|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **DVH-statistics** | **CovP-ITV[%]** | **PTV 1-3[%]** | **p-value**  | **CovP-ITV se** | **Covp-ITV sd** | **PTV1-3 se** | **PTV1-3 sd** |
| V60 | 100.00 | 99.41 | 0.007 | 0.000 | 0.000 | 0.149 | 0.772 |
| V65 | 100.00 | 98.72 | 0.000 | 0.000 | 0.000 | 0.274 | 1.422 |
| V70 | 99.67 | 97.22 | 0.000 | 0.085 | 0.439 | 0.482 | 2.505 |
| V74 | 90.39 | 93.45 | 0.364 | 1.490 | 7.741 | 0.794 | 4.124 |
| V75 | 80.90 | 90.99 | 0.000 | 2.314 | 12.025 | 0.926 | 4.814 |
| V78 | 26.77 | 47.41 | 0.000 | 3.131 | 16.271 | 1.010 | 5.246 |
| V80 | 4.52 | 0.21 | 0.000 | 1.073 | 5.577 | 0.029 | 0.148 |

**Supplement Table 1:** Mean DVH-statistics of CovP-ITV and conventional PTV1-3

DVH= dose volume histogram, PTV= planning target volume, VX = Volume receiving X Gray. Se= standard error, sd= standard deviation

**Supplement Table 2:** Mean DVH-statistics of CovP-bladder and bladder 1-3 and of CovP-rectum and rectum 1-3

|  |  |  |  |
| --- | --- | --- | --- |
| **DVH-statistics** | **CovP-bladder[%]** | **Bladder 1-3[%]** | **p-value**  |
| V60 | 18.84 | 19.06 | 6.153 |
| V65 | 15.64 | 16.69 | 3.157 |
| V70 | 11.08 | 14.25 | 0.161 |
| V74 | 6.15 | 11.25 | 0.000 |
| V75 | 4.58 | 10.16 | 0.000 |
| V78 | 0.77 | 3.36 | 0.007 |
| V80 | 0.09 | 0.02 | 0.441 |
|  |  |  |  |
| **DVH-statistics** | **CovP-rectum[%]** | **Rectum 1-3 [%]** | **p-value** |
| V60 | 34.75 | 28.09 | 0.000 |
| V65 | 24.89 | 22.80 | 0.889 |
| V70 | 13.03 | 17.29 | 0.014 |
| V74 | 3.69 | 10.80 | 0.000 |
| V75 | 2.21 | 8.87 | 0.000 |
| V78 | 0.30 | 2.15 | 0.000 |
| V80 | 0.05 | 0.00 | 1,960 |

DVH= dose volume histogram

**Supplemental Table 3:** Verification-, prescription- and margin concept of CovP and PTV-based IMRT

|  |  |  |
| --- | --- | --- |
| **Strategy** | **PTV/IGRT** | **CovP/IGRT** |
| Setup Correction | CBCT bony anatomy match | CBCT bony anatomy match |
| Organ movement  | Single planning CT, one geometry instance | Triple planning CT, three geometry instances |
| Residual errors for margin compensation | Uncorrected setup error (rotation, residual shifts) | Uncorrected setup error (rotation, residual shifts) |
| Organ motion | Organ motion exceeding input instances |
| Delivery | Delivery |
| Intra-fraction movement (organs, setup) | Intra-fraction movement (setup) |
| Margin size | 7 mm | 7 mm |
| Prescription | 100% of PTV receive >95% of dose | expected CTV fraction to receive >95% of dose is 100% |

**Supplement Table 4:** DVH parameters for mean CTV of pCT 1, 2 and 3 as well as CTV hull compared to Covp-CTV given in %

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **CTV\_1** | **CTV\_2** | **CTV\_3** | **CTV\_hull** | **cp\_CTV** |
| V0 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V5 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V10 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V15 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V20 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V25 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V30 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V35 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V40 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V45 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V50 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V55 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V60 |  | 100.00 | 100.00 | 99.97 | 99.98 | 100.00 |
| V65 |  | 100.00 | 99.97 | 99.86 | 99.87 | 100.00 |
| V70 |  | 100.00 | 99.70 | 99.53 | 99.44 | 100.00 |
| V74 |  | 99.86 | 98.53 | 98.18 | 97.88 | 99.86 |
| V75 |  | 99.59 | 97.45 | 97.24 | 96.73 | 99.59 |
| V78 |  | 67.69 | 61.18 | 62.25 | 60.67 | 67.58 |
| V80 |   | 0.12 | 0.10 | 0.12 | 0.13 | 0.12 |

