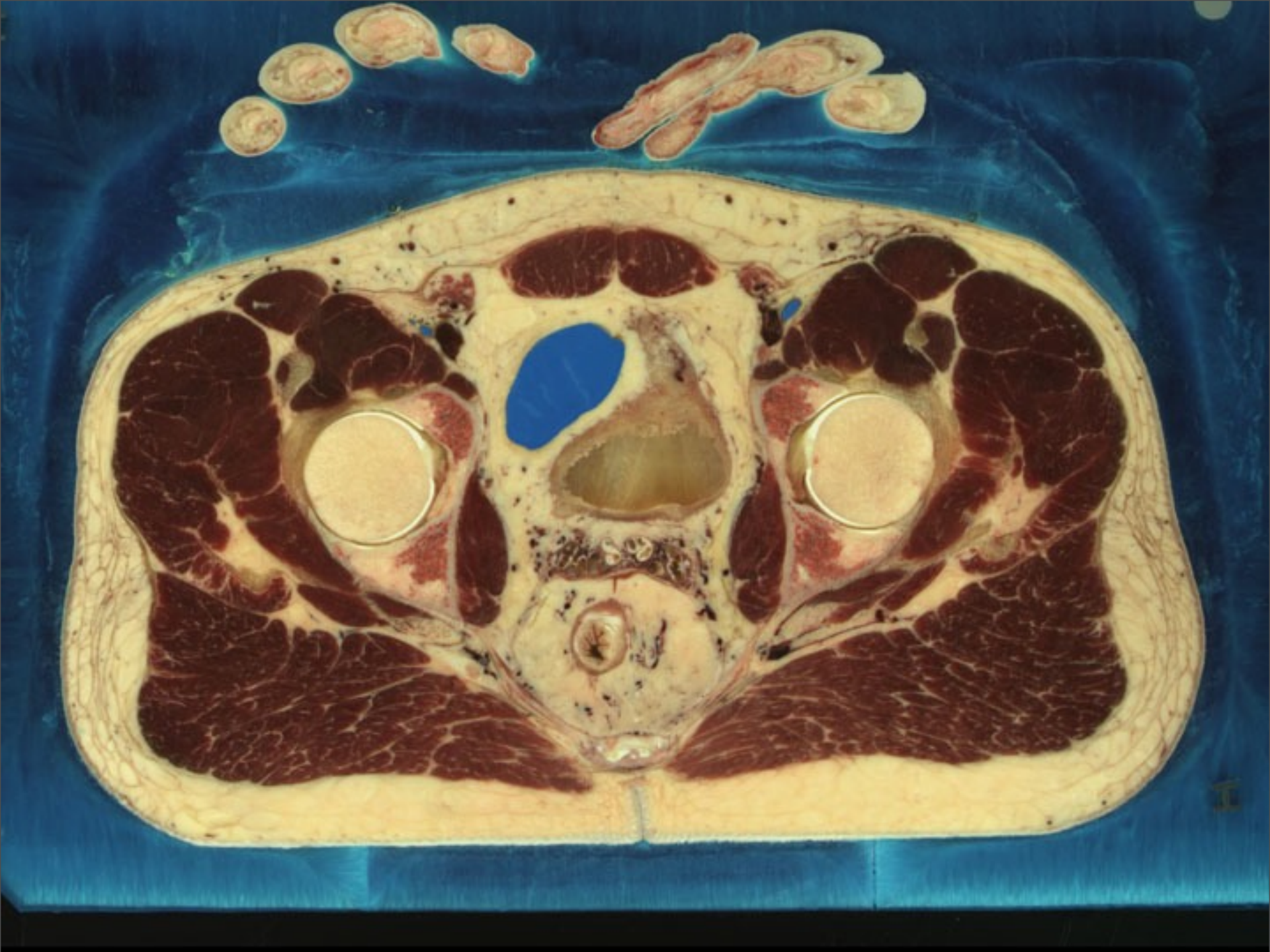




Friday, April 6, 12









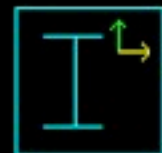


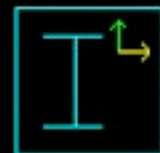
CT Contouring

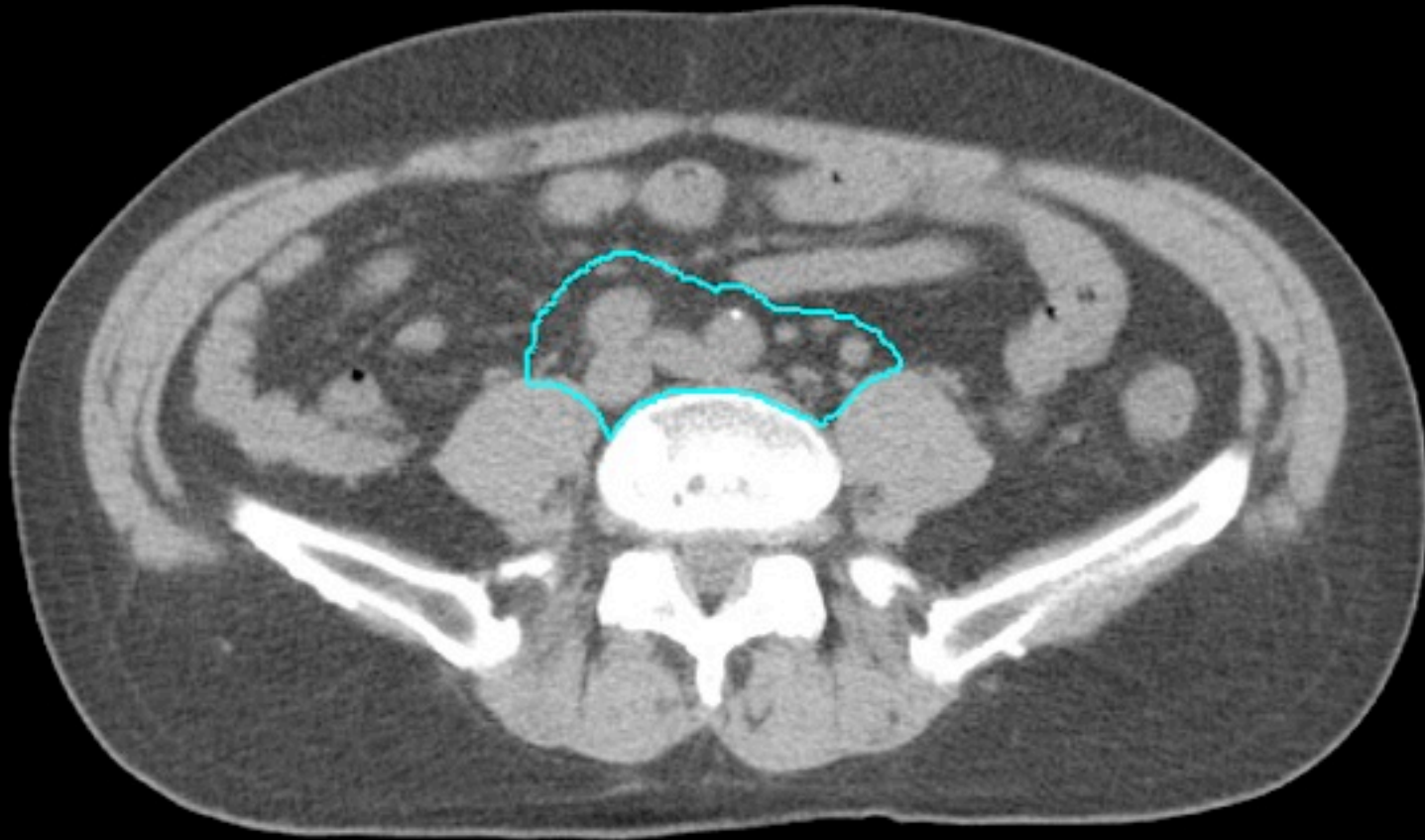


Work Flow

1. Resident contours every 3rd slice
2. 7 mm around vessels, remove bowel, bone, muscle
3. Attending edit (add margins). Interpolate contours
4. Attending edit again and approves

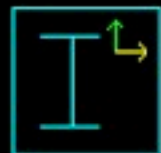


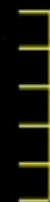


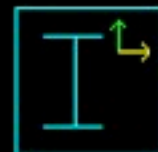
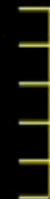


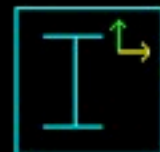
Common Iliac Nodes: 7-mm
margin around vessels: extend
posterior and lateral borders to
psoas and vertebral body



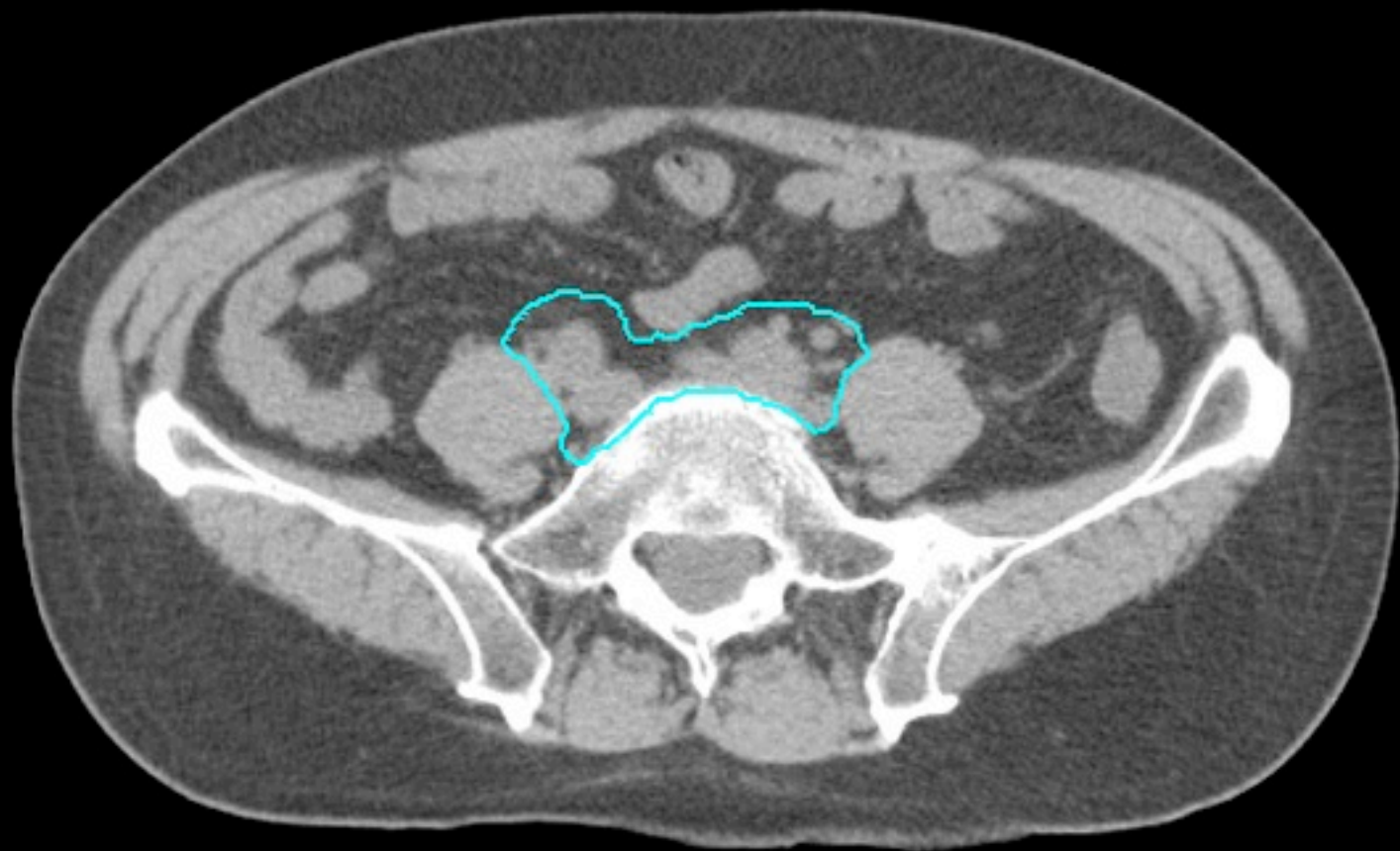








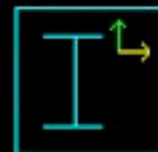


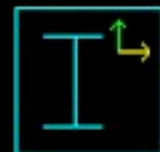


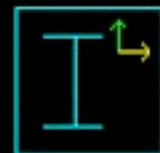
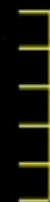
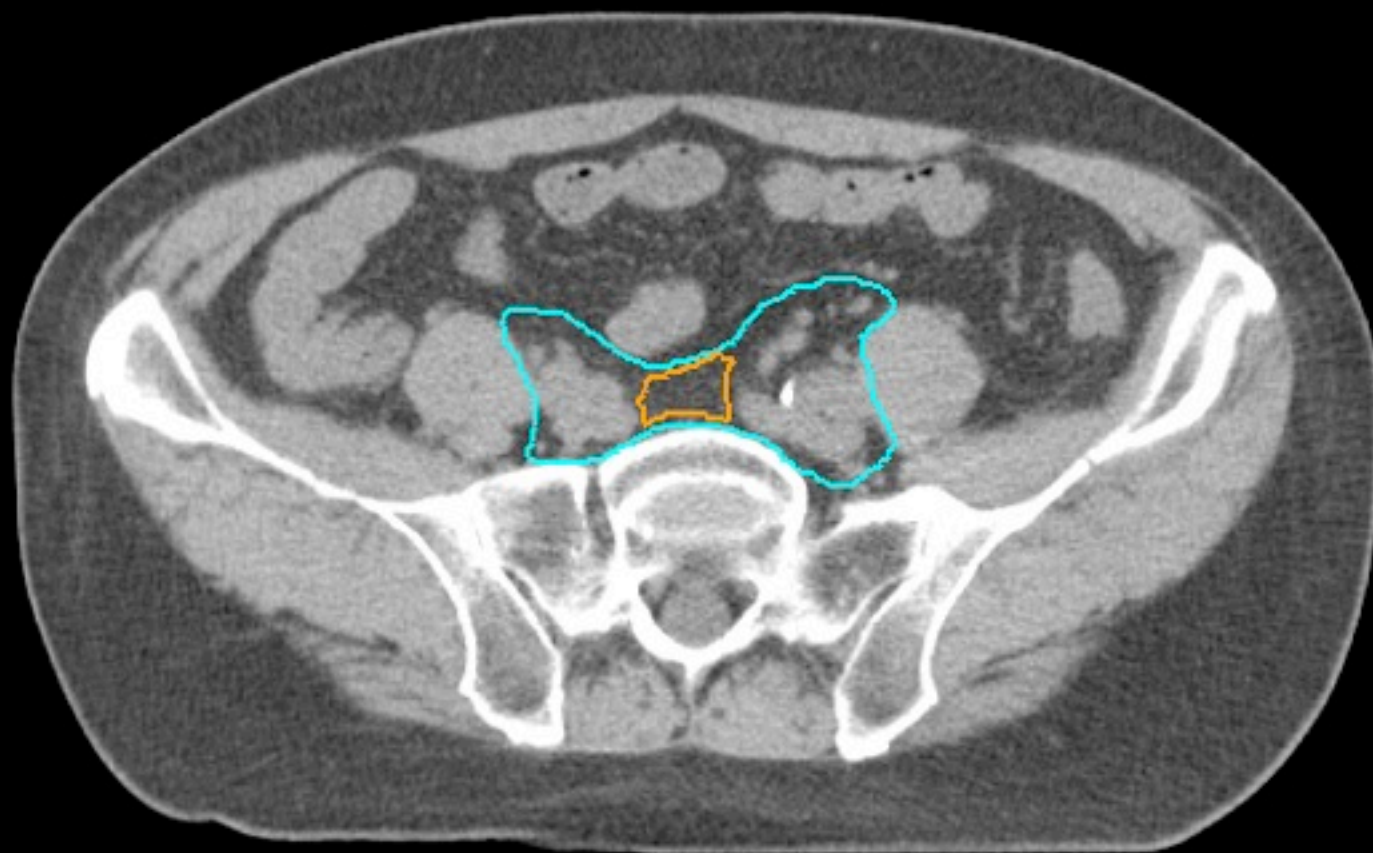


