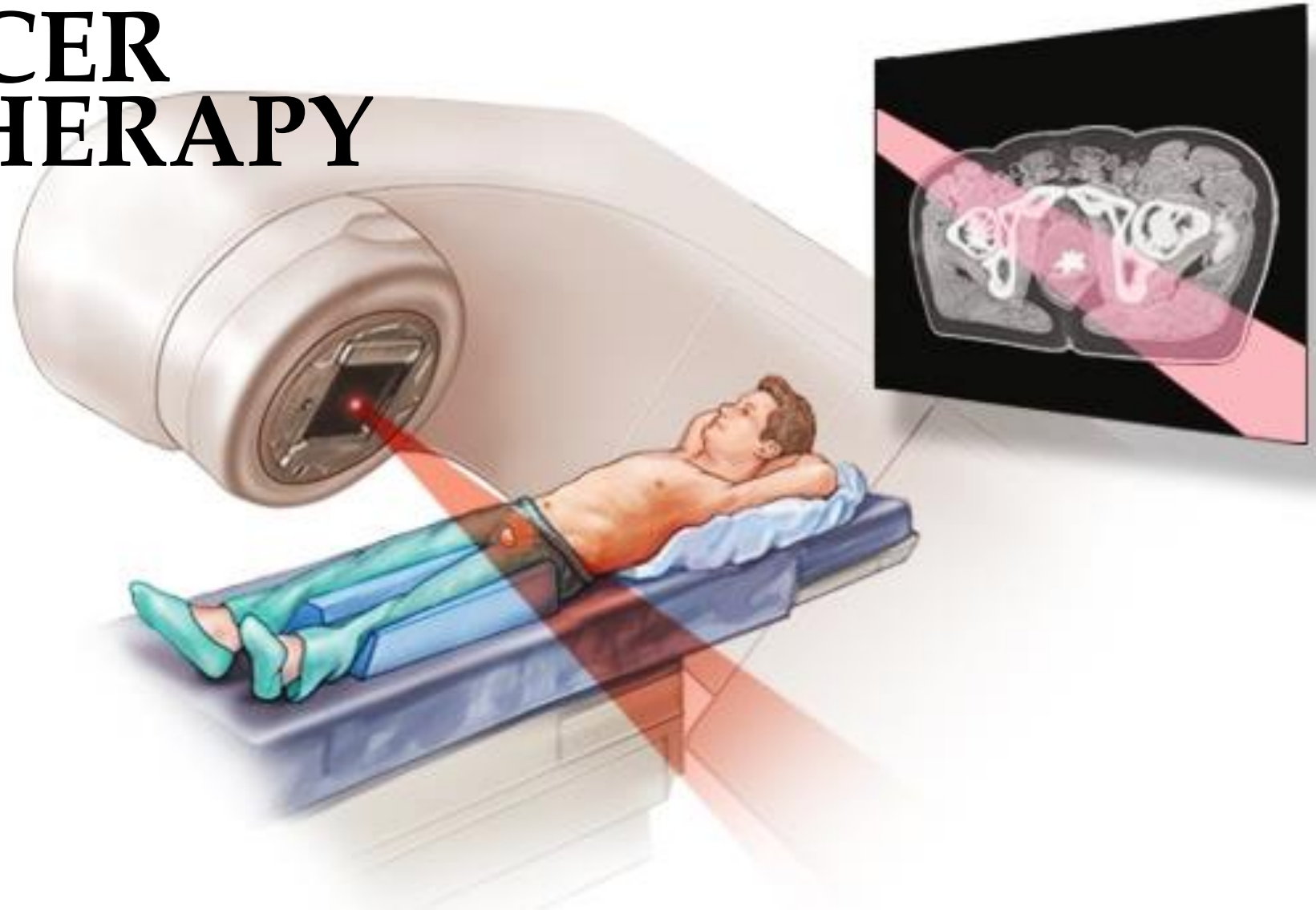
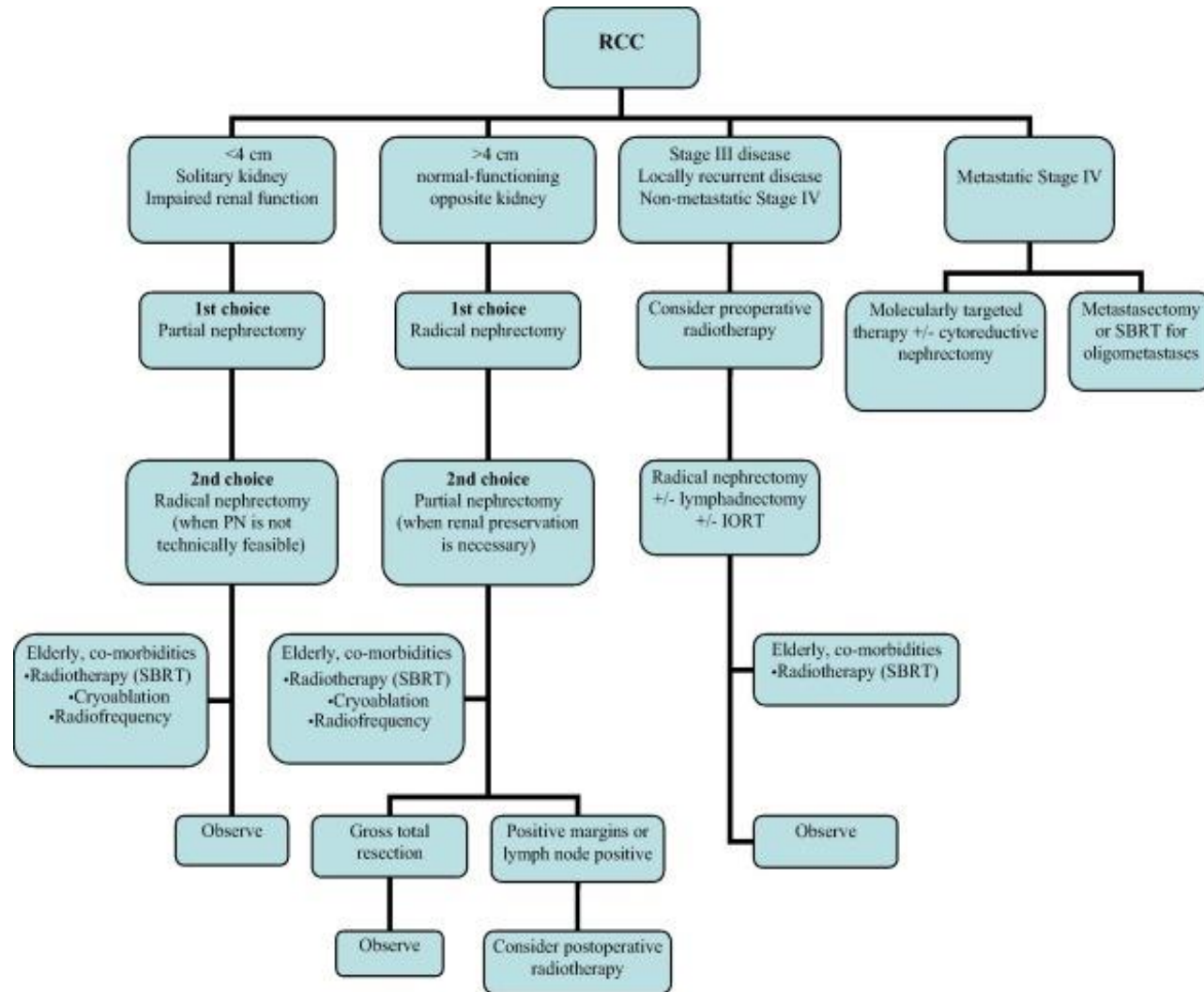


UROGENITAL CANCER RADIOTHERAPY



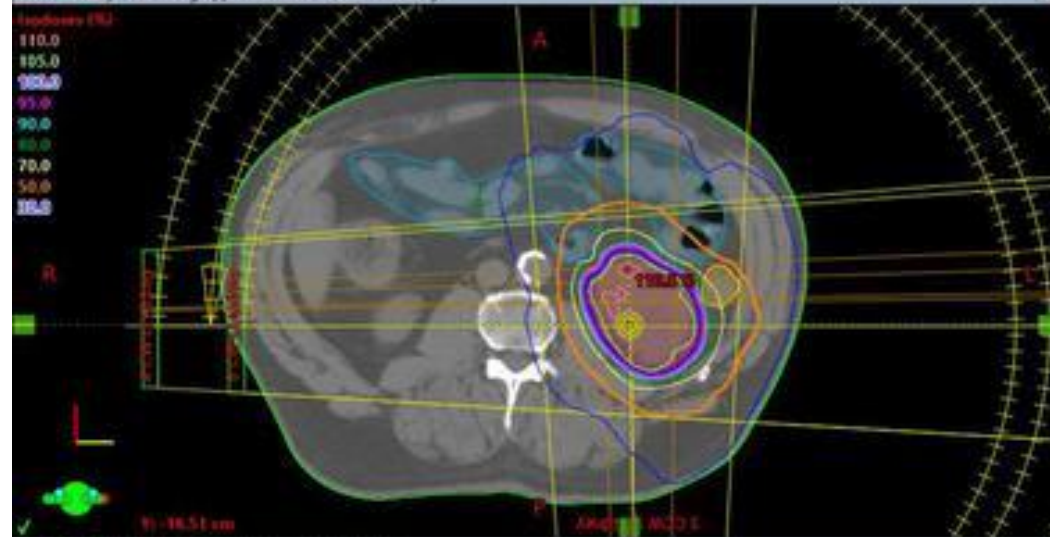
KIDNEY CANCER RADIOOTHERAPY



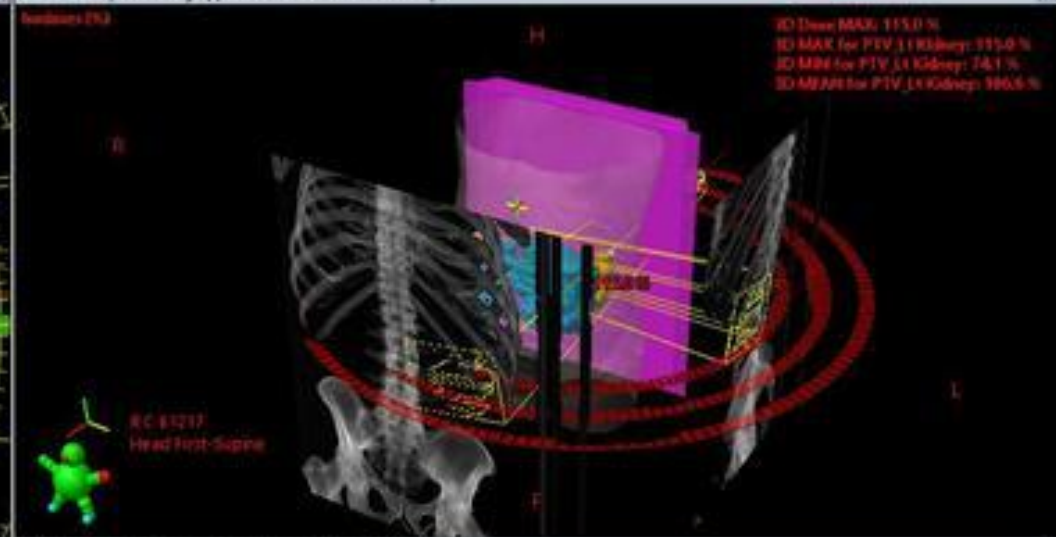
- Renal cell carcinoma belongs to the group of radioresistant tumors
- In the vicinity of the kidneys, there are organs that, due to their radiosensitivity, make it impossible to apply the appropriate therapeutic dose to the tumor (liver, spinal cord, meanders of the small and large intestine, spleen).
- Radiotherapy is most often used in symptomatic patients, as palliative, or to achieve disease control in unresectable local recurrences or in metastatic disease.
- More recent studies show improved efficacy of radiotherapy if used with radiosensitizers, such as bisphosphonates.
- Bisphosphonates have shown radiosensitization of various renal carcinoma cell lines including 786-O, A-498, and ACHN cells, but not Caki-1 cells.
- High radiation dose has been observed to show an immunogenic effect in RCC patients.

- Preoperative radiotherapy
 - Consider in unresectable and locally advanced renal carcinoma.
 - The use of postoperative radiation therapy after nephrectomy has shown a certain benefit in several clinical studies. The most frequently administered doses ranged from 46 to 50 Gy. - without significant impact on long-term survival.
-
- Intraoperative radiotherapy
 - Intraoperative radiotherapy is used in patients with locally recurrent and/or locally advanced non-metastatic RCC. Intraoperative radiotherapy is used in clinical studies as monotherapy or in combination with EBRT. In both cases, limited efficacy was demonstrated.

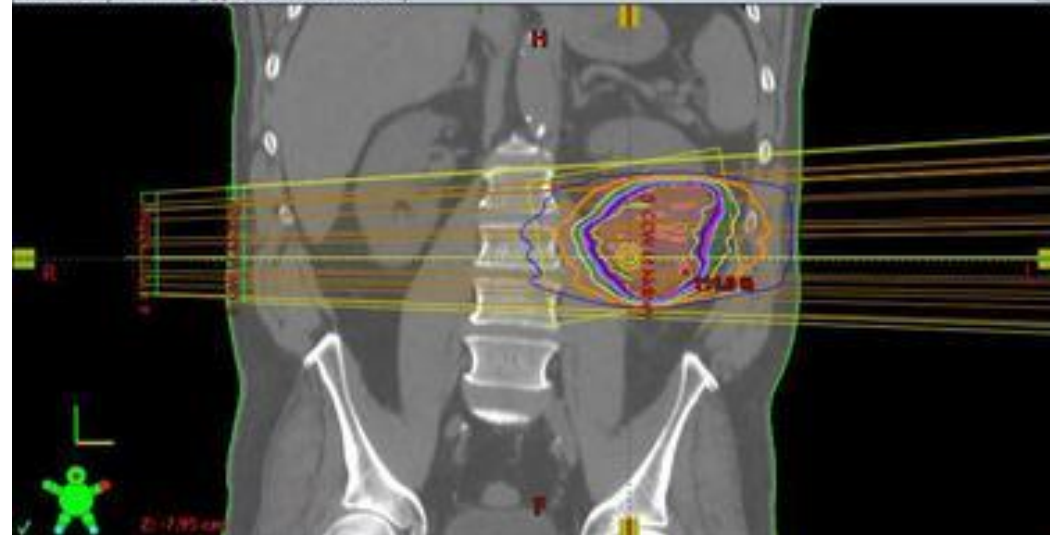
SBRT LxKidney - Planning Approved - Transversal - Lt Kidney



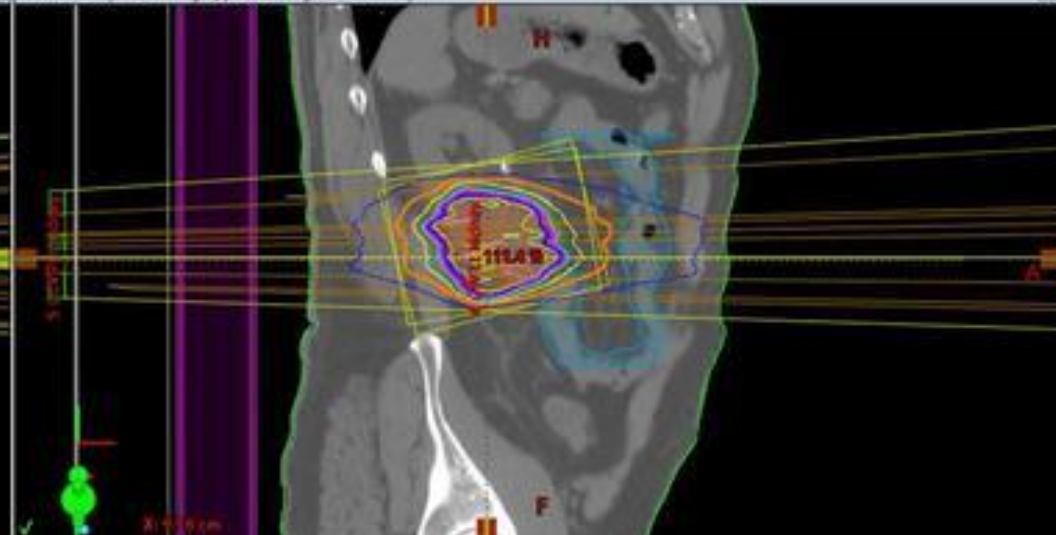
SBRT LxKidney - Planning Approved - Model View - Lt Kidney