**Supplement Table 5:** DVH parameters for mean bladder of pCT 1, 2 and 3 as well as CTV hull compared to Covp-CTV in %

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **bladder\_1** | **bladder\_2** | **bladder\_3** | **bladder\_hull** | **cp\_bladder** |
| V0 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V5 |  | 75.60 | 75.80 | 79.44 | 66.02 | 74.97 |
| V10 |  | 59.91 | 60.41 | 62.08 | 50.42 | 59.25 |
| V15 |  | 54.53 | 55.12 | 56.09 | 45.40 | 53.90 |
| V20 |  | 50.54 | 51.07 | 51.79 | 41.65 | 49.96 |
| V25 |  | 45.71 | 46.31 | 47.01 | 37.17 | 45.31 |
| V30 |  | 40.34 | 41.30 | 41.55 | 32.55 | 40.05 |
| V35 |  | 35.65 | 36.97 | 36.84 | 28.79 | 35.40 |
| V40 |  | 31.02 | 32.81 | 32.32 | 25.25 | 30.84 |
| V45 |  | 26.66 | 28.87 | 28.00 | 21.96 | 26.52 |
| V50 |  | 23.17 | 25.71 | 24.55 | 19.35 | 23.04 |
| V55 |  | 20.25 | 23.12 | 21.59 | 17.15 | 20.15 |
| V60 |  | 17.56 | 20.72 | 18.89 | 15.11 | 17.47 |
| V65 |  | 15.11 | 18.54 | 16.43 | 13.25 | 15.03 |
| V70 |  | 12.62 | 16.28 | 13.84 | 11.32 | 12.56 |
| V74 |  | 9.56 | 13.49 | 10.68 | 8.93 | 9.52 |
| V75 |  | 8.46 | 12.43 | 9.58 | 8.09 | 8.41 |
| V78 |  | 2.21 | 4.81 | 3.07 | 2.68 | 2.19 |
| V80 |   | 0.01 | 0.03 | 0.01 | 0.01 | 0.00 |

**Supplement Table 6:** DVH parameters for mean rectum of pCT 1, 2 and 3 as well as CTV hull compared to Covp-CTV in %

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **rectum\_1** | **rectum\_2** | **rectum\_3** | **rectum\_hull** | **cp\_rectum** |
| V0 |  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| V5 |  | 91.07 | 91.69 | 92.02 | 89.60 | 91.52 |
| V10 |  | 80.29 | 81.97 | 81.05 | 77.49 | 81.21 |
| V15 |  | 76.99 | 78.92 | 77.85 | 74.23 | 77.95 |
| V20 |  | 74.99 | 76.84 | 75.81 | 72.15 | 75.90 |
| V25 |  | 73.09 | 74.91 | 73.86 | 70.38 | 74.00 |
| V30 |  | 70.69 | 72.63 | 71.53 | 68.19 | 71.48 |
| V35 |  | 66.40 | 68.73 | 67.45 | 64.25 | 66.64 |
| V40 |  | 59.43 | 61.95 | 60.41 | 57.81 | 59.39 |
| V45 |  | 49.98 | 52.28 | 50.81 | 49.48 | 49.98 |
| V50 |  | 41.00 | 42.72 | 41.24 | 41.67 | 41.10 |
| V55 |  | 33.53 | 35.01 | 33.50 | 35.30 | 33.59 |
| V60 |  | 27.65 | 29.04 | 27.57 | 30.23 | 27.71 |
| V65 |  | 22.22 | 23.76 | 22.41 | 25.57 | 22.21 |
| V70 |  | 16.36 | 18.29 | 17.23 | 20.55 | 16.33 |
| V74 |  | 9.04 | 11.91 | 11.45 | 14.44 | 8.97 |
| V75 |  | 6.85 | 10.10 | 9.65 | 12.38 | 6.76 |
| V78 |  | 0.61 | 3.16 | 2.68 | 3.89 | 0.61 |
| V80 |   | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 |

*Bladder and rectum protocol*

After micturition, the patients were encouraged to drink 250-500 ml of liquid to fill the bladder 60 minutes before each CT/treatment. RT should be performed with an empty rectum.

*Treatment and verification strategy*

The LINAC is equipped with a 4mm multileaf-collimator. Orthogonal portal imaging was used for verification of the isocenter with an intervention threshold of 3 mm. The verification protocol was performed daily during the first week. Thereafter, the patient was positioned to the median shift of the first week. From week 2-8, verification was performed at least twice weekly.