GYN GEC-ESTRO/ICRU 89
Target Concept

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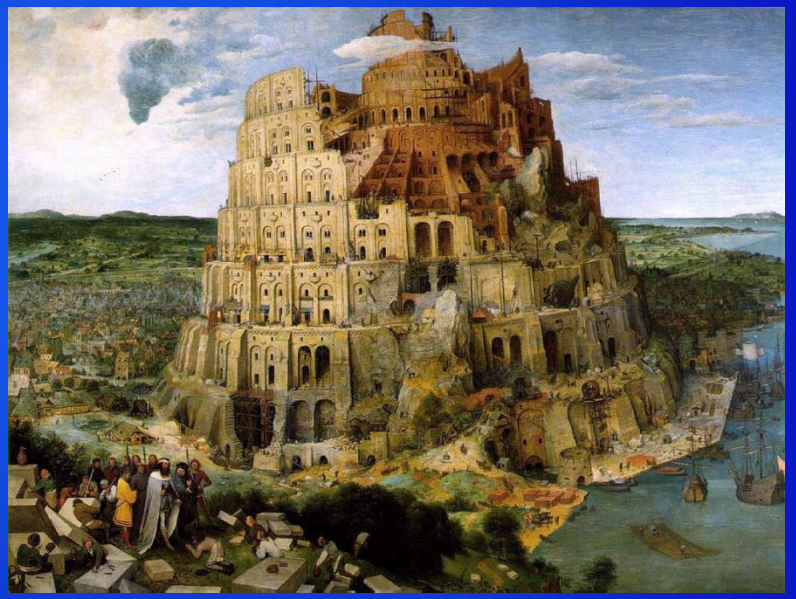
GYN GEC ESTRO RECOMMENDATIONS-BACKGROUND
From 2D to 3D/4D

Historical difficulties in communicating results of cervical BT
due to different traditions (60 Gy reference volume, point A…, midline block)

- CTV according to GTV at diagnosis?
- CTV according to GTV at BT?



Building the tower of Babel
(confusion of languages)
Brueghel, 16th century (1563)
Vienna, Museum of Fine Arts

We need a common language!

Gyn GEC ESTRO Recommendations 2005

ICRU GEC ESTRO Report 89 (published 062016)

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Journal of the

ICRU REPORT 89

Prescribing, Recording, an
Brachytherapy for Cancer

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ESTRO

OXFORD UNIVERSITY PRESS INTE

PRESCRIBING, RECORDING, AND REPORTING BRACHYTHERAPY FOR CANCER OF THE CERVIX

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Purpose of the ICRU/GEC ESTRO Report 89

To provide common concepts and terms for

- *** volumes, in particular initial/residual GTV**
  initial/adaptive CTV and OAR (3D/4D)
- *** radiobiological variations (equi-effective dose)**
- *** dose volume parameters (3D/4D)**
- *** the process from planning aims to prescription**
- *** dose point paramters (2D)**
- *** different levels of clinical practice (level 1, 2, 3)**

ICRU report 89 (258 pages)

Prescribing, Recording, and Reporting Brachytherapy for Cancer of the Cervix

Sections 1-12

Summary (end of each section)
Key messages (1-4, 9, 12)
Recommendations (5-8,10-11)

Chapter *(1)* – Introduction
Chapter *(2)* – Prevention, Diagnosis, Prognosis, Treatment and Outcome
Chapter *(3)* – Brachytherapy Techniques and Systems
Chapter *(4)* – Brachytherapy Imaging for Treatment Planning
Chapter *(5)* – Tumor and Target Volumes and Adaptive Radiotherapy
Chapter *(6)* – Organs At Risk and Morbidity-Related Concepts and Volumes
Chapter (7) – Radiobiological considerations
Chapter *(8)* – Dose and Volume Parameters for Prescribing, Recording, and Reporting Brachytherapy, Alone or combined with External Beam Therapy
Chapter *(9)* – Volumetric Dose Assessment
Chapter *(10)* – Radiographic Dose Assessment
Chapter *(11)* – Sources and Absorbed-Dose Calculation
Chapter *(12)* – Treatment planning
Chapter (13) – Summary of The Recommendations

Appendix A: 9 Comprehensive Clinical Examples (various clinical/technical scenarios)

CTV for the primary tumor (CTV-T)

- GTV and assumed sub-clinical malignant disease
- CTV-T encompasses the microscopic tumor spread at the boundary of the primary tumor GTV

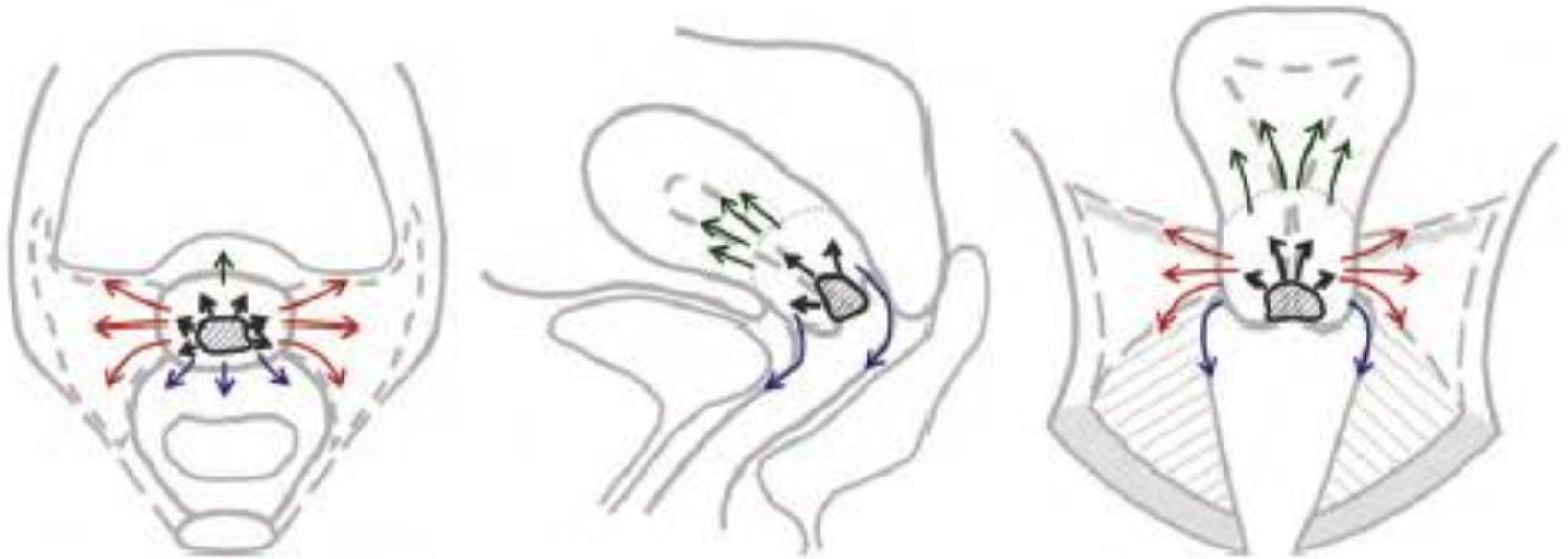
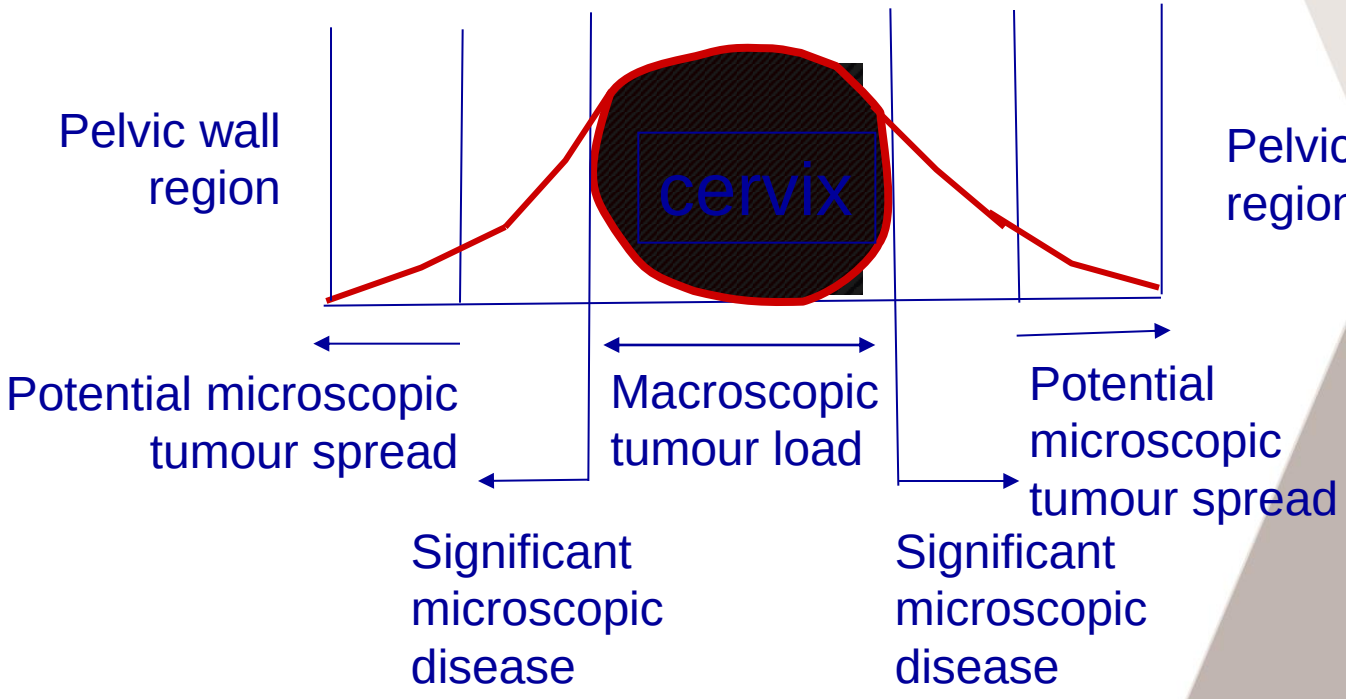


Figure 5.5. Schematic axial (left) mid-sagittal (middle) and mid-coronal (right) views of typical cervix cancer growth in—and outside—th
cervix with extra-cervical infiltration into adjacent structures such as parametria, uterine corpus, vagina [see also electronic appendi
Gyn GEC ESTRO Rec II (Lim *et al.*, 2011; Pötter *et al.*, 2006)].

CTVs concepts

Cancer cell density
in 3 different target volumes



Tumor and target volume definitions for the primary tumor

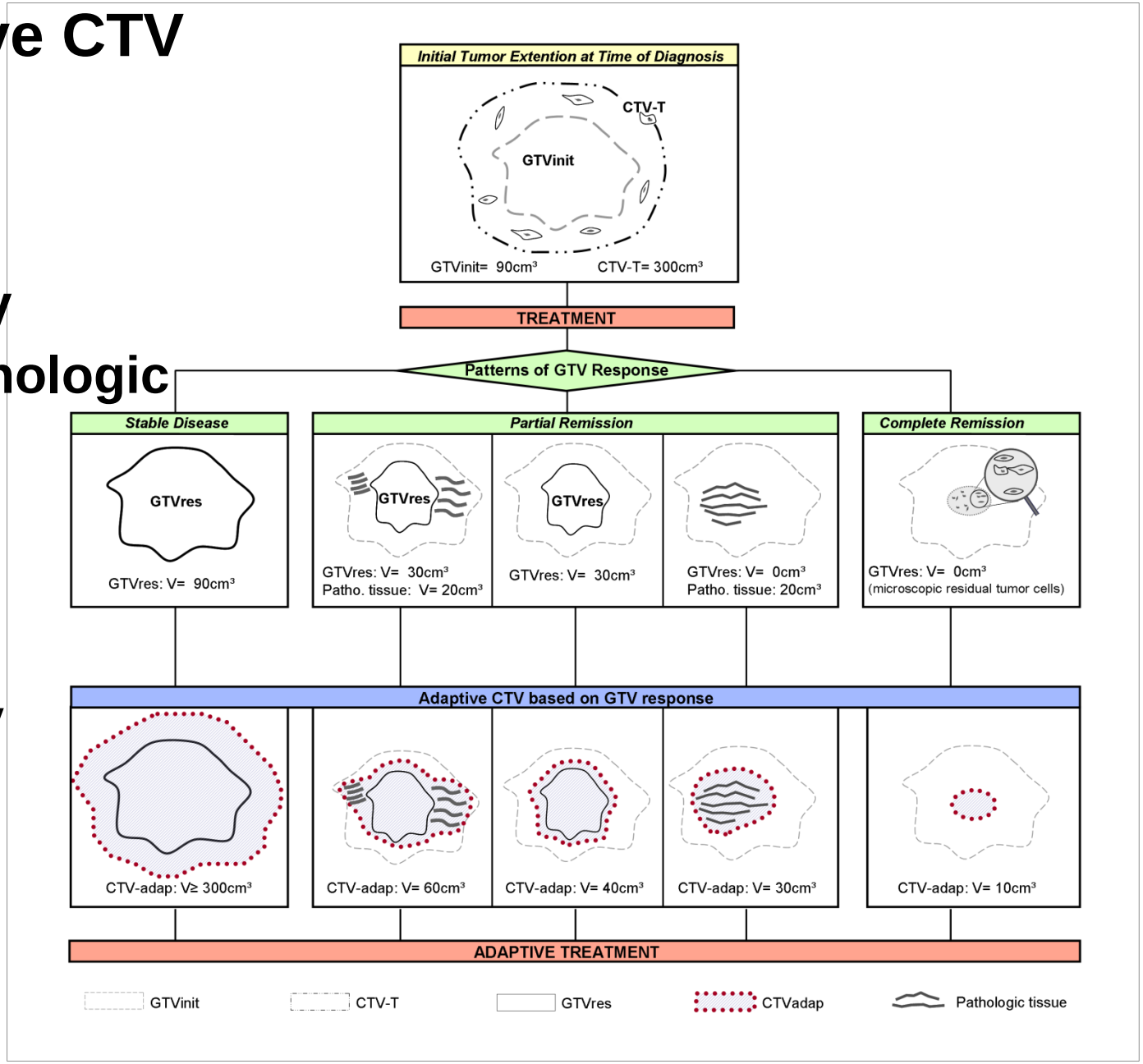
Gyn GEC ESTRO, ICRU 89, EMBRACE II

- initial GTV for the primary tumor (GTV-T_{init})
- initial CTV for the primary tumor (CTV-T_{init})
- Residual GTV-T (GTV-T_{res})
- Adaptive CTV-T (CTV-T_{adapt})
- High-Risk CTV-T (CTV-T_{HR})
- Intermediate-Risk CTV-T (CTV-T_{IR})
- Low-Risk CTV-T (CTV-T_{LR}) (init/res)
- Planning Target Volume (PTV-T)

