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| [Brain Mets/Palliative/Oligo/Immuno](https://bit.ly/PalliativeRoR)| [Breast](https://bit.ly/BreastRoR) | [CNS/Peds](http://bit.ly/CNSandPeds) | [**Constraints**](https://bit.ly/RoRConstraints)| [GI](https://bit.ly/RoRGI) | [GU](https://bit.ly/GURoR) | [Gyn](https://bit.ly/RoRGyn) | [H&N/Skin](https://bit.ly/HNRoR) | [Heme](https://bit.ly/RoRHeme) | [Sarcoma](https://bit.ly/RoRSarcoma) | [Thorax](https://bit.ly/RoRThorax) | [Rad Phys/Bio](https://bit.ly/RORPhysBio)  [**www.RadOncReview.org**](http://www.radoncreview.org)  For best navigation, click on the table of contents to navigate and click on a subheader or header to return to the table of contents. Otherwise, use the Document Outline feature or control-F to search for a clinical trial of interest. Best held horizontally on mobile. Type '20 to see what's new. Click on any superscript font for a direct link to references.  **This document is a collaborative resource. All comments, corrections, and additions are welcome! Editing tips [**[**here**](https://docs.google.com/document/d/163jAwVLz8Wnno7jttJnDIM-4kTxkSSmj9XLP1W5pPJs/edit)**].** |

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# **Constraints and Toxicity**

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| [The Basics](#_dmqec1o90lbc)  [**Master Constraints**](#_hjf4rn360avr)  [CNS](#_z1n7n1n9ds6t)  [H&N](#_b6c4y9fe6v3v)  [Thorax](#_32fci3qg0zf)  [Abdomen](#_8v4ceuj5tqti)  [Pelvis](#_ab2rhzp2bs8x)  [**Conventional fractionation**](#_qjaeawxtdvf4)  [CNS](#_6pcmqjkcnat5)  [Head and Neck](#_bcgrt8p9agpw)  [Thorax](#_99sufzarng6t)  [Abdomen](#_hl8qgj4yw23f)  [Pelvis](#_fk6t2v2tqs8g)  [**SRS**](#_9ik22kl34ydn)  [CNS](#_s1voz8905w2g)  [H&N](#_645t4ixpoc4h)  [Thorax](#_c7vq3be29g8p)  [Abdomen](#_idgj7ed0yr5o)  [Pelvis](#_vocho1wttpvu)  [**SBRT (3 and 5 fractions)**](#_qguuewqzsx54)  [CNS](#_8x994kszmew)  [H&N](#_vyjl5vj9wyrt)  [Thorax](#_l8cy2jnhvjo5)  [Abdomen](#_tc3j87b5pttr)  [Pelvis](#_60c237wxszfo)  [**Hypofractionation (8, 10 and 15 fractions)**](#_7wdnwdj7hwus)  [CNS](#_efk5i11qetxs)  [H&N](#_wm5mn5dnqcqb)  [Thorax](#_e0bpk65tyqu3)  [Abdomen](#_ugkyb8ltp2xk)  [Pelvis](#_z510y33yg38) | [**Site Specific Constraints and Protocols**](#_yrs27vvto6ww)  [**CNS**](#_baj2f0bgqu6o)  [**Head and Neck**](#_3nmoy2ncyifu)  [**Breast**](#_smys2stdl3vk)  [**Thoracic**](#_a9nbojacknw0)  [NSCLC](#_ny512cy1lnpj)  [SCLC](#_ga5xjxwv5knh)  [Thymoma](#_qwi8e2db3bjo)  [Mesothelioma](#_c1ikqi6r7n3)  [**Gastrointestinal**](#_n27nn4wi9egm)  [Esophageal and Gastric](#_g27c3aefgv7u)  [Pancreas](#_of2fu5a2xnfr)  [Liver](#_srxu8ide998x)  [Gallbladder / Cholangiocarcinoma](#_ww6hlm2rnkbr)  [Rectum](#_igfhnfq5gpug)  [Anal](#_pvu21iybxaik)  [**Genitourinary**](#_94zmszgtb19l)  [Conventional Prostate](#_1kz4qqh7b19p)  [Hypofrac Prostate](#_20cfbxqf5iri)  [Bladder](#_ggj7lkvvreel)  [Renal Cell Carcinoma](#_1lu5boo5g9i7)  [Seminoma](#_3ex27ocrw1is)  [**Gyn**](#_ybd77zimnmv7)  [Endometrial](#_vcaauxl2trpg)  [Cervical](#_15vlro4pmyx)  [Vaginal/Vulvar](#_hl9bkltlahau)  [**Sarcoma**](#_op78fu5la0x0)  [**Pediatrics**](#_a29cku6suph4)  [**Treatment of Toxicity**](#_xlobsme86ths)  [**CNS Toxicity and Reirradiation**](#_q73agnmmjgi)  [**Conventional Toxicity**](#_g2glais3jw1t)  [**SRS and SBRT Toxicity**](#_y1p5yi8j0m9h) |

NOTE: If you're ever pushing SRS/SBRT constraints, the best answer for boards (and most of the time in clinical practice) is conventional fractionation. If SRS or SBRT is done carelessly, then kiss that license goodbye. **ALL SUPERSCRIPT FONT IS HYPERLINKED TO THE RESOURCE - CLICK IT!**

As they say in brachytherapy, no amount of optimization can compensate for a bad application.\*\*\*

We're not going to attempt to summarize QUANTEC data. Click on any [[QUANTEC](https://www.redjournal.org/issue/S0360-3016(10)X0002-5)] lettering to bring you to the paper of interest.

Currently, there is little discussion on management of toxicity as plenty of resources can address this in much more detail.

We believe a set of "master constraints" may be useful in the initial part of the treatment planning process.

Dx% = Dose covering X% of the volume.

Vx = Percent volume of target receiving "X" dose.

Key:

HyTEC = Spinal cord dose tolerance to SBRT [[Sahgal IJROBP '19](https://www.ncbi.nlm.nih.gov/pubmed/31606528)]:

TG-101 = One/Three/Five fraction constraints per [[TG 101](https://www.aapm.org/pubs/reports/rpt_101.pdf)].

T = Timmerman.

UK = UK/AAPM Consensus on Normal Tissue Dose constraints for SBRT [[Hanna CO '18](https://www.sciencedirect.com/science/article/pii/S093665551730434X)].

Application of Critical DVH Constraints for SBRT in NRG Radiation Therapy trials [[Ritter IJROBP '17](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5754194/#R1)].

A Systematic Review of Contouring Guidelines in Radiation Oncology [[Lin IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/32311418)]

Click on any superscript font to link to the paper.

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/) The Basics  * National Comprehensive Cancer Network (NCCN): [[NCCN]](https://www.nccn.org/) * NCCN [[Radiation Therapy Compendium](https://www.nccn.org/professionals/radiation/Default.aspx)] * Choosing Wisely ASTRO [[Website](https://www.choosingwisely.org/societies/american-society-for-radiation-oncology/)] * RCR Doses and Fractionation:[[Radiotherapy dose fractionation, third edition](https://www.rcr.ac.uk/publication/radiotherapy-dose-fractionation-third-edition)] * [[ACR Appropriateness Criteria](https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria)] * ESMO Guidelines [[Website](https://www.esmo.org/guidelines)] [[Mobile application](https://www.esmo.org/guidelines/pocket-guidelines-mobile-app)] * ASCO Guidelines [[Website](https://www.asco.org/research-guidelines/quality-guidelines/guidelines)], includes application. * MRI basics for Radiation Oncologists [[van der Heide CTRO '19](https://www.ncbi.nlm.nih.gov/pubmed/31341980)] * The transformation of radiation oncology using real-time magnetic resonance guidance: A review [[Hall EJC '19](https://www.ncbi.nlm.nih.gov/pubmed/31614288)]  Staying Up To Date Resources  * QuadShot: [[QuadShotNews]](http://www.quadshotnews.com/) * ACR Journal Advisor: [[ACR Journal Advisor]](https://www.acrjournaladvisor.com/) * The Mednet: [[theMedNet.org]](https://www.themednet.org/) * ACRO YouTube Channel: [[ACRO YouTube Channel]](https://www.youtube.com/channel/UCSzpY2tx6ujMHFghiC65a8g)  Education Resources  * Radiation Oncology Education Collaborative Study group (ROECSG) [[Web resources](https://voices.uchicago.edu/roecsg/web-resources/study-materials/)] * Estes RadOnc Tables Guides: [[Rad Onc Tables]](https://radonctables.wordpress.com/2017/08/31/first-blog-post/) * RadOncQuestions.com Question Bank: [[Rad Onc Questions]](https://www.radoncquestions.com/) * Association of Residents in Radiation Oncology (ARRO) Resident Resources: [[ARRO Resources]](https://www.astro.org/Affiliate/ARRO/Resident-Resources) * Rad Onc Review ;) (No obligation to put it - I don't expect anything in return for doing this!)  General Contouring and Planning Resources  * eContour: [[eContour]](https://econtour.org/) * Standardizing Normal Tissue Contouring ASTRO Consensus (Table E1 & E2) [[Wright PRO '19]](https://www.ncbi.nlm.nih.gov/pubmed/30576843) * Global Harmonization Group consensus guidelines: OAR delineation for radiation therapy clinical trials [[Mir RTO '20](https://doi.org/10.1016/j.radonc.2020.05.038)]. * How Path and Recurrence Patterns Inform CTV [[Chharbra Semin Rad Onc '18]](https://www.ncbi.nlm.nih.gov/pubmed/29933882) * CB-CHOP plan evaluation system: [[Dean Applied Rad Onc]](https://appliedradiationoncology.com/articles/cb-chop-a-simple-acronym-for-evaluating-a-radiation-treatment-plan) * Meet me in Treatment Planning: [[ASTRO-ARRO Meet Me in Treatment Planning](https://www.astro.org/Affiliate/ARRO/Resident-Resources/Educational-Resources/ASTRO-ARRO-Meet-Me-in-Treatment-Planning-Webinars)] * Chartrounds.com: [[ChartRounds.com]](https://chartrounds.com/) * Upper Abdominal Normal Organ Contouring Consensus Guidelines [[RTOG Contouring Atlases](https://www.nrgoncology.org/Portals/0/Scientific%20Program/CIRO/Atlases/UpperAbdominal.pdf), [Jabbour PRO ‘14](https://www.practicalradonc.org/article/S1879-8500(13)00262-2/abstract)] * RTOG pelvic normal tissue contouring guidelines [[Male normal pelvis Atlas](https://www.nrgoncology.org/Scientific-Program/Center-for-Innovation-in-Radiation-Oncology/Male-RTOG-Normal-Pelvis), [Gay IJROBP '12](https://www.ncbi.nlm.nih.gov/pubmed/22483697)] * eContour [[Thoracic OARs and lobar anatomy](https://econtour.org/cases/89), [Kong IJROBP '11](https://www.ncbi.nlm.nih.gov/pubmed/20934273)] * Standardized method to contour the lumbosacral plexus [[Yi IJROBP '11](https://www.ncbi.nlm.nih.gov/pubmed/22342301)] * CT-based Upper Abdominal OAR Consensus Guidelines [[RTOG Contouring Atlases](https://www.nrgoncology.org/Portals/0/Scientific%20Program/CIRO/Atlases/UpperAbdominal.pdf), [Jabbour PRO ‘14](https://www.practicalradonc.org/article/S1879-8500(13)00262-2/abstract)] * MRI-Based Upper Abdominal Organs-at-Risk Atlas for Radiation Oncology [[eContour](http://econtour.org/cases/112), [Lukovic IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/31953061)] * SIOPE brain tumor group consensus guideline on CSI target volumes [[Ajithkumar RTO' 18](https://www.ncbi.nlm.nih.gov/pubmed/29729847)] [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.hjfebnhgu5ka) * Head and Neck: Cranial Nerves IX-XII [[RTOG Contouring Atlases](https://www.rtog.org/CoreLab/ContouringAtlases.aspx)] * Practical clinical guidelines for contouring the trigeminal nerve (V) and its branches [[Atlas (Supplement) Biau RTO '19](https://www.thegreenjournal.com/article/S0167-8140(18)33458-3/abstract)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.q4gl8dq6tbz5) * PNI in Head and Neck Cancer [[Bakst IJROBP '19](https://www.sciencedirect.com/science/article/pii/S0360301618341750)]: How to chase nerves, recommended doses. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.q4gl8dq6tbz5) * Standardized Method for Contouring Brachial Plexus [[Hall IJROBP '08]](https://www.sciencedirect.com/science/article/pii/S0360301608004161?via%3Dihub). * TG-101: One/Three/Five fraction constraints per [[TG 101 AAPM '10](https://www.aapm.org/pubs/reports/rpt_101.pdf)]. [RoR](#_hjf4rn360avr) * UK: UK/AAPM Consensus on Normal Tissue Dose constraints for SBRT [[Hanna CO '18](https://www.sciencedirect.com/science/article/pii/S093665551730434X)]. [RoR](#_hjf4rn360avr) * HyTEC: Spinal cord dose tolerance to SBRT [[Sahgal IJROBP '19](https://www.ncbi.nlm.nih.gov/pubmed/31606528)]. [RoR](#kix.klvlwgqivafe) * NRG BR002 [[Pending](https://ascopubs.org/doi/abs/10.1200/JCO.2016.34.15_suppl.TPS1098), [Protocol](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)]: Phase II/III. Standard of care and tx of symptomatic mets vs. LCT. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.kyz8axqivny8)  Students Resources  * Radiation Oncology: A Primer for Medical Students [[Berman J Cancer Educ '13](https://www.ncbi.nlm.nih.gov/pubmed/23807599)] * ROECSG Introduction to Radiation Oncology [[website](https://voices.uchicago.edu/roecsg/introduction-to-radiation-oncology/)]. * Applying to Radiation Oncology: A Program Director's Perspective [[Neha Vapiwala YouTube](https://www.youtube.com/watch?v=faLDYAqABxg)]  Patient Education Resources  * ASTRO Videos [[Patient Videos](https://www.astro.org/Patient-Care-and-Research/Patient-Education/Patient-Videos)] * ASTRO Brochures [[Patient Brochures](https://www.astro.org/Patient-Care-and-Research/Patient-Education/Patient-Brochures)] * ACS [[Patient education materials](https://www.cancer.org/health-care-professionals/patient-education-materials-for-professionals.html)] * NCI [[Patient education](https://www.cancer.gov/publications/patient-education)] * ASCO [[Patient Education](https://www.cancer.net/about-us/asco-answers-patient-education-materials/asco-answers-fact-sheets)] * ESMO [[Patient education](https://www.esmo.org/for-patients)] * JAMA: What is SBRT? [[Knoll JAMA Onc '19](https://jamanetwork.com/journals/jamaoncology/fullarticle/2720476)] |

For resected brain metastases, hot spots in the cavity [[appear not to matter](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.cbvktsaf9nlk)].

Stereotactic Treatment of Brain Metastasis: [[Tips to keep late asymptomatic radionecrosis ≤ 10%](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.8pa05e5s4qz8)].

See [[Treatment of Central and Ultracentral Tumors](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.4q1lwlblkw4q)] section.

## 

# [Master Constraints](#_bvprouf2ng3w)

Click on any header (e.g. conventional, SRS, 3 fraction, 5 fraction etc) to see correlations with clinical outcomes for each fractionation scheme.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| [CNS](#_bvprouf2ng3w) | [[**Conventional**](#_6pcmqjkcnat5)] | [[**SRS**](#_s1voz8905w2g)] | [[**3 fraction**](#_8x994kszmew)] | [[**5 fraction**](#_8x994kszmew)] | [[**8 fraction**](#_efk5i11qetxs)] | [[**10 fraction**](#_efk5i11qetxs)] |
| **Brain** | Whole brain 50 Gy  Partial brain 60 - 72 Gy | **12 Gy** (**8 - 8.5cc**)  12 Gy (10 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | **18 Gy** (**30.2 cc**) [intact](http://www.redjournal.org/article/S0360-3016(16)00325-4/fulltext)  **24 Gy** (**16.8 cc**) [post-op](https://www.ncbi.nlm.nih.gov/pubmed/23683828) | **30 Gy** (**10.5 cc**)[intact](https://www.sciencedirect.com/science/article/pii/S0360301619344761?via%3Dihub)  **33.5 Gy** (**0.05 cc**)[post-op](https://www.ncbi.nlm.nih.gov/pubmed/31586666) |  |  |
| **Brainstem**  (not medulla) | **54 - 60 Gy**,52 Gy [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  **60 Gy** to PRV (+ 3mm)  59 Gy (1-10cc) [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03582-2/fulltext) | **15 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  10 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | **23.1 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  18 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | **31 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  23 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  | 40.5 Gy  29.4 Gy (0.5 cc) |
| **Cord** (includes medulla) | **44.6 Gy EQD2** [HyTEC 2019](#kix.klvlwgqivafe)  **45 - 50 Gy** [06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649), [13-08](https://clinicaltrials.gov/ct2/show/NCT01993810)  41 Gy BID [CALGB 30610 (new)](https://clinicaltrials.gov/ct2/show/NCT00632853)  36 Gy BID [Turrisi (old)](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.ameifz489gnc)  **50 Gy** to PRV (+ 5mm) | 22.7 Gy [HyTEC](#kix.klvlwgqivafe), Daly 2011  **12.4** - **14 Gy**[HyTEC](#kix.klvlwgqivafe),[T](https://www.karger.com/Article/Abstract/322503)/[101](https://www.aapm.org/pubs/reports/rpt_101.pdf)/[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx)  10 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  10 Gy (10%) [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre)  10 Gy (0.35 cc) [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  7 - 8 Gy (1.2 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx), T  7 Gy (1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) (5 cc) [HyTEC](#kix.klvlwgqivafe) | 22.5 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  21.9 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  **20.3 Gy**[HyTEC 2019](#kix.klvlwgqivafe)  18 Gy (0.1 cc, 10%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  18 Gy (0.35 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  12.3 - 13 Gy (1.2 cc)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  12.3 Gy (1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 32 Gy (+3 mm PRV)[SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  30 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [T](https://www.karger.com/Article/Abstract/322503), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  28 Gy [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **25.3 Gy** [HyTEC '19](#kix.klvlwgqivafe)  23 Gy (0.1 cc, 10%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  22.5 Gy (0.25 cc) [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  22 - 23 Gy (0.35 cc) T , [101,](https://www.aapm.org/pubs/reports/rpt_101.pdf)[BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  14.5 - 15.6 Gy (1.2 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  14.5 Gy (1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  13.5 Gy (0.5 cc) [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067) | 36.5 Gy [VUMC-0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  34 Gy (PTV + 3 mm) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  32 Gy (0.5 cc) [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  32 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  28 Gy [VUMC](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  25 Gy (0.1 cc)  27 Gy (0.25 cc)[0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  15.5 Gy (0.5 cc)[0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub) | 40 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  35 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  34 Gy [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411)  34 Gy (PTV + 3 mm) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  32 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  29.4 Gy (0.35 cc)  17.9 Gy (1.2 cc) |
| **OC/ON** | **54 - 55 Gy** (60 Gy) [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf) | **10 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  8 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  8 Gy (0.2 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | **17.4 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  15 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  15.3 Gy (0.2 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | **25 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  22.5 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  23 Gy (0.2 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  | 32.2 Gy  29.4 (0.2 cc) |
| **Cochlea** | **55 Gy** (**5%**)  Mean 35-40 Gy  Max 45-55 Gy. | **9 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  Mean me< 4 Gy | **17.1 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | **25 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) |  | 32.2 Gy |
| Pituitary | 45 Gy; Mean < 40 Gy | 13 - 19 Gy |  | 7.3 Gy (40%) |  |  |
| Hippocampus | Dmax < 16 Gy [CC001](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.fnhdj8o51q84), [09-33](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.5cr1ltgf2z9c)  D100 < 9 Gy [CC001](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.fnhdj8o51q84), [09-33](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.5cr1ltgf2z9c) |  |  |  |  |  |
| **Lens** | 7 Gy [08-25](#edyucegijgvn)  6 - 15 Gy | 1.5 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) |  |  |  |  |
| **Orbit** | 55 Gy  Mean < 35 Gy | 8 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | **26 Gy** T / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  24 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  20.4 - **22 Gy** (**3 cc**)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf),T,[BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  24 - 26 Gy (0.5 cc) UK | **32 Gy** [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  30.5 Gy [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  27 - **30 Gy** (**3 cc**)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  27 - 29 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) |  |  |
| Retina | **45 - 50 Gy** |  | **25.5 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  24 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  21.9 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **32 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **30 Gy** (**5 cc**) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |  |
| **Brachial Plexus** | **Mean < 69 Gy**  75 Gy (0.1 cc)  74 Gy (0.5 cc)  70 Gy (1 cc)  **66** **Gy** (2 cc) | **17.5 Gy** [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx) / [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  14 Gy (3 cc) [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx) / T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **24 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  22.5 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 35 Gy [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  **32 Gy** [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  30.5 Gy [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  27 - **30 Gy** (**3 cc**)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  27 - 29 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 38 Gy (0.5 cc) [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  41.36 Gy (0.5 cc) [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  39 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  27-38 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 55 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  50 Gy (0.2 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  39 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  34.9 Gy (3 cc) |
| **Cauda Equina** | 66 - 70 Gy | **16 Gy** [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre) / T/ 101 / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)**/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  14 Gy (5 cc) [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre) / T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **18 Gy** (**30.2 cc**) [intact](http://www.redjournal.org/article/S0360-3016(16)00325-4/fulltext)  **24 Gy** (**16.8 cc**) [post-op](https://www.ncbi.nlm.nih.gov/pubmed/23683828) | **30 Gy** (**10.5 cc**)[intact](https://www.sciencedirect.com/science/article/pii/S0360301619344761?via%3Dihub)  **33.5 Gy** (**0.05 cc**)[post-op](https://www.ncbi.nlm.nih.gov/pubmed/31586666) |  | 41.9 Gy  39.1 Gy (5 cc) |
| **Sacral Plexus** | 66 - 70 Gy | **18 Gy** [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre)**/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  16 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  14.4 Gy (5 cc) [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre), T, [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)**,** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **23.1 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  18 Gy (0.1cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) (0.5cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | **31 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  23 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  | 41.9 Gy  39.1 Gy (5 cc) |

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| [H&N](#_hjf4rn360avr) | [[**Conventional**](#_bcgrt8p9agpw)] | [[**SRS**](#_645t4ixpoc4h)] | [[**3 fraction**](#_vyjl5vj9wyrt)] | [[**5 fraction**](#_vyjl5vj9wyrt)] | [[**8 fraction**](#_wm5mn5dnqcqb)] | [[**10 fraction**](#_wm5mn5dnqcqb)] |
| **Cartilage** | Chondritis is rare if fraction size < 3 Gy. | | | | | |
| Skin | 20 - 30 Gy | **27.5 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf); 26 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  25.5 Gy (10 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  23 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | **33 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / Z4099 / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  31 Gy (10 cc) T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  30 (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 39.5 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  **38.5 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  36.5 Gy (10 cc) T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  32 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  30 Gy (10 cc) [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067) |  | 82 Gy [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  52.3 Gy  50 Gy (60 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  48.1 Gy (10 cc)  40 Gy (120 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  30 Gy (250 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807) |
| Temporal lobe | 65 - 72 Gy *Early stage NPC* [Lee '19](https://www.redjournal.org/article/S0360-3016(19)33428-5/pdf)  70 - 72 Gy *Late stage NPC* [Lee '19](https://www.redjournal.org/article/S0360-3016(19)33428-5/pdf) |  |  |  |  |  |
| Lips | Mean < 20 Gy [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  35 Gy (50 Gy for OC) |  |  |  |  |  |
| Parotid | **Mean < 24 - 26 Gy**  Ipsi mean 26 - 33 Gy  OR **total 20 Gy** (**20cc)**  OR **1 gland 30 Gy (50%**)  Contra mean < 20 Gy.  40 Gy (33%) contra if unilateral | *Unstimulated salivary production contribution from SL / Parotid / SM of 7→ 20→ 65%.* |  |  |  |  |
| Submandibular | **Mean < 30 - 35 Gy**  Contralateral mean < 39 Gy [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8) |  |  |  |  |  |
| Uninvolved salivary glands | Mean < 24 Gy |  |  |  |  |  |
| Thyroid | 45 Gy  Mean < 37 Gy |  |  |  |  |  |
| Pharyngeal constrictors | Mean < 50 Gy (superior)  Mean < 20 Gy (inferior) |  |  |  |  |  |
| Larynx | **63-66 Gy** [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03292-1/fulltext)  **Mean < 45 Gy** [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  Mean < 40 Gy (NP) < 20 Gy (OP)  60 Gy (15%) [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  50 Gy (33%) [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  50 Gy (66%) |  |  |  |  |  |
| Glottic larynx | Mean ≤ 35 Gy [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  D2% ≤ 50% |  |  |  |  |  |
| Post-cricoid pharynx | Mean < 45 Gy (55 Gy) |  |  |  |  |  |
| Cervical esophagus | **Mean < 30 Gy** [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8) ; 50 Gy |  |  |  |  |  |
| OC - PTV | **55 Gy**  Mean 40 - 50 Gy  Mean 30 Gy for uninvolved [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8) |  |  |  |  |  |
| Mandible, TMJ | 70 - 75 Gy(1-2%) [02-25](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.1s01ns9udsv6)  66 Gy [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8) |  |  |  |  |  |

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| [Thorax](#_hjf4rn360avr) | [[**Conventional**](#_99sufzarng6t)] | [[**SRS**](#_c7vq3be29g8p)] | [[**3 fraction**](#_l8cy2jnhvjo5)] | [[**5 fraction**](#_l8cy2jnhvjo5)] | [[**8 fraction**](#_e0bpk65tyqu3)] | [[**10 fraction**](#_e0bpk65tyqu3)] |
| **Heart / pericardium** | Mean < 26 - 35 Gy  **Mean < 20 Gy**  70 Gy, 60 Gy (33%)[06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649)  **50 Gy** (**25%**[Speirs](https://www.jto.org/article/S1556-0864(16)31144-3/fulltext)- 33%)  45 Gy (35[13-08](https://clinicaltrials.gov/ct2/show/NCT01993810)- 66% [06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649))  40 Gy (80-100% [06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649)) | **22 Gy** [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre) / [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  16 Gy (15 cc) [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre) / T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | **36 Gy**  30 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  24 - 26 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  24 Gy (15 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 62 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  52.5 - 63 Gy (0.05 cc)[08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  50 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  **38 Gy** [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf), 30 Gy [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993)  **32 Gy** (**15 cc**) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  27 - 29 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | **Not applicable** [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  64 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332), [VUMC-0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  50-60 Gy (0.5 cc)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  60 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  44 Gy [VUMC](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  38.4 Gy (15 cc) [0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub) | 64 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  60 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  60 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  45 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  41.9 Gy (15 cc) |
| **Great vessels** |  | **37 Gy** [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre), [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx), [T](https://www.karger.com/Article/Abstract/322503), [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)**,** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  31 Gy (10 cc)[0631](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre), [0915](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx), [101,](https://www.aapm.org/pubs/reports/rpt_101.pdf) [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **45 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  45 Gy (0.5 cc)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  39 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 62 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  52.5 - 63 Gy (0.05 cc)[08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  **53 Gy** [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  50 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  47 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  53 Gy (0.5 cc)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | **Not applicable** [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  No hot spot [VUMC](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  63 Gy[VUMC-0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  56.8 Gy (10 cc)[0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub) | 75 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  64 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  60 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  50 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  63.5 Gy (100 cc) |
| **Trachea**  *The leaves (are different from the branches) are different from the trunk [*[*Chaudhuri Lung Ca '15]*](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.ctkqot8uicm)*, [*[*HILUS*](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.dldhobpv14xl)*].* | **Not limited per 0617** | 20.2 Gy [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx) / [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  10.5 Gy (4 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  17.4 Gy (4 cc) T **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 30 Gy Z4099 / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  30 - 32 Gy (0.5cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  25.8 Gy (5 cc) T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  15 Gy (4 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 60 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  **52.5** - 63 **Gy** (**0.05 cc**)[08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  50 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  **50 Gy** (**0.03 cc**)[Manyam](https://www.ncbi.nlm.nih.gov/pubmed/31987965)  **47.1 Gy** (**0.33 cc**)[Manyam](https://www.ncbi.nlm.nih.gov/pubmed/31987965)  **40 Gy** [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  32 - 35 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  32 Gy (5 cc) [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  16.5 - 18 Gy (4 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067) | 64 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  63 Gy[VUMC-0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  60 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  44 - 46.68 Gy [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036), [VUMC](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  32 - 44 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  20.8 Gy (4 cc)[0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub) | 64 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  60 Gy [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  60 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  20.6 Gy (4 cc) |
| **Bronchial tree** | **Not limited per 0617**  80 Gy [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03293-3/fulltext) | 13.3 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  12.4 Gy (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 23.1 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  18.9 Gy (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 33 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  21 Gy (0.5cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  | 60 Gy [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  50 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807) |
| **Esophagus** | 74 Gy (1 cc)[13-08](https://clinicaltrials.gov/ct2/show/NCT01993810), [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03283-0/fulltext)  Max 105% Rx  Mean 34 - 37 Gy[06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649)  **60 Gy (17%)**  **55 Gy (33%)** | **15.4 Gy**[06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre), [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [T](https://www.karger.com/Article/Abstract/322503)**,** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  11.9 Gy (5 cc)[06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre), [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **27 Gy** 06-18 / T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  25.2 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  17.7 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 52.5 - 63 Gy (0.05 cc)[08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  40 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  **35 Gy** [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  32 - 34 Gy (0.5 cc)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  35 Gy (5 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  19.5 - **27.5 Gy** (**5 cc**)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf),[08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067),[BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 63 Gy[VUMC-0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 - 43.52 Gy [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  40 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  40 Gy (5 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  32.8 Gy (5 cc) [0813 extrapolation](http://v) | 50 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  40 Gy (5 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  24.6 Gy (5 cc) |
| **Lung** | **Mean 20 Gy** [06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649), [13-08](https://clinicaltrials.gov/ct2/show/NCT01993810), [10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290)  **20 Gy (37%**) [06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649), [13-08](https://clinicaltrials.gov/ct2/show/NCT01993810)  20 Gy (25%)[10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290)  10 Gy (40%)[10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290)  5 Gy (60%) [13-08](https://clinicaltrials.gov/ct2/show/NCT01993810), [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03293-3/fulltext)  5 Gy (50%) [10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290) | 8 Gy (37%) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  7 Gy (1500 cc\*) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  7.4 Gy (1000 cc\*) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  7.6 Gy (1000 cc\*) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  \*Min volume spared | 20 Gy (15%) 06-18, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  20 Gy (10%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  12.4 Gy (1000 cc\*)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  10.5 Gy (1500 cc\*)T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  11.6 Gy (1500 cc\*)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  11.4 Gy (1000 cc\*)T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  11 Gy (37%\*) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | Mean 5 - 6 Gy  Mean 12 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  20 Gy (10%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  13.5 Gy (37%) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  13.5 Gy (1000 cc\*)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)/ [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  12.5 Gy (1500 cc\*)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  \*Min volume spared. | Mean < 12 Gy  20 Gy (10%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  \*Min volume spared. | Mean < 9 Gy [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  Mean < 12 Gy  40 Gy (7%) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  15.2 Gy (1500 cc\*)  16.5 Gy (1000 cc\*)  \*Min volume spared. |
| **Rib** | **Not limited per 0617** | 33 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  30 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  28 Gy (5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  22 Gy (1 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 50 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  36.9 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  40 Gy (5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  30 Gy (30 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 57 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  43 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  45 Gy (5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  35 Gy (1 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  | 57.6 Gy  46 Gy (1 cc) |
| **Chest Wall** |  | 30 Gy [T](https://www.karger.com/Article/Abstract/322503) | 37 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  30 Gy (30 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 43 Gy [T](https://www.karger.com/Article/Abstract/322503)  39 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  32 Gy (30 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | **Not applicable** [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  39 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  35 Gy (30 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 82 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  50 Gy (60 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  40 Gy (120 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  30 Gy (250 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807) |

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| [Abdomen](#_hjf4rn360avr) | [[**Conventional**](#_hl8qgj4yw23f)] | [[**SRS**](#_idgj7ed0yr5o)] | [[**3 fraction**](#_tc3j87b5pttr)] | [[**5 fraction**](#_tc3j87b5pttr)] | [[**8 fraction**](#_ugkyb8ltp2xk)] | [[**10 fraction**](#_ugkyb8ltp2xk)] |
| **Stomach** | **50 Gy** (54 Gy pancreas)  54 Gy (10%)  50 Gy (10-15%, 1cc)  **45 Gy**  45 Gy (15%)  20 Gy (50%\*) | **22 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  12.4 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  17.4 Gy (5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  11.2 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | **30 Gy** T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) / [IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)  22.2 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  22.5 Gy (10 cc) T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  16.5 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 35 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  33 - 35 Gy (0.5 cc)T, [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  32 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  18 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  26.5 Gy (5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **25 Gy** (**5 - 10 cc**) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  12 Gy (50 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332) | 41.9 Gy  45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  37 Gy (1 cc) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411)  22.6 Gy (10 cc) |
| **Duodenum** | 50 Gy  60 Gy (2cc) [Verma '14](https://www.sciencedirect.com/science/article/pii/S0360301613032793?via%3Dihub)  55 Gy (15cc) [Verma '14](https://www.sciencedirect.com/science/article/pii/S0360301613032793?via%3Dihub)  55 Gy (1cc) [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648)  50 Gy (4cc) [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648) | **17 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  12.4 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  11.2 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  9 Gy (10 cc) T, [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 30 Gy [IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)  **24 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  22.2 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)/ [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  16.5 Gy (5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  15 Gy (10 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  11.4 Gy (10 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 35 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  35 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  **30 Gy** (0.5 cc) [1112](https://www.rtog.org/Portals/0/RTOG%20Broadcasts/Attachments/1112_master_w_update_5.7.13.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  32 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  **25 Gy** (**5 - 10 cc)**[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  18-18.3 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  12.5 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332) | 41.9 Gy  45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  37 Gy (1 cc) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411)  22.6 Gy (5 cc)  15.2 Gy (10 cc) |
| **Small bowel** (jejunum/ileum) | **55 Gy** (5 - 10 cc - bag)[EMBRACE II](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.fh42uw20ltay)  50 - 52 Gy  **45 Gy** (**195 cc - bag**)[Roeske RTO '03](https://pubmed.ncbi.nlm.nih.gov/14643959/)  45 Gy (150 - 200 cc) [05-34 (SPPORT)](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  **40 Gy** (**30%**)[TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644), [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418), [07-24](http://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdf), [GU-001](https://clinicaltrials.gov/ProvidedDocs/48/NCT02316548/Prot_SAP_000.pdf)  **15 Gy** (**120cc - loop**) | 15.4 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  11.9 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 30 Gy [IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)  25.2 Gy (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  17.7 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)/ [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  12.5 Gy (30 cc)[IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111) | 35 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  **30 - 35 Gy** (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  19.5 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  **25 Gy (5 - 10 cc**)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332) | 46 Gy  45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  37 Gy (1 cc) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411)  24.6 Gy (5 cc) |
| Spleen | Mean < 9 Gy, 5 Gy (20%) MDACC |  |  | Mean 2 Gy |  |  |
| **Liver - GTV** | 25 - 32 Gy mean  36 - 40 Gy (30%)  48 Gy (66%)  30 Gy (60%)  Liver TD 5/5 = 30 Gy | 9.1 Gy (700 cc\*) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  11 Gy (700 cc\*) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  \*Min volume spared | Mean < 13 - 15 Gy  **15 - 19.2 Gy** (**700 cc**)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)  19.2 Gy (700 cc\*) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  17.1 Gy (700 cc\*)T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  15 Gy (15%\*) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | Mean < 13 - 17 Gy [1112](https://www.rtog.org/Portals/0/RTOG%20Broadcasts/Attachments/1112_master_w_update_5.7.13.pdf)  **21 Gy** (**700cc\***)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  10 Gy (70%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  5 Gy (60%) [Pursley IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/32353390)  Mean < 15.2 Gy [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  \*Min volume spared |  | 26.7 Gy (700 cc)  27 Gy (30%) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411)  24 Gy (50%) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411) |
| **Bile duct** | < 80 Gy max? | **30 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **36 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  50 Gy (0.5cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  33.8 Gy (21 cc) [NoFlyZone](#kpry5msyhjzx)  32 Gy (24 cc) [NoFlyZone](#kpry5msyhjzx) | **41 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  50 Gy (0.5cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  40 Gy (21 cc) [NoFlyZone](#kpry5msyhjzx)  37.7 Gy (24 cc) [NoFlyZone](#kpry5msyhjzx) |  |  |
| **Renal Cortex** | Mean kidney dose 18 Gy [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03282-9/fulltext)  30 Gy (20%) [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03282-9/fulltext)  20 Gy (30%) [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03282-9/fulltext), [10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290)  18 Gy (30-50%, 67% [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418) , [07-24](http://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdfhttp://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdf))  18 Gy (33%) [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03282-9/fulltext)  One functional kidney:  Mean kidney dose 9 Gy.  20 Gy (15 - 20%) [10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290)  18 Gy (10-15%)  8 Gy (50% each) - testicular. | 9.5 Gy (200 cc\*) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  8.4 Gy (200 cc\*) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  \*Min volume spared | 15 - 16 Gy (200 cc\*)T, [101](https://www.aapm.org/pubs/reports/rpt_101.pdf),[BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  \*Min volume spared | 17.5 - 18 Gy (200cc\*)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) 16 Gy (200 cc\*) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  Mean < 10 Gy [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  \*Min volume spared  Solitary kidney or one kidney > 10 Gy: 10 Gy (10 - 45%)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) |  | 21.9 Gy (200 cc)  10 Gy (10%) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411) |
| **Renal hilum** |  | 18.6 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  10.6 Gy (67%) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  14 Gy (15 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 19.5 Gy (15 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 23 Gy (67%) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  23 Gy (15 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |  |