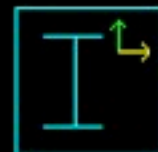
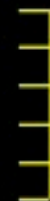


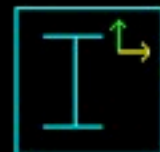


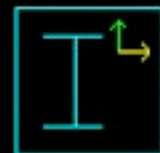
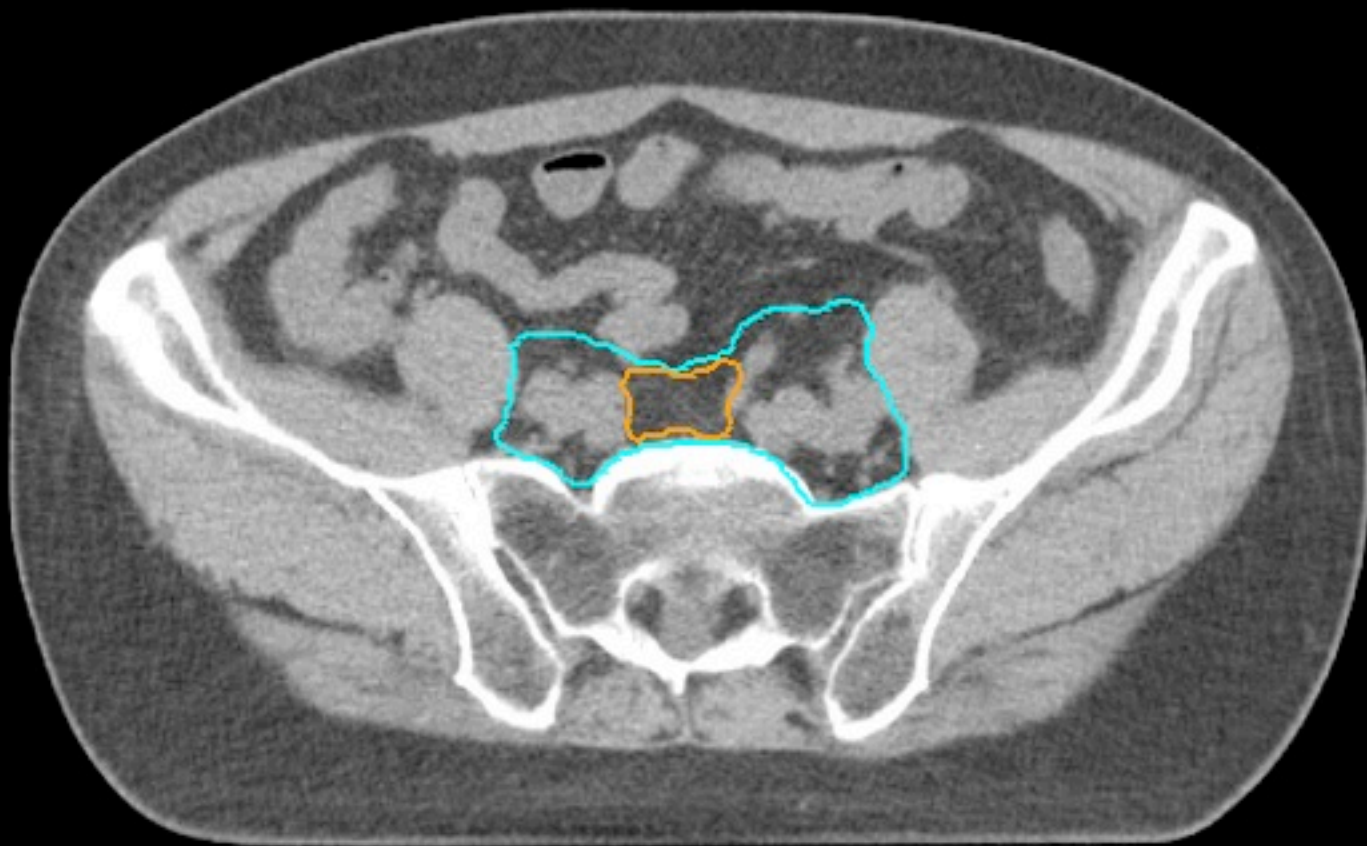


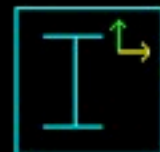


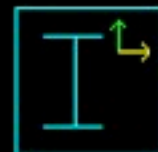
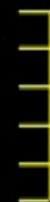


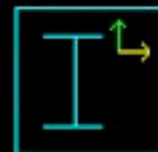
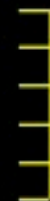
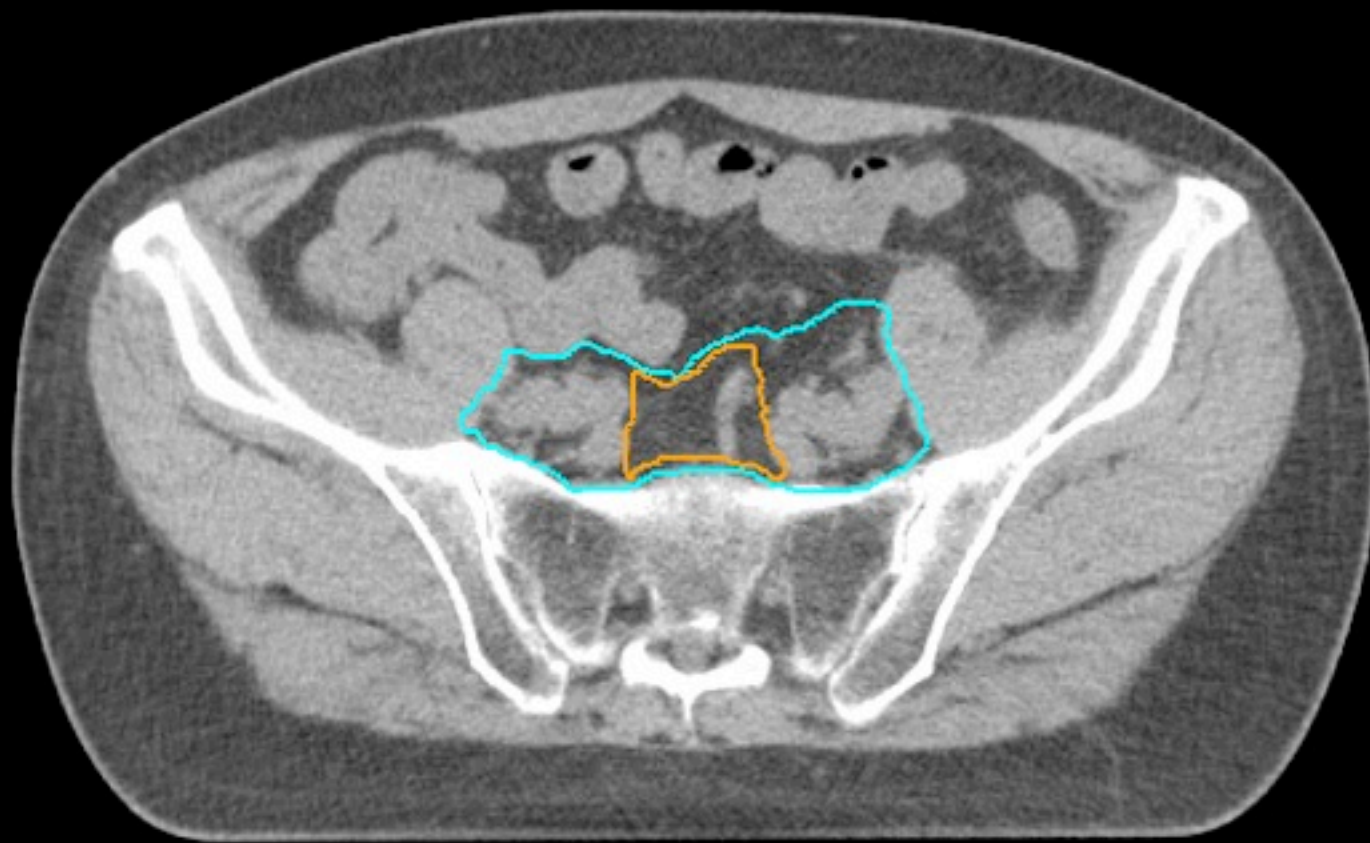


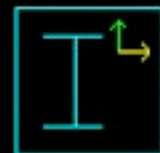


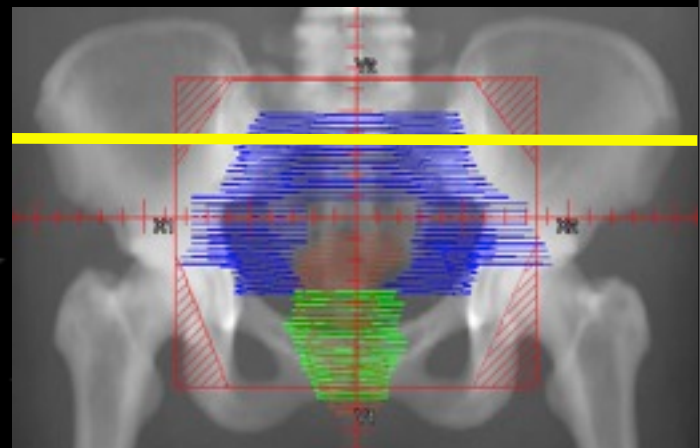


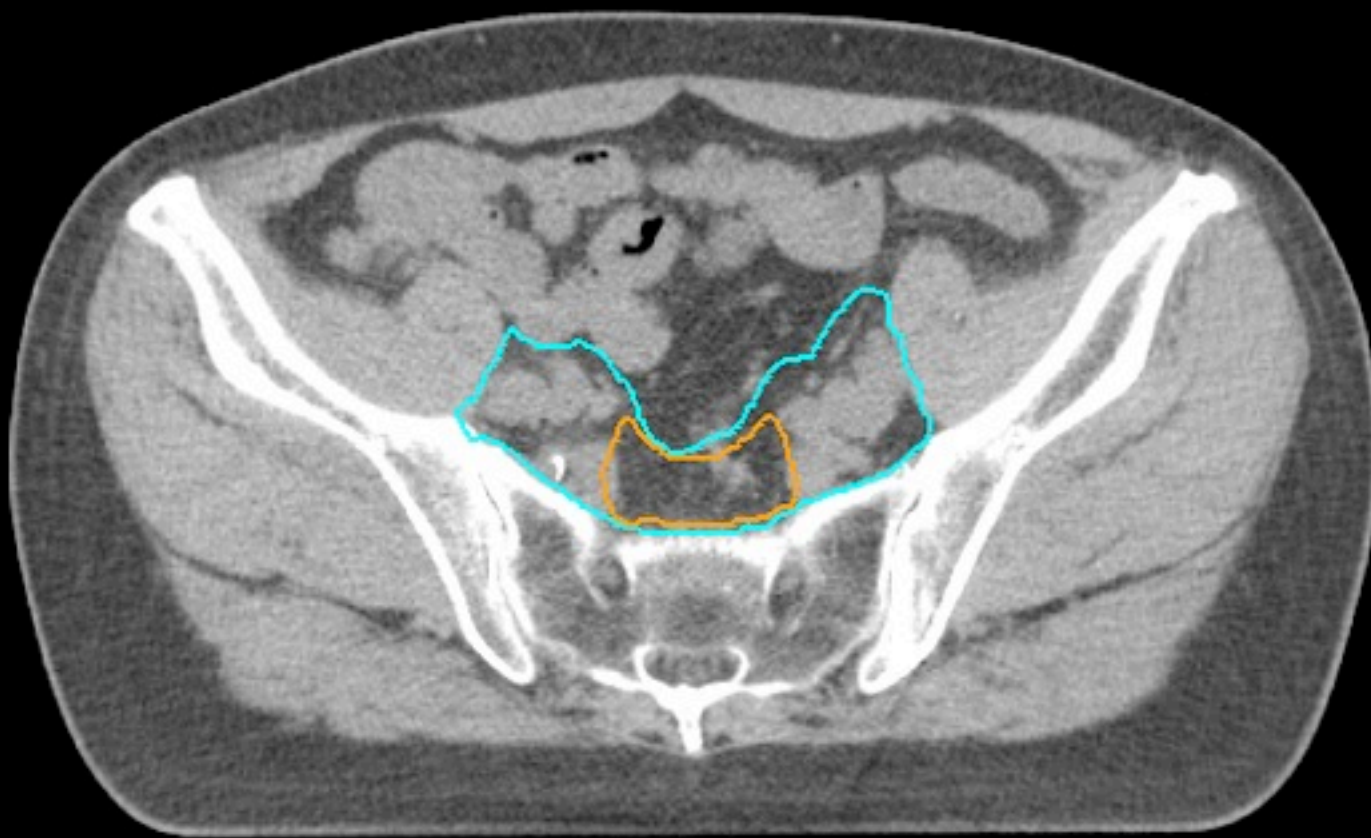




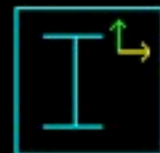


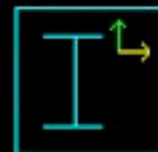
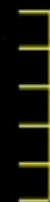






Presacral Nodes: 10-mm
strip over anterior sacrum

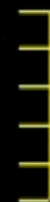


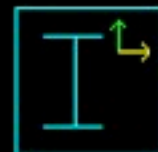


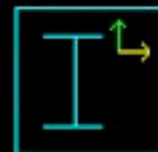
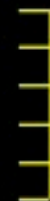