SBRT LxKidney - Planning Approved - Frontal - Lt Kidney

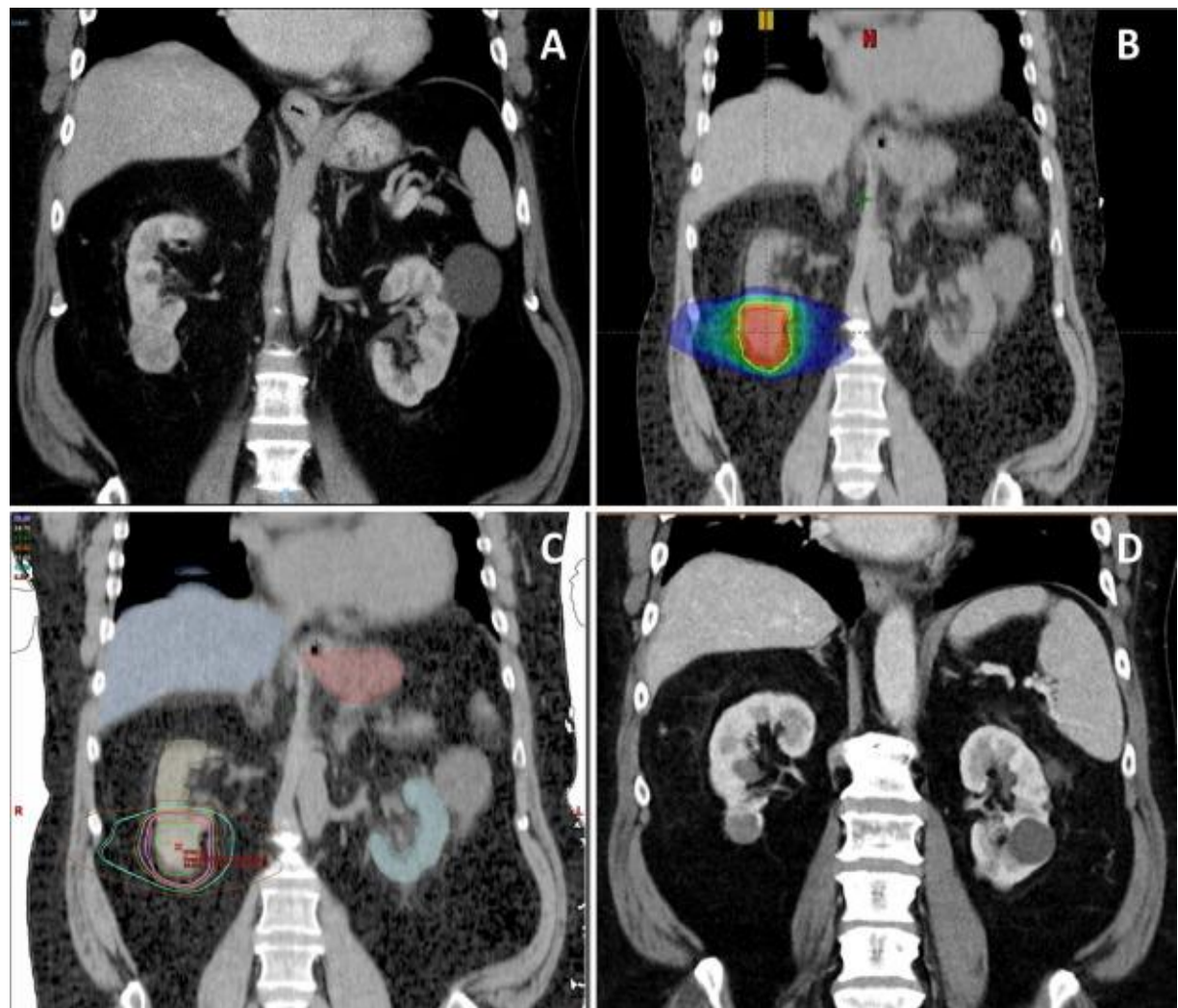


SBRT LxKidney - Planning Approved - Sagittal - Lt Kidney

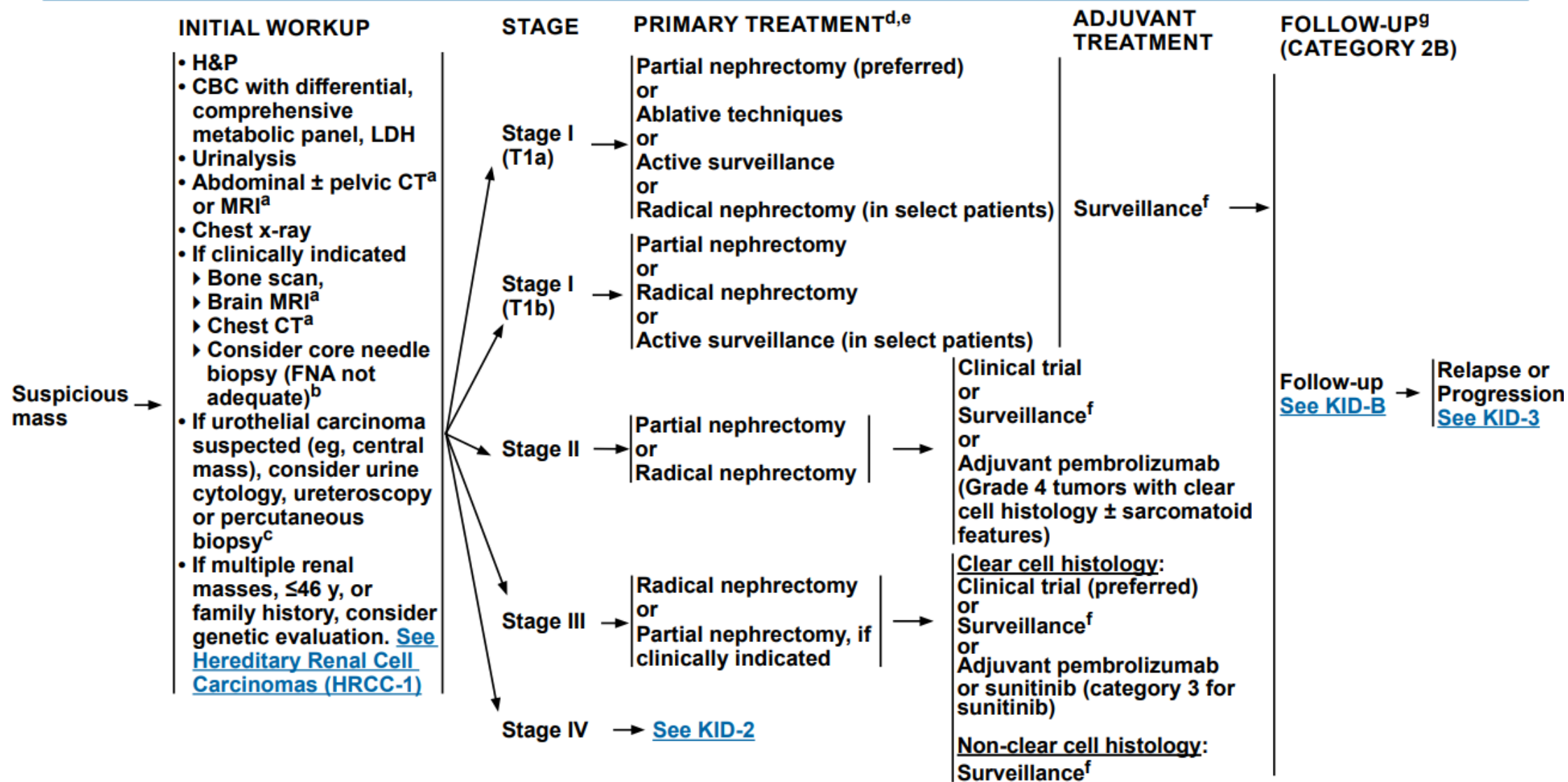


SABR

- Combining ablative radiotherapy with immunotherapy increases treatment success.
- The relative radioresistance of RCC, as well as the experiences of treating brain metastases originating from kidney cancer, have led to an increasing interest in the use of SBRT in the treatment of kidney cancer.
- Indications for the use of SBRT:
 - - Kidney tumor smaller than 5 cm
 - - Without involvement of regional lymph nodes
 - - When surgical treatment is contraindicated (one functioning kidney, bilateral kidney cancer, medically inoperable tumor or locally recurrent tumor after conservative surgical resection)
- Contraindications for this type of treatment are large tumors due to the high single dose that affects a large volume of surrounding healthy tissue.



Study	Patients (<i>n</i>)	Total dose (Gy)	Fractions/fractional dose (Gy)	Outcomes
Beitler et al ²⁰	9 patients, 2 with bilateral RCC	40	8	4/9 patients alive at median f/u 26.7 mo
Svedman et al ²²	30 patients, 82 lesions	32, 40, 30, 45	8, 10, 15, 15	Stable disease, partial/complete response in 98% of lesions
Teh et al ²⁵	14 patients, 23 extracranial sites, 2 primary RCC	24–40	3–6	Median f/u 9 mo; 93% symptomatic relief, 87% LC


^a Imaging with and without contrast is strongly preferred, such as a renal protocol.

^b Biopsy of small lesions may be considered to obtain or confirm a diagnosis of malignancy and guide surveillance or ablative techniques, cryosurgery, and radiofrequency ablation strategies.

^c If metastatic disease is present or the patient cannot tolerate ureteroscopy.

^d [See Principles of Surgery \(KID-A\)](#).

^e Stereotactic body radiotherapy (SBRT) may be considered for medically inoperable patients with Stage I kidney cancer (category 2B), with Stage II/III kidney cancer (both category 3).

^f [See Follow-up \(KID-B\)](#).

^g No single follow-up plan is appropriate for all patients. Follow-up should be individualized based on patient requirements.

MALIGNANT TUMORS OF THE RENAL PELVIS AND URETER

- **Radiotherapy of renal pelvis and ureter cancer**
- **The application of postoperative radiotherapy of the tumor bed would theoretically aim to achieve local control of the disease and prevent recurrence. To achieve a therapeutic effect, it is necessary to apply a dose of at least 50 Gy to the target volume, which should include the entire kidney and ureter. Since it is not possible to exclude the surrounding organs from the irradiated volume, whose radiotolerance threshold does not allow the application of the specified dose of radiation (convolutions of the small and large intestine, liver, spinal cord, spleen), radiotherapy is not normally applied in the treatment of renal pelvis and ureter cancer.**

BLADDER MALIGNANCIES

Radiotherapy is used in the treatment of invasive and locally/locoregionally advanced stages of bladder cancer (T2-T4 and as palliative radiotherapy of metastatic disease. In combination with surgery (after TUR or cystectomy), as the only form of treatment or with chemotherapy, it can be carried out as a preoperative or postoperative radiotherapy: Radiotherapy is not routinely used in the treatment of non-invasive bladder tumors. In case of multiple recurrences (resistance to TUR and intravesical chemo/immunotherapy) and if for any reason it is not possible to perform a cystectomy, as an alternative treatment with chemoradiotherapy is considered.

Due to relatively good accessibility, in some centers, small tumors of the urinary bladder are treated with brachytherapy, which is carried out by introducing radioactive isotope beads directly into the tumor tissue.

Preoperative radiotherapy of operable invasive bladder cancer leads to a reduction in tumor volume during 4-6 weeks after TRT and does not increase the level of postoperative complications. Preoperative radiotherapy for operable invasive bladder cancer has not been shown to increase survival. The use of adjuvant chemoradiotherapy after previously performed TUR of the tumor achieves better treatment results compared to the use of radiotherapy as the only type of adjuvant treatment.

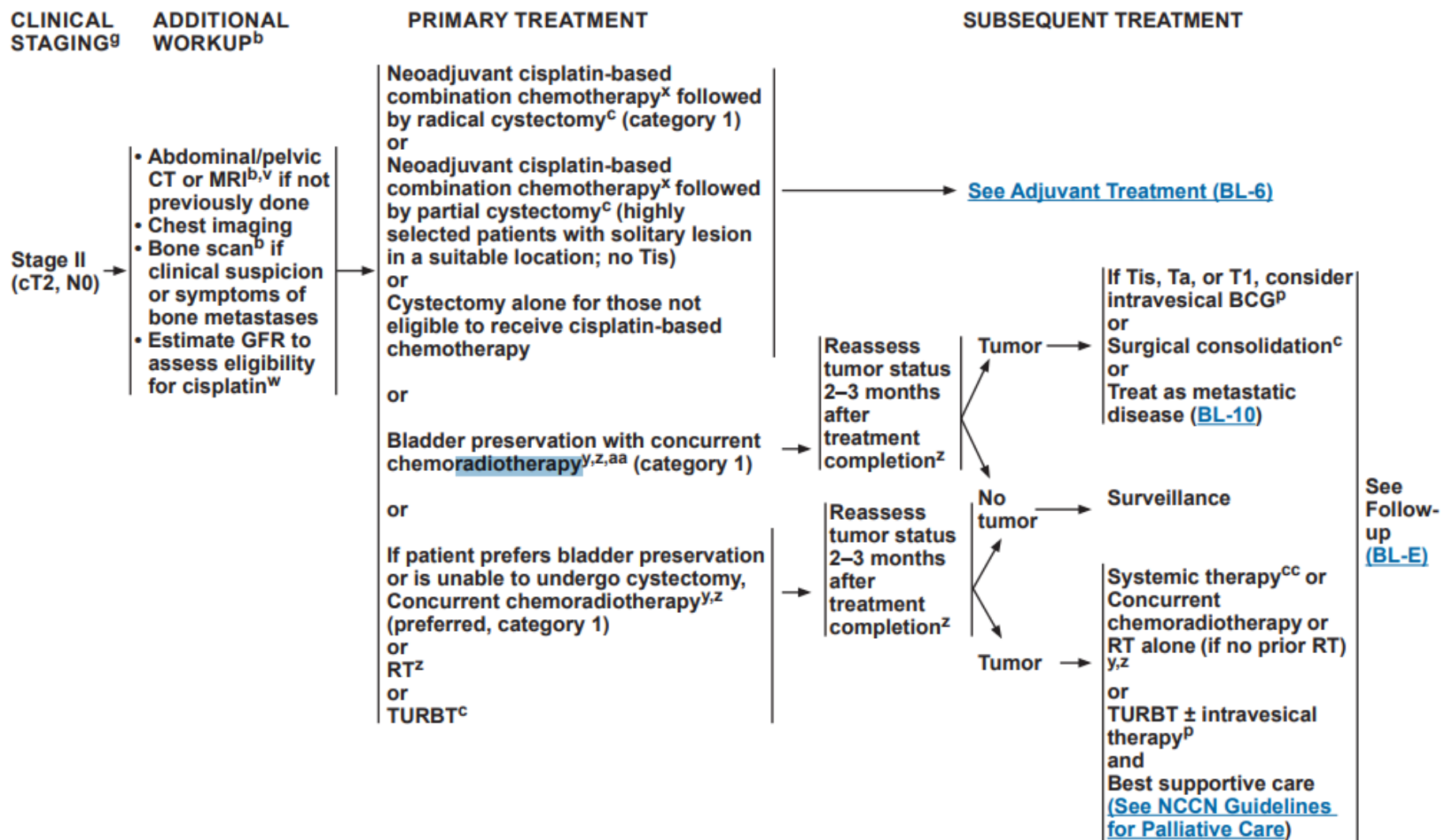
Concomitant chemoradiotherapy after previously performed TUR of the tumor, as a sparing ("bladder sparing") therapy, can be an alternative to cystectomy, in patients with a smaller and solitary invasive tumor, without hydronephrosis or in situ present tumor (T.s) in other parts of the bladder urothelium and in the cN0 stage . During the first and fourth weeks of radiotherapy, the patient is prescribed cisplatin with or without 5-Fu, or 5-Fu and mitomycin-C in a concomitant regimen.

Adjuvant radiotherapy (without chemotherapy) can be applied after radical cystectomy, in patients with locally/locoregionally advanced disease (stage pT3; pN2; R1 resection) in order to improve locoregional control and overall survival. A dose of 45 to 50.4 Gy is applied to the target volume, without HT.

The cumulative toxic effects of the use of chemoradiotherapy should be taken into account, so chemotherapy in combination with radiotherapy is not applied if the dose per fraction is > 3 Gy.

Radiotherapy in various combinations with surgery and/or chemotherapy can be used in the multidisciplinary treatment of stage IVA bladder cancer (cT4b, any N, M0; any T, any N, M).

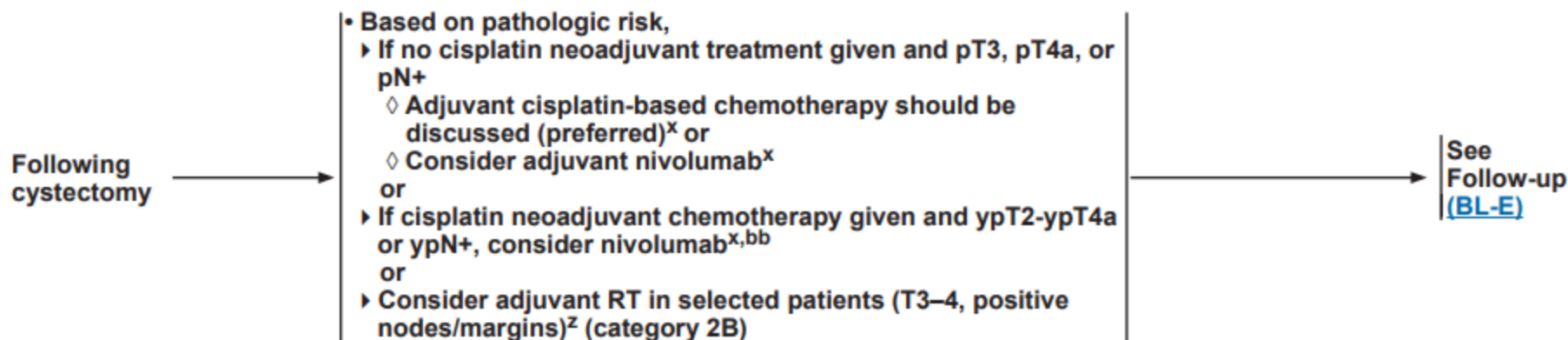
Palliative radiotherapy can be used in bone metastases, in order to achieve an antipain effect, in macrohematuria in order to achieve a hemostatic effect, or in solving problems related to hydronephrosis caused by tumor infiltration of the vesical mouth of the ureter.



Note: All recommendations are category 2A unless otherwise indicated.
Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.

[See Footnotes on BL-6](#)

ADJUVANT TREATMENT



^b See Principles of Imaging for Bladder/Urothelial Cancer (BL-A).

^c See Principles of Surgical Management (BL-B).

^g The modifier “c” refers to clinical staging based on bimanual EUA, endoscopic surgery (biopsy or transurethral resection), and imaging studies. The modifier “p” refers to pathologic staging based on cystectomy and lymph node dissection.

^p See Principles of Intravesical Treatment (BL-F).

^v Consider FDG-PET/CT scan (skull base to mid-thigh) (category 2B).

^w For patients with borderline glomerular filtration rate (GFR) consider timed urine collection, which may more accurately determine eligibility for cisplatin.

^x See Principles of Systemic Therapy (BL-G 1 of 7).