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| [Pelvis](#_hjf4rn360avr) | [[**Conventional**](#_fk6t2v2tqs8g)] | [[**SRS**](#_vocho1wttpvu)**]** | [[**3 fraction**](#_60c237wxszfo)] | [[**5 fraction**](#_60c237wxszfo)] | [[**8 fraction**](#_z510y33yg38)] | [[**10 fraction**](#_z510y33yg38)] |
| **Colon / Bowel** | 60 Gy  Anal:  30 Gy (200 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  35 Gy (150 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  45 Gy (20 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) | 29.2 GyT, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **18.4 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  18 Gy (20 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  14.3 Gy (20 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 42 Gy (1.5 cc) [IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)  34.5 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **28.2 Gy** (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  24 Gy (20 cc) T, [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 38 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), 40 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **32 Gy** (0.5 cc)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  28.5 Gy (20 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **25 Gy** (**20 cc**)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  | 50.2 Gy  32.2 Gy (20 cc) |
| **Rectum** | **75 Gy** (**15**%) [QUANTEC](https://www.srobf.cz/downloads/dokumenty/rectum.pdf)  **70 Gy** (**20%**) [QUANTEC](https://www.srobf.cz/downloads/dokumenty/rectum.pdf)  **65 Gy** (**25%**) [QUANTEC](https://www.srobf.cz/downloads/dokumenty/rectum.pdf)  69.5 Gy EQD2 (2 cc)  **65 Gy** EQD2 (**2 cc**)  55 Gy EQD2 (11 cc)  50 Gy (50%)[PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub), [QUANTEC](https://www.srobf.cz/downloads/dokumenty/rectum.pdf)  40 Gy (55 **-** 60%)[05-34 (SPPORT)](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044) | **44.2 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  39 Gy (3.5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  18.4 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  14.3 - 22 Gy (20 cc)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **49.5 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  45 Gy (3.5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  28.2 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)/ [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  28.2 Gy (0.5 cc)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  24 - 27.5 Gy (20 cc)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf),T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **55 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  50 Gy (3.5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  38 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  **38.06 Gy** - 40 Gy [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  34.4 Gy - 36 Gy (3 cc) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  **32 Gy** (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  **25 - 32.5 Gy** (**20 cc**) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  | 50.2 Gy  32.2 Gy (20 cc) |
| **Bladder wall** | **75 Gy** (**25%**) [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03285-4/fulltext)  **70 Gy** (**35%**) [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03285-4/fulltext)  **65 Gy** (**50%**)[QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03285-4/fulltext)  50 Gy (50%)[CHHiP](https://www.ncbi.nlm.nih.gov/pubmed/28296582), [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub)  **40 Gy** (**70% -** 77.5%)[05-34 (SPPORT)](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044) | **25 Gy**T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  18.4 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  11.4 - 12 Gy (15 cc)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **33 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  28.2 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  16.8 Gy (15 cc)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **38 Gy** T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  38.06 Gy- 40 Gy [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  20 Gy (15 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  18.12 Gy - 20 Gy (10%) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  18.3 Gy (15 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) |  | 50.2 Gy  23 Gy (15 cc) |
| **Ureter / Urethra** | 70 Gy | **35 Gy**T | **40 Gy** T / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **45 Gy** T / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  42 Gy (50%) [PACE / UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  38.78 Gy - 43.5 Gy [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702) |  |  |
| **Penile bulb** | Mean < 52.5 Gy [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  70 Gy (60-70%)  50 Gy (90-95%)  Mean < 24 Gy [CHHiP](https://www.ncbi.nlm.nih.gov/pubmed/32072028) | 34 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  14 - 16 Gy (3 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 42 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  40 Gy T  21.9 - 25 Gy (3 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) , T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 50 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  30 Gy (3 cc) T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  | 67 Gy  39.1 Gy (3 cc) |
| **Vagina** | Upper < 120-150 Gy  Mid < 80-90 Gy  Lower < 60-70 Gy | 14 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  15 Gy (10 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |  |  |  |
| **Femoral heads** | Mean < 45 Gy  **30 Gy** (**50%**)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) | 29.2 GyT, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **18.4 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  18 Gy (20 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  14.3 Gy (20 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 24 Gy (10 cc)T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  21.9 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 30 Gy (10 cc) T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  | 39.1 Gy (10 cc) |
| **Iliac crest** | **30 Gy** (**50%**)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) |  |  |  |  |  |
| **Bone marrow**  (Cervical cancer) | **Median < 34.2 Gy**[Klopp IJROBP '16](https://pubmed.ncbi.nlm.nih.gov/23582248/)  **40 Gy** (**37%**)[TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644) / [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418), [Klopp '16](https://pubmed.ncbi.nlm.nih.gov/23582248/)  20 Gy (75%) [Mell IJROBP '06](https://pubmed.ncbi.nlm.nih.gov/16757127/)  **10 Gy** (**90%**)[TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644) / [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418), [Mell '06](https://pubmed.ncbi.nlm.nih.gov/16757127/) |  |  |  |  |  |
| **Bone marrow**  (Anal cancer) | 30 Gy (750 cc) [Lee IJROBP '17](https://pubmed.ncbi.nlm.nih.gov/28068238/)  40 Gy (23%) [Lee IJROBP '17](https://pubmed.ncbi.nlm.nih.gov/28068238/) |  |  |  |  |  |

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# [Conventional fractionation](#_bvprouf2ng3w)

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| [CNS](#_qjaeawxtdvf4) | [[**Conventional**](#_z1n7n1n9ds6t)] |  |
| **Brain** | Whole brain 50 Gy  Partial brain 60 - 72 Gy | **Symptomatic necrosis for 60 / 72 / 90 Gy of < 3→ 5→ 10%.** [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03287-8/fulltext)  BED3 is used for the brain. Symptomatic radionecrosis for 100 - 140 Gy of 5%, or 10% for 140 - 170 Gy. |
| **Brainstem**  (not medulla) | **54 - 60 Gy**[DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf),52 Gy [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  **60 Gy** [08-25](#edyucegijgvn)  59 Gy (1-10cc) [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03582-2/fulltext) | Permanent cranial neuropathy or necrosis for < 5% for 59 Gy to 1-10 cc. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03582-2/fulltext)  The risk increases markedly at doses > 64 Gy. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03582-2/fulltext) |
| **Cord**  (includes medulla)  Initial SRS/SBRT constraints are based off of 45 Gy to the cord, despite [[Quantec] data](https://www.sciencedirect.com/science/article/pii/S0360301609032969?via%3Dihub) that demonstrates ≤ 1% RM if ≤ 54 Gy | **44.6 Gy EQD2** [HyTEC 2019](#kix.klvlwgqivafe)  **45 - 50 Gy** [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf), [06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649)  41 Gy BID [CALGB 30610 (new)](https://clinicaltrials.gov/ct2/show/NCT00632853)  36 Gy BID [Turrisi (old)](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.ameifz489gnc)  **50 Gy** to PRV (+ 5 mm) | **Spinal cord myelopathy rates at 5y for 50 / 54 / 60 / 69 Gy of 0.2→ 1→ 6→ 50%** [QUANTEC](https://www.sciencedirect.com/science/article/pii/S0360301609032969?via%3Dihub)  Spinal cord: Lhermitte's may occur at doses as low as 35 Gy, may persist up to a year.   * TD5/5 = 50 Gy for 10 cm length, 55 Gy for 5 cm length. * TD50/5= 70 Gy.   See notes on spinal cord reirradiation for conventional [Nieder IJROBP '06](#h4b3zg719535)and SBRT. [HyTEC 2019](#kix.klvlwgqivafe) |
| **OC/ON** | **54 - 55 Gy** (60 Gy) [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf) | **Optic neuropathy rates for 55 / 60 / 60+ Gy of 3→ 7→ 7-20%.** [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03284-2/fulltext) |
| **Cochlea** | **55 - 60 Gy** (**5%**) [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf)  Mean 45 - 50 Gy [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf)  Max 45 - 55 Gy. | SNHL for acoustic neuroma: Mean dose to cochlea. Limit to 35-45 Gy. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03298-2/fulltext)   * Mean cochlear dose of 45 Gy with < 30% risk of SNHL (similar to 14/1). [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03298-2/fulltext) * Mean cochlear dose of 32 Gy with < 20% risk of G2+ tinnitus [[Lee Rad Onc '15]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4574090/) |
| **Pituitary** | 45 Gy; Mean < 40 Gy  20 Gy [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf) | Hypopituitarism TD 5/5 40-45 Gy. GH decreases first, then LH/FSH followed by TSH/ACTH. |
| **Hippocampus** | Dmax < 16 - 17 Gy [CC001](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.fnhdj8o51q84), [09-33](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.5cr1ltgf2z9c)  D100 < 9 - 10 Gy [CC001](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.fnhdj8o51q84), [09-33](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.5cr1ltgf2z9c)  7.2 Gy (40%) [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf) | 10 Gy leads to neural stem cell reduction.  Risk for poor memory for D40% ± 7.2 Gy of 11→ 66% [[Gondi IJROBP '13](https://pubmed.ncbi.nlm.nih.gov/22209148/)] |
| **Lens** | 7 Gy [08-25](#edyucegijgvn)  6 - 15 Gy | 33% develop cataracts after 8y latent period with 2.5-6.5 Gy.  66% develop cataracts after 4y latent period with 6.5-11.5 Gy. Lens opacification at > 13-16 Gy. |
| **Front of eye** | 30 - 35 Gy [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf) | Eyelash: Loss at >20 Gy conventional fractionation (20/10 for Graves). Chronic skin/eyelid changes > 50 Gy.  Conjunctivitis: Acute > 30 Gy, chronic >50 Gy, permanent conjunctival scarring > 60 Gy.  Corneal ulceration: > 60 Gy, late conjunctival scarring > 50 Gy. |
| **Retina** | **45 - 50 Gy** [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf) | 5y retinopathy for < 24 / 45-50 / 55 / 70-80 Gy of 0→ 5→ 50→ 85%. *There is a sharp increase above 50 Gy.* |
| **Lacrimal gland** | 25 - 30 Gy [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf)  60 Gy permanent  TD 5/5 for DES 35 Gy | **Xerophthalmia**: TD 5/5 35 Gy. TD 50/5 50 Gy, permanent > 60 Gy mean. *There is a sharp increase above 50 Gy.*  Severe DES with visual compromise for 35-40 / 45-50 / 60-65 Gy of 6→ 50→ 90% [[Bhandare IJROBP '12](https://www.sciencedirect.com/science/article/pii/S0360301611007498)].   * Latency to DES for 35 / 40 / 50+ Gy mean of 30→ 20→ 10 mo. * Freedom from severe DES for < 45 / 45-59.9 / ≥ 60 Gy mean of 93→ 29→ 3%.   Late iritis/keratitis: 100% for >70 Gy, mean latency 15 mo [[Kwok Ophthal '98](https://www.sciencedirect.com/science/article/pii/S016164209891123X?via%3Dihub)]. No keratitis < 59 Gy. |
| **Brachial plexus** | **Mean < 69 Gy**  75 Gy (0.1 - 0.5 cc) [13-08](https://clinicaltrials.gov/ct2/show/NCT01993810)  74 Gy (0.5 - 1.0 cc) [13-08](https://clinicaltrials.gov/ct2/show/NCT01993810)  70 Gy (1 - 1.5 cc) [13-08](https://clinicaltrials.gov/ct2/show/NCT01993810)  **66** **Gy** (2 -2.5 cc) [13-08](https://clinicaltrials.gov/ct2/show/NCT01993810) |  |
| **Cauda Equina** | 66 - 70 Gy |  |
| **Sacral Plexus** | 66 - 70 Gy |  |

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Oropharynx: RTOG 10-16. NPX: RTOG 02-25.

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| [Head and Neck](#_qjaeawxtdvf4) | [[**Conventional**](#_b6c4y9fe6v3v)] |  |
| **Cartilage** | Chondritis is rare if fraction size < 3 Gy. | |
| **Mandible, TMJ** | 70 - 75 Gy(1-2%) [02-25](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.1s01ns9udsv6)  66 Gy [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8), 72 Gy [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf) |  |
| **Temporal lobe** | 65-72 Gy *Early NPC* [Lee '19](https://www.redjournal.org/article/S0360-3016(19)33428-5/pdf)  70-72 Gy *Late stage NPC* [Lee '19](https://www.redjournal.org/article/S0360-3016(19)33428-5/pdf) | TD 5/5 and 50/5 of 60.3→ 77 Gy (2 cc). [Feng Cancer Med '18](https://pubmed.ncbi.nlm.nih.gov/29473319/?dopt=Abstract) Dmax < 68 Gy, 58 Gy (1 cc), and 40 Gy (5 cc). [Su RTO '12](https://pubmed.ncbi.nlm.nih.gov/22857858/?dopt=Abstract)  TD 5/5 and 50/5 of 63→ 78 Gy (1 cc). [Zeng Radiology '15](https://pubmed.ncbi.nlm.nih.gov/25658039/?dopt=Abstract). For T4, 71 Gy (1 cc) and 72 Gy max. [Huang Rad Onc '19](https://pubmed.ncbi.nlm.nih.gov/30736809/?dopt=Abstract) 45 Gy (15 cc) [Zhou IJROBP '14](https://pubmed.ncbi.nlm.nih.gov/25066214/?dopt=Abstract) |
| **Lateral Pterygoid** | Mean < 61 Gy [Kamal RTO ‘20](https://www.ncbi.nlm.nih.gov/pubmed/32387489)  27 Gy (98.6%) [Kamal RTO ‘20](https://www.ncbi.nlm.nih.gov/pubmed/32387489) |  |
| **Lips** | Mean < 20 Gy [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf), [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  35 Gy (50 Gy for OC) |  |
| **Parotid**  Stimulated salivary production contribution from SL / Parotid / SM of 7→ 65→ 20%. | **Total mean 24 - 26 Gy** [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf)  Ipsi mean 26 - 33 Gy  OR total 20 Gy (20 cc)  OR 1 gland 30 Gy (50%)  **Contra mean 20 Gy** [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf)  40 Gy (33%) contra if uni | Risk of reduced parotid gland function to < 25% of pre-RT level (Grade 4 xerostomia):   * Mean bilateral parotid dose of 25 / 39 Gy with < 20→ 50% risk. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03289-1/fulltext) * Mean unilateral parotid dose of 20 Gy with < 20% risk. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03289-1/fulltext)   Mean doses of 26 Gy results in around 20% probability of G4 saliva reduction at 1 year (flow < 25% pretreatment), while 40 Gy leads to around 50% risk of flow ratio < 25% [[Dijkema IJROBP '10](https://www.ncbi.nlm.nih.gov/pubmed/20056347)] |
| **Submandibular**  Unstimulated saliva from SL / Parotid / SM of 7→ 20→ 65%. | **Mean < 30 - 35 Gy** [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf)  Contra mean < 39 Gy [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8) | Complete loss of salivary gland function is possible after 35-39 Gy. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03289-1/fulltext)  SM are more mucinous and important for alleviating xerostomia [[Jha IJROBP '12](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5746194/)].   * At mean doses < 39 Gy, flow rates recover by ~2.2%/month. Output decreases sharply with mean doses above 30-40 Gy [[Murdoch-Kinch IJROBP '08](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3734803/)]. |
| **Uninvolved salivary glands** | Mean 24 Gy | The sublingual and minor salivary glands produce the majority of mucinous output which is critical for lubricating mucosa.  Mean oral cavity dose can be a substitute for minor salivary gland output (i.e., inner lips, buccal mucosa, palate, oral tongue). |
| **Thyroid** | 40 - 45 Gy [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf)  Mean 37 Gy | Thyroid V50 ± 25% with hypothyroidism of 34→ 55% [[Zhou Rad Onc '20](https://www.ncbi.nlm.nih.gov/pubmed/32293496)]  A recent study suggests mean thyroid dose of 42 Gy may be a better cutoff [[Kamal ARO '19](https://www.ncbi.nlm.nih.gov/pubmed/32051897)] |
| **Pharyngeal constrictors** | Mean 50 Gy (superior)  Mean 20 Gy (inferior)  Mean 55 Gy [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf) | Mean < 50 Gy with ~20% symptomatic dysphagia and aspiration. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03292-1/fulltext)  Sup constrictor < 50 Gy most important, or for OP/NPX, limit the larynx and inf constrictors to ≤ 20-30 Gy [[Eisbruch IJROBP '11](https://www.ncbi.nlm.nih.gov/pubmed/21592678)] |
| **Larynx**  [[eContour Atlas](http://econtour.org/cases/72)**]** | **63-66 Gy** [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03292-1/fulltext)  **Mean 45 Gy** [09-20](https://www.thegreenjournal.com/article/S0167-8140(09)00188-1/abstract)  Mean 40 Gy (NP)  Mean 20 Gy (OP) [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  60 Gy (15%) [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  50 Gy (33%) [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  50 Gy (66%) | 70 Gy to larynx carries 5% risk of cartilage necrosis.  66 Gy to larynx carries < 20% risk of vocal dysfunction with chemotherapy. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03292-1/fulltext)  Risk of aspiration/laryngeal edema with Mean laryngeal dose [[Sanguineti IJROBP '07](https://www.redjournal.org/article/S0360-3016(07)00113-7/fulltext)]   * Risk of aspiration with mean laryngeal dose 50 Gy < 30%. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03292-1/fulltext) * Mean laryngeal dose of 44 Gy (RT alone) with < 20% edema.[QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03292-1/fulltext) * Keep MLD < 43.5 Gy to minimize risk of G2+ edema. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03292-1/fulltext)   V50 < 27% with < 20% edema.QUANTEC |
| **Glottic larynx** | Mean 35 - 40 Gy [DAHANCA](https://www.dahanca.dk/assets/files/GUID_DAHANCA%20Radiotherapy%20Guidelines%202019.pdf), [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  D2% ≤ 50% |  |
| **Post-cricoid pharynx** | Mean 45 Gy (55 Gy) |  |
| **Cervical esophagus** | **Mean 30 Gy** [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8) ; 50 Gy |  |
| **OC - PTV** | **55 - 65 Gy** (Oral cavity)  Mean 40 - 50 Gy (non-OC)  Mean 30 Gy uninvolved [10-16](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8) | Oral cavity mean dose < 40 Gy is associated with low patient reported xerostomia [[Little IJROBP '12](https://www.ncbi.nlm.nih.gov/pubmed/22056067)].  Mean oral cavity dose of 53 Gy is associated with severe dysgeusia at 3 months [[Sapir IJROBP '16](https://www.ncbi.nlm.nih.gov/pubmed/27473816)].  Point doses < 32 Gy were associated with minimal mucositis, while point doses > 39 Gy had mucositis > 1 mo [[Narayan IJROBP '08](https://www.ncbi.nlm.nih.gov/pubmed/18417299)]. |
| **Skin** | 20 - 30 Gy | Epilation |

## 

Lung: RTOG 06-17, RTOG 13-08. Esophagus: RTOG 10-10.

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| [Thorax](#_qjaeawxtdvf4) | [[**Conventional**](#_32fci3qg0zf)] |  |
| **Heart** | Mean < 26 - 35 Gy  **Mean < 20 Gy**  70 Gy  60 Gy (33%)[06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649)  **50 Gy** (**25%**[Speirs](https://www.jto.org/article/S1556-0864(16)31144-3/fulltext)- 33%)  45 Gy (35%,[13-08](https://clinicaltrials.gov/ct2/show/NCT01993810), 50%[10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290), 66% [06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649))  40 Gy (80-100% [06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649))  35 Gy (30% PORT)  30 Gy (50%[13-08](https://clinicaltrials.gov/ct2/show/NCT01993810), 100%[10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290))  V5, V30 [06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649) | Cardiac morbidity: Pooled analysis of 6 dose escalation trials for stage III NSCLC [[Wang JCO '17](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5455462/)]   * 2y cardiac events for Mean Heart Dose < 10 / 10-20 / >20 Gy of 4→ 7→ 21%.   Among pts w baseline cardiac dz, MHD of 5 / 12 Gy with 2y G3+ cardiac events of 10→ 15% [[Dess JCO '17](https://www.ncbi.nlm.nih.gov/pubmed/28301264)]  Among pts w healthy hearts, MHD of 23 / 29 Gy with 1y G3+ cardiac events of 10→ 15% [[Dess JCO '17](https://www.ncbi.nlm.nih.gov/pubmed/28301264)]  Mean heart dose > 10 Gy appears to be associated with mortality in healthy patients [[Atkins JACC '19](https://www.ncbi.nlm.nih.gov/pubmed/31196455)].  V50 < 25% is independently associated with overall survival [[Speirs JTO '17](https://www.jto.org/article/S1556-0864(16)31144-3/fulltext)]  Mean heart dose < 26 Gy has < 15% pericarditis. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03290-8/fulltext)  V30 < 46% has < 15% pericarditis. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03290-8/fulltext)  V25 < 10% has < 1% long term cardiac mortality 15y after RT. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03290-8/fulltext) |
| **Great vessels** |  |  |
| **Trachea** | **Not limited per 0617** |  |
| **Bronchial tree** | **Not limited per 0617**  80 Gy [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03293-3/fulltext) |  |
| **Esophagus** | 74 Gy (1 cc - 1.5cc)[13-08](https://clinicaltrials.gov/ct2/show/NCT01993810), [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03283-0/fulltext)  Max 105% Rx  Mean < 34 - 37 Gy[06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649)  **60 Gy** (**17%)**  **55 Gy** (**33%**) | Point doses of 74 Gy appear to be safe even with concurrent carboplatin and paclitaxel. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03283-0/fulltext)  Mean dose < 34 Gy on RTOG 06-17 is not mandated! [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03283-0/fulltext)  G2+ esophagitis < 30% for the following values: [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03283-0/fulltext)   * V70 < 20% * V50 < 40% * V35 < 50%   The length of partial and near-full circumference esophagus receiving 50-60 Gy appears to contribute to weight loss [QS](http://www.quadshotnews.com/2020/03/the-lengths-some-people-go-to.html) [[Han PRO '20](https://www.practicalradonc.org/article/S1879-8500(20)30062-X/fulltext)] |
| **Total Lung - GTV** | **Mean < 20 Gy** [06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649), [13-08](https://clinicaltrials.gov/ct2/show/NCT01993810), [10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290)  **20 Gy (37%** - 40%) [06-17](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649), [13-08](https://clinicaltrials.gov/ct2/show/NCT01993810)  20 Gy (25%)[10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290)  10 Gy (40%)[10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290)  5 Gy (60% - 65%) [13-08](https://clinicaltrials.gov/ct2/show/NCT01993810), [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03293-3/fulltext)  5 Gy (50%) [10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290) | For WLI, TD5/5 / TD 50/5 of 17.5→ 24.5 Gy [Emami IJROBP '91].  For exposure to 33% of the lung, TD 5/5 / TD 50/5 of 45→ 65 Gy [Emami IJROBP '91].  For RT alone, Lung V20 < 40% will have 15% RP [[Graham IJROBP '99](#oynjssbtnta1)].  For CCRT Lung V20 < 20%, around 20% of patients will have symptomatic RP [[Palma IJROBP '14](#ph8crzjgok4m)].  For CCRT Lung V20 < 40%, around 33% of patients will have symptomatic RP [[Palma IJROBP '14](#ph8crzjgok4m)].  For CCRT, Carboplatin/Paclitaxel in patients > 65y will have > 50% symptomatic RP [[Palma IJROBP '14](#ph8crzjgok4m)].  V20 < 30-35% and MLD < 20 Gy has a 20% risk of symptomatic RP. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03293-3/fulltext)  MLD of 7 / 13 / **20** / 24 / 27 Gy with 5→ 10→ **20**→ 30→ 40% risk of symptomatic RP. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03293-3/fulltext)  After EPP, Lung V20 ± 7% with 42x increased risk of PRD than those with lower V20 [[Rice IJROBP '07]](https://www.sciencedirect.com/science/article/pii/S0360301607005056?via%3Dihub). |
| **Rib** | **Not limited per 0617** |  |
| **Contra Lung** | Mean < 8 Gy  20 Gy (7-10%)  10 Gy (13%)  5 Gy (60-75%) |  |
| **Liver** | Mean 21 Gy  30 Gy (30%) |  |

## 

GI: RTOG 05-29. Pancreas (post-op): RTOG 08-48

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| [Abdomen](#_qjaeawxtdvf4) | [[**Conventional**](#_8v4ceuj5tqti)] |  |
| **Stomach RTOG 05-29\*** | **50 Gy** (54 Gy pancreas)  54 Gy (10%)  50 Gy (10-15%, 1 cc)  **45 Gy**  45 Gy (15%)  20 Gy (50%\*) | Stomach D100 to 45 Gy with < 7% gastric ulceration. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03286-6/fulltext) |
| **Duodenum** | 50 Gy  60 Gy (2 cc) [Verma '14](https://www.sciencedirect.com/science/article/pii/S0360301613032793?via%3Dihub)  55 Gy (15 cc) [Verma '14](https://www.sciencedirect.com/science/article/pii/S0360301613032793?via%3Dihub)  55 Gy (1 cc) [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648)  50 Gy (4 cc) [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648) | 3y G2+ for D2cc ± 60 Gy of 4→ 19% [Verma '14](https://www.sciencedirect.com/science/article/pii/S0360301613032793?via%3Dihub)  3y G2+ for V55 ± 15 cc of 7→ 49% [Verma '14](https://www.sciencedirect.com/science/article/pii/S0360301613032793?via%3Dihub)  G2+ for V55 ± 1 cc or V50 ± 4 cc of 4→ 8% [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648)  G2+ for V55 1 / 10cc of 10→ 20% [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648)  G2+ for V50 4 / 10cc of 10→ 14% [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648) |
| **Small bowel** (jejunum/ileum) | **55 Gy** (5 - 10 cc - bag) [EMBRACE II](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.fh42uw20ltay)  50 Gy (2 cc - bag) [Jethwa ARO '19](https://pubmed.ncbi.nlm.nih.gov/31673659/)  50 - 52 Gy  **45 Gy** (**195 cc - bag**)[Roeske RTO '03](https://pubmed.ncbi.nlm.nih.gov/14643959/)  45 Gy (150 - 200 cc) [05-34 (SPPORT)](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  **40 Gy** (**30% - bag**)[TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644), [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418), [07-24](http://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdf), [GU-001](https://clinicaltrials.gov/ProvidedDocs/48/NCT02316548/Prot_SAP_000.pdf)  **15 Gy** (**120cc - loop**)  Rectal:  35 Gy (180 cc) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  40 Gy (100 cc) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  45 Gy (65 cc) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  50 Gy [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  Anal:  30 Gy (200 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  35 Gy (150 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  45 Gy (20 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  50 Gy [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) | Small bowel: TD 5/5 50 Gy.  G3+ acute toxicity < 10% for bowel bag V45 < 195 cc. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03286-6/fulltext)  G3+ acute toxicity < 10% for individual loops V15 < 120 cc [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03286-6/fulltext)  **RTOG 05-29 Predictors of RT-related GI toxicity** [[Olsen IJROBP '17](https://www.redjournal.org/article/S0360-3016(17)30332-2/fulltext)]: Compare to Quantec V45 < 195cc.   * Small bowel V25 ≤ 186 cc, V30 ≤ 155 cc, V35 ≤ 41 cc, **V40 ≤ 30.4 cc** correlate to G2+ acute GI. * Larger patients may benefit from being prone to decrease bowel dose. |
| **Spleen** | Mean < 9 Gy MDACC  15 Gy (20%) MDACC | Lymphopenia |
| **Liver** | 25 - 32 Gy mean  36 - 40 Gy (30%)  48 Gy (66%)  30 Gy (60%)  Liver TD 5/5 = 30 Gy | MLD of 30-32 Gy with < 5% RILD (excludes cirrhosis). [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03295-7/fulltext)  MLD of 28 Gy with < 5% RILD in Child-Pugh A / HCC. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03295-7/fulltext) |
| **Biliary tree** | < 80 Gy max? |  |
| **Kidney** | Mean kidney dose 18 Gy [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03282-9/fulltext)  30 Gy (20%) [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03282-9/fulltext)  20 Gy (30%) [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03282-9/fulltext), [10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290)  18 Gy (30-50%, 67% [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418) , [07-24](http://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdfhttp://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdf))  18 Gy (33%) [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03282-9/fulltext)  One functional kidney:  Mean kidney dose 9 Gy.  20 Gy (15 - 20%) [10-10](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290)  18 Gy (10-15%)  8 Gy (50% each) - testicular. | Combined mean kidney dose of 18 / 28 Gy with < 5 → < 50% clinically relevant kidney dysfunction. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03282-9/fulltext)  Clinically relevant renal dysfunction < 5% for the following values: [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03282-9/fulltext)   * V28 < 20% * V23 < 30% * V20 < 32% * V12 < 55% |

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Prostate: RTOG 0534 / SPPORT (bed), RTOG 0415 (intact), RTOG 0815 (intact).

Rectal: RTOG 0822. Anal: RTOG 0529.

Gyn: RTOG 0418, TIME-C / RTOG 1203, RTOG 0724.

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| [Pelvis](#_qjaeawxtdvf4) | [[**Conventional**](#_ab2rhzp2bs8x)] |  |
| **Large bowel** | 60 Gy  Anal:  30 Gy (200 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  35 Gy (150 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  45 Gy (20 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) |  |
| **Rectum** | **75 Gy** (**15**%) (20%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub) (74 Gy)  **70 Gy** (**20%**) (25 - 30%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub)  **65 Gy** (**25%**) (35 - 40%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149), [05-34](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  69.5 Gy EQD2 (2 cc)[Mazeron RTO '16](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.hi7c3wdz8bwq)  **65 Gy** EQD2 (**2 cc**)[Kircheiner RTO '16](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=kix.lb7csgs1k37)  55 Gy EQD2 (11 cc)[Ujaimi BT '17](https://www.sciencedirect.com/science/article/pii/S1538472117303938?via%3Dihub)  60 Gy (50 - 55%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  50 Gy (50%)[PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub), [QUANTEC](https://www.srobf.cz/downloads/dokumenty/rectum.pdf)  45 Gy (60%) [07-24](http://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdfhttp://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdf)  40 Gy (55 **-** 60%)[05-34 (SPPORT)](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  40 Gy (80% - 100%) [TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644) / [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418)  30 Gy (60%) [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418) | Late G3+ and G2+ of < 10% and < 15% for the following constraints: [QUANTEC](https://www.srobf.cz/downloads/dokumenty/rectum.pdf)   * V75 < 15%. *Add 10% for bladder (V75 < 25%).* * V70 < 20%. *Add 15% for bladder (V70 < 35%).* * V65 < 25%. *Add 25% for bladder (V65 < 50%).* * V60 < 35%. * V50 < 50%.   TL;DR - V65-V75 and their corresponding numbers all add up to 90% for the rectum - the "Rectal Rule of 90s". One hundred minus 90 is 10%, which is the rate of late G3+ rectal toxicity with these values.  Maintain rectal V70 < 20-25% to mitigate the risk of "bowel bowel", although this "bowel bother" would be unlikely to affect your patients golf game (PROST-QA) [[Hamstra IJROBP '13](https://www.sciencedirect.com/science/article/pii/S0360301613001739?via%3Dihub)]. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.3slu4sysck4r) |
| **Bladder** | 80 Gy (2 cc)[Jensen RTO '17](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.rn92zdko5mc4)  80 Gy (15 - 20%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  **75 Gy** (**25%**) (30%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  **70 Gy** (**35%**) (40%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  **65 Gy** (**50%**)(55%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149), [05-34](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  50 Gy (50%)[CHHiP](https://www.ncbi.nlm.nih.gov/pubmed/28296582), [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub)  45 Gy (35%) [TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644) / [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418) / [07-24](http://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdf)  **40 Gy** (**70% -** 77.5%)[05-34 (SPPORT)](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  Rectal:  40 Gy (40%) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  45 Gy (15%) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  50 Gy [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  Anal:  35 Gy (50%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  40 Gy (35%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  50 Gy (5%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) | Whole bladder 50 Gy = 5-10% late G3-4 effects.[QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03285-4/fulltext)  Whole bladder 60 Gy = 10-40% late G3-4 effects.[QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03285-4/fulltext)  Dmax < 65 Gy with late G3+ toxicity ≤ 6% (bladder cancer). [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03285-4/fulltext)  Minimize late G3+ toxicity with the following constraints: [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03285-4/fulltext)   * V80 < 15% * **V75 < 25%**. *Subtract 10% for rectum (V75 < 15%).* * **V70 < 35%**. *Subtract 15% for rectum (V70 < 20%).* * **V65 < 50%**. *Subtract 25% for rectum (V65 < 25%).*   TL;DR - know the "rule of 90s" for the V75-65 of the rectum, then add 10%, 15%, and 25% in descending order. There is low single digit bladder toxicity with these values.  RTOG 05-34 / SPPORT allows variation acceptable if no bladder constraints are met.  Of note, SPPORT and other prostate bed trials subtract CTV from the bladder. |
| **Urethra** | 70 Gy | Urethra: < 70 Gy with < 5% risk of stricture. |
| **Penile bulb** | Mean < 52.5 Gy [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  70 Gy (60-70%)  50 Gy (90-95%)  Mean < 24 Gy [CHHiP](https://www.ncbi.nlm.nih.gov/pubmed/32072028) | Mean dose < 52.5 Gy and limiting 90% of the prostate to 50% has a < 35% incidence of severe ED. QUANTEC  Limiting 60-70% of the penile bulb has a < 55% incidence of severe ED. QUANTEC |
| **Vagina** | Upper < 120-150 Gy  Mid < 80-90 Gy  Lower < 60-70 Gy | Vaginal doses >50-60 Gy can cause significant fibrosis.  G2+ vaginal stenosis for 65 / 75 / 85 Gy of 20→ 27→ 34% [[Kirchheiner RTO '16]](https://www.sciencedirect.com/science/article/pii/S0167814016000025?via%3Dihub) |
| **Femoral Heads** | Mean < 45 Gy  Rectal:  40 Gy (40%) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  45 Gy (25%) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  50 Gy [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  Anal:  **30 Gy** (**50%**)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  40 Gy (35%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  44 Gy (5%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) |  |
| **Iliac crest** | **30 Gy** (**50%**)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  40 Gy (35%)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  50 Gy (5%)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) |  |
| **Bone marrow**  (Cervical cancer) | **Median < 34.2 Gy**[Klopp IJROBP '16](https://pubmed.ncbi.nlm.nih.gov/23582248/)  **40 Gy** (**37%**)[TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644) / [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418), [Klopp IJROBP '16](https://pubmed.ncbi.nlm.nih.gov/23582248/)  20 Gy (75%) [Mell IJROBP '06](https://pubmed.ncbi.nlm.nih.gov/16757127/)  **10 Gy** (**90%**)[TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644) / [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418), [Mell IJROBP '06](https://pubmed.ncbi.nlm.nih.gov/16757127/) | Cervical cancer (weekly cisplatin):  G2+ heme for BM V40 ± 37% or median BM ± 34.2 **Gy** of 40→ 75% [[Klopp IJROBP '16](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4572833/)]. *V20 and V10 did not pan out.*  G2+ neutropenia for BM V10 ± 90% of 11→ 74% and BM V20 ± 75% of 14→ 25% [[Mell IJROBP '06](https://pubmed.ncbi.nlm.nih.gov/16757127/)]. *V40 did not pan out.* |
| **Bone marrow**  (Anal cancer) | 30 Gy (750 cc) [Lee IJROBP '17](https://pubmed.ncbi.nlm.nih.gov/28068238/)  40 Gy (23%) [Lee IJROBP '17](https://pubmed.ncbi.nlm.nih.gov/28068238/) | Anal cancer (MMC): It makes sense that V40 is a lower value than for cervical cancer, as MMC has significant heme toxicity.  Patients who had ≥ 750 cc spared from ≥ 30 Gy had 0% G3 heme at week 3.  G3+ neutropenia for BM V40 ± 23% of 8→ 33%. |
| **External genitalia** | 20 Gy (50%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  30 Gy (35%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  40 Gy (5%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) | Testicles: Permanent sterility > 6 Gy single dose or 3 Gy fractionated.  Oligospermia 0.15 Gy (with 6w latency). Azoospermia 0.5 Gy. Recovery is dose-dependent (1y after 2 Gy).  Effective sterilizing dose at birth / 10y / 20y / 30y of 20→ 18→ 16→ 14 Gy [[Skrzypek AAEM '19](https://www.ncbi.nlm.nih.gov/pubmed/31885235)]. |
| **Gluteal folds** | < 36 Gy if possible |  |
| **Skin (0.5 cm rind)** | Minimize dose, 20 Gy |  |

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# [SRS](#_bvprouf2ng3w)

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| [CNS](#_bvprouf2ng3w) | [[**Single fraction**](#_z1n7n1n9ds6t)] | **As a common theme, 12 Gy is "safe" most anywhere as a point dose (potential exception: ON/OC).** |
| **Brain** | **12 Gy** (**8 - 8.5cc**)  12 Gy (10 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  5 Gy (50%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | V12 < 5-10 cc with < 20% symptomatic necrosis. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03287-8/fulltext)  Limit V12 to 8-8.5 cc, otherwise consider hypofractionated treatment [[Blonigen IJROBP '10](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.zd9ese6mzhea), [Minniti Rad Onc '11](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.9frr833stuhc)].  There is suggestive data that more eloquent areas of the brain should be hypofractionated or treated to less than 20/1 if ≥ 1 cm. |
| **Brainstem**  (not medulla) | **15 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  10 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 12.5 Gy with < 5% permanent cranial neuropathy or necrosis. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03582-2/fulltext)  There is suggestion of 27 / 45 Gy touching stem with 11→ 18% significant permanent facial numbness [[Smith IJROBP '11](https://www.sciencedirect.com/science/article/pii/S0360301610008059?via%3Dihub)] |
| **Cord** (includes medulla) | 22.7 Gy [HyTEC](#kix.klvlwgqivafe), Daly 2011  **12.4** - **14 Gy**[HyTEC](#kix.klvlwgqivafe), [T](https://www.karger.com/Article/Abstract/322503)/[101](https://www.aapm.org/pubs/reports/rpt_101.pdf)/[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx)  10 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) (10%) [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre)  10 Gy (0.35 cc) [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  7 - 8 Gy (1.2 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx), T  7 Gy (1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) (5 cc) [HyTEC](#kix.klvlwgqivafe) | 13 Gy with < 1% incidence of myelopathy. QUANTEC  Percentage applies to subvolume of cord (e.g. 5-6 mm above and below lesion). |
| **OC/ON** | **10 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  8 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  8 Gy (0.2 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 12 Gy with 10% incidence of optic neuropathy [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03284-2/fulltext). 12 Gy is now considered "safe", but still ballsy [[Pollock NS '14]](https://academic.oup.com/neurosurgery/article-abstract/75/4/456/2447765?redirectedFrom=fulltext).  Very low < 8 Gy, 12 Gy < 10%, >10% for 12-15 Gy [[Mayo IJROBP '10](https://www.sciencedirect.com/science/article/pii/S0360301609032842?via%3Dihub), [Pollock NS '14]](https://academic.oup.com/neurosurgery/article-abstract/75/4/456/2447765?redirectedFrom=fulltext).  Delivery of up to 12 Gy for single fraction SRS appears to be safe. Toxicity increases greatly for SRS doses above 12 Gy. |
| **Cochlea** | **9 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  Mean < 4 Gy | 14 Gy with < 25% incidence of SNHL (similar to 45/25). Limit prescription dose to 12-14 Gy to preserve hearing. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03298-2/fulltext)  Hearing preservation drops above 13 Gy [[Mendenhall JNS '96](https://thejns.org/view/journals/j-neurosurg/85/6/article-p1013.xml), [Combs IJROBP '10](https://www.redjournal.org/article/S0360-3016(09)00208-9/fulltext)]. |
| Pituitary | 13 - 19 Gy | For adenomas, panhypopituitarism for 13 / 19 Gy of 33→ 100%. Give 14-16 Gy if nonfunctional, 18-20 Gy if functional. |
| Hippocampus |  |  |
| **Lens** | 1.5 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) |  |
| **Orbit** | 8 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) |  |
| Retina |  |  |
| **Brachial Plexus** | **17.5 Gy** [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx) / [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  14 Gy (3 cc) [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx) / T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Cauda Equina** | **16 Gy** [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre) / T/ 101 / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)**/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  14 Gy (5 cc) [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre) / T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Sacral Plexus** | **18 Gy** [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre)**/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  16 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  14.4 Gy (5 cc) [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre), T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| [H&N](#_9ik22kl34ydn) | [[**Single fraction**](#_b6c4y9fe6v3v)] |  |
| **Cartilage** |  | Chondritis is rare if fraction size < 3 Gy |
| **Skin** | **27.5 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf); 26 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  25.5 Gy (10 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  23 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  |

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| [Thorax](#_9ik22kl34ydn) | [[**Single fraction**](#_32fci3qg0zf)] |  |
| **Heart / pericardium** | **22 Gy** [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre) / [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  16 Gy (15 cc) [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre) / T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  |
| **Great vessels** | **37 Gy** [06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre), [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx), [T](https://www.karger.com/Article/Abstract/322503), [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)**,** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  31 Gy (10 cc)[0631](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre), [0915](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx), [101,](https://www.aapm.org/pubs/reports/rpt_101.pdf) [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Trachea and large bronchus** | 20.2 Gy [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx) / [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  10.5 Gy (4 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  17.4 Gy (4 cc) T **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Esophagus** | **15.4 Gy**[06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre), [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [T](https://www.karger.com/Article/Abstract/322503)**,** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  11.9 Gy (5 cc)[06-31](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre), [09-15](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Lung** | 8 Gy (37%) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  7 Gy (1500 cc\*) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  7.4 Gy (1000 cc\*) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  7.6 Gy (1000 cc\*) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  \*Min volume spared |  |
| **Smaller bronchus** | 13.3 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  12.4 Gy (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  |
| **Rib** | 33 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  30 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  28 Gy (5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  22 Gy (1 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  |
| **Chest Wall** | 30 Gy [T](https://www.karger.com/Article/Abstract/322503) |  |