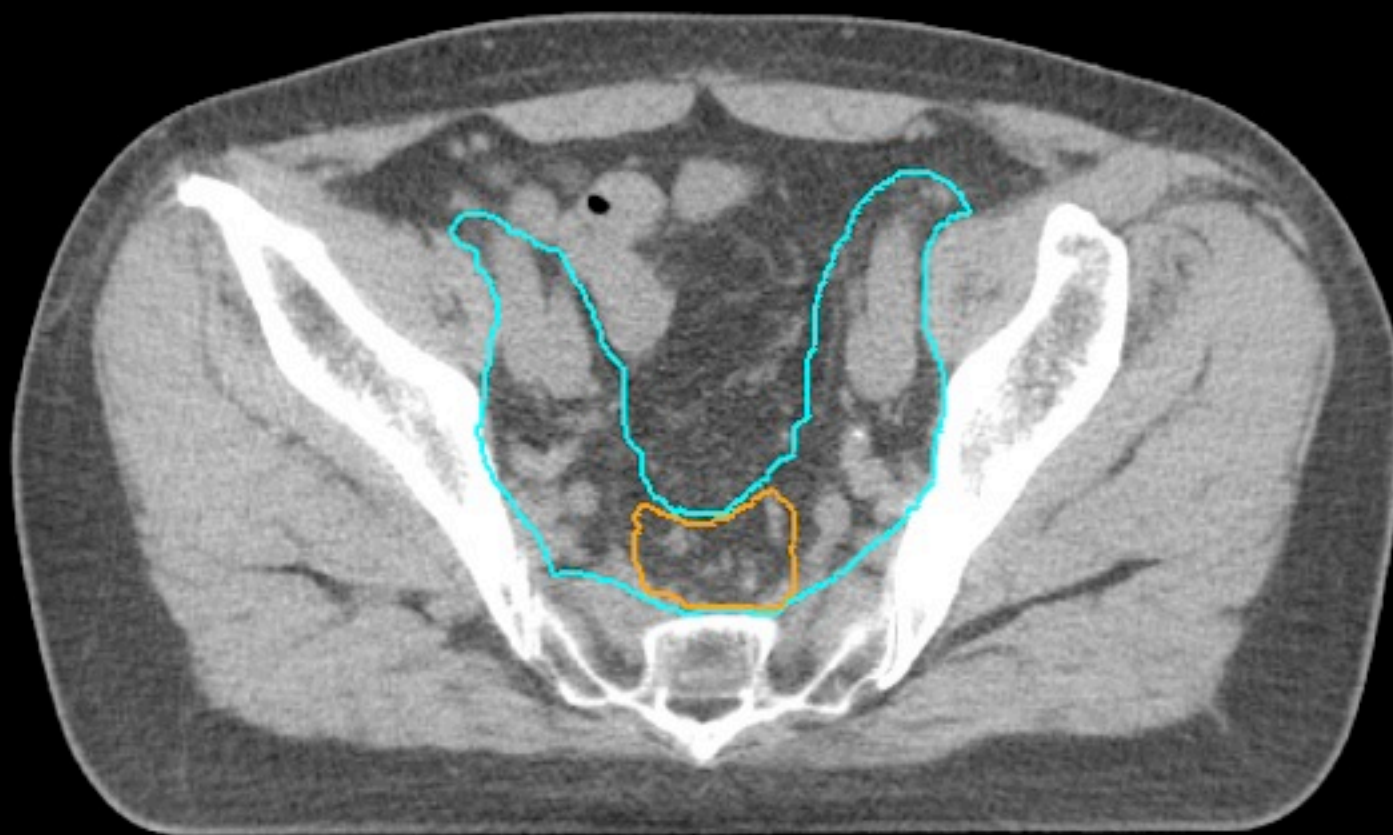


E. Iliac Nodes: 7-mm margin around vessels; extend anterior border by additional 10-mm anterolaterally along iliopsoas muscle to include lateral external nodes

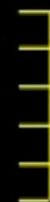


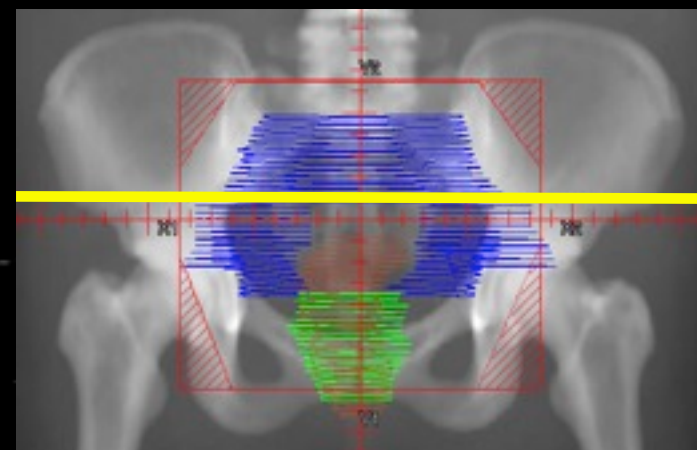
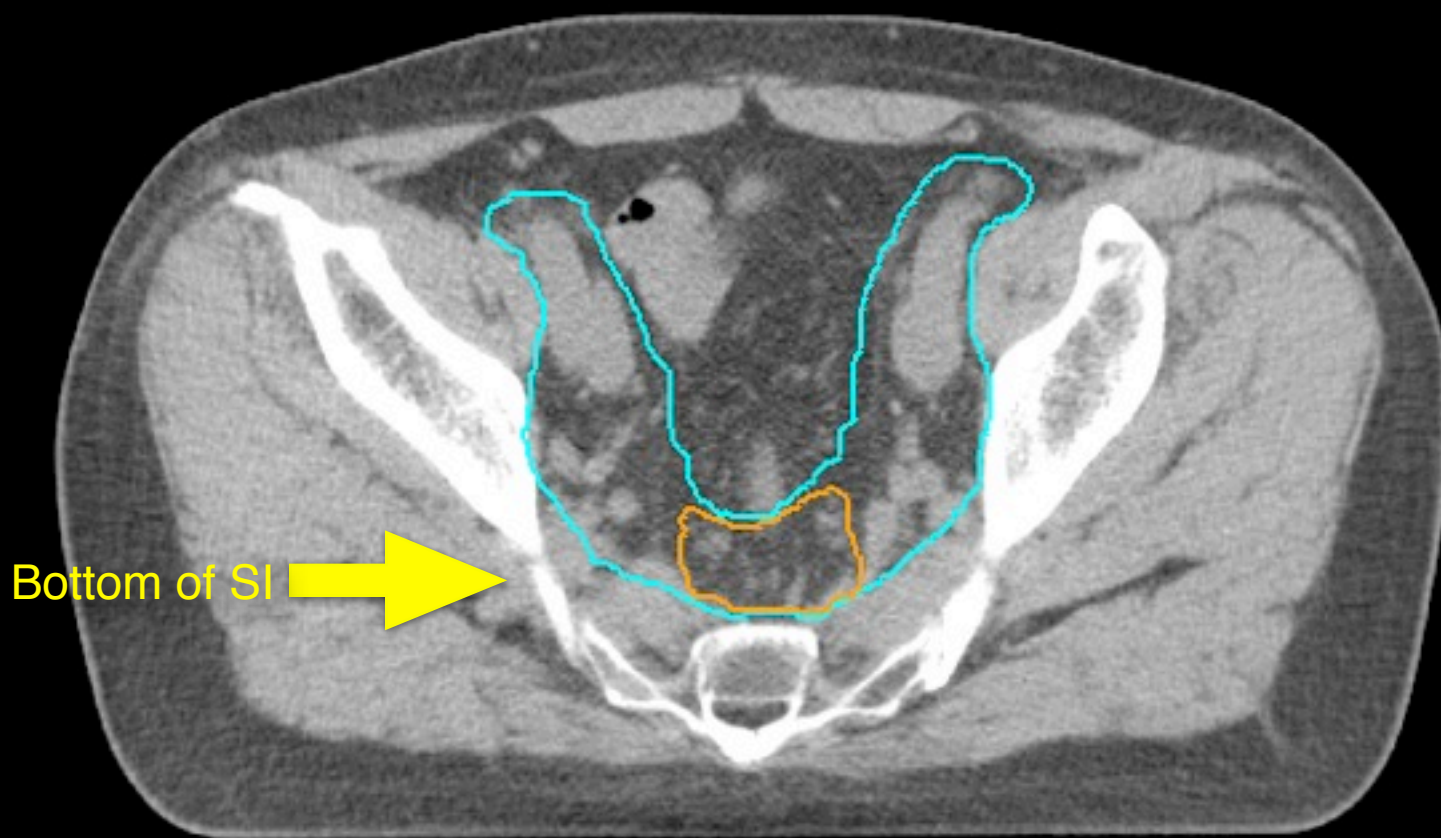


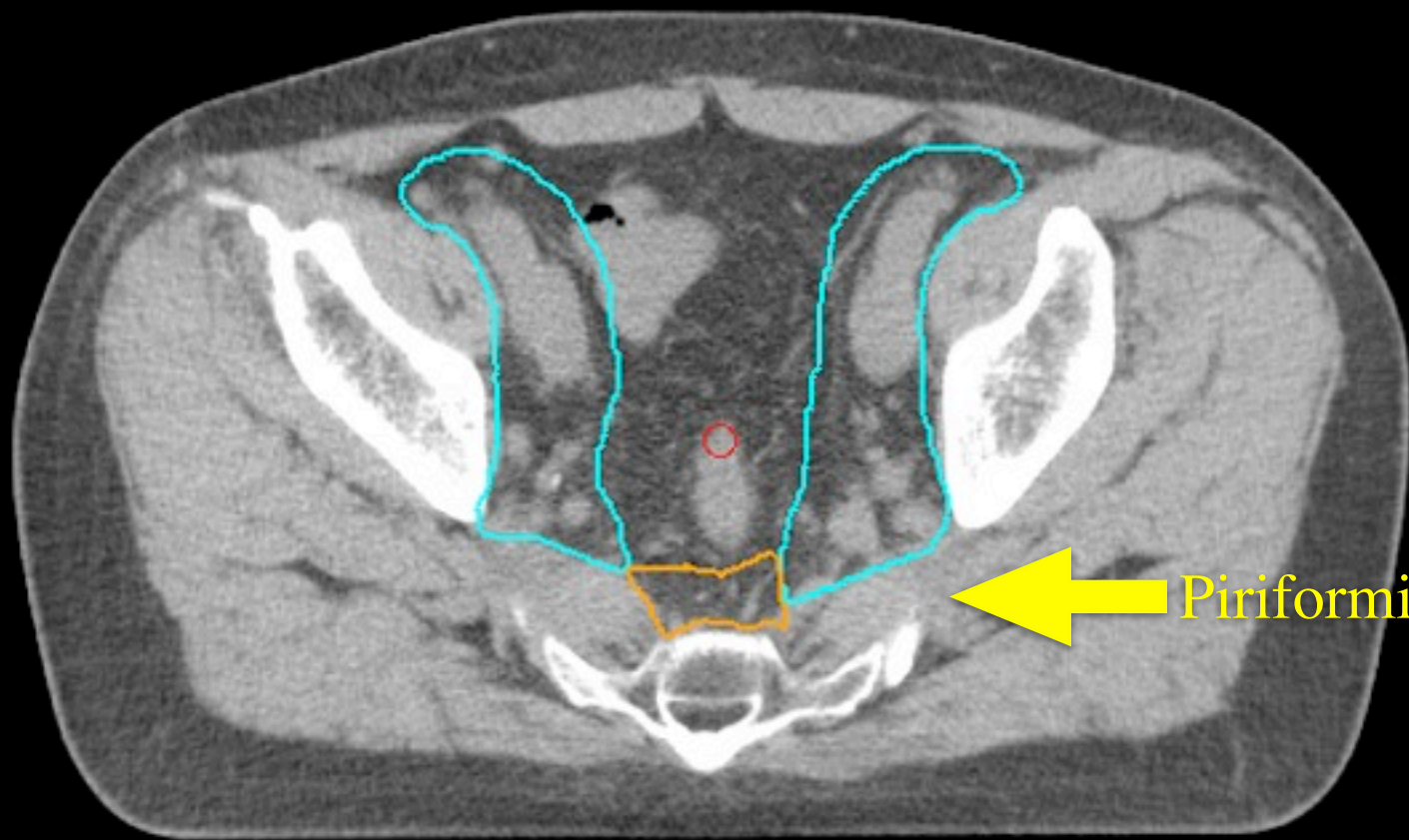




Internal Iliac Nodes: 7-mm
margin around vessels; extend
lateral borders to pelvic sidewall



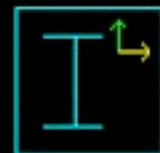
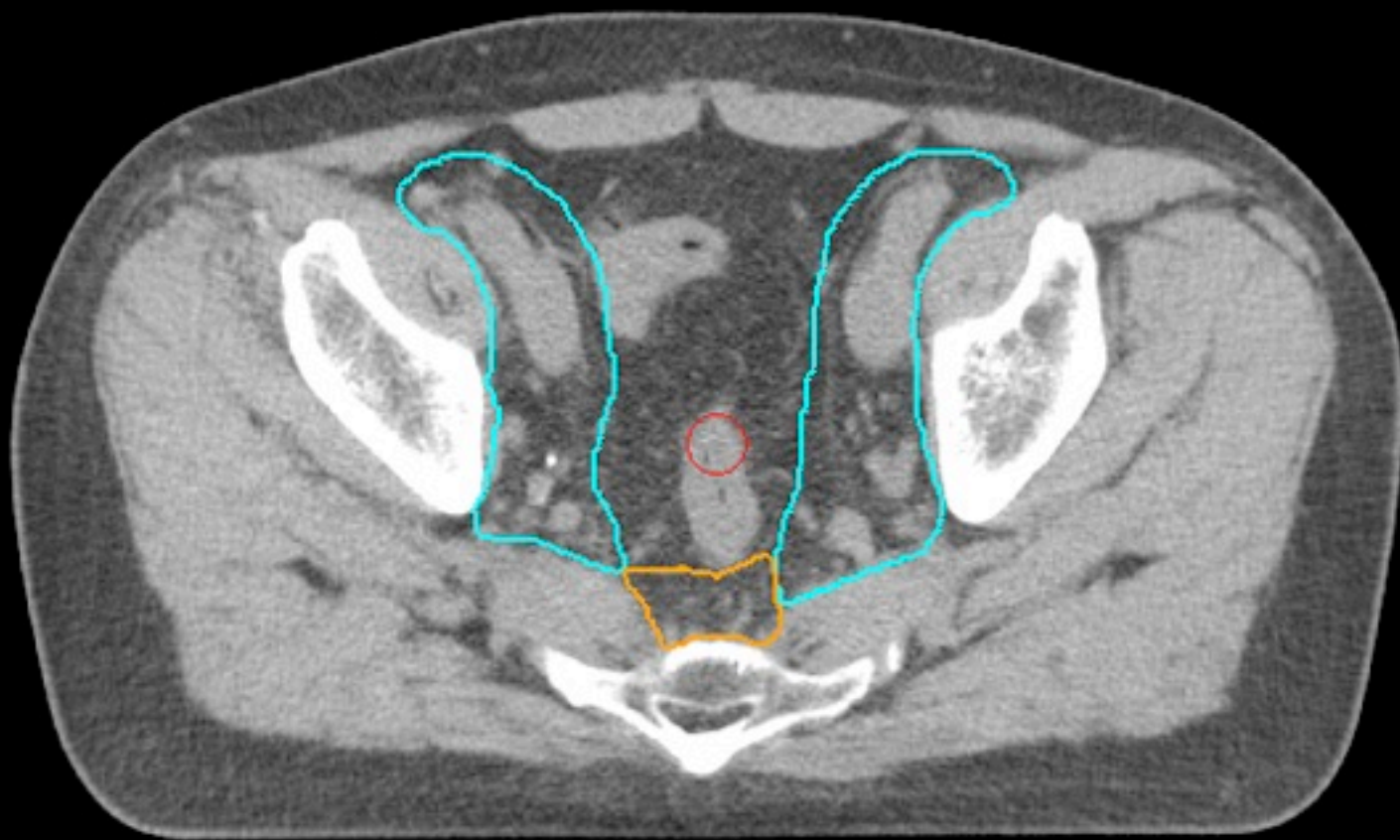




