



BrachyNext

Working Together to Shape the Future of
Brachytherapy



The New ICRU/GEC-ESTRO Report in Clinical Practice

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Disclosures

Christian Kirisits, MSc, PhD, was a consultant to Nucletron, an Elekta Company.

Richard Pötter, MD, does not have any financial relationships or products or devices with any commercial interest related to the content of this activity of any amount during the past 12 months.

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Level Concept

Concepts and terminology for prescribing

Reporting and recording in a level concept:

- **Level 1 – *Minimum standard for reporting***
- **Level 2 – *Advanced standard for reporting***
- **Level 3 – *Research-oriented reporting***



From Planning Aims to Prescription

Traditional concepts:

“when prescribing to a target, the prescription dose is the planned dose to cover this target as completely as possible.”

or

prescription to a 100% isodose which is “to cover” the target volume

Chapter 8

Need for Common Terminology According to ICRU Reports on Proton Treatment and IMRT

- **Planning aim dose**
 - Set of dose and dose/volume constraints for a treatment
- **Prescribed dose**
 - Finally accepted treatment plan (which is assumed to be delivered to an individual patient)
- **Delivered dose**
 - Actually delivered dose to the individual patient

Chapter 8



Need for Common Terminology According to ICRU Reports on Proton Treatment and IMRT

Example:

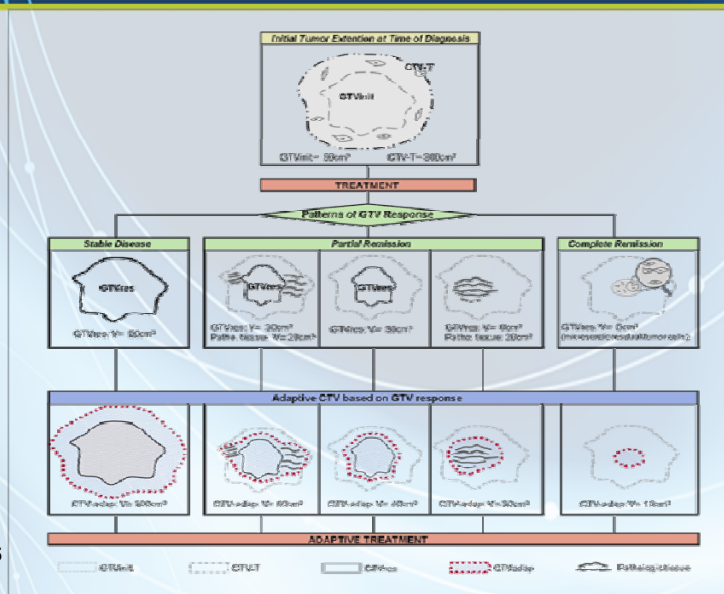
~~Previously: 4x7 Gy ~ 84 Gy EQD2 prescribed, D90 was mean 93 Gy~~

Planning aim was to deliver 4 x 7 Gy ~ 84 Gy, D_{2cm^3} for rectum, sigmoid <70 Gy EQD2, bladder <90 Gy EQD2

Prescribed dose was mean 93 Gy ± 13 Gy (1SD) EQD2 to D_{90} HR CTV

Delivered dose? *Depending on variations and uncertainties – on average no systematic deviation from prescribed dose*

