**One Fraction Timmerman, 11-2016**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Serial Tissue** | Volume | **Volume Max (Gy)** | **Max Point Dose (Gy)\*\*** | **Endpoint (≥Grade 3)** |
| Optic Pathway | <0.2 cc | 8 Gy | 10 Gy | neuritis |
| Cochlea |  |  | 9 Gy | hearing loss |
| Brainstem (not medulla) | <0.5 cc | 10 Gy | 15 Gy | cranial neuropathy |
| Spinal Cord and medulla | <0.35 cc | 10 Gy | 14 Gy | myelitis |
| Cauda Equina | <5 cc | 14 Gy | 16 Gy | neuritis |
| Sacral Plexus | <5 cc | 14.4 Gy | 16 Gy | neuropathy |
| Esophagus\* | <5 cc | 20 Gy | 24 Gy | esophagitis |
| Brachial Plexus | <3 cc | 13.6 Gy | 16.4 Gy | neuropathy |
| Heart/Pericardium | <15 cc | 16 Gy | 22 Gy | pericarditis |
| Great vessels | <10 cc | 31 Gy | 37 Gy | aneurysm |
| Trachea and Large Bronchus\* | <4 cc | 27.5 Gy | 30 Gy | impairment of pulmonary toilet |
| Bronchus- smaller airways | <0.5 cc | 17.4 Gy | 20.2 Gy | stenosis with atelectasis |
| Rib | <5 cc | 28 Gy | 33 Gy | Pain or fracture |
| Skin | <10 cc | 25.5 Gy | 27.5 Gy | ulceration |
| Stomach | <5 cc | 17.4 Gy | 22 Gy | ulceration/fistula |
| Bile duct |  |  | 30 Gy | stenosis |
| Duodenum\* | <5 cc | 17.4 Gy | 22 Gy | ulceration |
| Jejunum/Ileum\* | <30 cc | 17.6 Gy | 20 Gy | enteritis/obstruction |
| Colon\* | <20 cc | 20.5 Gy | 31 Gy | colitis/fistula |
| Rectum\* | <3.5 cc  <20 cc | 30 Gy  23 Gy | 33.7 Gy | proctitis/fistula |
| Ureter |  |  | 35 Gy | stenosis |
| Bladder wall | <15 cc | 12 Gy | 25 Gy | cystitis/fistula |
| Penile bulb | <3 cc | 16 Gy |  | impotence |
| Femoral Heads | <10 cc | 15 Gy |  | necrosis |
| Renal hilum/vascular trunk | 15 cc | 14 Gy |  | malignant hypertension |
| Lung (Right & Left) | 1500 cc for males and 950cc for females\*\*\* | 7.2 Gy |  | Basic Lung Function |
| Lung (Right & Left) |  |  | V-8Gy <37% | Radiation Pneumonitis |
| Liver | 700 cc\*\*\* | 11.6 Gy |  | Basic Liver Function |
| Renal cortex (Right & Left) | 200 cc\*\*\* | 9.5 Gy |  | Basic renal function |

**\*Avoid circumferential irradiation**

**\*\* “point” defined as 0.035cc or less**

**\*\*\*or one third of the “native” total organ volume (prior to any resection or volume reducing disease), whichever is greater**

**Two Fractions Timmerman**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Serial Tissue** | Volume | **Volume Max (Gy)** | **Max Point Dose (Gy)\*\*** | **Endpoint (≥Grade 3)** |
| Optic Pathway | <0.2 cc | 11.7 Gy | 13.7 Gy | neuritis |
| Cochlea |  |  | 11.7 Gy | hearing loss |
| Brainstem (not medulla) | <0.5 cc | 13 Gy | 19.1 Gy | cranial neuropathy |
| Spinal Cord and medulla | <0.35 cc | 13 Gy | 18.3 Gy | myelitis |
| Cauda Equina | <5 cc | 18 Gy | 20.8 Gy | neuritis |
| Sacral Plexus | <5 cc | 18.5 Gy | 20.8 Gy | neuropathy |
| Esophagus\* | <5 cc | 24.3 Gy | 28.3 Gy | esophagitis |
| Brachial Plexus | <3 cc | 17.8 Gy | 21.2 Gy | neuropathy |
| Heart/Pericardium | <15 cc | 20 Gy | 26 Gy | pericarditis |
| Great vessels | <10 cc | 35 Gy | 41 Gy | aneurysm |
| Trachea and Large Bronchus\* | <4 cc | 34.5 Gy | 38 Gy | impairment of pulmonary toilet |
| Bronchus- smaller airways | <0.5 cc | 21.6 Gy | 25.1 Gy | stenosis with atelectasis |
| Rib | <5 cc | 34 Gy | 41.5 Gy | Pain or fracture |
| Skin | <10 cc | 28.3 Gy | 30.3 Gy | ulceration |
| Stomach | <5 cc | 20 Gy | 26 Gy | ulceration/fistula |
| Bile duct |  |  | 33 Gy | stenosis |
| Duodenum\* | <5 cc | 20 Gy | 26 Gy | ulceration |
| Jejunum/Ileum\* | <30 cc | 19.2 Gy | 24 Gy | enteritis/obstruction |
| Colon\* | <20 cc | 25.8 Gy | 39 Gy | colitis/fistula |
| Rectum\* | <3.5 cc  <20 cc | 38 Gy  26.7 Gy | 41.3 Gy | proctitis/fistula |
| Ureter |  |  | 37.5 Gy | stenosis |
| Bladder wall | <15 cc | 14.5 Gy | 29 Gy | cystitis/fistula |
| Penile bulb | <3 cc | 20.5 Gy |  | impotence |
| Femoral Heads | <10 cc | 19.5 Gy |  | necrosis |
| Renal hilum/vascular trunk | 15 cc | 16.8 Gy |  | malignant hypertension |
| Lung (Right & Left) | 1500 cc for males and 950cc for females\*\*\* | 9.4 Gy |  | Basic Lung Function |
| Lung (Right & Left) |  |  | V-10Gy <37% | Radiation Pneumonitis |
| Liver | 700 cc\*\*\* | 15.1 Gy |  | Basic Liver Function |
| Renal cortex (Right & Left) | 200 cc\*\*\* | 12.5 Gy |  | Basic renal function |