Various patterns of tumor response and adaptive CTV

Residual GTV
Residual pathologic tissue

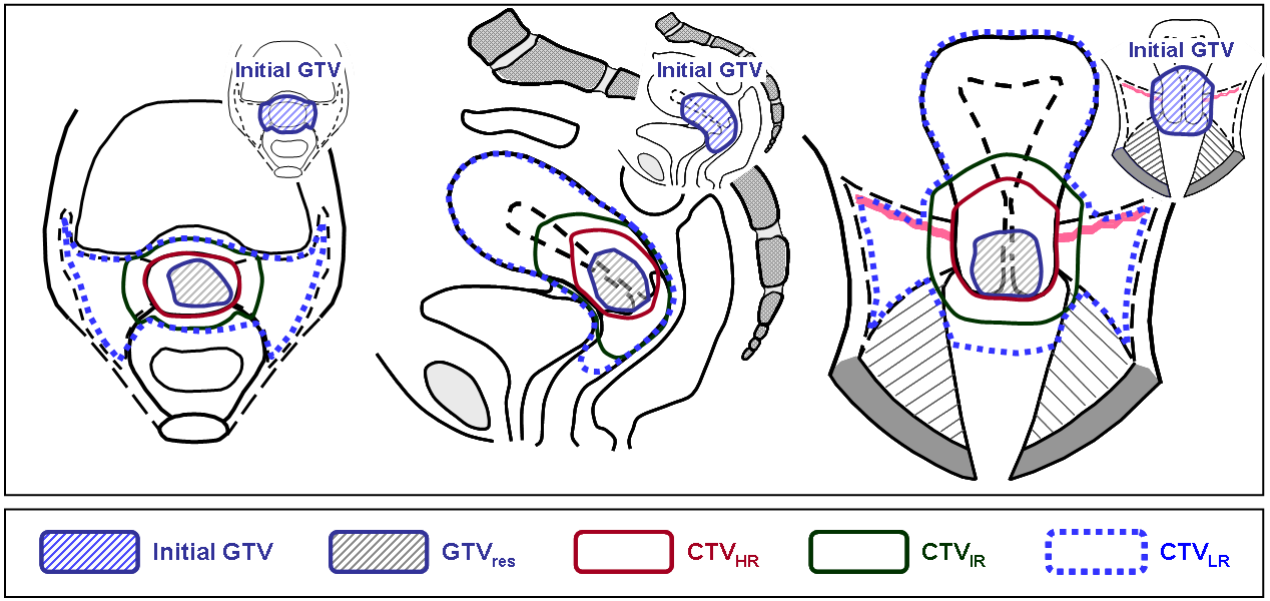
Adaptive CTV

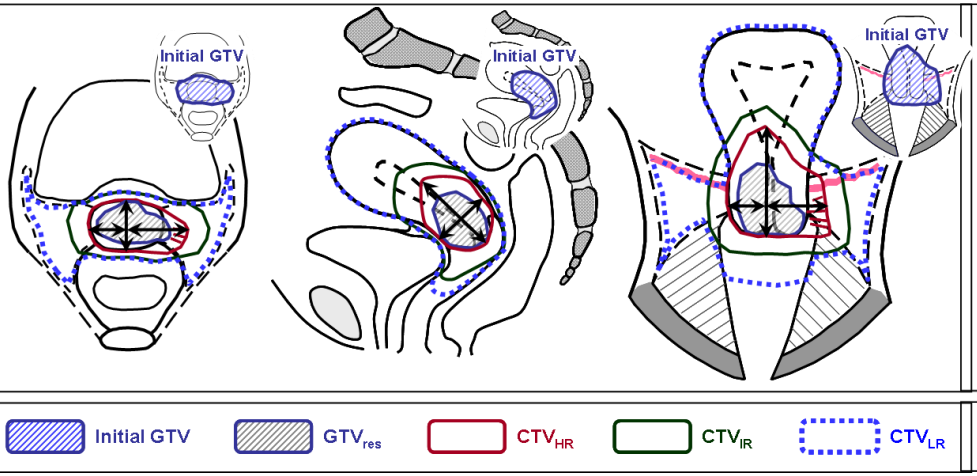


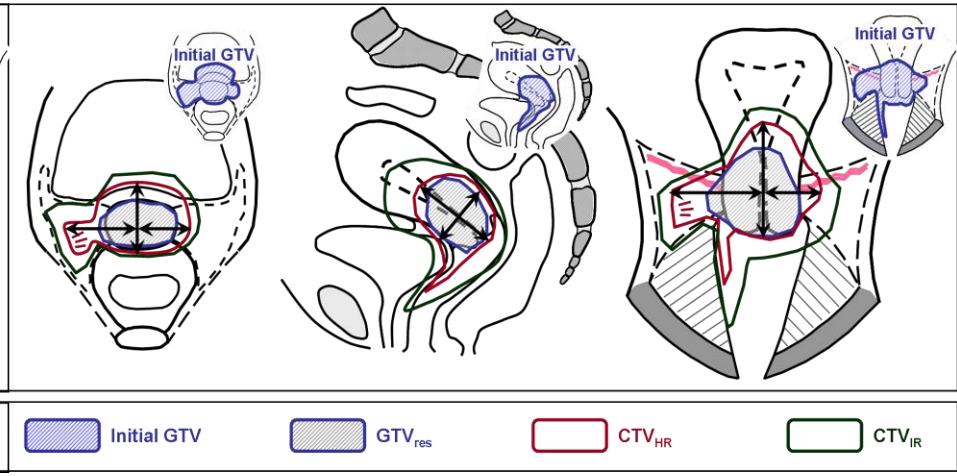
ICRU/GEC ESTRO report 89 Fig. 5.4

Overview of adaptive target concept in cervix cancer

ICRU/GEC ESTRO
report 89
Fig. 5.9-11







Target volume concepts

High Risk CTV :

GTV at time of brachytherapy

In all cases includes:

- GTV + whole cervix
- Presumed tumour extension in adjacent tissues
  - **Clinical assessment**
  - **Residual grey zones on MRI**

NO SAFETY MARGINS

Intermediate Risk CTV :

GTV at time of diagnosis

In all cases includes:

- HR-CTV
- integrates initial GTV

SAFETY MARGINS :

1-1.5 cm cranially

0.5cm antero-posteriorly

1cm laterally

Overview

- Stage IB1
- Stage IB2
- Stage IIB
- Stage IIIB

- Limited disease
- Extensive disease, sufficient response
- Extensive disease, insufficient response

Target volume concepts

High Risk CTV (IB1):

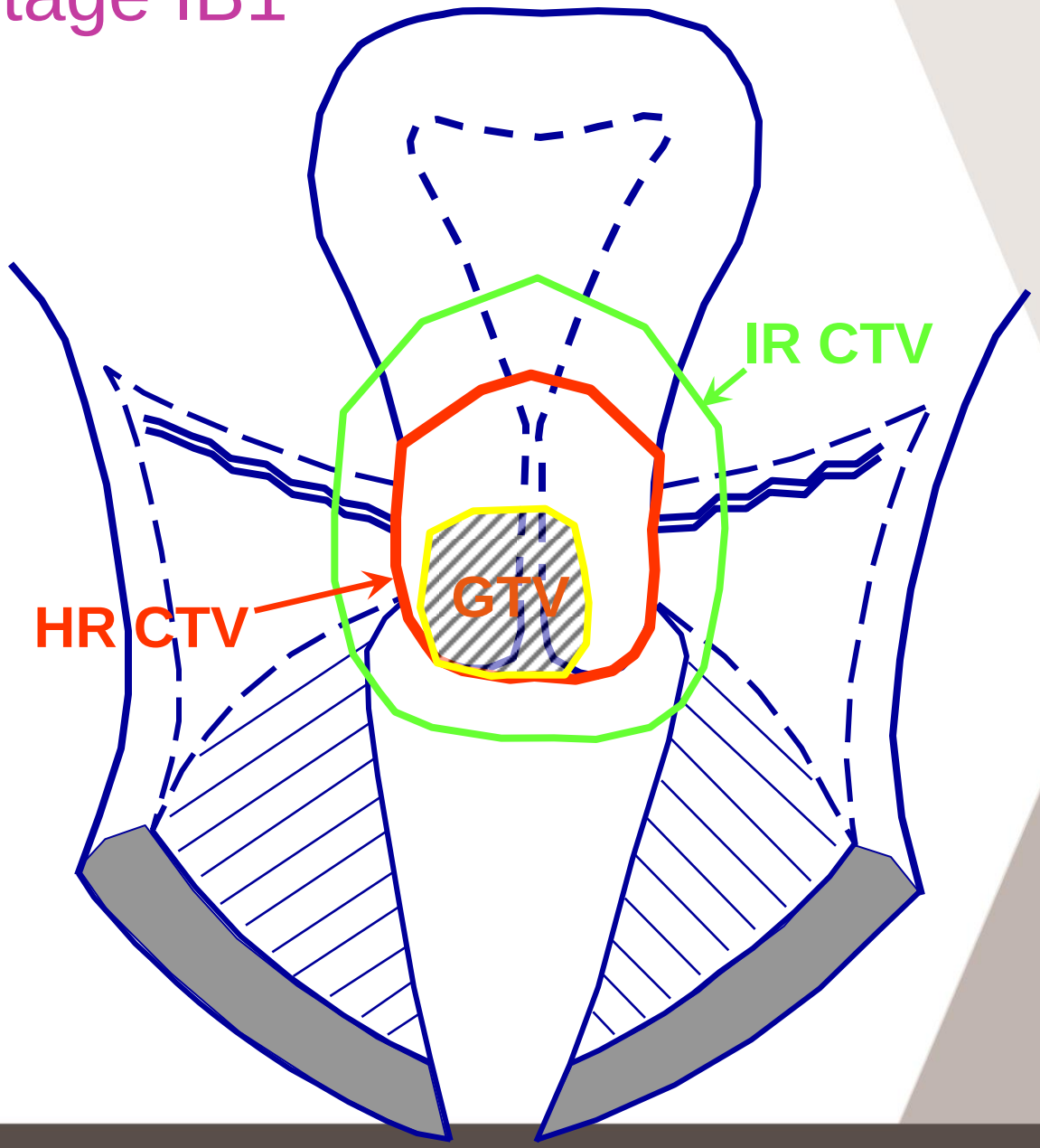
GTV at time of brachytherapy

In all cases includes:

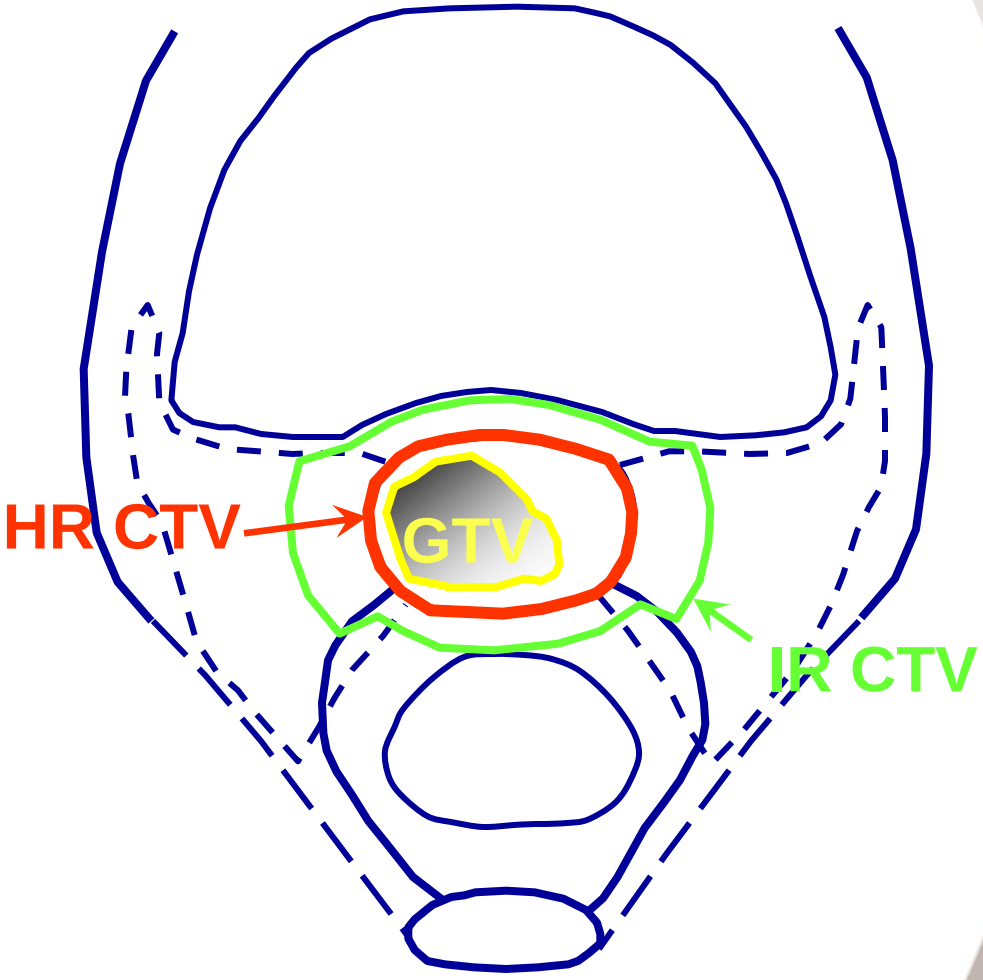
- Whole cervix
- MRI and clinical assessment