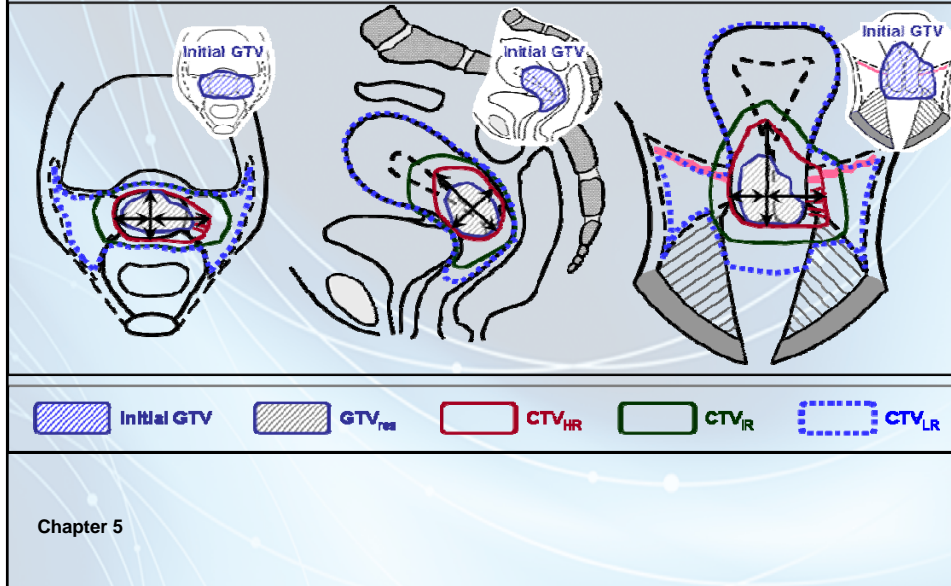
Various Patterns of Tumor Response-Adapted CTV



Chapter 5



Various Patterns of Tumor Response-Adapted CTV

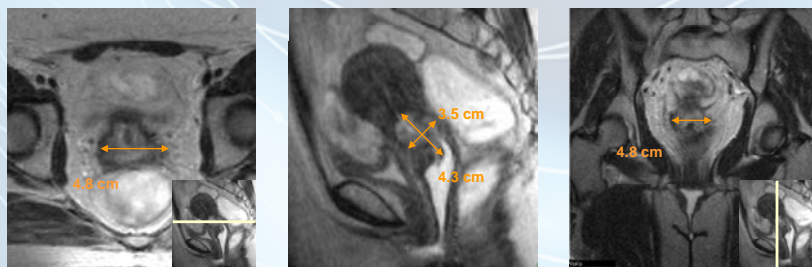
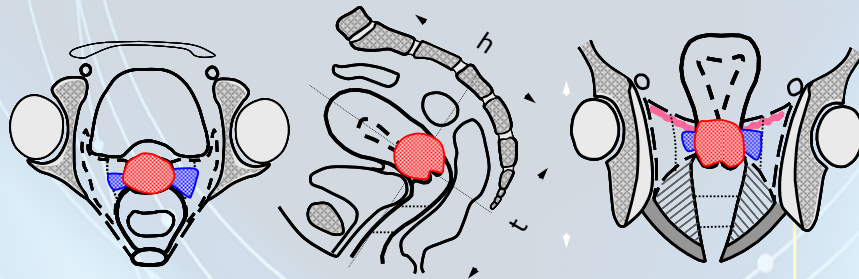


Level 1 – Minimum Standard for Reporting

- Comprehensive clinical gynecologic examination
- Volumetric imaging (MRI, CT, US, PET CT) at time of diagnosis and BT
- FIGO/TNM stage
- Baseline morbidity and QoL assessment
- Schematic 3D documentation on a clinical diagram indicating dimensions and volumes for:
 - GTV_{init} (GTV at diagnosis)
 - GTV_{res} (GTV at brachytherapy)
 - CTV_{HR} (GTV_{res} plus residual pathologic tissue plus whole cervix)
 - (CTV_{IR}: GTV_{init} and CTV_{HR} plus safety margin if used for prescription)



Example – Clinical Drawings



Example

Dimensions and volumes of GTVs and CTVs at diagnosis and at brachytherapy

| | | Diagnosis | BT1+2 | BT3+4 |
|---------------------------------------|--------------------|--------------|--------------|--------------|
| Clinical dimensions GTV | w * t (mm) | 60 *40 | - | - |
| MRI dimensions GTV | w * t * h (mm) | 55*40*45 | 35*35*43 | 35*35*43 |
| MRI volume GTV | (cm ³) | 52 | 33 | 33 |
| Clinical dimensions CTV _{HR} | w * t (mm) | - | 50*40 | 50*40 |
| MRI dimensions CTV _{HR} | w * t * h (mm) | - | 48*35*43 | 46*32*41 |
| CTV _{HR} | (cm ³) | - | 43 | 43 |
| CTV _{IR} | (cm ³) | - | 88 | 88 |
| Left parametrium | | proximal | proximal | proximal |
| Right parametrium | | proximal | proximal | proximal |
| Vagina | | upper third | not involved | not involved |
| Bladder | | not involved | not involved | not involved |
| Rectum | | not involved | not involved | not involved |