**\*Avoid circumferential irradiation**

**\*\* “point” defined as 0.035cc or less**

**\*\*\*or one third of the “native” total organ volume (prior to any resection or volume reducing disease), whichever is greater**

**Three Fractions Timmerman**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Serial Tissue** | Volume | **Volume Max (Gy)** | **Max Point Dose (Gy)\*\*** | **Endpoint (≥Grade 3)** |
| Optic Pathway | <0.2 cc | 15.3 Gy | 17.4 Gy | neuritis |
| Cochlea |  |  | 14.4 Gy | hearing loss |
| Brainstem (not medulla) | <0.5 cc | 15.9 Gy | 23.1 Gy | cranial neuropathy |
| Spinal Cord and medulla | <0.35 cc | 15.9 Gy | 22.5 Gy | myelitis |
| Cauda Equina | <5 cc | 21.9 Gy | 25.5 Gy | neuritis |
| Sacral Plexus | <5 cc | 22.5 Gy | 25.5 Gy | neuropathy |
| Esophagus\* | <5 cc | 27.9 Gy | 32.4 Gy | esophagitis |
| Brachial Plexus | <3 cc | 22 Gy | 26 Gy | neuropathy |
| Heart/Pericardium | <15 cc | 24 Gy | 30 Gy | pericarditis |
| Great vessels | <10 cc | 39 Gy | 45 Gy | aneurysm |
| Trachea and Large Bronchus\* | <5 cc | 39 Gy | 43 Gy | impairment of pulmonary toilet |
| Bronchus- smaller airways | <0.5 cc | 25.8 Gy | 30 Gy | stenosis with atelectasis |
| Rib | <5 cc | 40 Gy | 50 Gy | Pain or fracture |
| Skin | <10 cc | 31 Gy | 33 Gy | ulceration |
| Stomach | <5 cc | 22.5 Gy | 30 Gy | ulceration/fistula |
| Bile duct |  |  | 36 Gy | stenosis |
| Duodenum\* | <5 cc | 22.5 Gy | 30 Gy | ulceration |
| Jejunum/Ileum\* | <30 cc | 20.7 Gy | 28.5 Gy | enteritis/obstruction |
| Colon\* | <20 cc | 28.8 Gy | 45 Gy | colitis/fistula |
| Rectum\* | <3.5 cc  <20 cc | 43 Gy  30.3 Gy | 47 Gy | proctitis/fistula |
| Ureter |  |  | 40 Gy | stenosis |
| Bladder wall | <15 cc | 17 Gy | 33 Gy | cystitis/fistula |
| Penile bulb | <3 cc | 25 Gy |  | impotence |
| Femoral Heads | <10 cc | 24 Gy |  | necrosis |
| Renal hilum/vascular trunk | 15 cc | 19.5 Gy |  | malignant hypertension |
| Lung (Right & Left) | 1500 cc for males and 950cc for females\*\*\* | 10.8 Gy |  | Basic Lung Function |
| Lung (Right & Left) |  |  | V-11.4Gy<37% | Pneumonitis |
| Liver | 700 cc\*\*\* | 17.7 Gy |  | Basic Liver Function |
| Renal cortex (Right & Left) | 200 cc\*\*\* | 14.7 Gy |  | Basic renal function |

**\*Avoid circumferential irradiation**

**\*\* “point” defined as 0.035cc or less**

**\*\*\*or one third of the “native” total organ volume (prior to any resection or volume reducing disease), whichever is greater**

**Four Fractions Timmerman**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Serial Tissue** | Volume | **Volume Max (Gy)** | **Max Point Dose (Gy)\*\*** | **Endpoint (≥Grade 3)** |
| Optic Pathway | <0.2 cc | 19.2 Gy | 21.2 Gy | neuritis |
| Cochlea |  |  | 18 Gy | hearing loss |
| Brainstem (not medulla) | <0.5 cc | 20.8 Gy | 27.2 Gy | cranial neuropathy |
| Spinal Cord and medulla | <0.35 cc | 18 Gy | 25.6 Gy | myelitis |
| Cauda Equina | <5 cc | 26 Gy | 28.8 Gy | neuritis |
| Sacral Plexus | <5 cc | 26 Gy | 28.8 Gy | neuropathy |
| Esophagus\* | <5 cc | 30.4 Gy | 35.6 Gy | esophagitis |
| Brachial Plexus | <3 cc | 24.8 Gy | 29.6 Gy | neuropathy |
| Heart/Pericardium | <15 cc | 28 Gy | 34 Gy | pericarditis |
| Great vessels | <10 cc | 43 Gy | 49 Gy | aneurysm |
| Trachea and Large Bronchus\* | <5 cc | 42.4 Gy | 47 Gy | impairment of pulmonary toilet |
| Bronchus- smaller airways | <0.5 cc | 28.8 Gy | 34.8 Gy | stenosis with atelectasis |
| Rib | <5 cc | 43 Gy | 54 Gy | Pain or fracture |
| Skin | <10 cc | 33.6 Gy | 36 Gy | ulceration |
| Stomach | <5 cc | 25 Gy | 33.2 Gy | ulceration/fistula |
| Bile duct |  |  | 38.4 Gy | stenosis |
| Duodenum\* | <5 cc | 25 Gy | 33.2 Gy | ulceration |
| Jejunum/Ileum\* | <30 cc | 22.4 Gy | 31.6 Gy | enteritis/obstruction |
| Colon\* | <20 cc | 30.8 Gy | 48.5 Gy | colitis/fistula |
| Rectum\* | <3.5 cc  <20 cc | 47.2 Gy  34 Gy | 51.6 Gy | proctitis/fistula |
| Ureter |  |  | 43 Gy | stenosis |
| Bladder wall | <15 cc | 18.5 Gy | 35.6 Gy | cystitis/fistula |
| Penile Bulb | <3 cc | 27 Gy |  | impotence |
| Femoral Heads | <10 cc | 27 Gy |  | necrosis |
| Renal hilum/vascular trunk | 15 cc | 21.5 Gy |  | malignant hypertension |
| Lung (Right & Left) | 1500 cc for males and 950cc for females\*\*\* | 12 Gy |  | Basic Lung Function |
| Lung (Right & Left) |  |  | V-12.8Gy<37% | Pneumonitis |
| Liver | 700 cc\*\*\* | 19.6 Gy |  | Basic Liver Function |
| Renal cortex (Right & Left) | 200 cc\*\*\* | 16 Gy |  | Basic renal function |