NO SAFETY MARGINS

Stage IB1



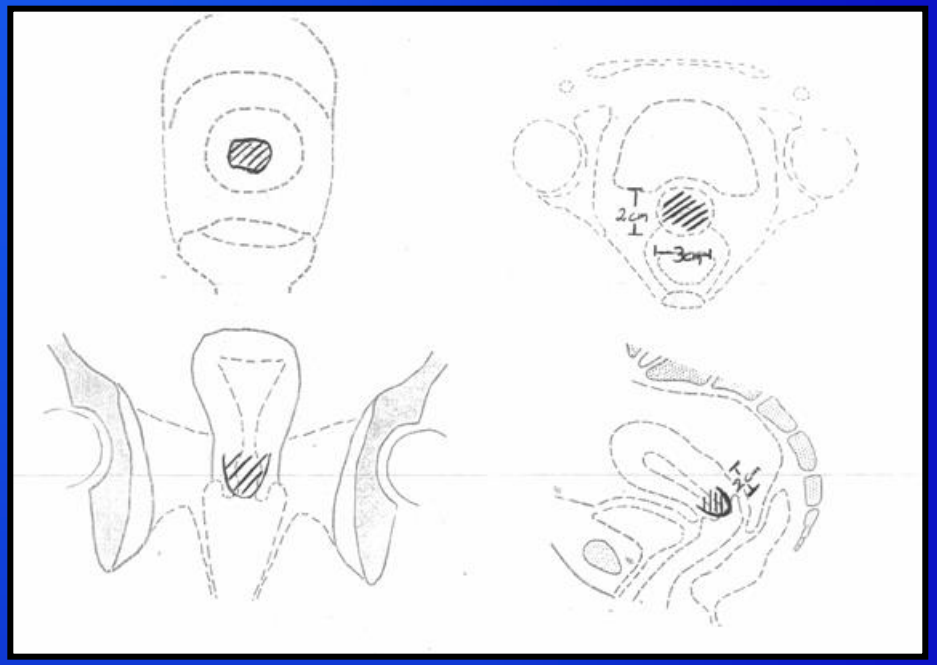
Stage IB1



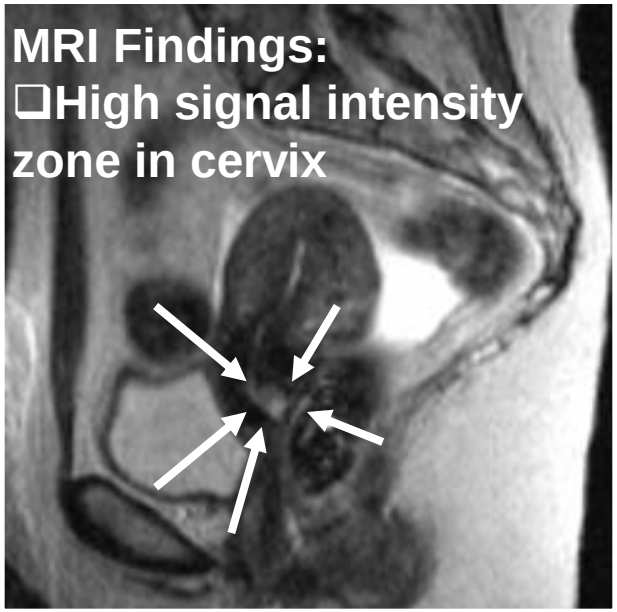
1. Limited disease (tumour size<4cm)

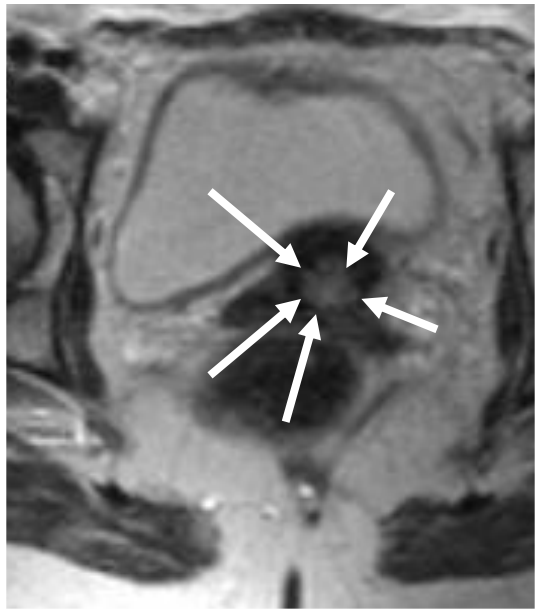
Definition of GTV

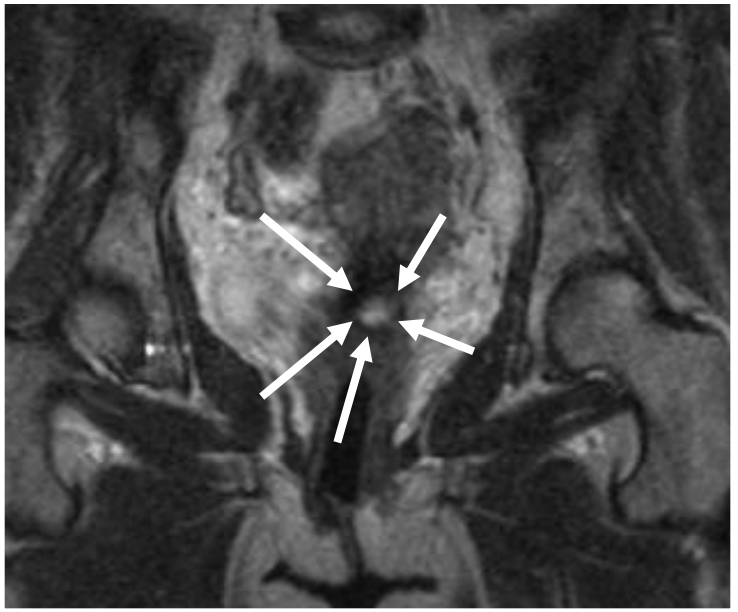
Clinical Examination:
macroscopic tumour



MRI Findings:
- **High signal intensity zone in cervix**



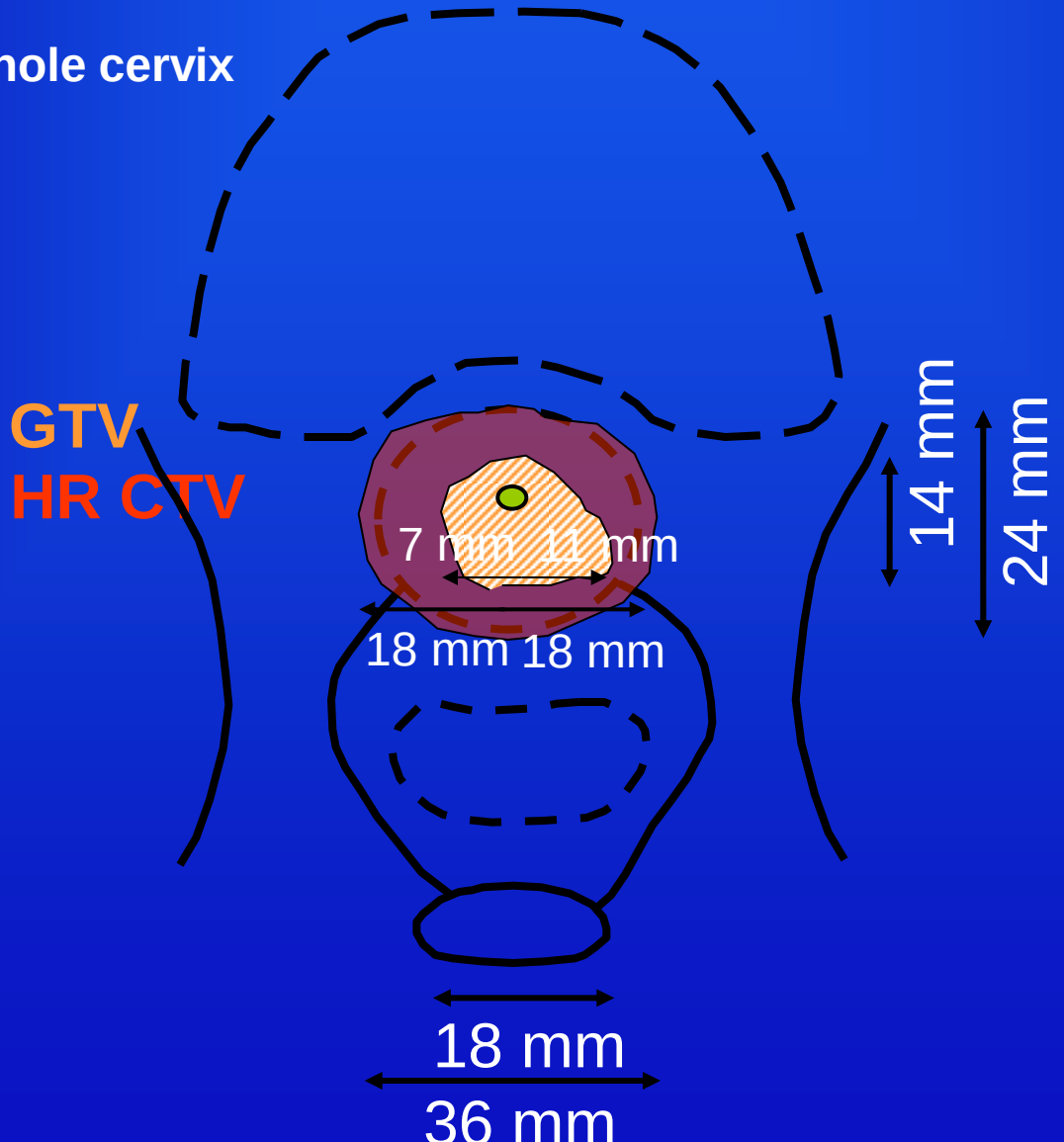




1. Limited disease (tumour size<4cm)

Definition of HR-CTV:

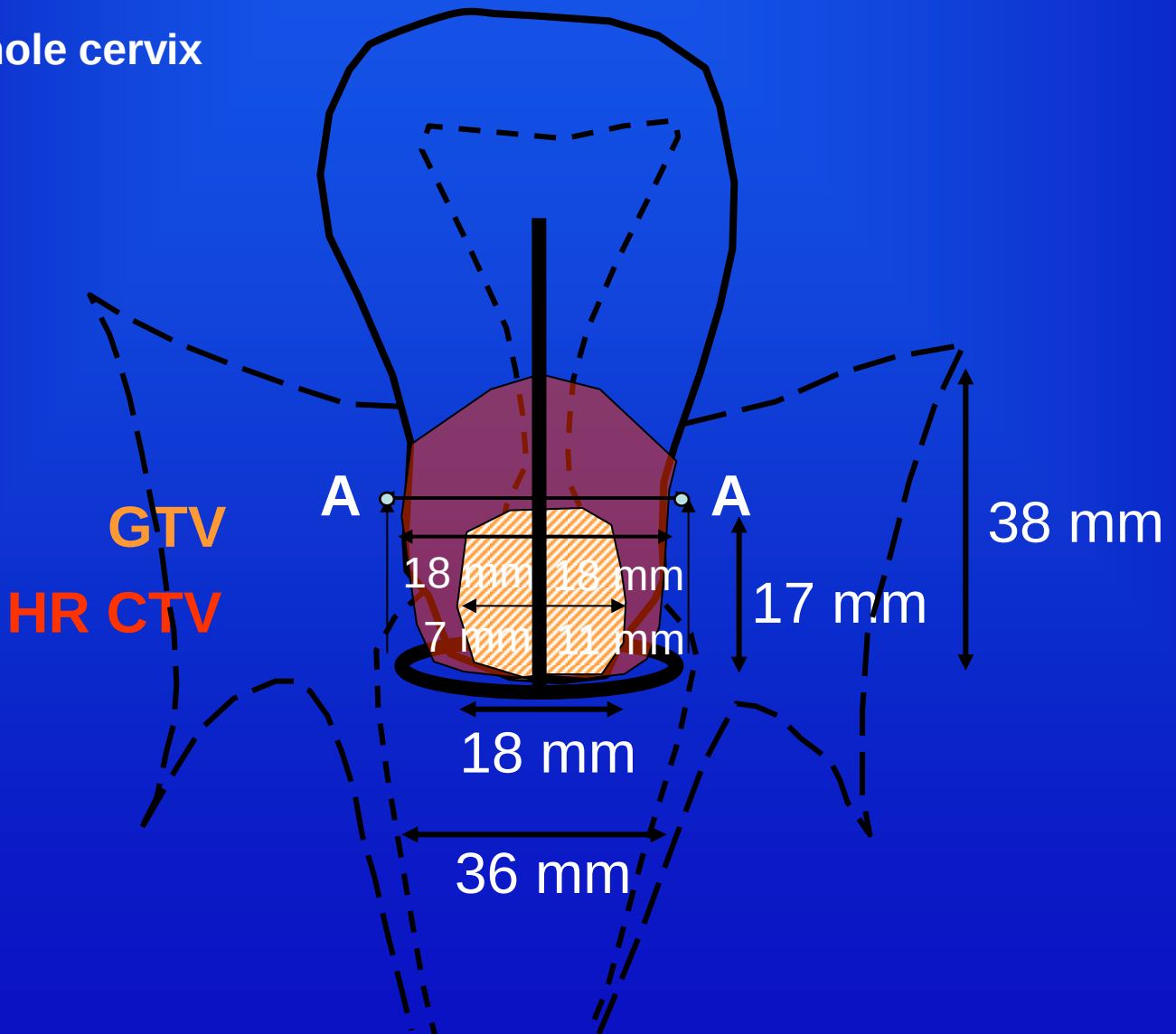
GTV + whole cervix



1. Limited disease (tumour size<4cm)

Definition of HR-CTV:

GTV + whole cervix



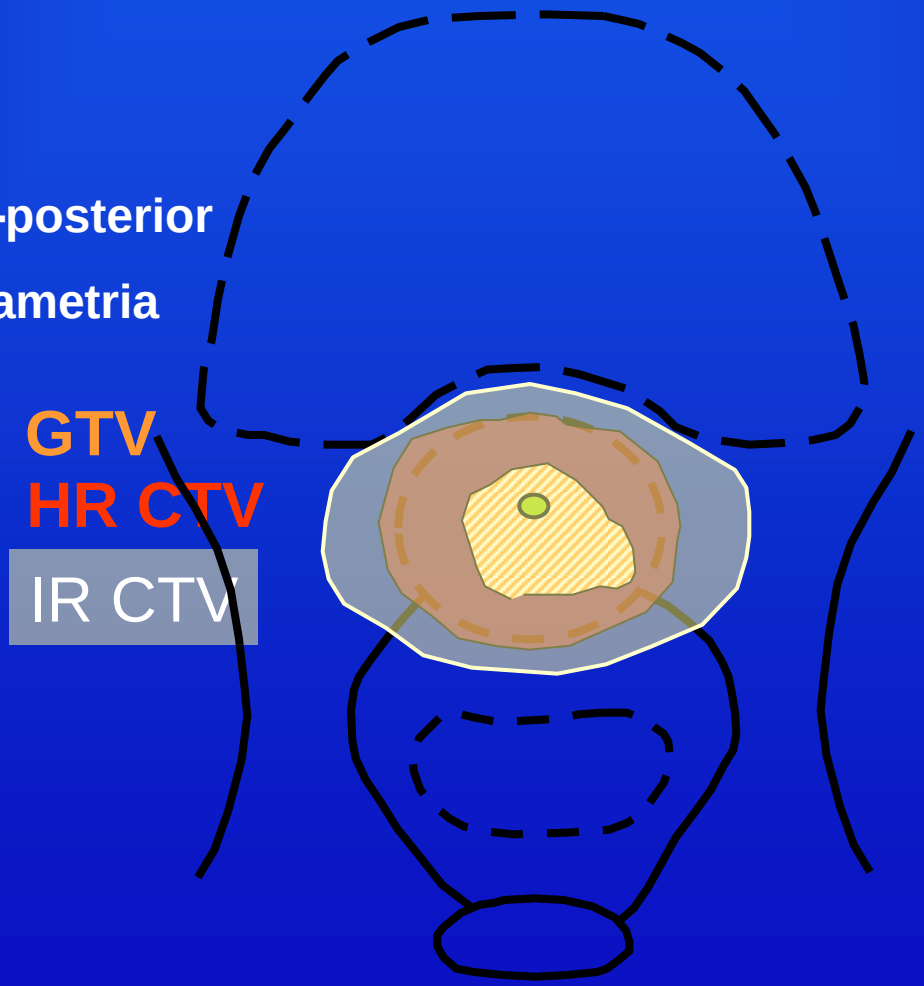
1. Limited disease (tumour size<4cm)