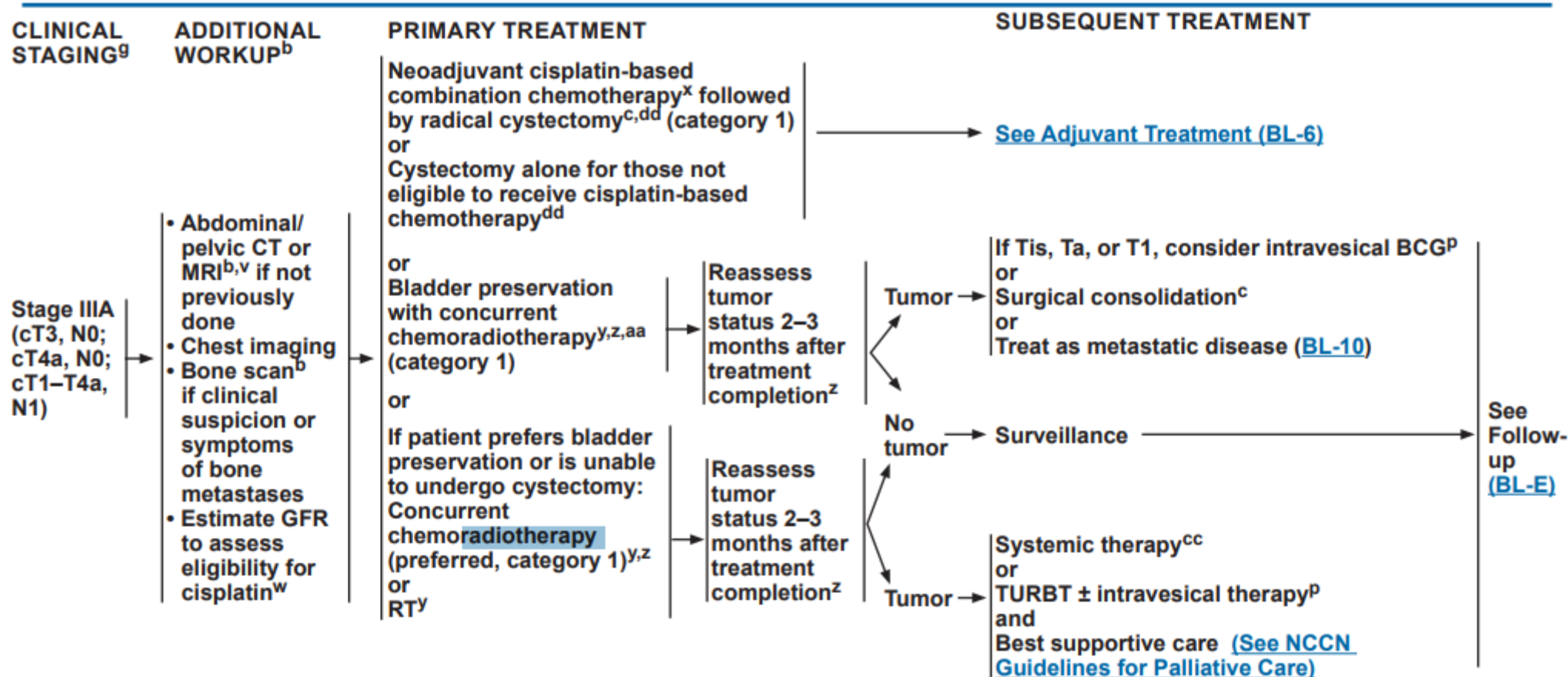
^y See Principles of Systemic Therapy (BL-G 5 of 7).

^z See Principles of Radiation Management of Invasive Disease (BL-H).

^{aa} Optimal candidates for bladder preservation with chemoradiotherapy include patients with tumors that present without moderate/severe hydronephrosis, are without concurrent extensive or multifocal Tis, and are <6 cm. Ideally, tumors should allow a visually complete or maximally debulking TURBT. See Principles of Radiation Management of Invasive Disease (BL-H).

^{bb} Most appropriate for patients who value an opportunity to delay recurrence even if the chance of cure was not improved, and for whom the risk of side effects was acceptable.

^{cc} See Principles of Systemic Therapy (BL-G 2 of 7).



^b See Principles of Imaging for Bladder/Urothelial Cancer ([BL-A](#)).

^c See Principles of Surgical Management ([BL-B](#)).

^g The modifier "c" refers to clinical staging based on bimanual EUA, endoscopic surgery (biopsy or transurethral resection), and imaging studies. The modifier "p" refers to pathologic staging based on cystectomy and lymph node dissection.

^p See Principles of Intravesical Treatment ([BL-F](#)).

^v Consider FDG-PET/CT scan (skull base to mid-thigh) (category 2B).

^w For patients with borderline GFR consider timed urine collection, which may more accurately determine eligibility for cisplatin.

^x See Principles of Systemic Therapy ([BL-G 1 of 7](#)).

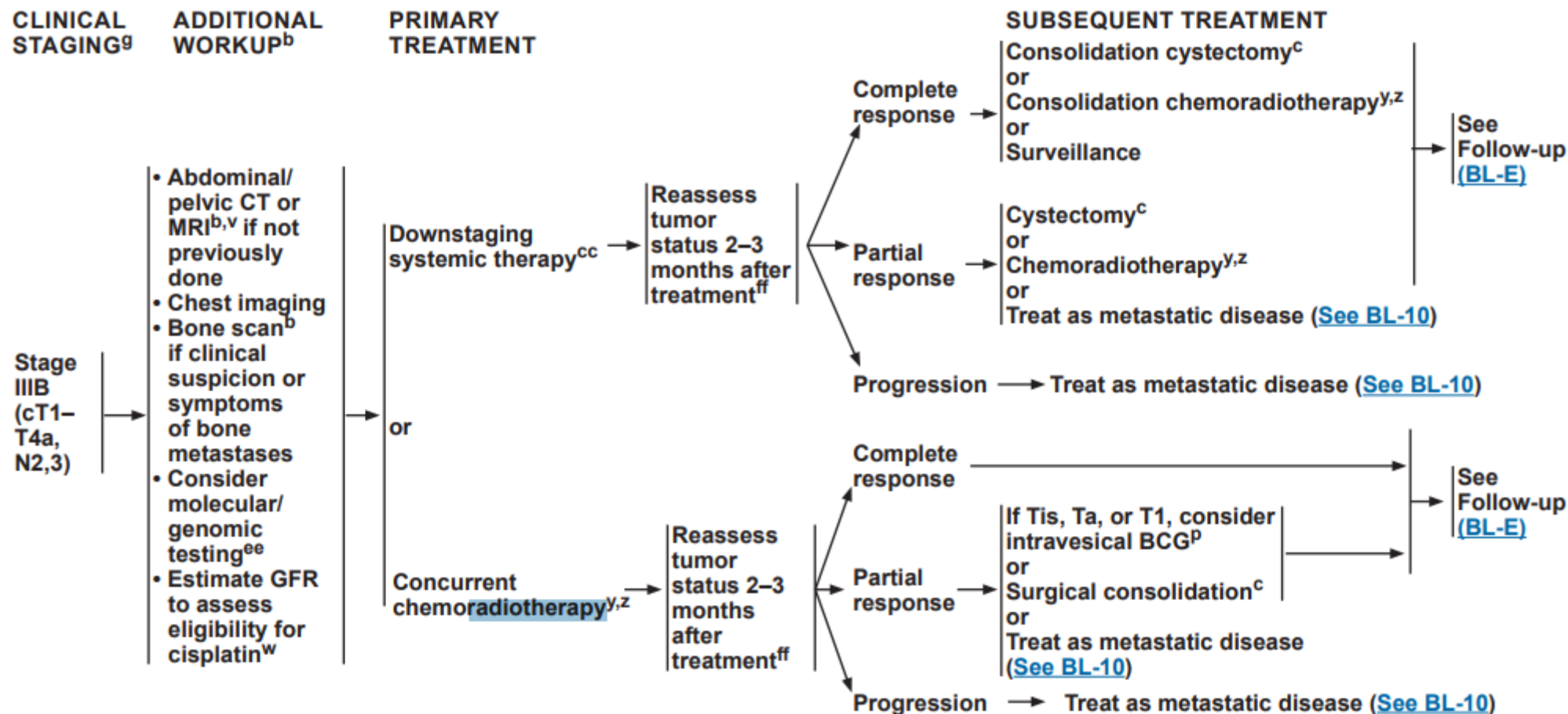
^y See Principles of Systemic Therapy ([BL-G 5 of 7](#)).

^z See Principles of Radiation Management of Invasive Disease ([BL-H](#)).

^{aa} Optimal candidates for bladder preservation with chemoradiotherapy include patients with tumors that present without moderate/severe hydronephrosis, are without concurrent extensive or multifocal Tis, and are <6 cm. Ideally, tumors should allow a visually complete or maximally debulking TURBT. See Principles of Radiation Management of Invasive Disease ([BL-H](#)).

^{cc} See Principles of Systemic Therapy ([BL-G 2 of 7](#)).

^{dd} Patients with cN1 disease have better outcomes if they are given neoadjuvant chemotherapy and have a response.



^b See Principles of Imaging for Bladder/Urothelial Cancer (BL-A).

^c See Principles of Surgical Management (BL-B).

^g The modifier "c" refers to clinical staging based on bimanual EUA, endoscopic surgery (biopsy or transurethral resection), and imaging studies. The modifier "p" refers to pathologic staging based on cystectomy and lymph node dissection.

^p See Principles of Intravesical Treatment (BL-F).

^v Consider FDG-PET/CT scan (skull base to mid-thigh) (category 2B).

^w For patients with borderline GFR consider timed urine collection, which may more accurately determine eligibility for cisplatin.

^y See Principles of Systemic Therapy (BL-G 5 of 7).

^z See Principles of Radiation Management of Invasive Disease (BL-H).

^{cc} See Principles of Systemic Therapy (BL-G 2 of 7).

^{ee} Molecular/genomic testing in a CLIA-approved laboratory, including FGFR RGQ RT-PCR for *FGFR3* or *FGFR2* genetic alterations. See Discussion.

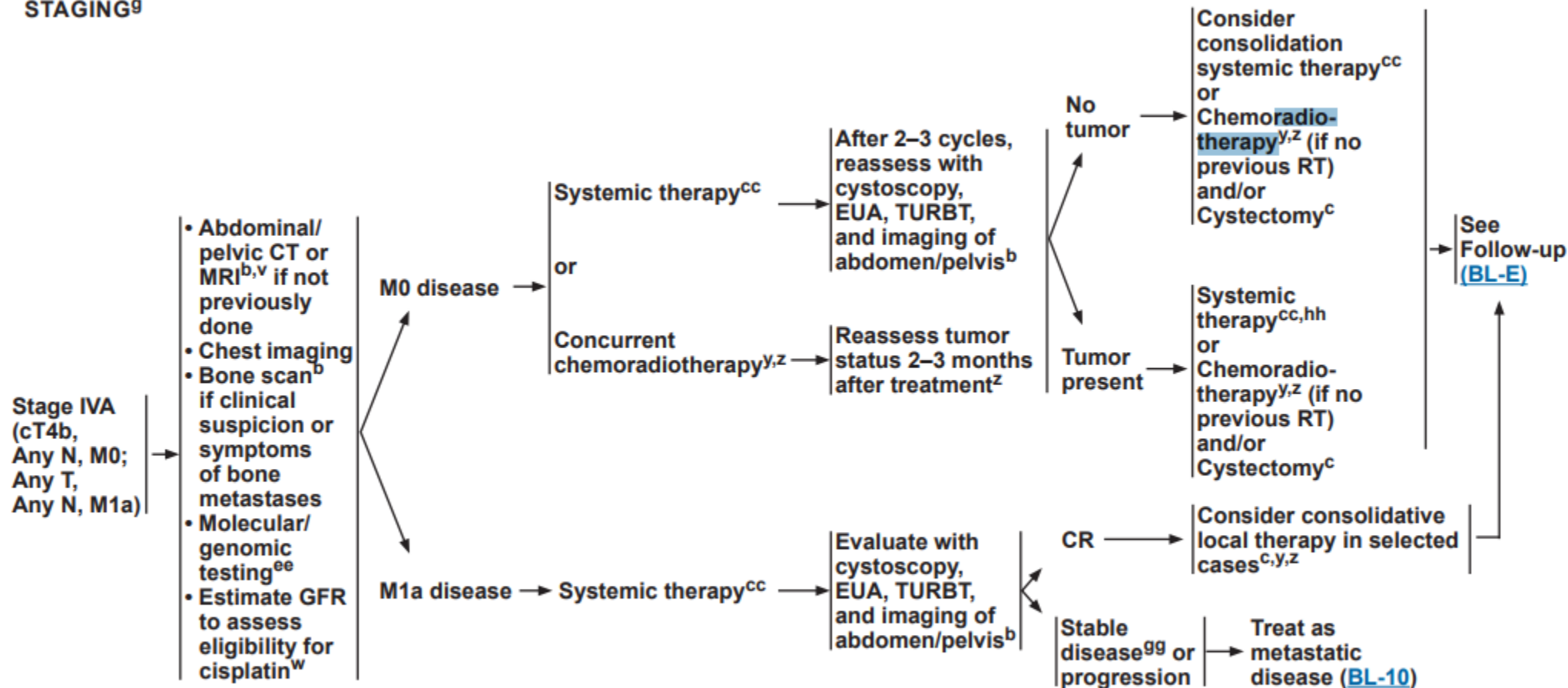
^{ff} Imaging with CT of chest/abdomen/pelvis with contrast. If there is no evidence of distant disease on imaging reassessment, further cystoscopic assessment of tumor response in the bladder may be considered.

CLINICAL
STAGING⁹

ADDITIONAL WORKUP^b

PRIMARY TREATMENT

SUBSEQUENT TREATMENT



^b See Principles of Imaging for Bladder/Urothelial Cancer (BL-A).

^c See Principles of Surgical Management (BL-B).

⁹ The modifier "c" refers to clinical staging based on bimanual EUA, endoscopic surgery (biopsy or transurethral resection), and imaging studies. The modifier "p" refers to pathologic staging based on cystectomy and lymph node dissection.

^v Consider FDG-PET/CT scan (skull base to mid-thigh) (category 2B).

^w For patients with borderline GFR consider timed urine collection, which may more accurately determine eligibility for cisplatin.

^y See Principles of Systemic Therapy (BL-G 5 of 7).

^z See Principles of Radiation Management of Invasive Disease (BL-H).

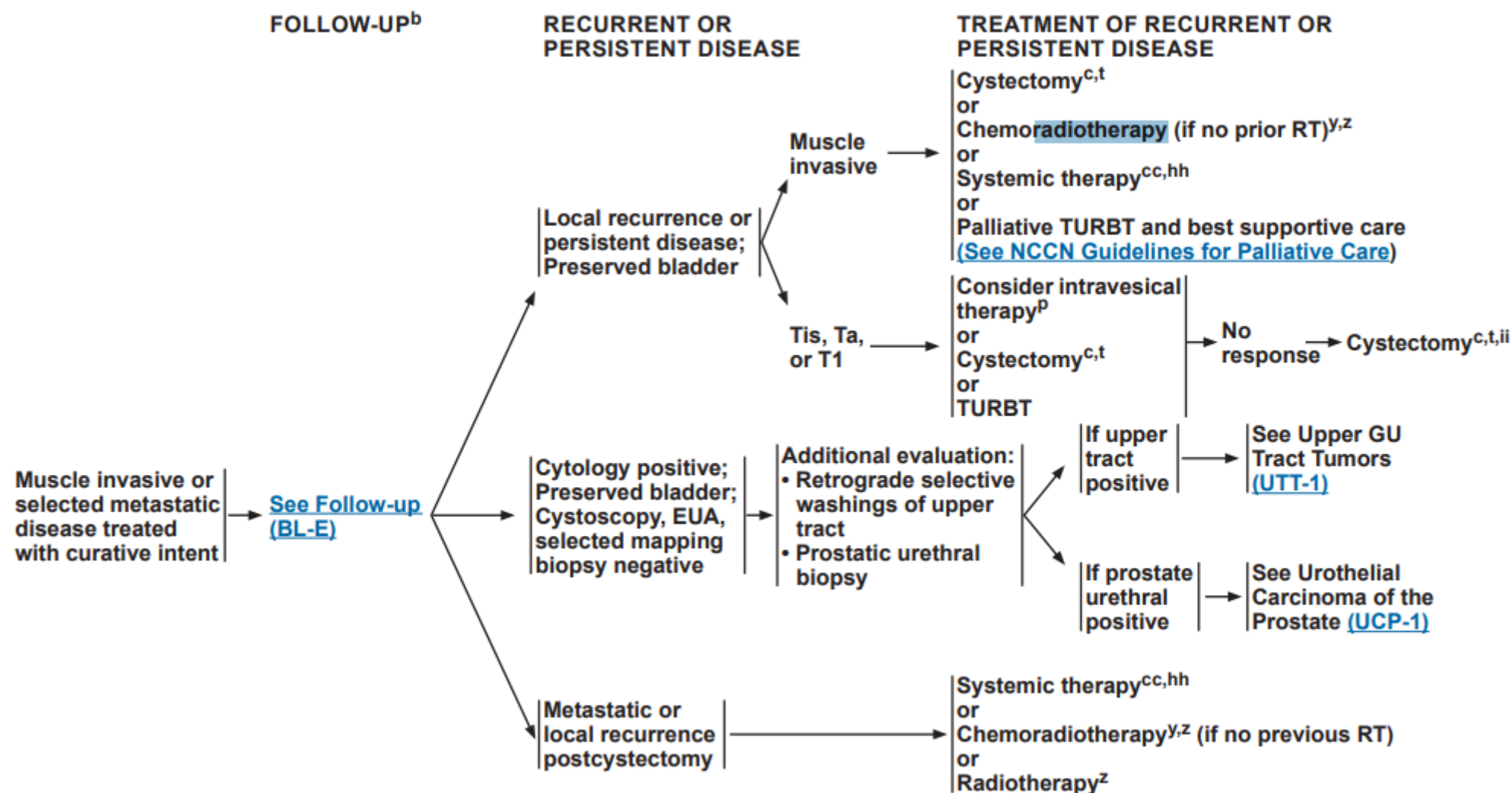
^{bb} Most appropriate for patients who value an opportunity to delay recurrence even if the chance of cure was not improved, and for whom the risk of side effects was acceptable.

^{cc} See Principles of Systemic Therapy (BL-G 2 of 7).

^{ee} Molecular/genomic testing in a CLIA-approved laboratory, including FGFR RGQ RT-PCR for *FGFR3* or *FGFR2* genetic alterations. See Discussion.

^{gg} Non-bulky disease and no significant clinical progression.

^{hh} See Principles of Systemic Therapy (BL-G 3 of 7 and 4 of 7).



^b See Principles of Imaging for Bladder/Urothelial Cancer (BL-A).

^c See Principles of Surgical Management (BL-B).

^p See Principles of Intravesical Treatment (BL-F).

^t See Follow-Up (BL-E).

^y See Principles of Systemic Therapy (BL-G 5 of 7).