**\*Avoid circumferential irradiation**

**\*\* “point” defined as 0.035cc or less**

**\*\*\*or one third of the “native” total organ volume (prior to any resection or volume reducing disease), whichever is greater**

**Five Fractions Timmerman**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Serial Tissue** | Volume | **Volume Max (Gy)** | **Max Point Dose (Gy)\*\*** | **Endpoint (≥Grade 3)** |
| Optic Pathway | <0.2 cc | 23 Gy | 25 Gy | neuritis |
| Cochlea |  |  | 22 Gy | hearing loss |
| Brainstem (not medulla) | <0.5 cc | 23 Gy | 31 Gy | cranial neuropathy |
| Spinal Cord and medulla | <0.35 cc | 22 Gy | 28 Gy | myelitis |
| Cauda Equina | <5 cc | 30 Gy | 31.5 Gy | neuritis |
| Sacral Plexus | <5 cc | 30 Gy | 32 Gy | neuropathy |
| Esophagus\* | <5 cc | 32.5 Gy | 38 Gy | esophagitis |
| Brachial Plexus | <3 cc | 27 Gy | 32.5 Gy | neuropathy |
| Heart/Pericardium | <15 cc | 32 Gy | 38 Gy | pericarditis |
| Great vessels | <10 cc | 47 Gy | 53 Gy | aneurysm |
| Trachea and Large Bronchus\* | <5 cc | 45 Gy | 50 Gy | impairment of pulmonary toilet |
| Bronchus- smaller airways | <0.5 cc | 32 Gy | 40 Gy | stenosis with atelectasis |
| Rib | <5 cc | 45 Gy | 57 Gy | Pain or fracture |
| Skin | <10 cc | 36.5 Gy | 38.5 Gy | ulceration |
| Stomach | <5cc | 26.5 Gy | 35 Gy | ulceration/fistula |
| Bile duct |  |  | 41 Gy | stenosis |
| Duodenum\* | <5 cc | 26.5 Gy | 35 Gy | ulceration |
| Jejunum/Ileum\* | <30 cc | 24 Gy | 34.5 Gy | enteritis/obstruction |
| Colon\* | <20 cc | 32.5 Gy | 52.5 Gy | colitis/fistula |
| Rectum\* | <3.5 cc  <20 cc | 50 Gy  37.5 Gy | 55 Gy | proctitis/fistula |
| Ureter |  |  | 45 Gy | stenosis |
| Bladder wall | <15 cc | 20 Gy | 38 Gy | cystitis/fistula |
| Penile Bulb | <3 cc | 30 Gy |  | impotence |
| Femoral Heads | <10 cc | 30 Gy |  | necrosis |
| Renal hilum/vascular trunk | 15 cc | 23 Gy |  | malignant hypertension |
| Lung (Right & Left) | 1500 cc for males and 950cc for females\*\*\* | 12.5 Gy |  | Basic Lung Function |
| Lung (Right & Left) |  |  | V-13.5Gy<37% | Pneumonitis |
| Liver | 700 cc\*\*\* | 21.5 Gy |  | Basic Liver Function |
| Renal cortex (Right & Left) | 200 cc\*\*\* | 17.5 Gy |  | Basic renal function |

**\*Avoid circumferential irradiation**

**\*\* “point” defined as 0.035cc or less**

**\*\*\*or one third of the “native” total organ volume (prior to any resection or volume reducing disease), whichever is greater**

**Eight Fractions Timmerman**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Serial Tissue** | Volume | **Volume Max (Gy)** | **Max Point Dose (Gy)\*\*** | **Endpoint (≥Grade 3)** |
| Optic Pathway | <0.2 cc | 27.2 Gy | 29.6 Gy | neuritis |
| Cochlea |  |  | 26.4 Gy | hearing loss |
| Brainstem (not medulla) | <0.5 cc | 27.2 Gy | 37.6 Gy | cranial neuropathy |
| Spinal Cord and medulla | <0.35 cc | 26.4 Gy | 33.6 Gy | myelitis |
| Cauda Equina | <5 cc | 34 Gy | 38.4 Gy | neuritis |
| Sacral Plexus | <5 cc | 34 Gy | 38.4 Gy | neuropathy |
| Esophagus\* | <5 cc | 36.8 Gy | 43.2 Gy | esophagitis |
| Brachial Plexus | <3 cc | 32.8 Gy | 39.2 Gy | neuropathy |
| Heart/Pericardium | <15 cc | 34.4 Gy | 40 Gy | pericarditis |
| Great vessels | <10 cc | 55.2 Gy | 62 Gy | aneurysm |
| Trachea and Large Bronchus\* | <5 cc | 50 Gy | 56 Gy | impairment of pulmonary toilet |
| Bronchus- smaller airways | <0.5 cc | 38.4 Gy | 48.8 Gy | stenosis with atelectasis |
| Rib | <5 cc | 50 Gy | 63 Gy | Pain or fracture |
| Skin | <10 cc | 43.2 Gy | 45.6 Gy | ulceration |
| Stomach | <5 cc | 31.2 Gy | 42 Gy | ulceration/fistula |
| Bile duct |  |  | 48 Gy | stenosis |
| Duodenum\* | <5 cc | 31.2 Gy | 42 Gy | ulceration |
| Jejunum/Ileum\* | <30 cc | 28.8 Gy | 40 Gy | enteritis/obstruction |
| Colon\* | <20 cc | 35.2 Gy | 57.5 Gy | colitis/fistula |
| Rectum\* | <3.5 cc  <20 cc | 56 Gy  45 Gy | 61.5 Gy | proctitis/fistula |
| Ureter |  |  | 53 Gy | stenosis |
| Bladder wall | <15 cc | 22.4 Gy | 44.8 Gy | cystitis/fistula |
| Penile Bulb | <3 cc | 35 |  | impotence |
| Femoral Heads | <10 cc | 35 Gy |  | necrosis |
| Renal hilum/vascular trunk | 15 cc | 28 Gy |  | malignant hypertension |
| Lung (Right & Left) | 1500 cc for males and 950cc for females\*\*\* | 14.4 Gy |  | Basic Lung Function |
| Lung (Right & Left) |  |  | V-15.2Gy<37% | Pneumonitis |
| Liver | 700 cc\*\*\* | 24.8 Gy |  | Basic Liver Function |
| Renal cortex (Right & Left) | 200 cc\*\*\* | 20 Gy |  | Basic renal function |