Definition of IR-CTV

HR CTV + safety margin
(area of adjacent significant microscopic tumour load)

5 mm anterior –posterior

10 mm into parametria



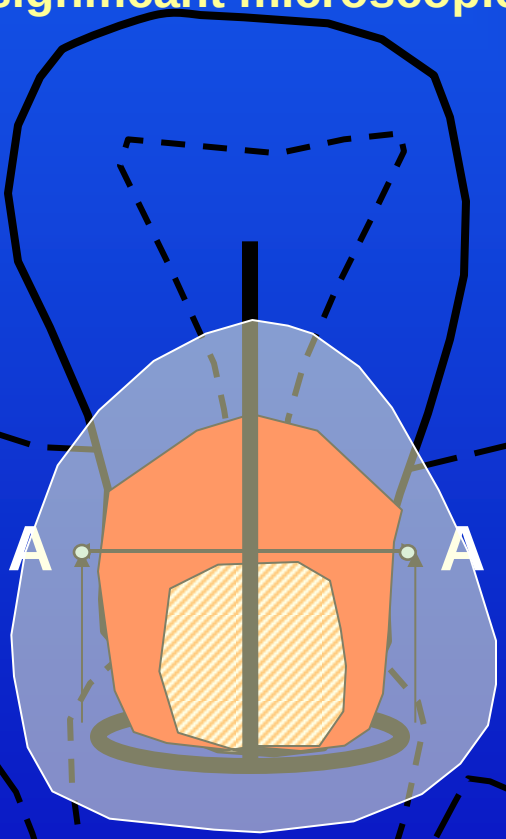
1. Limited disease (tumour size<4cm)

Definition of IR-CTV

HR CTV + safety margin
(area of potential adjacent significant microscopic tumour load)

5 mm anterior –posterior

10 mm into parametria



GTV

HR CTV

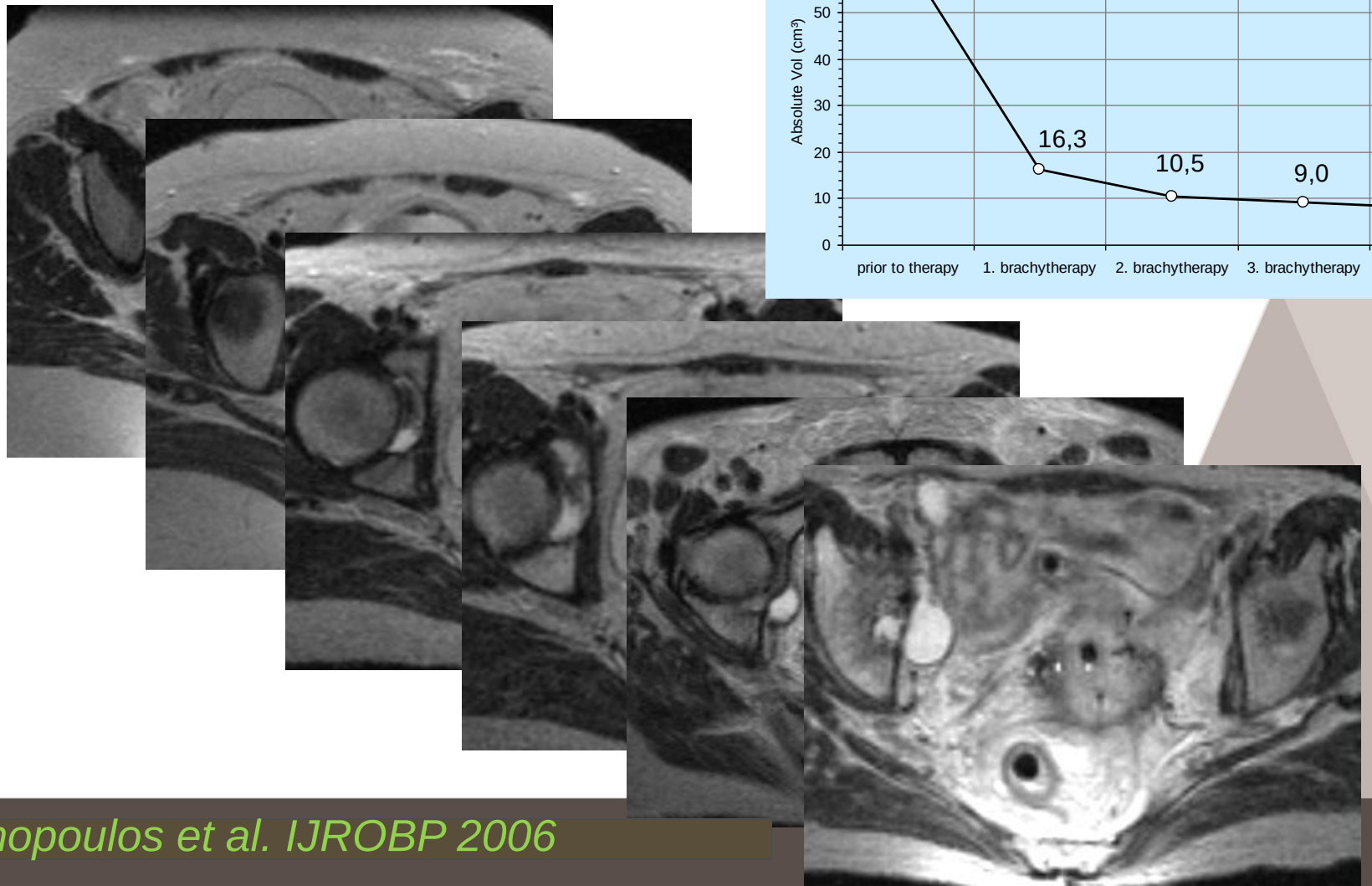
IR CTV

10 mm into the corpus

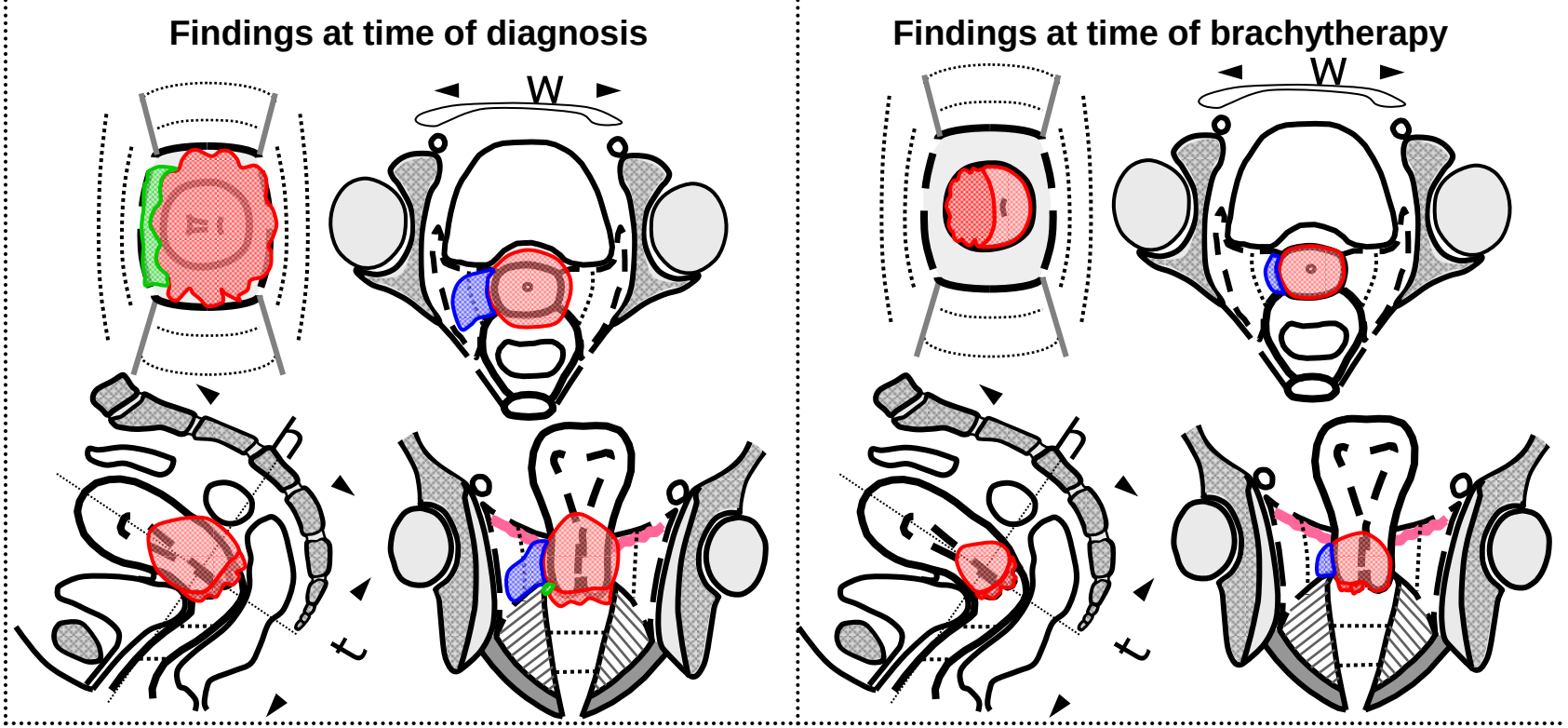
10 mm into the vagina

+/- additional 5 mm

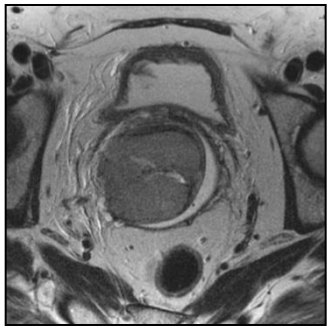
Adaptive MRI based planning concept

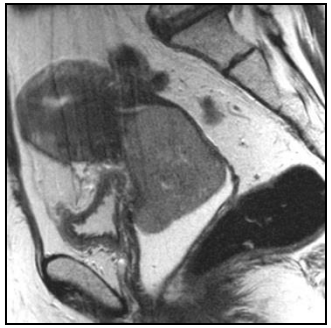


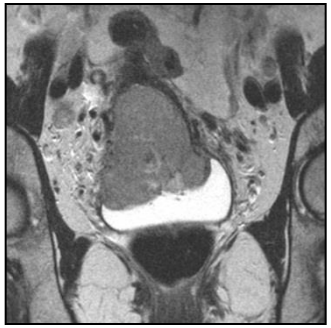
Dimopoulos et al. IJROBP 2006



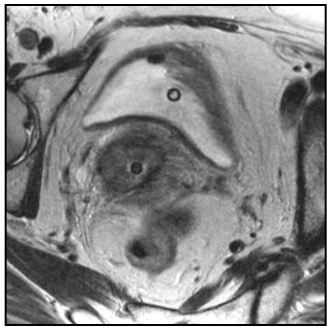
Dimensions (cm):
Width: 7
Thickness:>5
Height: >5
Vaginal inv.: 0.5
(right fornix)

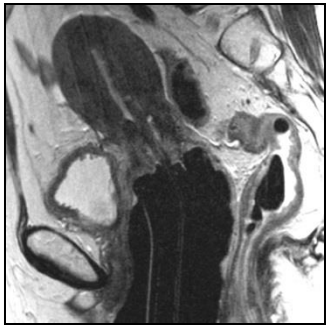






Dimensions (cm):
Width: 3.5
Thickness: 2
Height: 2
Vaginal inv.: 0





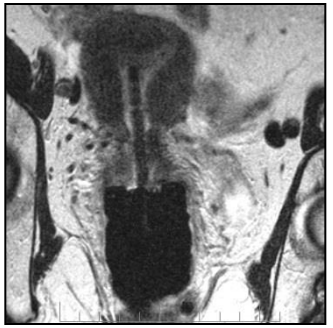
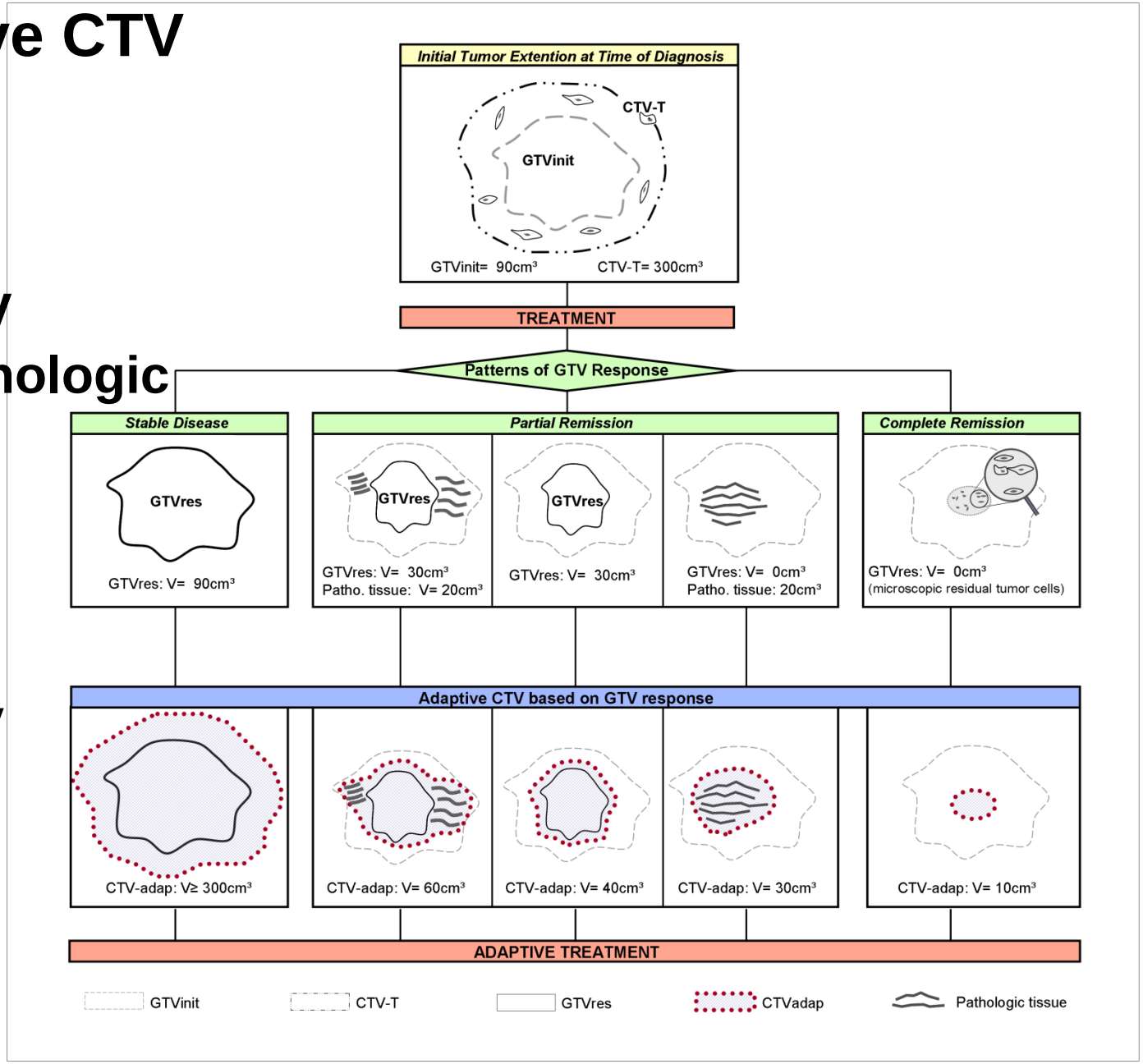