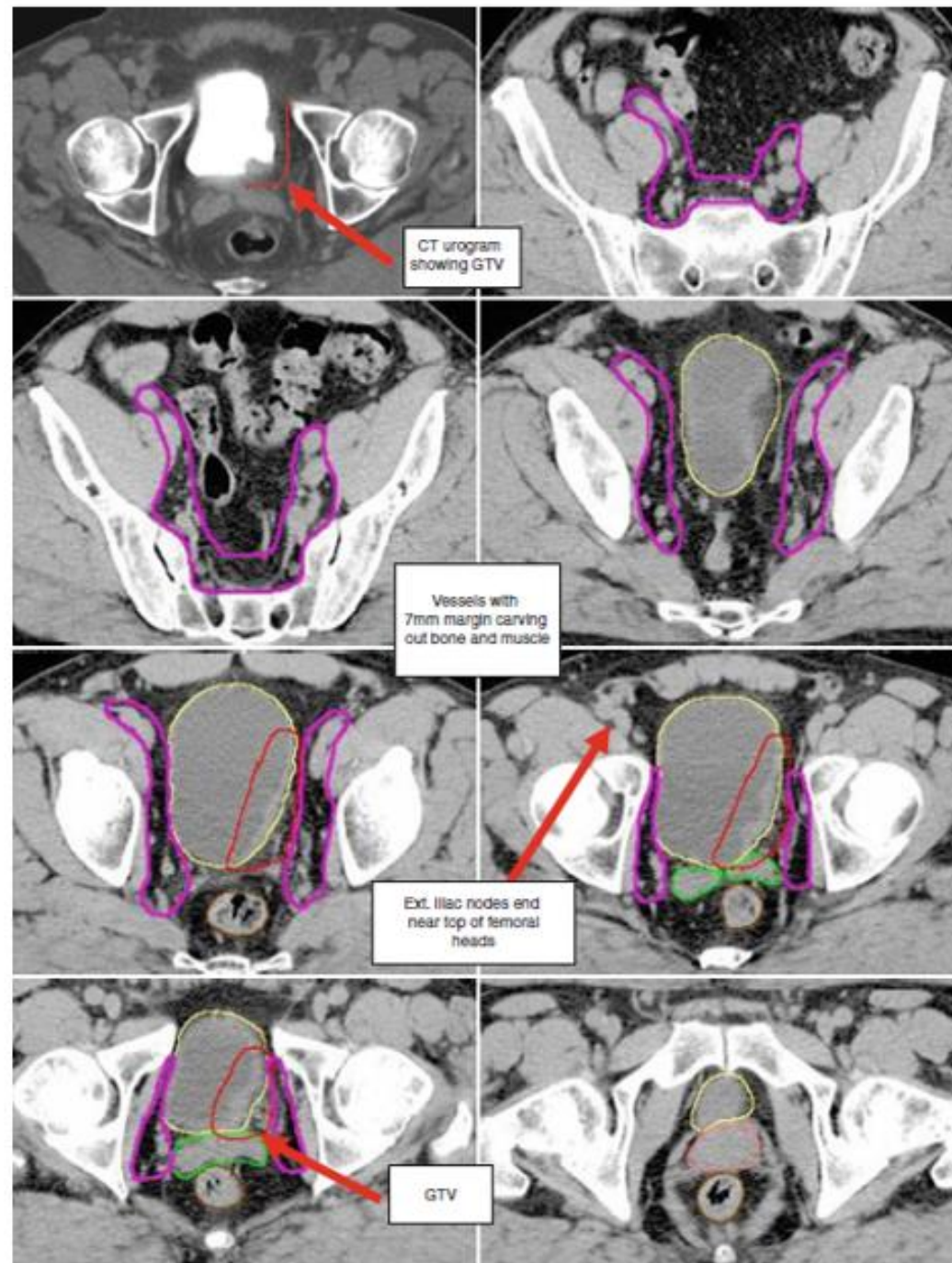
^z See Principles of Radiation Management of Invasive Disease (BL-H).

^{cc} See Principles of Systemic Therapy (BL-G 2 of 7).

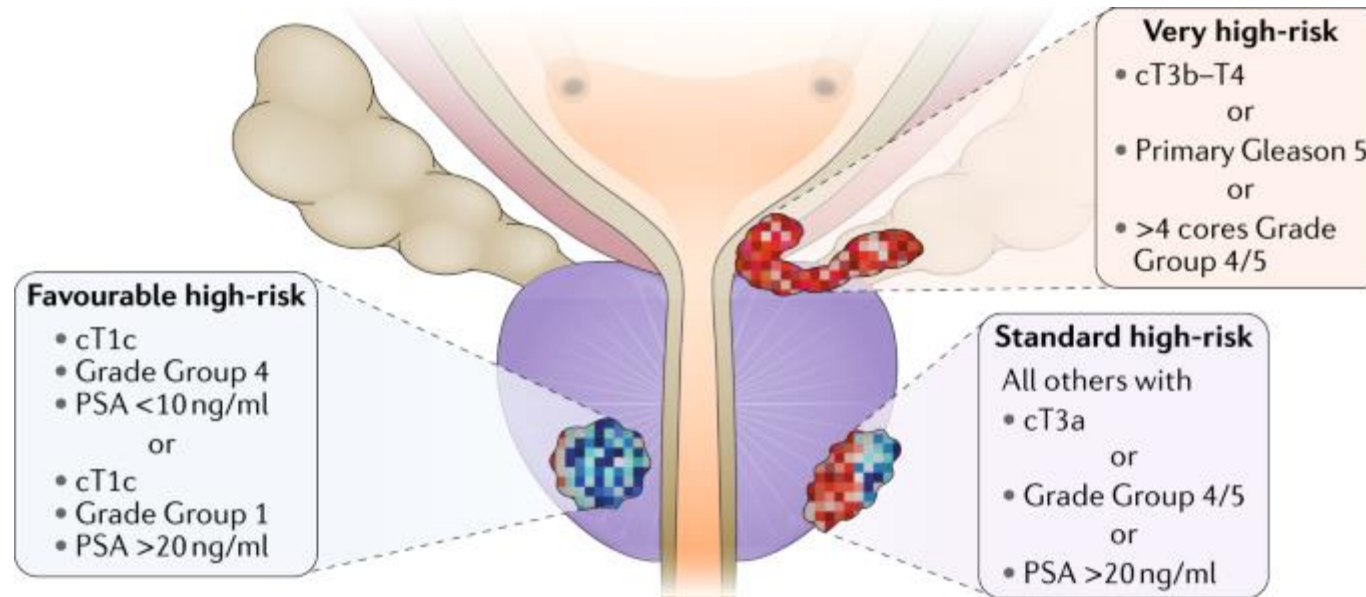
^{hh} See Principles of Systemic Therapy (BL-G 3 of 7 and 4 of 7).

ⁱⁱ If not a cystectomy candidate, consider concurrent chemoradiotherapy (See BL-G 5 of 7) (if no prior RT), change in intravesical agent, or a clinical trial.

Definition of structures of target volumes and radiation dose for planning radical radiotherapy of bladder cancer using 3D-CRT and IMRT/VMAT radiation technique



PROSTATE CANCER



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PROSTATE CANCER

Genomics and risk stratification in high-risk prostate cancer

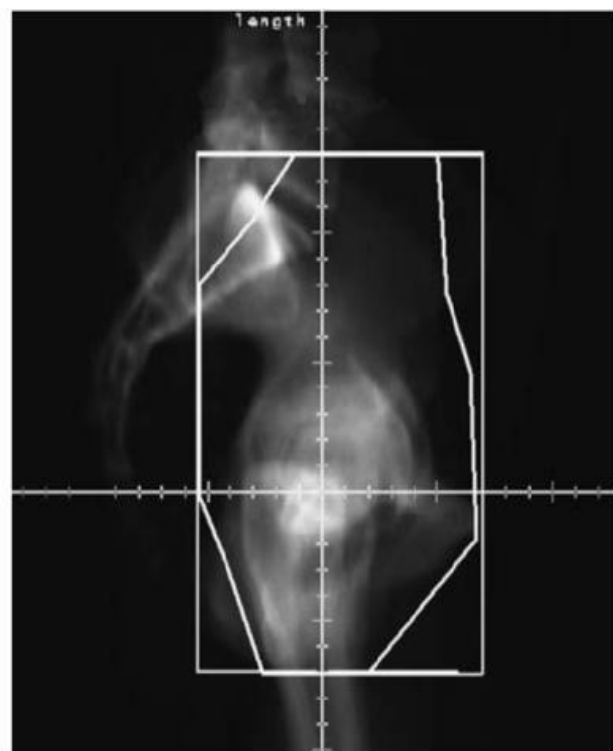
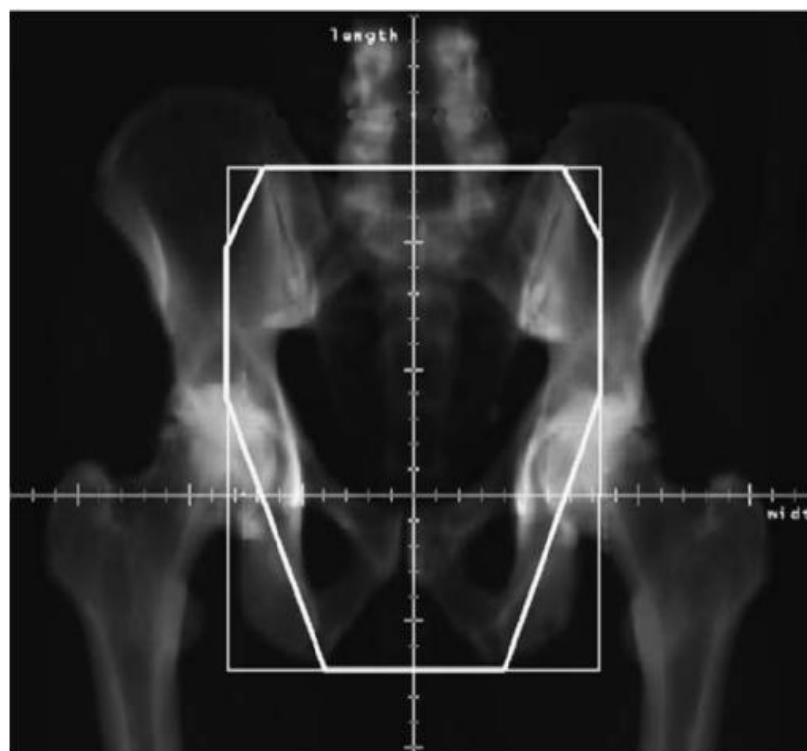
[Bashir Al Hussein Al Awamlh](#) & [Jonathan F. Shoag](#)

[Nature Reviews Urology](#) **16**, 641–642 (2019) | [Cite this article](#)

Table 2

NCCN Risk Stratification and Management of Localized Prostate Cancer

Risk Group and Features	Initial Therapy
Very low Stage T1c, GS < 6, PSA < 10, < 3 positive biopsy cores, cancer in < 50% each core, and PSA density < 0.15	<ul style="list-style-type: none"> • LE < 10 y: observation • LE 10-19 y: AS • LE > 20 y: same as low risk with > 10 y expected survival
Low Stage T1-2a, GS < 6, and PSA < 10	<ul style="list-style-type: none"> • LE < 10 y: observation • LE ≥ 10 y: either: AS, EBRT, brachytherapy, RP±PLND
Favorable intermediate Stage T2b-2c or GS 3+4=7 or PSA 10-20 and < 50% positive biopsy cores	<ul style="list-style-type: none"> • LE < 10 y: either observation, EBRT, or brachytherapy • LE ≥ 10 y: same as low risk with > 10 y expected survival
Unfavorable intermediate Stage T2b-2c or GS 3+4=7 or PSA 10-20	<ul style="list-style-type: none"> • LE < 10 y: either observation, EBRT+short-term ADT, or EBRT+brachytherapy+short-term ADT • LE ≥ 10 y: RP±PLND, EBRT+short-term ADT, or EBRT+brachytherapy+short-term ADT
High or very high Stage T3a-T4, GS 8 to 10, primary Gleason pattern 5, PSA > 20	<ul style="list-style-type: none"> • LE > 5 y: either: EBRT+long-term ADT, EBRT+brachytherapy+long-term ADT, or RP±PLND
ADT: androgen-deprivation therapy; AS: active surveillance; EBRT: external beam radiation therapy; GS: Gleason score; LE: life expectancy; PLND: pelvic lymph node dissection; PSA: prostate-specific antigen; RP: radical prostatectomy. Source: Reference 12.	

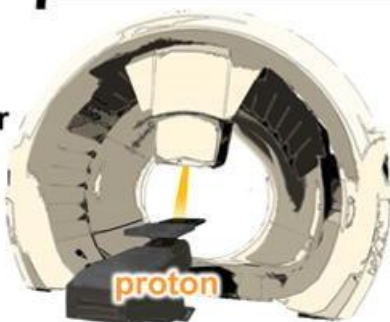


external or
internal RT

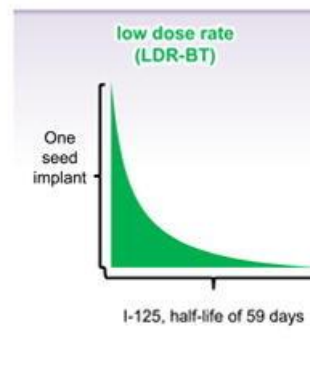
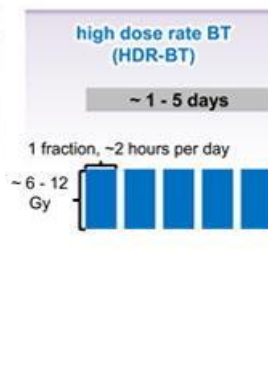
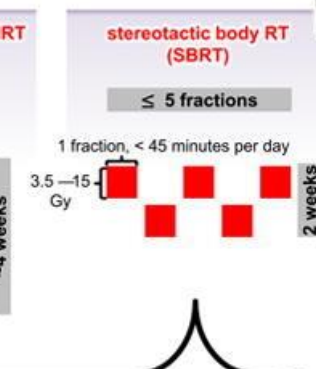
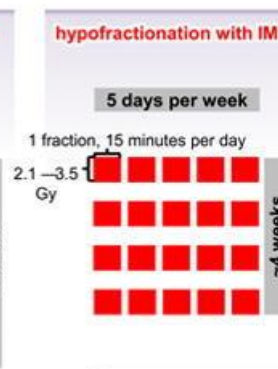
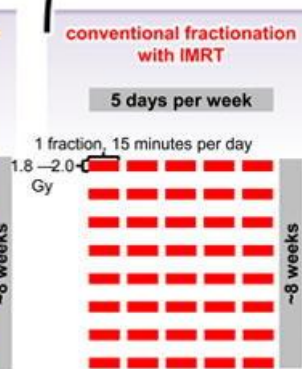
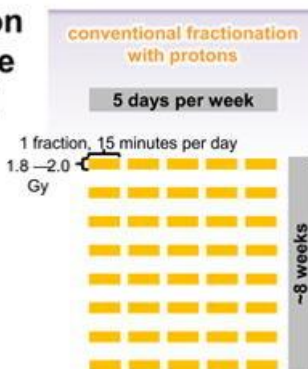
External beam

Brachytherapy

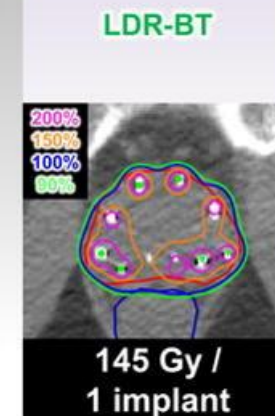
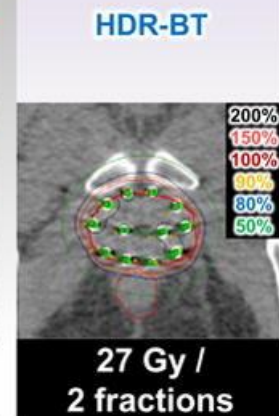
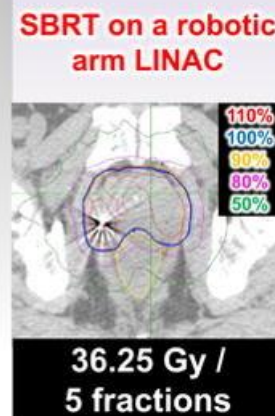
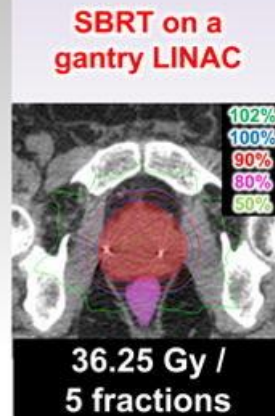
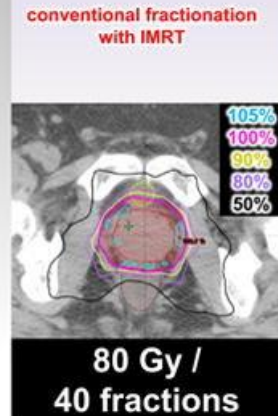
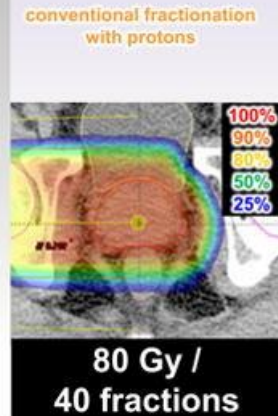
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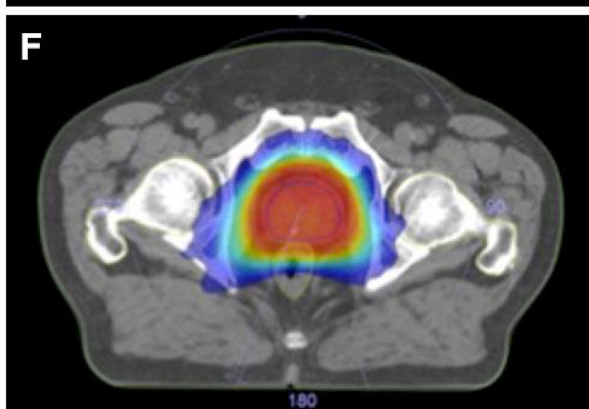
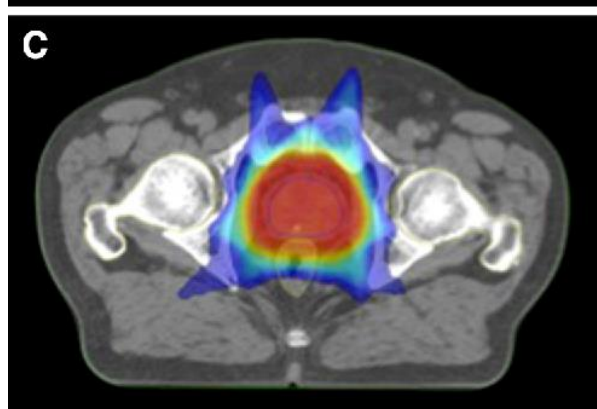
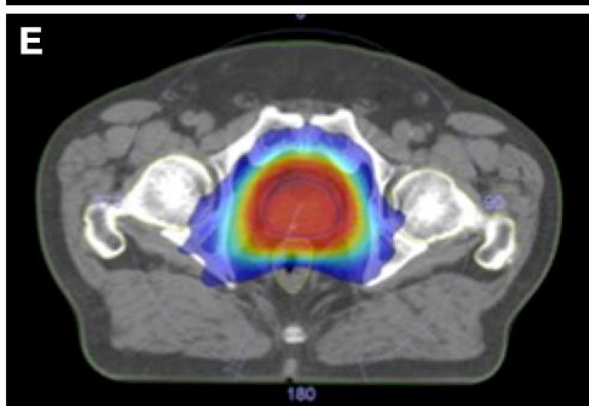
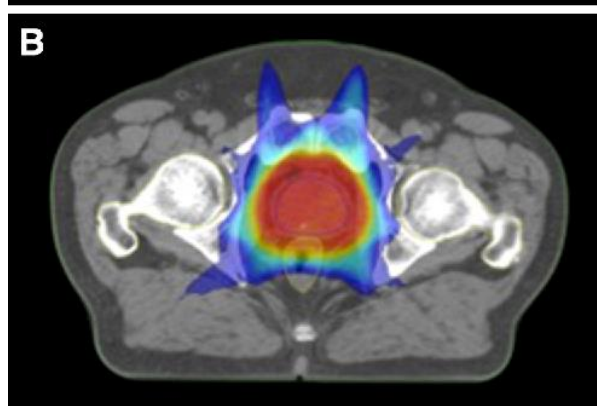
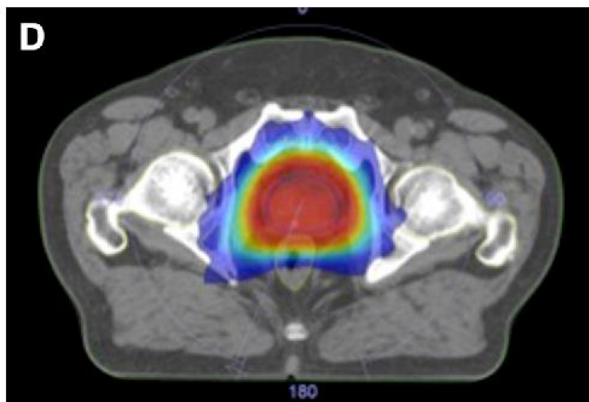
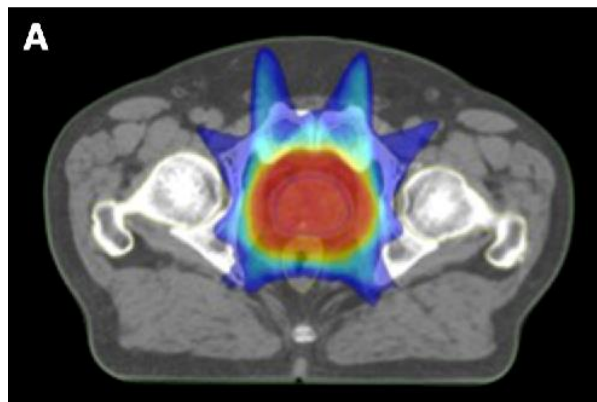