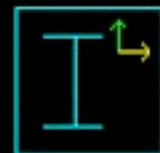
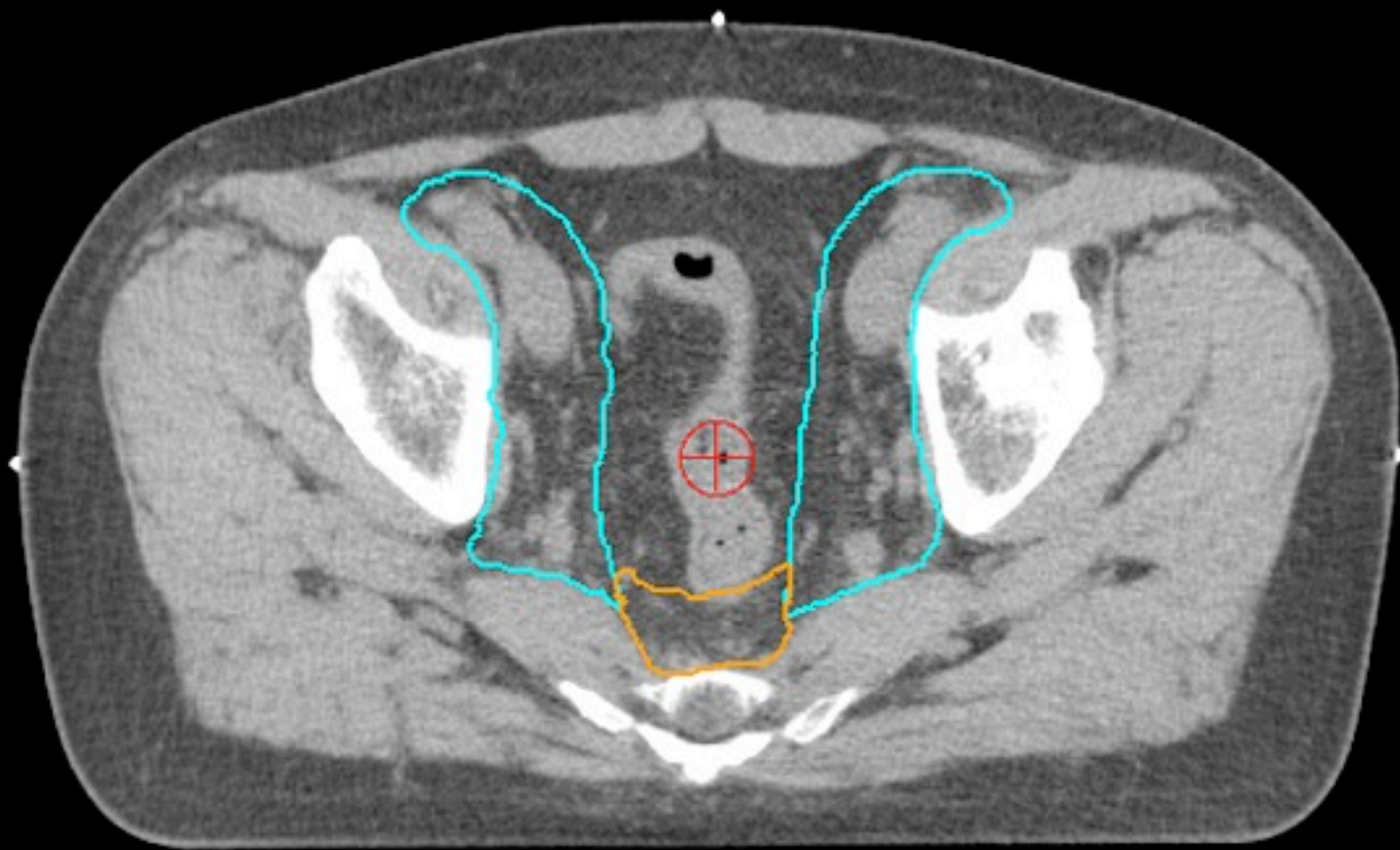
← Piriformis M.

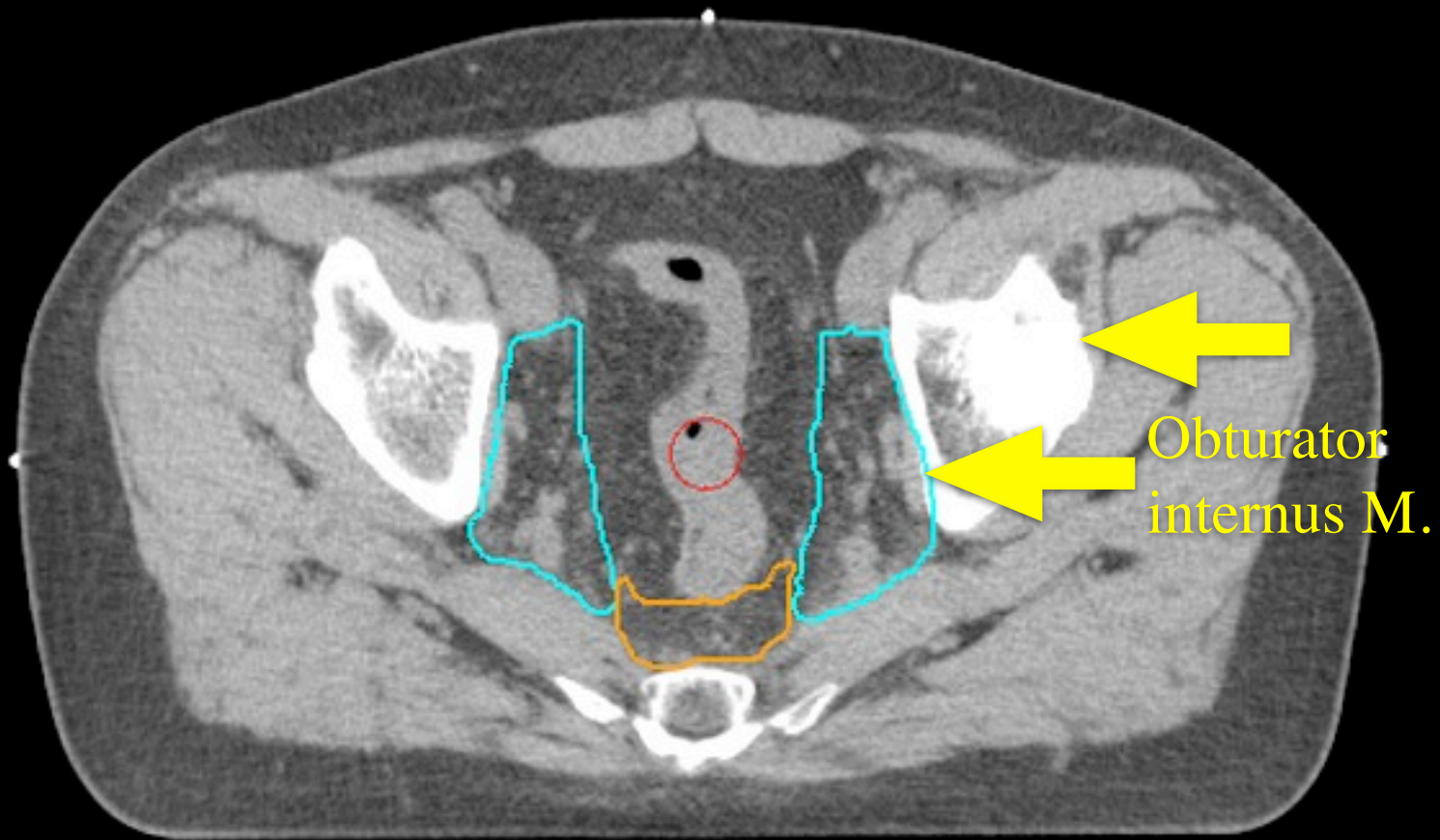
Internal Iliac Nodes: 7-mm
margin around vessels; extend
lateral borders to pelvic sidewall