Fig.5.1

Various patterns of tumor response and adaptive CTV

Residual GTV
Residual pathologic tissue

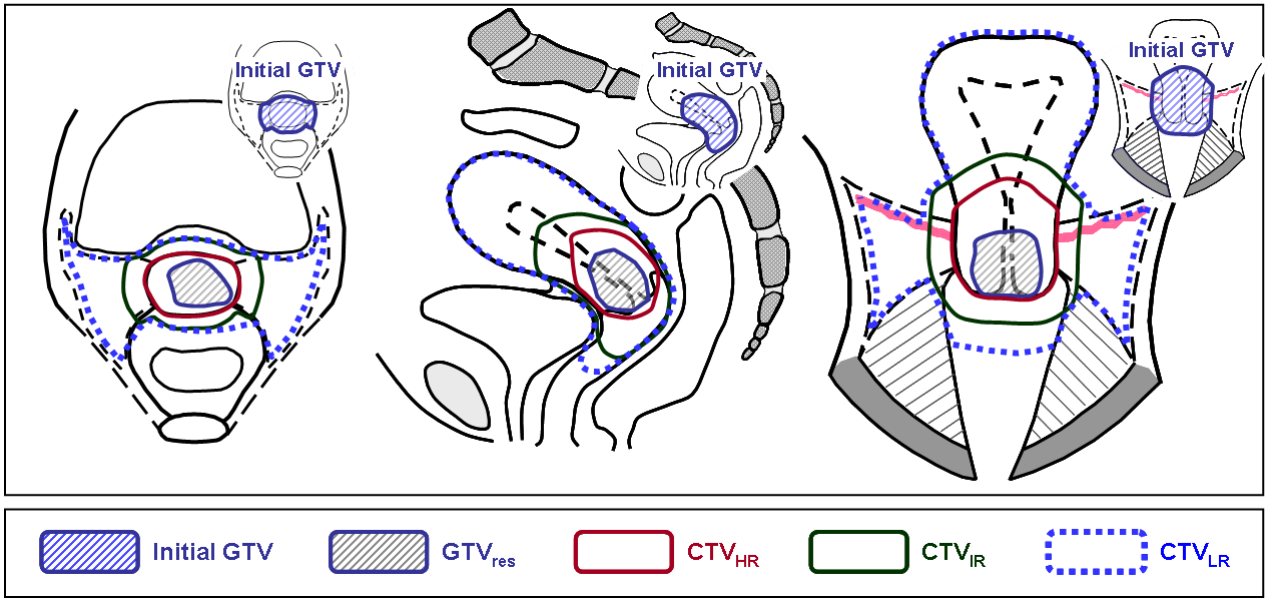
Adaptive CTV

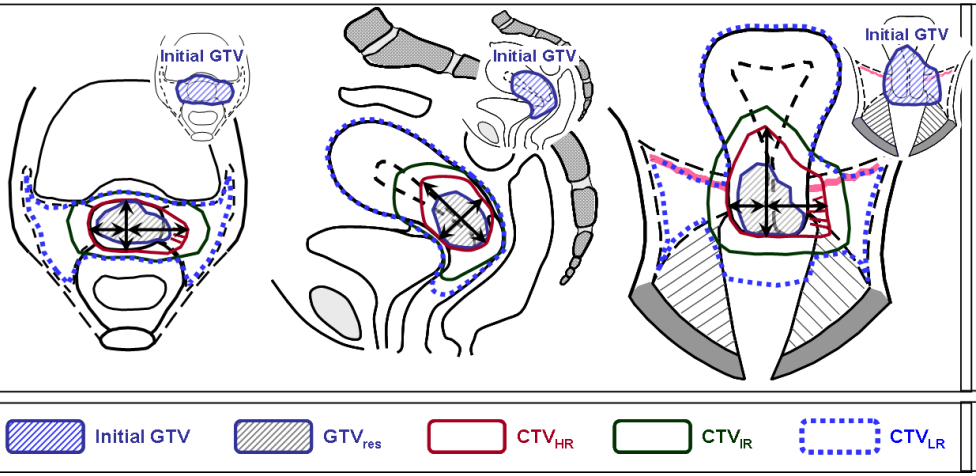


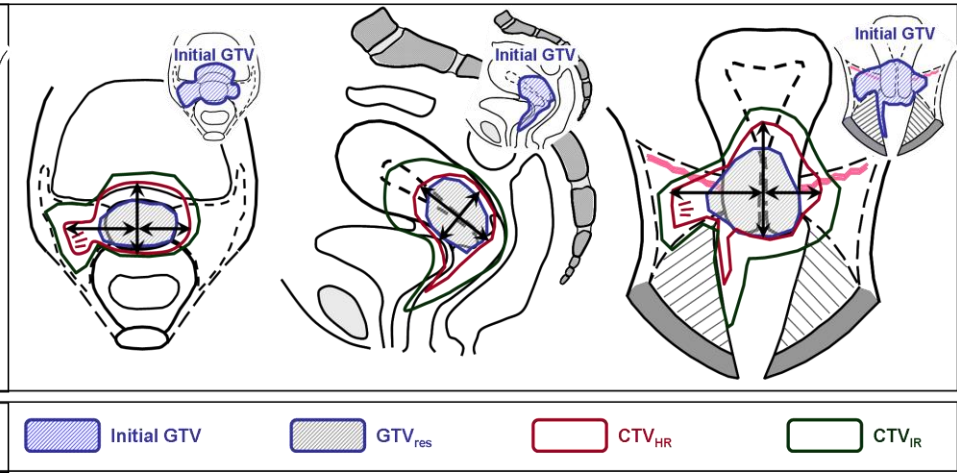
ICRU/GEC ESTRO report 89 Fig. 5.4

Overview of adaptive target concept in cervix cancer

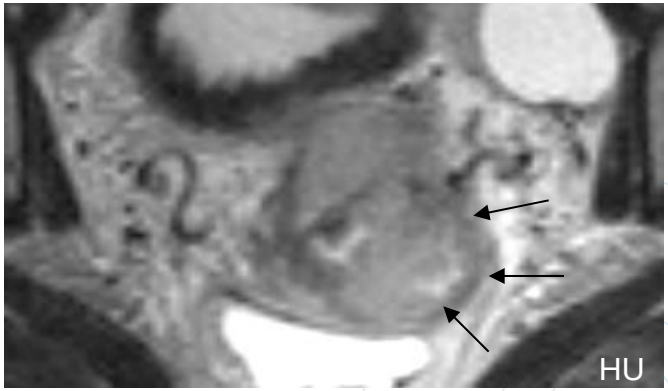
ICRU/GEC ESTRO
report 89
Fig. 5.9-11

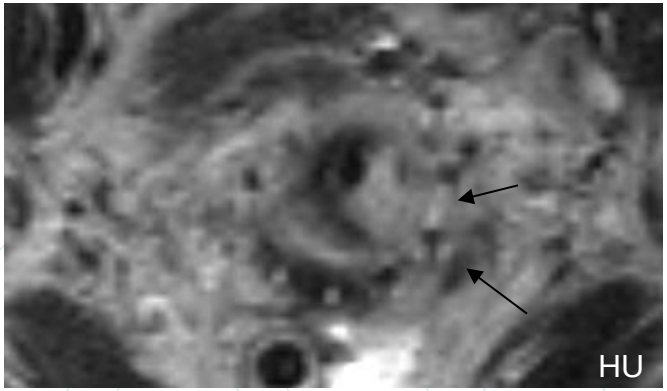






Initial GTV, Residual GTV, Residual Pathologic Tissue



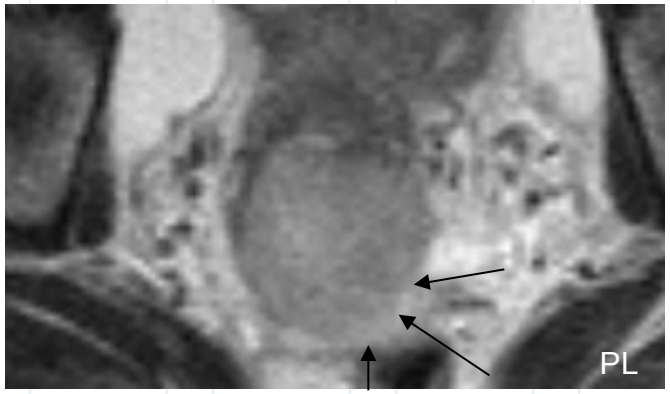


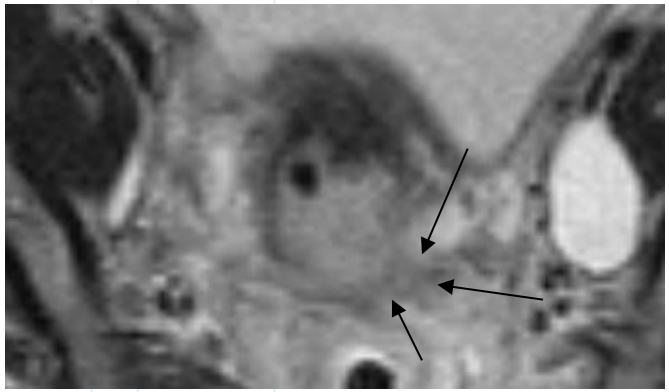
infiltrative outer half

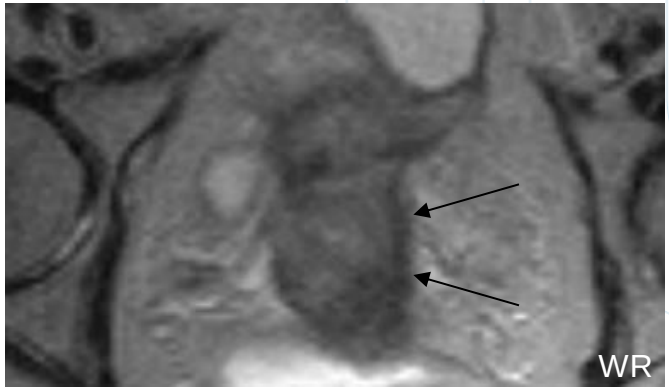
→ grey and bright zones

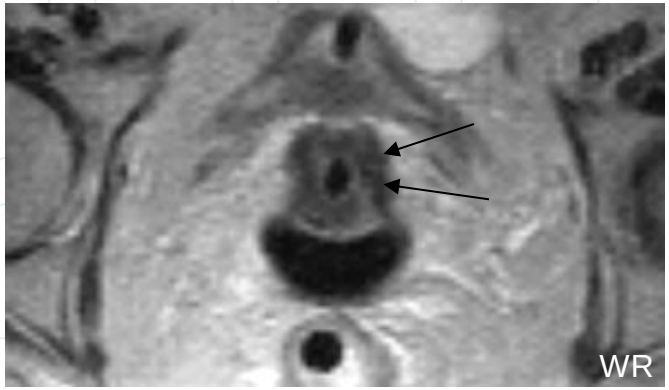
expansive with spiculae + infilt. part

→ grey zones in the PM









expansive with spiculae

→ no patholgic tissue in the PM

Target volume concepts

High Risk CTV (IB2):

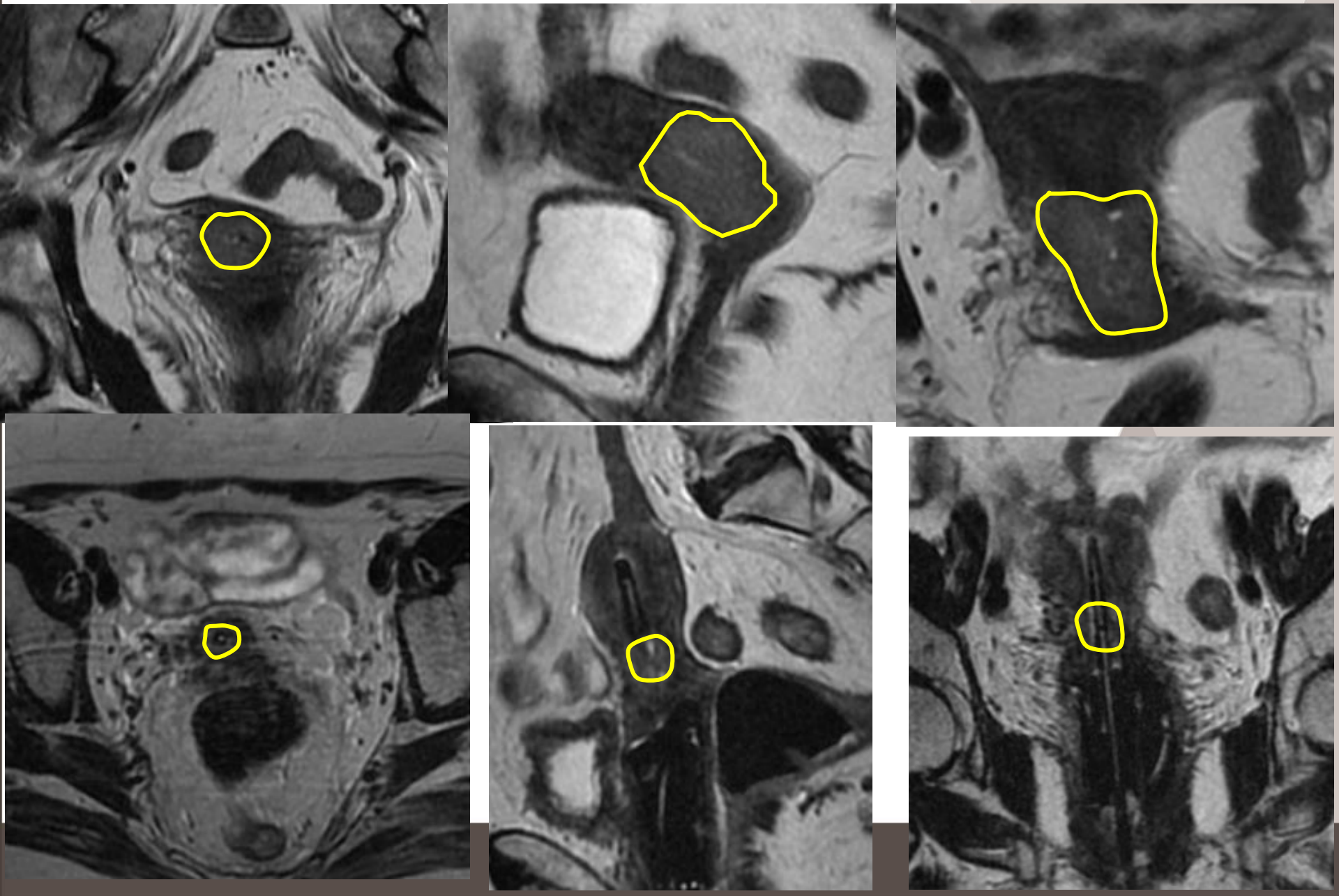
Residual GTV at time of brachytherapy (bright (MRI)