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| [Abdomen](#_9ik22kl34ydn) | [[**Single fraction**](#_8v4ceuj5tqti)] |  |
| **Stomach** | **22 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  12.4 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  17.4 Gy (5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  11.2 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | Stomach V22.5 < 5 cc (4%). [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03286-6/fulltext)  [[IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)]: 15.4 Gy (1.5 cc). |
| **Duodenum** | **17 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  12.4 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  11.2 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  9 Gy (10 cc) T, [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | Small bowel receiving 12.5 Gy should be < 30 cc with avoidance of circumferential coverage above that dose. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03286-6/fulltext) |
| **Small bowel** (jejunum/ileum) | 15.4 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  11.9 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | Small bowel receiving 12.5 Gy should be < 30 cc with avoidance of circumferential coverage above that dose. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03286-6/fulltext)  [[IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)]: 26 Gy, 22.5 Gy (5 cc). Aim for < 13 Gy to full circumference of small bowel loop. |
| **Liver - GTV** | 9.1 Gy (700 cc\*) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  11 Gy (700 cc\*) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  \*Min volume spared | [[IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)]: Mean dose and dose to 700 cc to be documented. |
| **Bile duct** | **30 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Kidney** / Renal Cortex | 9.5 Gy (200 cc\*) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  8.4 Gy (200 cc\*) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  \*Min volume spared | [[IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)]: ALARA: minimise volume of high dose regions (> 50% IDL) within the kidney and outside the ITV. Contralateral kidney 10 Gy (33%). |
| Renal hilum / vascular trunk | 18.6 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  10.6 Gy (67%) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  14 Gy (15 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| [Pelvis](#_9ik22kl34ydn) | [[**Single fraction**](#_ab2rhzp2bs8x)] |  |
| **Colon / Bowel** | 29.2 GyT, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **18.4 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  18 Gy (20 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  14.3 Gy (20 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | [[IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)]: ALARA. Aim for 26 Gy (1.5 cc). |
| **Rectum** | **44.2 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  39 Gy (3.5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  18.4 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  14.3 - 22 Gy (20 cc)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Bladder wall** | **25 Gy**T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  18.4 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  11.4 - 12 Gy (15 cc)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Ureter / Urethra** | **35 Gy**T |  |
| **Penile bulb** | 34 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  14 - 16 Gy (3 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Femoral heads** | 14 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  15 Gy (10 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |

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# [SBRT](#_bvprouf2ng3w)

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| [CNS](#_bvprouf2ng3w) | [[**3 fractions**](#_z1n7n1n9ds6t)] | [[**5 fractions**](#_z1n7n1n9ds6t)] | **As a common theme, 25/5 is "safe" most anywhere as a point dose.** |
| **Brain** | **18 Gy** (**30.2 cc**) [intact](http://www.redjournal.org/article/S0360-3016(16)00325-4/fulltext)  **24 Gy** (**16.8 cc**) [post-op](https://www.ncbi.nlm.nih.gov/pubmed/23683828) | **30 Gy** (**10.5 cc**)[intact](https://www.sciencedirect.com/science/article/pii/S0360301619344761?via%3Dihub)  **33.5 Gy** (**0.05 cc**)[post-op](https://www.ncbi.nlm.nih.gov/pubmed/31586666) | Hot spots within the surgical cavity do not appear to matter.  See Tips and Tricks to deliver SRS safely. [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=kix.8fr41ufr96ex) |
| **Brainstem**  (not medulla) | **23.1 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  18 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | **31 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  23 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  |
| **Cord** (includes medulla) | 22.5 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  21.9 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  **20.3 Gy** [HyTEC 2019](#kix.klvlwgqivafe)  18 Gy (0.1 cc, 10%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  18 Gy (0.35 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  12.3 - 13 Gy (1.2 cc)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  12.3 Gy (1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 32 Gy (+3 mm PRV)[SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  30 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [T](https://www.karger.com/Article/Abstract/322503), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  28 Gy [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **25.3 Gy** [HyTEC '19](#kix.klvlwgqivafe)  23 Gy (0.1 cc, 10%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  22.5 Gy (0.25 cc) [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  22 - 23 Gy (0.35 cc) T , [101,](https://www.aapm.org/pubs/reports/rpt_101.pdf)[BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  14.5 - 15.6 Gy (1.2 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  14.5 Gy (1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  13.5 Gy (0.5 cc) [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067) | Percentages apply to subvolume of cord (e.g. 5-6 mm above and below lesion). |
| **OC/ON** | **17.4 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  15 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  15.3 Gy (0.2 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | **25 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  22.5 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  23 Gy (0.2 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  |
| **Cochlea** | **17.1 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | **25 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | Rx acoustic neuromas to 25/5 if between 1.5 and 3 cm. Give 12.5/1 for < 1.5 cm. |
| Hippocampus |  | 7.3 Gy (40%) |  |
| **Lens** |  |  |  |
| **Orbit** |  |  |  |
| **Brachial Plexus** | **26 Gy** T / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  24 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  20.4 - **22 Gy** (**3 cc**) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  24 - 26 Gy (0.5 cc) UK | 35 Gy [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  **32 Gy** [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  30.5 Gy [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  27 - **30 Gy** (**3 cc**)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  27 - 29 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | "Limit the brachial plexus to 25-32 Gy in 3-5 fractions" - Joe Chang  Brachial plexopathy [[Forquer RTO '09](https://www.thegreenjournal.com/article/S0167-8140(09)00193-5/fulltext)]: 3-4 fractions.   * 2y risk of brachial plexopathy for Dmax of ± 26 Gy of 8→ 46%. |
| **Cauda Equina** | **25.5 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  24 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  21.9 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **32 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **30 Gy** (**5 cc**) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Sacral Plexus** | **24 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  22.5 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **32 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)/ [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **30 Gy** (**5 cc**) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| [H&N](#_qguuewqzsx54) | [[**3 fractions**](#_b6c4y9fe6v3v)] | [[**5 fractions**](#_b6c4y9fe6v3v)] |  |
| **Cartilage** |  |  | Chondritis is rare if fraction size < 3 Gy |
| **Skin** | **33 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / Z4099 / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) **/** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  31 Gy (10 cc) T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  30 (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 39.5 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  **38.5 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  36.5 Gy (10 cc) T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  32 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  30 Gy (10 cc) [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067) |  |

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| --- | --- | --- | --- |
| [Thorax](#_qguuewqzsx54) | [[**3 fractions**](#_32fci3qg0zf)] | [[**5 fractions**](#_32fci3qg0zf)] |  |
| **Heart / pericardium** | **36 Gy**  30 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  24 - 26 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  24 Gy (15 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 62 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  52.5 - 63 Gy (0.05 cc)[08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  50 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  **38 Gy** [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf), 30 Gy [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993)  **32 Gy** (**15 cc**) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  27 - 29 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) |  |
| **Great vessels**  and hilar vessels | **45 Gy** [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  45 Gy (0.5 cc)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  39 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 62 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  52.5 - 63 Gy (0.05 cc)[08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  **53 Gy** [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  50 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  47 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Trachea**  See tx of [[Central and Ultracentral Lung](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.4q1lwlblkw4q)]  *The leaves (are different from the branches) are different from the trunk [*[*Chaudhuri Lung Ca '15]*](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.ctkqot8uicm)*, [*[*HILUS*](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.dldhobpv14xl)*].* | 30 Gy Z4099 / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  30 - 32 Gy (0.5cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  25.8 Gy (5 cc) T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  15 Gy (4 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 60 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  **52.5** - 63 **Gy** (**0.05 cc**)[08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  50 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  **50 Gy** (**0.03 cc**)[Manyam](https://www.ncbi.nlm.nih.gov/pubmed/31987965)  **47.1 Gy** (**0.33 cc**)[Manyam](https://www.ncbi.nlm.nih.gov/pubmed/31987965)  **40 Gy** [T](https://www.karger.com/Article/Abstract/322503) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  32 - 35 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  32 Gy (5 cc) [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  16.5 - 18 Gy (4 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067) | Point doses above 50 Gy in 5 fractions are associated with G5 non-pneumonitis toxicity on a number of studies. Fortunately, 08-13 is an "insurance policy" if you choose to push the PBT to 105% of 50/5 (Even 60/5). Manyam constraints suggest < 95% of your BED10 ≅ 100 Gy prescription (i.e., 50/5) may be more wise the 105%, which is in line with BED10 ≅ 100 Gy for other fractionation schemes (i.e., 60/8 and 65/10). For example, 8 fraction regimens recommend 53 Gy HILUS while 10 fraction regimens recommend 60 Gy MDACC. However, lesions ≤ 1 cm from the mainstem had 14% G5 toxicity on [HILUS]. Be mindful as there is a paucity of data with lesions close to the mainstem treated with 70/10. Also, keep in mind the BED10 of 70/10 is 119 Gy, which is more than 60/8 or even 50/5. There is no evidence that 8 or 10 fraction regimens are any more safe than 5 fraction regimens, especially when the new Manyam constraints are taken into account. TL;DR BED3 ≥ 180 Gy (36/3, 45/5, 55/8, 60/10) appears risky. |
| **Bronchial tree** | 23.1 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  18.9 Gy (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 38 Gy [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  33 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  21 Gy (0.5cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) |  |
| **Esophagus** | **27 Gy** 06-18 / T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  25.2 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  17.7 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 52.5 - 63 Gy (0.05 cc)[08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)  40 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  **35 Gy** [T](https://www.karger.com/Article/Abstract/322503), [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)**,** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)**,** [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  32 - 34 Gy (0.5 cc)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  35 Gy (5 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  19.5 - **27.5 Gy** (**5 cc**)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)**,** [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |
| **Lung** | 20 Gy (15%) 06-18, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  20 Gy (10%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  12.4 Gy (1000 cc\*)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  10.5 Gy (1500 cc\*)T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  11.6 Gy (1500 cc\*)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  11.4 Gy (1000 cc\*)T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  11 Gy (37%\*) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  \*Min volume spared. | Mean 5-6 Gy  Mean 12 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  20 Gy (10%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  13.5 Gy (37%) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  13.5 Gy (1000 cc\*)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)/ [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  12.5 Gy (1500 cc\*)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  \*Min volume spared. |  |
| Rib | 50 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  36.9 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  40 Gy (5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  30 Gy (30 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  28.8 Gy (1 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 57 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  43 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  45 Gy (5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  35 Gy (1 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | Who cares about rib toxicity? Most heal on their own without intervention[[Park J GE Hepatol '20](https://www.ncbi.nlm.nih.gov/pubmed/32052884)]  Pettersson [[RTO '09](https://www.ncbi.nlm.nih.gov/pubmed/19410314/)]: 3 fraction. Rib D2cc of 27 / 50 Gy with 5→ 50% rib fractures.  Dunlap [[IJROBP '10]](https://www.sciencedirect.com/science/article/pii/S0360301609002521?via%3Dihub): CW + 3 cm V30 < 30cc, but very few pts met this unrealistic goal.  MSKCC [[Mutter IJROBP '12]](https://www.sciencedirect.com/science/article/pii/S0360301611005190?via%3Dihub): CW + 2 cm V30 ± 70cc with 2y G2+ CW pain of 22→ 54%. |
| Chest Wall | 37 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  30 Gy (30 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 43 Gy [T](https://www.karger.com/Article/Abstract/322503)  **21 Gy** (**700cc\***)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  39 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  32 Gy (30 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) |
| Breast |  | 42.5 Gy (50 cc) [Rahimi IJROBP ‘20](https://pubmed.ncbi.nlm.nih.gov/32464155/)  45 Gy (20 cc) [Rahimi IJROBP ‘20](https://pubmed.ncbi.nlm.nih.gov/32464155/)  47.5 Gy (1 cc) [Rahimi IJROBP ‘20](https://pubmed.ncbi.nlm.nih.gov/32464155/)  Dmax 48 Gy [Rahimi IJROBP ‘20](https://pubmed.ncbi.nlm.nih.gov/32464155/)  PTV < 100 cc [Rahimi IJROBP ‘20](https://pubmed.ncbi.nlm.nih.gov/32464155/) | **Dosimetric predictors of fat necrosis** [[Rahimi IJROBP ‘20](https://pubmed.ncbi.nlm.nih.gov/32464155/)]: **5 fraction S-PBI**.   * 75 patients. 2011-2015. Stage 0-II with tumor < 3 cm. MFU 5y.   + CTV = excision cavity + 15 mm, staying 5 mm from skin. Exclude chest wall. * MTT fat necrosis 13 mo. * Higher V35-50, receiving two treatments on consecutive days, and Dmax predictive of painful fat necrosis. |

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| --- | --- | --- | --- | --- |
| [Abdomen](#_qguuewqzsx54) | [[**3 fractions**](#_8v4ceuj5tqti)] | [[**5 fractions**](#_8v4ceuj5tqti)] | **5 fxPancreas / UC Lung** |  |
| **Stomach** | **30 Gy** T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) / [IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)  22.2 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  22.5 Gy (10 cc) T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  16.5 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 35 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  33 - 35 Gy (0.5 cc)T, [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  32 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  18 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  26.5 Gy (5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **25 Gy** (**5 - 10 cc**) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  12 Gy (50 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | i40 Gy (0.5 cc) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  i35Gy (1 cc) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993)  i30 Gy (2 cc) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993)  33 Gy (1 cc) [Herman](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4368473/)  20 Gy (3 cc) [Herman](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4368473/)  15 Gy (9 cc) [Herman](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4368473/) | For 3 fraction SBRT, keep the point dose at 30 Gy. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03286-6/fulltext) |
| **Duodenum** | 30 Gy [IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)  **24 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  22.2 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)/ [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  16.5 Gy (5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  15 Gy (10 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  11.4 Gy (10 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | 35 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  35 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  **30 Gy** (0.5 cc) [1112](https://www.rtog.org/Portals/0/RTOG%20Broadcasts/Attachments/1112_master_w_update_5.7.13.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  32 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  **25 Gy** (**5 - 10 cc)**[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  18-18.3 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  12.5 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | i40 Gy (0.5 cc) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  i35 Gy (1 cc) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993)  i30 Gy (3 cc) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993)  33 Gy (1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [Herman](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4368473/)  20 Gy (3 cc) [Herman](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4368473/)  15 Gy (9 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [Herman](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4368473/) | For 3-5 fx SBRT, max point dose should be 30 Gy. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03286-6/fulltext)  [[IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)] (3 fraction): Limit maximum dose covering full circumference of bowel wall to 22.5 Gy . |
| **Small bowel** (jejunum/ileum) | 30 Gy [IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)  25.2 Gy (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  17.7 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)/ [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  12.5 Gy (30 cc)[IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111) | 35 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  **30 - 35 Gy** (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  19.5 Gy (5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  **25 Gy (5 - 10 cc**)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | i40 Gy (0.5 cc) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  i35 Gy (1 cc) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993)  i30 Gy (3 cc) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) | For 3-5 fx SBRT, the max point dose should be 30 Gy. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03286-6/fulltext)  [[IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)] (3 fraction): Limit maximum dose covering full circumference of bowel wall to 22.5 Gy. |
| Spleen |  | Mean 2 Gy |  |  |
| **Liver - GTV** | Mean < 13 - 15 Gy  **15 - 19.2 Gy** (**700 cc**)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)  19.2 Gy (700 cc\*) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  17.1 Gy (700 cc\*)T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  15 Gy (15%\*) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  \*Min volume spared | Mean < 13 - 17 Gy [1112](https://www.rtog.org/Portals/0/RTOG%20Broadcasts/Attachments/1112_master_w_update_5.7.13.pdf)  **21 Gy** (**700cc\***)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  10 Gy (70%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  5 Gy (60%) [Pursley IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/32353390)  Mean < 15.2 Gy [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  \*Min volume spared | 12 Gy (50%\*) [Herman](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4368473/) | 3 fraction MLD 15 Gy (healthy liver) with < 5% classical RILD. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03295-7/fulltext)  3 fraction MLD 13 Gy (cirrhosis) with < 5% classical RILD. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03295-7/fulltext)  Limit 700 cc to 15 Gy for < 5% chance of classical RILD for 3 or 5 fractions.[QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03295-7/fulltext) |
| **Bile duct**  Central hepatobiliary tract | **36 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  50 Gy (0.5cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  33.8 Gy (21 cc) [NoFlyZone](#kpry5msyhjzx)  32 Gy (24 cc) [NoFlyZone](#kpry5msyhjzx) | **41 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  50 Gy (0.5cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  40 Gy (21 cc) [NoFlyZone](#kpry5msyhjzx)  37.7 Gy (24 cc) [NoFlyZone](#kpry5msyhjzx) | **55 Gy** [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) | [[Central hepatobiliary tract](#kpry5msyhjzx)]= PV from splenic confluence to first bifurcation of L/R poral veins + 1.5 cm. Similar to the "no fly zone" in lung cancer, there is one in liver cancer [[Zaorsky](https://twitter.com/NicholasZaorsky/status/1213175389713051652)]. These values are associated with G3+ hepatobiliary toxicity.[NoFlyZone](#kpry5msyhjzx) |
| **Kidney**  (Renal Cortex) | 15 - 16 Gy (200 cc\*)T, [101](https://www.aapm.org/pubs/reports/rpt_101.pdf),[BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  \*Min volume spared | 17.5 - 18 Gy (200cc\*)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) 16 Gy (200 cc\*) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  Mean < 10 Gy [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  \*Min volume spared  Solitary kidney or one kidney > 10 Gy: 10 Gy (10 - 45%)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 12 Gy (75%) [Herman](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4368473/) | [[IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)] (3 fraction): ALARA. Minimise volume of high dose regions (> 50% IDL) within the kidney and outside the ITV. Contralateral kidney 10 Gy (33%). |
| **Renal hilum** | 19.5 Gy (15 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 23 Gy (67%) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  23 Gy (15 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |  |

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| --- | --- | --- | --- | --- |
| [Pelvis](#_qguuewqzsx54) | [[**3 fractions**](#_ab2rhzp2bs8x)] | [[**5 fractions**](#_ab2rhzp2bs8x)] |  |  |
| **Colon / Bowel** | 42 Gy (1.5 cc) [IROCK](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)  34.5 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **28.2 Gy** (0.5 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  24 Gy (20 cc) T, [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 38 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf), 40 Gy T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **32 Gy** (0.5 cc)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  28.5 Gy (20 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  **25 Gy** (**20 cc**)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf) | i35 Gy (1 cc)[PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) |  |
| **Rectum** | **49.5 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  45 Gy (3.5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  28.2 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)/ [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  28.2 Gy (0.5 cc)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  24 - 27.5 Gy (20 cc)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf),T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **55 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  50 Gy (3.5 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  38 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  **38.06 Gy** - 40 Gy [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  34.4 Gy - 36 Gy (3 cc) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  **32 Gy** (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  **25 - 32.5 Gy** (**20 cc**) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / T / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |  |
| **Bladder wall** | **33 Gy** T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  28.2 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf)  16.8 Gy (15 cc)[101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **38 Gy** T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  38.06 Gy- 40 Gy [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  20 Gy (15 cc) T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  18.12 Gy - 20 Gy (10%) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  18.3 Gy (15 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) |  |  |
| **Ureter / Urethra** | **40 Gy** T / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | **45 Gy** T / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  42 Gy (50%) [PACE / UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  38.78 Gy - 43.5 Gy [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702) |  |  |
| **Penile bulb** | 42 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  40 Gy T  21.9 - 25 Gy (3 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) , T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) | 50 Gy [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  30 Gy (3 cc) T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |  |
| **Femoral heads** | 24 Gy (10 cc)T, [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)  21.9 Gy (10 cc) [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 30 Gy (10 cc) T / [101](https://www.aapm.org/pubs/reports/rpt_101.pdf) / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) / [BR002](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf) |  |  |

# [Hypofractionation](#_bvprouf2ng3w)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| [CNS](#_bvprouf2ng3w) | [[**8 fractions**](#_z1n7n1n9ds6t)] | [[**10 fractions**](#_z1n7n1n9ds6t)] | [[**15 fractions**](#_z1n7n1n9ds6t)] |  |
| **Brain** |  |  |  |  |
| **Brainstem**  (not medulla) |  | 40.5 Gy  29.4 Gy (0.5 cc) |  |  |
| **Cord** (includes medulla) | 36.5 Gy [VUMC-0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  34 Gy (PTV + 3 mm) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  32 Gy (0.5 cc) [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  32 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  28 Gy [VUMC](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  25 Gy (0.1 cc)  27 Gy (0.25 cc)[0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  15.5 Gy (0.5 cc)[0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub) | 40 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  35 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  34 Gy [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411)  34 Gy (PTV + 3 mm) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  32 Gy (0.1 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X), [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  29.4 Gy (0.35 cc)  17.9 Gy (1.2 cc) | 39.5 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  42 Gy (PTV + 3 mm) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  30 Gy [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) |  |
| **OC/ON** |  | 32.2 Gy  29.4 (0.2 cc) |  |  |
| **Cochlea** |  | 32.2 Gy |  |  |
| Pituitary |  |  |  |  |
| Hippocampus |  |  |  |  |
| **Lens** |  |  | 4 Gy [Perry](https://www.ncbi.nlm.nih.gov/pubmed/28296618) |  |
| **Orbit** |  |  |  |  |
| Retina |  |  |  |  |
| **Brachial Plexus** | 38 Gy (0.5 cc) [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  41.36 Gy (0.5 cc) [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  39 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  27-38 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 55 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  50 Gy (0.2 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  39 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  34.9 Gy (3 cc) | 50 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332) |  |
| **Cauda Equina** |  | 41.9 Gy  39.1 Gy (5 cc) |  |  |
| **Sacral Plexus** |  | 41.9 Gy  39.1 Gy (5 cc) |  |  |
| [H&N](#_7wdnwdj7hwus) | [[**8 fractions**](#_b6c4y9fe6v3v)] | [[**10 fractions**](#_b6c4y9fe6v3v)] | [[**15 fractions**](#_b6c4y9fe6v3v)] |  |
| **Cartilage** |  |  |  | Chondritis is rare if fraction size < 3 Gy |
| **Skin** |  | 82 Gy [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  52.3 Gy  50 Gy (60 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  48.1 Gy (10 cc)  40 Gy (120 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  30 Gy (250 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807) |  |  |

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| --- | --- | --- | --- | --- |
| [Thorax](#_7wdnwdj7hwus) | [[**8 fractions**](#_32fci3qg0zf)] | [[**10 fractions**](#_32fci3qg0zf)] | [[**15 fractions**](#_32fci3qg0zf)] |  |
| **Heart / pericardium** | **Not applicable** [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  64 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  63 Gy [VUMC-0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  50-60 Gy (0.5 cc)[UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  60 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  44 Gy [VUMC](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  38.4 Gy (15 cc) [0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub) | 64 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  60 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  60 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  45 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  41.9 Gy (15 cc) | 66 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  62 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  55 Gy [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993)  50 Gy (1 cc) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993)  40 Gy (10%) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) |  |
| **Great vessels**  and hilar vessels | **Not applicable** [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  No hot spot [VUMC](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  63 Gy[VUMC-0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  56.8 Gy (10 cc)[0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub) | 75 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  64 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  60 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  50 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  63.5 Gy (100 cc) | 64 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  60 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332) |  |
| **Trachea** | 64 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  63 Gy[VUMC-0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  60 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  44 - 46.68 Gy [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036), [VUMC](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  32 - 44 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  20.8 Gy (4 cc)[0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub) | 64 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  60 Gy [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  60 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  20.6 Gy (4 cc) | 66 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  62 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332) |  |
| **Bronchial tree** |  | 60 Gy [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  50 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  26.7 Gy (0.5 cc) |  |  |
| **Esophagus** | 63 Gy[VUMC-0813 extrapolation](https://www.sciencedirect.com/science/article/pii/S0167814015005101?via%3Dihub)  45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 - 43.52 Gy [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  40 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  40 Gy (5 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  32.8 Gy (5 cc) [0813 extrapolation](http://v) | 50 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (1 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  40 Gy (5 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  24.6 Gy (5 cc) | 50.5 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  48 Gy (5 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  50 Gy (4 cc) [Kong IJROBP '20](https://doi.org/10.1016/j.ijrobp.2020.03.038) |  |
| **Lung** | Mean < 12 Gy  20 Gy (10%) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | Mean < 9 Gy [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  Mean < 12 Gy  40 Gy (7%) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  15.2 Gy (1500 cc\*)  16.5 Gy (1000 cc\*)  \*Min tissue below threshold. | Mean < 12 Gy [Kong IJROBP '20](https://doi.org/10.1016/j.ijrobp.2020.03.038)  Mean < 14 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  5 Gy (40-50%) [Kong IJROBP '20](https://doi.org/10.1016/j.ijrobp.2020.03.038) |  |
| **Rib** |  | 57.6 Gy  46 Gy (1 cc) |  |  |
| **Chest Wall** | **Not applicable** [LungTECH](https://www.birpublications.org/doi/10.1259/bjr.20150036)  39 Gy (0.5 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  35 Gy (30 cc) [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X) | 82 Gy [08-13](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067), [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  50 Gy (60 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  46 Gy (1 cc)  40 Gy (120 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807)  30 Gy (250 cc) [MDACC](https://www.ncbi.nlm.nih.gov/pubmed/25514807) |  |  |

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| --- | --- | --- | --- | --- |
| [Abdomen](#_7wdnwdj7hwus) | [[**8 fractions**](#_8v4ceuj5tqti)] | [[**10 fractions**](#_8v4ceuj5tqti)] | [[**15 fractions**](#_8v4ceuj5tqti)] |  |
| **Stomach** | 45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332) | 41.9 Gy  45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  37 Gy (1 cc) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411)  22.6 Gy (10 cc) | 50 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  48 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  45 Gy [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) |  |
| **Duodenum** | 45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332) | 41.9 Gy  45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  37 Gy (1 cc) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411)  22.6 Gy (5 cc)  15.2 Gy (10 cc) | 50 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  48 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  45 Gy [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) |  |
| **Small bowel** (jejunum/ileum) | 45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332) | 46 Gy  45 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  40 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  37 Gy (1 cc) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411)  24.6 Gy (5 cc) | 50 Gy [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  48 Gy (10 cc) [SUNSET](https://www.ncbi.nlm.nih.gov/pubmed/29759332)  45 Gy [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) |  |
| **Spleen** |  |  | Mean 6 Gy [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) |  |
| **Liver - GTV** |  | 26.7 Gy (700 cc)  27 Gy (30%) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411)  24 Gy (50%) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411) | 24 Gy (700 cc) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993)  Mean 24 Gy [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993)  5 Gy (60%) [Pursley IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/32353390) |  |
| **Bile duct** |  |  | 70 Gy[PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) |  |
| **Renal Cortex** |  | 21.9 Gy (200 cc)  10 Gy (10%) [04-38](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7411) | 20 Gy (33%) [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) |  |
| **Renal hilum** |  |  |  |  |
| [Pelvis](#_7wdnwdj7hwus) | [[**8 fractions**](#_ab2rhzp2bs8x)] | [[**10 fractions**](#_ab2rhzp2bs8x)] | [[**15 fractions**](#_ab2rhzp2bs8x)] |  |
| **Colon / Bowel** |  | 50.2 Gy  32.2 Gy (20 cc) | 50 Gy [PRO 2020](https://www.ncbi.nlm.nih.gov/pubmed/32061993) |  |
| **Rectum** |  | 50.2 Gy  32.2 Gy (20 cc) |  |  |
| **Bladder wall** |  | 50.2 Gy  23 Gy (15 cc) |  |  |
| **Ureter / Urethra** |  |  |  |  |
| **Penile bulb** |  | 67 Gy  39.1 Gy (3 cc) |  |  |
| **Femoral heads** |  | 39.1 Gy (10 cc) |  |  |

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# [Site Specific](#_bvprouf2ng3w)

## [CNS](#_yrs27vvto6ww)

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  **Gliomas (HGG & LGG)**  Zaorsky: [[MRI characteristics of brain lesions](https://twitter.com/NicholasZaorsky/status/1211367193654562816)], [[Pseudoprogression vs. radiation necrosis](https://twitter.com/NicholasZaorsky/status/1211368296693538818)], [[RANO criteria for GBM recurrence](https://twitter.com/NicholasZaorsky/status/1211369359047827456)].  ARRO: [[GBM-PNET](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROCase_GBMPNET.pdf)], [[GBM](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROcase_GBM.pdf)], [[Glioblastoma Multiforme (GBM) Case](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/ARROCASEGMB(1).pdf), [Contour](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/ARROContourGBM.pdf)], [[Low Grade Glioma (LGG)](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/ARROCase-Low-Grade-Glioma.pdf)].  eContour: [[GBM](http://econtour.org/cases/116)], [[AVARO GBM](http://econtour.org/cases/79)], [[Intact brain mets](http://econtour.org/cases/100)], [[LGG](http://econtour.org/cases/101)], [[Meningioma](http://econtour.org/cases/102)], [[Recurrent pituitary adenoma](http://econtour.org/cases/93)], [[Vestibular schwannoma](http://econtour.org/cases/92)].  Contouring   * [ESTRO-ACROP Guidelines [Niyazi RTO '16]](https://www.sciencedirect.com/science/article/pii/S0167814015006611?via%3Dihub): Cover at least 2 cm on T1c. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.ab4u4krn8j02) * OARs in the brain and their dose-constraints in adults and children [[Scoccianti RTO '15](https://www.ncbi.nlm.nih.gov/pubmed/25701297)] * NRG brain tumor specialists consensus guidelines for GBM contouring [[Kruser JNO '19](https://link.springer.com/article/10.1007/s11060-019-03152-9)]   Summary Articles   * Early vs. Delayed PORT for treatment of low grade gliomas [[Dhawan Cochrane Rev '20](https://www.ncbi.nlm.nih.gov/pubmed/31958162)] [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=kix.trgp32pu40hr) * Pseudoprogression review article [[Brandsma Lancet '08]](https://www.sciencedirect.com/science/article/pii/S1470204508701256?via%3Dihub). [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.ii5e7lbfszey) * GBM Patterns of failure [[Minniti RTO '10]](https://www.sciencedirect.com/science/article/pii/S0167814010005256?via%3Dihub): EORTC (T1c + 2 cm) vs. RTOG (T2 + 2 cm to 46 Gy) created to compare. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.ii5e7lbfszey)   Society Guidelines   * [ASCO/ASTRO Guideline: RT for Glioblastoma](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/neurooncology#/14706) *November 28, 2016* * ESMO Clinical Practice Guideline: High-Grade Malignant Glioma [[Stupp Ann Onc '14](https://www.esmo.org/Guidelines/Neuro-Oncology/High-Grade-Malignant-Glioma)]   Relevant Accessible Radiation Protocols (GBM)   * RTOG 0825 (2009-2011) [[Protocol (Supplement) Gilbert NEJM '14]](https://www.nejm.org/doi/full/10.1056/NEJMoa1308573): Stupp ± bevacizumab q2w. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.9vdn6lam37jn)   + CTV1\_46 = T2/bed + 2 cm (or T1c + 2.5 cm if no edema). All margins may be reduced to 0.5 cm.   + CTV2\_60 = T1c/bed + 2 cm. All margins may be reduced to 0.5 cm.   + PTV = CTV + 0.3 - 0.5 cm. * RTOG 0525 (2006-2008) [[(Methods) Gilbert JCO '13](https://www.ncbi.nlm.nih.gov/pubmed/24101040)]: Stupp→ TMZ vs. ddTMZ. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.21vmldtn01k4)   + CTV\_RTOG: 46/23 to T1c/edema + 2 cm, 14/7 boost to T1c/cavity + 2.5 cm.   + CTV\_EORTC: 60/30 to T1c/cavity + 2-3 cm (no cone-down). * EORTC 26062-22061/NCIC CE.6 (2007-2013) [[Protocol (Supplement) Perry NEJM '17](https://www.ncbi.nlm.nih.gov/pubmed/28296618)]: 40.05/15 (2.67 Gy) ± TMZ. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.w1xynp9nvlyr)   + CTV = T1c/bed + 1.5 cm (no mention of edema). PTV = CTV + 0.5 cm. * Roa (2010 - 2013) [[Protocol (Supplement) IAEA JCO '15]](http://ascopubs.org/doi/full/10.1200/JCO.2015.62.6606): 40/15 vs. 25/5. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.i60yw7492o7f)   + CTV = T1c/bed + 2 cm (no mention of edema). PTV = CTV + 0.5 cm. * RTOG 1205 (2012-2016) [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13508), [Tsien ASTRO’19](https://www.eventscribe.com/2019/ASTRO/fsPopup.asp?Mode=presInfo&PresentationID=558957)]: Bev naive. Recurrent GBM Bev q2w ± 35/10. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.xzfivij513h6)   + CTV = T1c/bed + 0 mm, though 5 mm allowed for < 3.5 cm lesions or new lesions. * MDACC Evaluation of Peritumoral Edema in Delineation of CTV [[Chang IJROBP '07](https://www.sciencedirect.com/science/article/pii/S0360301606036492?via%3Dihub)]: SIB technique. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.ab4u4krn8j02)   + GTV\_60/30 to T1c, CTV\_50/30 to T1c + 2 cm.   Relevant Accessible Radiation Protocols (HGG)   * CATNON/EORTC 26053-22043 (2007-2015) [[Protocol](http://www.eortc.be/services/doc/protocols/26053-22054-version4.0.pdf)]: Four arms. RT ± TMZ→ ± TMZ. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.3b6onftqpo93)   + RT: 59.4/33. Allows cone-down after 55 Gy only if limited by OAR (e.g., OC/ON).   + CTV = T1c/bed/edema + 1.5 - 2 cm (allows 0.7-1 cm at tentorium/meninges). PTV = CTV + 0.5 - 0.7 cm. * RTOG 9402 (2002) [[Cairncross JCO '06](http://ascopubs.org.library1.unmc.edu:2048/doi/10.1200/JCO.2005.04.3414), [Protocol (Supplementary) JCO '13](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3732012/)]: Anaplastic oligo ± iPCV x4→ 59.4 Gy. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.yq5yz7h1ur5e)   + CTV1\_50.4 = T2 + 2 cm margin   + CTV2\_59.4 = T1c/bed + 1 cm. * EORTC 26951 (2002) [[van den Bent JCO '06](http://ascopubs.org.library1.unmc.edu:2048/doi/full/10.1200/JCO.2005.04.6078)]: 59.4 Gy→ ± PCV x6.[RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.x8qsad863sfc)   + RT: 45/25 T2 + 2.5 cm→ 14.4/8 to post-op enhancing tumor on CT (MRI if non-enhancing) + 1.5 cm.   Relevant Accessible Radiation Protocols (Low Grade)   * RTOG 9802 (2002) [[Buckner NEJM '16 - Protocol (Supplementary)](http://www.nejm.org/doi/full/10.1056/NEJMoa1500925)]: 54/30→ ± PCV x6. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.bjvsr43qisfb)   + RT: T2 + 2 cm to block edge (may be reduced to 1 cm around critical structures). * RTOG 0424 (2009) [[Fischer IJROBP '15 (Methods)](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4329190/)]: Phase II. Stupp to 54/30. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=kix.cqs7stc8mnab)   + RT: T2 + 2 cm. * EORTC 22033 (2010) [Protocol[]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5124485/): TMZ vs. 50.4/28. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.kpvuvbc86n2j)   + RT: CTV = T2 + 1-1.5 cm (0.5 cm at tentorium and meninges). PTV = CTV + 0.5 - 0.7 cm.   Quality of Life/Toxicity   * EORTC 26981/NCIC CE.3 (Stupp) HR-QoL [[Taphoorn Lanc Onc '05](https://www.ncbi.nlm.nih.gov/pubmed/16321761)[]](https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(09)70025-7/fulltext): GBM. 60 Gy ± TMZ→ 6m TMZ. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.rgyxm1mwwcjf) * French (Table 3) [[Keime-Guibert NEJM '07]](https://www.nejm.org/doi/10.1056/NEJMoa065901?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dwww.ncbi.nlm.nih.gov): Elderly GBM. Surgery→ supportive care vs. 50.4/28.[RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.7l36bvdg222a) * EF-14 Maintenance TTF HR-QoL [[Taphoorn JAMA Onc '18](https://www.ncbi.nlm.nih.gov/pubmed/29392280)[]](https://jamanetwork.com/journals/jama/fullarticle/2666504): Stupp→ TMZ ± TTF. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.gf4tca9degfx) * RTOG 9402 QoL [[Wang IJROBP '10](https://www.ncbi.nlm.nih.gov/pubmed/19783377)]: WHO III. ± iPCV x4→ 59.4/33. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.yq5yz7h1ur5e) * EORTC 22033 HR-QoL [[Reijneveld Lanc Onc '16](https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(16)30305-9/fulltext)[]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5124485/): WHO II. TMZ vs. 50.4/28. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.kpvuvbc86n2j)   **Miscellaneous Brain/Spine**  Zaorsky: [[General MRI characteristics of brain lesions](https://twitter.com/NicholasZaorsky/status/1211367193654562816)], [[Pseudoprogression vs. radiation necrosis](https://twitter.com/NicholasZaorsky/status/1211368296693538818)], [[SBRT for spinal mets: Defining the zones of treatment](https://twitter.com/NicholasZaorsky/status/1226200897027551235?s=20)], [[For HA-WBRT, use an inclined headboard at 30 degrees to minimize dose to orbits](https://twitter.com/NicholasZaorsky/status/1234224691612672002?s=20)], [[HA-Atlas and relevant landmarks](https://twitter.com/NicholasZaorsky/status/1211365353189781506)].  ARRO: [[Arteriovenous malformation (AVM)](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/AVM.pdf)], [[Spinal Cord Glioma](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROCase_spinalglioma.pdf)], [[Trigeminal Neuralgia](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/trigeminalneuralgia.pdf)], [[Vestibular Schwannoma](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROCase_GlioMulti.pdf)], [[uveal melanoma](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/UvealMelanoma.pdf)], [[Paraganglioma of skull base](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ParagangliomaSkullBase.pdf)]  Contouring   * Hippocampal sparing [[RTOG Contouring Atlases](https://www.nrgoncology.org/Portals/0/Scientific%20Program/CIRO/Atlases/RTOG_Contouring_Guidelines-Hippocampus_version2.ppt)] * Consensus Contouring Guidelines for Post Op Completely Resected SRS for Brain Metastases [[Soliman IJROBP '18](https://www.sciencedirect.com/science/article/pii/S0360301617339536?via%3Dihub)] [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.piysv0nm4em7) * International Spine Radiosurgery Consensus Guidelines for CTV definition in spinal SRS [[Cox IJROBP '12](https://www.sciencedirect.com/science/article/pii/S0360301612003677)] [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.6af30yccpo3p) * Consensus Contouring Guidelines for Postop SBRT for solid metastatic spinal tumors [[Redmond IJROBP '17](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5600487/)] [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.hd2zilsfszw0) * International consensus recommendations for target volume delineation specific to sacral mets [[Dunne RTO '19](https://www.ncbi.nlm.nih.gov/pubmed/31874346)] [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.mec5clghoife) * International Practice Patterns for Non-Spine Bone Mets [[Nguyen PRO '20](https://www.ncbi.nlm.nih.gov/pubmed/32171852)] [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.5e9eevis0v) * DEGRO working group on SRS: Treatment of Brain metastasis [[Kocher STO '14](https://www.ncbi.nlm.nih.gov/pubmed/24715242)]   Review Articles   * Current multidisciplinary management of brain metastases [[Moravan Cancer '20](https://www.ncbi.nlm.nih.gov/pubmed/31971613)]. [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.focksuac7esp) * Current approaches to the management of brain metastases [[Suh NRCO '20](https://www.ncbi.nlm.nih.gov/pubmed/32080373)] [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.focksuac7esp) * Molecular Subtypes and Breast Brain Metastases [[Darlix BJC ‘19](https://www.ncbi.nlm.nih.gov/pubmed/31719684)]: Retro. HER2(-)HR(+) / TP / TN / HER2(+)HR(-). [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.4w7gzgv86rp5) * Comparison of SRS modalities [[Vergalasova Fronteirs Oncology '19](https://www.frontiersin.org/articles/10.3389/fonc.2019.00483/full)] [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.15ubv1c929su) * SRS for management of Vestibular Schwannoma: A short review [[Buss Neurosurg Rev '20](https://www.ncbi.nlm.nih.gov/pubmed/32170501)] [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.r3u1wdp25mtu) * SRS for Pituitary Adenomas: Modern review of literature, Target Delineation, and optimal dose [[Minniti RTO '16](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5057503/)] [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.4ntswz64ymcw) * RT in the Management of Pituitary Adenomas [[Loeffler JCEM '11](https://academic.oup.com/jcem/article/96/7/1992/2833948)] [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.yyplo9ywrvwe) * Arteriovenous Malformations of the Brain [[Solomon NEJM '17](https://www.ncbi.nlm.nih.gov/pubmed/28489992)] [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.vktjx3razv69) * ISRS Guidelines: SRS for Spetzler Martin GI-II AVMs [[Graffeo NS '20](https://www.ncbi.nlm.nih.gov/pubmed/32065836)]. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.vktjx3razv69) * EANO Guidelines for the diagnosis and treatment of meningiomas [[Goldbrunner Lanc Onc '16](https://www.ncbi.nlm.nih.gov/pubmed/27599143)]. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.cx411pj1kje8) * Chasing your dural tail: Factors predicting local control after SRS for benign meningiomas [[Rogers IJROBP '04](https://www.redjournal.org/article/S0360-3016(05)00361-5/abstract)]. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.ih1uwjlffapo) * Patterns of failure after chemotherapy and involved field for localized germinoma [[Alapetite Neuro Onc '10](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3018943/)] [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.52geklyhbgjn)   Society Guidelines   * EANO Guidelines for the diagnosis and treatment of meningiomas [[Goldbrunner Lanc Onc '16](https://www.ncbi.nlm.nih.gov/pubmed/27599143)] [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.cx411pj1kje8) * ASCO/SNO Guideline: [Anticonvulsant Ppx and Steroid Use in Adults w Metastatic Brain Tumors](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/neurooncology#/35226) *March 18, 2019* [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#heading=h.2cssl05b68h2) * ASCO Guideline: [Recommendations on Dz Mgmt for Pts w Advanced HER2+ BrCa and Brain Mets](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/9791) *June 25, 2018* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.6qg3fgpjq7sz) * [The ABS consensus guidelines for plaque BT of uveal melanoma and retinoblastoma guidelines [ABS '14]](https://www.sciencedirect.com/science/article/pii/S1538472113003966?via%3Dihub). [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.4nhizqz5xdaw)   Relevant Accessible Radiation Protocols (Misc brain / Spine)   * RTOG 0539 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&Fil%20eID=4644)]: 54 Gy for G1 recurrent/G2 GTR and 60 Gy for G2 recurrent/G3 STR meningiomas. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.l0ycc2thlo1g) * EORTC 22042-26042 [[NCT00626730](https://clinicaltrials.gov/ct2/show/NCT00626730), [Supplement (Protocol) Weber Rad Onc '18](https://www.sciencedirect.com/science/article/pii/S0167814018333334)]: Phase II. Meningiomas. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.l0ycc2thlo1g) * IMRT for primary optic nerve sheath meningiomas (Table 2) [[Eckert Rad Onc '19](https://ro-journal.biomedcentral.com/articles/10.1186/s13014-019-1438-2)]: Retro. 51-54/30 SIB.[RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.4aygma7wqza) * NRG CC001 [[Protocol Brown JCO '20](https://ascopubs.org/doi/abs/10.1200/JCO.19.02767)]: 6 mo Memantine + 30/10 WBRT ± HA. [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.fnhdj8o51q84) * RTOG 0631 SRS procedure [[Ryu PRO '14](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3711083/)]: Phase II/III. Spinal mets for pain control. 8/1 vs. 16/18 SRS. V16 > 80-90%. [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.pe268mbiryre)   Quality of Life/Toxicity   * Shields / Shields Nomograms for Uveal Melanoma Clinical and Treatment Outcomes [[www.fighteyecancer.com/nomograms](http://www.fighteyecancer.com/nomograms)] * Acoustic Neuroma SRS QoL [[Breivik NS '13](https://academic.oup.com/neurosurgery/article-abstract/73/1/48/2417749?redirectedFrom=fulltext)]: Prospective. Obs vs. 12 Gy SRS. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.za4fr7tpirtq) * Hormone deficiency (Table 1) [[Darzy Nature Rev Endo '09]](https://www.nature.com/articles/ncpendmet1051): Pituitary RT to 30-50 Gy. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.36jb6dvhxdoi) * Risk of necrosis is related to V12 [[Flickinger IJROBP '00]](https://www.sciencedirect.com/science/article/pii/S0360301699005131): Median 20 Gy to 3.5cc AVMs. [RoR](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.5mnur6ssy5pf) |