**\*Avoid circumferential irradiation**

**\*\* “point” defined as 0.035cc or less**

**\*\*\*or one third of the “native” total organ volume (prior to any resection or volume reducing disease), whichever is greater**

**Ten Fractions Timmerman**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Serial Tissue** | Contouring Instructions | Volume | **Volume Max (Gy)** | **Max Point Dose (Gy)** | **Endpoint (≥Grade 3)** |
| Optic Pathway | One structure both sides from posterior globe, including chiasm, to proximal optic radiations | <0.5 cc | 30.6 Gy | 33.1 Gy | neuritis |
| Eye (retina) | Each side separately, entire globe | Mean dose | <26 Gy | 30 Gy | retinitis |
| Lens | Each side separately |  |  | 7 Gy | cataract |
| Eyelid – Meibomian glands (one side) | Each side separately, upper and lower lid as one structure |  |  | 21.3 Gy | dry eye syndrome |
| Lacrimal gland (one side) | Each side separately | <1 cc | 14.1 Gy | 23.6 Gy | lack of tears |
| Cochlea | Each side separately, include at least 3 CT slices | <0.5 cc | 25 Gy | 27 Gy | hearing loss |
| Brainstem (not medulla) | Superiorly from incisura, midbrain and pons only, one structure | <5 cc | 32 Gy | 38 Gy | cranial neuropathy |
| Spinal Cord | entire bony canal including at least 10 cm superior and inferior to PTV | <5 cc | 31 Gy | 36 Gy | myelitis |
| Salivary gland (one side) | Each parotid gland separately | <7 cc  Mean dose | 14.1 Gy  <17.7 Gy | 21.3 Gy | xerostomia |
| Larynx | Starting 1 cm above first appearance of true vocal cord include entire cord, arytenoid muscles, corniculate and arytenoid cartilages and portions of thyroid cartilage abutting these structures ending at the first appearance of the cricothyroid ligament. | <3 cc | 30 Gy | 45 Gy | necrosis/edema |
| TM joint | Each side separately starting at the superior articular surface near the zygoma bone and ending at the notch at the superior part of the ramus of the mandible. | <1cc | 37.7 Gy | 41.4 Gy | inflammation |
| Cauda Equina | Based on the bony limits of the spinal canal starting superiorly at the bottom of the spinal cord (typically around L2) and ending at the inferior extent of the thecal sac (typically S3) | <5 cc | 35 Gy | 41 Gy | neuritis |
| Sacral Plexus | Outlining the space defined medially by the sacral foramina from S1-S3 including contouring within the sacral foramina, posteriorly along the limits of the true pelvis, laterally to 2-3 cm lateral to the sacral foramina, and anteriorly about 3-5 mm from the posterior limits of the countour | <5 cc | 35 Gy | 41 Gy | neuropathy |
| Esophagus | Include the mucosal, submucosa, and all muscular layers out to the fatty adventitia at least 10 cm superior and inferior to PTV | <5 cc | 40 Gy | 48 Gy | esophagitis |
| Brachial Plexus | Each side separately from the spinal nerves exiting the neuroforamina from around C5 to T2 to include only the major trunks of the brachial plexus using the subclavian and axillary vessels as a surrogate for identifying its location extending proximally at the bifurcation of the brachiocephalic trunk into the jugular/subclavian veins (or carotid/subclavian arteries) and following along the route of the subclavian vein to the axillary vein ending after the neurovascular structures cross the second rib. | <3 cc | 37 Gy | 43 Gy | neuropathy |
| Heart/Pericardium | Contoured along with the pericardial sac. The superior aspect (or base) for purposes of contouring will begin at the level of the inferior aspect of the aortic arch (aorto-pulmonary window) and extend inferiorly to the apex of the heart. | <15 cc | 36.6 Gy | 42.5 Gy | pericarditis |
| Great vessels | The wall and lumen of the named vessel at least 10 cm superior and inferior to PTV | <10 cc | 55.7 Gy | 62.9 Gy | aneurysm |
| Trachea and Large Bronchus | Contour the trachea and cartilage rings starting 10 cm superior to the PTV extending inferiorly to the bronchi ending at the first bifurcation of the named lobar bronchus. | <5 cc | 52 Gy | 59 Gy | impairment of pulmonary toilet |
| Skin | The outer 0.5 cm of the body surface anywhere within the whole body contour. | <10 cc | 46.3 Gy | 48.9 Gy | ulceration |
| Stomach | The entire stomach wall and the gastric contents included from the GE junction to the proximal duodenum at the pyloris. | <50 cc | 33.9 Gy | 45 Gy | ulceration/fistula |
| Duodenum | The entire duodenal wall and lumen from the pyloris to the duodenojejunal flexure. | <5 cc | 33.9 Gy | 45 Gy | ulceration |
| Jejunum/Ileum | Any and all loops of small bowel as one structure within 10 cm of the PTV in any direction. | <120 cc | 33.9 Gy | 41 Gy | enteritis/obstruction |
| Renal hilum/vascular trunk | Each side separately including major calyces, renal pelvis, and proximal renal artery medially to the aorta | 15 cc | 30.7 Gy |  | malignant hypertension |
| Colon | One structure including wall and contents of lumen starting 10 cm superior to PTV and ending 10 cm below PTV. | <20 cc | 47 Gy | 60 Gy | colitis/fistula |
| Rectum (including stool) | One structure including wall of rectum and all contents in lumen. Start contouring 10 cm superior to PTV then inferior to anal sphincter. | <10 cc  <20 cc  <30 cc  <40 cc | 52 Gy  49 Gy  46 Gy  43 Gy | 65 Gy | proctitis/fistula |
| Bladder (with urine) | Contour the bladder wall and all urine ending inferiorly at the base of the prostate. | <90 cc  <125 cc | 48 Gy  45 Gy | 53 Gy | cystitis/fistula |
| Bladder (suprapubic wall) | Contour the anterior inferior wall resting above and around the superior aspect of the pubic bone starting at the prostate inferiorly and extending 2-3 cm superiorly from there. | <5 cc | 23 Gy | 42 Gy | dysuria |
| Penile bulb | Contour starting superiorly at the inferior aspect of the pelvic diaphragm (urethral sphincter) and extending inferiorly and anteriorly up to 3 cm | <3 cc | 38 Gy | 44 Gy | impotence |
| Femoral Heads | Contour both right and left separately. | <10 cc | 38 Gy | 43.5 Gy | necrosis |
| Lung (Right & Left) minus GTV | Contour right and left lung as one structure including all parenchymal lung tissue but exluding the GTV and major airways (trachea and main/lobar bronchi) | 1500 cc for males and 950cc for females\*\*\* | 15 Gy |  | Basic Lung Function |
| Lung (Right & Left) minus GTV | Contour right and left lung as one structure including all parenchymal lung tissue but exluding the GTV and major airways (trachea and main/lobar bronchi) |  |  | V-16Gy <37% | Pneumonitis |
| Liver minus GTV | Contour right and left lobes as one structure including all parenchymal liver tissue but exluding the GTV and major draining ducts, extrahepatic portal vein, and gall bladder. | 700 cc\*\*\* | 27 Gy |  | Basic Liver Function |
| Renal cortex (Right & Left) | Contour right and left kidney as one structure including all parenchymal capsular tissue but exluding the renal hilum/vascular trunk (see above) | 200 cc\*\*\* | 21 Gy |  | Basic renal function |