In all cases includes:

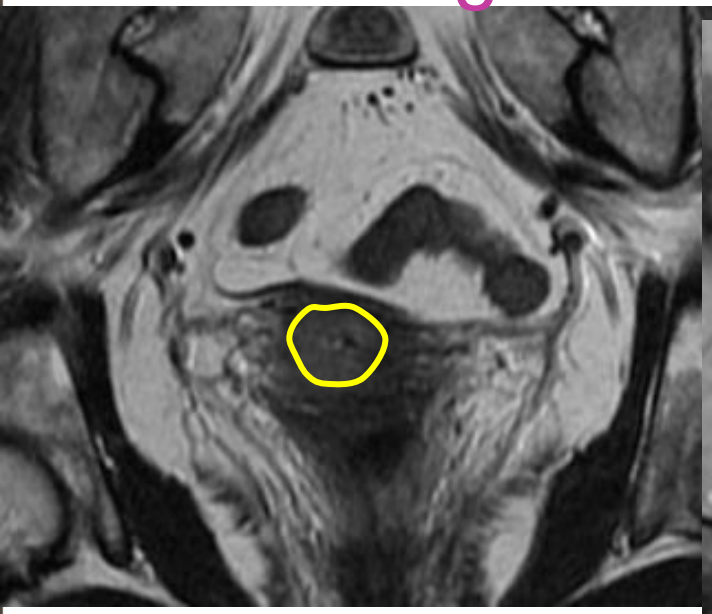
- Whole cervix
- (intra-uterine GTV extension)