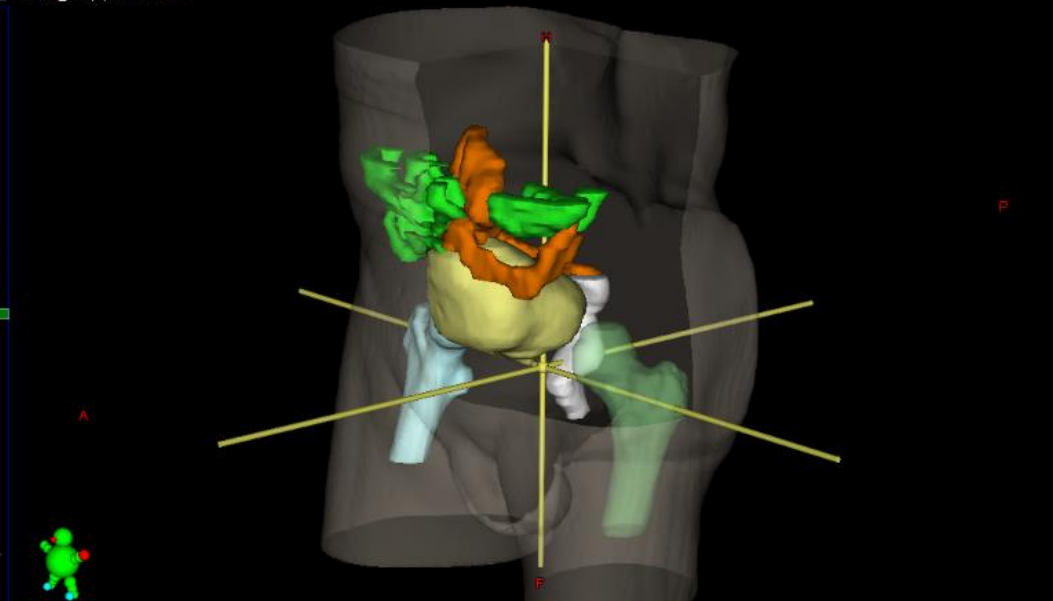
fractionation
that may be
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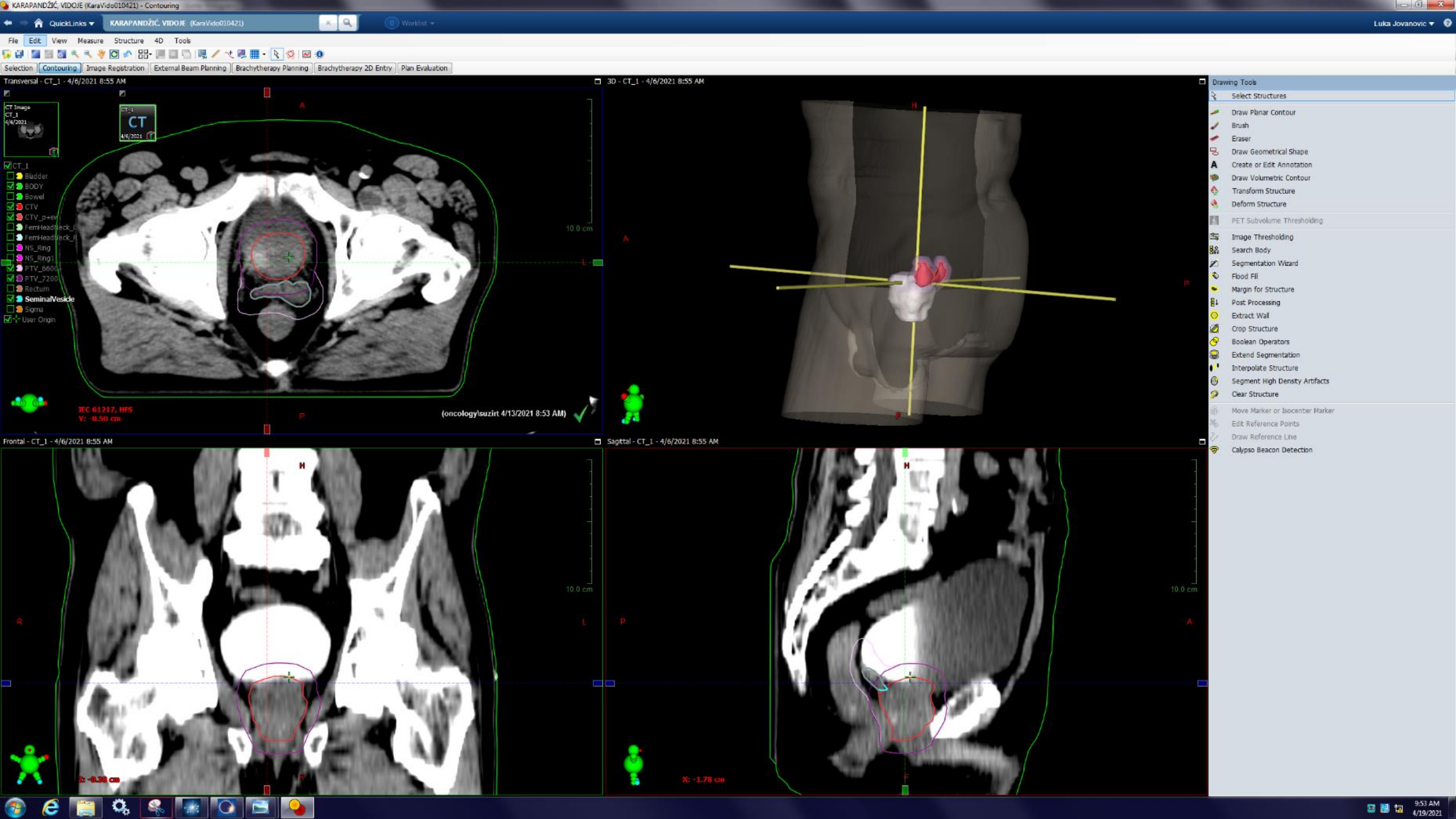
comparison
of plans

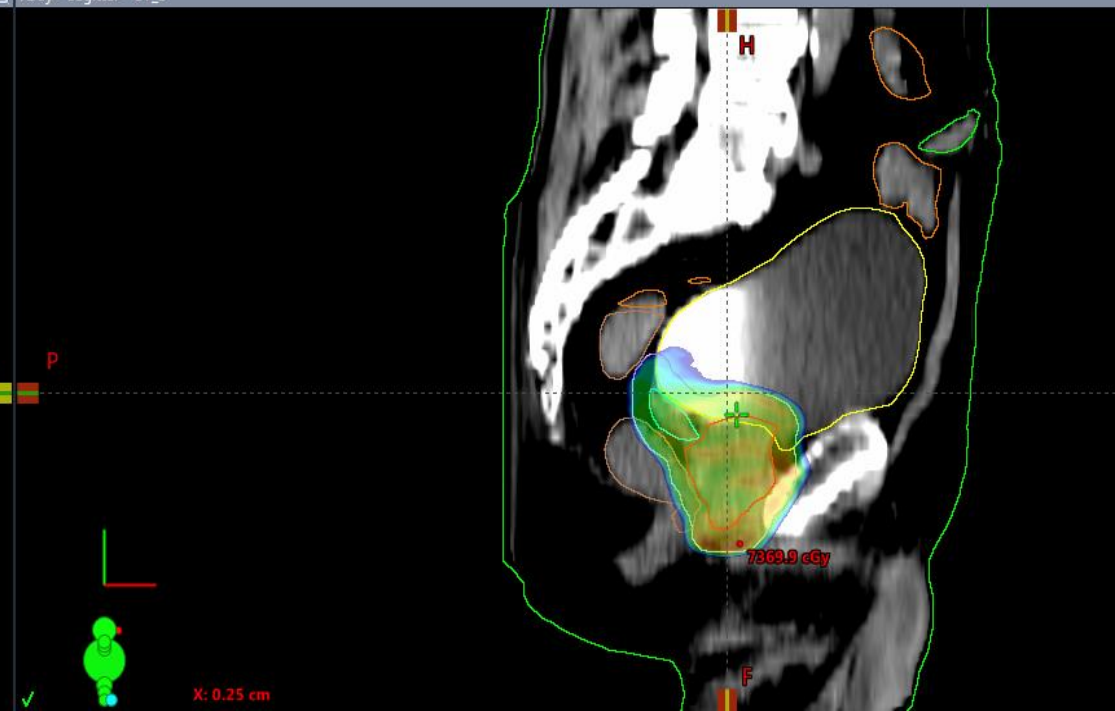
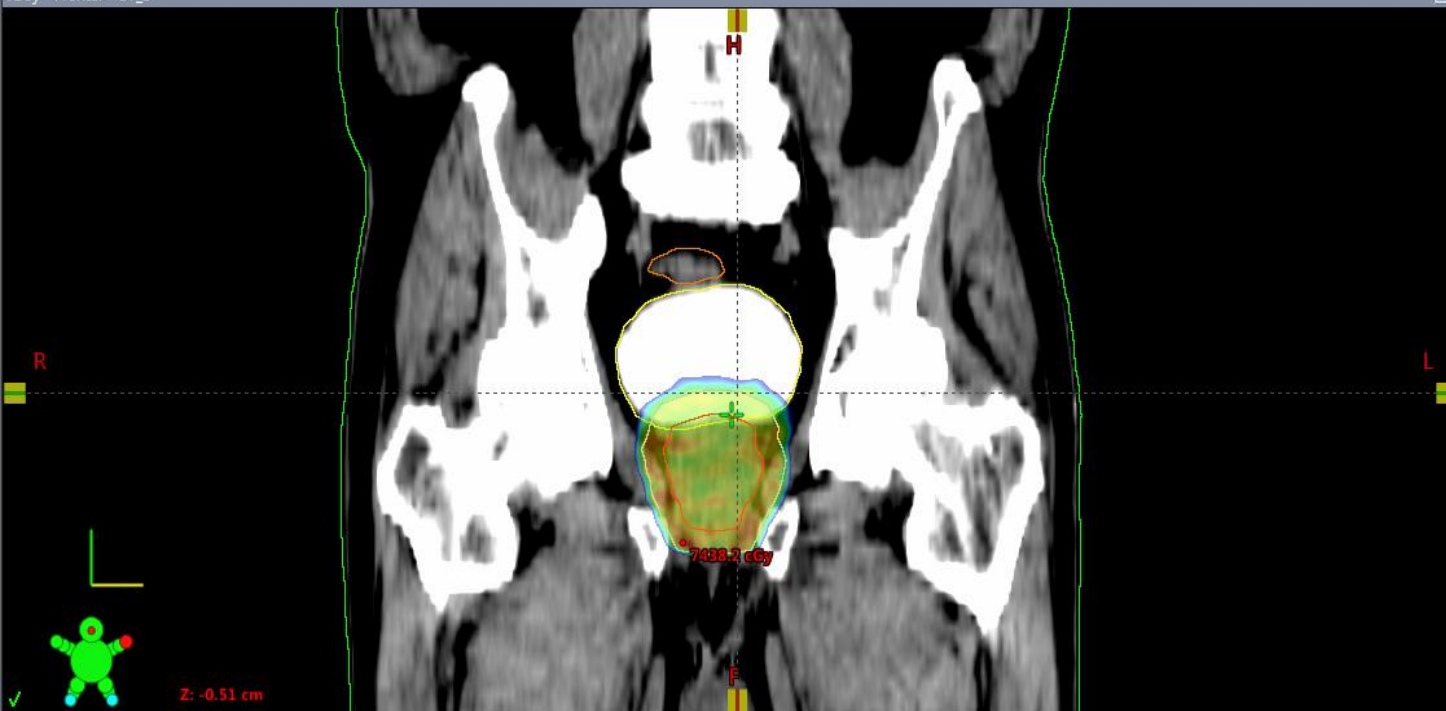
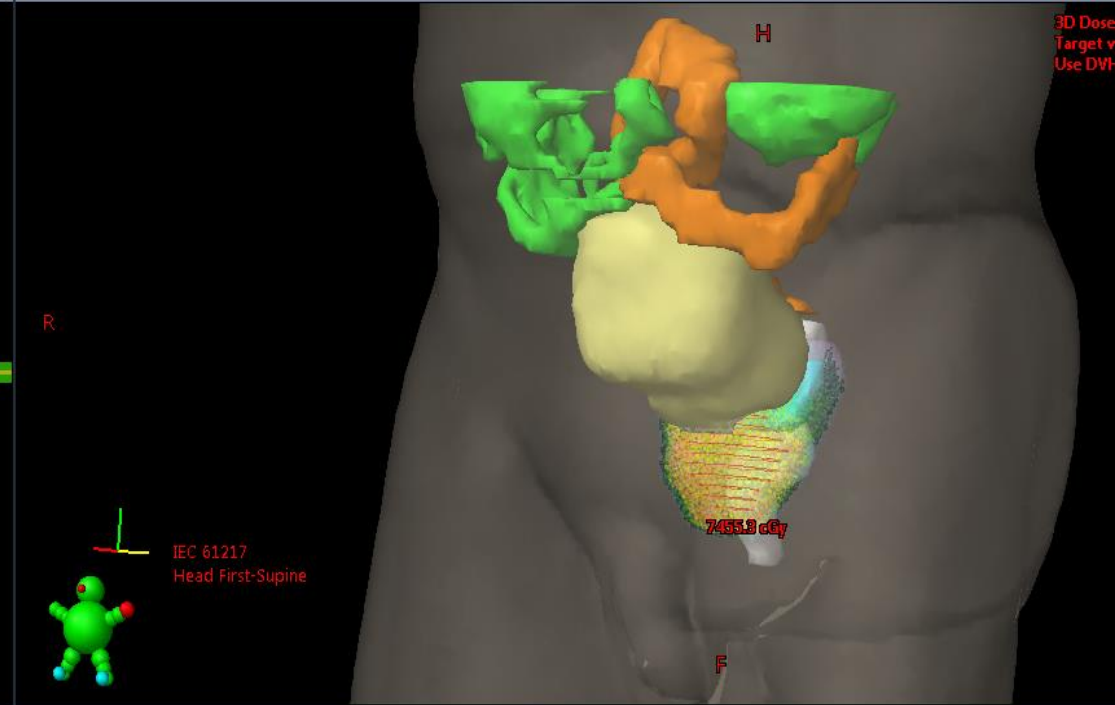
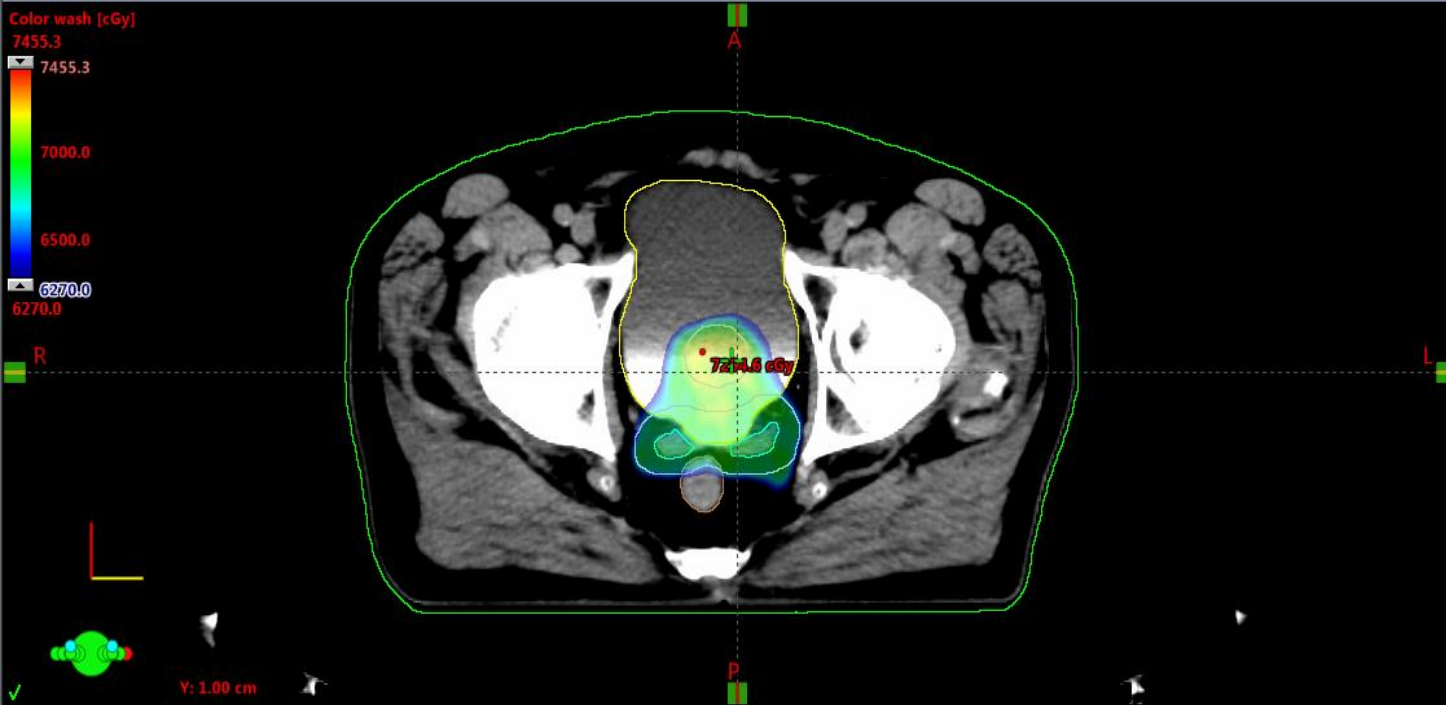