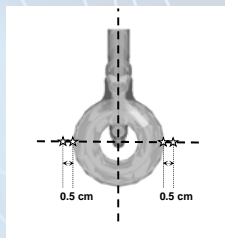
Level 1 – Minimum Standard for Reporting

Dose reporting:

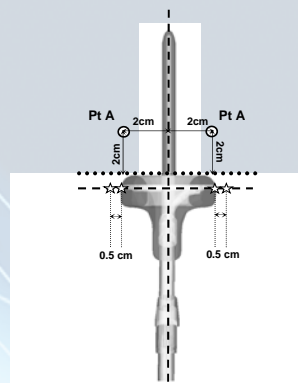
- TRAK
- Point A dose
- Recto-vaginal reference point dose
- $D_{0.1\text{cm}^3}, D_{2\text{cm}^3}$ for bladder, rectum
or
Bladder reference point for radiographs

Chapter 8 and Chapter 10

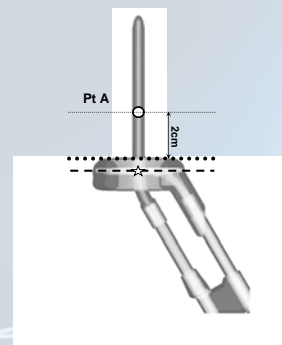
Point A



Axial



Coronal

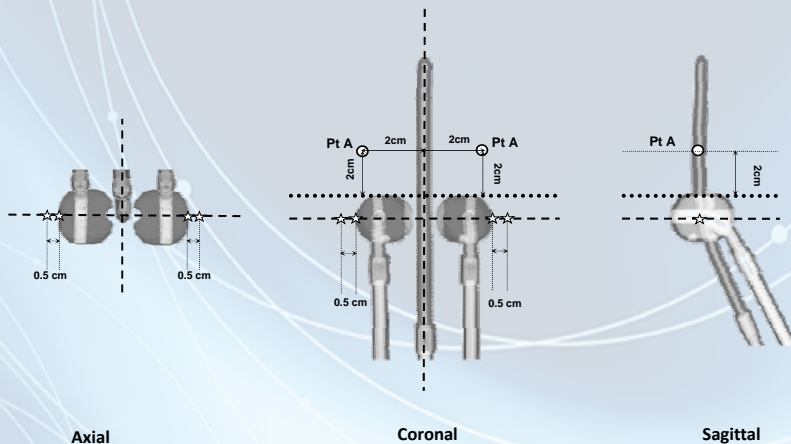


Sagittal

Chapter 10

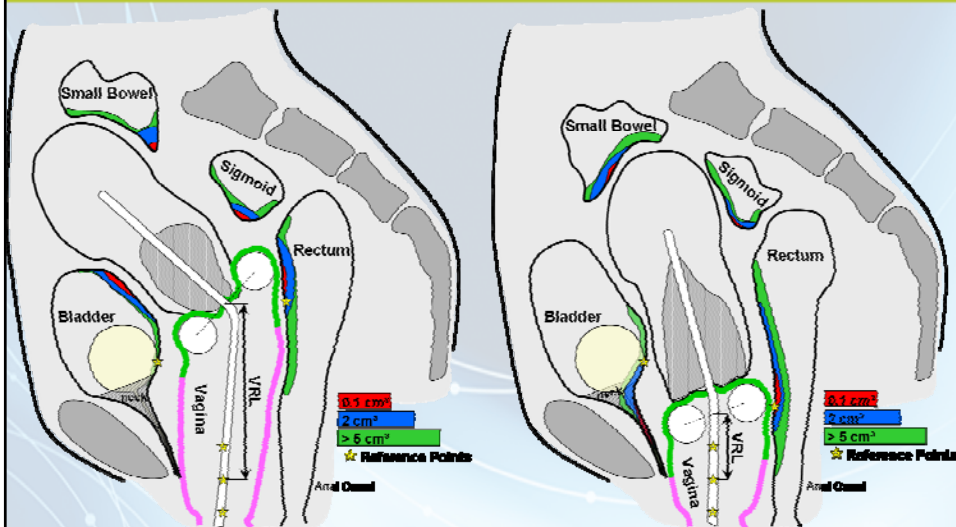


Point A



Chapter 10

OAR Concept and Related Volumes



Chapter 6



Level 2 – Advanced Standard for Reporting

All that is reported in level 1 plus:

3D delineation of volumes (on volumetric images with applicator and on clinical diagrams):

- GTV_{res}
- CTV_{HR}
- (CTV_{IR} if used for prescription)