**\*Avoid circumferential irradiation**

**\*\* “point” defined as 0.035cc or less**

**\*\*\*or one third of the “native” total organ volume (prior to any resection or volume reducing disease), whichever is greater**

**Fifteen Fractions Timmerman**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Serial Tissue** | Contouring Instructions | Volume | **Volume Max (Gy)** | **Max Point Dose (Gy)** | **Endpoint (≥Grade 3)** |
| Optic Pathway | One structure both sides from posterior globe, including chiasm, to proximal optic radiations | <0.5 cc | 39 Gy | 42 Gy | neuritis |
| Eye (retina) | Each side separately, entire globe | Mean dose | <33 Gy | 37.5 Gy | retinitis |
| Lens | Each side separately |  |  | 9 Gy | cataract |
| Eyelid – Meibomian glands (one side) | Each side separately, upper and lower lid as one structure |  |  | 27 Gy | dry eye syndrome |
| Lacrimal gland (one side) | Each side separately | <1 cc | 18 Gy | 30 Gy | lack of tears |
| Cochlea | Each side separately, include at least 3 CT slices | <0.5 cc | 30 Gy | 33 Gy | hearing loss |
| Brainstem (not medulla) | Superiorly from incisura, midbrain and pons only, one structure | <5 cc | 40 Gy | 44 Gy | cranial neuropathy |
| Spinal Cord | entire bony canal including at least 10 cm superior and inferior to PTV | <5 cc | 39 Gy | 42.0 Gy | myelitis |
| Salivary gland (one side) | Each parotid gland separately | <7 cc  Mean dose | 18 Gy  <22.5 Gy | 27 Gy | xerostomia |
| Larynx | Starting 1 cm above first appearance of true vocal cord include entire cord, arytenoid muscles, corniculate and arytenoid cartilages and portions of thyroid cartilage abutting these structures ending at the first appearance of the cricothyroid ligament. | <3 cc | 34.5 Gy | 52.5 Gy | necrosis/edema |
| TM joint | Each side separately starting at the superior articular surface near the zygoma bone and ending at the notch at the superior part of the ramus of the mandible. | <1cc | 48 Gy | 52.5 Gy | inflammation |
| Cauda Equina | Based on the bony limits of the spinal canal starting superiorly at the bottom of the spinal cord (typically around L2) and ending at the inferior extent of the thecal sac (typically S3) | <5 cc | 40.5 Gy | 48 Gy | neuritis |
| Sacral Plexus | Outlining the space defined medially by the sacral foramina from S1-S3 including contouring within the sacral foramina, posteriorly along the limits of the true pelvis, laterally to 2-3 cm lateral to the sacral foramina, and anteriorly about 3-5 mm from the posterior limits of the countour | <5 cc | 40.5 Gy | 48 Gy | neuropathy |
| Esophagus | Include the mucosal, submucosa, and all muscular layers out to the fatty adventitia at least 10 cm superior and inferior to PTV | <5 cc | 45 Gy | 54 Gy | esophagitis |
| Brachial Plexus | Each side separately from the spinal nerves exiting the neuroforamina from around C5 to T2 to include only the major trunks of the brachial plexus using the subclavian and axillary vessels as a surrogate for identifying its location extending proximally at the bifurcation of the brachiocephalic trunk into the jugular/subclavian veins (or carotid/subclavian arteries) and following along the route of the subclavian vein to the axillary vein ending after the neurovascular structures cross the second rib. | <3 cc | 48 Gy | 52.5 Gy | neuropathy |
| Heart/Pericardium | Contoured along with the pericardial sac. The superior aspect (or base) for purposes of contouring will begin at the level of the inferior aspect of the aortic arch (aorto-pulmonary window) and extend inferiorly to the apex of the heart. | <15 cc | 42 Gy | 48.9 Gy | pericarditis |
| Great vessels | The wall and lumen of the named vessel at least 10 cm superior and inferior to PTV | <10 cc | 57 Gy | 65 Gy | aneurysm |
| Trachea and Large Bronchus | Contour the trachea and cartilage rings starting 10 cm superior to the PTV extending inferiorly to the bronchi ending at the first bifurcation of the named lobar bronchus. | <5 cc | 55.5 Gy | 63 Gy | impairment of pulmonary toilet |
| Skin | The outer 0.5 cm of the body surface anywhere within the whole body contour. | <10 cc | 54 Gy | 57 Gy | ulceration |
| Stomach | The entire stomach wall and the gastric contents included from the GE junction to the proximal duodenum at the pyloris. | <50 cc | 39 Gy | 51 Gy | ulceration/fistula |
| Duodenum | The entire duodenal wall and lumen from the pyloris to the duodenojejunal flexure. | <5 cc | 39 Gy | 51 Gy | ulceration |
| Jejunum/Ileum | Any and all loops of small bowel as one structure within 10 cm of the PTV in any direction. | <120 cc | 39 Gy | 46.5 Gy | enteritis/obstruction |
| Renal hilum/vascular trunk | Each side separately including major calyces, renal pelvis, and proximal renal artery medially to the aorta | 15 cc | 37.5 Gy |  | malignant hypertension |
| Colon | One structure including wall and contents of lumen starting 10 cm superior to PTV and ending 10 cm below PTV. | <20 cc | 47 Gy | 64.5 Gy | colitis/fistula |
| Rectum (including stool) | One structure including wall of rectum and all contents in lumen. Start contouring 10 cm superior to PTV then inferior to anal sphincter. | <10 cc  <20 cc  <30 cc  <40 cc | 60 Gy  57 Gy  52.5 Gy  49.5 Gy | 70.5 Gy | proctitis/fistula |
| Bladder (with urine) | Contour the bladder wall and all urine ending inferiorly at the base of the prostate. | <90 cc  <125 cc | 55.5 Gy  52.5 Gy | 61.5 Gy | cystitis/fistula |
| Bladder (suprapubic wall) | Contour the anterior inferior wall resting above and around the superior aspect of the pubic bone starting at the prostate inferiorly and extending 2-3 cm superiorly from there. | <5 cc | 26 Gy | 48 Gy | dysuria |
| Penile bulb | Contour starting superiorly at the inferior aspect of the pelvic diaphragm (urethral sphincter) and extending inferiorly and anteriorly up to 3 cm | <3 cc | 42 Gy | 48 Gy | impotence |
| Femoral Heads | Contour both right and left separately. | <10 cc | 40 Gy | 46.5 Gy | necrosis |
| Lung (Right & Left) minus GTV | Contour right and left lung as one structure including all parenchymal lung tissue but exluding the GTV and major airways (trachea and main/lobar bronchi) | 1500 cc for males and 950cc for females\*\*\* | 16.5 Gy |  | Basic Lung Function |
| Lung (Right & Left) minus GTV | Contour right and left lung as one structure including all parenchymal lung tissue but exluding the GTV and major airways (trachea and main/lobar bronchi) |  |  | V-18Gy <37% | Pneumonitis |
| Liver minus GTV | Contour right and left lobes as one structure including all parenchymal liver tissue but exluding the GTV and major draining ducts, extrahepatic portal vein, and gall bladder. | 700 cc\*\*\* | 30 Gy |  | Basic Liver Function |
| Renal cortex (Right & Left) | Contour right and left kidney as one structure including all parenchymal capsular tissue but exluding the renal hilum/vascular trunk (see above) | 200 cc\*\*\* | 24 Gy |  | Basic renal function |