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* Brainstem: SRS 12.5 Gy Dmax with < 5% permanent cranial neuropathy or necrosis.
* Brain: SRS V12 < 5-10 cc with < 20% symptomatic necrosis.
* Optic nerve SRS: Very low < 8 Gy, 12 Gy < 10%, >10% for 12-15 Gy [[Mayo IJROBP '10](https://www.sciencedirect.com/science/article/pii/S0360301609032842?via%3Dihub), [Pollock NS '14]](https://academic.oup.com/neurosurgery/article-abstract/75/4/456/2447765?redirectedFrom=fulltext).
* Rates increase greatly for SRS doses above 12 Gy. Delivery of up to 12 Gy for single fraction SRS appears to be safe.
* Optic neuropathy rates for 55 / 60 / 60+ Gy of 3→ 7→ 7-20%.
* 5y spinal cord myelopathy for 50 / 54 / 60 / 69 Gy of 0.2→ 1→ 6→ 50% [[Kirkpatrick IJROBP '10](https://www.sciencedirect.com/science/article/pii/S0360301609032969?via%3Dihub)].
* Generally speaking, whether optic nerve/chiasm or spinal cord, there is a ≤ 6% chance of long term toxicity with 60 Gy. Rates increase briskly with doses above this level.
* However, the optic nerve differs in that 55 Gy has < 3% rate of significant side effects, while 54 Gy to the cord has < 1% chance of side effects.
* Lenses V7 ≤ 0.03 cc
* Retinae V50 ≤ 0.03 cc
* Optic nerve V55 ≤ 0.03 cc
* Optic chiasm V56 ≤ 0.03 cc
* Brainstem V60 ≤ 0.03 cc
* RTOG 0539 (Meningioma)

OAR Group II Group III

Lenses 5 Gy 7 Gy

Retinae 45 Gy 50 Gy

Optic nerves 50 Gy 55 Gy

Optic chiasm 54 Gy 56 Gy

Brainstem 55 Gy 60 Gy

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## [Head and Neck](#_yrs27vvto6ww)

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  Zaorsky: [[Counting teeth made easy](https://twitter.com/nicholaszaorsky/status/1211453658950488066?s=21)], [[Otalgia](https://twitter.com/NicholasZaorsky/status/1211452057573613569)], [[Neuroforamen on axial CT scans](https://twitter.com/NicholasZaorsky/status/1211362859621502976)], [[Nasopharyngeal cancer staging](https://twitter.com/NicholasZaorsky/status/1211454984518295558)], [[Types of laryngeal surgeries](https://twitter.com/NicholasZaorsky/status/1211456862958358528)], [[Types of neck dissections](https://twitter.com/NicholasZaorsky/status/1211383604523257858)], [[Anatomy of lateral view on cranial x-ray](https://twitter.com/NicholasZaorsky/status/1211377339113840647)].  ARRO: [[Early stage glottic larynx](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROCaseEarlyStageGlottic.pdf)], [[Esthesioneuroblastoma](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROCase_Esthesioneuroblastoma.pdf)], [[Nasopharynx](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/Nasopharynx.pdf)], [[Parotid Adenoid Cystic with PNI](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROCase_HN_PerineuralInvasion.pdf)], [[Merkel cell of extremity](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROCase_MerkelCell.pdf)], [[Cancer of unknown primary](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/OccultPrimaryofHN.pdf)], [[oligometastatic HPV+ OP](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROcase_Oligomet_HN.pdf)], [[OP case](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/BOTCase.pdf%5C), [OP contour](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/BOTContour.pdf), [OP HPV+ de-escalation](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROCase_HPV_OPX.pdf)], [[Palliative advanced non-melanoma skin cancer](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/PalliativeRONonmelanoma.pdf)], [[Paranasal sinus cancer](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/SNUC.pdf)], [[Salivary gland tumors](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROCase_SalivaryGlandTumors.pdf)], [[Supraglottic larynx (post-tracheostomy) case](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/SupraglotticLarynx.pdf), [contour](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/ARROContourSupraglottic.pdf)].  Contouring   * eContour: [[OARs](http://econtour.org/cases/72), [Choi Rad Onc '14](https://www.ncbi.nlm.nih.gov/pubmed/25499048), [Brouwer RTO '15](https://www.sciencedirect.com/science/article/pii/S0167814015004016?via%3Dihub)], [[Maxillary sinus](http://econtour.org/cases/37)], [[Nasopharynx](http://econtour.org/cases/2)], [[Hard palate / Adenoid cystic (V2)](http://econtour.org/cases/19)], [[Parotid (VII)](http://econtour.org/cases/30)], [[Buccal mucosa](http://econtour.org/cases/28)], [[Oral cavity](http://econtour.org/cases/3)], [[Oropharynx (ipsilateral neck)](http://econtour.org/cases/31)], [[Base of tongue](http://econtour.org/cases/1)], [[Supraglottic larynx](http://econtour.org/cases/18)], [[Early stage glottic larynx](http://econtour.org/cases/5)], [[Subglottic larynx](http://econtour.org/cases/27)], [[Pyriform sinus](http://econtour.org/cases/24)], [[Thyroid](http://econtour.org/cases/21)], [[Cancer of unknown primary](http://econtour.org/cases/6)]. * AVARO: [[AVARO Neck node levels and Brachial plexus](http://econtour.org/cases/81)], [[AVARO constrictors and OARs](http://econtour.org/cases/83)], [[AVARO Skull Base](http://econtour.org/cases/82)] * Head and Neck: Cranial Nerves IX-XII [[RTOG Contouring Atlases](https://www.rtog.org/CoreLab/ContouringAtlases.aspx)] * Delineation of neck node levels for head and neck tumors [[Grégoire RTO '13](https://www.sciencedirect.com/science/article/pii/S0167814013005148?via%3Dihub), [RTOG Contouring Atlases](https://www.rtog.org/CoreLab/ContouringAtlases.aspx), [Radiopaedia Interactive atlas](https://radiopaedia.org/cases/lymph-node-levels-of-the-head-and-neck-annotated-ct?lang=us)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.rzy8rvsdopq0) * Delineation of CTVp in H&N cancer [[Grégoire Rad Onc '18](https://www.sciencedirect.com/science/article/pii/S0167814017326567)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=kix.kqkdc6ce2kxe) * Delineation of CTVp and CTVn in the primary RT of OC, OP, hypopharyngeal and laryngeal [[Grégoire Oral Onc '18](https://www.ncbi.nlm.nih.gov/pubmed/30527228)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.jotgn0jfcaxd) * Selection of lymph node target volumes of neck node levels for definitive H&N RT [[Biau RTO '19](https://www.sciencedirect.com/science/article/pii/S0167814019300234)]. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.rzy8rvsdopq0) * Practical clinical guidelines for contouring the trigeminal nerve (V) and its branches [[Atlas (Supplement) Biau RTO '19](https://www.thegreenjournal.com/article/S0167-8140(18)33458-3/abstract)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.q4gl8dq6tbz5) * PNI in Head and Neck Cancer [[Bakst IJROBP '19](https://www.sciencedirect.com/science/article/pii/S0360301618341750)]: How to chase nerves, recommended doses. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.q4gl8dq6tbz5) * Standardized Method for Contouring Brachial Plexus [[Hall IJROBP '08]](https://www.sciencedirect.com/science/article/pii/S0360301608004161?via%3Dihub). * Delineating brachial plexus, cochlea, pharyngeal constrictors, and optic chiasm in H&N RT [[Genovesi Radiol Med '15](https://www.ncbi.nlm.nih.gov/pubmed/25091709)] * Guidelines for delineation of OARs for NPX Cancer (Scrollable atlas in Supplementary) [[Sun RTO '14](https://www.ncbi.nlm.nih.gov/pubmed/24721546)]. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.jzpa1pl26apt) * International guidelines for delineation of CTV for NPX Cancer [[A Lee RTO '18](https://www.sciencedirect.com/science/article/pii/S0167814017326865?via%3Dihub)]. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.jzpa1pl26apt) * International guidelines for Dose Prioritization and Acceptance Criteria in NPX RT Planning [[A Lee IJROBP '19](https://www.redjournal.org/article/S0360-3016(19)33428-5/pdf)]. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.jzpa1pl26apt) * Target delineation for postoperative treatment of H&N cancer [[Evans and Beasley Oral Onc '18](https://www.ncbi.nlm.nih.gov/pubmed/30409314)]. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.3idlkksib7f2) * IMRT for H&N Cancer: Emphasis on selection and delineation of targets [[Eisbruch SRO '02]](https://www.sciencedirect.com/science/article/pii/S1053429602800649?via%3Dihub). * IMRT contouring for glottic cancer [[Berwouts H&N '16](https://onlinelibrary.wiley.com/doi/full/10.1002/hed.23967)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.yte8cgcrznq) * CT based contouring of H&N OARs (DAHANCA, EORTC, GORTEC, NCIC, NRG, TROG) [[Brouwer RTO '15,](https://www.sciencedirect.com/science/article/pii/S0167814015004016?via%3Dihub) [eContour Atlas](http://econtour.org/cases/72)[]](https://www.sciencedirect.com/science/article/pii/S0167814015004016?via%3Dihub). * Development of a standardized method for contouring the larynx and its substructures [[Choi Rad Onc '14](https://www.ncbi.nlm.nih.gov/pubmed/25499048), [eContour Atlas](http://econtour.org/cases/72)] * Functional swallowing units as OARs for RT [[Gawryszuk RTO '19](https://www.ncbi.nlm.nih.gov/pubmed/30551889)]. * Delineation of OARs involved in swallowing for RT treatment planning [[Christianen RTO '11](https://www.ncbi.nlm.nih.gov/pubmed/21664711)] * Delineation for OARs involved in radiation induced salivary dysfunction and xerostomia [[van de Water RTO '09](https://www.ncbi.nlm.nih.gov/pubmed/19853316)]. * Contouring guidelines with an MR-based atlas KB of brainstem structures involved in RINV [[Beddok RTO '19](https://www.ncbi.nlm.nih.gov/pubmed/30172454)]. * Contouring the middle and inner ear on RT planning scans [[Pacholke AJCO '05](https://www.ncbi.nlm.nih.gov/pubmed/15803007)] * Clinical practice guidance for RT planning after induction chemo in H&N cancer [[Salama IJROBP '09](https://www.ncbi.nlm.nih.gov/pubmed/19362781)] * GEORCC target volumes for H&N cancer of unknown primary [[Cabrera Rodriguez CROH '18](https://www.ncbi.nlm.nih.gov/pubmed/30196912)] * Standardization of target volume delineation in carotid-sparing IMRT for early glottic cancer [[Gujral Clin Onc '17](https://www.ncbi.nlm.nih.gov/pubmed/27815039)] * Guideline for dose specification and target delineation for post op RT for OC cancer [[Liu H&N '15](https://www.ncbi.nlm.nih.gov/pubmed/24634078)] * Consensus guideline for H&N cancers with PNI [[Ko PRO '14](https://www.ncbi.nlm.nih.gov/pubmed/25407876)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=kix.dfi3g7fv2yl8)   Review Articles   * T4 Laryngeal Cancer with Good Function: Should we be Reluctant to Treat Without Surgery? [[Beitler IJROBP '18](https://www.redjournal.org/article/S0360-3016(18)30531-5/fulltext)]. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.9vi261r1ok6d) * Incidence and Mortality Risk Spectrum across aggressive variants of Papillary Thyroid Cancer [QS](http://www.quadshotnews.com/2020/03/pappy.html) [[Ho JAMA Onc '20](https://jamanetwork.com/journals/jamaoncology/fullarticle/2761983)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.o2tfl8pl8yjb) * Head and Neck Cancer [[Chow NEJM '19](https://www.ncbi.nlm.nih.gov/pubmed/31893516)]: Excellent Review Article with Interactive Graphic for Treatment Options. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.yc56opxk661h) * Characteristics and Management of Cancer of Unknown Primary [[Galloway JCO '15](http://ascopubs.org/doi/abs/10.1200/jco.2015.61.0063)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.wcda29odiys8) * 2b or not 2b? [[Dziegielewski Cancer '19](https://www.ncbi.nlm.nih.gov/pubmed/31873950)]: Selective Neck Dissection ± Level 2b dissection on dominant-hand side. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.m4be3b3op7yd) * Association of CCRT Regimens with OS in pts with NPC [QS](http://www.quadshotnews.com/2019/10/tsa-postcheck.html) [[Zhang JAMA ‘19](https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2753250)]: Meta. CCRT→ CTX vs. CTX→ CCRT [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.7thk137pajfm) * Assessment of the Rate of Skip Mets to Neck Nodal Level IV in cN0 OC SqCC [QS](http://www.quadshotnews.com/2019/05/level-snore.html) [[Warshavsky JAMA H&N '19](https://jamanetwork.com/journals/jamaotolaryngology/article-abstract/2733034)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.uaoykhjhhnc2) * UK Evaluation of LRR Patterns in PORT for OC SqCC [[Waldram Clin Onc '19](https://www.ncbi.nlm.nih.gov/pubmed/31668378)]: Retro. Surgery and PO-IMRT ± concurrent chemo. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#heading=h.d6be4rtf20e3)   Society Guidelines   * ASTRO 2017 Evidence-Based Practice Guidelines for Oropharynx [[Quon JCO '17](http://ascopubs.org/doi/full/10.1200/JCO.2017.73.8633)] * ASCO Guideline: [Management of the Neck in SqCC of the Oral Cavity and Oropharynx](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/head-and-neck-cancer#/34961) *February 27, 2019* * ASCO Guideline: Diagnosis and Management of SqCC CUP in the H&N [[Maghami JCO '20](https://www.ncbi.nlm.nih.gov/pubmed/32324430)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.477l53rleeod) * ASCO Guideline: [Role of Treatment Deintensification in the management of p16+ OP cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/head-and-neck-cancer#/35966) *April 25, 2019.* * ESMO H&N guidelines [[Nasopharyngeal and SqCC of the H&N](https://www.esmo.org/guidelines/head-and-neck-cancers)] * Dental management of the head and neck cancer patient treated with radiation therapy [[Murdoch-Kinch JMDA '11](https://www.ncbi.nlm.nih.gov/pubmed/21888251)]   Relevant Accessible Radiation Protocols   * RTOG 1008 [[Protocol](http://rpc.mdanderson.org/rpc/credentialing/files/1008.pdf), [NCT01220583](https://clinicaltrials.gov/ct2/show/NCT01220583)]: Phase II/III. PORT 60-66/30 ± CDDP 40 in salivary gland tumors. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.8nu4hbjj05mo) * RTOG 1016 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=open%20File&FileID=8629)]: Non-inferiority. HPV+ OPC. DAHANCA-style 70 Gy/6w + Cetuximab vs. CDDP. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8) * ORATOR [QS](http://www.quadshotnews.com/2019/08/because-tors.html)[[Protocol (Appendix)](https://www.sciencedirect.com/science/article/pii/S1470204519304103?via%3Dihub)]: Phase II. HPV+ OP. TORS/LND ± PO(C)RT vs. Definitive (CC)RT. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=kix.6jzqx268nabc) * RTOG 9512 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=9512)]: 70/35 vs. 79.2/66 (1.2 BID); 7 vs. 6.5 weeks. Hyper vs conventional fractionation T2 larynx. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.x1e7eiei4xls) * Early Glottic Field Borders (Figure 1) [[Mendenhall IJROBP '88](https://www.ncbi.nlm.nih.gov/pubmed/3143690)] * RTOG 0615 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=12509)]: NPX. 3D or IMRT 54-59.4-70/33 + CDDP 100 q3w x3c. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.d3b3b2dl7zu) * Chinese Induction Chemo [[Protocol (Appendix)](https://www.nejm.org/doi/full/10.1056/NEJMoa1905287)]: ± GemCis q3w x3c→ CCRT with CDDP 100 q3w for NPX. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.358wunsjjhdd) * CRUK/14/014 [[Protocol](https://pubmed.ncbi.nlm.nih.gov/27716125/), [Nutting ASCO '20](https://meetinglibrary.asco.org/record/186722/abstract)]: Phase III. IMRT ± Dysphagia optimization (Do-IMRT). [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.nnkyleqzj5pb)   Quality of Life/Toxicity  Long term aspects of QoL in H&N cancer patients treated with IMRT [[Abel ARO '20](https://www.ncbi.nlm.nih.gov/pubmed/32051896)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.ak3s3ce5sict)  Delayed lower cranial neuropathy after oropharyngeal IMRT [[Hutcheson H&N '17](https://onlinelibrary.wiley.com/doi/abs/10.1002/hed.24789)]: Definitive RT 66-72 Gy. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.fmdi2j4qkm8w)  Chinese Induction Chemo (Table 3) [[Zhang NEJM '19](https://www.nejm.org/doi/full/10.1056/NEJMoa1905287)]: ± GemCis q3w x3c→ CCRT with CDDP 100 q3w. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.358wunsjjhdd)  RTOG 1016 [[(Table 2 and supplementary)](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(18)32779-X/fulltext)]: HPV+ OPC. DAHANCA-style 70 Gy/6w + Cetuximab vs. CDDP. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.vglx194p7sw8)  RTOG 9111 (Table 2) [[Forastierre NEJM '03](https://www.nejm.org/doi/10.1056/NEJMoa031317?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dwww.ncbi.nlm.nih.gov)]: Advanced Larynx. RT alone vs. CDDP/5FU x3→ RT vs. CCRT. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.f7mvtrc9v11d)  Factors associated with Severe Late Toxicity after CCRT [[Machtay JCO '08]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4911537/): Review of RTOG 91-11, 97-03, and 99-14. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.oalwx2995ok0)  Severe late dysphagia and cause of death in 91-11 eligible patients [[Ward Oral Onc '16](https://www.ncbi.nlm.nih.gov/pubmed/27208840)] [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.ysmexeavpuc1)  RTOG 9501 (Table 2) [[Cooper NEJM '04](http://www.nejm.org/doi/full/10.1056/NEJMoa032646)]: PORT vs. POCRT. [RoR](https://docs.google.com/document/d/1STZuiggtbkDIuuNMpDVSsqT2KMyp1017y8qV5Gz_GGc/edit#bookmark=id.ld367uc5hl20) |

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* **Osteoradionecrosis vs. soft tissue necrosis**:
  + Evaluation by an oral surgeon for ORN, consider HBO.
  + Addition of pentoxifylline ER (400 mg po tid) and Vit E (1000 u qd).
* **Consider statins to reduce neck fibrosis**, may have 30% reduction if on for a year [[Pravacur phase II Bourgier IJROBP '19](https://www.ncbi.nlm.nih.gov/pubmed/30776452)]
  + Better tolerated than the historical standard of pentoxifylline and Vit E [[Delanian JCO '03](http://ascopubs.org/doi/full/10.1200/JCO.2003.06.064)]
* **Consider probiotic pills to potentially decrease acute G3+ oral mucositis** from 45→ 16% [[Jiang Cancer '18](https://onlinelibrary.wiley.com/doi/full/10.1002/cncr.31907)]
* **Delayed lower cranial neuropathy after oropharyngeal IMRT** [[Hutcheson H&N '17](https://onlinelibrary.wiley.com/doi/abs/10.1002/hed.24789)]: **Definitive RT 66-72 Gy**.
  + Three of 59 OP pts (5%) developed hypoglossal palsy at a median time of 7y (4.6 - 7.6y).
    - RT was 66/30 (2.2 Gy) or up to 72/40 (1.8 Gy).
      * Suggestion to limit carotid space to 70 Gy and superior pharyngeal constrictor to 62 Gy.
    - Over half got induction chemo, remaining concurrent with CDDP alone.
    - Functional assessment: modified barium swallow, swallow-specific CN exam, and questionnaire at baseline, 6 mo, 12 mo and 24 mo after RT.
  + 6y incidence of hypoglossal neuropathy of 5%. 5y and 7y rates of 2.1 and 6.1%.
  + Swallowing related lower cranial nerve palsy (LCNP) preceded progressive dysphagia in all cases.
  + Published studies demonstrated median incidence of radiation-associated LCNP of 10% for NPC.
* **Video case reports on pharyngeal paresis and hypoglossal palsy** [[Hutcheson H&N '14](https://onlinelibrary.wiley.com/doi/abs/10.1002/hed.23840)]
  + Fibrosis and a widened vallecular recess noted.
  + Supraglottic airway closure is limited by fixation of the hyolaryngeal complex, leading to delayed aspiration of liquids from residual within the laryngeal vestibule and hypopharynx.
  + Minimal clearance of thicker bolus from oral and pharyngeal cavities due to bilateral pharyngeal paresis and hypoglossal palsy.
* **Beware of parotid gland atrophy on CT after radiation therapy to the neck** [[Saleem '14](https://posterng.netkey.at/esr/viewing/index.php?module=viewing_posteraction&task=downloadpdf&pi=121877)]: **Parotid RT 66-72 Gy**.
  + Perhaps try statins or pentoxifylline w Vitamin E if parotid gland atrophy is noted after high-dose RT to the parotid.
  + However, be sure not to give Vitamin E with RT. It's best to wait six months or so to be overly cautious.
  + Zero data here. Personal practice tidbit that likely won't harm the patient, but *might* help. The theory is that fibrosis and potential resultant de-oxygenation issues are leading to denervation.

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| **Clinical Pearl: Cranial nerve palsy (CNP) after irradiation**   * Upper CNP is more often tumor invasion, while lower CNP is typically a result of late RT injury. * CN neuropathy can occur at a median of 6y after RT. * See interesting case report above, which suggests late upper CNP from RT (upper CNP is not strictly tumor invasion). * Motor functions for swallowing: Irradiated side of neck/OP will have palatal elevation and tongue deviation ipsilaterally.   + CN IX: Pharyngeal shortening/constriction.   + CN X: Glottic closure, velar elevation, pharyngeal constriction.   + CN XII: Tongue mobility. * In the 70s, it was suggested that location of injury determines the number of nerves affected:   + Isolated XII nerve palsy is presumably related to submandibular gland damage.   + Isolated X nerve palsy is presumably related to carotid sheath damage.   + Any combination of X, XI and XII nerves reflects skull base pathology. * In the modern era, delayed cranial neuropathy is reported with dose escalation to the carotid sheath, parapharyngeal space, or treatment of large subdigastric lymph nodes or retropharyngeal nodes. * Lower CNP: Suggestion of 5% incidence. * Upper CNP: Suggestion of 10% incidence after treatment of NPX.   **Cavernous sinus**: **Chasing PNI**   * Cavernous sinus: For doses of 60 Gy, there is a < 6% chance of optic neuropathy occurring.  *With direct involvement, limit Meckel's cave / cisternal segment to 60 Gy for < 6% chance of CNP.*   *Without direct involvement, try to limit Meckel's cave / cisternal segment to 54 Gy for a < 3% chance of CNP.*   * For doses of 66-72 Gy, think of this as potentially doubling the 6% rate of occurrence of CNP. |

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| [Breast](#_yrs27vvto6ww) | **Conventional** | **Hypo** | **UK Fast Forward** [[Protocol](https://www.icr.ac.uk/our-research/centres-and-collaborations/centres-at-the-icr/clinical-trials-and-statistics-unit/clinical-trials/fast_forward_page)] |
| Peds | 5-10 Gy |  |  |
| Heart | **4 Gy** - 5 Gy mean [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366), [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  35 - 40 Gy  40 Gy (5%) [DBCG SKAGEN](https://www.dbcg.dk/PDF%20Filer/SKAGEN%20Trial%201_%20protokol.pdf)  20 Gy (10%)[DBCG SKAGEN](https://www.dbcg.dk/PDF%20Filer/SKAGEN%20Trial%201_%20protokol.pdf)  L sided: 25 Gy if RNI (5%) [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  L sided: **20 Gy** (5%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366), [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  L sided: 15 Gy if RNI (30%) [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  L sided: **10 Gy** (30 - 35%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366), [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  R sided: 25 Gy if RNI (0%) [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  R sided: 20 Gy (0%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366), [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  R sided: 15 Gy if RNI (10%)[NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  R sided: 10 Gy (10 - 15%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366), [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975) | **3.2 Gy** - 4 Gy mean [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366)  L sided: **16 Gy** - 20 Gy (5%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366)  L sided: **8 Gy** (30-35%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366)  R sided: 16 Gy - 20 Gy (0%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366)  R sided: 8 Gy (10-15%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366) | 7 Gy (5%) [FAST-Forward](https://www.icr.ac.uk/our-research/centres-and-collaborations/centres-at-the-icr/clinical-trials-and-statistics-unit/clinical-trials/fast_forward_page)  1.5 Gy (30%) [FAST-Forward](https://www.icr.ac.uk/our-research/centres-and-collaborations/centres-at-the-icr/clinical-trials-and-statistics-unit/clinical-trials/fast_forward_page) |
| LV and combined bilateral ventricles | 5 Gy (10%)  25 Gy (5%) |  |  |
| Ipsilateral lung | 20 Gy (up to 35% if RNI)[NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975), [DBCG SKAGEN](https://www.dbcg.dk/PDF%20Filer/SKAGEN%20Trial%201_%20protokol.pdf)  **20 Gy** (15-20%)[10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366), [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  10 Gy (up to 50% if RNI)[NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  **10 Gy** (35-40%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366), [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  5 Gy (up to 65% if RNI)[NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  **5 Gy** (50-55%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366), [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975) | **16 Gy** (15-20%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366)  **8 Gy** (35-40%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366)  **4 Gy** (50-55%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366) | **8 Gy** (15%) [FAST-Forward](https://www.icr.ac.uk/our-research/centres-and-collaborations/centres-at-the-icr/clinical-trials-and-statistics-unit/clinical-trials/fast_forward_page) |
| Contralateral lung | **5 Gy** (10-15%)[10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366) | **4 Gy** (10-15%) |  |
| Contralateral breast | **1.86 Gy** - 3.1 Gy (5%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366), [NSABP B-51](https://clinicaltrials.gov/ct2/show/NCT01872975)  3.1 - 4.96 Gy | **1.44 Gy** - 2.40 Gy (5%) [10-05](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366)  2.4 - 3.84 Gy |  |

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  Zaorsky: [[simplified mammography diagram](https://twitter.com/NicholasZaorsky/status/1211646810676064258)], [[mammography interpretations](https://twitter.com/NicholasZaorsky/status/1212008844198592513)], [[lymph node stations](https://twitter.com/NicholasZaorsky/status/1211701256412172288)], [[atlas](https://twitter.com/NicholasZaorsky/status/1211727554299809792)], [[nodal couch kick](https://twitter.com/NicholasZaorsky/status/1211702308649799681)] and [[field matching](https://twitter.com/NicholasZaorsky/status/1211705635424718848)].  ARRO: [[APBI case](https://www.astro.org/uploadedFiles/Affiliates/ARRO/Resident_Resources/Educational_Resources/Case_Vingettes/APBI.pdf), [contour](https://www.astro.org/uploadedFiles/Affiliates/ARRO/Resident_Resources/Educational_Resources/Case_Vingettes/APBI_Contour.pdf)], [[DCIS case](https://www.astro.org/uploadedFiles/DCIS.pdf), [contour](https://www.astro.org/uploadedFiles/DCISContour.pdf)], [[Inflammatory breast cancer](https://www.astro.org/uploadedFiles/Affiliates/ARRO/Resident_Resources/Educational_Resources/Case_Vingettes/InflammatoryBreast.pdf)], [[Radiation indications in the setting of NAC](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/NeoadjuvantchemoBreastCancer.pdf)].  Contouring   * Atlases: [[RTOG Breast Cancer Atlas](https://www.rtog.org/corelab/contouringatlases/breastcanceratlas.aspx), [ESTRO](https://www.ncbi.nlm.nih.gov/pubmed/26791404), [RADCOMP Breast Atlas](https://www.rtog.org/CoreLab/ContouringAtlases/RADCOMPBreastAtlas.aspx)] * There is discrepancy in the posterior border of the Chest wall CTV in PMRT [[Vargo and Beriwal IJROBP '15](https://www.sciencedirect.com/science/article/pii/S0360301615002643?via%3Dihub)] * eContour [[early breast cancer](https://econtour.org/cases/73)], [[regional nodal irradiation](https://econtour.org/cases/74)], [[AVARO RNI and Brachial Plexus](http://econtour.org/cases/80)], [[PMRT](https://econtour.org/cases/75)], [[heart avoidance]](http://econtour.org/cases/73). * eContour hypofractionation: [[MSKCC PBI](http://econtour.org/cases/108)], [[UK Fast Forward](http://www.econtour.org/cases/117)], [[Florence](http://econtour.org/cases/47)] and [[RT CHARM](http://econtour.org/cases/110)]. * ESTRO ACROP Consensus Guidelines for Post-implant Breast Contours [[Kaidar-Person RTO '19](https://www.sciencedirect.com/science/article/pii/S0167814019303627)]. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.rzv3trcpeyty) * Development and validation of a heart atlas to study cardiac exposure to RT (Figure 1) [[Feng IJROBP '11](https://www.ncbi.nlm.nih.gov/pubmed/20421148)]. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.rzv3trcpeyty)   Review Articles   * Bernard Fisher: 1918-2019 [[Wolmark JCO '20](https://www.ncbi.nlm.nih.gov/pubmed/32286901)] [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.lo7ae5d744xf) * An Overview of the NSABP Trials [[50 years of NSABP](https://www.ctsu.ox.ac.uk/research/the-early-breast-cancer-trialists-collaborative-group-ebctcg/previous-findings)]. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.tnkj36sl1zgt) * Previous Findings from EBCTCG [[Website](https://www.ctsu.ox.ac.uk/research/the-early-breast-cancer-trialists-collaborative-group-ebctcg/previous-findings)]. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.82m26dr3iu6o) * EBCTCG: Overview of the RCTs for RT in DCIS [[Correa JNCI '10]](https://academic.oup.com/jncimono/article/2010/41/162/891149) BCS ± RT. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=kix.cccr6qx2zy8w) * EBCTCG 20y risks of breast cancer recurrence after stopping endocrine therapy at 5y [QS](http://www.quadshotnews.com/2017/11/roy-moore-louis-ck-and-tamoxifen.html) [[Pan NEJM '17]](https://www.nejm.org/doi/10.1056/NEJMoa1701830?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dwww.ncbi.nlm.nih.gov) [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.82zqrt8uc9jh) * EBCTCG [[Lancet ‘15](https://www.ncbi.nlm.nih.gov/pubmed/26211827)]: Tamoxifen vs. AIs x5y in early breast cancer. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=kix.fwfjjv658917) * EBCTCG Tamoxifen data [[Lancet ‘11](https://www.ncbi.nlm.nih.gov/pubmed/21802721)]: 5y Tamoxifen. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=kix.3b8g17edtta1) * EBCTCG Bisphosphonates [[Lancet '15](https://www.ncbi.nlm.nih.gov/pubmed/26211824)]: ± Bisphosphonates x2-5y. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.2i6yu4c186on) * EBCTCG Chemoendocrine therapy [[Lancet ~~'05~~](https://www.sciencedirect.com/science/article/pii/S0140673605665440?via%3Dihub), ['12](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3273723/)]: Anthracyclines > non-anthracyclines. Add a taxane to it. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=kix.nz0bfwbyu5e2) * EBCTCG Chemotherapy dose intensification [[Lancet ‘19](https://www.ncbi.nlm.nih.gov/pubmed/30739743)] [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=kix.xz3icbgdbgje) * EBCTCG Meta [[McGale Lancet Onc '18](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5757427/)]: NAC vs. adjuvant chemo. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=kix.ve0k2ylu5cos) * Management of the cN0, pN+ Axilla in Breast Cancer in 2017 [[Morrow JAMA Onc '18](https://jamanetwork.com/journals/jamaoncology/fullarticle/2665748)] [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.ja7mbv9tjlmf)  Radiotherapy in the setting of breast reconstruction: types, techniques, and timing [[Ho Lancet Onc '17]](https://www.sciencedirect.com/science/article/pii/S1470204517306174?via%3Dihub) [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.qmtzz7lgjk35)  * Inflammatory Breast Cancer: The MDACC approach [[Stecklein PRO '19](https://www.sciencedirect.com/science/article/pii/S1879850019301420)]. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.omzse5sy3eew) * Simplified BRCA Testing Criteria [QS](http://www.quadshotnews.com/2019/05/family-history.html) [[Mainstream Cancer Genetics](https://www.mcgprogramme.com/mcg-criteria/)], Prospectively validated [[Kemp JAMA Onc '19](https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2734071)]. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.3aqx4kfnqf7b) * BRCA1 vs. 2 [[Chen JCO '07](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2267287/)]: BRCA1 vs. BRCA2. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.hk03sm1ttqie) * To-Be trial [QS](http://www.quadshotnews.com/2019/05/to-beor-not.html) [[Hofvind Lanc Onc '19](https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(19)30161-5/fulltext)]: Tomosynthesis vs. standard digital mammography. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.6sfrmho53inn) * DENSE trial [QS](http://www.quadshotnews.com/2019/12/i-can-see-clearly-now.html) [[Bakker NEJM '19](https://www.nejm.org/doi/full/10.1056/NEJMoa1903986)]: Screening MMA ± MRI. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.obqs2tflze8i) * DCIS: To Boost or Not to Boost? Extrapolation from invasive disease [[Moran JAMA Oncol '17]](https://jamanetwork.com/journals/jamaoncology/fullarticle/2613411):Retro. ± boost. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.h7h1guhmrp33) * RT without endocrine therapy for women age 70+ [[Ward IJROBP '19](https://www.sciencedirect.com/science/article/pii/S0360301619308491?via%3Dihub)]: Anastrozole x5y vs. 40/15 WBRT. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.81qc2yfdoqim) * PERSEPHONE [QS](http://www.quadshotnews.com/2019/06/persephone.html) [[Earl Lancet '19](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(19)30650-6/fulltext)], PHARE [QS](http://www.quadshotnews.com/2019/06/phare-was-very-similar-french-trial.html) [[Pivot Lancet '19](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(19)30653-1/fulltext)]: Non-inferiority. Adjuvant Trastuzumab 12 vs. 6 mo. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.adf18mug7ag7) * BrighTNess [QS](http://www.quadshotnews.com/2018/03/parp-while-you-can.html) [[Loibl Lanc Onc '18](https://www.sciencedirect.com/science/article/pii/S1470204518301116)]: 3 arm. TNBC. T→ AC vs. CarboT→ AC vs. CarboT + Veliparib (PARPi)→ AC. 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[RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.4w7gzgv86rp5) * Ho [[Rad Onc '18](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6154906/)]: VMAT IMRT for challenging cardiac anatomy, not recommended routinely [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.jhd55xejii4n)   Society Guidelines   * [ASTRO 2018 Whole Breast Guidelines [Smith PRO '18]](http://www.practicalradonc.org/article/S1879-8500(18)30051-1/fulltext) [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.r8iruj3496kg) * ASTRO APBI Guidelines Update [[Correa PRO ' 17](https://www.ncbi.nlm.nih.gov/pubmed/27866865)] [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.54abrrjq00bl) * ASTRO/ASCO/SSO Guidelines for PMRT [[Recht JCO '16]](https://www.sciencedirect.com/science/article/pii/S187985001630159X) [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.h3zdqlymf9yk) * ASTRO-SSO Margin Consensus for stage I-II invasive breast cancer [[Moran IJROBP '14]](https://www.ncbi.nlm.nih.gov/pubmed/?term=24521674) [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.w6phwca7f39u) * ASCO Guideline: SLNB [for Patients With Early-Stage Breast Cancer Update](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/9801) *December 12, 2016* * American Society of Breast Surgeons [[Official Statements](https://www.breastsurgeons.org/resources/statements)]. * USPSTF Guideline: Risk Assessment, Genetic Counseling, and Genetic Testing for BRCA-related cancer [[JAMA '19](https://jamanetwork.com/journals/jama/fullarticle/2748515)] [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.3aqx4kfnqf7b) * ASCO/ASTRO/SSO Guideline: Management of Hereditary Breast Cancer [[Tung JCO '20](https://www.ncbi.nlm.nih.gov/pubmed/32243226)] [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.3aqx4kfnqf7b) * [ASCO Guideline: Management of Male Breast Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/142881) *Last update: 2/14/2020.* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=kix.xy7oows32oj7) * ASCO Guideline: [Human Epidermal Growth Factor Receptor 2 Testing in Breast Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/assays-and-predictive-markers#/9751) *May 30, 2018* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.liw4bgn0vv04) * ASCO Guideline: [Systemic Tx for Pts w Advanced HER2+ Breast Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/9786) 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[RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.cbwzl0emu5qo) * ASCO Guideline: [Use of Endocrine Therapy for Breast Cancer Risk Reduction](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/9816) *September 3, 2019.* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.ejlescbn4mhm) * ASCO Guideline: [Selection of Optimal Adjuvant Chemo and Targeted Therapy for Early Breast Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/11081) *May 22, 2018* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.su5gyvr8p391) * ASCO Guideline: [Role of Pt and Dz Factors in Adjuvant Systemic Tx for Early-Stage, Operable IBC](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/10696) *June 17, 2019* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.su5gyvr8p391) * ASCO Guideline: [Chemo-and Targeted Tx for HER2- (or unknown) Advanced Breast Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/9781) *September 2, 2014* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.su5gyvr8p391) * ASCO Guideline: [Use of Biomarkers to Guide Decisions on Adjuvant Systemic Tx for Early-Stage IBC](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/9746) *May 31, 2019* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.k6751yb54q9w) * ASCO Guideline: [Use of Biomarkers to Guide Decisions on Systemic Tx for Metastatic Breast Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/assays-and-predictive-markers#/9676) *July 20, 2015* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.dpu41fwc4mrv) * ASCO Guideline: [Endocrine Therapy for HR+ Metastatic Breast Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/11751) *May 23, 2016* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.dpu41fwc4mrv) * ASCO Guideline: [Role of Bone-Modifying Agents in Metastatic Breast Cancer Update](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/9831) *October 16, 2017* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.dpu41fwc4mrv) * USPSTF Recommendation: Medication Use to Reduce Risk of Breast Cancer [[JAMA 2019](https://jamanetwork.com/journals/jama/fullarticle/2749221)] [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.ejlescbn4mhm) * ASCO/SIO Guideline: [Integrative Therapies During and After Breast Cancer Treatment](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/31666) *June 11, 2018* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.4l6gym5dzm0x) * ASCO Guideline: [ACS/ASCO Breast Cancer Survivorship Care Guideline](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/9526) *December 7, 2015* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.4l6gym5dzm0x) * ASCO Guideline: [Breast Cancer Follow-Up and Management After Primary Treatment](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/breast-cancer#/9821) *March 1, 2012.* [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#heading=h.4l6gym5dzm0x)   Relevant Accessible Radiation Protocols   * Whole breast   + RTOG 1005 [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366)]: Sequential vs. SIB. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit?pli=1#bookmark=id.qa4vcyb22mdh) * Accelerated Partial Breast   + UK IMPORT LOW [[Coles Lancet '17]](https://www.sciencedirect.com/science/article/pii/S0140673617311455?via%3Dihub) (Protocol in Appendix). [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit?pli=1#bookmark=id.uc5qrqivb4gv)   + RAPID (Canadian) [[Whelan Lancet '19](https://doi.org/10.1016/S0140-6736(19)32515-2)] (Protocol in Appendix). [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit?pli=1#bookmark=id.938ey8lo9d7)   + NSABP B-39 / RTOG 0413 [[Protocol](http://rpc.mdanderson.org/rpc/credentialing/files/B39_Protocol1.pdf), [Vincini Lancet '19](https://doi.org/10.1016/S0140-6736(19)32514-0)]: WBRT vs. 3D/BT PBI. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit?pli=1#bookmark=id.kszol2mb6nlx)   + RTOG 1014 breast re-irradiation [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=6358), [Arthur JAMA Onc '19](https://www.ncbi.nlm.nih.gov/pubmed/31750868)]: Repeat BCS→ 3D PBI (45/30 BID). [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit?pli=1#bookmark=id.yz8pzuucy4t2) * Comprehensive Nodal: Protocols available in supplementary.   + MA.20 (2000-2007) [[Whelan NEJM '15]](http://www.nejm.org/doi/10.1056/NEJMoa1415340?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dwww.ncbi.nlm.nih.gov&): BCT/ALND ± RNI (IM, SCN, high axillary). [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit?pli=1#bookmark=id.np3h8u4rk4zb)   + EORTC 22922 (1996-2004) [[Poortmans NEJM '15]](http://www.nejm.org/doi/10.1056/NEJMoa1415369?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dwww.ncbi.nlm.nih.gov): ALND or SLNB→ ALND if positive ± RNI. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit?pli=1#bookmark=id.dxztgnjii4qv) * SUPREMO [[Protocol](https://www.supremotrial.com/SUPREMO%20protocol%20version27.pdf)]: ± PMRT (no RNI) for high risk node negative or N1 disease. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit?pli=1#bookmark=id.obk959jr658f) * NSABP B-51 / RTOG 1304 [[Constraints (table 3)](https://www.ncbi.nlm.nih.gov/pubmed/26617210)]: cT1-3N1 NAC→ SLN ypN0 ± CW/RNI. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit?pli=1#bookmark=id.tc7hrjgeh2zs) * UK FAST Forward [[Protocol](https://www.icr.ac.uk/our-research/centres-and-collaborations/centres-at-the-icr/clinical-trials-and-statistics-unit/clinical-trials/fast_forward_page) , [eContour](http://www.econtour.org/cases/117)]: 40.05/15 (2.67 Gy) vs. 27/5 (5.4 Gy) vs. 26/5 (5.2 Gy). 5.2 Gy boost allowed. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.l20q82q32xzg) * NRG BR002 [[Pending](https://ascopubs.org/doi/abs/10.1200/JCO.2016.34.15_suppl.TPS1098), [Protocol](https://www.newjerseyck.com/wp-content/uploads/2017/07/NRG-BR002-Protocol-20160222.pdf)]: Phase II/III. Standard of care and tx of symptomatic mets vs. LCT. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.kyz8axqivny8) * MSKCC [[Braunstein IJROBP '19](https://www.sciencedirect.com/science/article/pii/S0360301619303062?via%3Dihub), [eContour](http://econtour.org/cases/108)]: 40/10 Qday PBI [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.hqc35ujj7v4e)   Techniques/Historical Fields  DBCCG PMRT from 2D to 3D [[Thomsen Acta Onc '08](https://www.ncbi.nlm.nih.gov/pubmed/18465333)].  Comparison of seven PMRT techniques [[Pierce IJROBP '02](https://www.ncbi.nlm.nih.gov/pubmed/11955732)].  PMRT 2D techniques [[Hardenbergh Semin Rad Onc '99](https://www.ncbi.nlm.nih.gov/pubmed/10378965)]. |