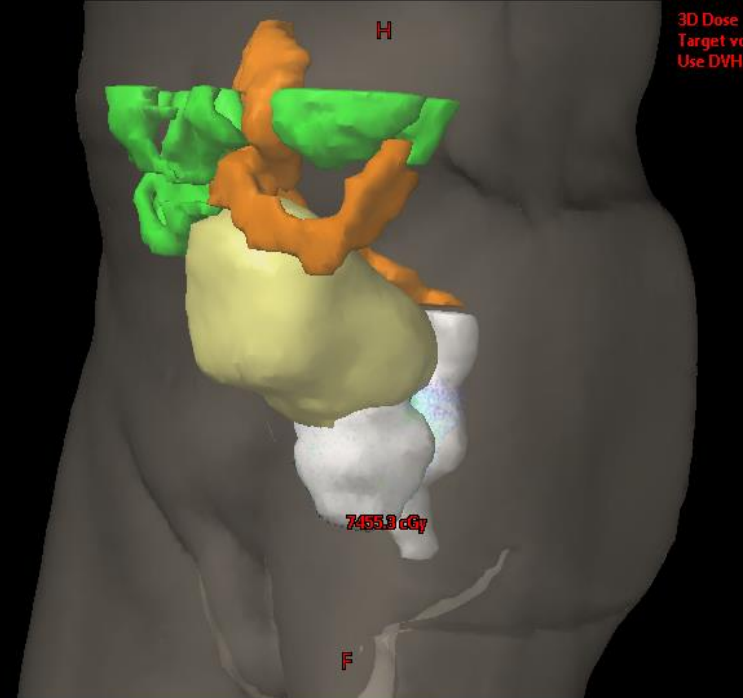
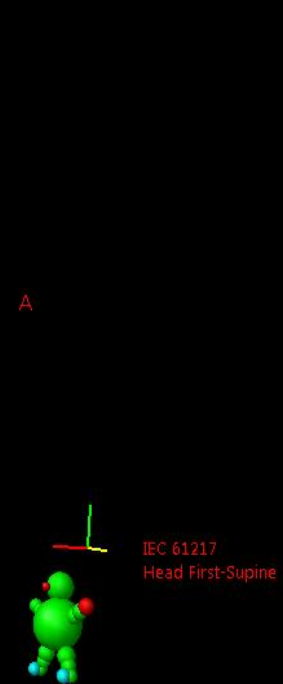




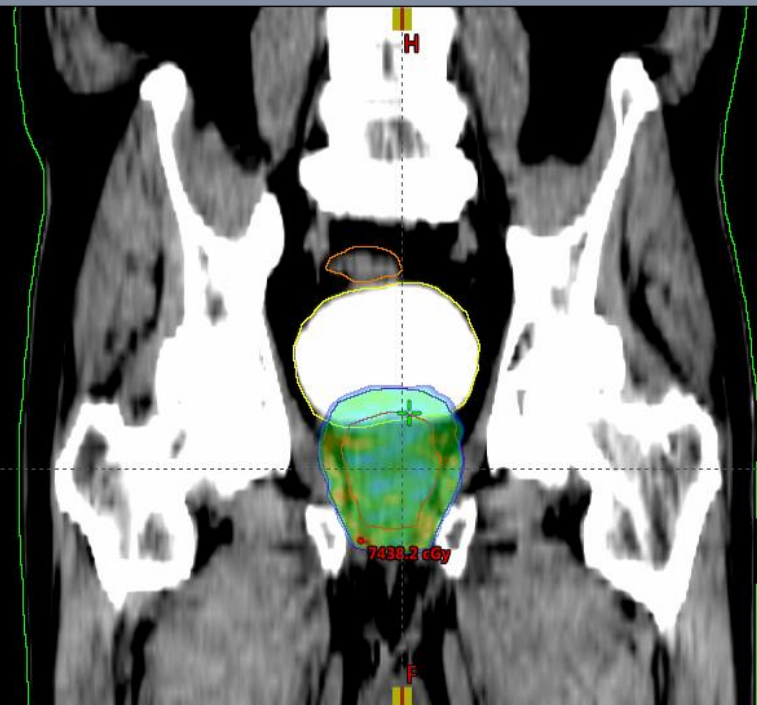
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- Deform Structure
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- Image Thresholding
- Search Body
- Segmentation Wizard
- Flood Fill
- Margin for Structure
- Post Processing
- Extract Wall
- Crop Structure
- Boolean Operators
- Extend Segmentation
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- Segment High Density Artifacts
- Clear Structure
- Move Marker or Isocenter Marker
- Edit Reference Points
- Draw Reference Line
- Calypso Beacon Detection



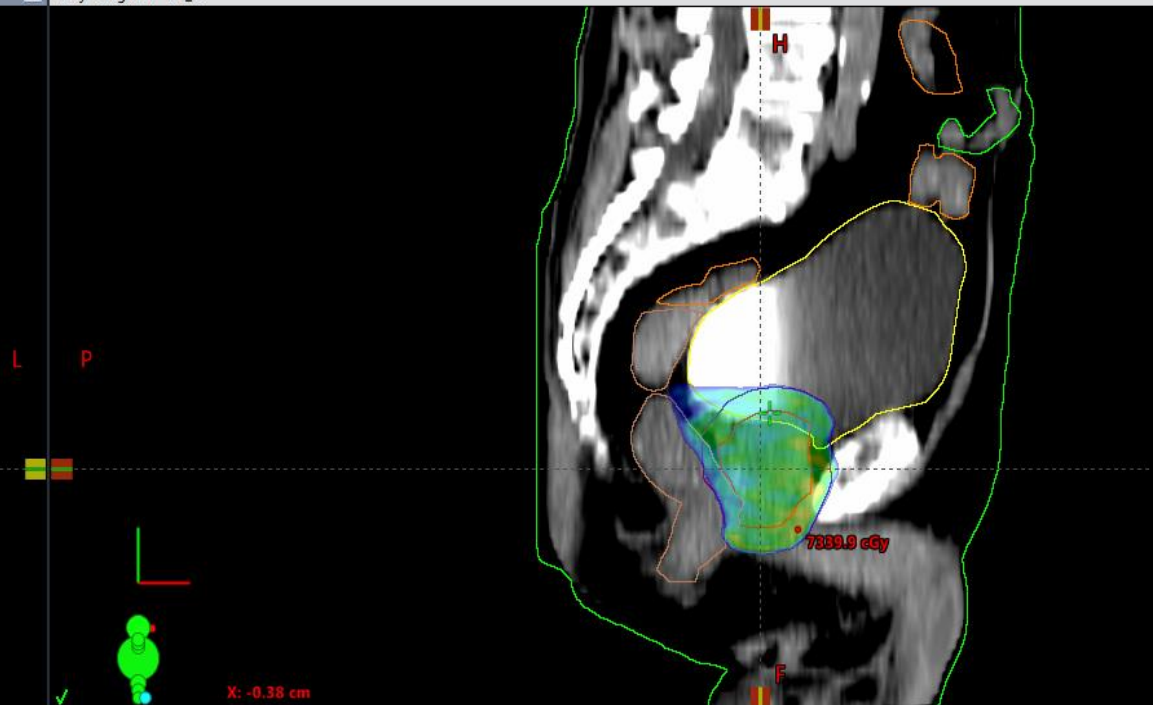


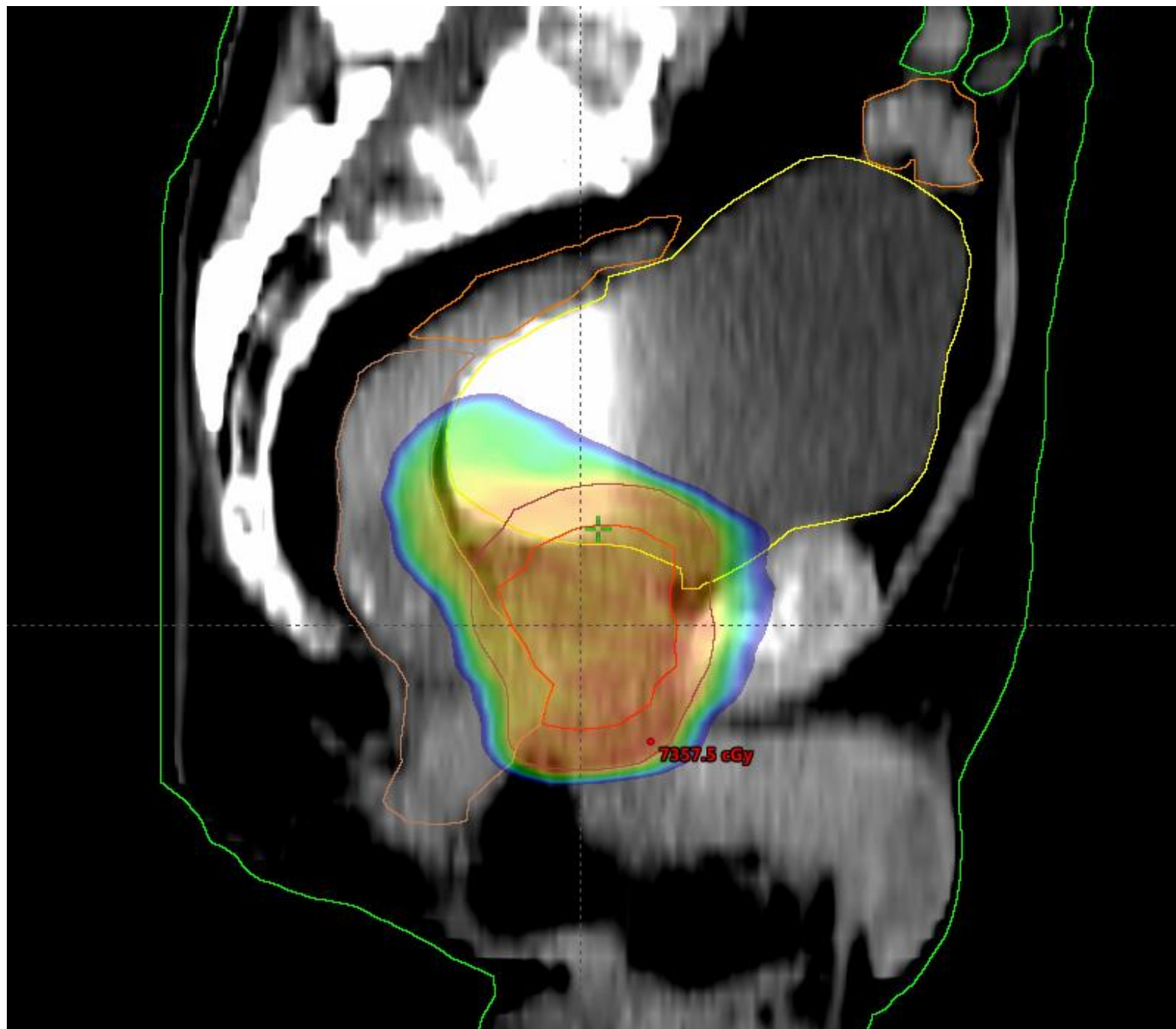


72Gy - Frontal - CT_1



72Gy - Sagittal - CT_1





OAR constrains

Bladder	V65 < 50% V70 < 35% V75 < 25% V80 < 15%
Sygmoid	V50 < 50% V60 < 35% V65 < 25% V70 < 20% V75 < 15%
Rectum	V50 < 50% V60 < 35% V65 < 25% V70 < 20% V75 < 15%
Bowell	V45 < 195 cm ³ V15 < 120 cm ³
Femur	V40 < 40% V45 < 25% V50 < 10%

- Kang SW, Chung JB, Kim JS, Kim IA, Eom KY, Song C, Lee JW, Kim JY, Suh TS. Optimal planning strategy among various arc arrangements for prostate stereotactic body radiotherapy with volumetric modulated arc therapy technique. *Radiol Oncol*. 2017 Jan 15;51(1):112-120.

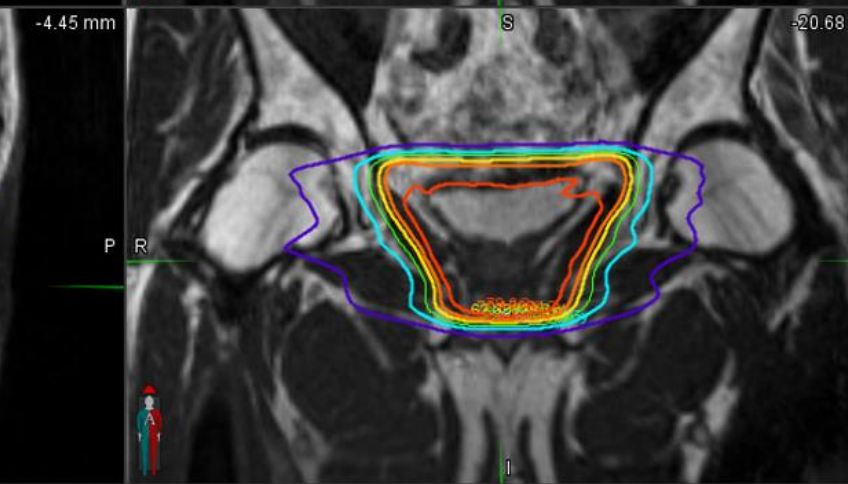
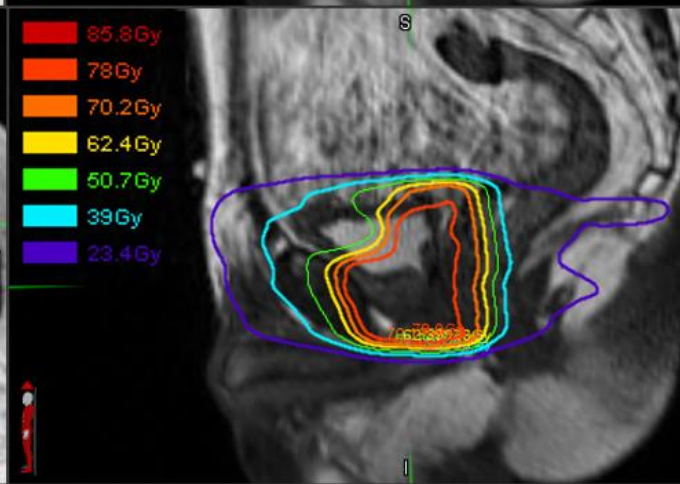
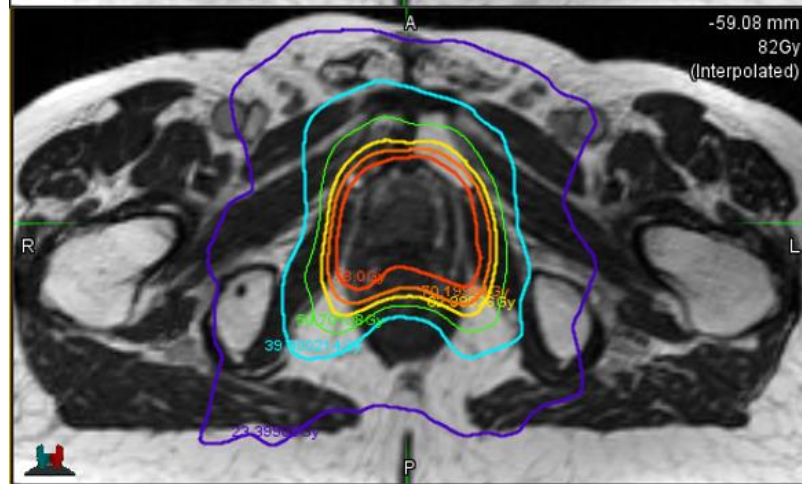
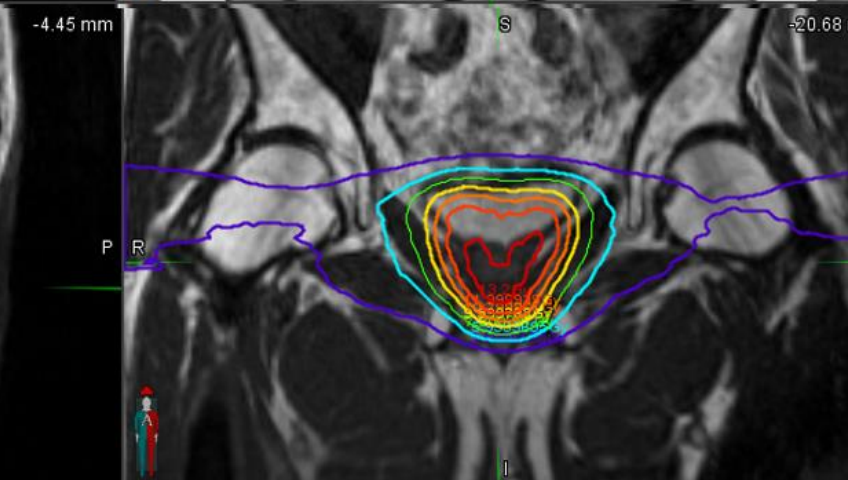
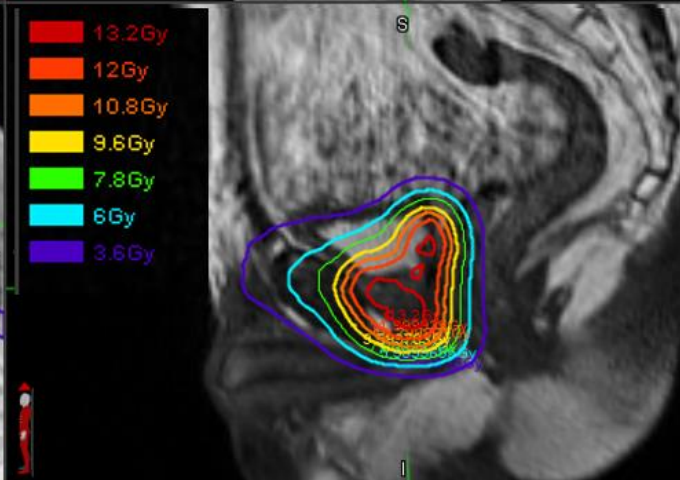
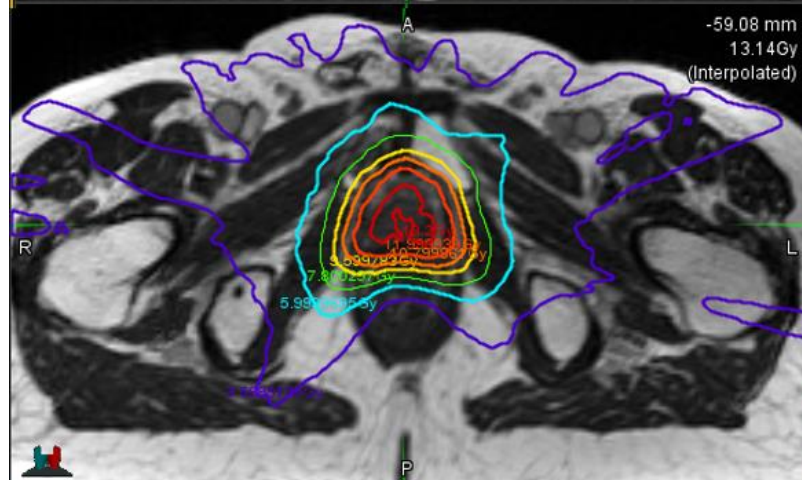
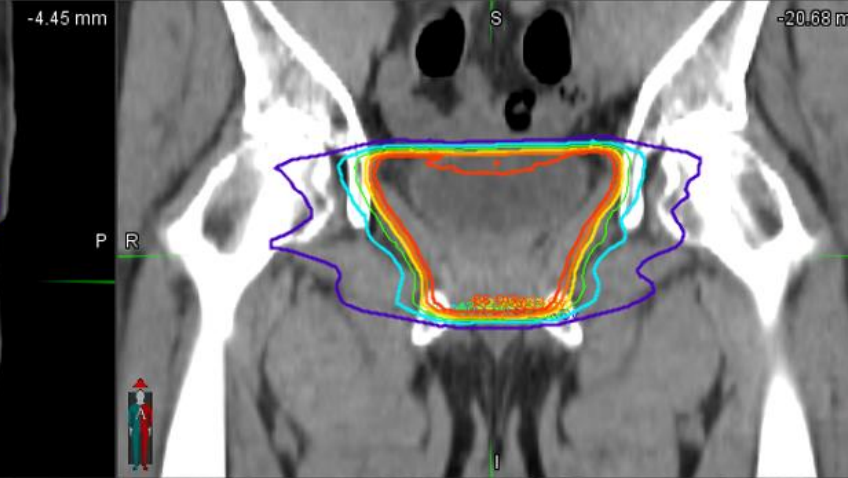
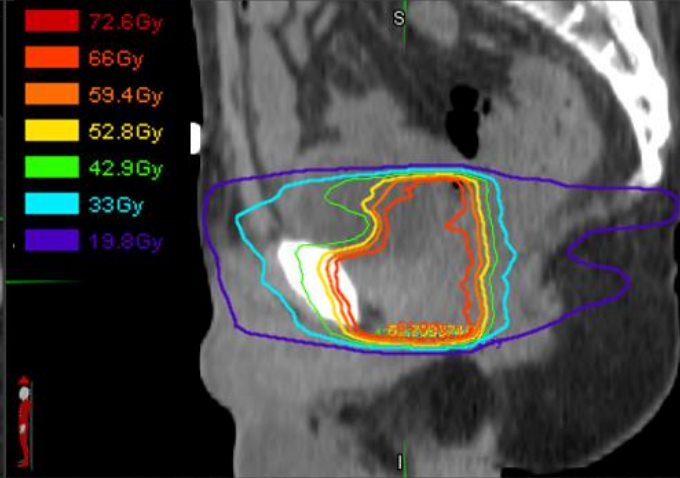
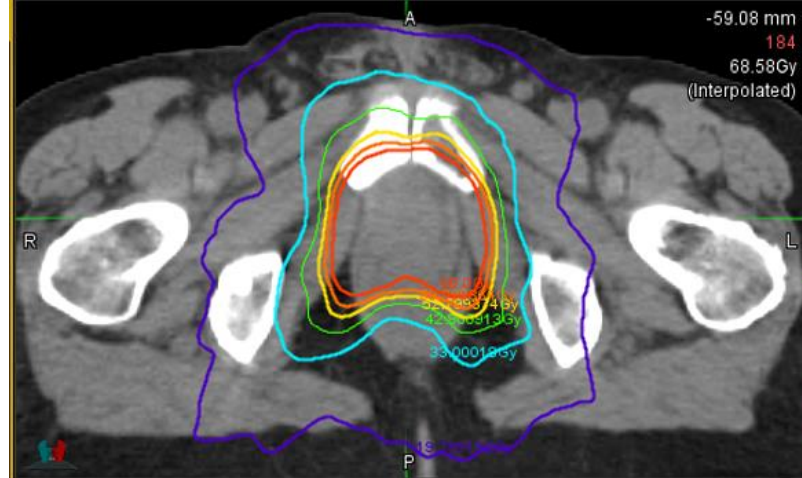