- With maximum width, height, thickness and with volume

Chapter 5

Level 2 – Advanced Standard for Reporting

All that is reported in level 1 plus:

Dose reporting for defined volumes:

- D_{98} , D_{90} , D_{50} for CTV_{HR}
- (D_{98} , D_{90} for CTV_{IR} if used for prescription)
- D_{98} for GTV_{res}
- D_{98} for pathological lymph nodes

Chapter 8



Level 2 – Advanced Standard for Reporting

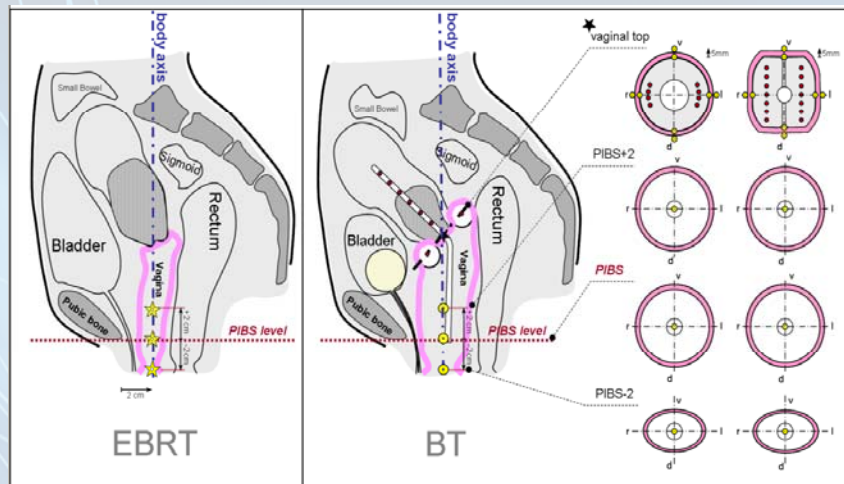
All that is reported in level 1 plus:

Dose reporting OARs:

- Bladder reference point dose
- $D_{0.1cm^3}, D_{2cm^3}$ for sigmoid*
- D_{2cm^3} bowel (if fixed)*
- Intermediate and low dose parameters in bladder, rectum, sigmoid, bowel (e.g. $V_{25Gy}, V_{35Gy}, V_{45Gy}$ or $D_{98\%}, D_{50\%}, D_{2\%}$)
- Vaginal point doses at level of sources (lateral at 5 mm)**
- Lower and mid vagina doses (PIBS, PIBS $\pm 2cm$)**