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* UK FAST Forward [[Protocol](https://www.icr.ac.uk/our-research/centres-and-collaborations/centres-at-the-icr/clinical-trials-and-statistics-unit/clinical-trials/fast_forward_page), [Brunt Lancet '20](https://doi.org/10.1016/S0140-6736(20)30932-6)]: **40.05/15 (2.67 Gy) vs. 27/5 (5.4 Gy) vs. 26/5 (5.2 Gy) ± boost**. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.l20q82q32xzg)

TBL [QS](http://www.quadshotnews.com/2020/05/flashback.html): If you’re comfortable with 15-16 fraction breast planning, there’s nothing dramatically different with this 5-fraction approach.

* + V95 > 95%, V105 < 5%, V107 < 2%, Dmax < 110%.
  + 5 fraction regimens:
  + Lung 8 Gy (15-17%)
  + Heart 7 Gy (5%), 1.5 Gy (30%)
* See [[Florence trial](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit#bookmark=id.gjfriadaxyj0)]: **WBRT 50/25 + 10 Gy boost vs. APBI 30/5** IMRT over 2w.

See eContour case on [[MSKCC PBI](http://econtour.org/cases/108)] and [[Florence](http://econtour.org/cases/47)].

* + Dmax < 110%
  + V105% (31.5Gy) < 5% of breast volume
  + Ipsi breast - PTV 15 Gy (50%)
  + Contra breast Dmax < 1Gy
  + Ipsi lung 10 Gy (20%)
  + Contra lung 5 Gy (10%)
* **MSKCC** [[Braunstein IJROBP '19](https://www.sciencedirect.com/science/article/pii/S0360301619303062?via%3Dihub)]: **40/10 Qday PBI**

See eContour case on [[MSKCC PBI](http://econtour.org/cases/108)] and [[Florence](http://econtour.org/cases/47)].

* + CTV\_40 = Cavity + 1-1.5 cm cropped at anterior surface of pec major.
  + PTV\_40 = CTV + 0.5 - 1.0 cm. Subtract 0.5 cm from skin and CW.
  + PTV volume < 35% of whole breast volume.
  + 50% of non-target breast tissue is limited to 50% of Rx dose.
  + Ipsi lung 20 Gy (3%)
  + Heart max dose < 90% of prescription (36 Gy).
  + Breast 20 Gy (45%).
* **NSABP B-39 / RTOG 0413** [[Protocol](http://rpc.mdanderson.org/rpc/credentialing/files/B39_Protocol1.pdf), [White ASTRO '19](https://www.eventscribe.com/2019/ASTRO/fsPopup.asp?Mode=presinfo&PresentationID=599238), [Vincini Lancet '19](https://doi.org/10.1016/S0140-6736(19)32514-0)]: **WBRT vs. 3D/BT PBI**. [RoR](https://docs.google.com/document/d/1sWQwqcSH23B30CKCVOaQ2kb4D4qES6YfPqmgJYR5rnY/edit?pli=1#bookmark=id.kszol2mb6nlx)
  + **WBRT**: **50 Gy ± 10-16.6 Gy boost** (80%).
  + **3D PBI** (73%): **38.5/10 BID**.
  + **BT PBI**: **34/10 BID if IS** (21%) **or IC** (6%).
  + 3D PBI: CTV: Clips + 1.5 cm for CTV (1 cm on RAPID). CTV/PTVe crop 5 mm skin and pec. Add 1 cm for PTV.
    - Breast V60% < 50%, V100% < 35%. *The treatment volume should only be around 1/3 of the breast!*
    - Contralateral breast should receive < 3% of prescribed dose.
    - Ipsi lung V30% < 15%, Contra lung V5% < 15%.
    - Heart (R-sided) V5% < 5%, Heart (L-sided) V5% < 40%.
    - Thyroid maximum point dose 3% of prescribed dose.
    - Dmax < 120%. PTVe: V95% ≥ 95% (V90% ≥ 90%).
  + Interstitial: CTV = lumpectomy/clips + 1.5 cm. PTV > 5mm from skin.
    - DHI: 1 = V150/V100 ≥ 0.75.
    - PTVe: V95% ≥ 95% (V90% ≥ 90%).
    - V150% ≤ 70cc, V200% ≤ 20 cc.
    - Breast V60% < 50% (45%)
  + Intracavitary: CTV = lumpectomy/clips + 1 cm, PTV > 5 mm from skin. Skin bridge 5-7 mm.
    - Typical balloon diameter of 4 to 5 cm and a final fill volume of 35 to 70 mL
    - Ideal balloon-to-skin surface distance of 7 mm; 5 mm okay. 5 mm from the chest wall..
    - CT after device placement on all patients to determine conformance.
    - Conformance (%PTVe coverage - (vol trapped air/vol PTVe)\*100 = ≥ 90%.
    - PTVe: V90% ≥ 90%. If 5% of PTVe is displaced by air/seroma, then V95% ≥ 90%.
    - Typically when volume of trapped air/fluid is < 10% of PTVe, then coverage can be achieved.
    - Symmetry: ≤ 2 mm deviation from expected.
    - Max skin dose: Ideal ≤ 125%. Acceptable ≤ 145%.
    - V150% ≤ 50 cc, V200: ≤ 10 cc.
    - Breast V60% < 50% (45%)
* **RTOG 1005** [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9366)]: **Sequential vs. SIB.** 50/25 or 42.67/16 + 12-14 boost vs. 40/15 (2.67) with 48/15 (3.2) SIB.
  + Evaluates hypofractionation with concurrent boost vs. sequential boost for higher risk group than NCIC (e.g. NAC, high grade, LVSI, young age, ER-, etc.)
  + CTV = lumpectomy cavity + 1 cm. PTV = CTV = 7mm.
  + Coverage:
    - PTVe/Lump V95% ≥ 95% (V90% ≥ 90%).
    - For boost: PTVe V54 > 50% and V100% > 30%.
    - IMN V90% ≥ 95% (V80% ≥ 90%).
    - V105 < 10%, dmax 108%.
    - Dmax < 110-115% (breast).
    - Dmax < 115-120% (lump).
* Darby: MCE increased by 7.4% for each 1 Gy increase to MHD.

### SBRT

NRG-BR002:

Non-osseous sites: 30/1, 45/3, 50/5.

Osseous sites: 20/1, 30/3, 35/5.

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## Thoracic

### NSCLC

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| **This NSCLC Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  Zaorsky: [[LN stations in lungs](https://twitter.com/NicholasZaorsky/status/1211640873634664453)].  ARRO: [[Management of Chest Wall Toxicity After SBRT](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ChestWallToxicity.pdf)], [[Central Lung Early Stage NSCLC](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROCase_SABR_Lung_EarlyStage.pdf)].  Contouring   * eContour [[Thoracic OARs and lobar anatomy](https://econtour.org/cases/89), [Kong IJROBP '11](https://www.ncbi.nlm.nih.gov/pubmed/20934273)] * Cardiac Contouring Atlas (Supplement) [[Duane RTO '17](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5356506/)] * RTOG 1106 OARs [[RTOG Contouring Atlases](https://www.nrgoncology.org/ciro-lung)]: PET-Guided therapy for stage III NSCLC. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.p1qgl9x43th3) * EORTC guidelines for planning and delivery of high-dose, high precision RT for lung cancer [[De Ruysscher RTO '17](https://www.ncbi.nlm.nih.gov/pubmed/28666551)] * CT-based definition of thoracic LN stations: An atlas from the University of Michigan [[Chapet IJROBP '05](https://www.ncbi.nlm.nih.gov/pubmed/16111586)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#heading=h.6jx2f37knu1t) * ESTRO ACROP guidelines for target volume definition for LA-NSCLC [[Nestle RTO '18](https://www.thegreenjournal.com/article/S0167-8140(18)30115-4/fulltext)]. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.7m90wr8h9gsx) * Australia & NZ consensus guidelines for use of advanced technologies in RT for LA-NSCLC [[Dwyer JMIRO '16](https://www.ncbi.nlm.nih.gov/pubmed/27470188)]. * Margin selection to compensate for loss of target dose coverage due to target motion [[Foster JACMP '15](https://www.ncbi.nlm.nih.gov/pubmed/25679166)]. * IAEA consensus: PET/CT imaging for target volume delineation in curative intent RT for NSCLC [[Konert RTO '15](https://www.ncbi.nlm.nih.gov/pubmed/25869338)]   Review Articles   * RT for Lung Cancer Collaborative Group for SBRT without pathology [[Berman TLCR '19](http://tlcr.amegroups.com/article/view/26375/19723)]. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#heading=h.canzrk46c7jc) * Differential Relapse Patterns for NSCLC Subtypes [[McAleese Clin Onc '19](https://www.ncbi.nlm.nih.gov/pubmed/31351746)]: Retro. AC vs. SqCC. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#heading=h.12dcu6uefto4) * What is the role of RT for ES-SCLC in the immunotherapy era? [QS](http://www.quadshotnews.com/2019/07/chest-bump.html) [[Nesbit TLCR '19](http://tlcr.amegroups.com/article/view/28932)]. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.snu066265ta7) * Oligo Review of NSCLC Oligometastases [Giulani IJROBP '20]. [RoR](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#heading=h.sfi9w935mota) * 4π VMAT RT [[Dong IJROBP '13](https://www.redjournal.org/article/S0360-3016(12)03636-X/fulltext)]: Extensive non-coplanar beams. "Poor man's proton therapy". [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.fisjtvppfzs8) * Onishi [JTO '07]: Goal BED ≥ 100 Gy (dose to iso, though), comparable OS to Ginsberg which was only stage IA. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.4elbijb8sf9m) * Tumor size < 2.45 cm and PTV D95 BED10 ≥ 113 Gy maximizes local control in SBRT [[Kang IJROBP '19](https://www.ncbi.nlm.nih.gov/pubmed/31586665)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.862515115833) * Implications on pCR beyond Mediastinal Nodal Clearance with high dose CCRT [[Vyfhuis IJROBP '18](https://www.sciencedirect.com/science/article/pii/S0360301618302505?via%3Dihub#fig1)]. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.tf2fioskkctm)   Society Guidelines   * ASCO/ASTRO Guideline: [Stereotactic Body Radiotherapy for Early-Stage NSCLC](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/thoracic-cancer#/28316) *November 6, 2017* [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.r6yxnlb4f49j) * ESTRO/ACROP consensus guidelines for SBRT of peripherally located Early-Stage NSCLC [[Guckenberger RTO '17](https://www.ncbi.nlm.nih.gov/pubmed/28687397)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.3hkmkuz2stjz) * [ACCP and STS RFA Consensus Statement [Chest '12]](https://www.sciencedirect.com/science/article/pii/S0012369212606990?via%3Dihub) * HyTEC: LC following SBRT for Stage I NSCLC [[Lee IJROBP '19](https://www.redjournal.org/article/S0360-3016(19)30572-3/pdf)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.g64ukngzwack) * UK/AAPM Consensus on Normal Tissue Dose constraints for SBRT [[Hanna CO '18](https://www.sciencedirect.com/science/article/pii/S093665551730434X)] [RoR](#_hjf4rn360avr) * ASCO Guidelines for Surveillance after Definitive Curative-Intent therapy [[Schneider JCO '19](https://www.ncbi.nlm.nih.gov/pubmed/31829901)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.x0pt4mmhjq2i) * [ASTRO Guideline: Definitive and Adjuvant RT in Locally Advanced NSCLC](https://www.astro.org/Patient-Care-and-Research/Clinical-Practice-Statements/ASTRO-39;s-guideline-on-definitive-and-adjuvant-RT)*June 2015* [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.rwh1mjpib8up) * ASCO Guideline: [Adjuvant Chemo and Adjuvant RT for Stages I-IIIA Resectable NSCLC](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/thoracic-cancer#/10226) *April 24, 2017* [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.m7i6kd44jxna) * ASCO Guideline: [Therapy for Stage IV Non–Small-Cell Lung Cancer without Driver Alterations](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/thoracic-cancer#/10201) *January 28, 2020* [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.xjv5dd9pjsex) * ASCO Guideline: [Molecular Testing for Selection of Pts w Lung Cancer for Tx w Targeted TKIs](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/thoracic-cancer#/9776) *February 5, 2018* [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#heading=h.wp55nx1rut9o) * ASCO Guidelines for Surveillance after Definitive Curative-Intent therapy [[Schneider JCO '19](https://www.ncbi.nlm.nih.gov/pubmed/31829901)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.x0pt4mmhjq2i)   Relevant Accessible Radiation Protocols (SBRT)   * RTOG 0236 [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?study=0236)]: Phase II. Equivalent of 54/3 biw in medically inoperable early NSCLC. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.a7j9wvgpo9h0) * RTOG 0618 [[Protocol](http://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4650)]: Phase II. 54/3 biw in medically *operable* early NSCLC. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.a3yfypawrt4n) * RTOG 0813 [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=9067)]: Phase I/II. Dose escalation for medically inoperable central NSCLC lesions. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.vmah88n82ask) * SUNSET (Table 2) [[NCT03306680](https://clinicaltrials.gov/ct2/show/NCT03306680), [Giuliani Clin Lung Cancer '18](https://www.ncbi.nlm.nih.gov/pubmed/29759332)]: Phase I Central dose escalation. 60/(15-10-8-6-5). [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.2btlcyn3xrm9) * RTOG 0915 [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?study=0915&mode=bro%20adcasts&ptid=387)]: Phase II. 34/1 (BED 150) vs 48/4 (BED 105) medically inoperable peripheral NSCLC. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.yy4w2zafo8vx) * CHISEL (Australia) [[Protocol (Supplement) Ball Lanc Onc '19]](https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(18)30896-9/fulltext): 1:2. Conventional RT vs. SBRT stage I NSCLC. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.2jnczabvubqg) * LUSTRE (Canada) [[(Treatment and Interventions, Table 1)](https://www.sciencedirect.com/science/article/pii/S1525730416302248?via%3Dihub): 60/15 vs. SBRT 48/4 or 60/8 (for central). [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.ina2v8rfz7lo) * ASPIRE-ILD Protocol [[Palma BMC Cancer '19](https://www.ncbi.nlm.nih.gov/pubmed/31829203)]: Phase II, single arm. Dose de-escalation for patients with ILD. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=kix.o1he394ouy3r) * Consider PTV sacrifice if concern for DLT [[Shaverdian BJR '16](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4986505/)]. Hypothesis-generating. Ensure 100% coverage of ITV [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.xrsc2jfubvx4)   Relevant Accessible Radiation Protocols (Locally advanced)   * Definitive Chemoradiation   + RTOG 0617 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4649)]: 60 vs. 74 Gy Carbo/Pacli ± Cetuximab. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.rjeb8sfzf5ot)   + RTOG 1308 [[Table 1 Giaddui Rad Onc '16](https://www.ncbi.nlm.nih.gov/pubmed/27142674)]: Phase III. Photon vs. Proton dose-escalated CCRT. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.to0a6x1hf507) * Post-Operative   + LUNG-ART / EORTC 22055 [[Protocol](http://www.ifct.fr/images/stories/Protocoles/DocsPratiques/IFCT-0503-LungArt/Protocole_LungART_v8.pdf)]: Phase III. N2 disease→ ± PORT to 54/30 ± seq CTX. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.jqiyx32hj0hi) * Isotoxic RT:   + High dose RT based on normal tissue constraints [[Zhao RTO '19](https://www.ncbi.nlm.nih.gov/pubmed/31869678)]: Retro. Standard (< 66 Gy) vs.≥ 66 Gy. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.81n83icjfhfv)   Quality of Life/Toxicity (SBRT)   * VATS vs. open thoracotomy lobectomy [[Paul JTCVS '10](https://www.sciencedirect.com/science/article/pii/S0022522309010800?via%3Dihub)]: Consider minimally invasive VATS lobectomy. * Safety and Effectiveness of SABR for ultra-central lung lesions [Chen JTO '19] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.iuao5xsxaskw) * LungTECH summary of RILTs for Central SBRT to the Lung (Table 3) [[Adebahr BJR '15](https://www.birpublications.org/doi/10.1259/bjr.20150036)]. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=kix.hsgc4mx4om77) * Stanford [[Chaudhuri Lung Ca '15](https://www.ncbi.nlm.nih.gov/pubmed/25997421)]: Retro. Central and Ultracentral. 50/(4-5). [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.ctkqot8uicm) * HILUS trial [[Lindberg JTO abstract '17](https://www.jto.org/article/S1556-0864(16)31610-0/pdf)]: Phase II. Central tumors. 56/8. Lesions < 1 cm from mainstem very high risk. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.dldhobpv14xl) * MSKCC [QS](http://www.quadshotnews.com/2018/10/not-so-fast.html) [[Wang IJROBP '18](https://www.sciencedirect.com/science/article/pii/S0360301618311192)]: Retro. Central and Ultracentral. 60/8 (n=14), 50/5 (n=25), 45/5 (n=25). [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.o1jeelwgulz6) * ROSEL PRO SABR vs surgery [[Louie RTO '15](https://www.ncbi.nlm.nih.gov/pubmed/26492839)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.rx1mp1g7p9vd) * RTOG 0813(Table 3) [[Bezjak JCO '19](https://ascopubs.org/doi/full/10.1200/JCO.18.00622)]: Phase I/II. Dose escalation for medically inoperable central NSCLC lesions. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.vmah88n82ask) * Validation of RTOG 0813 PBT constraints for non-pneumonitis toxicity (NPT) [[Manyam IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/31987965)]. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.vpyexbt32q11) * Lung SBRT and Concurrent Immunotherapy [[Tian IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/31982496)]: SBRT ± ICI. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.70uud96bc7wd) * OARs in Lung SBRT: What is safe for lung parenchyma? [[Kong IJROBP '19](https://www.sciencedirect.com/science/article/pii/S0360301618340148)]: AAPM Reporting Guidelines for RP. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.sz9jsyj0jga4) * RTOG 0236(Table 4/5) [[Timmerman JCO '10](https://jamanetwork.com/journals/jama/fullarticle/185547)]: Phase II. Equivalent of 54/3 biw in medically inoperable early NSCLC. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.a7j9wvgpo9h0) * Rib fracture rates analysis for 3 fractions [[Pettersson RTO '09](https://www.ncbi.nlm.nih.gov/pubmed/19410314/)]. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.xqqctftfgb5b)   + Who cares about rib toxicity? Most heal on their own without intervention[[Park J GE Hepatol '20](https://www.ncbi.nlm.nih.gov/pubmed/32052884)] * Brachial plexopathy [[Forquer RTO '09](https://www.thegreenjournal.com/article/S0167-8140(09)00193-5/fulltext)]: Retro. 3-4 fraction SBRT.   Quality of Life/Toxicity (Locally advanced)   * RTOG 0617 QoL secondary analysis [[Movsas JAMA Onc '16](https://www.ncbi.nlm.nih.gov/pubmed/26606200)].[RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.rjeb8sfzf5ot) * RTOG 0617 IMRT vs 3D secondary analysis [[Chun JCO '17]](http://ascopubs.org/doi/abs/10.1200/JCO.2016.69.1378).[RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.rjeb8sfzf5ot) * Heart V50 independently predicts for decreased OS [[Speirs JTO '17](https://www.jto.org/article/S1556-0864(16)31144-3/fulltext)]. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.jgrlfoasvoc2) * Cardiac morbidity: Pooled analysis of 6 dose escalation trials for stage III NSCLC [[Wang JCO '17](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5455462/)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.jgrlfoasvoc2) * Dess [[JCO '17](https://www.ncbi.nlm.nih.gov/pubmed/28301264)]: Prospective trials. Cardiac morbidity for ± baseline heart disease and CCRT. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.jgrlfoasvoc2) * Exploring the relationship of RT dose and length of esophagus to weight loss in lung cancer [QS](http://www.quadshotnews.com/2020/03/the-lengths-some-people-go-to.html) [[Han PRO '20](https://www.practicalradonc.org/article/S1879-8500(20)30062-X/fulltext)]: Retro. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.jgrlfoasvoc2) * RP for combined V20 [[Graham IJROBP '99]](https://www.sciencedirect.com/science/article/pii/S0360301699001832?via%3Dihub): Retro. Less than half received concurrent chemo. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.jgrlfoasvoc2) * Optimal Chemotherapy for CCRT remains unknown! [[Eberhardt JCO '15]](http://ascopubs.org/doi/full/10.1200/JCO.2014.58.9812) [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#heading=h.8fm890uhgxjw)   + STRIPE pneumonitis meta-analysis [[Palma IJROBP '13]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3448004/): Median 60 Gy CCRT. CarboP vs. EP. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#heading=h.8fm890uhgxjw)   + STRIPE esophagitis meta-analysis [[Palma IJROBP '13](https://www.sciencedirect.com/science/article/pii/S0360301613029003)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#heading=h.8fm890uhgxjw)   + VA Health [[Santana-Davila JCO '15](http://ascopubs.org/doi/full/10.1200/JCO.2014.56.2587)]: Retro. CCRT CarboP vs. EP [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#heading=h.8fm890uhgxjw) * PACIFIC Trial Toxicity (Table 3) [[Antonia NEJM '17](https://www.nejm.org/doi/full/10.1056/NEJMoa1709937)]. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.xpwgdlid9n6k)   + Around 1/4 of patients do not initiate durva due to disease progression or CCRT toxicity [[Shaveridan RTO '19](https://www.ncbi.nlm.nih.gov/pubmed/31786421)]. * China [QS](http://www.quadshotnews.com/2020/04/easy-does-it.html%5C) [[Kong IJROBP '20](https://doi.org/10.1016/j.ijrobp.2020.03.038)]: Retro. Stage II-III NSCLC. Induction chemo→ 60/15. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#heading=h.16zvai86raju) |

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  Contouring   * See protocols for guidance. * Cardiac Contouring Atlas (Supplement) [[Duane RTO '17](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5356506/)] * ARRO: [[Small Cell Lung Cancer](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROCaseSmallCell.pdf)].   Review Articles   * What is the role of RT for ES-SCLC in the immunotherapy era? [QS](http://www.quadshotnews.com/2019/07/chest-bump.html) [[Nesbit TLCR '19](http://tlcr.amegroups.com/article/view/28932)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.snu066265ta7) * Start date of any treatment to End of RT (SER) [[De Ruysscher JCO '06]](http://ascopubs.org/doi/abs/10.1200/JCO.2005.02.9793?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed): Aim for SER < 30 days! [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.8g80j0b22nvp) * LS-SCLC: Is PCI Necessary? [[Farris PRO '19](https://www.sciencedirect.com/science/article/abs/pii/S1879850019301857)]: Retro. Obs vs. PCI. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#heading=h.6a2wqadfkp6a)   Society Guidelines   * ASCO/ACCP Guideline: [Treatment of Small-Cell Lung Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/thoracic-cancer#/9991) *September 8, 2015* [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.nbv7mkaxnlnw) * ESMO Guidelines for Diagnosis, Treatment and Follow up [[Früh Ann Onc '13](https://www.esmo.org/guidelines/lung-and-chest-tumours/small-cell-lung-cancer)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.nbv7mkaxnlnw) * ASTRO Guideline: RT for Small Cell Lung Cancer [[Simone PRO '20](https://www.ncbi.nlm.nih.gov/pubmed/32222430)] [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#heading=h.nruipiivq02s)   Relevant Accessible Radiation Protocols   * LS-SCLC   + CONVERT / EORTC 8072 (Supplement 1) [[Salem JAMA Onc '18](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6439849/)]: 45/30 BID vs. 66/33 with CE x4-6c. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.jgrlfoasvoc2) * ES-SCLC   + RTOG 0937 [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=11137)[]:](https://www.jto.org/article/S1556-0864(17)30468-9/fulltext) Phase II. Up to 4 extracranial mets. PCI (25/10) ± thoracic/oligo RT (45/15, 30/10). [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.jgrlfoasvoc2)   Quality of Life/Toxicity   * CONVERT (Table 4) [[Faivre-Finn Lanc Onc '17](https://www.sciencedirect.com/science/article/pii/S1470204517303182?via%3Dihub), [Salem JAMA Onc '18](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6439849/)]: 45/30 BID vs. 66/33 with CE x4-6c. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.g5ydzigdyk9u) * CREST (Table 2) [[Slotman Lancet '15](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(14)61085-0/fulltext)]: 4-6c chemo→ PR/CR→ PCI (dealers choice) ± Thoracic RT 30/10. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.xm6erzs5c8vp) * RTOG 0212 PCI QoL [[Wolfson IJROBP '11](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3024447/)[]](https://academic.oup.com/annonc/article/22/5/1154/178653): 25/10 vs. 36/18 vs. 36/24 BID for pts in CR. [RoR](https://docs.google.com/document/d/1oKD3L5ieCk03FWU6fCnj8aiHKRPJD-q6IpjXpQCuexw/edit#bookmark=id.rzv3trcpeyty) |

### Thymoma

ARRO: [[Thymoma](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/Thymoma.pdf)]. AVARO [[Normal Thorax Anatomy](http://econtour.org/cases/89)], [[Thoracic nodal levels](http://econtour.org/cases/88)]

RT definitions and reporting guidelines for thymic malignancies [[Gomez JTO '11](https://www.ncbi.nlm.nih.gov/pubmed/21847057)]

IMRT CCRT (Methods) [QS](http://www.quadshotnews.com/2020/02/bonus-round.html) [[Fan IJROBP '20](https://www.redjournal.org/article/S0360-3016(20)30063-8/fulltext)]: Phase II. Thymic Epithelial Tumors. 60/30 + CE x2c→ CE x2c.

### Mesothelioma

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## [Gastrointestinal](#_yrs27vvto6ww)

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|  | **Rectal** | **Anal** |  |
| Rectal |  |  |  |
| Bladder | 40 Gy (40%) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  45 Gy (15%) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  50 Gy [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822) | 35 Gy (50%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  40 Gy (35%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  50 Gy (5%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) |  |
| Large bowel |  | 30 Gy (200 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  35 Gy (150 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  45 Gy (20 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) |  |
| Small bowel | 35 Gy (180 cc) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  40 Gy (100 cc) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  45 Gy (65 cc) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  50 Gy [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822) | 30 Gy (200 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  35 Gy (150 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  45 Gy (20 cc) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  50 Gy [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) | **RTOG 05-29 Predictors of RT-related GI toxicity** [[Olsen IJROBP '17](https://www.redjournal.org/article/S0360-3016(17)30332-2/fulltext)]: Compare to Quantec V45 < 195cc.   * Small bowel V25 ≤ 186 cc, V30 ≤ 155 cc, V35 ≤ 41 cc, **V40 ≤ 30.4 cc** correlate to G2+ acute GI. * Larger patients may benefit from being prone to decrease bowel dose. |
| FH | 40 Gy (40%) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  45 Gy (25%) [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)  50 Gy [08-22](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822) | **30 Gy** (**50%**)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  40 Gy (35%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  44 Gy (5%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) |  |
| Iliac crest |  | **30 Gy** (**50%**)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  40 Gy (35%)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  50 Gy (5%)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) |  |
| External genitalia |  | 20 Gy (50%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  30 Gy (35%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  40 Gy (5%) [05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) |  |
| **Bone marrow**  (Anal cancer) |  | 30 Gy (750 cc) [Lee '17](https://pubmed.ncbi.nlm.nih.gov/28068238/)  40 Gy (23%) [Lee '17](https://pubmed.ncbi.nlm.nih.gov/28068238/) | Anal cancer (MMC): It makes sense that V40 is a lower value than for cervical cancer, as MMC has significant heme toxicity.  Patients who had ≥ 750 cc spared from ≥ 30 Gy had 0% G3 heme at week 3.  G3+ neutropenia for BM V40 ± 23% of 8→ 33%. |

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### Esophageal and Gastric

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  Zaorsky: [[Distance from incisors, lymph node risk, Siewert illustrations](https://twitter.com/NicholasZaorsky/status/1212012362322063360)], [[Gastric cancer LND](https://twitter.com/NicholasZaorsky/status/1212805291022180356)], [[Gastric cancer regional nodes](https://twitter.com/NicholasZaorsky/status/1212805553317122048)].  ARRO: [[Esophageal cancer case](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/Esophageal.pdf), [contour](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/EsophagealContour.pdf)].  eContour [[esophageal](http://econtour.org/cases/60)], [[MRI-based upper abdominal OAR](http://econtour.org/cases/112)].  Contouring   * CT-based Upper Abdominal OAR Consensus Guidelines [[RTOG Contouring Atlases](https://www.nrgoncology.org/Portals/0/Scientific%20Program/CIRO/Atlases/UpperAbdominal.pdf), [Jabbour PRO ‘14](https://www.practicalradonc.org/article/S1879-8500(13)00262-2/abstract)] * MRI-Based Upper Abdominal Organs-at-Risk Atlas for Radiation Oncology [[eContour](http://econtour.org/cases/112), [Lukovic IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/31953061)] * Expert consensus guidelines for IMRT in esophageal and GEJ cancer [[Wu IJROBP '15](https://www.ncbi.nlm.nih.gov/pubmed/26104943)] * Gastric lymph node contouring atlas [[Wo PRO '13](https://www.ncbi.nlm.nih.gov/pubmed/24674268)] * GTV for SqCC of the esophagus: Debate and consensus based on path and clinical outcomes [[Han J Cancer '16](https://www.ncbi.nlm.nih.gov/pubmed/26819644)] * CTVn for SqCC of the esophagus [[Huang RTO '15](https://www.ncbi.nlm.nih.gov/pubmed/26142269)]   Society Guidelines   * EORTC-ROG RT Volume and Treatment Guidelines for neoadjuvant RT of the GEJ and stomach [[Matzinger RTO '08](https://www.ncbi.nlm.nih.gov/pubmed/19375186)] * ESMO esophageal guidelines [[Lordick Ann Onc '16](https://www.esmo.org/guidelines/gastrointestinal-cancers/oesophageal-cancer)] * ESMO gastric guidelines [[Smith Ann Onc '16](https://www.esmo.org/guidelines/gastrointestinal-cancers/gastric-cancer)]   Relevant Accessible Radiation Protocols (Esophagus / GEJ)   * CROSS trial [[Protocol (Supplement) Van Hagen NEJM '12](https://www.nejm.org/doi/full/10.1056/NEJMoa1112088)[]:](http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(15)00040-6/abstract) GEJ. ± 41.4/CarboP→ Surgery. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.tiq9n3ta4k31) * RTOG 0436 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4629)]. Non-operative esophageal CRT with/without Cetuximab. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=kix.5wxoay47lz5u) * RTOG 1010 [[Protocol](https://www.rtog.org/LinkClick.aspx?fileticket=52jdx-MJBUQ=&tabid=290)]: Ongoing. Phase III. Esophageal. 50.4/28 with carboP ± Trastuzumab→ Surgery. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.mp8n2jmhrbe2)   Relevant Accessible Radiation Protocols (Gastric)   * CRITICS [[Protocol](http://www.cirro.dk/assets/files/Protokoller/CIRRO-IP050109-CRITICS.pdf), [Verheij ASCO '16](http://ascopubs.org/doi/abs/10.1200/JCO.2016.34.15_suppl.4000), [Cats Lanc Onc '18](https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(18)30132-3/fulltext)]: Gastric. ECC x3→ Surgery→ ECC x3 vs. 45 Gy/CDDP/X. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.dopybxt53lsk) * RTOG 9904 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=9904), [Ajani JCO '06](http://ascopubs.org/doi/full/10.1200/JCO.2006.06.4840?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed)]: Phase II. Gastric. PLF x2→ CCRT 45 Gy→ surgery. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.jev2fnmsvnny) * RTOG 0114 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&Fil%20eID=7533), [Schwartz JCO '09](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2669761/)]: Phase II. Resected gastric cancer. CCRT w PC ± 5-FU. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.3k01qjcw49pi)   Quality of Life/Toxicity   * CROSS trial [[(Table 2) Van Hagen NEJM '12](https://www.nejm.org/doi/full/10.1056/NEJMoa1112088), [(QoL) Noordman JCO '18](https://www.ncbi.nlm.nih.gov/pubmed/29161204)][:](http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(15)00040-6/abstract) GEJ. ± 41.4/CarboP→ Surgery. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.tiq9n3ta4k31) * Adjuvant CRT for Gastric Cancer QoL [[Goody JCO '17](https://ascopubs.org/doi/abs/10.1200/jco.2016.34.4_suppl.164)]. * INT 0116 (Table 3) [[Macdonald NEJM '01](http://www.nejm.org/doi/10.1056/NEJMoa010187?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dwww.ncbi.nlm.nih.gov), ['12](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4517071/)]: Gastric. D0-1/R0→ ± 45 Gy/5-FU. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.ts88naupic5c) |