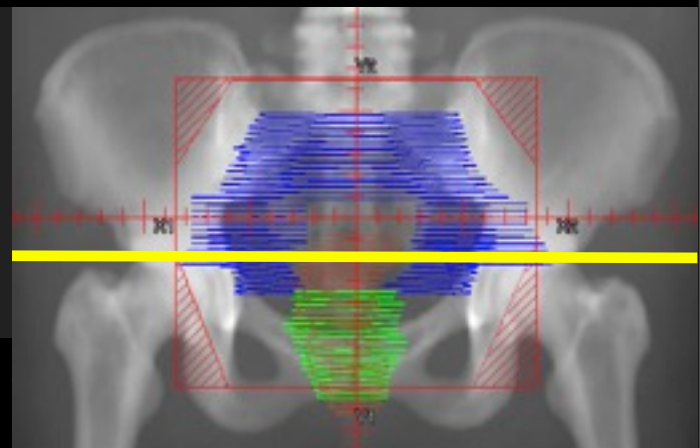


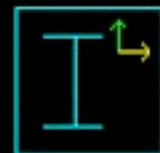


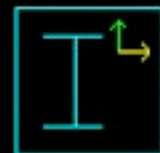


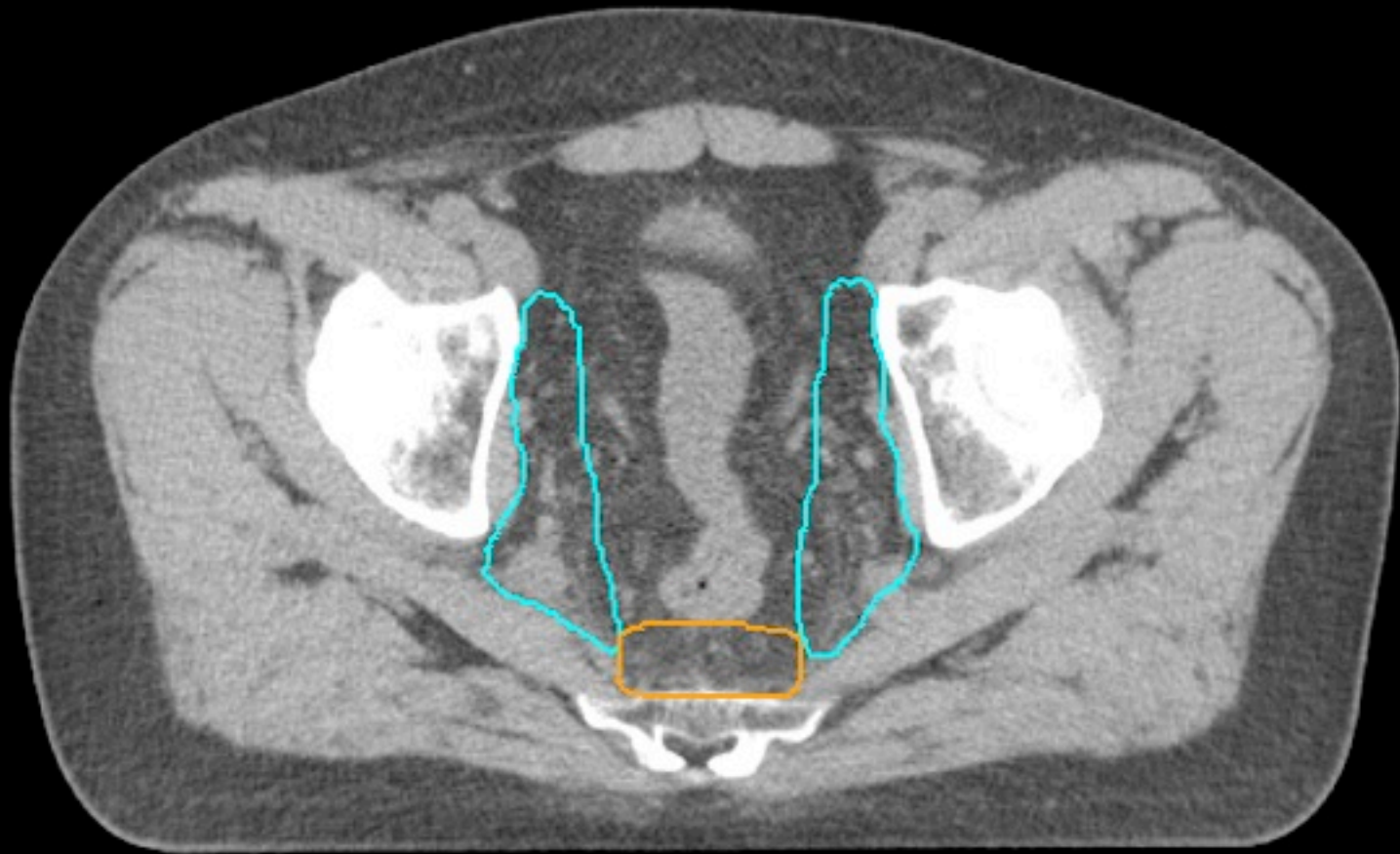


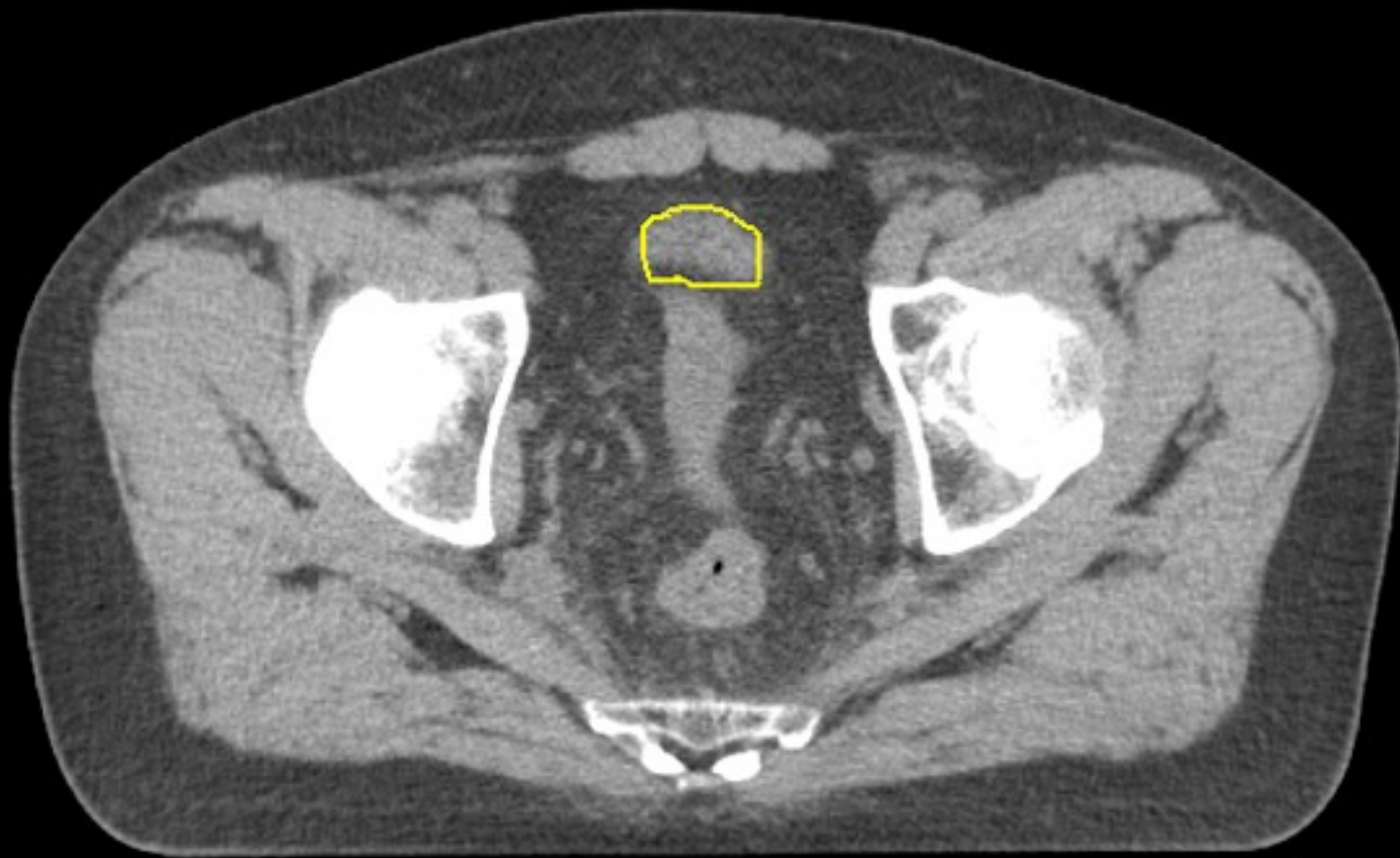
Obturator Nodes: Join external and internal iliac region with 18-mm-wide strip along pelvic sidewall

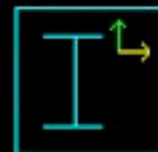


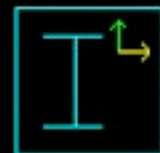


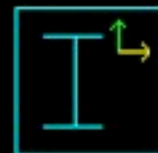
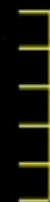


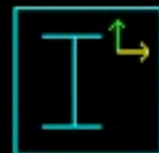
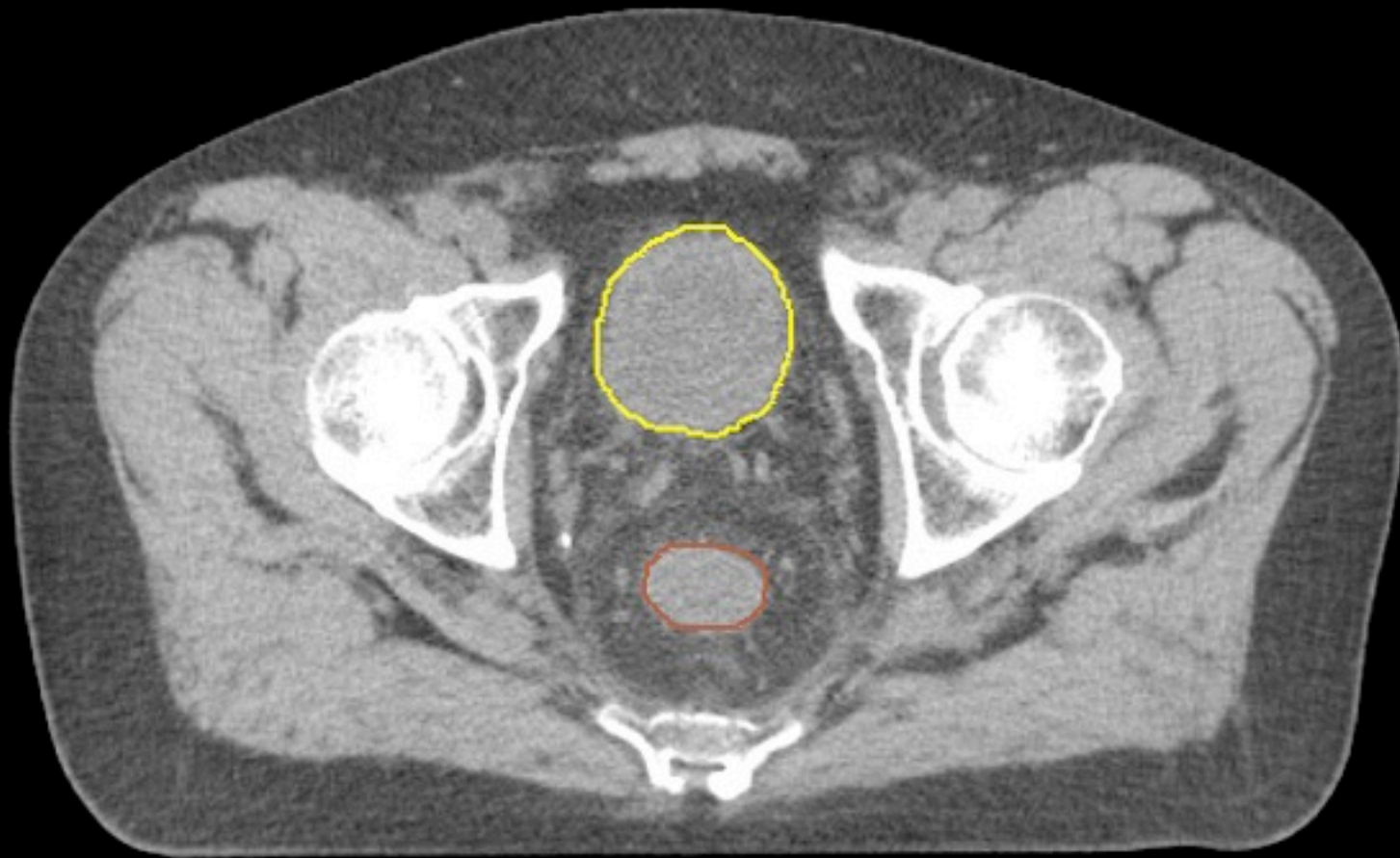


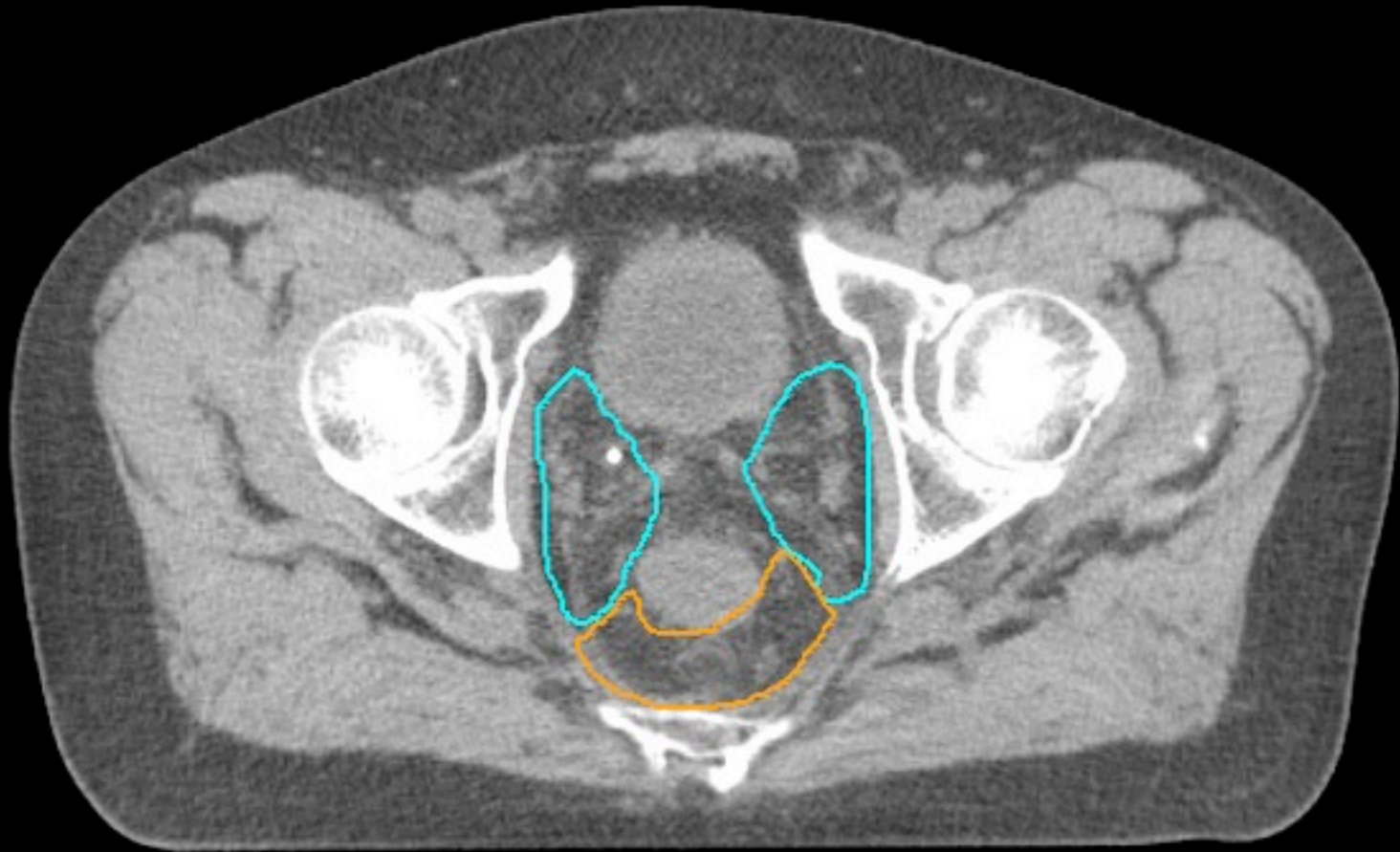


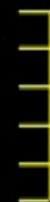
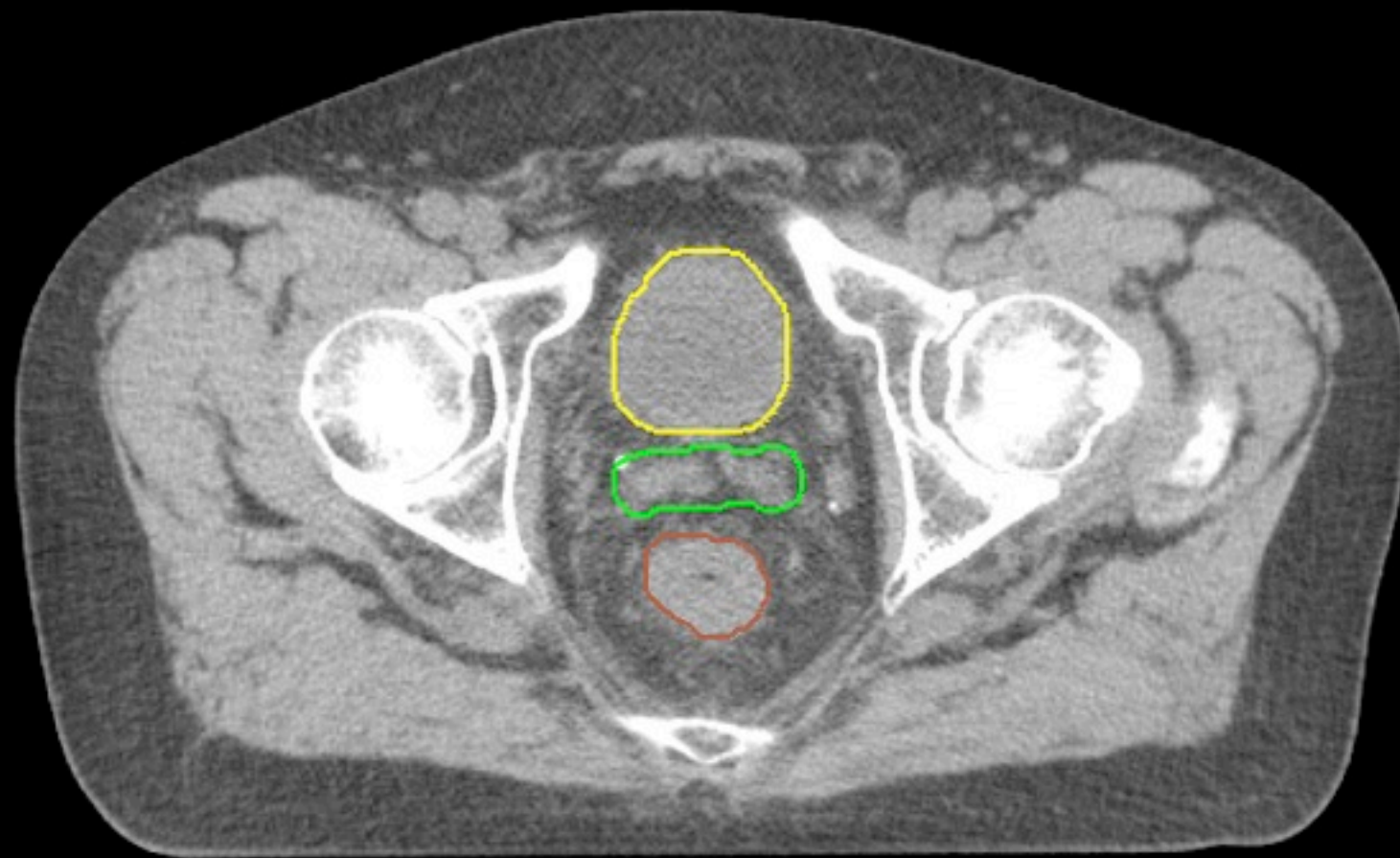