**\*Avoid circumferential irradiation**

**\*\* “point” defined as 0.035cc or less**

**\*\*\*or one third of the “native” total organ volume (prior to any resection or volume reducing disease), whichever is greater**

**20 Fractions Timmerman**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Serial Tissue** | Contouring Instructions | Volume | **Volume Max (Gy)** | **Max Point Dose (Gy)** | **Endpoint (≥Grade 3)** |
| Optic Pathway | One structure both sides from posterior globe, including chiasm, to proximal optic radiations | <0.5 cc | 42 Gy | 48 Gy | neuritis |
| Eye (retina) | Each side separately, entire globe | Mean dose | <36 Gy | 42 Gy | retinitis |
| Lens | Each side separately |  |  | 10 Gy | cataract |
| Eyelid – Meibomian glands (one side) | Each side separately, upper and lower lid as one structure |  |  | 30 Gy | dry eye syndrome |
| Lacrimal gland (one side) | Each side separately | <1 cc | 18 Gy | 32 Gy | lack of tears |
| Cochlea | Each side separately, include at least 3 CT slices | <0.5 cc | 32 Gy | 36 Gy | hearing loss |
| Brainstem (not medulla) | Superiorly from incisura, midbrain and pons only, one structure | <5 cc | 44 Gy | 50 Gy | cranial neuropathy |
| Spinal Cord and medulla | For medulla: starting at inferior pons to foramen magnum. For cord: entire bony canal including at least 10 cm superior and inferior to PTV | <5 cc | 42 Gy | 46 Gy | myelitis |
| Salivary gland (one side) | Each parotid gland separately | <7 cc  Mean dose | 18 Gy  <24 Gy | 30 Gy | xerostomia |
| Larynx | Starting 1 cm above first appearance of true vocal cord include entire cord, arytenoid muscles, corniculate and arytenoid cartilages and portions of thyroid cartilage abutting these structures ending at the first appearance of the cricothyroid ligament. | <3 cc | 36 Gy | 58 Gy | necrosis/edema |
| TM joint | Each side separately starting at the superior articular surface near the zygoma bone and ending at the notch at the superior part of the ramus of the mandible. | <1cc | 52 Gy | 58 Gy | inflammation |
| Cauda Equina | Based on the bony limits of the spinal canal starting superiorly at the bottom of the spinal cord (typically around L2) and ending at the inferior extent of the thecal sac (typically S3) | <5 cc | 44 Gy | 52 Gy | neuritis |
| Sacral Plexus | Outlining the space defined medially by the sacral foramina from S1-S3 including contouring within the sacral foramina, posteriorly along the limits of the true pelvis, laterally to 2-3 cm lateral to the sacral foramina, and anteriorly about 3-5 mm from the posterior limits of the countour | <5 cc | 44 Gy | 52 Gy | neuropathy |
| Esophagus | Include the mucosal, submucosa, and all muscular layers out to the fatty adventitia at least 10 cm superior and inferior to PTV | <5 cc | 48 Gy | 58 Gy | esophagitis |
| Brachial Plexus | Each side separately from the spinal nerves exiting the neuroforamina from around C5 to T2 to include only the major trunks of the brachial plexus using the subclavian and axillary vessels as a surrogate for identifying its location extending proximally at the bifurcation of the brachiocephalic trunk into the jugular/subclavian veins (or carotid/subclavian arteries) and following along the route of the subclavian vein to the axillary vein ending after the neurovascular structures cross the second rib. | <3 cc | 54 Gy | 58 Gy | neuropathy |
| Heart/Pericardium | Contoured along with the pericardial sac. The superior aspect (or base) for purposes of contouring will begin at the level of the inferior aspect of the aortic arch (aorto-pulmonary window) and extend inferiorly to the apex of the heart. | <15 cc | 46 Gy | 52 Gy | pericarditis |