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### Pancreas

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ARRO: [[Borderline resectable pancreatic cancer case](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/BorderlineResectablePancreatic.pdf), [contour](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/ARROContourBRPancreas.pdf)], [[Pancreas SBRT](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROcasePancreasSBRT.pdf)].  Contouring   * eContour: [[MRI-based upper abdominal OAR](http://econtour.org/cases/112)], [[post-op pancreas](http://econtour.org/cases/4)]. * RTOG Postoperative Pancreas CTV Consensus [[RTOG Contouring Atlases](https://www.nrgoncology.org/Portals/0/Scientific%20Program/CIRO/Atlases/Pancreas.pdf), [Goodman IJROBP '12](https://www.ncbi.nlm.nih.gov/pubmed/22483737)]. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.4vmczcjankg0) * Preop and definitive CTV including ENI [[Caravatta Rad Onc '12](https://www.ncbi.nlm.nih.gov/pubmed/22691275)]. * Pancreatic GTV on CT compared with MRI [[Hall PRO '18](https://www.ncbi.nlm.nih.gov/pubmed/30675238)]. * CT-based Upper Abdominal OAR Consensus Guidelines [[RTOG Contouring Atlases](https://www.nrgoncology.org/Portals/0/Scientific%20Program/CIRO/Atlases/UpperAbdominal.pdf), [Jabbour PRO ‘14](https://www.practicalradonc.org/article/S1879-8500(13)00262-2/abstract)] * MRI-based contouring of GTV and OARs for pancreatic cancer [[Heerkens PRO '17](https://www.ncbi.nlm.nih.gov/pubmed/28089481)]. * MRI-Based Upper Abdominal Organs-at-Risk Atlas for Radiation Oncology [[eContour](http://econtour.org/cases/112), [Lukovic IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/31953061)] * Dose-escalated RT for pancreatic cancer: A SIB Approach [[Koay PRO '20](https://www.practicalradonc.org/article/S1879-8500(20)30035-7/fulltext)]: 37.5-67.5/15 and 50/5. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.cjxbbaw0ppu)   Review Articles   * Patterns of Failure when omitting RT: ESPAC-4 [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.465jo26ke0j7) [[Jones JAMA Surg ‘19](https://jamanetwork.com/journals/jamasurgery/article-abstract/2749409)] and PRODIGE-24 [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.ioh3k34i1c28) [[Conroy NEJM '18](https://www.nejm.org/doi/full/10.1056/NEJMoa1809775)]. * Patterns of Failure after Pancreatic SBRT [[Zhu IJROBP '19](https://www.sciencedirect.com/science/article/pii/S0360301619301579)] [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.750ku551ntwz) * Meta for Pancreatic RT [[Tchelebi Cancer '20](https://acsjournals.onlinelibrary.wiley.com/doi/abs/10.1002/cncr.32756)]: Conventionally fractionated vs. SBRT. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#heading=h.7msg877il527)   Society Guidelines   * ASTRO Guidelines: Radiation Therapy for Pancreatic Cancer [[Palta PRO '19](https://www.practicalradonc.org/article/S1879-8500(19)30187-0/fulltext)] [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.gi2hxts9ic4) * ASCO Guideline: [Metastatic Pancreatic Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/gastrointestinal-cancer#/12156) *May 23, 2018* * ASCO Guideline: [Locally Advanced Pancreatic Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/gastrointestinal-cancer#/12151) *May 31, 2016* * AGITG and TROG guidelines for pancreatic SBRT [[Oar PRO ‘19](https://www.ncbi.nlm.nih.gov/pubmed/31761541)] [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#heading=h.gbv1dx4w5rxg) * ASCO Guideline: [Potentially Curable Pancreatic Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/gastrointestinal-cancer#/12146) *June 10, 2019* * ESMO pancreatic cancer guidelines [[Ducreux Ann Onc '15](https://www.esmo.org/Guidelines/Gastrointestinal-Cancers/Cancer-of-the-Pancreas)] * ISGPS borderline resectable consensus statement [[Bockhorn Surgery '14](https://www.ncbi.nlm.nih.gov/pubmed/24856119)]   Relevant Accessible Radiation Protocols   * LAP07 [[Protocol (Supplement)](https://jamanetwork.com/journals/jama/fullarticle/2518265)]: LAPC. Gem ± erlotinib x4→ same chemo x2 vs. CCRT/X (54 Gy/Cap).[RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.o6k1ho3htjf9) * RTOG 1201 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&Fil%20eID=10172), [NCT01921751](https://clinicaltrials.gov/ct2/show/NCT01921751)]: LAPC. Gem + Nab-paclitaxel x3c (9 doses)→ Chemo ± 50.4/28 vs. 63/28. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.310lk77xls71) * RTOG 9704 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&Fil%20eID=7546)]: R0/R1→ (peri-CCRT 5-FU vs. Gem) + 50.4/5-FU. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.p3q1mfggc7qo) * RTOG 0848 [[Protocol](http://rpc.mdanderson.org/RPC/CREDENTIALING/files/0848.pdf)]: Phase II/III. 2 stage randomization Chemo x 6 mo ± RT/X. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=kix.2vyqud3jxmlg) * Hopkins [[(Methods) Herman Cancer '15](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4368473/)]: Phase II. Gem x1→ 33/5→ adjuvant gem until toxicity or progression. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.gwib8zhi06ly) * Beth-Israel [[(Methods) Mahadevan IJROBP '11](https://www.redjournal.org/article/S0360-3016(11)00566-9/fulltext)]: Gem x2c w no mets→ C3 gem, fiducials→ 24-36/3→ Gem c4. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.eicxrbxn3wgd) * Moffitt [[(Methods) Mellon Acta '15](https://www.tandfonline.com/doi/full/10.3109/0284186X.2015.1004367)]: Induction chemo→ fiducials, 30-40/5 SBRT. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.gi2hxts9ic4) * Dose-escalated RT for pancreatic cancer: SIB Approach (Constraints, Volumes) [[Koay PRO '20](https://www.practicalradonc.org/article/S1879-8500(20)30035-7/fulltext)]: 37.5-67.5/15 and 50/5. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.cjxbbaw0ppu)   Quality of Life/Toxicity   * LAP07 (Table 2) [[Hammel JAMA '16](https://jamanetwork.com/journals/jama/fullarticle/2518265)]: LAPC. Gem ± erlotinib x4→ same chemo x2 vs. CCRT/X (54 Gy/Cap).[RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.o6k1ho3htjf9) * ESPAC-1 (Results) [[Neoptolemos NEJM '04]](https://www.nejm.org/doi/full/10.1056/NEJMoa032295): 2x2. R0/1→ ± 5FU, ± 40 Gy split→ 5FU x6c. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.sldug5ttks4k) |

### Liver

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  Zaorsky: [[Liver anatomy explained by using your right fist](https://twitter.com/NicholasZaorsky/status/1212807418503192584)], [[Similar to the "no fly zone" in lung cancer, there is one in liver cancer](https://twitter.com/NicholasZaorsky/status/1213175389713051652)].  ARRO: [[HCC](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/HCC.pdf)], [[HCC and SBRT](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROCaseHCCSBRT.pdf)], [[Resected IHCC](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ResectedIntrahepaticCholangiocarcinoma.pdf)], [[Unresectable IHCC](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROCaseUnresectableIntrahepaticCholangiocarcinoma.pdf)].  Contouring   * eContour: [[HCC SBRT]](https://econtour.org/cases/76), [[AVARO Liver Segments](http://econtour.org/cases/78)] * CT-based Upper Abdominal OAR Consensus Guidelines [[RTOG Contouring Atlases](https://www.nrgoncology.org/Portals/0/Scientific%20Program/CIRO/Atlases/UpperAbdominal.pdf), [Jabbour PRO ‘14](https://www.practicalradonc.org/article/S1879-8500(13)00262-2/abstract)] * MRI-Based Upper Abdominal Organs-at-Risk Atlas for Radiation Oncology [[eContour](http://econtour.org/cases/112), [Lukovic IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/31953061)] * RTOG Interobserver variability in target definition for HCC ± PVT [[Hong IJROBP '14](https://www.ncbi.nlm.nih.gov/pubmed/24969794)]   Summary Articles   * Radiotherapy for HCC: Ready for Prime Time? [[Bang and Dawson JHEP '20](https://www.ncbi.nlm.nih.gov/pubmed/32039361)]. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.z3gd3elgnxbv) * Patterns of Recurrence for mCRC to liver treated with local therapy [[de Jong ASO '09](https://insights.ovid.com/pubmed?pmid=19730175)] [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.oqbck3bk6zi) * Hepatic Metastasis from CRC [[Kow JGO '19](https://www.ncbi.nlm.nih.gov/pubmed/31949948)]: Great introduction on the management of mCRC to the liver. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.1i4g32ct4820)   *This article highlights the fact that surgery is standard of care, belittling the utility of SBRT. See our commentary above.*  Society Guidelines   * AASLD Guidelines: HCC Dx, Staging, and management [[Marrero Hepatology '18](https://www.aasld.org/publications/hepatocellular-carcinoma-management)] [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.f5knq5jtudda) * ACR/LI-RADS [[CT/MRI LI-RADS '18](https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems/LI-RADS/CT-MRI-LI-RADS-v2018)] * APPLE: Consensus for Radiotherapy in HCC [[Park Liver Ca '16](https://www.ncbi.nlm.nih.gov/pubmed/27493892)] * EASL-EORTC Management of HCC [[Journal of Hepatology '18](https://easl.eu/publication/easl-clinical-practice-guidelines-management-of-hepatocellular-carcinoma/)] * ESMO HCC guidelines [[Vogel Ann Onc '18](https://www.esmo.org/Guidelines/Gastrointestinal-Cancers/Hepatocellular-Carcinoma)].   Relevant Accessible Radiation Protocols   * RTOG 1112 [[Protocol](https://www.rtog.org/Portals/0/RTOG%20Broadcasts/Attachments/1112_master_w_update_5.7.13.pdf)]: HCC nonsurgical/RFA/TACE candidates ± SBRT→ sorafenib. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.bs9veb4cul9j) * Phase I-II trial SBRT for HCC CPC A and B [[(Methods, Appendix) Lasley PRO '15](https://www.practicalradonc.org/article/S1879-8500(15)00070-3/fulltext)]: CPA 48/3, CPB 40/5. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.l0aytyt37eqc) * RTOG 0438 [[Katz Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0438), [Dawson PRO '19](https://www.ncbi.nlm.nih.gov/pubmed/30825666)]: Phase I. 35-50/10. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.m2f8kxg042w1) * Phase I/II dose escalation for Liver Mets (Methods) [[Rusthoven JCO '09](http://ascopubs.org/doi/full/10.1200/JCO.2008.19.6329)]: 36-60/3. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.x08rskahsvfj) * Milan phase II for liver mets (Methods) [[Scorsetti IJROBP '13](https://www.redjournal.org/article/S0360-3016(12)03917-X/fulltext)]: 75/3. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.bmobfcjygmgj)   Quality of Life/Toxicity   * Phase I-II trial SBRT for HCC CPC A and B (Table 2) [[Lasley PRO '15](https://www.practicalradonc.org/article/S1879-8500(15)00070-3/fulltext)]: CPA 48/3, CPB 40/5. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.l0aytyt37eqc) * Milan phase II for liver mets [[Scorsetti JCRCO '15](https://www.ncbi.nlm.nih.gov/pubmed/25245052)]: 75/3. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.bmobfcjygmgj) * Liver No Fly Zone [[Osmundson IJROBP '15](https://www.ncbi.nlm.nih.gov/pubmed/25659885)]: Retro. Liver SBRT, Median BED10 = 85.5 Gy (e.g., 45/5). [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.lvc9hv1fqtei) |

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### Gallbladder / Cholangiocarcinoma

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### Rectum

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  Zaorsky: [[From 7th to 8th ed, rectal cancer staging is mostly unchanged while anal cancer has changed](https://twitter.com/NicholasZaorsky/status/1213911340567453697)], [[Anal and rectal cancer anatomy and terminology](https://twitter.com/NicholasZaorsky/status/1213907270779785216)], [LN definitions come from Australasian Gastrointestinal Trials Group (AGITG) consensus guidelines], [[anal CTV definitions](https://twitter.com/NicholasZaorsky/status/1213904269084184577)] and [[rectal CTV definitions](https://twitter.com/NicholasZaorsky/status/1213905147514019843)].  ARRO: [[Rectal cancer case](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROCaseRectal.pdf), [contour](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROContourRectal.pdf)].  Contouring   * eContour [[Preop rectum](https://econtour.org/fundamentals)], [[AVARO Rectum](http://econtour.org/cases/87)] * International consensus guidelines on CTV delineation in rectal cancer [[Valentini RTO '16](https://www.ncbi.nlm.nih.gov/pubmed/27528121)]. * RTOG Elective Anorectal CTV [[Contouring Atlas](https://www.nrgoncology.org/Portals/0/Scientific%20Program/CIRO/Atlases/AnorectalContouringGuidelines.pdf), [Myerson IJROBP '09](https://www.ncbi.nlm.nih.gov/pubmed/19117696)].   Review Articles   * Radiation Therapy for Rectal Cancer [[Tseng JGO '19](https://www.ncbi.nlm.nih.gov/pubmed/31949945)] [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#heading=h.edmjmqevmmvz) * Lateral Node Study Consortium [QS](http://www.quadshotnews.com/2019/09/west-side-story.html#more) [[Ogura JAMA Surg '19](https://jamanetwork.com/journals/jamasurgery/fullarticle/2736895)] [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.fzfx43bpa8fc)   Society Guidelines   * American Society of Colon and Rectal Surgeons (ASCRS) [[Practice Guidelines](https://fascrs.org/healthcare-providers/education/clinical-practice-guidelines)] * ESMO Guidelines for Rectal cancer [[Glynne-Jones Ann Onc '17](https://www.esmo.org/guidelines/gastrointestinal-cancers/rectal-cancer)] [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.3mju38pjxp4e) * ASTRO Clinical Practice Statement for Stage II and III rectal cancer [[Goodman PRO '16](https://www.ncbi.nlm.nih.gov/pubmed/26922700)] * ACR Appropriateness Criteria for Resectable Rectal Cancer [[Jones Rad Onc '12](https://www.ncbi.nlm.nih.gov/pubmed/23006527)] * ARS Appropriate Use Criteria for Local Excision (LE) in Rectal Cancer [[Russo IJROBP '19](https://www.sciencedirect.com/science/article/pii/S0360301619336545)] [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.cioodmvvzqbb)   Relevant Accessible Radiation Protocols   * RTOG 0822 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0822)]: Phase II. 50.4/XO→ LAR/APR→ FOLFOX. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.qjgje3irsn5) * TROG 01.04 (Supplementary) [[Ngan JCO '12](https://www.ncbi.nlm.nih.gov/pubmed/23008301)]: 25/5→ 6c adj 5-FU (surgery 1w) vs. 50.4/5-FU→ 4c adj (surgery 4-6w). [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.yel2xb1e9sit) * German Rectal Cancer Study (Methods) [[Sauer NEJM '04](http://www.nejm.org/doi/full/10.1056/NEJMoa040694)[]](https://www.ncbi.nlm.nih.gov/pubmed/22529255?dopt=Abstract): CCRT Post-op (55.8) vs. Preop (50.4) in TME setting. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.wiz7jps4huwe) * Stockholm III (Methods) [[Erlandsson RTO ‘19](https://www.ncbi.nlm.nih.gov/pubmed/31015165)]: 3 arm: SC→ 1w vs. 4-8w vs. 50/25 RT *alone* with 4-8w to surgery. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.etpw41kctq25)   Quality of Life/Toxicity   * RTOG 0822 (Table 3) [[Hong IJROBP '15](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4540628/)]: Phase II. 50.4/XO→ LAR/APR→ FOLFOX. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.qjgje3irsn5) * NSABP R-03 (Table 3) [[Roh JCO '09](http://ascopubs.org/doi/full/10.1200/JCO.2009.22.0467)]: POCCRT vs. Pre-op CCRT 50.4 Gy/5-FU→ TME→ adjuvant chemo. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.nnzj1ncdavuh) * TROG 01.04 (Table 4) [[Ngan JCO '12](https://www.ncbi.nlm.nih.gov/pubmed/23008301)]: 25/5→ 6c adj 5-FU (surgery in 1w) vs. 50.4/5-FU→ 4c adj (surgery in 4-6w). [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.yel2xb1e9sit) * Dutch TME trial HR-QoL [[Witlink EJC '14](https://www.ncbi.nlm.nih.gov/pubmed/25060825)]: ± 25/5→ TME. Only 1 week delay to surgery. No chemo. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.9zbqxzggszz3) * MRC CR07 QoL[[Stephens JCO '10](https://www.ncbi.nlm.nih.gov/pubmed/20585099)]: 25/5 preop vs. selective PORT (if CRM+ - 12%) 45/25 + 5-FU. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.bxjexswxtk3p) |

### Anal

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  Zaorsky: [[From 7th to 8th ed, rectal cancer staging is mostly unchanged while anal cancer has changed](https://twitter.com/NicholasZaorsky/status/1213911340567453697)], [[Anal and rectal cancer anatomy and terminology](https://twitter.com/NicholasZaorsky/status/1213907270779785216)], [[LN definitions come from Australasian Gastrointestinal Trials Group (AGITG) consensus guidelines](https://twitter.com/NicholasZaorsky/status/1213900646044307461), [Ng IJROBP '12](https://www.ncbi.nlm.nih.gov/pubmed/22401917)], [[anal CTV definitions](https://twitter.com/NicholasZaorsky/status/1213904269084184577)] and [[rectal CTV definitions](https://twitter.com/NicholasZaorsky/status/1213905147514019843)].  ARRO: [[Anal cancer](https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROcase_AnalCancer.pdf)], [[Anal canal carcinoma](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/AnalCanalCarcinoma.pdf)].  Contouring   * eContour [[Anal](https://econtour.org/cases/10)] * AGITG Australasian Atlas and planning guidelines for IMRT in anal cancer [[Ng IJROBP '12](https://www.ncbi.nlm.nih.gov/pubmed/22401917), [Zaorsky](https://twitter.com/NicholasZaorsky/status/1213900646044307461)]. * RTOG Elective Anorectal CTV [[Contouring Atlas](https://www.nrgoncology.org/Portals/0/Scientific%20Program/CIRO/Atlases/AnorectalContouringGuidelines.pdf), [Myerson IJROBP '09](https://www.ncbi.nlm.nih.gov/pubmed/19117696)]. * Technical aspects of radiation therapy for anal cancer [[Scher JGO '14](https://www.ncbi.nlm.nih.gov/pubmed/24982768)] * Proposed genitalia contouring guidelines in anal cancer IMRT [[Brooks Br J Rad '15](https://www.ncbi.nlm.nih.gov/pubmed/25955229)]   Review Articles   * UK Patterns and predictors of relapse following SIB IMRT CCRT [[Shakir IJROBP '19](https://www.ncbi.nlm.nih.gov/pubmed/31629837)]: Retro. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.rtdvsrmv2t14)   Society Guidelines   * American Society of Colon and Rectal Surgeons (ASCRS) [[Practice Guidelines](https://fascrs.org/healthcare-providers/education/clinical-practice-guidelines)] * ESMO Guidelines for Anal cancer [[Glynne-Jones Ann Onc '14](https://www.esmo.org/Guidelines/Gastrointestinal-Cancers/Anal-Cancer)]   Relevant Accessible Radiation Protocols   * RTOG 0529 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)]: Phase II. 45-54/30 IMRT with 5FU/MMC. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.yey5kyny3hv) * RTOG 9811 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=9811)]: CCRT CDDP\*/5-FU vs. MMC/5-FU. \*with induction. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.nkkozts41rl0) * ACCORD 03 [[Protocol (supplement) Peiffert JCO '12](http://ascopubs.org/doi/full/10.1200/JCO.2011.35.4837?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed)]: 2x2. ± induction x2c→ 45/25/CDDP/5-FU ± RT Boost. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.5wcsaljx22e3)   Quality of Life/Toxicity   * RTOG 0529 (Tables 4/5) [[Kachnic IJROBP '13](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3619011/)]: Phase II. 45-54/30 IMRT with 5FU/MMC. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.yey5kyny3hv) * RTOG 9811 (Table 3) [[Gunderson JCO '12](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3515768/)]: CCRT CDDP\*/5-FU vs. MMC/5-FU. \*with induction. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.nkkozts41rl0) * Norweigan national cohort QoL [[Bentzen Acta Onc '13](https://www.ncbi.nlm.nih.gov/pubmed/23438358)]: CCRT. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.nnq0lm252t2i) * UK One-year oncological and PROs [[Gilbert EJC '20](https://www.ncbi.nlm.nih.gov/pubmed/32109852)]: Prospective. IMRT with MMC/5-FU or Xeloda. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.8ybfsg121ych) * Canadian national cohort QoL [[Han IJROBP '14](https://www.ncbi.nlm.nih.gov/pubmed/25194664)]: Prospective. IMRT. [RoR](https://docs.google.com/document/d/13NEZCS6s13MVLixabbO2vjY73zHxJ37qE16gBbApSdY/edit#bookmark=id.imq91rcp47iq) |

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## [Genitourinary](#_yrs27vvto6ww)

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| Conventional Prostate | **RTOG 08-15** [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile%20&FileID=13149)]  **RTOG 04-15** | **RTOG 05-34** [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)]  **GU003** (66.6/37) | **GU003** (62.5/25) |  |  |  |
|  | **Intact** | **Post-op** | **Post-op** | **WPRT** | **QUANTEC** | **Notes** |
| Rectal  \*05-34 postop | **75 Gy** (**15**%) (20%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub) (74 Gy)  **70 Gy** (**20%**) (25 - 30%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub)  **65 Gy** (**25%**) (35 - 40%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149), [05-34](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  60 Gy (50 - 55%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  50 Gy (50%)[PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub) | 70 Gy (10%)  65 Gy (35%) GU-003  40 Gy (55%) GU-003, [05-34](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  35 Gy (40%) | 59 Gy (35%) GU-003  36 Gy (55%) GU-003 | 45 Gy (10%)  35 Gy (25%)  25 Gy (50%) | V75 < 15%  V70 < 20%  V65 < 25%  V60 < 35%  V50 < 50% | QUANTEC values for < 15% G2+ and < 10% G3+ toxicity. |
| Bladder  \*05-34 | 80 Gy (15 - 20%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  **75 Gy** (**25%** - 30%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  **70 Gy** (**35%** - 40%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  **65 Gy** (**50%** - 55%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149), [05-34](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  50 Gy (50%)[CHHiP](https://www.ncbi.nlm.nih.gov/pubmed/28296582), [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub) | 75 Gy (10%)  65 Gy (50%) GU-003  60 Gy (40%)  40 Gy (70%) GU-003, [05-34](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  35 Gy (60%) | 57 Gy (50%) GU-003  35 Gy (70%) GU-003 | 35 Gy (20%)  25 Gy (50%) | 65 Gy | G3+ toxicity is limited with QUANTEC values. |
| Urethra | 70 Gy |  |  |  |  |  |
| FH  \*05-34 | Mean < 45 Gy  50 Gy (10 - 15%) to each  50 Gy (5%)  30 Gy (50%) | 50 Gy (10%) to each GU-003 | 44 Gy (10%) to each GU-003 | 25 Gy each (10%) |  |  |
| Penile bulb | Mean < 52.5 Gy [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624)  70 Gy (60-70%)  50 Gy (90-95%)  Mean < 24 Gy [CHHiP](https://www.ncbi.nlm.nih.gov/pubmed/32072028) |  |  | 25 Gy (50%) | 70 Gy (60-70%)  50 Gy (90-95%) | All constraints listed have a < 35% incidence of severe erectile dysfunction. |
| Large bowel | 60 Gy |  |  |  |  |  |
| Small bowel  \*05-34 | 50 - 52 Gy  \*45 Gy (150cc - 200cc - bag) |  |  |  |  |  |
| Prostate |  |  |  |  |  |  |
| Kidney | Total V20 < 30%.  8 Gy (50%) each (testicular).  If single kidney, V20 < 15%. |  |  |  |  |  |
| Liver | 36 - 40 Gy (30%) |  |  |  |  |  |

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Contouring   * eContour training module [[Prostate Fossa](https://econtour.org/fundamentals)]. * eContour cases [[post-prostatectomy](http://econtour.org/cases/35)]. * RTOG pelvic normal tissue contouring guidelines [[Gay IJROBP '12](https://www.ncbi.nlm.nih.gov/pubmed/22483697), [Male normal pelvis Atlas](https://www.nrgoncology.org/Scientific-Program/Center-for-Innovation-in-Radiation-Oncology/Male-RTOG-Normal-Pelvis)] * RTOG PLNs for prostate cancer [[Harris IJROBP '15](https://www.ncbi.nlm.nih.gov/pubmed/26104940), [RTOG Contouring Atlas](https://www.nrgoncology.org/Portals/0/Scientific%20Program/CIRO/Atlases/Prostate%20Pelvic%20Lymph%20Nodes.ppt)] * RTOG consensus guidelines for delineation of postop CTV in prostate cancer [[Michalski IJROBP '10](https://www.ncbi.nlm.nih.gov/pubmed/19394158), [Post-op Atlas](https://www.rtog.org/CoreLab/ContouringAtlases.aspx)]   Review Articles   * Natural history of progression of PSA recurrence after RP [[Antonarakis BJU Int '13](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3204323/)] [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.gdeho2qslf5e) * Stephenson Nomogram [[JCO '07]](http://ascopubs.org/doi/full/10.1200/JCO.2006.08.9607): Predicting outcomes for SRT. bcPFS only. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.i7kgh6aebogz) * Tendulkar Nomogram [[JCO '16]](http://ascopubs.org/doi/abs/10.1200/JCO.2016.67.9647): SRT ± ADT. Adds DMFS data to Stephenson.[RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.i7kgh6aebogz) * Campbell Nomogram [[ASTRO '19](https://www.eventscribe.com/2019/ASTRO/fsPopup.asp?Mode=presInfo&PresentationID=559444)]: SRT ± ADT. Adds PSA-DT and post-op initial PSA value data to Tendulkar. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.i7kgh6aebogz) * European Association of Urology Validation of bcF Risk Groups [[Tilki Euro Uro '19](https://www.europeanurology.com/article/S0302-2838(19)30202-7/fulltext)]: Retro. HR vs. LR. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.i7kgh6aebogz) * Patterns of recurrence after prostate bed RT [[Brand RTO '19](https://www.thegreenjournal.com/article/S0167-8140(19)33091-9/fulltext)]: Retro. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.p72dqbs603jv)   Society Guidelines   * [ASTRO/AUA Guideline: Adjuvant and Salvage Radiotherapy after Prostatectomy](https://www.astro.org/Patient-Care-and-Research/Clinical-Practice-Statements/ASTRO-39;s-guideline-on-adjuvant-and-salvage-RT-af) *April 2019* [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.fsvw5do60a4r) * ASTRO/AUA Guidelines Amendment [QS](http://www.quadshotnews.com/2019/07/easy-a.html) [[Pisansky PRO '19](https://www.sciencedirect.com/science/article/pii/S1879850019301201)]   Relevant Accessible Radiation Protocols   * RTOG 0534/SPPORT [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044), [Pollack ASTRO '18](https://www.eventscribe.com/2018/ASTRO/fsPopup.asp?Mode=presInfo&PresentationID=449001)]: 3 arm: 64.8-70.2 Gy BedRT ± 4-6 mo ADT ± 45 Gy WPRT. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.4ow42z6z244k)   Quality of Life/Toxicity   * SWOG 8794 [[Moinpour JCO '08]](https://www.sciencedirect.com/science/article/pii/S1078143908001890): QoL initially got worse with adjuvant RT (worse GU and GI symptoms with RT, though GI differences were gone by two years. Worsened GU symptoms persisted). QoL improved with time favoring RT arm over observation arm in the long term . [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.14s8wspcxf2a) * SAAK 09/10 [[Ghadjar JCO ’15](http://ascopubs.org/doi/full/10.1200/JCO.2015.63.3529)]: 70 Gy (vs. 64 Gy) has minor effect on QoL with clinically relevant worsening in urinary symptoms. However, especially if you want 1 year prior to starting radiotherapy after RP to allow for urinary incontinence to recover, improvement of urinary incontinence is not delayed by SRT. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.8xz8mqv46t4l) * Functional outcomes and QoL [[Adam Euro Uro '17](https://www.ncbi.nlm.nih.gov/pubmed/27887941)]: RP vs. RP/RT vs. RT/ADT vs. MaxRP (RP/RT/ADT). [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.wjqadxjt2mwo) * PROs and late toxicity after post-prostatectomy IMRT [[Akthar Euro Uro '19](https://www.europeanurology.com/article/S0302-2838(19)30415-4/fulltext)] [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.wjqadxjt2mwo)   **Prostate (Intact)**  Zaorsky: [[Obesity and prostate cancer: Weighing the evidence](https://twitter.com/NicholasZaorsky/status/1226862227078164480?s=20)], [[PTV advantage of brachytherapy](https://twitter.com/NicholasZaorsky/status/1217886128193376257?s=20)], [[Risk of nodal involvement](https://twitter.com/NicholasZaorsky/status/1215670456130441216?s=20)], [[importance of full/empty bladder](https://twitter.com/NicholasZaorsky/status/1215669203887382531?s=20)], [[Prostate cancer failure patterns after prostatectomy](https://twitter.com/NicholasZaorsky/status/1228330423283068929?s=20)]  ARRO: [[HDR prostate brachytherapy](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROCaseProstatebrachy.pdf)].  Contouring   * eContour training module [[Intact prostate](https://econtour.org/fundamentals)], [[AVARO Prostate](http://econtour.org/cases/86)] * eContour cases [[intact conventional prostate](http://econtour.org/cases/34)] and [[intact prostate hypofractionation](http://econtour.org/cases/109)]. * RTOG pelvic normal tissue contouring guidelines [[Gay IJROBP '12](https://www.ncbi.nlm.nih.gov/pubmed/22483697), [Male normal pelvis Atlas](https://www.nrgoncology.org/Scientific-Program/Center-for-Innovation-in-Radiation-Oncology/Male-RTOG-Normal-Pelvis)] * RTOG PLNs for prostate cancer [[Harris IJROBP '15](https://www.ncbi.nlm.nih.gov/pubmed/26104940), [RTOG Contouring Atlas](https://www.nrgoncology.org/Portals/0/Scientific%20Program/CIRO/Atlases/Prostate%20Pelvic%20Lymph%20Nodes.ppt)] * Combined RMH and RTOG guidelines [[Harris IJROBP '15](https://www.ncbi.nlm.nih.gov/pubmed/26104940)]: See Table 2. Atlas in Supplement.   + Start at L5/S1 superiorly. Add 0.7 cm to vessels.   + Presacrals to S3 should use a 1.2 cm brush instead of a 1.0 cm brush. Ensure the entire width of sacrum is included.   + Connect internal and external iliac volumes with a 1.8 cm strip.   + Obturator region is a 1.8 cm wide strip. Stop 1 cm above pubic symphysis (RTOG stops at symphysis).   + Exclude bowel + 3 mm margin from lymph node volumes.   Review Articles   * Excellent Prostate LDR review article [[Stish TAU '18](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6043740/#r22)]. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.13ndhxnku715) * Excellent Prostate HDR monotherapy review article [[Demanes BT '14](https://www.sciencedirect.com/science/article/pii/S1538472114005054)]. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.13ndhxnku715) * HDR BT in the treatment of prostate cancer [[Mendez and Morton TAU '18](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6043748/)] [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.13ndhxnku715) * Optimal therapy for localized PrCa: recreation of the self-fulfilling prophecy w Combo BT? [[Spratt/Carroll JCO '18](https://ascopubs.org/doi/full/10.1200/JCO.2018.78.6236)] [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=kix.6xx8kqrbj7i7) * Natural history of progression of PSA recurrence after EBRT [[Zumsteg Eur Urol '15](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5002994/)]: 75.6-86.4 Gy [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.gdeho2qslf5e) * MSKCC Patterns of Recurrence after EBRT to Prostate [[Zumsteg JUro '15](https://www.jurology.com/article/S0022-5347(15)04327-X/fulltext)]: Retro. Median 81 Gy/45 (1.8 Gy). [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.p72dqbs603jv)   Society Guidelines   * [ASTRO/AUA/SUO Guideline on Clinically Localized Prostate Cancer](https://www.astro.org/Patient-Care-and-Research/Clinical-Practice-Statements/ASTRO-39;s-evidence-based-guideline-on-clinically) *April 2017* * ASCO Guideline: [Clinically Localized Prostate Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/genitourinary-cancer#/32796) *September 5, 2018* * [ASCO Guideline: Optimum Imaging Strategies for Advanced Prostate Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/genitourinary-cancer#/142641) *January 15, 2020* * AAPM/ABS/ASTRO/ACR/ESTRO guidelines [[Yamada BT '12](https://www.americanbrachytherapy.org/consensus-statements/prostate/)] * GEC/ESTRO guidelines on HDR BT for localized prostate cancer: An Update [[Hoskin RTO '13](https://www.sciencedirect.com/science/article/pii/S0167814013002004?via%3Dihub)] * ASCO/CCO Guideline: [Brachytherapy for Patients with Prostate Cancer](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/genitourinary-cancer#/24836) *March 27, 2017*   Relevant Accessible Radiation Protocols   * Standard fractionation   + RTOG 0815 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)]: 79.2 Gy or EBRT ± brachy ± 6 mo ADT in IR prostate cancer. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.w4m1lnri8ylr)   + RTOG 0924 [[Protocol](http://rpc.mdanderson.org/rpc/credentialing/files/0924.pdf)]: 6 or 32 mo ADT + 79.2 Gy ± WPRT in unfavorable IR and fav HR pts. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.b9vs521mx0wa) * Combined external beam and brachytherapy   + ASCENDE-RT [[Protocol (Supplement)](https://www.redjournal.org/article/S0360-3016(16)33484-8/abstract)]: 8m ADT→ 46 Gy WPRT→ 32 Gy vs. I-125(115 Gy)→ 4m ADT. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.vkruo3hfpp9t)   Quality of Life/Toxicity   * UK Database [QS](http://www.quadshotnews.com/2019/06/inclusion.html) [[Parry JCO '19](https://ascopubs.org/doi/full/10.1200/JCO.18.02237)]: Retro. Prostate-only ± PLN IMRT. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.wjqadxjt2mwo) * SBRT Meta for LR and IR (Figure 2 - excellent breakdown all modalities) [[Kishan JAMA Netw Open '19](https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2723641)]: 33.5-40/4-5 * Patient reported outcomes [[Donovan NEJM '16](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.hct7ox581mgn)]: AM vs. RT/ADT x3-6 mo (EBRT vs. BT) vs. RP. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.wjqadxjt2mwo) * PROST-QA prospective cohort [[Sanda NEJM ' 08](https://www.ncbi.nlm.nih.gov/pubmed/18354103/)]. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.u4o3jkg9fc6w) * DART 01/05 4 mo vs. 28 mo ADT cardiac events doubled with 28 mo [[Zapatero IJROBP '16](https://www.sciencedirect.com/science/article/pii/S0360301616327808?via%3Dihub)]. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=kix.e3l2ore4ci9f) * ASCENDE-RT [[Rhodda IJROBP '17](https://www.sciencedirect.com/science/article/pii/S0360301617300081?via%3Dihub)]: 5y G3 GU cumulative incidence 20%. Half resolved after TURP. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.vkruo3hfpp9t) |

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| Hypofrac Prostate | **70/28**  GU-005, 04-15 | **57-60/20**  CHiPP [[Wilkins IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/31987974)] | **36.25/5**  PACE, GU005 |
| Rectal | 70 Gy (10 cc)  74 Gy (15%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  69 Gy (25%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  64 Gy (35%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  59 Gy (50%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  40 Gy (35%)  Thor [[JTO '19](https://www.sciencedirect.com/science/article/pii/S0167814019300854)] Reducing D5% from ≤ 65 Gy to ≤ 62 Gy suggests reduction of late GI 2+ from 20→ 10%. | New constraints:  60 Gy (0.01%) *Previously 3%* [Wilkins](https://www.ncbi.nlm.nih.gov/pubmed/31987974)  50 Gy (22%) *Previously ~30%.*[Wilkins](https://www.ncbi.nlm.nih.gov/pubmed/31987974)  40 Gy (38%) *Previously ~60%.* [Wilkins](https://www.ncbi.nlm.nih.gov/pubmed/31987974)  30 Gy (57%) *Previously ~70%.*[Wilkins](https://www.ncbi.nlm.nih.gov/pubmed/31987974)  Old constraints:  60 Gy (3%)[Table S1, Wilkins](https://www.ncbi.nlm.nih.gov/pubmed/31987974)  56.7 Gy (15%) [Table S1, Wilkins](https://www.ncbi.nlm.nih.gov/pubmed/31987974)  52.3 Gy (30%) [Table S1, Wilkins](https://www.ncbi.nlm.nih.gov/pubmed/31987974)  48.6 Gy (50%) [Table S1, Wilkins](https://www.ncbi.nlm.nih.gov/pubmed/31987974)  40.8 Gy (60%) [Table S1, Wilkins](https://www.ncbi.nlm.nih.gov/pubmed/31987974)  32.4 Gy\* (70%) [Table S1, Wilkins \*Optional](https://www.ncbi.nlm.nih.gov/pubmed/31987974) | 55 Gy T  50 Gy (3.5 cc) T  **38.06 Gy** - 40 Gy [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  38 Gy 101  36 Gy (1 cc) [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub)  34.4 Gy - 36 Gy (3 cc) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  32 Gy (0.5cc) UK  32.63 Gy - 34 Gy (10%) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  25 - 32.5 Gy (20 cc) 101 / T  29 Gy (20%) [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub)  29 Gy - 30 Gy (20%) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  18.1 Gy (50%) [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub)  18.13 Gy - 19 Gy (50%) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702) |
| Bladder | 70 Gy (10 cc)  79 Gy (15%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  74 Gy (25%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  69 Gy (35 - 40%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  64 Gy (50 - 55%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  35 Gy (90%) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  40 Gy (35%) | 60 Gy (5%)  48.6 Gy (25%)  40.8 Gy (50%) | 38 Gy 101  38.06 Gy- 40 Gy [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  37 Gy (5 - 10 cc) [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub)  18.3 Gy (15 cc) 101  18.12 Gy - 20 Gy (10%) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  18.1 Gy (40%) [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub) |
| Urethra |  |  | **45 Gy** T / [UK](https://www.sciencedirect.com/science/article/pii/S093665551730434X)  42 Gy (50%) [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub)  38.78 Gy - 43.5 Gy [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702) |
| FH | 40 Gy [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702) | 40.5 (50%) | 30 Gy (10 cc)  101  19.9 Gy (10 cc) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  15.6 Gy (1 cc) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  14.5 Gy (5%) [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub) |
| Penile bulb | Mean 51 Gy [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702) | 35 Gy (50%) | 30 - 50 Gy (3cc)  101  36.25 Gy [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  19.9 Gy (3 cc) [GU-005](https://clinicaltrials.gov/ct2/show/NCT03367702)  29.5 Gy (50%) [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub) |
| Large bowel |  |  |  |
| Small bowel  \*05-34 | 40 Gy (1%) |  | 30 Gy (1cc)  18.1 Gy (5cc) |
| Prostate |  |  |  |
| Kidney |  |  | 23 Gy (66%)  17.5 Gy (200 cc) **101** |
| Liver |  |  | 21 Gy (700cc)  **101** |

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  **Prostate (Hypofractionation)**  Contouring   * eContour cases [[intact prostate hypofractionation](http://econtour.org/cases/109)]. * RTOG pelvic normal tissue contouring guidelines [[Gay IJROBP '12](https://www.ncbi.nlm.nih.gov/pubmed/22483697), [Male normal pelvis Atlas](https://www.nrgoncology.org/Scientific-Program/Center-for-Innovation-in-Radiation-Oncology/Male-RTOG-Normal-Pelvis)]   Society Guidelines   * ASTRO/ASCO/AUA [Hypofractionated Radiation Therapy for Localized Prostate Cancer Guidelines](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/genitourinary-cancer#/33301) [[PRO '18]](https://www.practicalradonc.org/article/S1879-8500(18)30247-9/fulltext) * UK/AAPM Consensus on Normal Tissue Dose constraints for SBRT [[Hanna CO '18](https://www.sciencedirect.com/science/article/pii/S093665551730434X)].   Relevant Accessible Radiation Protocols   * Hypo-fractionation   + CHHiP old constraints from new rectal constraints paper (Table S1) [[Wilkins IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/31987974)], new penile bulb mean < 22 Gy for conventional with reduced margins [[Murray CTRO '20](https://www.ncbi.nlm.nih.gov/pubmed/32072028)]. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.ltcdvol1eohk)   + PROFIT/OCOG [[Protocol (Supplement), Catton JCO '17]](http://ascopubs.org/doi/full/10.1200/JCO.2016.71.7397): Noninferiority. IR. 78/39 vs. 60/20. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.aam7zelf5zzf)   + RTOG 0415 [[Protocol (Supplement), Lee JCO '16](http://ascopubs.org/doi/full/10.1200/JCO.2016.67.0448), [Thor JTO '19](https://www.sciencedirect.com/science/article/pii/S0167814019300854)]: Noninferiority. 73.8/41 vs. 70/28 (2.5). [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.8ovpmh11fezp) * Stereotactic body radiotherapy (SBRT)   + HYPO-RT-PC [[Protocol](https://www.umu.se/en/research/groups/hypo-rt-pc/), [Widmark ASTRO '16,](https://www.redjournal.org/article/S0360-3016(16)33267-9/fulltext) [Lancet '19](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(19)31131-6/fulltext), [Rasmusson IJROBP '20](https://www.redjournal.org/article/S0360-3016(19)30957-5/fulltext)]: 78/39 vs. 42.7/7 (6.1 Gy) qod.   + RTOG 0938 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=8416)[]](https://www.sciencedirect.com/science/article/pii/S0360301618309611?via%3Dihub): Phase II. 36.25/5 (7.25 Gy) over 15-17d vs. 51.6/12 (4.3 Gy). [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.vpweyp85ssn1)   + PACE Arm B (non-surgical arm) [[Protocol (Supplement)](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub)]: 78/39 (or 62/20) vs. 36.25/5. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.dhztl3v0sura)   Quality of Life/Toxicity   * SBRT Meta for LR and IR (Figure 2 - excellent breakdown all modalities) [[Kishan JAMA Netw Open '19](https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2723641)]: 33.5-40/4-5 * CHHiP Acute Toxicity (Figure 4 - time points) [[Dearnaley Lanc Onc '16](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4961874/)]: Noninferiority. 74/37 vs. 57/19 vs. 60/20. * RTOG 0938 SBRT PRO [[Lukka IJROBP '18](https://www.sciencedirect.com/science/article/pii/S0360301618309611?via%3Dihub)]: 36.25/5 is well tolerated. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.vpweyp85ssn1) |