Table 1: Overview of Clinical Trials Evaluating Moderate Hypofractionation in Localized Prostate Cancer

Trial	N, Risk	RT Arms	Median Follow-up	Outcome	HR for Efficacy	Grade 2+ Toxicity
RTOG 0415 ¹	1,115 All low	73.8 Gy/41 fx 70 Gy/28 fx	5.8 years	Disease-free survival	0.85 (0.64–1.14)	Increased late grade 2/3 GI/GU toxicity
CHHiP ³	3,163 Mainly intermediate	74 Gy/37 fx 60 Gy/20 fx (57 Gy/19 fx)	5.2 years	Prostate-specific antigen failure	0.84 (0.68–1.03) for 60 Gy vs 74 Gy (57 Gy inferior)	No difference
PROFIT ⁴	1,206 Intermediate	78 Gy/39 fx 60 Gy/20 fx	6.0 years	Disease-free survival	0.99 (0.83–1.19)	No difference
HYPRO ⁵	820 Intermediate and high	78 Gy/39 fx 64.6 Gy/19 fx (3 fx/wk)	5.0 years	Recurrence-free survival	0.86 (0.63–1.16)	Increased late grade 2+ GI/GU toxicity

fx = fraction; GI/GU = gastrointestinal/genitourinary; HR = hazard ratio; RT = radiotherapy.

Brachytherapy

Indications of Brachy

Patient factors

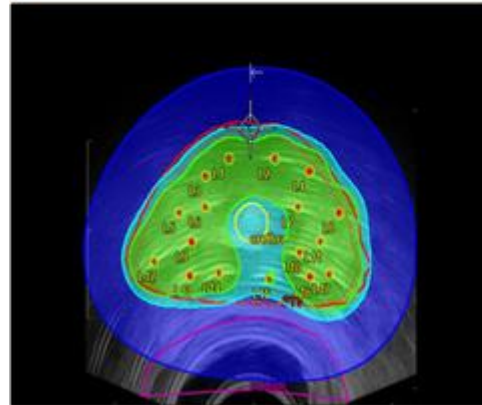
- Life expectancy > 5 year
- IPSS < 15
- Prostate volume < 60 cc
- No defect with previous TURP
- Minimal pubic arch interference

Tumor factors

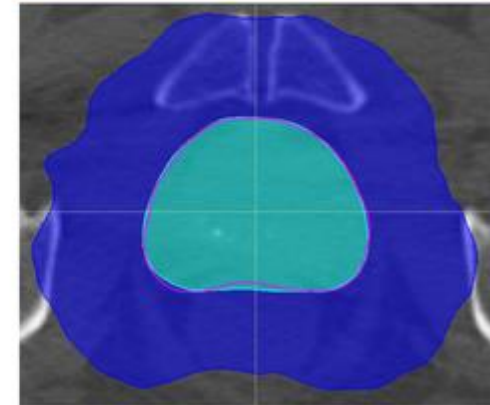
- Monotherapy
 - T1-T2b
 - Gleason ≤ 7 (3+4)
 - PSA ≤ 15
- Boost
 - $\geq T2c$
 - Gleason ≥ 7
 - PSA ≥ 10

American Brachytherapy Association

Brachytherapy



External radiotherapy



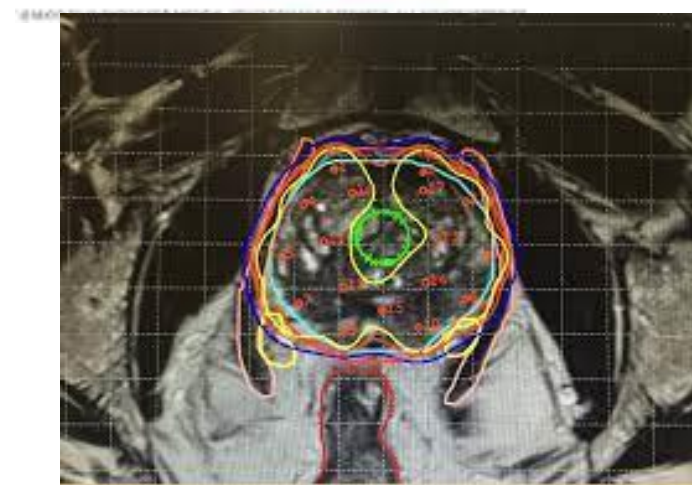
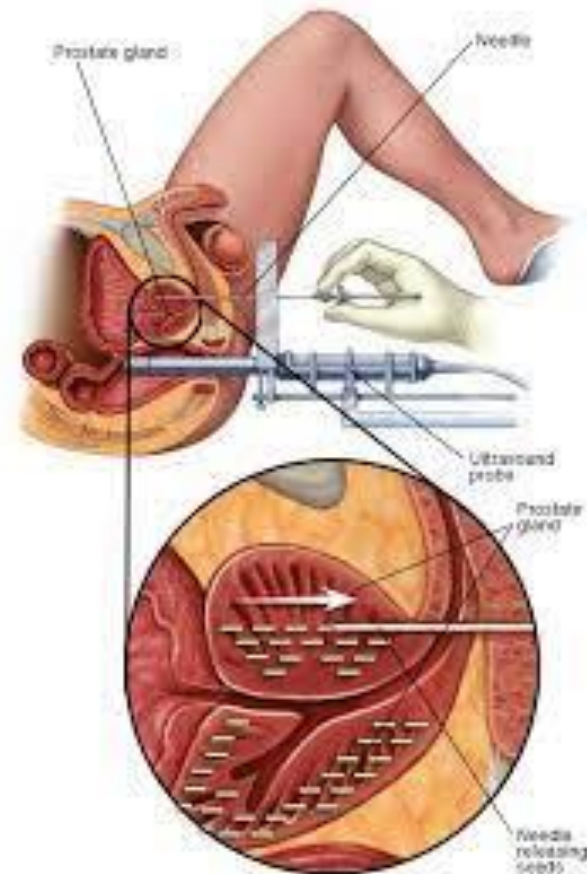
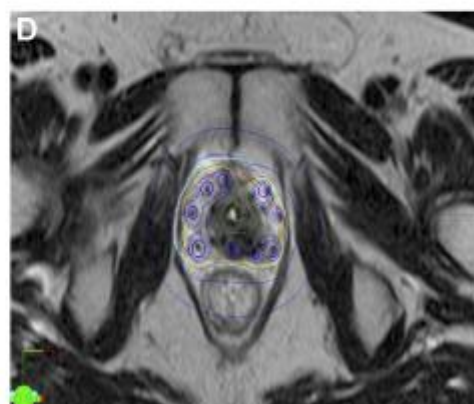
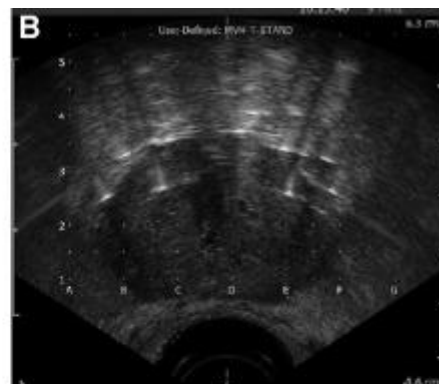
	Not at all	Less than 1 time in 5	Less than half the time	About half the time	More than half the time	Almost always	Your score
Incomplete emptying Over the past month, how often have you had a sensation of not emptying your bladder completely after you finish urinating?	0	1	2	3	4	5	
Frequency Over the past month, how often have you had to urinate again less than two hours after you finished urinating?	0	1	2	3	4	5	
Intermittency Over the past month, how often have you found you stopped and started again several times when you urinated?	0	1	2	3	4	5	
Urgency Over the last month, how difficult have you found it to postpone urination?	0	1	2	3	4	5	
Weak stream Over the past month, how often have you had a weak urinary stream?	0	1	2	3	4	5	
Straining Over the past month, how often have you had to push or strain to begin urination?	0	1	2	3	4	5	

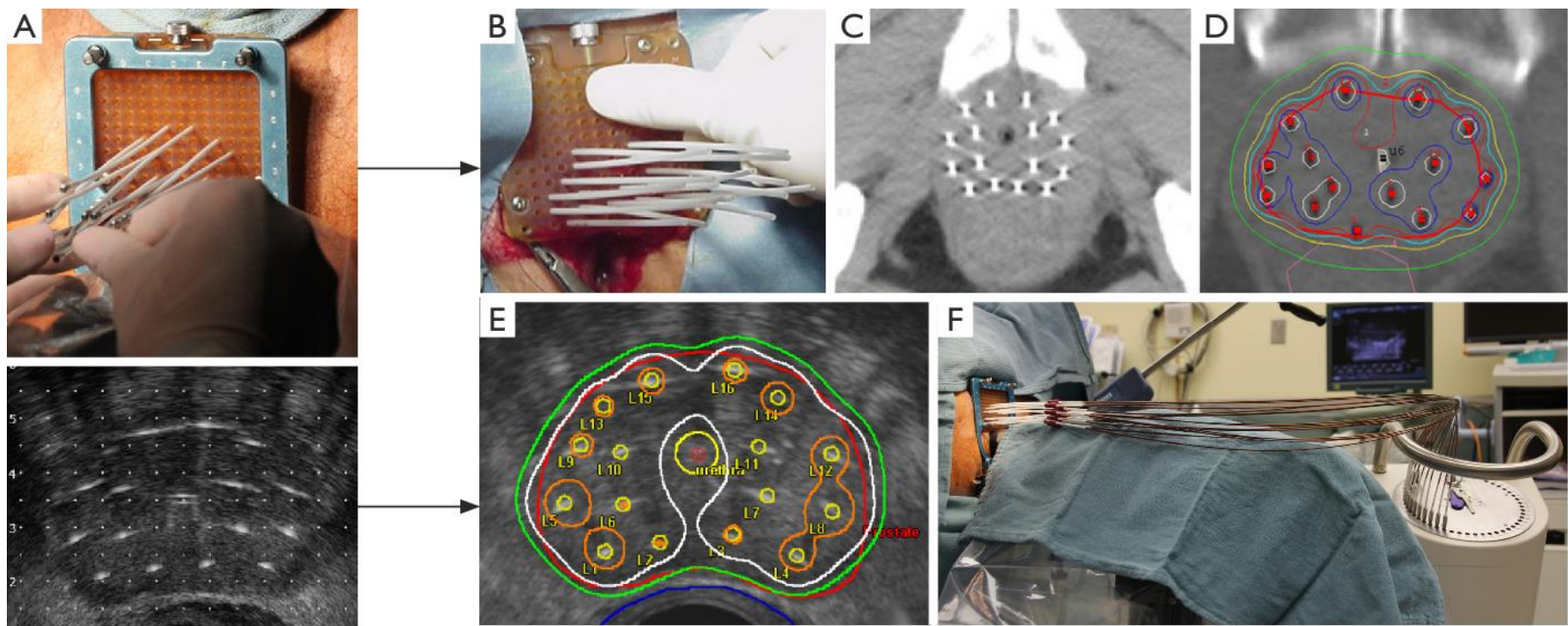
	None	1 time	2 times	3 times	4 times	5 times or more	Your score
Nocturia Over the past month, many times did you most typically get up to urinate from the time you went to bed until the time you got up in the morning?	0	1	2	3	4	5	

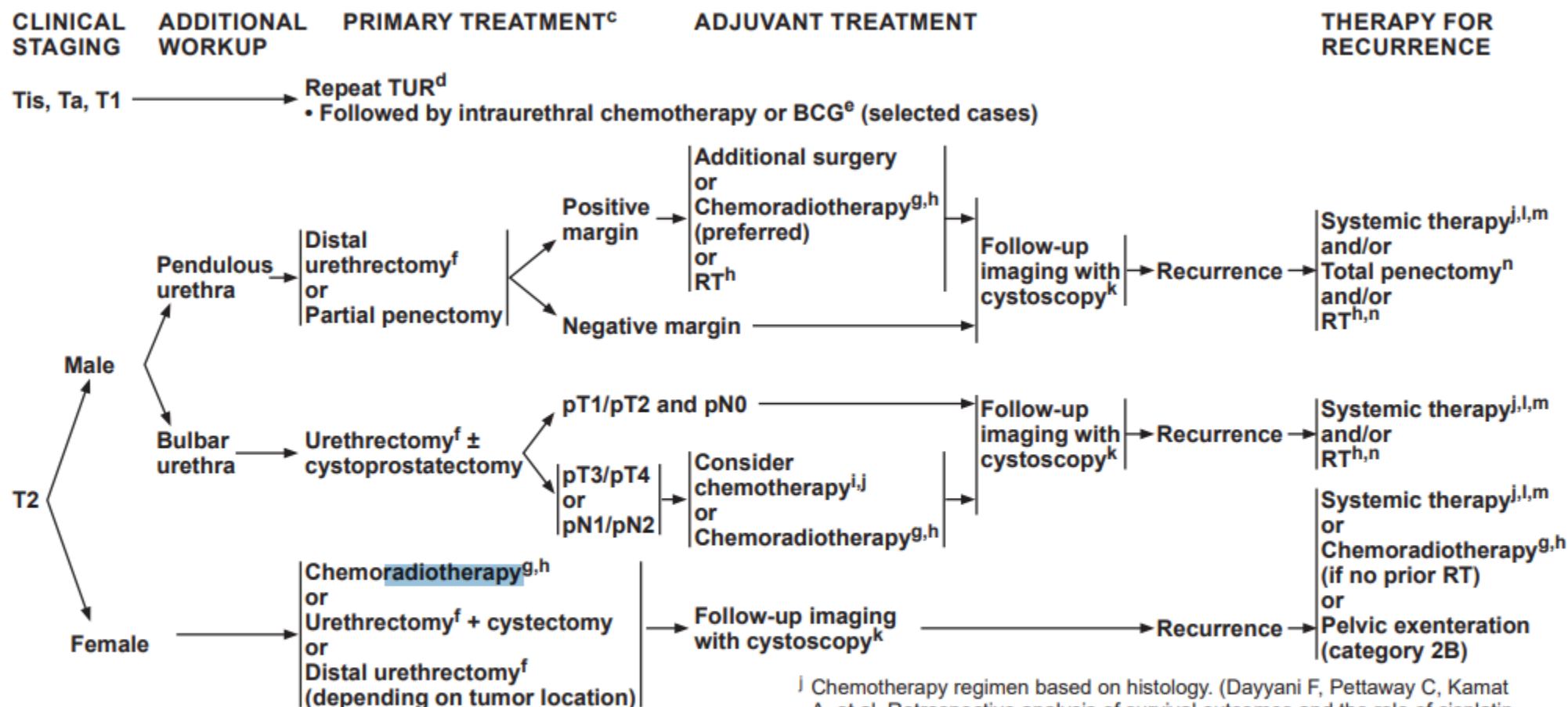
Add Your scores and write total in the box to the right.	
--	--

Total score: 0-7 Mildly symptomatic; 8-19 moderately symptomatic; 20-35 severely symptomatic.