Chapter 8

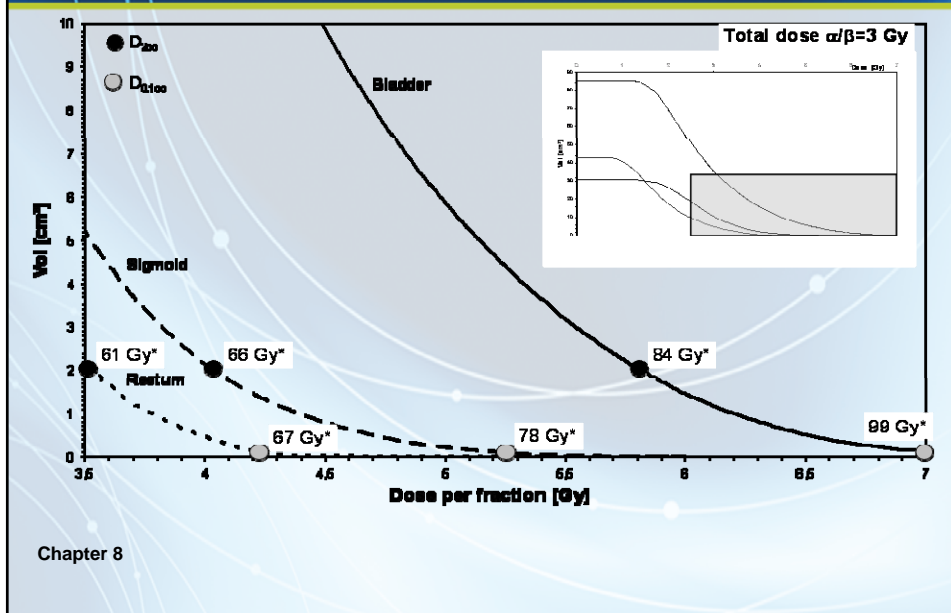
Vaginal Reference Points



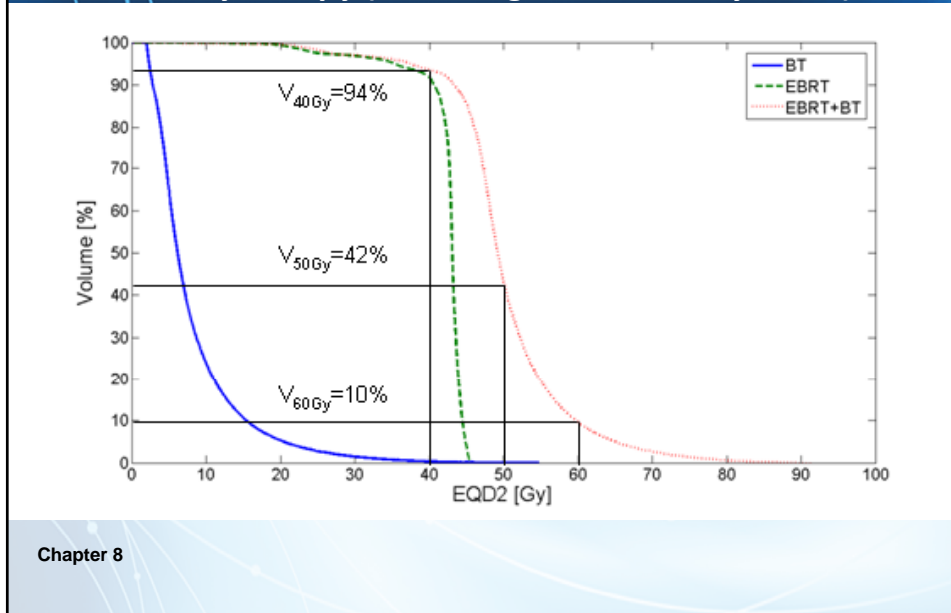
Chapter 8



DVH for OAR

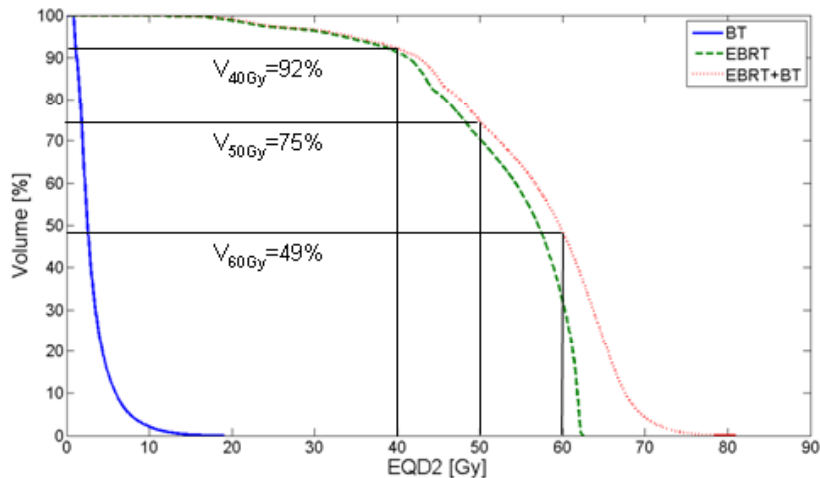


45 Gy Whole Pelvis EBRT plus 4 Fractions of HDR Brachytherapy (Total Target Dose: 85 Gy EQD2)



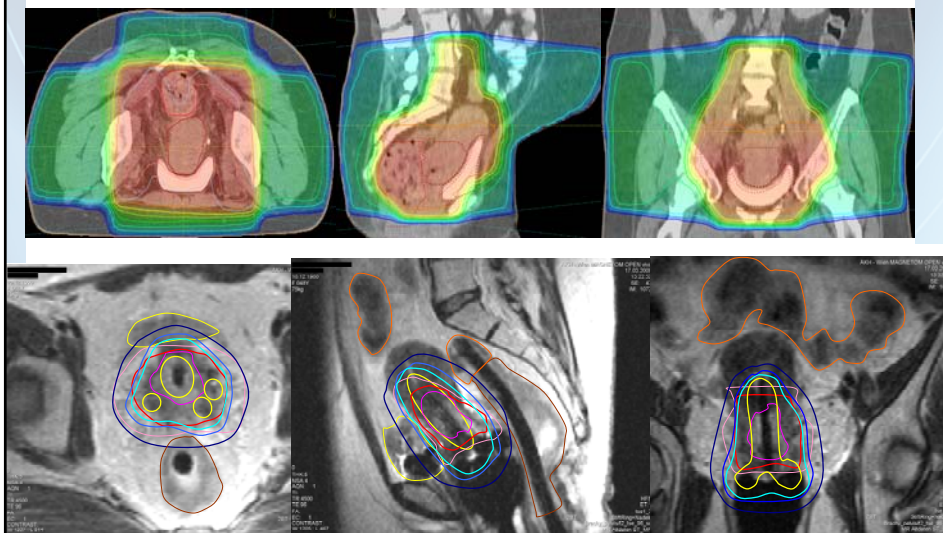


45 Gy Whole Pelvis EBRT plus 15 Gy EBRT Tumor Boost plus 2 Fractions of HDR Brachytherapy (Total Target Dose: 85 Gy EQD2)



Chapter 8

Example





| | | | Planning aim | Prescribed dose |
|-------------------|------------------------------|--------------------|--------------|-----------------|
| CTV _{HR} | D ₉₀ | EQD2 ₁₀ | ≥85 Gy | 92.3 Gy |
| Bladder | D _{2cm³} | EQD2 ₃ | ≤90 Gy | 80.6 Gy |
| Rectum | D _{2cm³} | EQD2 ₃ | ≤70 Gy | 64.3 Gy |
| Sigmoid | D _{2cm³} | EQD2 ₃ | ≤75 Gy | 51.7 Gy |