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### Bladder

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  Zaorsky: [[MGH/Shipley regimen for CCRT in bladder preservation](https://twitter.com/NicholasZaorsky/status/1219387727524827138?s=20)], [[urinary diversion options](https://twitter.com/NicholasZaorsky/status/1217887052269789185?s=20)], [[cystectomy](https://twitter.com/NicholasZaorsky/status/1217886710794784770?s=20)].  ARRO: [[Bladder cancer](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/Bladder.pdf)]  Contouring   * Consensus contouring guidelines for PORT after RC [[Baumann IJROBP '16](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5207044/)]. * RTOG pelvic normal tissue contouring guidelines [[Gay IJROBP '12](https://www.ncbi.nlm.nih.gov/pubmed/22483697), [Male normal pelvis Atlas](https://www.nrgoncology.org/Scientific-Program/Center-for-Innovation-in-Radiation-Oncology/Male-RTOG-Normal-Pelvis)] * Bladder PORT per NRG-GU001 [[RTOG Contouring Atlases](https://www.nrgoncology.org/Portals/0/Contouring%20guidelines%20for%20adjuvant%20RT%20for%20bladder%20Ca-%20NRG%20GU001%202016Aug21%20%5BRead-Only%5D.pdf)] [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.yjcw1hd6xgc) * eContour [[Bladder preservation](http://econtour.org/cases/63)] * Defining the CTV for intact MIBC [[Jenkins IJROBP '09](https://www.redjournal.org/article/S0360-3016(09)00209-0/fulltext)]   Review Articles   * [Pooled RTOG analysi](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4239302/)s of bladder preservation therapy [[Mak JCO '14]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4239302/) [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.umirepomlwp7) * Christodouleas [[IJROBP '16]](https://www.sciencedirect.com/science/article/pii/S0360301616000365?via%3Dihub): Pelvic failure estimates after RC. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.p72dqbs603jv)   Society Guidelines   * AUA/ASCO/ASTRO/GUO Guidelines: Treatment of Non-Metastatic Muscle-Invasive Bladder Cancer [[J Uro '17]](https://www.jurology.com/article/S0022-5347(17)57836-2/fulltext) [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.g45avjeozv5l)   Relevant Accessible Radiation Protocols   * BC2001 [[Protocol (Supplement) James NEJM '12](https://www.nejm.org/doi/10.1056/NEJMoa1106106)]: RT (55/20 or 64/23) ± 5-FU and MMC. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.wtljsk9dnxf4)   + PTV = outer empty bladder wall + 1.5 cm. Extravesicular dz + 2 cm. * RTOG 0712 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4659), [Coen JCO '19](https://www.ncbi.nlm.nih.gov/pubmed/30433852)]: Phase II. Max TURBT→ BID RT/CDDP/5-FU vs. Qday RT/Gem. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.aid7it94znye) * HYBRID study (Supplement) [[Hafeez IJROBP '17](https://www.ncbi.nlm.nih.gov/pubmed/28586948)]: Phase II. Palliative RT. 36/6 q1w. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.5wpuugs8cph6) * NRG-GU001 [[Protocol](https://clinicaltrials.gov/ProvidedDocs/48/NCT02316548/Prot_SAP_000.pdf), [NCT02316548](https://clinicaltrials.gov/ct2/show/NCT02316548)]: Phase II. RC with ileal conduit→ Obs vs. 50.4 Gy IMRT PORT. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.yjcw1hd6xgc)   Quality of Life/Toxicity   * BC 2001 CRUK/01/004 [[Acute toxicity (Table 2) James NEJM '12](https://www.nejm.org/doi/10.1056/NEJMoa1106106)[]](http://ascopubs.org/doi/abs/10.1200/JCO.2017.35.6_suppl.280): RT ± 5-FU and MMC. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.wtljsk9dnxf4) * Pooled RTOG analysis [[Efstathiou JCO '09](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2734419/)]: Late effects of bladder preservation do not appear prohibitive. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.bn94lqj5cygv) * GETUG 97-015 QOL for bladder preservation [[Lagrange IJROBP '11](https://www.ncbi.nlm.nih.gov/pubmed/20385453)] [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.2up50u2z14l8) * Quality of life in bladder preservation [[Feuerstein Curr Urol Rep '15](https://www.ncbi.nlm.nih.gov/pubmed/26343030)]: RC vs. TMT. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.79pxo23af2e2) * HYBRID study [[Hafeez IJROBP '17](https://www.ncbi.nlm.nih.gov/pubmed/28586948)]: Phase II. Palliative RT. 36/6 q1w. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#bookmark=id.5wpuugs8cph6) |

### Renal Cell Carcinoma

Zaorsky: [[Staging of kidney cancer](https://twitter.com/NicholasZaorsky/status/1219390416388313090?s=20)]

IROCK: SRS as a Treatment Option for Renal Tumors in the Solitary Kidney [[Correa J Uro '19](https://www.auajournals.org/doi/10.1097/JU.0000000000000111)]. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.lagazxl9a1jc)

ASCO Guideline: [Management of Small Renal Masses](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/genitourinary-cancer#/15516) *January 17, 2017* [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.8xt3c2tf7725)

### Seminoma

Zaorsky: [[Doses and fields for CS I and II seminoma](https://twitter.com/NicholasZaorsky/status/1219395983844478976?s=20)], [[failure patterns](https://twitter.com/NicholasZaorsky/status/1219395565936615430?s=20)], [[at-risk sites](https://twitter.com/NicholasZaorsky/status/1219392914285047809?s=20)]

eContour [[testicular dog-leg](http://econtour.org/cases/62)]

Radiotherapy Treatment Planning for Testicular Seminoma [[Wilder IJROBP '12]](https://www.sciencedirect.com/science/article/pii/S036030161200096X?via%3Dihub).

[BC [Kollmannsberger JCO '15]](http://ascopubs.org/doi/abs/10.1200/JCO.2014.56.2116?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed): Retro. Surveillance with salvage for relapse. [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.xw4igsc5rhtc)

Radiotherapy Treatment Planning for Testicular Seminoma [[Wilder IJROBP '12]](https://www.sciencedirect.com/science/article/pii/S036030161200096X?via%3Dihub) [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.pjkpjb9ykwkx)

Patterns of failure depends on the modality of treatment [[Mead JNCI '11](https://academic.oup.com/jnci/article/103/3/241/2517208)] [RoR](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.59pvmzpcgttf)

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| [Gyn](#_yrs27vvto6ww) | **Conventional** |  |
| Vagina | Upper < 120-150 Gy  Mid < 80-90 Gy  Lower < 60-70 Gy | Vaginal doses >50-60 Gy can cause significant fibrosis.  G2+ vaginal stenosis for 65 / 75 / 85 Gy of 20→ 27→ 34% [[Kirchheiner RTO '16]](https://www.sciencedirect.com/science/article/pii/S0167814016000025?via%3Dihub) |
| Rectum | **75 Gy** (**15**%) (20%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub) (74 Gy)  **70 Gy** (**20%**) (25 - 30%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [PACE](https://www.sciencedirect.com/science/article/pii/S1470204519305698?via%3Dihub)  **65 Gy** (**25%**) (35 - 40%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149), [05-34](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  69.5 Gy EQD2 (2 cc)  **65 Gy** EQD2 (**2 cc**)  55 Gy EQD2 (11 cc)  60 Gy (50 - 55%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  45 Gy (60%) [07-24](http://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdf)  40 Gy (80% - 100%) [TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644) / [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418)  30 Gy (60%) [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418) | Fistula for D2cc ± 75 Gy of 12→ 2% [[Mazeron RTO '16]](https://www.sciencedirect.com/science/article/pii/S0167814016311549?via%3Dihub).  G2+ Rectal proctitis/bleeding for D2cc ± 65 Gy of 10→ 4% [[Mazeron RTO '16]](https://www.sciencedirect.com/science/article/pii/S0167814016311549?via%3Dihub).  55 Gy > 11 cc may also be predictive of late G2+ rectal toxicity (in addition to D2cc < 70 Gy) [[Ujaimi BT '17]](https://www.sciencedirect.com/science/article/pii/S1538472117303938?via%3Dihub)  Late G3+ and G2+ of < 10% and < 15% for the following constraints: [QUANTEC](https://www.srobf.cz/downloads/dokumenty/rectum.pdf)   * V75 < 15%. *Add 10% for bladder (V75 < 25%).* * V70 < 20%. *Add 15% for bladder (V70 < 35%).* * V65 < 25%. *Add 25% for bladder (V65 < 50%).* * V60 < 35%. * V50 < 50%. |
| Bladder | **75 Gy** (**25%**) (30%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  **70 Gy** (**35%**) (40%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149)  **65 Gy** (**50%**)(55%) [04-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=4624), [08-15](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=13149), [05-34](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  **45 Gy** (**35%** - 70%) [TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644) / [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418) / [07-24](http://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdf) | Dmax < 65 Gy with late G3+ toxicity ≤ 6% (bladder cancer). [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03285-4/fulltext)  Minimize late G3+ toxicity with the following constraints: [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03285-4/fulltext)   * V80 < 15% * **V75 < 25%**. *Subtract 10% for rectum (V75 < 15%).* * **V70 < 35%**. *Subtract 15% for rectum (V70 < 20%).* * **V65 < 50%**. *Subtract 25% for rectum (V65 < 25%).* |
| Uterus | 100 Gy |  |
| Ureters | 75 Gy |  |
| Duodenum | 50 Gy  60 Gy (2cc) [Verma '14](https://www.sciencedirect.com/science/article/pii/S0360301613032793?via%3Dihub)  55 Gy (15cc) [Verma '14](https://www.sciencedirect.com/science/article/pii/S0360301613032793?via%3Dihub)  55 Gy (1cc) [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648)  50 Gy (4cc) [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648) | 3y G2+ for D2cc ± 60 Gy of 4→ 19% [Verma '14](https://www.sciencedirect.com/science/article/pii/S0360301613032793?via%3Dihub)  3y G2+ for V55 ± 15 cc of 7→ 49% [Verma '14](https://www.sciencedirect.com/science/article/pii/S0360301613032793?via%3Dihub)  G2+ for V55 ± 1 cc or V50 ± 4 cc of 4→ 8% [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648)  G2+ for V55 1 / 10cc of 10→ 20% [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648)  G2+ for V50 4 / 10cc of 10→ 14% [George '20](https://www.ncbi.nlm.nih.gov/pubmed/31495648) |
| Small bowel | **55 Gy** (5 - 10 cc - bag)[EMBRACE II](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.fh42uw20ltay)  50 - 52 Gy  **45 Gy** (**195cc** - bag)[Roeske RTO '03](https://pubmed.ncbi.nlm.nih.gov/14643959/)  45 Gy (150 - 200 cc) [05-34 (SPPORT)](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=13044)  **40 Gy** (**30%** - 70%)[TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644) / [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418) / [07-24](http://rpc.mdanderson.org/rpc/credentialing/files/R0724-master-12%5B1%5D.29.10.pdf)  **15 Gy** (**120cc** - loop) | Small bowel: TD 5/5 50 Gy.  G3+ acute toxicity < 10% for bowel bag V45 < 195 cc. QUANTEC  G3+ acute toxicity < 10% for individual loops V15 < 20cc. QUANTEC |
| FH | Mean < 45 Gy  44 Gy (5%)  **40 Gy** (**50%**, 35%)  35 Gy (10%)  30 Gy (15 - 20%) [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418) |  |
| **Iliac crest** | **30 Gy** (**50%**)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  40 Gy (35%)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529)  50 Gy (5%)[05-29](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0529) |  |
| Bone marrow  (Cervical) | **Median < 34.2 Gy**[Klopp IJROBP '16](https://pubmed.ncbi.nlm.nih.gov/23582248/)  **40 Gy** (**37%**)[TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644) / [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418), [Klopp IJROBP '16](https://pubmed.ncbi.nlm.nih.gov/23582248/)  20 Gy (75%) [Mell IJROBP '06](https://pubmed.ncbi.nlm.nih.gov/16757127/)  **10 Gy** (**90%**)[TIME-C](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=9644) / [04-18](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418), [Mell IJROBP '06](https://pubmed.ncbi.nlm.nih.gov/16757127/) | Cervical cancer (weekly cisplatin):  G2+ heme for BM V40 ± 37% or median BM ± 34.2 **Gy** of 40→ 75% [[Klopp IJROBP '16](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4572833/)]. *V20 and V10 did not pan out.*  G2+ neutropenia for BM V10 ± 90% of 11→ 74% and BM V20 ± 75% of 14→ 25% [[Mell IJROBP '06](https://pubmed.ncbi.nlm.nih.gov/16757127/)]. *V40 did not pan out.* |
| Liver | Mean < 30 Gy |  |
| Kidney | 18 Gy (67% each) 04-18  16 Gy (25%)  Mean < 15 Gy | Combined mean kidney dose of 18 / 28 Gy with < 5 → < 50% clinically relevant kidney dysfunction. QUANTEC |

### Endometrial

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  Zaorsky: [[Gyn staging](https://twitter.com/NicholasZaorsky/status/1219773291528884229?s=20)], [[Comparison of surgeries](https://twitter.com/NicholasZaorsky/status/1221824856834158592?s=20)], [[Gyn nodes AP](https://twitter.com/NicholasZaorsky/status/1221823861978693632?s=20), [Lat](https://twitter.com/NicholasZaorsky/status/1221824276740956162?s=20)], [[Cervical staging](https://twitter.com/NicholasZaorsky/status/1221828307068604417?s=20)], [[Cervical EBRT](https://twitter.com/NicholasZaorsky/status/1222649051235127296?s=20)], [[Cervical BT](https://twitter.com/NicholasZaorsky/status/1222648780903849986?s=20)].  ARRO: [[Cervical cancer](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/CervicalCancer.pdf)].  Contouring:   * eContour: [[AVARO cervix](http://econtour.org/cases/84)], [[post op cervix](http://econtour.org/cases/55)], [[EMBRACE 2 cervix](http://econtour.org/cases/111)] and [[NRG cervix](http://econtour.org/cases/38)]. * Female Normal Pelvis Atlas [[RTOG Contouring Atlases](https://www.nrgoncology.org/ciro-gynecologic)] * Improving target volume delineation in intact cervical cancer [[Eminowicz PRO '16](https://www.ncbi.nlm.nih.gov/pubmed/27032573)]. * Consensus guidelines for delineation of CTV for IMRT for definitive tx of cervix cancer [[Lim IJROBP '11]](https://www.ncbi.nlm.nih.gov/pubmed/20472347). * Consensus guidelines for delineation of CTV in Endo/Cervical PORT [[RTOG Gyn Atlas](http://www.rtog.org/corelab/contouringatlases/gyn.aspx), [Small IJROBP '09](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2752724/)]. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.8tjrn056kqnl) * Comparison and CTV consensus for CT and MR-based BT in L-A Cervical Ca [[RTOG Atlas](https://www.nrgoncology.org/ciro-gynecologic), [Viswanathan IJROBP '14](https://www.redjournal.org/article/S0360-3016(14)03328-8/fulltext)] [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=kix.8yrje68n0x79)   Review Articles   * Gynecologic Malignancies [[Suneja and Viswanathan Heme/Onc Clin N. Amer '20](https://www.sciencedirect.com/science/article/pii/S088985881930111X?via%3Dihub)] [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.t4kv4aacj9qi)   Society Guidelines   * ASCO Guideline: Mgmt [and Care of Women with Invasive Cervical Ca Resource-Stratified Guideline](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/gynecologic-cancer#/11801) *May 25, 2016* * Society of Gynecologic Oncology (SGO) [[Guidelines]](https://www.sgo.org/clinical-practice/guidelines/) * FIGO Report: Cancer of the cervix uteri [[Bhatla IJGO '18](https://www.ncbi.nlm.nih.gov/pubmed/30306584)] * [[ESMO Guidelines](https://www.esmo.org/guidelines/gynaecological-cancers)] for Gynecological Cancers. * ESGO-ESTRO-ESP guidelines for the management of patients with cervical cancer [[June '18]](https://link.springer.com/article/10.1007%2Fs00428-018-2362-9) [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.a6plw395yelu) * ABS:   + ABS Consensus Guidelines [[Viswanathan BT '12]](https://www.sciencedirect.com/science/article/pii/S1538472111003527): Part I: General principles. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.l14oefxoqiz)   + ABS Consensus Guidelines [[Viswanathan BT '12]](https://www.sciencedirect.com/science/article/pii/S1538472111003515): Part II: HDR BT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.1vb7u8jdcrdy)   + ABS Consensus Guidelines [[Lee BT '12](https://www.ncbi.nlm.nih.gov/pubmed/22265438)]: Part III: LDR and PDR BT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.cj81a18qu433)   + ABS Task Group [[Albuquerque BT '19](https://www.sciencedirect.com/science/article/pii/S1538472118306305?via%3Dihub)] Compendium of fractionation schedules for Gyn HDR BT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.hs48ru8dcnxy)   Relevant Accessible Radiation Protocols:   * TIME-C/RTOG 1203 [[Protocol (Supplement) Klopp JCO '18](http://ascopubs.org/doi/full/10.1200/JCO.2017.77.4273)]: Cervix/Endo (M)RH→ WPRT vs. IMRT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=kix.nqh4mp4cd7f2) * RTOG 0418 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418)] for post-operative cervical and endometrial. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=kix.n1e5fah4ao76) * OUTBACK / ANZGOG 0902 / GOG 0274 / RTOG 1174 [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=10105)]: Phase III. (WPRT/EFRT)/B→ ± CarboP x4c. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.tgrkocfn51fu) * RTOG 0116 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7534)]: Phase I/II. EFRT/B/CDDP ± amifostine. *Extended field with 3D is too toxic.* [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.2s9lxocmlkr1) * RTOG 0417 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileId=4625)]: Phase II→ CCRT/B + Bevacizumab. *1/3 fail above WPRT field in pAO nodes.*  [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.gsbf2k20udq7)   + RTOG 09-21 [[Viswanathan Cancer '15](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4685031/), ['16](https://www.redjournal.org/article/S0360-3016(16)30456-4/fulltext)][RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.eshihl13t11t) demonstrated IMRT high nodal boosts are safe. * EMBRACE II [[Pötter CTRO '18]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5862686/) aims to benchmark high level of local, nodal, and systemic control with IGABT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.n9hc7b9umqu)   Quality of Life/Toxicity:   * TIME-C/RTOG 1203 [[Yeung JCO '20](https://www.ncbi.nlm.nih.gov/pubmed/32073955)]: (M)RH→ 3D-WPRT vs. IMRT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=kix.nqh4mp4cd7f2) * RTOG 9001 [[Eifel JCO '04](http://ascopubs.org/doi/abs/10.1200/JCO.2004.07.197?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed)]: EFRT/B vs. CCWPRT/B. *Acute toxicity with CCRT worse initially, evens out in long run.* [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.tasa0vnpp4s2) * RTOG 0116 [[Small IJROBP '07](https://www.ncbi.nlm.nih.gov/pubmed/17398031), [IJCG '11](https://www.ncbi.nlm.nih.gov/pubmed/21892091)]: Phase I/II. EFRT/B/CDDP ± amifostine. *40% late G3/4 toxicity.* [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.2s9lxocmlkr1) * EMBRACE I [[Fortin BT '16]](https://www.brachyjournal.com/article/S1538-4721(16)30054-X/fulltext): IS/IC BT for parametrial involvement [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.efhwb1dgreff) * EMBRACE I [[Mazeron RTO '16](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.hi7c3wdz8bwq)]: Limit the rectal D2cc to ≤ 69.5 Gy EQD2 for around 10% late G2+ rectal morbidity. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.efhwb1dgreff) * EMBRACE I [[Ujaimi BT '17]](https://www.sciencedirect.com/science/article/pii/S1538472117303938?via%3Dihub): Limit the rectal V55 < 11 cc to minimize late G2+ rectal morbidity. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.efhwb1dgreff) * EMBRACE I [[Kircheiner RTO '16](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=kix.lb7csgs1k37)]: Limit the rectovaginal D2cc to ≤ 65 Gy EQD2. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.efhwb1dgreff) |

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### Cervical

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| **This Summary Box was made possible by the ACRO Resident Committee.**  **A more comprehensive collection of resources for all disease sites may be found at** [**http://www.acro.org/**](http://www.acro.org/)  Zaorsky: [[Gyn staging](https://twitter.com/NicholasZaorsky/status/1219773291528884229?s=20)], [[Comparison of surgeries](https://twitter.com/NicholasZaorsky/status/1221824856834158592?s=20)], [[Gyn nodes AP](https://twitter.com/NicholasZaorsky/status/1221823861978693632?s=20), [Lat](https://twitter.com/NicholasZaorsky/status/1221824276740956162?s=20)], [[Cervical staging](https://twitter.com/NicholasZaorsky/status/1221828307068604417?s=20)], [[Cervical EBRT](https://twitter.com/NicholasZaorsky/status/1222649051235127296?s=20)], [[Cervical BT](https://twitter.com/NicholasZaorsky/status/1222648780903849986?s=20)].  ARRO: [[Cervical cancer](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/Content_Pieces/CervicalCancer.pdf)].  Contouring:   * eContour: [[AVARO cervix](http://econtour.org/cases/84)], [[post op cervix](http://econtour.org/cases/55)], [[EMBRACE 2 cervix](http://econtour.org/cases/111)] and [[NRG cervix](http://econtour.org/cases/38)]. * Female Normal Pelvis Atlas [[RTOG Contouring Atlases](https://www.nrgoncology.org/ciro-gynecologic)] * Improving target volume delineation in intact cervical cancer [[Eminowicz PRO '16](https://www.ncbi.nlm.nih.gov/pubmed/27032573)]. * Consensus guidelines for delineation of CTV for IMRT for definitive tx of cervix cancer [[Lim IJROBP '11]](https://www.ncbi.nlm.nih.gov/pubmed/20472347). * Consensus guidelines for delineation of CTV in Endo/Cervical PORT [[RTOG Gyn Atlas](http://www.rtog.org/corelab/contouringatlases/gyn.aspx), [Small IJROBP '09](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2752724/)]. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.8tjrn056kqnl) * Comparison and CTV consensus for CT and MR-based BT in L-A Cervical Ca [[RTOG Atlas](https://www.nrgoncology.org/ciro-gynecologic), [Viswanathan IJROBP '14](https://www.redjournal.org/article/S0360-3016(14)03328-8/fulltext)] [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=kix.8yrje68n0x79)   Review Articles   * Gynecologic Malignancies [[Suneja and Viswanathan Heme/Onc Clin N. Amer '20](https://www.sciencedirect.com/science/article/pii/S088985881930111X?via%3Dihub)] [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.t4kv4aacj9qi)   Society Guidelines   * ASCO Guideline: Mgmt [and Care of Women with Invasive Cervical Ca Resource-Stratified Guideline](https://www.asco.org/research-guidelines/quality-guidelines/guidelines/gynecologic-cancer#/11801) *May 25, 2016* * Society of Gynecologic Oncology (SGO) [[Guidelines]](https://www.sgo.org/clinical-practice/guidelines/) * FIGO Report: Cancer of the cervix uteri [[Bhatla IJGO '18](https://www.ncbi.nlm.nih.gov/pubmed/30306584)] * [[ESMO Guidelines](https://www.esmo.org/guidelines/gynaecological-cancers)] for Gynecological Cancers. * ESGO-ESTRO-ESP guidelines for the management of patients with cervical cancer [[June '18]](https://link.springer.com/article/10.1007%2Fs00428-018-2362-9) [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.a6plw395yelu) * ABS:   + ABS Consensus Guidelines [[Viswanathan BT '12]](https://www.sciencedirect.com/science/article/pii/S1538472111003527): Part I: General principles. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.l14oefxoqiz)   + ABS Consensus Guidelines [[Viswanathan BT '12]](https://www.sciencedirect.com/science/article/pii/S1538472111003515): Part II: HDR BT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.1vb7u8jdcrdy)   + ABS Consensus Guidelines [[Lee BT '12](https://www.ncbi.nlm.nih.gov/pubmed/22265438)]: Part III: LDR and PDR BT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.cj81a18qu433)   + ABS Task Group [[Albuquerque BT '19](https://www.sciencedirect.com/science/article/pii/S1538472118306305?via%3Dihub)] Compendium of fractionation schedules for Gyn HDR BT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.hs48ru8dcnxy)   Relevant Accessible Radiation Protocols:   * TIME-C/RTOG 1203 [[Protocol (Supplement) Klopp JCO '18](http://ascopubs.org/doi/full/10.1200/JCO.2017.77.4273)]: Cervix/Endo (M)RH→ WPRT vs. IMRT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=kix.nqh4mp4cd7f2) * RTOG 0418 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?study=0418)] for post-operative cervical and endometrial. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=kix.n1e5fah4ao76) * OUTBACK / ANZGOG 0902 / GOG 0274 / RTOG 1174 [[Protocol](https://www.rtog.org/clinicaltrials/protocoltable/studydetails.aspx?action=openFile&FileID=10105)]: Phase III. (WPRT/EFRT)/B→ ± CarboP x4c. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.tgrkocfn51fu) * RTOG 0116 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileID=7534)]: Phase I/II. EFRT/B/CDDP ± amifostine. *Extended field with 3D is too toxic.* [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.2s9lxocmlkr1) * RTOG 0417 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&FileId=4625)]: Phase II→ CCRT/B + Bevacizumab. *1/3 fail above WPRT field in pAO nodes.*  [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.gsbf2k20udq7)   + RTOG 09-21 [[Viswanathan Cancer '15](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4685031/), ['16](https://www.redjournal.org/article/S0360-3016(16)30456-4/fulltext)][RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.eshihl13t11t) demonstrated IMRT high nodal boosts are safe. * EMBRACE II [[Pötter CTRO '18]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5862686/) aims to benchmark high level of local, nodal, and systemic control with IGABT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.n9hc7b9umqu)   Quality of Life/Toxicity:   * TIME-C/RTOG 1203 [[Yeung JCO '20](https://www.ncbi.nlm.nih.gov/pubmed/32073955)]: (M)RH→ 3D-WPRT vs. IMRT. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=kix.nqh4mp4cd7f2) * RTOG 9001 [[Eifel JCO '04](http://ascopubs.org/doi/abs/10.1200/JCO.2004.07.197?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed)]: EFRT/B vs. CCWPRT/B. *Acute toxicity with CCRT worse initially, evens out in long run.* [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.tasa0vnpp4s2) * RTOG 0116 [[Small IJROBP '07](https://www.ncbi.nlm.nih.gov/pubmed/17398031), [IJCG '11](https://www.ncbi.nlm.nih.gov/pubmed/21892091)]: Phase I/II. EFRT/B/CDDP ± amifostine. *40% late G3/4 toxicity.* [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.2s9lxocmlkr1) * EMBRACE I [[Fortin BT '16]](https://www.brachyjournal.com/article/S1538-4721(16)30054-X/fulltext): IS/IC BT for parametrial involvement [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.efhwb1dgreff) * EMBRACE I [[Mazeron RTO '16](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=id.hi7c3wdz8bwq)]: Limit the rectal D2cc to ≤ 69.5 Gy EQD2 for around 10% late G2+ rectal morbidity. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.efhwb1dgreff) * EMBRACE I [[Ujaimi BT '17]](https://www.sciencedirect.com/science/article/pii/S1538472117303938?via%3Dihub): Limit the rectal V55 < 11 cc to minimize late G2+ rectal morbidity. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.efhwb1dgreff) * EMBRACE I [[Kircheiner RTO '16](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#bookmark=kix.lb7csgs1k37)]: Limit the rectovaginal D2cc to ≤ 65 Gy EQD2. [RoR](https://docs.google.com/document/d/1X-MmBeoIl3IECEGIUVV4sFz_AR_s5AEQb8Xsx4szmJg/edit#heading=h.efhwb1dgreff) |

### Vaginal/Vulvar

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## Sarcoma

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[RoR](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#bookmark=id.u8ch1u49og3r) * RTOG 0630[[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&Fil%20eID=9379)]: **Pre-op 3D** [[NCIC](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#bookmark=id.13fpkt8syajl)] **vs. IMRT**. 50/25. [RoR](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#bookmark=id.203njngpimdd) * CAN-NCIC-SR2 (Methods>Procedures) [[O'Sullivan Lanc '02](https://www.sciencedirect.com/science/article/pii/S0140673602092929?via%3Dihub)]. Preop vs PostOp extremity STS .[RoR](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#bookmark=id.13fpkt8syajl)   Quality of Life/Toxicity   * CAN-NCIC-SR2 (Tables 2/3) [[O'Sullivan Lanc '02](https://www.sciencedirect.com/science/article/pii/S0140673602092929?via%3Dihub)]. Preop vs PostOp extremity STS.[RoR](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#bookmark=id.13fpkt8syajl) * RTOG 0630 (Table 3) [[Wang JCO '15](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4486342/)] IGRT for extremity STS toxicity. [RoR](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#bookmark=id.203njngpimdd) * Pre-op IMRT flap avoidance decreases the rate of LE wound complications from 43→ 30% [[O'Sullivan Cancer '13](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#bookmark=kix.pb06s79tdjvu)]. [RoR](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#bookmark=kix.pb06s79tdjvu)   **Retroperitoneal**  Contouring   * ARRO: [[Retroperitoneal Sarcoma](https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROcaseRPSarcoma.pdf)] * Treatment Guidelines for Preop RT of Retroperitoneal Sarcomas [[Baldini IJROBP '15](https://www.redjournal.org/article/S0360-3016(15)00180-7/abstract), [2017 ASTRO Refresher](https://www.astro.org/uploadedFiles/_MAIN_SITE/Meetings_and_Education/ASTRO_Meetings/2017/Annual_Refresher_Course/Content_Pieces/Sarcomas-Baldini.pdf)] * NRG retroperitoneal sarcoma target volume and OAR agreement [[Baldini IJROBP '15](https://www.ncbi.nlm.nih.gov/pubmed/26194680)]   Review Articles   * RT in Retroperitoneal Sarcoma Management [[Haas JSO '17](https://onlinelibrary.wiley.com/doi/pdf/10.1002/jso.24892)]. [RoR](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#heading=h.oejspbehx9b8)   Society Guidelines   * [[ESMO Guidelines](https://www.esmo.org/Guidelines/Sarcoma-and-GIST)] for Sarcoma and GIST. * Transatlantic Australasian Retroperitoneal Sarco˜ma Working Group [[Papers](https://tarpswg.org/papers-from-tarpswg/)] * ABS Consensus Statement for Sarcoma Brachytherapy [[Holloway ABS 13](https://www.americanbrachytherapy.org/consensus-statements/other/)]   Relevant Accessible Radiation Protocols   * RTOG 0124 [[Protocol](https://www.rtog.org/ClinicalTrials/ProtocolTable/StudyDetails.aspx?action=openFile&Fil%20eID=7540)]. Multimodality treatment in primary/recurrent RP sarcoma. * CAN-NCIC-SR2 (Methods>Procedures) [[O'Sullivan Lanc '02](https://www.sciencedirect.com/science/article/pii/S0140673602092929?via%3Dihub)]. Preop vs PostOp extremity STS .[RoR](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#bookmark=id.13fpkt8syajl)   Quality of Life/Toxicity   * Retroperitoneal preoperative SIB IMRT + IORT (Tables 4/5) [[Roeder BMC Cancer '14](https://www.ncbi.nlm.nih.gov/pubmed/25163595)] . [RoR](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#bookmark=id.o4newt6jv7wi) * Toronto [[Wong Cureus '17]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5724811/): Cross-sectional retroperitoneallong-term QoL after preoperative RT and surgery. [RoR](https://docs.google.com/document/d/1eal6YYRhPGwh4_R5MPQdioLZLapJBSIAXZjuO3IeU6M/edit#bookmark=id.ut210rk1hfa5) |

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| [Pediatrics](#_yrs27vvto6ww) | **Conventional** | **Wilms** | **RMS** | **NB** | Notes |
| Brain | See the [[IQ dysfunction](#ickfcm9eo4u6)] section below. |  |  |  | Cognitive dysfunction in children is largely seen for whole brain doses of ≥ 18 Gy. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03287-8/fulltext) |
| Brainstem | 57.8 Gy (ependymoma, if residual disease) |  |  |  | 56.6 Gy CGE is associated with > 10% toxicity. See the [[Indelicato](#eknd2rdf9bf)] study. |
| Circle of Willis | 10 Gy[El-Fayech IJROBP '17](https://www.ncbi.nlm.nih.gov/pubmed/28068236) |  |  |  | See the [[Cardiac Toxicity](#flc0evbdwwgt)] section below. |
| Spinal cord | 45 Gy |  | 45 Gy [ARST 1431](http://rpc.mdanderson.org/rpc/credentialing/files/ARST1431_ProtocolDoc_032216.pdf) |  |  |
| OC/ON | 46.8 Gy |  | 46.8 Gy  54 Gy [ARST 1431](http://rpc.mdanderson.org/rpc/credentialing/files/ARST1431_ProtocolDoc_032216.pdf) |  | D0.1cc of 52.7 / 56.6 / 58.3 CGE with 1→ 5→ 10% risk of visual decline.[Bates ASTRO '19](https://www.eventscribe.com/2019/ASTRO/fsPopup.asp?Mode=presInfo&PresentationID=579997) Adults optic neuropathy rates for 55 / 60 / 60+ Gy of 3→ 7→ 7-20%. [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03284-2/fulltext) |
| Cochlea | Mean < 35 Gy  30 Gy (50%) |  |  |  | Risk of hearing loss < 5% if cochlea received ≤ 35 Gy, increasing to ~30% for 50 Gy.[Yock ASTRO '19](https://www.eventscribe.com/2019/ASTRO/fsPopup.asp?Mode=presInfo&PresentationID=559439)  Children < 5y may be at highest risk of developing RT-related hearing loss.[Yock ASTRO '19](https://www.eventscribe.com/2019/ASTRO/fsPopup.asp?Mode=presInfo&PresentationID=559439)  Adults mean cochlear dose of 45 Gy with < 30% risk of SNHL (similar to 14/1). [QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03298-2/fulltext)  Adults mean cochlear dose of 32 Gy with < 20% risk of G2+ tinnitus. [Lee Rad Onc '15](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4574090/) |
| Pituitary | 18 Gy |  | 18 Gy |  | Doses 18-24 Gy are associated with precocious or delayed puberty [[Hudson Obstr Gyn '16](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4729296/)]  More than 30 Gy may cause gonadotropin insufficiency and lack of pubertal onset.  GH 10-18 Gy; LF/FSH 30-40 Gy, TSH and ACTH >30 Gy.  GH deficiency for 18 / > 35 Gy of 0→ 100%. |
| Lens | 14.4 Gy |  | 14.4 Gy [ARST 1431](http://rpc.mdanderson.org/rpc/credentialing/files/ARST1431_ProtocolDoc_032216.pdf) |  |  |
| Lacrimal gland | 30 Gy |  | 41.4 Gy [ARST 1431](http://rpc.mdanderson.org/rpc/credentialing/files/ARST1431_ProtocolDoc_032216.pdf) |  |  |
| Thyroid | >15 Gy = 30% insuff  26 Gy (20%)  25 Gy (62.5%) |  | 30.6 Gy |  | Thyroid >15 Gy associated with a 30% risk of thyroid insufficiency. *Thyroid abnormalities are more common >26 Gy.* |
| Larynx | Block at 19.8 Gy when necessary for HL. |  |  |  |  |
| Breast tissue | 4 Gy (5-10 Gy) |  |  |  | Breast tissue growth and development affected at 5-10 Gy. |
| **Heart** | Mean < 5 Gy (15 Gy) |  | 30 Gy | ALARA [0532](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.snv62ndbowel)/[1531](https://www.qarc.org/COG/Neuroblastoma_.pdf) | Block apex at 15 Gy, and all at 30 Gy for HL. |
| **Left ventricle** | Mean < 2 Gy (10 Gy) |  |  |  |  |
| **Lung** | 20 Gy (37%)  Mean < 12 Gy |  | 15 Gy (100%) [ARST 1431](http://rpc.mdanderson.org/rpc/credentialing/files/ARST1431_ProtocolDoc_032216.pdf)  20 Gy (20%) [ARST 1431](http://rpc.mdanderson.org/rpc/credentialing/files/ARST1431_ProtocolDoc_032216.pdf) | 15 Gy (33%) [0532 - old school](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.snv62ndbowel)  20 Gy (30%)[1531 - new school](https://www.qarc.org/COG/Neuroblastoma_.pdf)  Ipsi 20 Gy (30%)[1531 - new school](https://www.qarc.org/COG/Neuroblastoma_.pdf)  Contra 20 Gy (10%)[1531 - new school](https://www.qarc.org/COG/Neuroblastoma_.pdf) | WLI 15/10 for > 7y (i.e., Ewings, RMS)  WLI 12/8 if < 7y (i.e., Wilms)  WLI 10.5/7 if < 1y (i.e., super young Wilms) |
| Small bowel | 45 Gy |  |  |  |  |
| **Kidney** |  |  | 14.4 Gy (100%) [ARST 1431](http://rpc.mdanderson.org/rpc/credentialing/files/ARST1431_ProtocolDoc_032216.pdf)  24 Gy (50%) [ARST 1431](http://rpc.mdanderson.org/rpc/credentialing/files/ARST1431_ProtocolDoc_032216.pdf) | Mean 14.4 Gy[0532 - old school](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.snv62ndbowel)  19.8 Gy (50% each)[0532 - old school](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.snv62ndbowel) | 14.4 Gy appears to be ok, only causing renal hypoplasia [Kandula Peds blood cancer '15](https://onlinelibrary.wiley.com/doi/full/10.1002/pbc.25372) |
| Ipsilateral kidney |  |  | D25 < 18 Gy  D100 < 14.4 Gy | 14.4 Gy (100%)[0532](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.snv62ndbowel)/[1531](https://www.qarc.org/COG/Neuroblastoma_.pdf)  Mean 18 Gy [1531 - new school](https://www.qarc.org/COG/Neuroblastoma_.pdf)  18 Gy (75%)[1531 - new school](https://www.qarc.org/COG/Neuroblastoma_.pdf)  19.8 Gy (50%)[0532 - old school](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.snv62ndbowel) | WART 24/16 with kidney blocking (i.e., Ewings, RMS).  14.4 Gy appears to be ok, only causing renal hypoplasia [Kandula Peds blood cancer '15](https://onlinelibrary.wiley.com/doi/full/10.1002/pbc.25372) |
| Contralateral kidney |  | 19.8 Gy AREN 0533  14.4 Gy (33%) AREN 0533 | 23.4 Gy | 18 Gy (25%)[1531 - new school](https://www.qarc.org/COG/Neuroblastoma_.pdf)  12 Gy (20%)[0532 - old school](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.snv62ndbowel)  8 Gy (50%)[0532 - old school](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.snv62ndbowel) | WART 10.5/7 (Wilms), TD 5/5 of 23 Gy (Wilms) |
| **Liver** |  | Uninvolved:  19.8 Gy (50%) AREN 0533  23.4 Gy AREN 0533  Liver mets:  D75 ≤ 30.6 Gy | 23.4 Gy [ARST 1431](http://rpc.mdanderson.org/rpc/credentialing/files/ARST1431_ProtocolDoc_032216.pdf)  30 Gy (50%) [ARST 1431](http://rpc.mdanderson.org/rpc/credentialing/files/ARST1431_ProtocolDoc_032216.pdf) | Mean 15 Gy[1531 - new school](https://www.qarc.org/COG/Neuroblastoma_.pdf)  30 Gy (15%)[1531 - new school](https://www.qarc.org/COG/Neuroblastoma_.pdf)  18 Gy (25%)[0532 - old school](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.snv62ndbowel)  9 Gy (50%)[0532 - old school](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.snv62ndbowel) | WART 24/16 with kidney blocking (i.e., Ewings, RMS)  WART 10.5/7 (Wilms)  Liver + 2 cm to 19.8/11 if involved (Wilms)  There appears to be no acute or late liver toxicity with 9 Gy to 50% of the liver. [Kandula Peds blood cancer '15](https://onlinelibrary.wiley.com/doi/full/10.1002/pbc.25372) |
| **Pancreas** |  |  | 10 Gy | 10 Gy[0532](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.snv62ndbowel)/[1531](https://www.qarc.org/COG/Neuroblastoma_.pdf) | Diabetes is seen with pancreas tail > 10 Gy. |
| **Soft tissue** | 25-30 Gy |  |  |  |  |
| **Bone** | 12 Gy |  |  |  | Bone growth affected starting at 8 Gy. Premature closure of epiphyseal plates >20 Gy. |

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| **ILROG Guidelines for Pediatric HD** [[Hodgson PRO '15](https://www.sciencedirect.com/science/article/pii/S1879850014001179?via%3Dihub)]  **Italian Expert Consensus on IMRT to the Mediastinum♱** [[Filippi Rad Onc '20](https://www.ncbi.nlm.nih.gov/pubmed/32164700)]  See the [[A note on Pediatric Hodgkin's Lymphoma](https://docs.google.com/document/d/1gKy2Hpx7FxInjOpKIBkTFJWpqhJ3I-gSXz9eRwq-NSY/edit#bookmark=id.8uj1461dcmqy)] Summary Box.  Newer [[ILROG guidelines](https://docs.google.com/document/d/1gKy2Hpx7FxInjOpKIBkTFJWpqhJ3I-gSXz9eRwq-NSY/edit#bookmark=id.gq1ic3qggdvh)] from 2020 essentially highlight the ease and importance of mean dose of OARs less than 5 Gy!  The [[EORTC-LYSA analysis](https://docs.google.com/document/d/1gKy2Hpx7FxInjOpKIBkTFJWpqhJ3I-gSXz9eRwq-NSY/edit#bookmark=id.wd0qpuiowed7)] suggested one cycles of anthracyclines is equivalent to 5 Gy mean heart dose  TL; DR - 5 Gy isodose lines matter! Regardless of whether it is pediatric or adults, HL or NHL.   * Target original extent of disease. Effectively describes ISRT without explicitly endorsing it. * Suggested constraints: Many dose limitations on the higher end are in the relapsed/refractory setting ቷ [[Wirth IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/32272184)].   + Heart: Mean < 5 Gy (15 Gy♱). V15 < 10% (25-35%)ቷ, V30 < 15% (20%)ቷ. Avoid coronary arteries and LV.     - Left ventricle < 2 Gy♱ (10 Gy)♱   + Lung: V20 < 20% (30 - 35%♱). V5 < 35% (55 - 60%♱). Mean < 8ቷ - 10 Gy**♱** (12-13.5 Gy**♱**).     - Ideally, limit V20 < 30%. Pneumonitis is uncommon with V24 < 30% except when used with bleomycin.   + Whole breast < 4 Gy (15 Gy). V4 < 10% (20%). V10 < 10%. Absolute: V5 < 55-60%.     - Breast tissue growth and development affected at 5-10 Gy.   + Thyroid V25 < 62.5%. V5 < 93%**♱**. V20 < 82%**♱**. V25 < 63%**♱** (70%**♱**). V30 < 62%**♱**. 2.2 mL < 25 Gy**♱**.     - Thyroid abnormalities are more common >26 Gy. *Around 65-75% risk of abnormal thyroid function.*     - Thyroid mean >15 Gy associated with a 30% risk of thyroid insufficiency.   + ST growth and development affected at 25-30 Gy. *Or, even at less than 25 Gy if age < 10 yo.*     - ST growth is only affected slightly if receiving < 20 Gy and age > 10 yo.   + Bone growth affected starting at 8 Gy.   + Premature closure of epiphyseal plates > 20 Gy.     - Dental abnormalities with doses of 20-40 Gy.     - Jaw dysfunction was more severe when the pterygoid and masseter received mean ≥ 20 Gy.[Tinkle IJROBP ‘20](https://www.ncbi.nlm.nih.gov/pubmed/31987969)     - Scoliosis at 15y for ± 24 Gy of ~35→ 70%, though severe physical and functional deformity uncommon.   + Orbital hypoplasia with mean bony orbit dose ≥ 30 Gy.[Tinkle IJROBP ‘20](https://www.ncbi.nlm.nih.gov/pubmed/31987969)   + FH: > 25 Gy increases risk of SCFE, and doses > 30-40 Gy increases risk of AVN. |

**IQ dysfunction**

See [[IQ Toxicity](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.kngxmosoyn6j)] section in pediatrics for more.