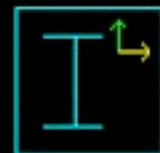


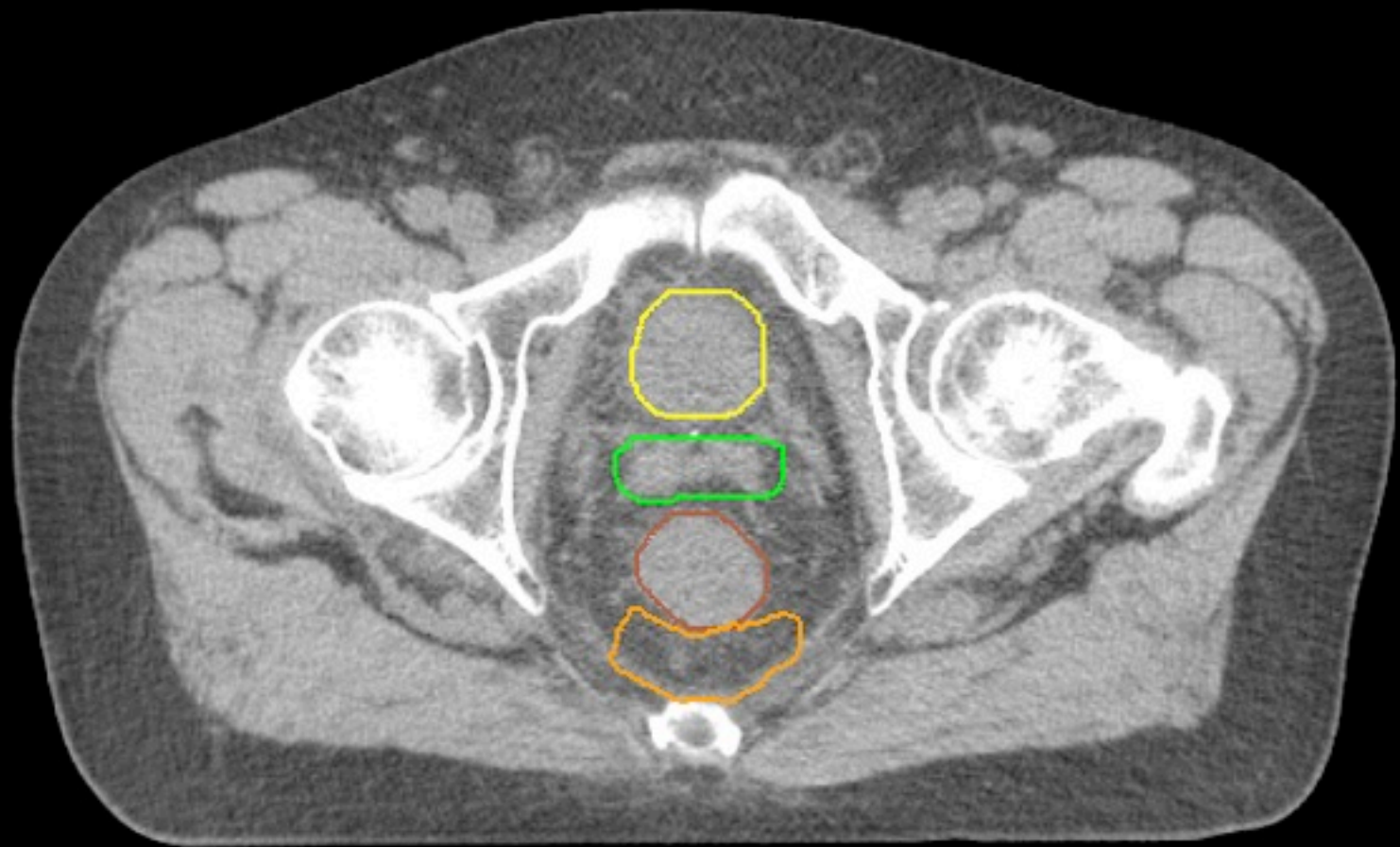




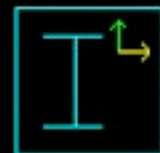
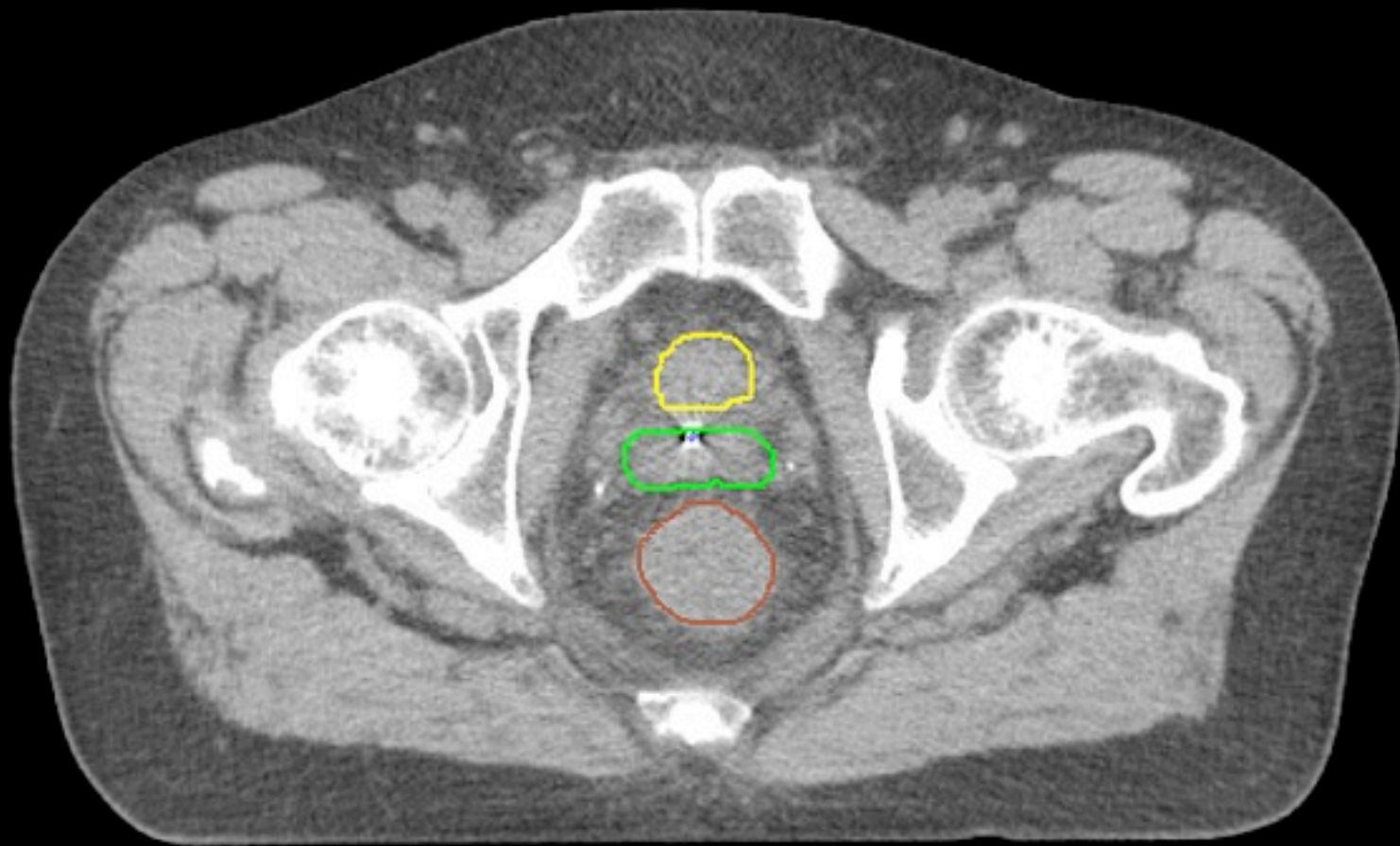


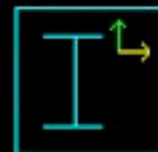
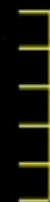


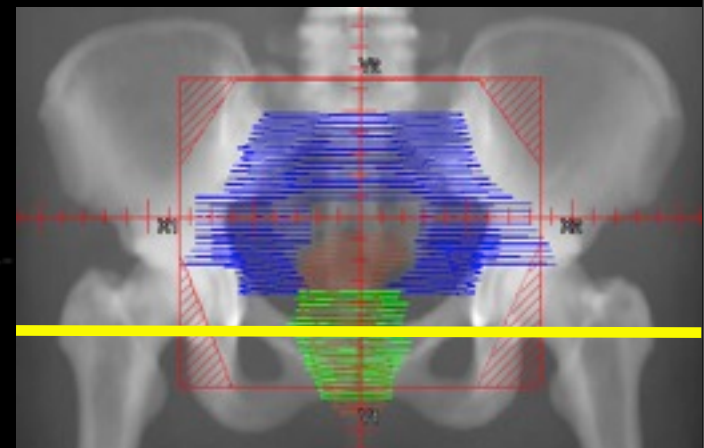


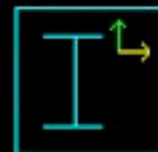


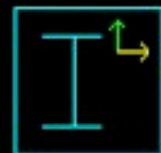


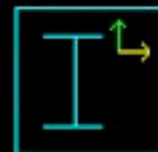
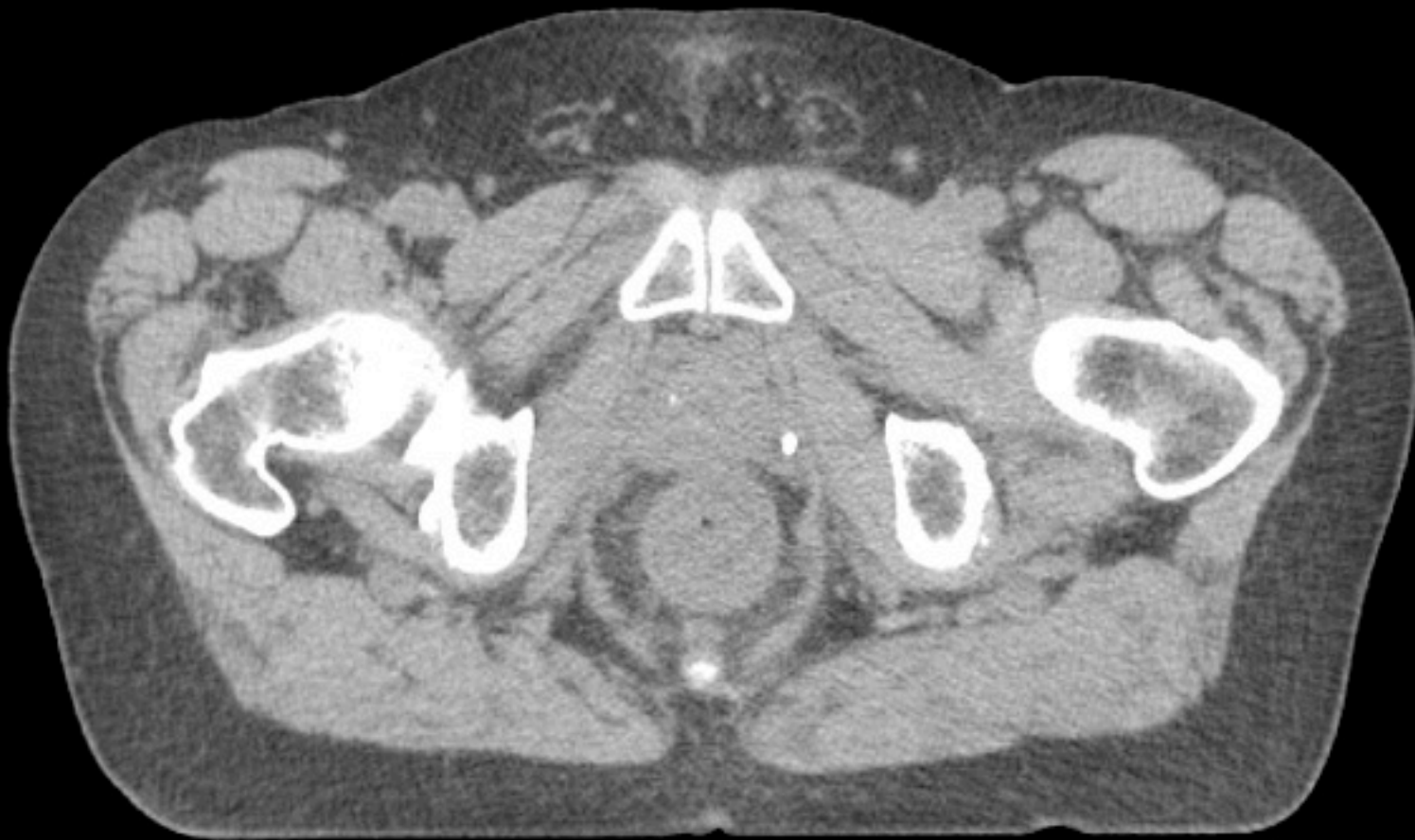


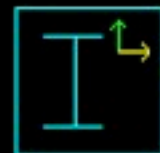
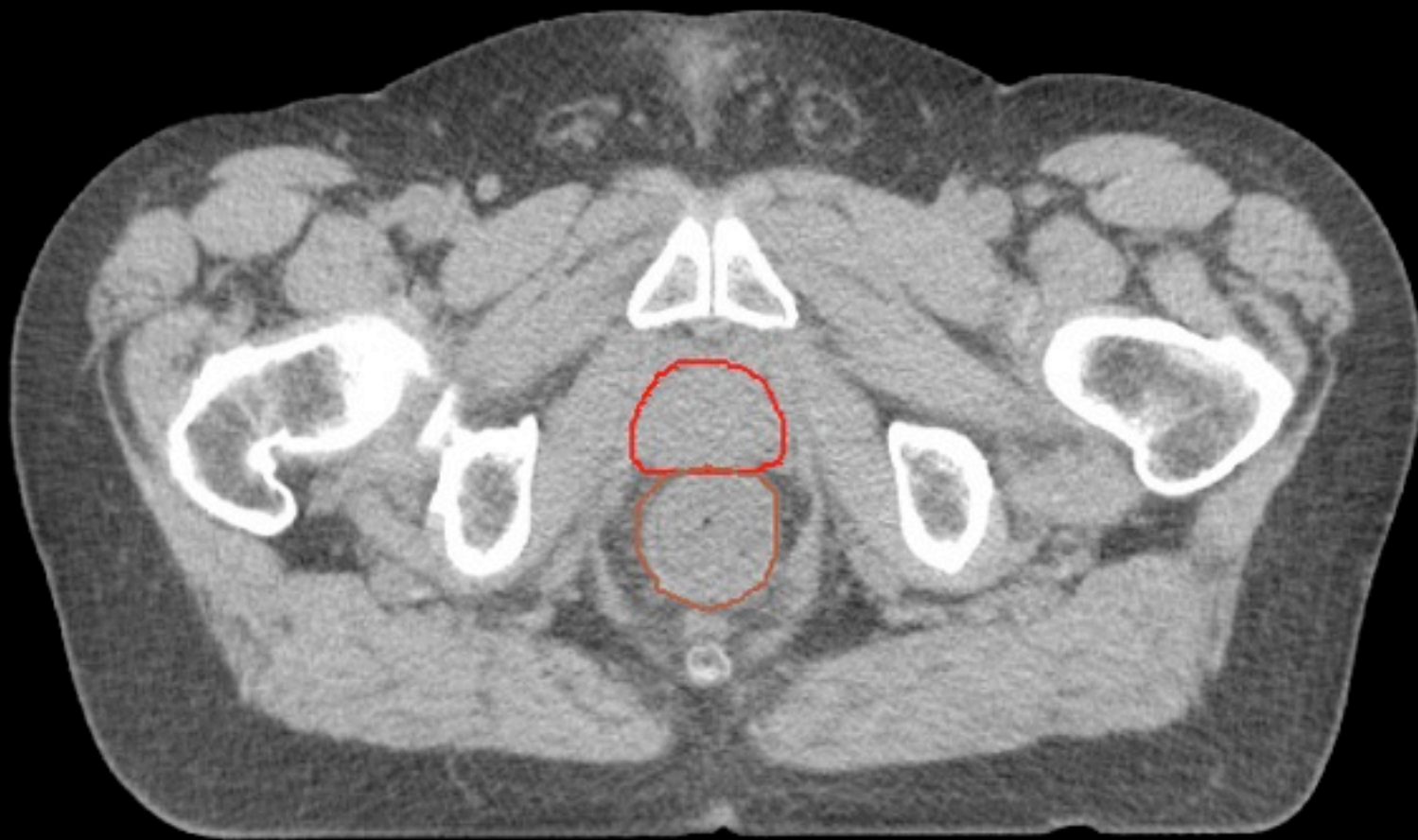