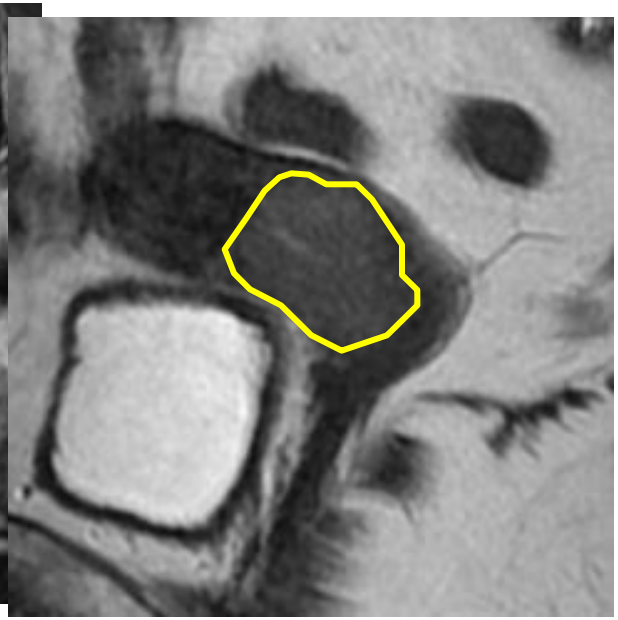
NO SAFETY MARGINS

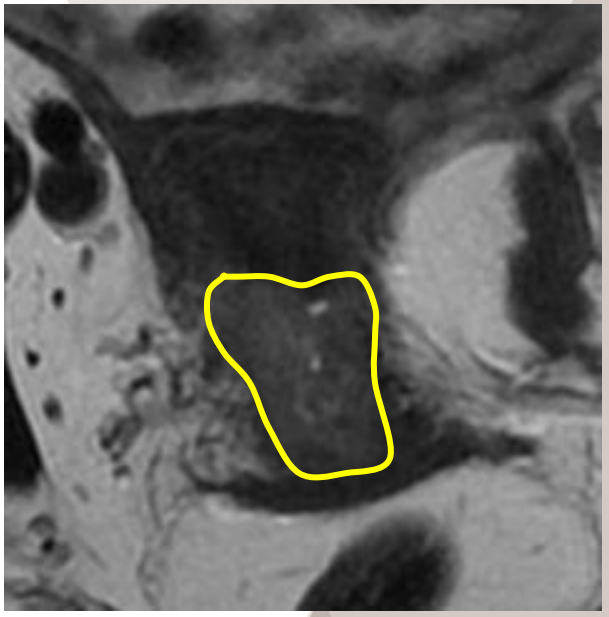
Stage IB2

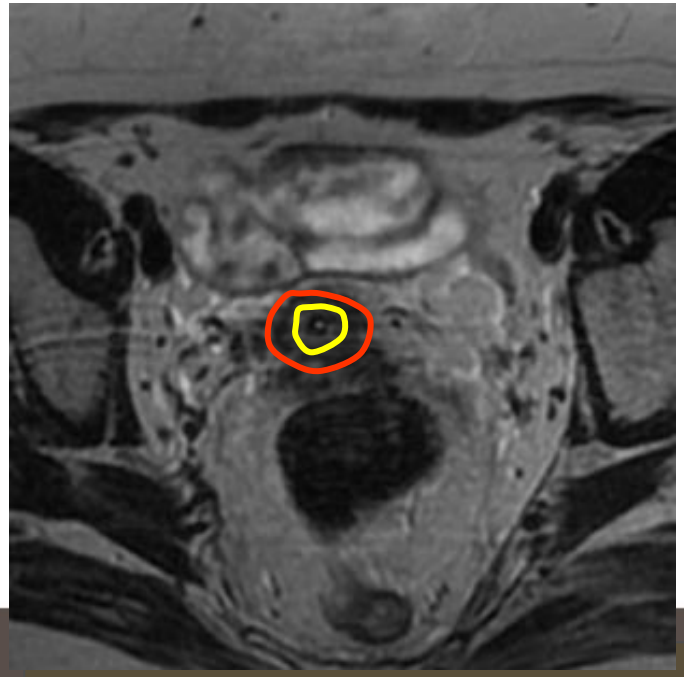


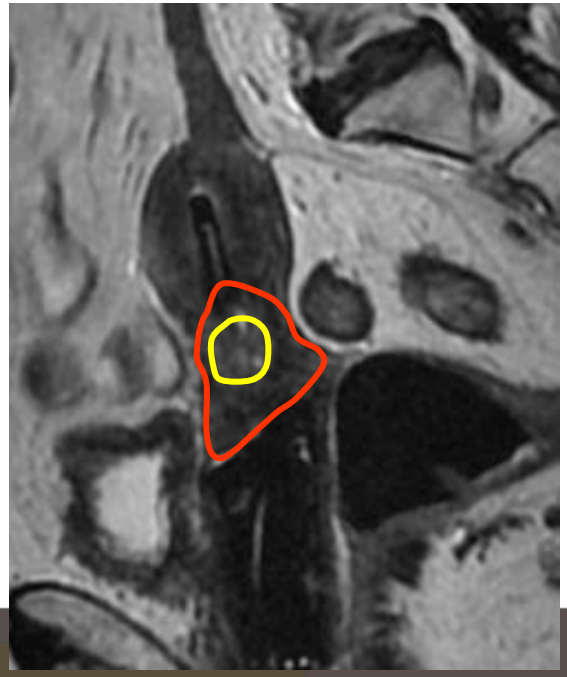
Stage IB2

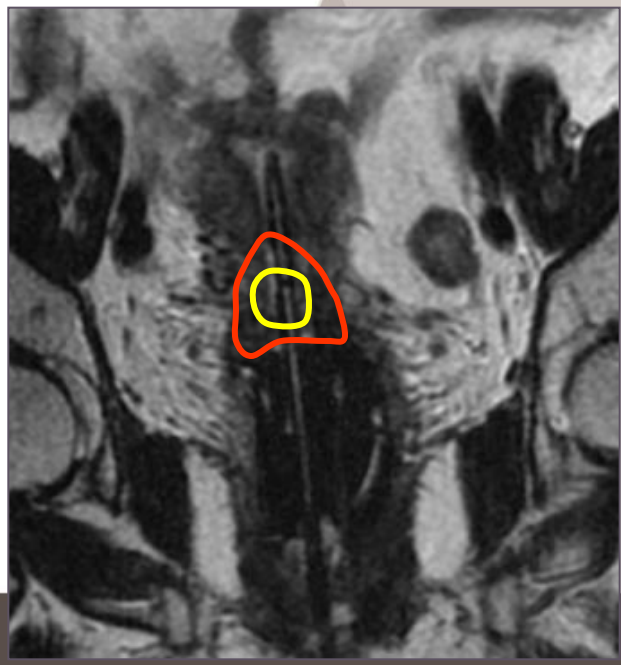




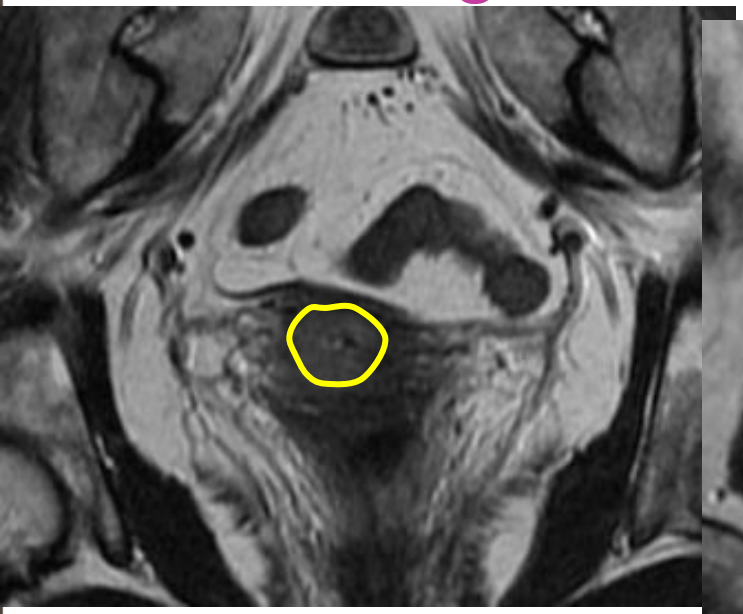


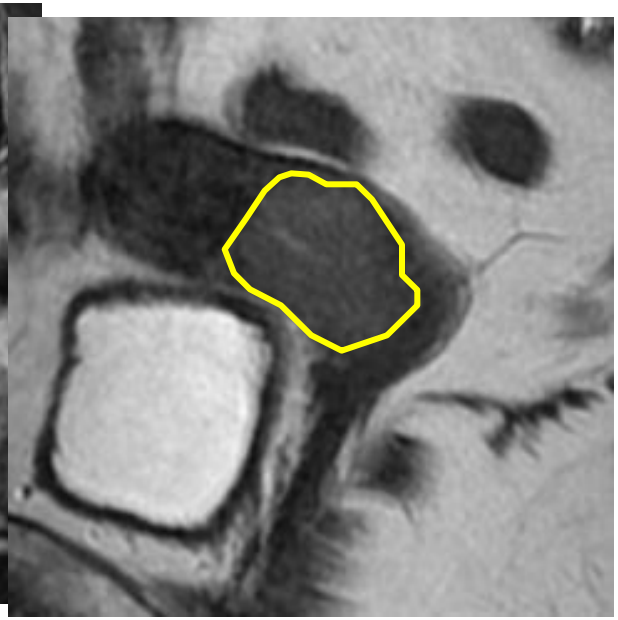


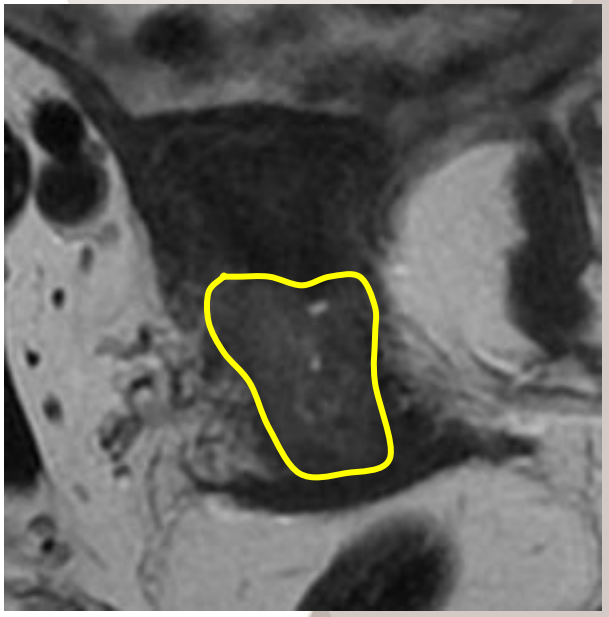


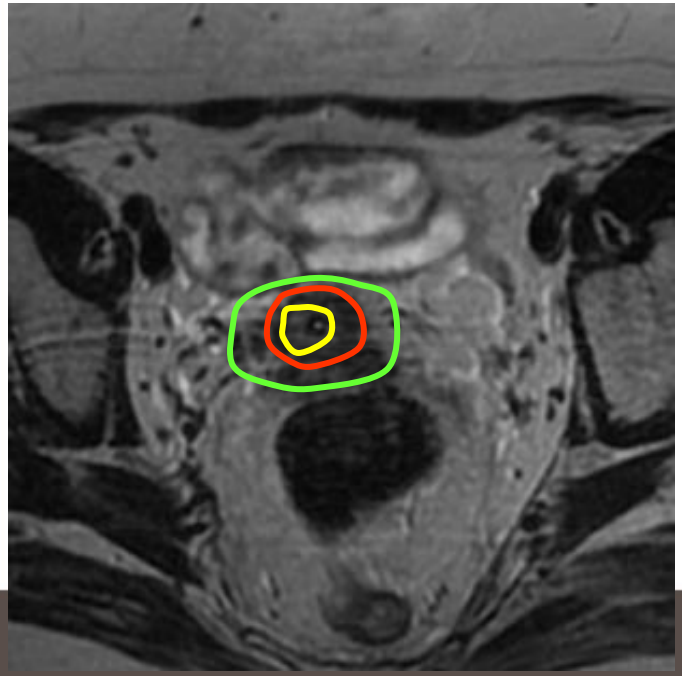


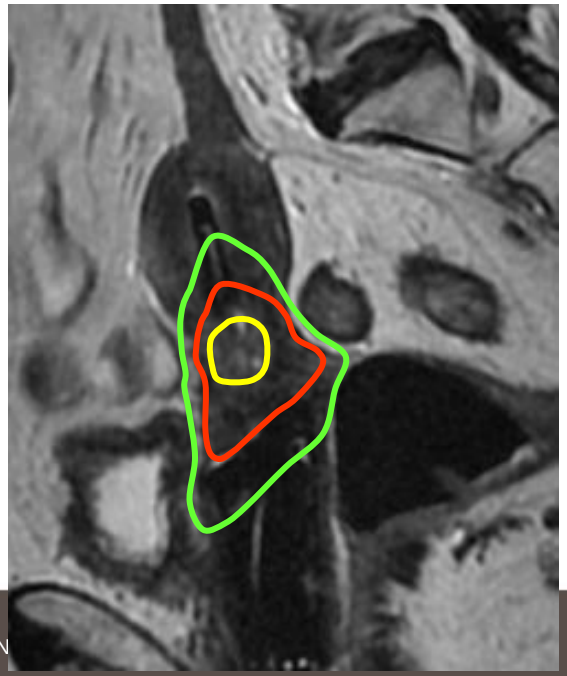
Stage IB2

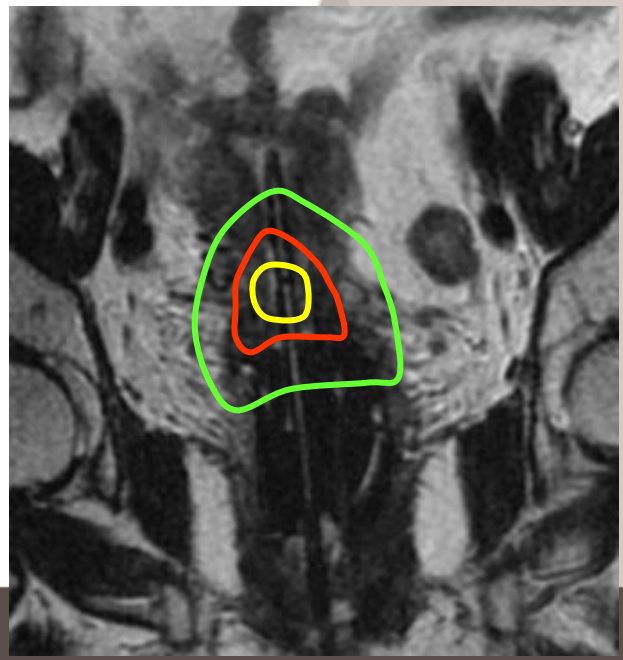






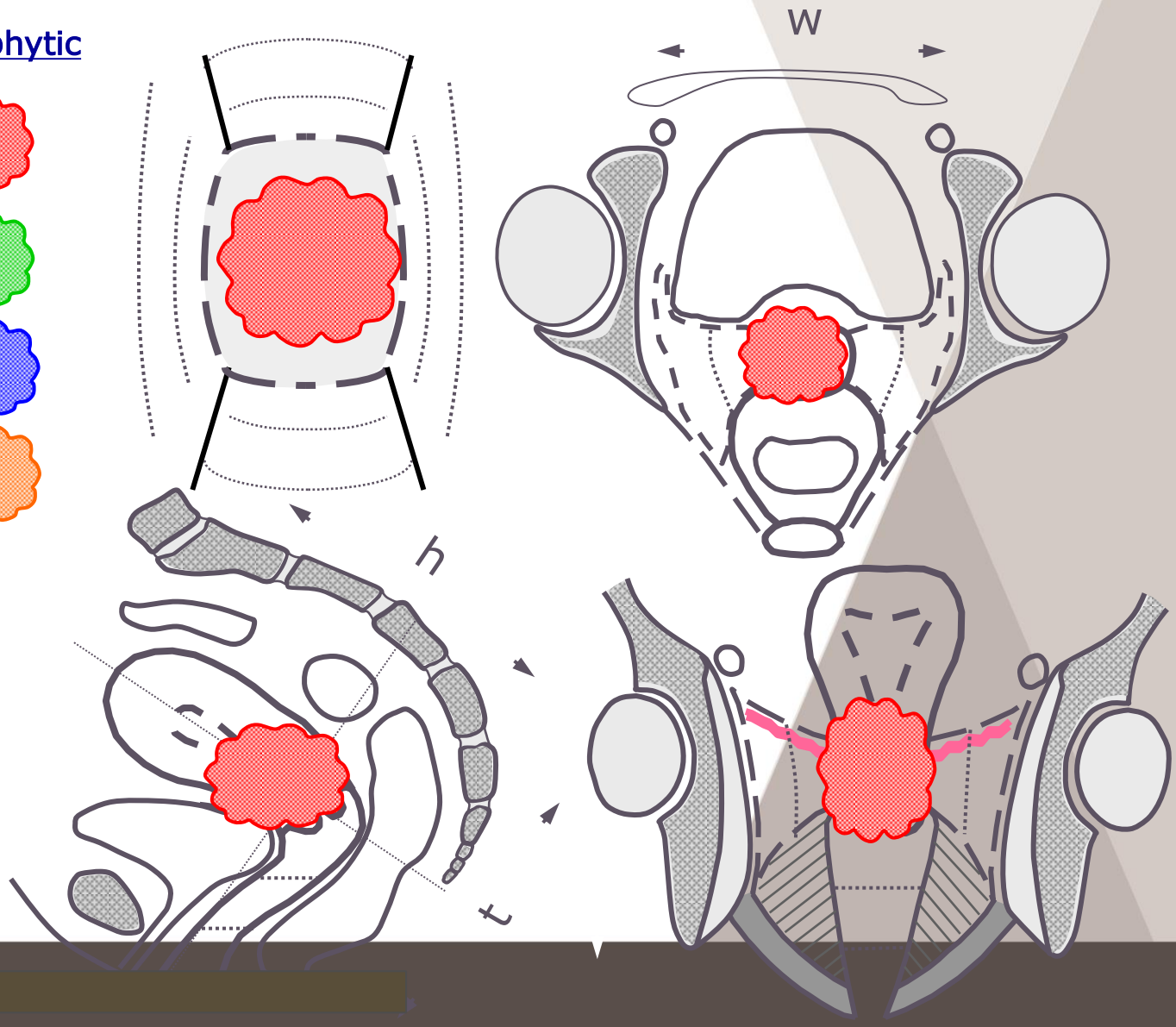






Stage IB2 : initial clinical examination

	Infiltrating	Exophytic
Cervix		
Vagina		
Parametrium		
Rectum or Bladder		



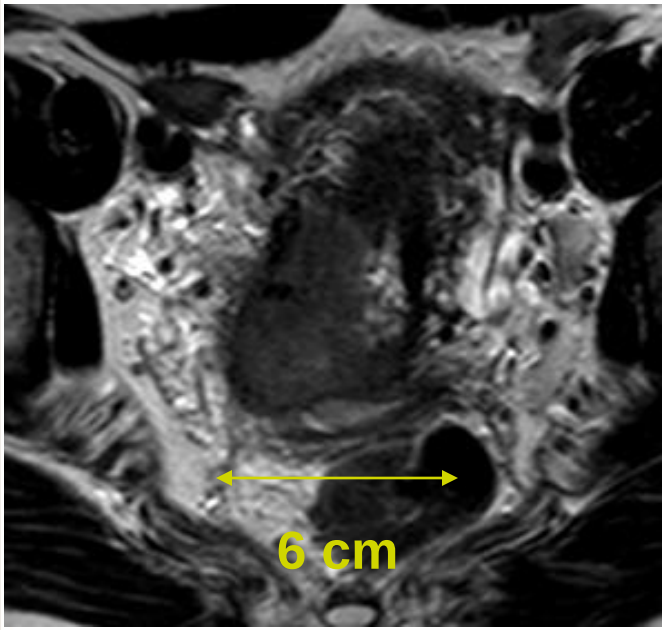
Dimensions (cm):

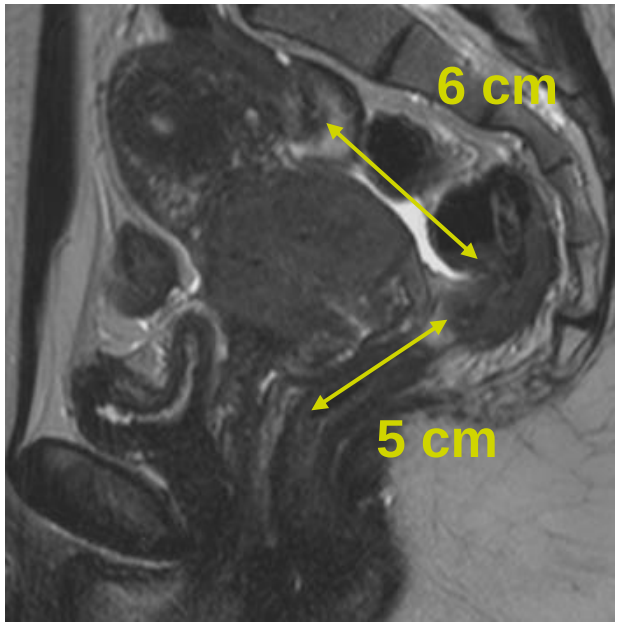
Width : 6

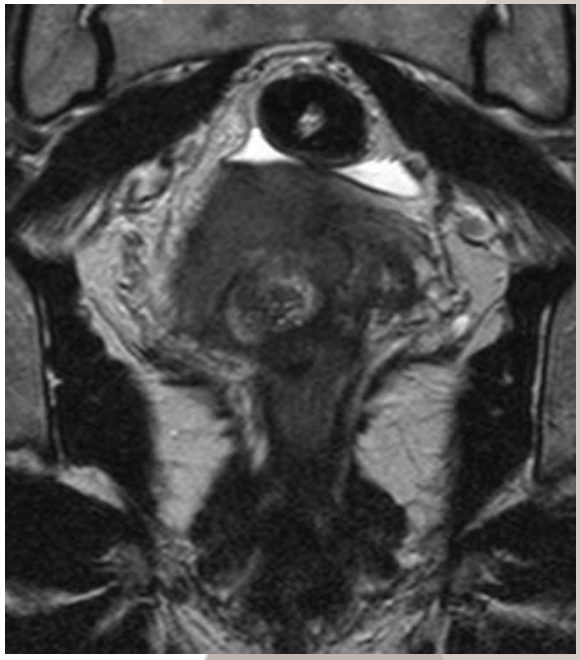
Thickness : 5

Height : 5

Stage IB2 : initial MRI

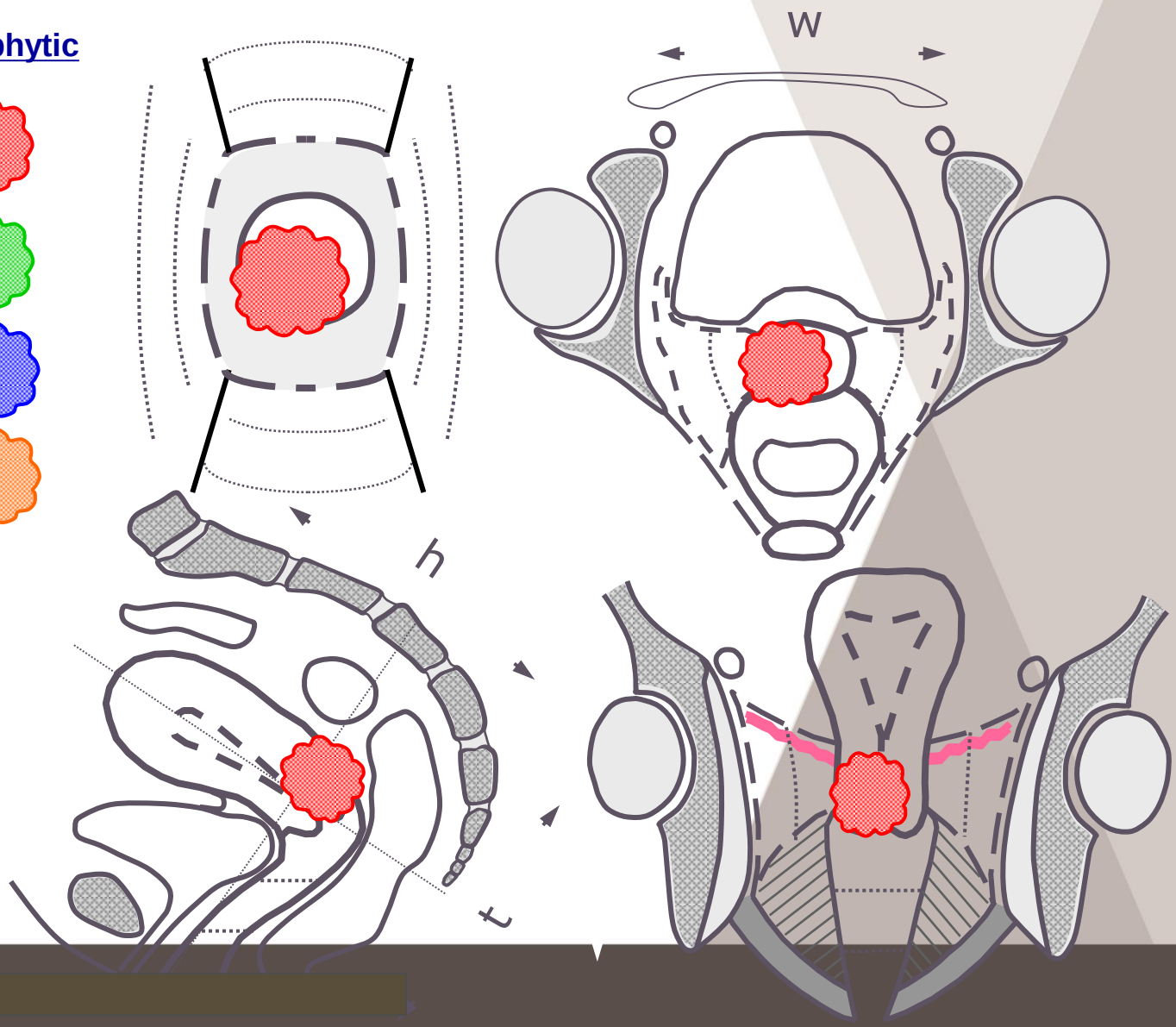






Stage IB2 : at the time of brachytherapy

	Infiltrating	Exophytic
Cervix		
Vagina		
Parametrium		
Rectum or Bladder		



Dimensions (cm):