Quality of life due to urinary symptoms	Delighted	Pleased	Mostly satisfied	Mixed: Equally satisfied / dissatisfied	Mostly dissatisfied	Unhappy	Terrible
If you were to spend the rest of your life with your urinary condition the way it is now, how would you feel about that?	0	1	2	3	4	5	6







^c See Principles of Surgical Management (BL-B).

^d In patients with a prior radical cystectomy and a cutaneous diversion, consider a total urethrectomy.

^e See Principles of Intravesical Treatment (BL-F).

^f Consider neoadjuvant chemotherapy (category 2B) or chemoradiation.

^g See Principles of Systemic Therapy (BL-G 5 of 7).

^h See Principles of Radiation Management of Invasive Disease-Carcinoma of the Urethra (BL-H 2 of 3).

ⁱ See Principles of Systemic Therapy (BL-G 1 of 7).

^j Chemotherapy regimen based on histology. (Dayyani F, Pettaway C, Kamat A, et al. Retrospective analysis of survival outcomes and the role of cisplatin-based chemotherapy in patients with urethral carcinomas referred to medical oncologists. Urol Oncol 2013;31:1171-1177.) Also see [Non-Urothelial Cell and Urothelial with Variant Histology \(BL-D\)](#).

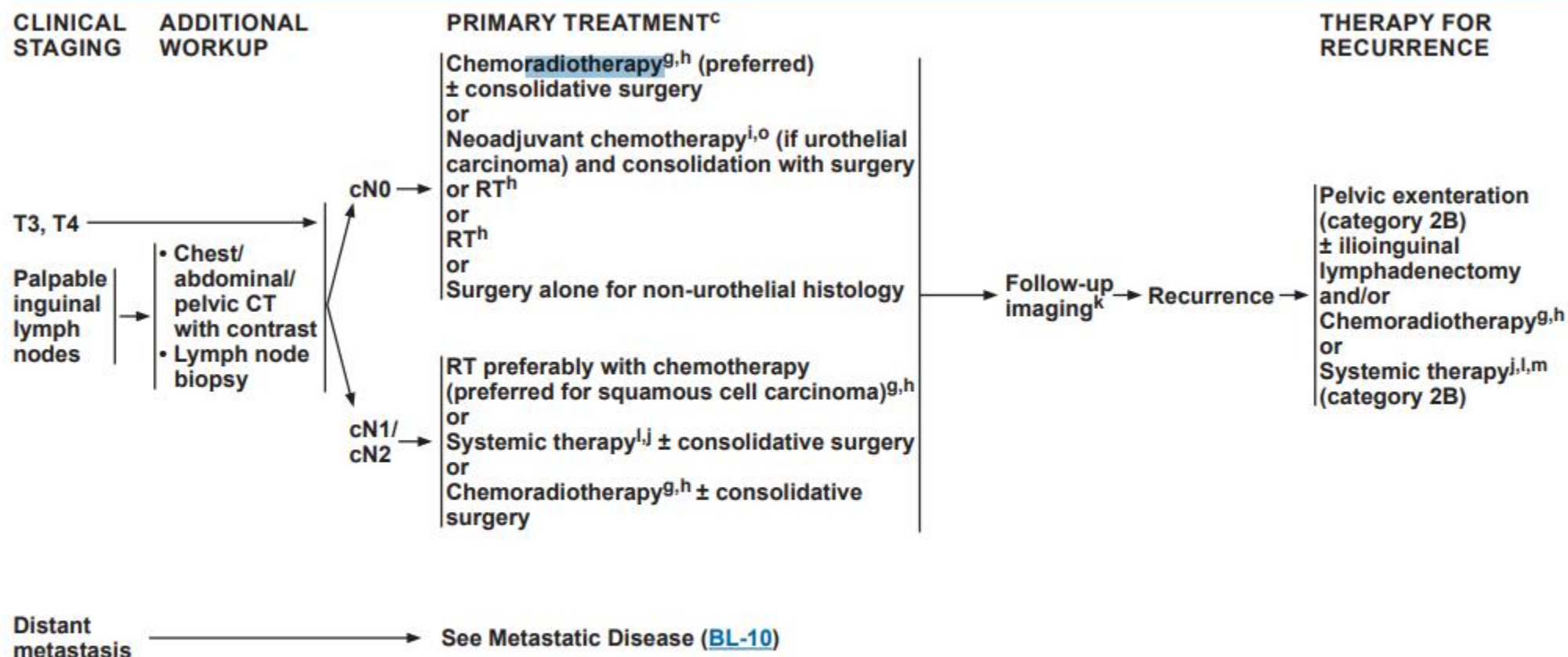
^k See Principles of Imaging for Bladder/Urothelial Cancer (BL-A).

^l See Principles of Systemic Therapy (BL-G 2 of 7).

^m See Principles of Systemic Therapy (BL-G 3 of 7 and 4 of 7).

ⁿ Consider for local recurrence (± chemotherapy).

NCCN recommendations have been developed to be inclusive of individuals of all sexual and gender identities to the greatest extent possible. On this page, the terms male and female refer to sex assigned at birth.



^c See Principles of Surgical Management (BL-B).

^g See Principles of Systemic Therapy (BL-G 5 of 7).

^h See Principles of Radiation Management of Invasive Disease-Carcinoma of the Urethra (BL-H 2 of 3).

ⁱ See Principles of Systemic Therapy (BL-G 1 of 7).

^j Chemotherapy regimen based on histology. (Dayyani F, Pettaway C, Kamat A, et al. Retrospective analysis of survival outcomes and the role of cisplatin-based chemotherapy in patients with urethral carcinomas referred to medical oncologists. Urol Oncol 2013;31:1171-1177.) Also see [Non-Urothelial Cell and Urothelial with Variant Histology](#) (BL-D).

^k See Principles of Imaging for Bladder/Urothelial Cancer (BL-A).

^l See Principles of Systemic Therapy (BL-G 2 of 7).

^m See Principles of Systemic Therapy (BL-G 3 of 7 and 4 of 7).

^o Data support neoadjuvant chemotherapy only for urothelial carcinoma.

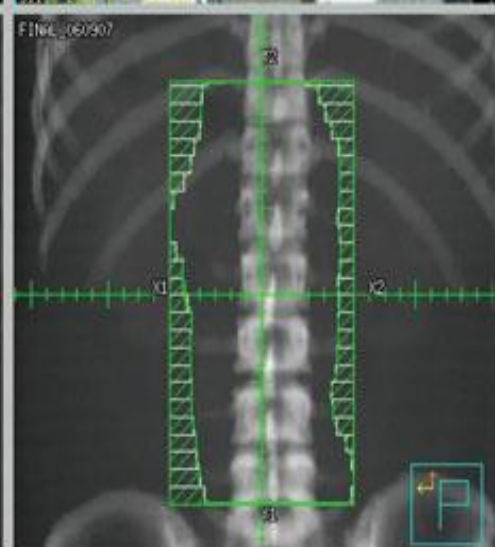
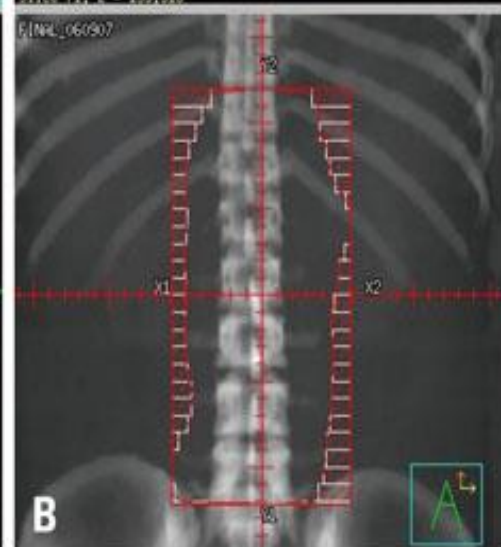
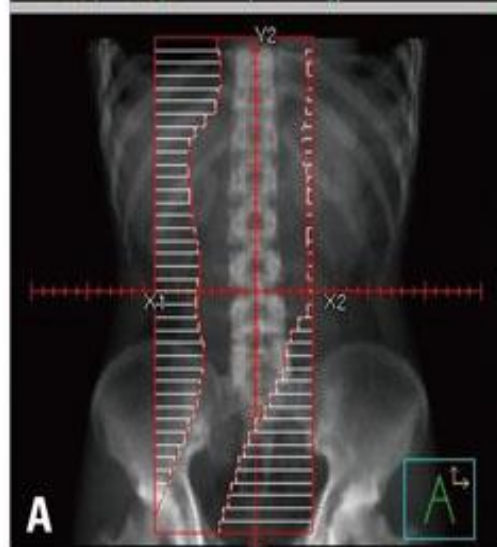
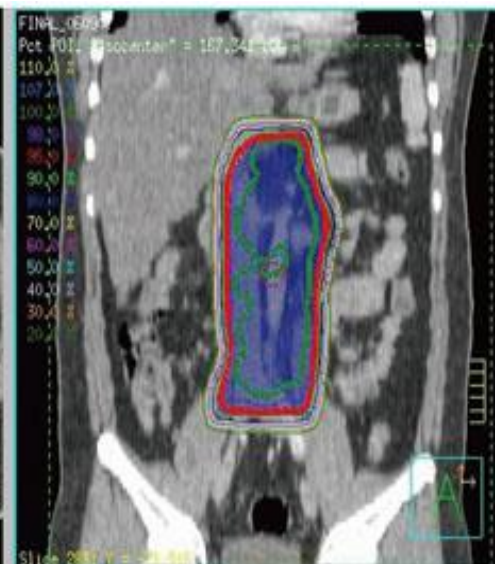
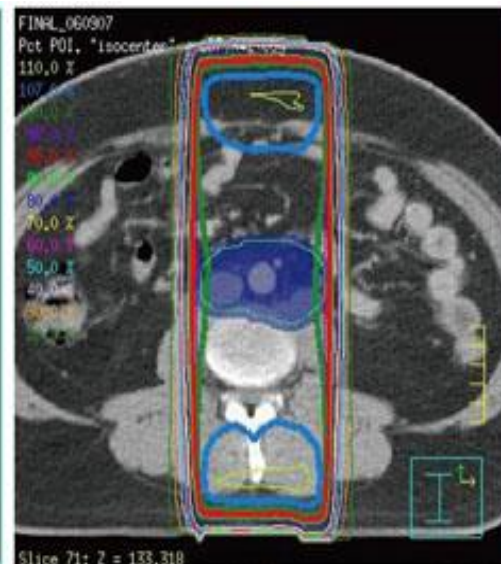
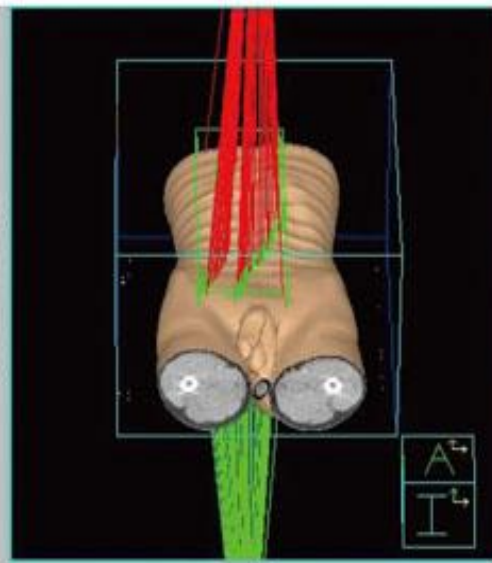
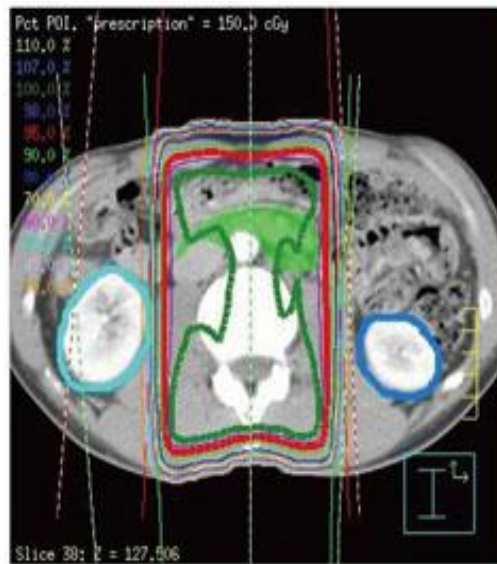


PRINCIPLES OF RADIATION MANAGEMENT OF INVASIVE DISEASE

Carcinoma of the Urethra: Unless otherwise stated, doses are 1.8–2.0 Gy daily fractionation.

- Data support the use of RT for urothelial carcinoma and squamous cell carcinoma of the urethra (case series and experience treating these carcinomas arising from other disease sites); radiation can also be considered for adenocarcinomas of the urethra.
- Definitive Radiation Therapy (organ preservation)
 - ▶ cT2 cN0
 - ◊ 66–70 Gy EBRT delivered to gross disease with a margin to encompass areas of potential microscopic spread. Concurrent chemotherapy with regimens used for bladder cancer is encouraged for added tumor cytotoxicity.
 - ◊ Strongly consider prophylactic radiation treatment of regional-nodal basins (inguinal and low pelvic nodes for female and distal male tumors; pelvic lymph nodes for proximal male tumors).
 - ▶ cT3–T4, or lymph node positive
 - ◊ 45–50.4 Gy EBRT delivered to gross disease with a margin to encompass areas of microscopic spread and to regional-nodal basins (inguinal and low pelvic nodes for female and distal male tumors; pelvic lymph nodes for proximal male tumors). Boost gross primary disease to 66–70 Gy and gross nodal disease to 54–66 Gy, if feasible. Dose delivered to gross nodal disease may be limited secondary to normal tissue dose constraints. Concurrent chemotherapy should be administered for added tumor cytotoxicity.
 - ▶ Postoperative adjuvant radiation therapy
 - ◊ Treatment field should encompass areas at risk for harboring residual microscopic disease based on pathologic findings at resection and may include resection bed, inguinal lymph nodes, and pelvic lymph nodes. Areas at risk for harboring residual microscopic disease should receive 45–50.4 Gy EBRT. Involved resection margins and areas of extranodal extension should be boosted to 54–60 Gy if feasible based on normal tissue constraints. Areas of gross residual disease should be boosted to 66–70 Gy, if feasible based on normal tissue constraints. Concurrent chemotherapy with regimens used for bladder cancer should be considered for added tumor cytotoxicity.
 - ▶ Recurrent disease
 - ◊ Clinical target volume (CTV) should include gross disease in any suspected areas of spread at 66–74 Gy (higher dose up to 74 Gy for larger tumor and non-urothelial histology) and consideration can be given to elective regional-nodal basins (45–50.4 Gy) as discussed above, if feasible based on normal tissue constraints.

TESTICULAR CANCER



PENILE CANCER



PRINCIPLES OF RADIOTHERAPY

Primary Radiation/Chemoradiation Therapy (Penile Preservation)

T1–2, N0

If tumor <4 cm

- Circumcision followed by either:
 - Brachytherapy alone^{1,2} (category 2B) (should be performed with interstitial implant);
or
 - EBRT (category 2B): Total dose 65–70 Gy with conventional fractionation using appropriate bolus to primary penile lesion with 2-cm margins.
 - EBRT with concurrent chemotherapy (category 3):³ Total dose 65–70 Gy with conventional fractionation using appropriate bolus to primary penile lesion with 2-cm margins.
 - Consider prophylactic EBRT to inguinal lymph nodes in patients who are not surgical candidates or who decline surgical management.

If tumor ≥4 cm

- Circumcision followed by either:
 - EBRT with concurrent chemotherapy (category 3):³ 45–50.4 Gy to a portion of or whole penile shaft depending on bulk and extent of lesion plus pelvic/inguinal nodes, then boost primary lesion with 2-cm margins (total dose 65–70 Gy);
or
 - Brachytherapy alone (category 2B) in select cases and with careful post-treatment surveillance.

T3–4 or N+ (surgically unresectable)

- Circumcision followed by:
 - EBRT with concurrent chemotherapy (category 3):³ 45–50.4 Gy to whole penile shaft, pelvic lymph nodes, and bilateral inguinal lymph nodes, then boost primary lesion with 2-cm margins and gross lymph nodes (total dose 60–70 Gy).

Primary Site Margin Positive Following Penectomy

- Postsurgical EBRT: If no gross disease: 45–60 Gy to the primary site and scar. If gross disease remains, follow guideline for T3–4, or N+.
- Treat bilateral inguinal lymph nodes and pelvic lymph nodes if no or inadequate lymph node dissection.
- Brachytherapy may be considered in select cases.

Adjuvant Chemoradiotherapy

- Inguinal and/or pelvic lymph node positive
 - Recommended for palpable bulky inguinal lymph nodes or enlarged pelvic lymph nodes;³ consider for palpable non-bulky inguinal lymph nodes pN2–3 disease (category 2B) or for local recurrence to inguinal region (category 2B).
 - Inguinal and pelvic lymph node EBRT to 45–50.4 Gy.
 - Boost gross nodes and areas of extracapsular extension to a total dose of 65–70 Gy.
 - Treat primary site of disease if positive margin.