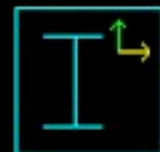
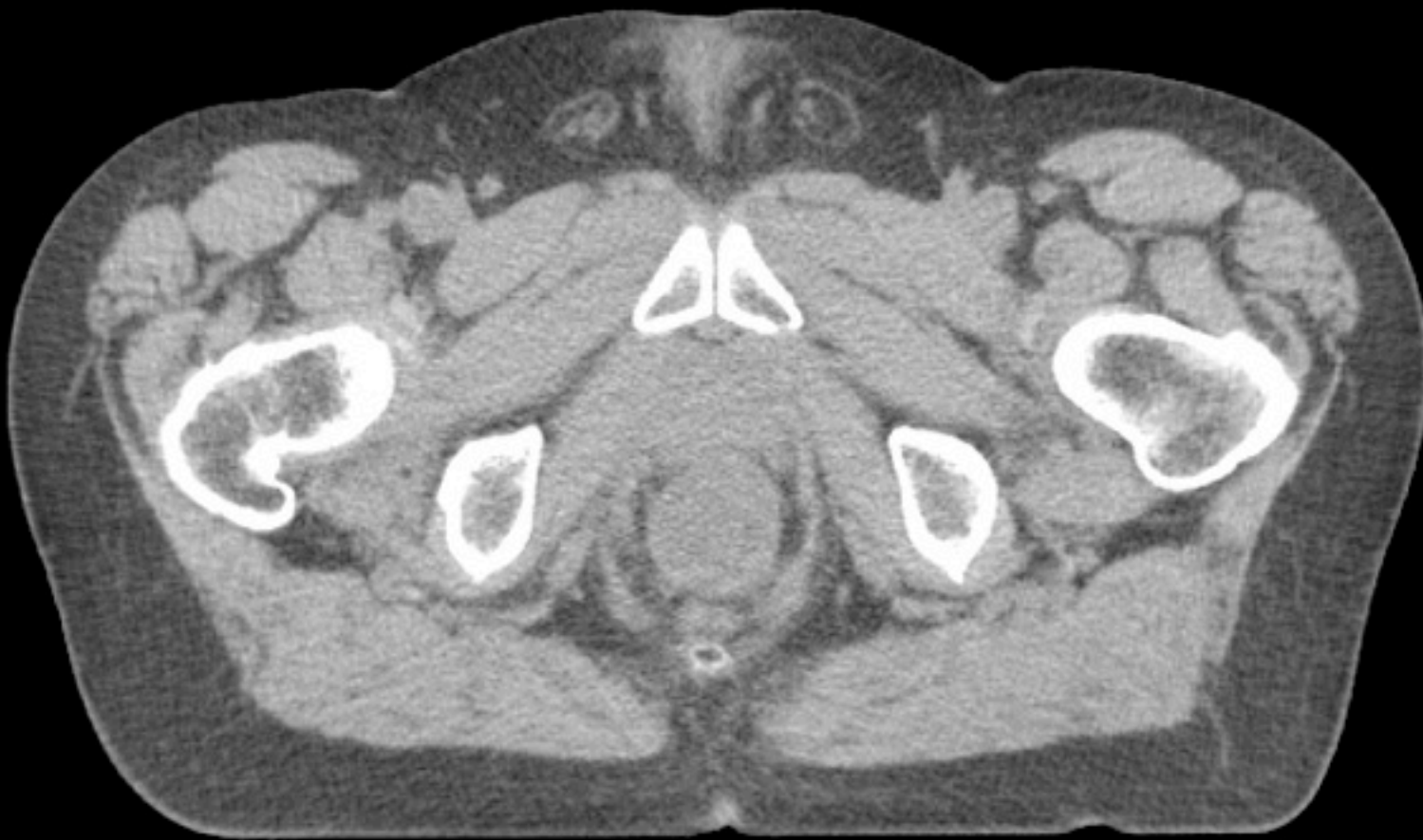


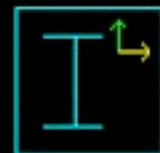
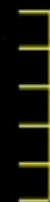


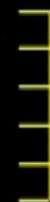


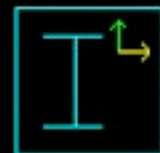
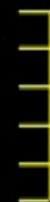


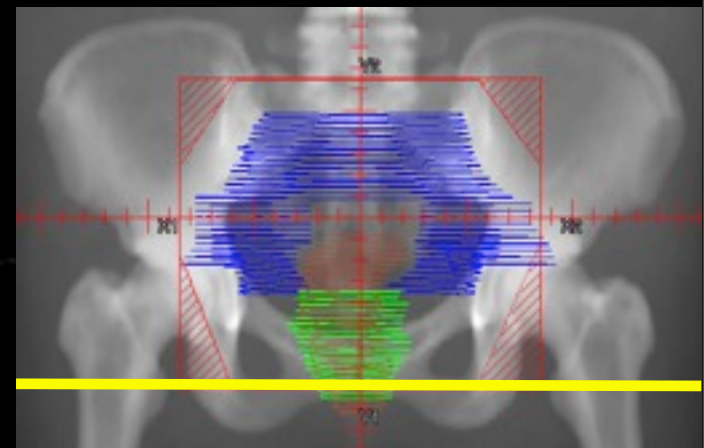
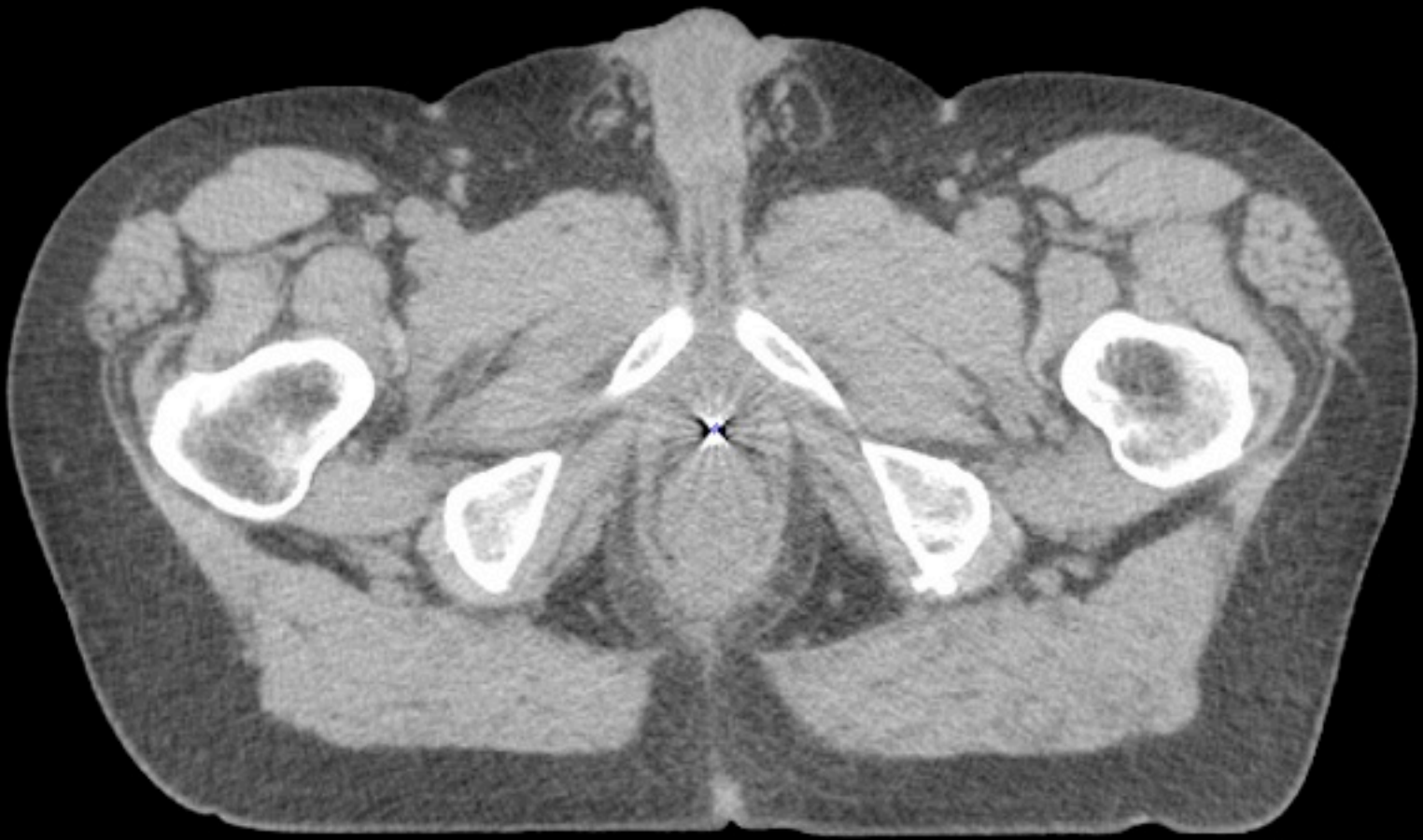


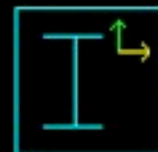
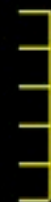


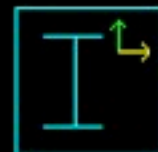
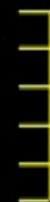


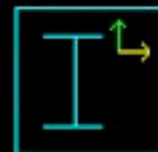


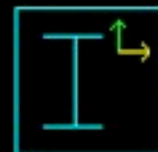


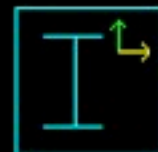
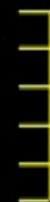


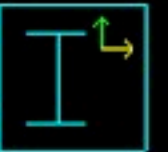


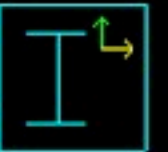
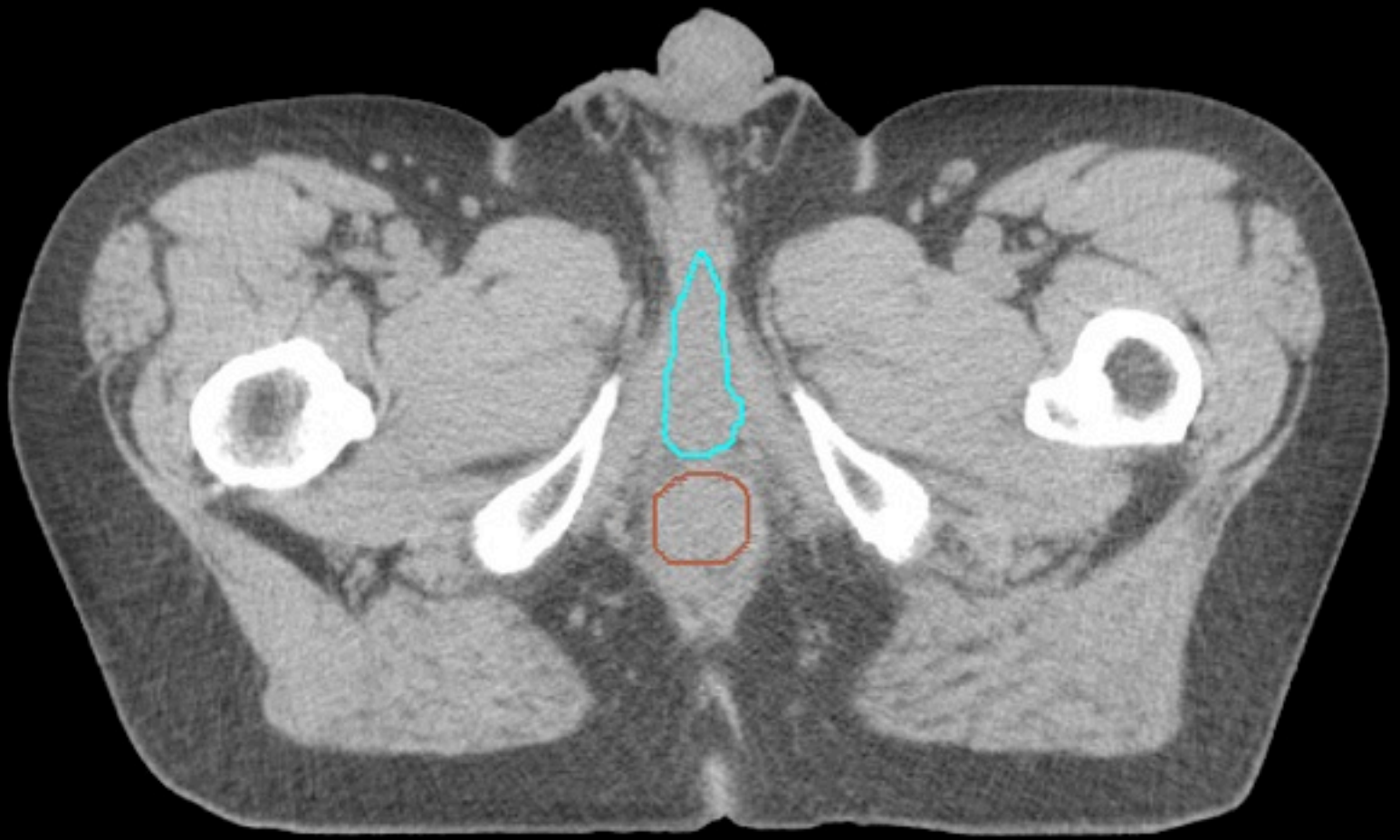