| Great vessels | The wall and lumen of the named vessel at least 10 cm superior and inferior to PTV | <10 cc | 60 Gy | 70 Gy | aneurysm |
| Trachea and Large Bronchus | Contour the trachea and cartilage rings starting 10 cm superior to the PTV extending inferiorly to the bronchi ending at the first bifurcation of the named lobar bronchus. | <5 cc | 58 Gy | 66 Gy | impairment of pulmonary toilet |
| Skin | The outer 0.5 cm of the body surface anywhere within the whole body contour. | <10 cc | 60 Gy | 64 Gy | ulceration |
| Stomach | The entire stomach wall and the gastric contents included from the GE junction to the proximal duodenum at the pyloris. | <50 cc | 42 Gy | 54 Gy | ulceration/fistula |
| Duodenum | The entire duodenal wall and lumen from the pyloris to the duodenojejunal flexure. | <5 cc | 42 Gy | 54 Gy | ulceration |
| Jejunum/Ileum | Any and all loops of small bowel as one structure within 10 cm of the PTV in any direction. | <120 cc | 42 Gy | 50 Gy | enteritis/obstruction |
| Renal hilum/vascular trunk | Each side separately including major calyces, renal pelvis, and proximal renal artery medially to the aorta | 15 cc | 40 Gy |  | malignant hypertension |
| Colon | One structure including wall and contents of lumen starting 10 cm superior to PTV and ending 10 cm below PTV. | <20 cc | 50 Gy | 66 Gy | colitis/fistula |
| Rectum (including stool) | One structure including wall of rectum and all contents in lumen. Start contouring 10 cm superior to PTV then inferior to anal sphincter. | <10 cc  <20 cc  <30 cc  <40 cc | 66 Gy  62 Gy  58 Gy  54 Gy | 74 Gy | proctitis/fistula |
| Bladder (with urine) | Contour the bladder wall and all urine ending inferiorly at the base of the prostate. | <90 cc  <125 cc | 60 Gy  56 Gy | 66 Gy | cystitis/fistula |
| Bladder (suprapubic wall) | Contour the anterior inferior wall resting above and around the superior aspect of the pubic bone starting at the prostate inferiorly and extending 2-3 cm superiorly from there. | <5 cc | 28 Gy | 52 Gy | dysuria |
| Penile bulb | Contour starting superiorly at the inferior aspect of the pelvic diaphragm (urethral sphincter) and extending inferiorly and anteriorly up to 3 cm | <3 cc | 44 Gy | 52 Gy | impotence |
| Femoral Heads | Contour both right and left separately. | <10 cc | 44 Gy | 50 Gy | necrosis |
| Lung (Right & Left) minus GTV | Contour right and left lung as one structure including all parenchymal lung tissue but exluding the GTV and major airways (trachea and main/lobar bronchi) | 1500 cc for males and 950cc for females\*\*\* | 18 Gy |  | Basic Lung Function |
| Lung (Right & Left) minus GTV | Contour right and left lung as one structure including all parenchymal lung tissue but exluding the GTV and major airways (trachea and main/lobar bronchi) |  |  | V-19Gy <37% | Pneumonitis |
| Liver minus GTV | Contour right and left lobes as one structure including all parenchymal liver tissue but exluding the GTV and major draining ducts, extrahepatic portal vein, and gall bladder. | 700 cc\*\*\* | 32 Gy |  | Basic Liver Function |
| Renal cortex (Right & Left) | Contour right and left kidney as one structure including all parenchymal capsular tissue but exluding the renal hilum/vascular trunk (see above) | 200 cc\*\*\* | 26 Gy |  | Basic renal function |

**\*Avoid circumferential irradiation**

**\*\* “point” defined as 0.035cc or less**

**\*\*\*or one third of the “native” total organ volume (prior to any resection or volume reducing disease), whichever is greater**