* “Cognitive dysfunction in children is largely seen for whole brain doses of ≥ 18 Gy” [[QUANTEC](https://www.redjournal.org/article/S0360-3016(09)03287-8/fulltext)].
* In the 1980s, patients with ALL received > 20 Gy WBRT. Late toxicity was associated with doses above 20 Gy, especially for patients who were ≤ 3-5y at the time of WBRT. Modern regimens for ALL CNS treatment prefer to tiptoe under the “20 Gy Line” with 18/10. See [[ALL](https://docs.google.com/document/d/1gKy2Hpx7FxInjOpKIBkTFJWpqhJ3I-gSXz9eRwq-NSY/edit#heading=h.dix8o3c34tab)] section for more.
* Children younger than 3-5y at time of RT appear to suffer from the greatest incremental decline in IQ, even 10 years out [[Hoppe-Hirsch Childs NS '90](https://link.springer.com/article/10.1007/BF00307922)]
* Post-surgical complications are a major contributing factor in IQ decline as well.

**Gonadal toxicity**

See [[Male gonadal Toxicity](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.xgsj6soryfpg)] and [[Female gonadal Toxicity](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.ew2qyukh5jj7)] in the pediatrics section for more.

See [[toxicity](https://docs.google.com/document/d/1j15zXLBPWwqty60Slm2jnHEiqaoT2iw5Gapp4iMWJsw/edit#heading=h.o8ghxjym8kv4)] section of testicular seminoma section for more information.

* Alkylating agents are associated with male and female infertility.
  + This includes cyclophosphamide (used in ABVE-PC) and dacarbazine (used in ABVD).
* **Testicles**: Permanent sterility **> 6 Gy single dose** or **3 Gy fractionated**.
  + Infertility is likely above 2-3 Gy. Perhaps more prolonged azoospermia if fractionated (e.g. 6/3 is worse than 6/1).
* Around 1% of pAO goes to the testicles, while around 2% goes to contra testicle with dog-leg. Clamshell decreases dose by 2-3 times [[Bieri Rad Onc '99]](https://www.sciencedirect.com/science/article/pii/S0167814099000237?via%3Dihub).
  + For dogleg, 4→ 1.5 cGy/fx. *Clamshell reduces dose to ~1% of 180 cGy/fx.*
  + For PA, 2→ 0.7 cGy/fx.
  + With clamshell, most pts will have oligospermia which tends to resolve within 4 mo to ~1y.
  + Have your patients wait at least 6 months before trying to have kids.
* The sperm maturation process takes a little over 2 mo. With clamshell and dog-leg, most pts will have oligospermia from 4 mo to ~1y.
  + 0.2-0.5 Gy temporary azoospermia, 0.5-1 Gy long-term azoospermia, 2-3 Gy sterilization.
  + 0.15-0.2 Gy little effect. *Think: pAO fields.*
  + **0.2-0.5 Gy temporary** azoospermiain 20-60%, recovers in 6-8 mo. *Think: Dogleg fields.*
  + 0.5-1 Gy prolonged azoospermia in 50-80%, recovers in 8-14 mo.
  + 1-2 Gy chronic azoospermia in 90-100%, recovers in 12-24 mo.
  + **2 Gy** **permanent** sterilization.
* Most kiddos will have testosterone deficiency after standard TBI doses (e.g., 12/6). Testosterone deficiency unlikely < 12 Gy [[Skinner Lanc Onc '17](https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(17)30026-8/fulltext)].
* Uterine damage (e.g. damage to musculature, vasculature or endometrium) is most severe before menarche, raising the incidence of stillborn above 10% with ≥ 2.5 Gy to the uterus before menarche [[Signorello Lancet '10](https://www.ncbi.nlm.nih.gov/pubmed/20655585)].
* Uterine damage is much different than oocyte damage. Oocytes are radioresistant at birth.
* Effective sterilizing dose at birth / 10y / 20y / 30y of 20→ 18→ 16→ 14 Gy [[Skrzypek AAEM '19](https://www.ncbi.nlm.nih.gov/pubmed/31885235)].
* **CCSS and SJLIFE: Predicting acute ovarian failure in female survivors** [[Clark Lanc Onc ‘20](https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(19)30818-6/fulltext)]

An [online calculator](https://ccss.stjude.org/tools-and-documents/calculators-and-other-tools/ccss-ovarian-risk-calculator.html) has been developed for the acute ovarian failure risk prediction calculator.

TBL [QS](http://www.quadshotnews.com/2020/02/preserved.html): Hard numbers can help patients decide when to pursue pre-treatment fertility preservation.

**Cardiac toxicity and Stroke risk**

See the [[reduction in breast and heart dose](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.j1llce7s6gd9)] with ISRT, as mean female breast dose is reduced on average from 18→ 4 Gy while mean heart dose 32→ 12 Gy.

Newer [[ILROG guidelines](https://docs.google.com/document/d/1gKy2Hpx7FxInjOpKIBkTFJWpqhJ3I-gSXz9eRwq-NSY/edit#bookmark=id.gq1ic3qggdvh)] from 2020 essentially highlight the ease and importance of mean dose of OARs less than 5 Gy!

The [[EORTC-LYSA analysis](https://docs.google.com/document/d/1gKy2Hpx7FxInjOpKIBkTFJWpqhJ3I-gSXz9eRwq-NSY/edit#bookmark=id.wd0qpuiowed7)] suggested one cycles of anthracyclines is equivalent to 5 Gy mean heart dose

TL; DR - 5 Gy isodose lines matter! Regardless of whether it is pediatric or adults, HL or NHL.

See the [[Cardiac Toxicity](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.qev0412w1zn6)] section in the Pediatric section for more.

* **By the age of 50, around 6% of childhood cancer survivors will experience ischemic heart disease (IHD) or stroke**.[Chow JCO '18](http://ascopubs.org/doi/full/10.1200/JCO.2017.74.8673)
  + Compare this to around 1% of matched siblings who have either IHD or stroke.
    - This is similar to the SIR of 6.0 for subsequent malignant neoplasms as above (~6% vs. ~1%).
  + Either **≥ 35 Gy thoracic RT** or **≥ 50 Gy cranial RT** increases the rate or IHD or stroke to ~15% by age of 50.
  + Less than 20 Gy of cranial RT does not appear to influence the risk of stroke by the age of 50 years.
  + Less than 5 Gy of RT to the heart does not appear to influence the risk of IHD by the age of 50 years.
  + Be wary: The use of an alkylator or thoracic RT ≥ 35 Gy in combination with cranial RT ≥ 30 Gy increases risk of stroke to 20%.
* **Specific examples of risks**: Compare to siblings, who had a ~1% chance of either IHD or stroke.[Chow JCO '18](http://ascopubs.org/doi/full/10.1200/JCO.2017.74.8673)

See the [[Cardiac Toxicity](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.qev0412w1zn6)] section in the Pediatric section for more

* + Ex: 12% risk of IHD ≥ 5 Gy thoracic RT.
  + Ex: **20% risk of IHD if ≥ 35 Gy thoracic RT *and* male**.
  + Ex: 7% risk of stroke if ≥ 20 Gy cranial RT or ≥ 35 Gy thoracic RT.
  + Ex: **20% risk of stroke if ≥ 50 Gy cranial RT** or ≥ 30 Gy cranial RT + (≥ 35 Gy chest RT / an alkylator).
* **St Jude CCSS Cardiovascular Risk Calculator** [**here**](https://ccss.stjude.org/tools-and-documents/calculators-and-other-tools/ccss-cardiovascular-risk-calculator.html).
* 10 Gy to the Circle of Willis appears to contribute to a 11% incidence of stoke by 45 years of age. The 11% risk of stroke with ≥ 10 Gy to willis circle isn’t too far off from the ~7% risk of stroke if ≥ 20 Gy cranial RT from the Chow paper above, which the St. Jude relies on (not circle of Willis dose).[El-Fayech IJROBP '17](https://www.ncbi.nlm.nih.gov/pubmed/28068236)
* Like breast cancer patients, there is an excess relative risk for coronary heart disease of 7.4% for each 1 Gy increase in mean heart dose [[Nimwegen JCO '16](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.4t4uhijcmxpe)]

**Secondary malignancies**

Hopelessly oversimplified, but the SIR of secondary malignancies in pediatrics is around 6 (this excludes secondary neoplasms like G1 meningiomas and SqCC/BCC).

See the [Secondary malignancies] section in the pediatrics section for more.

* Stochastic effects have severity independent of dose (e.g. development of SMNs).
* Usually comprised of two distinct groups:
  + Myelodysplasia and AML: Chemotherapy-related.
    - Brief latent period (< 10y). Related to alkylating agents, anthracycline and etoposide.
  + Solid neoplasms: Predominantly radiation related.
    - Risk of solid subsequent neoplasm escalates with time, with a latency of 20+ years.
    - Cumulative incidence of breast cancer by age 40-45y after mantle field ranges from 13-20%, compared to 1% in the general population. This risk is similar to what is observed for women with a BRCA gene mutation.
* Hodgkin Lymphoma, Ewing sarcoma and hereditary Retinoblastoma have the highest risk for subsequent malignant neoplasms (around 1% per year).
  + **Hodgkin**: Roughly around **1% risk of SMN per year**, does not appear to be affected by RT.
    - The SMN rate at 15y appears to be equivalent with or without RT at 15 years.
    - However, EFRT (which no one does anymore) is associated with increased SMNs, in particular AML, but these differences evened out at long term follow up as chemotherapy is also known to be associated with development of secondary AML.
  + **Ewings**: No association with congenital disease, but may have SMN after chemo such as etoposide (aka VP-16) or RT.
    - Secondary malignancy: **~1%/y** (like hereditary retinoblastoma), 10% over 15 years (primarily sarcoma).
      * Most common SMN after RT is sarcoma: 5% risk at 20y (less with chemo and surgery) [[Kuttesch JCO '96](http://ascopubs.org/doi/abs/10.1200/JCO.1996.14.10.2818)].
      * There appears to be no SMNs if < 40 Gy, while 130/10,000 for > 60 Gy.
  + **Retinoblastoma**: SMN for non-hereditary / hereditary of 0.1→ ≤ 1% per year [[Wong JAMA '97](https://jamanetwork.com/journals/jama/fullarticle/418394)].
    - Secondary malignancy **~1%/y for hereditary** (like Ewings), primarily sarcoma (like Ewings) or melanoma.
      * Most commonly, osteosarcomas.
    - With germline Rb, ~33% not treated with RT and ~66% of pts treated with RT will develop secondary tumors by 50y.
* Pediatric meningiomas are rare, but nearly half are atypical.
  + For 20+ Gy of cranial RT given ≤ 8y, half will develop a meningioma within 20 years.
  + Interestingly, there is a "short" 10y lag time to develop a meningioma if kiddos ~3y of age get cranial RT.
    - Typically, there is an over 20y lag time to development of meningiomas.
  + Despite these risks, screening for meningiomas in kiddos with a history of cranial RT is generally not recommended.
* Men with **GH-secreting** pituitary adenomas have increased rates of SMN after RT (generally, risk is ~1%) [[Norberg Clin Endo '07](https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2265.2007.03118.x)].
* Glioma chemo: For children, VCR and carboplatin is usd for chemo. In adults, add procarbazine (not used in kids bc increased SMN).
* CCSS NF-1 patients have a 2.4x increased risk of subsequent neoplasms versus non NF-1 CCSS patients. Radiation increases that relative risk by around 3 times, and this is more pronounced in patients who are preteen or younger. Therefore, radiation is typically reserved after chemo for younger patients with [[optic pathway gliomas](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.a33mvee8s8im)].
* Higher doses of platinum and alkylating agents are associated with increased SMNs [[Turcotte JCO '19](https://www.ncbi.nlm.nih.gov/pubmed/31622130)].
* There appears to be no difference in secondary malignancies with passively scattered proton CSI vs. photon CSI, but there is a trend to a higher rate of SMNs in the regions of exit dose rather then the target volume with photons. This study only had a short follow up of 10 years [[Paulino ASTRO '19](https://www.eventscribe.com/2019/ASTRO/fsPopup.asp?Mode=presInfo&PresentationID=559422)]

**Secondary Breast Cancer**

See the [[reduction in breast and heart dose](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#bookmark=id.j1llce7s6gd9)] with ISRT, as mean female breast dose is reduced on average from 18→ 4 Gy while mean heart dose 32→ 12 Gy.

Newer [[ILROG guidelines](https://docs.google.com/document/d/1gKy2Hpx7FxInjOpKIBkTFJWpqhJ3I-gSXz9eRwq-NSY/edit#bookmark=id.gq1ic3qggdvh)] from 2020 essentially highlight the ease and importance of mean dose of OARs less than 5 Gy!

The [[EORTC-LYSA analysis](https://docs.google.com/document/d/1gKy2Hpx7FxInjOpKIBkTFJWpqhJ3I-gSXz9eRwq-NSY/edit#bookmark=id.wd0qpuiowed7)] suggested one cycles of anthracyclines is equivalent to 5 Gy mean heart dose

TL; DR - 5 Gy isodose lines matter! Regardless of whether it is pediatric or adults, HL or NHL.

* There is an additive effect between RT and anthracycline use. See the [[Secondary Breast Cancer](https://docs.google.com/document/d/17O0LOemBhckXGuuPBCh6u8vqBfc6lg88r46B8YctMXU/edit#heading=h.cst7hj7d25r)] section in pediatrics for more.
* VB: minimal 18 Gy if overlaps with PTV.
* Spine: 36 Gy after induction with bleomycin and mitomycin.
* Diabetes: >10 Gy to pancreatic tail.

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| **Extremity/Other** | **Conventional** | **FSRS** | **SRS** |
| Anus/Vulva | V30 < 50% |  |  |
| Testis | V3 < 50% |  |  |
| Femoral neck | V60 < 5%  45 Gy.  Mean < 37 Gy.  V40 < 75% |  |  |
| Joint/bone | V50 < 50%  V30 < 50% |  |  |
| Skin strip (1 cm) | V20 < 50% |  |  |
| Plan eval | PTV97% > 99%  PTV110% < 20% |  |  |

* Premature closure of epiphysis at >20 Gy.
* Ablation of bone marrow at ≥ 40 Gy.
* Increased risk of fracture with ≥ 50 Gy to bone cortex.
  + Risk may be reduced by limiting V40 < 64%, mean bone dose <37 Gy, and bone Dmax < 59 Gy.
* Exclude joint space after 40-45 Gy to avoid fibrotic constriction.

# [Treatment of Toxicity](#_bvprouf2ng3w)

### Skin

* Management of Skin Toxicity [[Handout](https://www.sor.org/sites/default/files/images/5056_-_sor_design_doc_a_patient_infosheet_-_skin_care_a5_leaflet_z-fold_printready.pdf)]

### CNS

### H&N

### Thorax

* Who cares about rib toxicity? Most heal on their own without intervention[[Park J GE Hepatol '20](https://www.ncbi.nlm.nih.gov/pubmed/32052884)]

### Abdomen

### Pelvis

### Peds

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| --- |
| **Clinical Pearls: CNS Toxicity**   * If you're ever pushing SRS/SBRT constraints, the best answer for boards (and most of the time in clinical practice) is to conventionally fractionate. If SRS or SBRT is done carelessly, then kiss that license goodbye. * Keep in mind that Initial SRS/SBRT constraints were based off of 45 Gy conventional fractionation to the cord. This is despite [Quantec data](https://www.ncbi.nlm.nih.gov/pubmed/20171517) that demonstrates ≤ 1% RM for cord Dmax ≤ 54 Gy with conventional fractionation. Generally speaking, 54 Gy is "safe" as a point dose within the CNS, although cord toxicity is up to 1%. * General rules of thumb for CNS toxicity with conventional: **6**0 Gy has a ≤ **6**% chance of optic neuropathy or stem/cord permanent toxicity. There is at least 2x the rate of toxicity at doses above 66 Gy, unless peripheral nerves. Doses of 54 differ: There is < 1% toxicity for the cord, while for 55 Gy to the OC/ON, there is < 3% toxicity.   **Brain**   * SRS: Limit normal brain receiving 12 Gy to 8-8.5 cc, otherwise consider hypofractionated treatment [[Blonigen IJROBP '10](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.zd9ese6mzhea), [Minniti Rad Onc '11](https://docs.google.com/document/d/1CfbqB4YnaPB8U3r2LykLv2v3bRLJyYQV0tvX4Js2Mog/edit#bookmark=id.9frr833stuhc)]. * SBRT: 25/5 as a point dose is "safe" anywhere in the body.   + For 3 fraction, limit the normal brain receiving 18 Gy to 30 cc or 24 Gy to 16.8 cc to keep late asymptomatic radionecrosis to ≤ 10%.   + For 5 fraction, limit the normal brain receiving 30 Gy to 10.5 cc and 33.5 Gy to 0.05 cc to keep late asymptomatic radionecrosis to ≤ 10%.   + The best part about the above constraints is algorithm-based VMAT can commonly meet goals. Commonly, 27-30/3 and 30-35/5 are prescribed, but there is an association of toxicity with 30/3 and 35/5 when the above constraints are not taken into account. * Conventional: Symptomatic necrosis for 60 / 72 / 90 Gy of < 3→ 5→ 10%. QUANTEC   **Optic Chiasm**   * SRS: 8 Gy is safe. 12 Gy with 10% incidence of optic neuropathy. QUANTEC Newer data suggests 12 Gy is now considered "safe", but still ballsy [[Pollock NS '14]](https://academic.oup.com/neurosurgery/article-abstract/75/4/456/2447765?redirectedFrom=fulltext). * SBRT: 25/5 as a point dose is "safe" anywhere in the body. * Conventional: Optic neuropathy rates for 55 / 60 / 60+ Gy of 3→ 7→ 7-20%. QUANTEC   **Cord**   * SRS: Generally speaking, 14 Gy to the cord is acceptable. [HyTEC 2019](https://www.ncbi.nlm.nih.gov/pubmed/31606528) * SBRT: 25/5 as a point dose is "safe" anywhere in the body. * Conventional: 5y spinal cord myelopathy for 50 / 54 / 60 / 69 Gy of 0.2→ 1→ 6→ 50%.QUANTEC   **Brainstem**   * SRS: 12.5 Gy has < 5% permanent cranial neuropathy or necrosis. * SBRT: 30/5 may be acceptable as a point dose within a tumor, but try to limit it to 25/5 - or even less (i.e., 23 Gy). Better yet, fractionate! * Conventional: 59 Gy to 1-10cc has < 5% rate of permanent cranial neuropathy or necrosis.   **Plexuses**   * SRS: 16 Gy is safe. These are peripheral nerves, therefore the loose "12 Gy rule" for SRS in the brain does not apply. * SBRT: 30/5 as a point dose is "safe". These are peripheral nerves, therefore the loose "25/5 Gy rule" for SBRT in the brain does not apply. * Conventional: 66 Gy is "safe". 70 Gy is pushing it. These are peripheral nerves, therefore the loose "54 Gy rule" for conventional in the brain. |

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# [CNS Toxicity and Reirradiation](#_bvprouf2ng3w)

See the Summary Box above.

* **University of Florida symptomatic brainstem injury in peds** [[Indelicato Acta Onc '14](https://www.tandfonline.com/doi/full/10.3109/0284186X.2014.957414)]: Proton therapy. **> 50.4 CGE to the brainstem**.

UVA demonstrated age < 5y, posterior fossa location and dosimetric factors to be associated with increased risk of toxicity.

Doses above 56.6 Gy are associated with double-digit braintem toxicity.

* + 313 pts. 2007-2013. All patients < 18y with tumors of the brain or skull base. Median age 6y. MFU 2y.
    - Brainstem contour from inferior edge of third ventricle and optic tracts to the foramen magnum.
  + 2y cumulative incidence of toxicity 4%. 2y cumulative incidence of G3+ toxicity 2%. At the time of analysis, symptoms had stabilized or resolved in 9 of 10 living patients.
  + Median time to symptom onset of 3 mo (range 2 - 12 mo).
  + Patients ± 5y with brainstem toxicity 1→ 7%.
  + Mean brainstem V54 CGE was 26%. Mean D10 / D50 / D90 of 51.3→ 37.4→ 18.2 CGE.
  + Symptomatic brainstem injury for ± 56.6 Gy dmax of 2→ 11%
    - Also true for tumors in posterior fossa, D50% > 52.3 Gy, D10% > 55.4 Gy, and mean dose > 44 Gy.

* **HyTEC Spinal cord dose tolerance to SBRT** [[Sahgal IJROBP '19](https://www.ncbi.nlm.nih.gov/pubmed/31606528)]:

Keep cumulative BED2 ≤ 135.5 Gy. No single course with BED2 ≥ 102 Gy. Re-RT interval ≥ 6 mo. If cord compromise imminent, can consider > 2 mo.

Initial SRS/SBRT constraints were based off of 45 Gy conventional fractionation to the cord. This is despite [Quantec data](https://www.ncbi.nlm.nih.gov/pubmed/20171513) that demonstrates ≤ 1% RM for cord Dmax ≤ 54 Gy with conventional fractionation.

"It is important to understand that there may be patients where the risk of spinal cord damage from not achieving tumor control is higher than the risk of RM, therefore clinical judgement is required, alongside such data, to inform practice."

Moving forward, uniform Reporting Standards for a number of factors are essential to more clearly define constraints!

Also see: [Cord](#tfw8lxj9eio6) in the Constraints section.

TBL [QS](http://www.quadshotnews.com/2019/10/get-to-point.html): Here’s your go-to paper for spinal cord max dose constraints when doing spine SBRT.

* + Cord contours: PRV for T-spine ~1.5 mm, while in C-spine may be 2-3 mm. L-spine may include the entire canal. Be aware of heterogeneous reporting of PRV versus cord with constraints.
  + For de novo SBRT, limit cord Dmax to 12.4-14/1, 17/2, 20.3/3, 23/4, 25.3/5 for 1-5% risk of RM.
    - One example of higher dose levels SRS suggest up to 22.7/1 may be acceptable. Use extreme caution.
  + MTTRM after de novo / re-irradiation conventional RT of 18→ 11 mo.
  + MTTRM after de novo / re-irradiation SBRT of 12→ 6 mo.
  + For re-irradiation, suggested to limit thecal sac EQD2 using α/β of 2 to Dmax < 70 Gy, SBRT thecal sac EQD2 Dmax ≤ 25 Gy, thecal sac SBRT EQD2 Dmax / cumulative EQD2 Dmax ratio ≤ 0.5, and a minimum time interval to re-irradiation of ≥ 5 mo.
    - Spinal cord Dmax low RM risk for 3 / 5 fractions of 14.5→ 18 Gy, but depends on prior dose.
    - See Table 4 for further details, and pay attention to ground rules above.
    - There are no guidelines for SRS after 40/20, 45/25, or 50/25. Prior 50/25 should be limited to 15.5/5.

* **Spinal cord reirradiation** [[Nieder IJROBP '06]](https://www.sciencedirect.com/science/article/pii/S0360301606027726?via%3Dihub): **Radiation Myelopathy risk**.  
  If using this study, use α / β of 2 even though 3 is used for cord in the modern era.

Keep cumulative BED2 ≤ 135.5 Gy. No single course with BED2 ≥ 102 Gy. Re-RT interval ≥ 6 mo. If cord compromise imminent, can consider > 2 mo.

* + 38 pts from 5 institutions. A large variety of fractionation schedules with varying BED was used.
    - This study used α / β of 2 for the cervical cord, and 4 for the thoracic cord.
    - Median interval to treatment of 30 mo. MFU 8 mo.
  + No reported radiation myelitis at BED2< 120, interval > 6 mo, and neither course BED2 > 98.
  + Only 3% radiation myelitis at combined BED2 ≤ 135.5 (up to BED2 150 still was only 3%).
* **Sahgal** [[IJROBP '11]](https://www.sciencedirect.com/science/article/pii/S036030160900772X?via%3Dihub): **Spinal Cord Tolerance for SBRT**.
  + See table 4 for details.
* **Sahgal** [[IJROBP '12]](https://www.sciencedirect.com/science/article/pii/S036030160900772X?via%3Dihub): **Reirradiation Human Spinal Cord Tolerance for SBRT**.  
  For re-irradiation, suggested to limit thecal sac EQD2 using α/β of 2 to Dmax < 70 Gy, SBRT thecal sac EQD2 Dmax ≤ 25 Gy, SBRT thecal sac EQD2 Dmax / cumulative EQD2 Dmax ratio ≤ 0.5, and a minimum time interval to re-irradiation of ≥ 5 mo (although if cord compromise is imminent, consider ≥ 2 mo).
  + 14 controls with 16 treated spinal segments without RM vs. 5 cases with RM.
  + All were G4 RM.
  + First course thecal sac EQD22 Dmax 18.3-52.5 Gy, SBRT reirradiation thecal sac EQD22 Dmax 44.1 - 104.9 Gy.
  + RM cohorts: med SBRT EQD22 Dmax 62 Gy (44-105 Gy), cumulative EQD22 100 Gy (77-155 Gy).
  + No RM cohort: med SBRT EQD22 Dmax 12.5 Gy (2-59 Gy), cumulative EQD22 52 Gy (39-111 Gy).
  + Spinal cord Dmax for low RM risk for 3 / 5 fractions of 14.5→ 18 Gy, but depends on prior dose.
  + See Table 4 in [Sahgal HyTEC '19](https://www.ncbi.nlm.nih.gov/pubmed/31606528) for further details, and pay attention to ground rules above.
  + There are no guidelines for SRS after 40/20, 45/25, or 50/25. Prior 50/25 should be limited to 15.5/5.
* **Sahgal** [[IJROBP '13]](https://www.sciencedirect.com/science/article/pii/S0360301612006499?via%3Dihub): **Probabilities of Radiation Myelopathy Specific to SBRT to Guide Safe Practice**.
  + Thecal sac dmax for 2y myelopathy ≤ 5% for 1 / 3 / 5 fractions of 12.4→ 20.3→ 25.3 Gy.
* **Spinal cord tolerance to SRS partial volume irradiation** [[Medini IJROBP '11](https://www.ncbi.nlm.nih.gov/pubmed/20934278)]: **30/10→ 14-16-18-20-22-24/1 one year later.**No necrosis less than 17 Gy. If you wait a year, it's almost as if these pigs have never seen irradiation before.
  + 38 pigs. Yucatan minipigs. Measured gait change at one year.
    - RT: 5 x 2 cm volume lateral to the C-spine, with IDLs traversing the ipsi / central / contra cord of 90→ 50→ 10%.
  + No changes at 14-16 Gy. Small foci of demyelination at 18 - 20 Gy. Extensive tissue damage including grey matter infarct.
  + 96% calculated recovery after 30/10 at one year.
* **Existence of a Dose-Length Effect in Spinal Nerves** [[Hrycushko IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/31953062)]: Prospective. Dose escalation **16-18-20-22-25-36/1**.  
  A dose-length effect was observed for single-session irradiation of the spinal nerves in a Yucatan minipig model.
  + 27 Yucatan minipigs. 0.5 cm length of the left C6, C7, C8 spinal nerves was targeted. 5 pigs per dose level (except 2 at 36 Gy). MFU 1y.
    - Corresponding max doses of 16.7, 19.1, 21.3, 23.1, 25.5 and 38.6 Gy.
  + Marked gait change in 8 of 27 irradiated pigs.
  + Latency for responding pigs was 11-16 weeks after irradiation. Nearly 2/3 of these pigs had electrodiagnostic evidence of denervation of C6-7 innervated muscles.
  + Probit analysis of dose associated with a 50% incidence of gait change is 23.9 Gy (22.5-25.8 Gy), which is 20% higher than that reported in a companion study where 1.5 cm length was irradiated.
  + All symptomatic pigs had demyelination and fibrosis in the irradiated nerves.
* **Tolerance of brachial plexus to high-dose reirradiation** [[Chen IJROBP '17](https://www.ncbi.nlm.nih.gov/pubmed/28587056)]:
  + 43 patients. 1998-2016. Recurrent H&N tumors.
    - 26 patients (60%) were previously treated by definitive RT.
    - 17 patients (40%) were treated by primary surgery followed by PORT.
    - 19 patients (44%) had received CCRT as part of initial treatment.
    - 11 recurrences (26%) occurred in a previously dissected neck.
    - Median Rx dose for the initial course of radiation therapy was 66 Gy (60-72 Gy).
  + MTT re-irradiation of 24 mo (3-144 mo).
  + Reirradiation SBRT delivered in 6 patients (35-40/5), while IMRT in 37 patients (60-66/30-33).
    - 16 patients (37%) received salvage neck surgery, the same number received re-irradiation CCRT.
  + Dominant complaints of ipsilateral pain (54%), numbness/tingling (31%), motor weakness and/or difficulty with manual dexterity 15%.
  + Cumulative brachial plexus Dmax median 95 Gy (60.5 - 150 Gy).
  + Cumulative brachial plexus mean 64 Gy (20 - 112 Gy).
  + Median time to development of symptoms of 7 mo (2 - 16 mo).
  + 1y freedom from brachial plexopathy for cumulative Dmax ± 95 Gy of 67→ 86%.
  + 1y complication-free rate for ± 2 years from initial course of ~66→ 87% (p=0.06).
* **Radiation myelopathy in rhesus monkeys** [[Ang IJROBP '01]](https://www.redjournal.org/article/S0360-3016(01)01599-1/fulltext):
  + 56 monkeys. Two RT courses to cervical and upper thoracic spinal cord in 2.2 Gy fx. Initial course 44 Gy in all monkeys. Reirradiation dose 57.2 Gy given after 1 year (n=16) or 2 year (n=20) intervals, or 66 Gy given after 2y (n=4) or 3y (n=14) intervals.
    - Two monkeys developed intramedullary tumors before reirradiation and did not receive a second course.
    - Endpoint: Myoparesis, manifesting predominantly as LE weakness and decrease in balance, occurring within 2.5y after reirradiation, complemented by histologic examination of the spinal cord.
  + Only 4 of 45 monkeys developed myelopathy.
  + Most liberal model: 76% (33.6 Gy), 85% (37.6 Gy), and 101% (44.6 Gy) of dose forgotten at 1, 2 and 3 years.
  + Most conservative model: 61% (26.8 Gy) of dose forgotten (but none further after 1 year).
  + Intermediate model: Suggests about half the dose forgotten at two years. *This is what most people use.*

# [Conventional Toxicity](#_bvprouf2ng3w)

### H&N

### Thorax

* **Radiation pneumonitis for combined V20** [[Graham IJROBP '99]](https://www.sciencedirect.com/science/article/pii/S0360301699001832?via%3Dihub). QUANTEC V20 < 30% for < 20% G2+.
  + V20 ≤ 20% with 0%.
  + V20 ≤ 30% with < 10%.
  + V20 ≤ 40% with < 15%.
  + V20 > 40% with nearly 40%.
  + So, keep V20 below 37% for ~10% risk of RP.

* **Predicting RP after CCRT for Lung Cancer** [[Palma IJROBP '14](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3448004/)]: Median RT 60 Gy.
  + 836 pts from a systematic review of literature. Cis/Etopo 38%, Carbo/Paclitaxel 26%. MFU 2.3y.
  + Overall rate of symptomatic RP 30%, with fatal RP 1.9%.
  + V20 (OR 1.03 per 1% increase), Carboplatin/Paclitaxel (OR 3.33), and trend for age (OR 1.24/decade, p=0.09).
  + Highest risk of symptomatic RP (>50%) in pts > 65y receiving carboplatin/paclitaxel.
  + Predictors of fatal pneumonitis: Daily dose > 2 Gy, V20, and lower lobe tumor location.
  + V20 < 20% with symptomatic RP / fatal RP of 18→ 0%.
  + V20 < 30% with symptomatic RP / fatal RP of 30→ 1%
  + V20 < 40% with symptomatic RP / fatal RP of 33→ 3%
  + V20 > 40% with symptomatic RP / fatal RP of 36→ 3.5%.
* WLI TD 5/5 17.5 Gy, TD 50/5 24.5 Gy [[Emami IJROBP '91](https://www.redjournal.org/article/0360-3016(91)90171-Y/pdf)]
  + For exposure to 1/3 of lung, TD 5/5 is 45 Gy and TD 50/5 is 65 Gy.

### Abdomen

### Pelvis

### Peds

# [SRS and SBRT Toxicity](#_bvprouf2ng3w)

### H&N

### Thorax

* **Validation of RTOG 0813 PBT constraints for non-pneumonitis toxicity (NPT)** [[Manyam IJROBP '20](https://www.ncbi.nlm.nih.gov/pubmed/31987965)]:

Manyam data suggests Dmax closer to 95% may be more wise than RTOG 08-13 limiting the PBT to 105% of 50/5.

* + 132 pts. 2009-2016. MFU over 2y.
    - RTOG 0813 constraints: D4cc ≤ 18 Gy, D0.03cc ≤ 52.5 Gy.
  + G2+ NPT predicted by D0.03cc ≤ 50 Gy (Sn 88%, Sp 77%).
  + G3+ NPT predicted by D0.33cc ≤ 47.1 Gy (Sn 100%, Sp 86%).
  + Applying RTOG constraints for G2+ NPT had Sn ~33% and Sp ~92%.
  + A PBT dosimetric correlation for pneumonitis toxicity could not be identified.
* There may be an association with Right Ventricle 10 Gy dose and overall survival for SBRT to the lung [[Chan Clin Lung Cancer '19](https://www.ncbi.nlm.nih.gov/pubmed/31932217)]
* Dunlap [[IJROBP '10]](https://www.sciencedirect.com/science/article/pii/S0360301609002521?via%3Dihub): CW + 3 cm V30 < 30cc, but very few pts met this unrealistic goal.
* MSKCC [[Mutter IJROBP '12]](https://www.sciencedirect.com/science/article/pii/S0360301611005190?via%3Dihub): CW + 2 cm V30 ± 70cc with 2y G2+ CW pain of 22→ 54%.

### Abdomen

* **Duodenal constraints for SRS to pancreas** [[Murphy IJROBP '09]](https://www.sciencedirect.com/science/article/pii/S0360301609035226?via%3Dihub): **25/1**.
  + G2+ duodenal toxicity for V15 ± 9.1 cc of 11→ 52%.
  + Similar results for V20 ± 3.3 cc and Dmax ± 23 Gy.

* **Liver No Fly Zone** [[Osmundson IJROBP '15](https://www.ncbi.nlm.nih.gov/pubmed/25659885)]: Retro. **Liver SBRT**, Median BED10 = 85.5 Gy in 5 fractions.

Central hepatobiliary tract = PV from splenic confluence to first bifurcation of L/R portal veins + 1.5 cm.

Similar to the "no fly zone" in lung cancer, there is one in liver cancer [[Zaorsky](https://twitter.com/NicholasZaorsky/status/1213175389713051652)].

* + 96 pts. 2006-2013. MFU 13 mo. 50% five fractions, 30% three fractions.
  + Non Dosimetric factors predictive of toxicity: cholangiocarcinoma, primary liver tumor, biliary stent.
  + G3+ HB predictors: VBED1072 ≥ 21cc (RR 12), VBED1066 ≥ 24cc (RR11), MeanBED10 cHBT ≥ 14 Gy (RR 0.2).
  + VBED1066 corresponds to V40 and V37.7 for 5 fractions while V33.8 and V32 for 3 fractions.
    - 5 fractions: V40 < 21cc, V37.7 < 24cc.
    - 3 fractions: V33.8 < 21cc, V32 < 24cc.
  + G2+ in 24%, G3+ in 19%.
* RILD with mean liver dose
  + 21 Gy at 3 Gy fractions < 5%
  + SBRT: for < 5% RILD, < 13 Gy in 3 fractions, < 18 Gy in 6 fractions, < 6 Gy CPC B at 4-6 Gy/fx.
    - V15 < 700cc in 3-5 fx

### Pelvis

### Peds