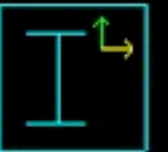
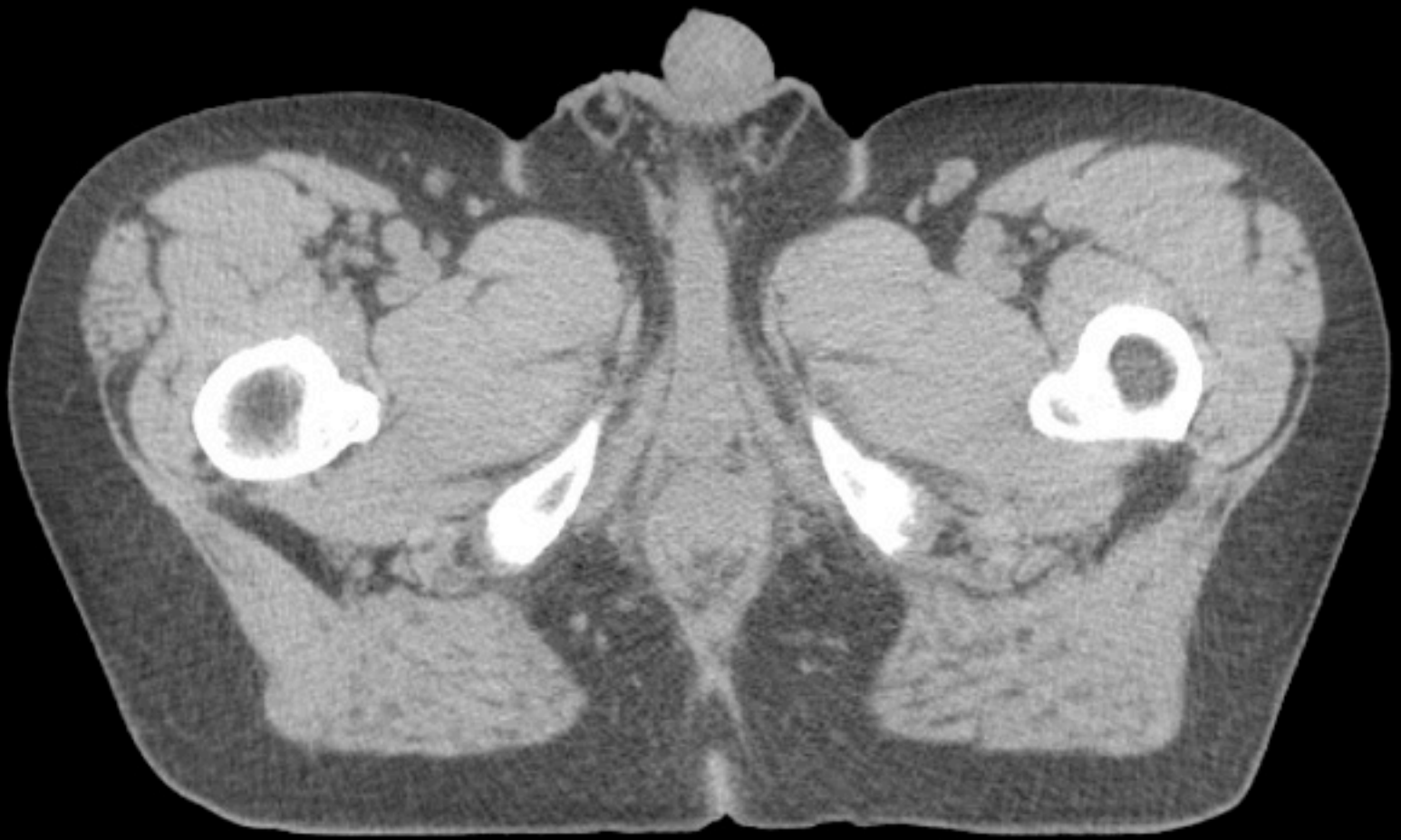


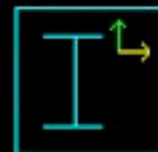


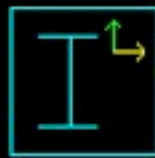
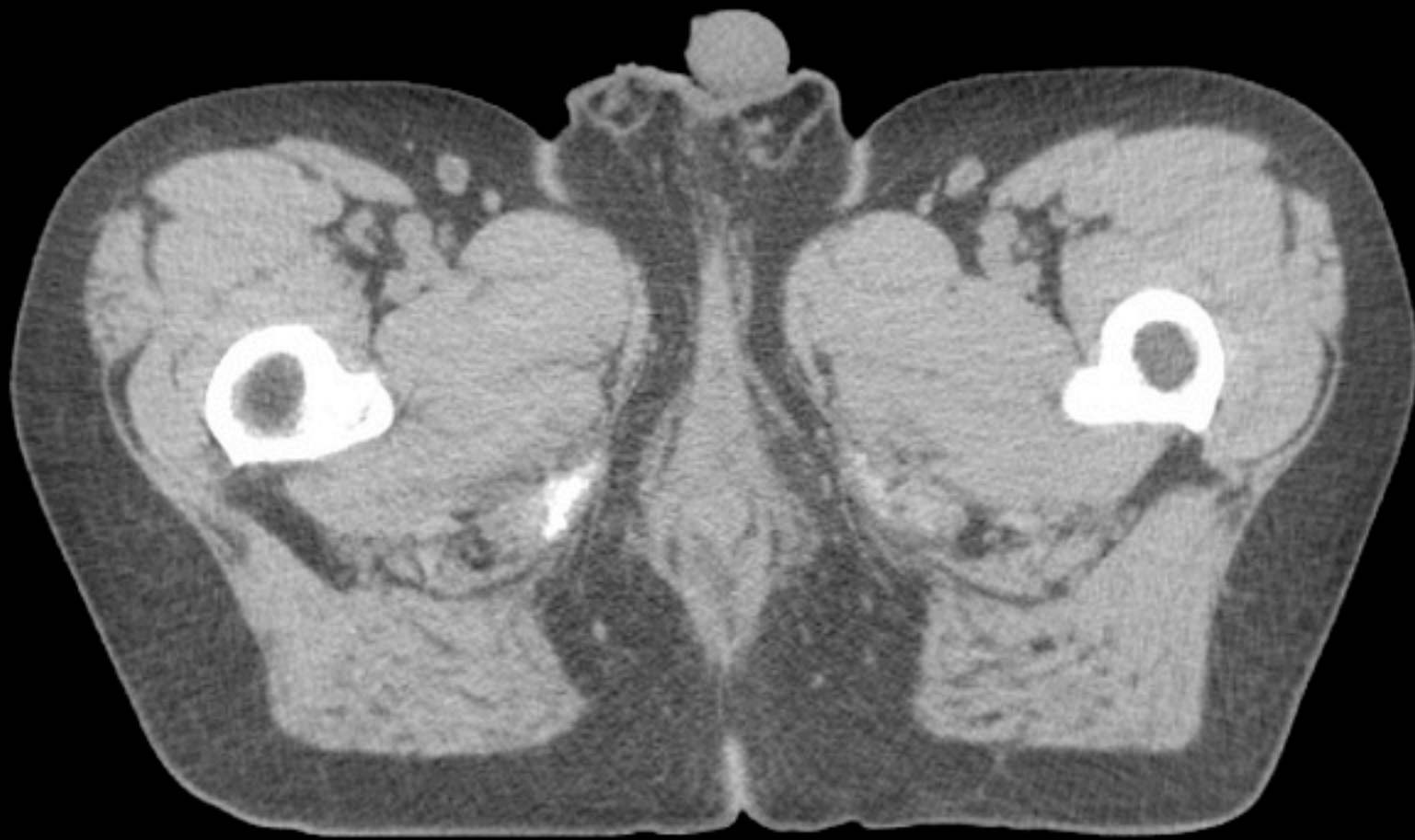


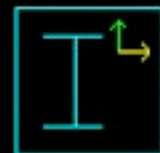
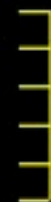


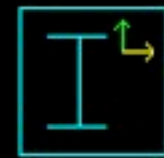
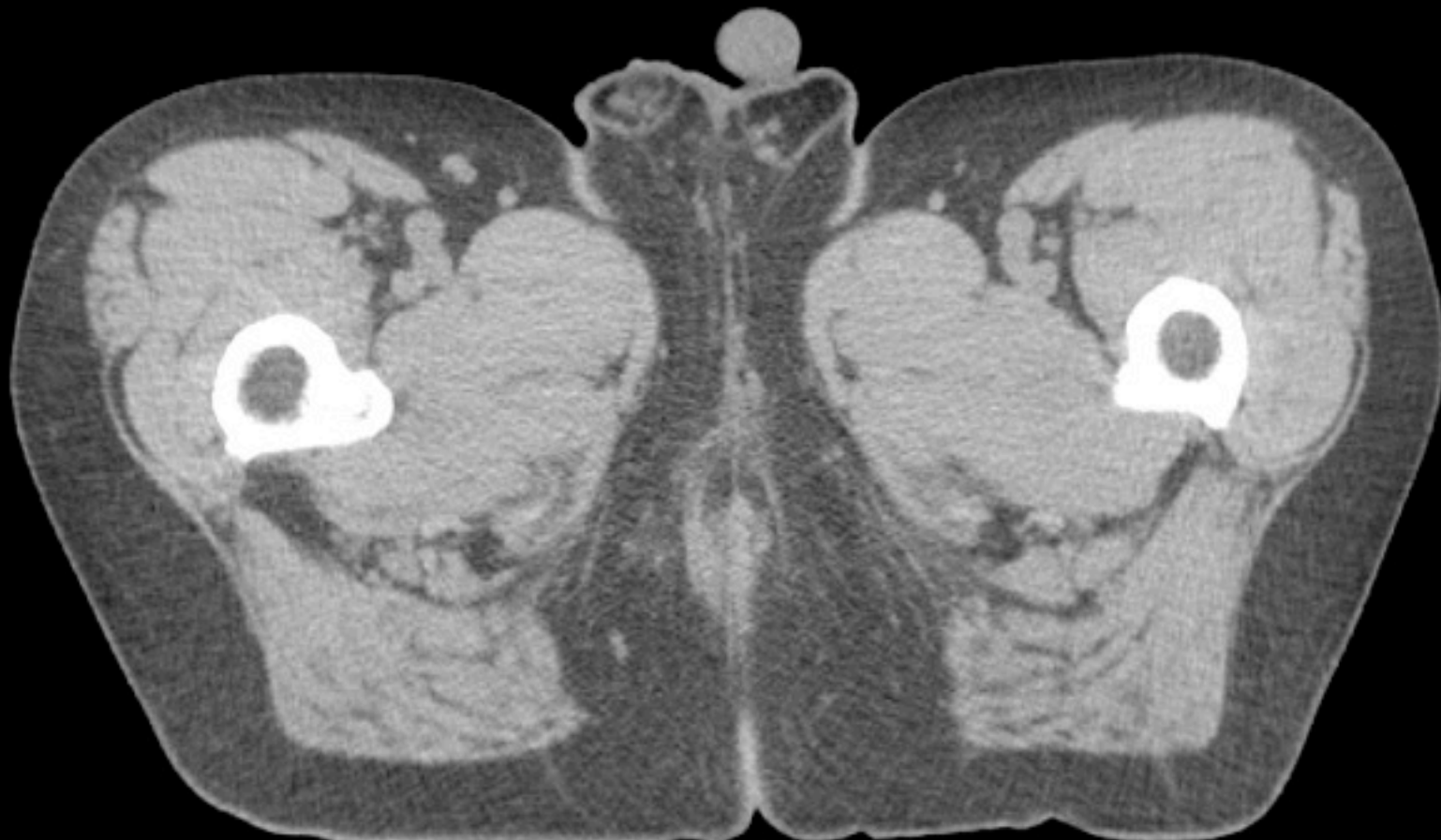


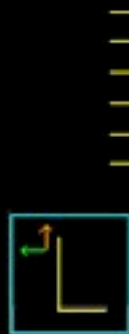
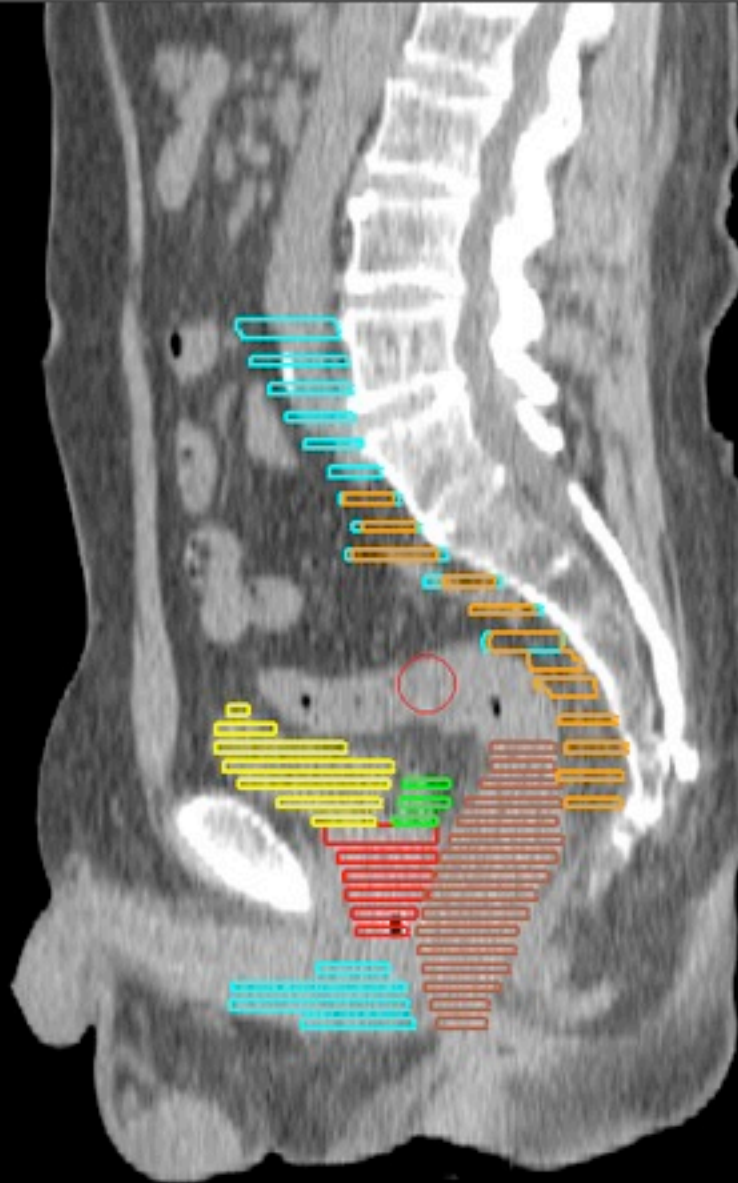


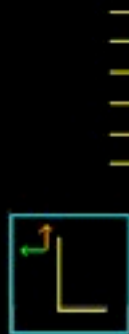












The End