**30 Fractions (Conventional Fractionation) Timmerman**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Serial Tissue** | Contouring Instructions | Volume | **Volume Max (Gy)** | **Max Point Dose (Gy)** | **Endpoint (≥Grade 3)** |
| Optic Pathway | One structure both sides from posterior globe, including chiasm, to proximal optic radiations | <0.5 cc | 44 Gy | 52 Gy | neuritis |
| Eye (retina) | Each side separately, entire globe | Mean dose | <38 Gy | 45 Gy | retinitis |
| Lens | Each side separately |  |  | 10 Gy | cataract |
| Eyelid – Meibomian glands (one side) | Each side separately, upper and lower lid as one structure |  |  | 32 Gy | dry eye syndrome |
| Lacrimal gland (one side) | Each side separately | <1 cc | 20 Gy | 36 Gy | lack of tears |
| Cochlea | Each side separately, include at least 3 CT slices | <0.5 cc | 36 Gy | 40 Gy | hearing loss |
| Brainstem (not medulla) | Superiorly from incisura, midbrain and pons only, one structure | <5 cc | 52 Gy | 60 Gy | cranial neuropathy |
| Spinal Cord and medulla | For medulla: starting at inferior pons to foramen magnum. For cord: entire bony canal including at least 10 cm superior and inferior to PTV | <5 cc | 47.4 Gy | 52.8 Gy | myelitis |
| Salivary gland (one side) | Each parotid gland separately | <7 cc  Mean dose | 20 Gy  <26 Gy | 32 Gy | xerostomia |
| Larynx | Starting 1 cm above first appearance of true vocal cord include entire cord, arytenoid muscles, corniculate and arytenoid cartilages and portions of thyroid cartilage abutting these structures ending at the first appearance of the cricothyroid ligament. | <3 cc | 39 Gy | 63 Gy | necrosis/edema |
| TM joint | Each side separately starting at the superior articular surface near the zygoma bone and ending at the notch at the superior part of the ramus of the mandible. | <1cc | 60 Gy | 65 Gy | inflammation |
| Cauda Equina | Based on the bony limits of the spinal canal starting superiorly at the bottom of the spinal cord (typically around L2) and ending at the inferior extent of the thecal sac (typically S3) | <5 cc | 50 Gy | 60 Gy | neuritis |
| Sacral Plexus | Outlining the space defined medially by the sacral foramina from S1-S3 including contouring within the sacral foramina, posteriorly along the limits of the true pelvis, laterally to 2-3 cm lateral to the sacral foramina, and anteriorly about 3-5 mm from the posterior limits of the countour | <5 cc | 50 Gy | 60 Gy | neuropathy |
| Esophagus | Include the mucosal, submucosa, and all muscular layers out to the fatty adventitia at least 10 cm superior and inferior to PTV | <5 cc | 51 Gy | 60 Gy | esophagitis |
| Brachial Plexus | Each side separately from the spinal nerves exiting the neuroforamina from around C5 to T2 to include only the major trunks of the brachial plexus using the subclavian and axillary vessels as a surrogate for identifying its location extending proximally at the bifurcation of the brachiocephalic trunk into the jugular/subclavian veins (or carotid/subclavian arteries) and following along the route of the subclavian vein to the axillary vein ending after the neurovascular structures cross the second rib. | <3 cc | 62 Gy | 66 Gy | neuropathy |
| Heart/Pericardium | Contoured along with the pericardial sac. The superior aspect (or base) for purposes of contouring will begin at the level of the inferior aspect of the aortic arch (aorto-pulmonary window) and extend inferiorly to the apex of the heart. | <15 cc | 60 Gy | 60 Gy | pericarditis |
| Great vessels | The wall and lumen of the named vessel at least 10 cm superior and inferior to PTV | <10 cc | 60 Gy | 76 Gy | aneurysm |
| Trachea and Large Bronchus | Contour the trachea and cartilage rings starting 10 cm superior to the PTV extending inferiorly to the bronchi ending at the first bifurcation of the named lobar bronchus. | <5 cc | 60 Gy | 69 Gy | impairment of pulmonary toilet |
| Skin | The outer 0.5 cm of the body surface anywhere within the whole body contour. | <10 cc | 70 Gy | 76 Gy | ulceration |
| Stomach | The entire stomach wall and the gastric contents included from the GE junction to the proximal duodenum at the pyloris. | <50 cc | 45 Gy | 60 Gy | ulceration/fistula |
| Duodenum | The entire duodenal wall and lumen from the pyloris to the duodenojejunal flexure. | <5 cc | 45 Gy | 60 Gy | ulceration |
| Jejunum/Ileum | Any and all loops of small bowel as one structure within 10 cm of the PTV in any direction. | <120 cc | 45 Gy | 54 Gy | enteritis/obstruction |
| Renal hilum/vascular trunk | Each side separately including major calyces, renal pelvis, and proximal renal artery medially to the aorta | 15 cc | 42 Gy |  | malignant hypertension |
| Colon | One structure including wall and contents of lumen starting 10 cm superior to PTV and ending 10 cm below PTV. | <20 cc | 54 Gy | 70 Gy | colitis/fistula |
| Rectum (including stool) | One structure including wall of rectum and all contents in lumen. Start contouring 10 cm superior to PTV then inferior to anal sphincter. | <10 cc  <20 cc  <30 cc  <40 cc | 75 Gy  70 Gy  65 Gy  60 Gy | 79 Gy | proctitis/fistula |
| Bladder (with urine) | Contour the bladder wall and all urine ending inferiorly at the base of the prostate. | <90 cc  <150 cc | 70 Gy  65 Gy | 79 Gy | cystitis/fistula |
| Bladder (suprapubic wall) | Contour the anterior inferior wall resting above and around the superior aspect of the pubic bone starting at the prostate inferiorly and extending 2-3 cm superiorly from there. | <5 cc | 30 Gy | 60 Gy | dysuria |
| Penile bulb | Contour starting superiorly at the inferior aspect of the pelvic diaphragm (urethral sphincter) and extending inferiorly and anteriorly up to 3 cm | <3 cc | 48 Gy | 56 Gy | impotence |
| Femoral Heads | Contour both right and left separately. | <10 cc | 48 Gy | 56 Gy | necrosis |
| Growth Plate (in pediatric patient) | Contour a single plate irradiated |  |  | 4-6 Gy (5% risk)  12 Gy (100% risk) | growth arrest |
| Lung (Right & Left) minus GTV | Contour right and left lung as one structure including all parenchymal lung tissue but exluding the GTV and major airways (trachea and main/lobar bronchi) | 1500 cc for males and 950cc for females\*\*\* | 18 Gy |  | Basic Lung Function |
| Lung (Right & Left) minus GTV | Contour right and left lung as one structure including all parenchymal lung tissue but exluding the GTV and major airways (trachea and main/lobar bronchi) |  |  | V-20Gy <37% | Pneumonitis |
| Liver minus GTV | Contour right and left lobes as one structure including all parenchymal liver tissue but exluding the GTV and major draining ducts, extrahepatic portal vein, and gall bladder. | 700 cc\*\*\* | 36 Gy |  | Basic Liver Function |
| Renal cortex (Right & Left) | Contour right and left kidney as one structure including all parenchymal capsular tissue but exluding the renal hilum/vascular trunk (see above) | 200 cc\*\*\* | 27 Gy |  | Basic renal function |

**\*Avoid circumferential irradiation**

**\*\* “point” defined as 0.035cc or less**

**\*\*\*or one third of the “native” total organ volume (prior to any resection or volume reducing disease), whichever is greater**