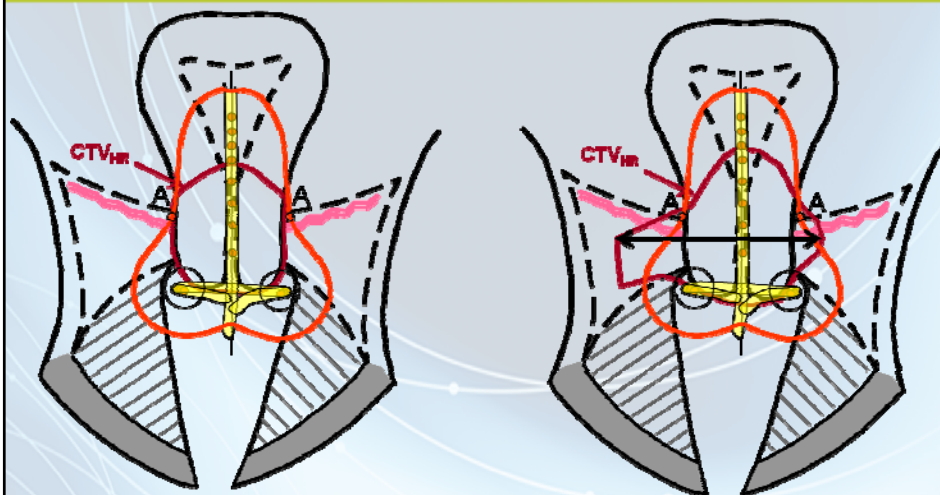
| Example | | | | | | | |
|---------------|-------|-------|-----------------------------|------|-----------------------------|------|--------------|
| | | | 1 st application | | 2 nd application | | Total dose |
| | | | BT1 | BT2 | BT3 | BT4 | EBRT+BT |
| | | | (Gy) | (Gy) | (Gy) | (Gy) | (Gy in EQD2) |
| Point A | | right | x* | x* | x* | x* | x* |
| | | left | 7.0 | 7.0 | 7.8 | 7.8 | 87.2 |
| Pelvic Wall | Point | right | 1.1 | 1.1 | 1.0 | 1.0 | 48.2 |
| | | left | 1.0 | 1.0 | 1.1 | 1.1 | 48.2 |
| Bladder | ICRU | point | 2.8 | 2.8 | 5.5 | 5.5 | 68.4 |
| Recto-Vaginal | ICRU | point | 2.4 | 2.4 | 3.5 | 3.5 | 57.5 |
| Vagina | 5 mm | right | 7.5 | 7.5 | 7.6 | 7.6 | 106.9 |
| | | left | 7.3 | 7.3 | 7.2 | 7.2 | 102.7 |
| PIBS** | | +2 cm | 5.9 | 5.9 | 6.3 | 6.3 | 88.8 |
| | | 0 cm | 2.6 | 2.6 | 2.4 | 2.4 | 53.4 |
| | | -2 cm | 0.6 | 0.6 | 0.7 | 0.7 | 7.3 |



Example

| | | 1 st application | | 2 nd application | | Total dose |
|--------------------|--------------------------------|-----------------------------|------|-----------------------------|------|--------------|
| | | BT1 | BT2 | BT3 | BT4 | EBRT+BT |
| | | (Gy) | (Gy) | (Gy) | (Gy) | (Gy in EQD2) |
| GTV _{res} | D ₉₈ | 10.1 | 10.1 | 10.7 | 10.7 | 115.0 |
| CTV _{HR} | D ₉₈ | 6.5 | 6.5 | 6.7 | 6.7 | 80.8 |
| | D ₉₀ | 7.9 | 7.9 | 8.1 | 8.1 | 92.3 |
| | D ₅₀ | 11.7 | 11.7 | 11.5 | 11.5 | 127.8 |
| Bladder | D _{0.1cm³} | 7.2 | 7.2 | 7.2 | 7.2 | 102.0 |
| | D _{2cm³} | 5.6 | 5.6 | 5.4 | 5.4 | 80.6 |
| Rectum | D _{0.1cm³} | 4.8 | 4.8 | 5.0 | 5.0 | 74.2 |
| | D _{2cm³} | 3.8 | 3.8 | 3.9 | 3.9 | 64.3 |
| Sigmoid | D _{0.1cm³} | 1.9 | 1.9 | 4.4 | 4.4 | 59.9 |
| | D _{2cm³} | 1.5 | 1.5 | 2.6 | 2.6 | 51.7 |

Dose Estimation in Case of Radiographs



Chapter 10



Conclusion

Concepts and terminology for prescribing, recording, and reporting

In a level concept:

- **Level 1 – *Minimum standard for reporting***
- **Level 2 – *Advanced standard for reporting***
- **Level 3 – *Research oriented reporting***

Thanks for your attention!