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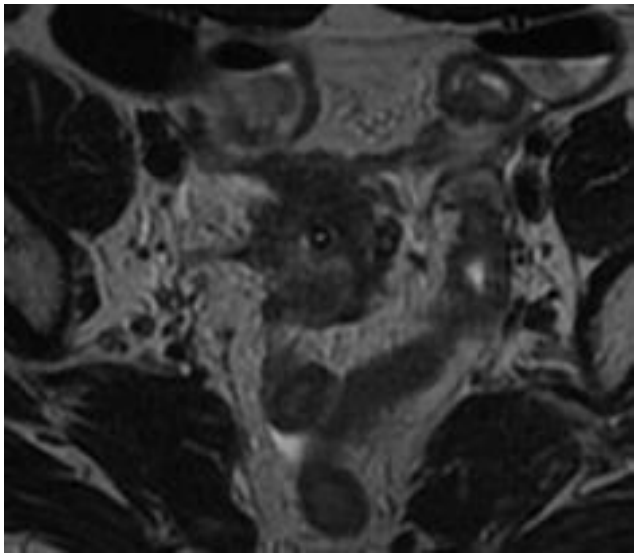
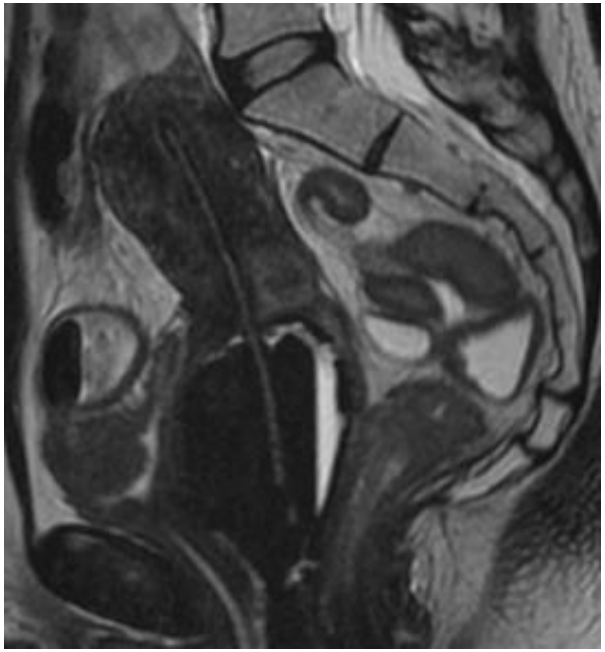
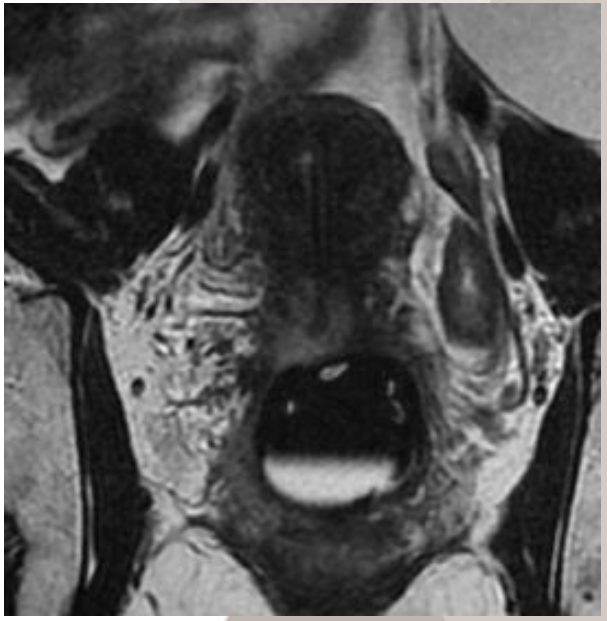
Thickness : 2

Height : 2.5

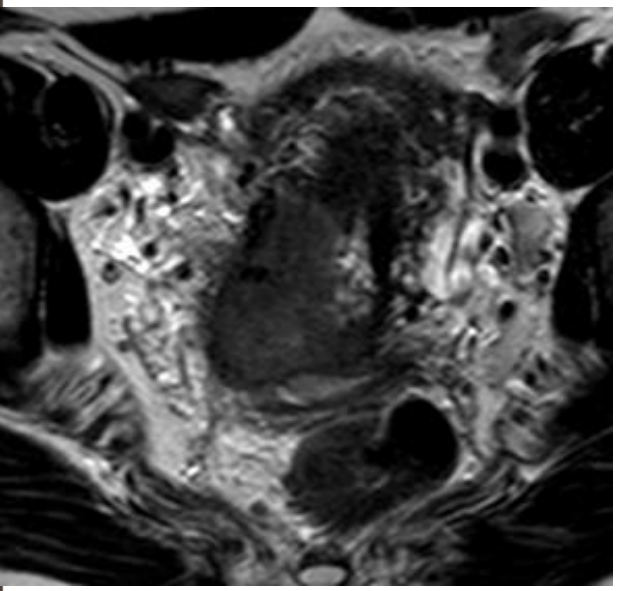
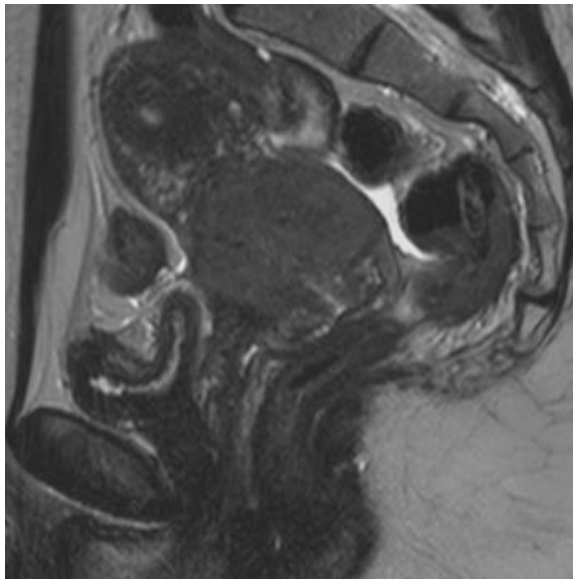
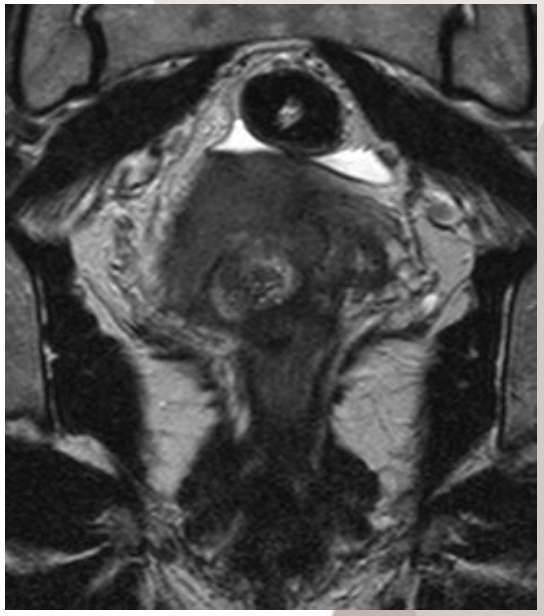
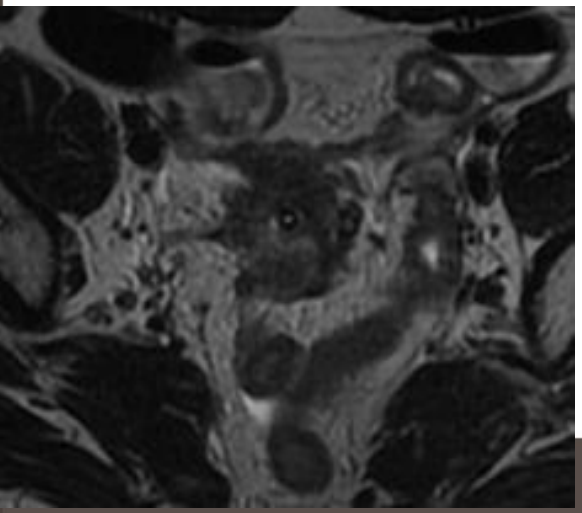
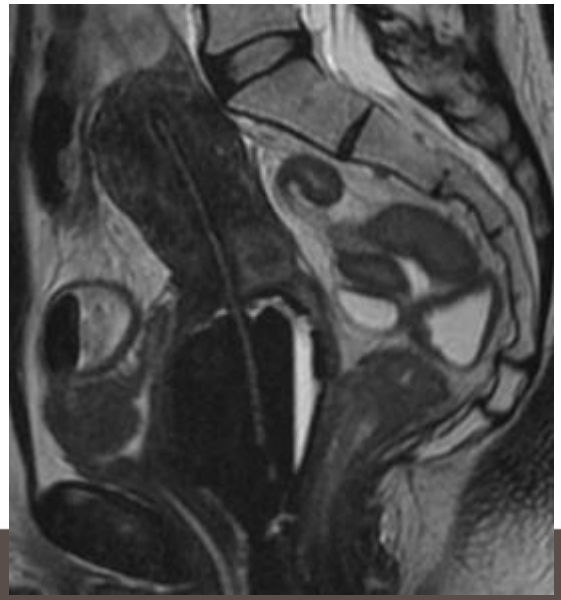
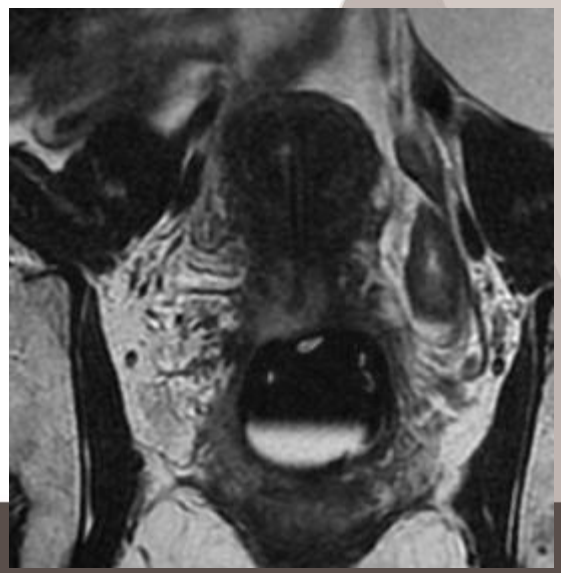
Stage IB2 : at the time of brachytherapy



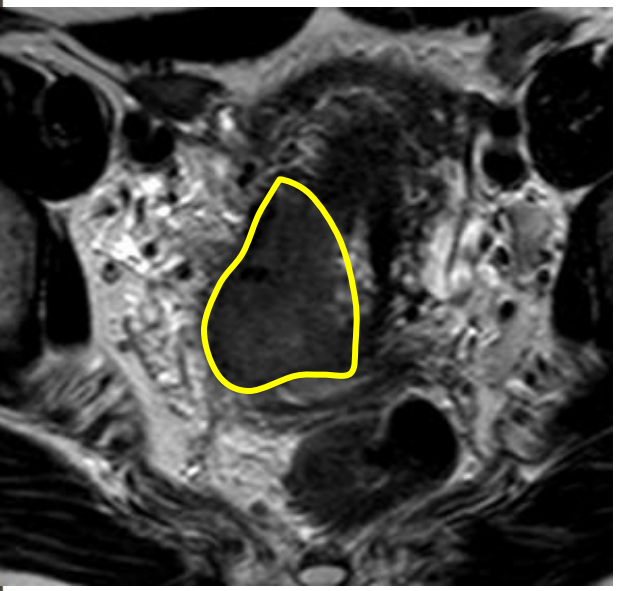


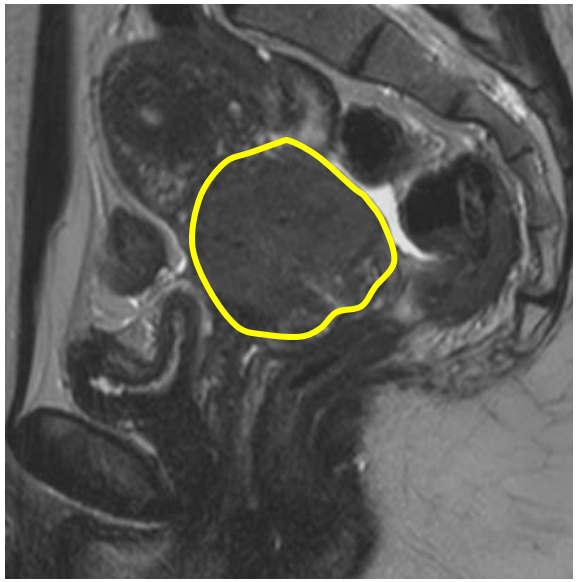


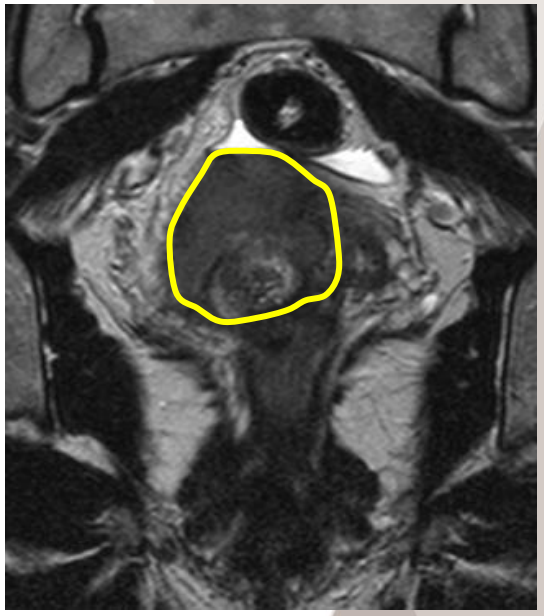
Stage IB2

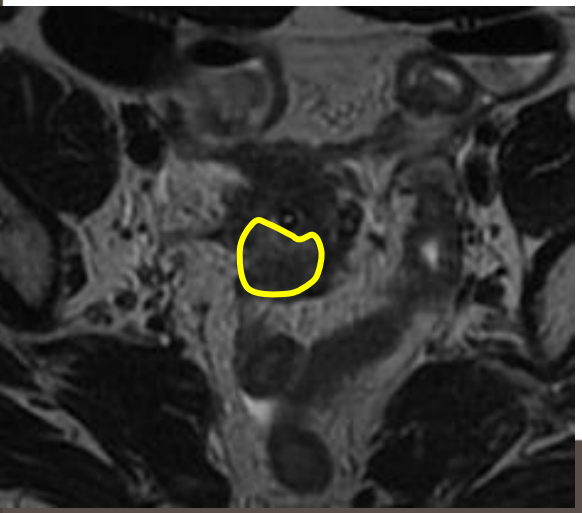







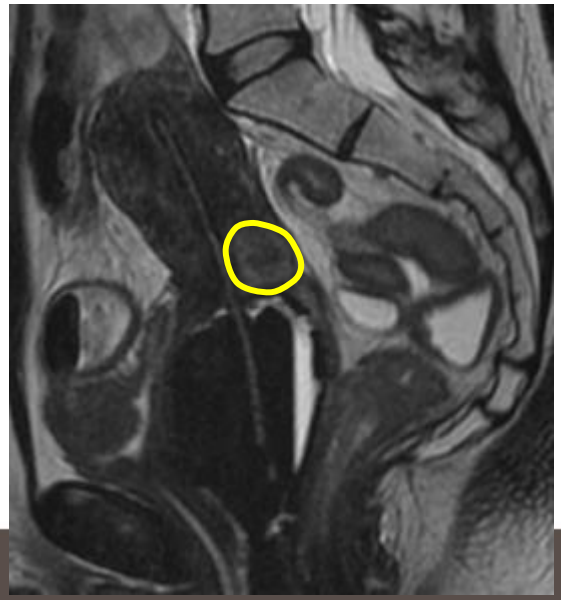
Stage IB2

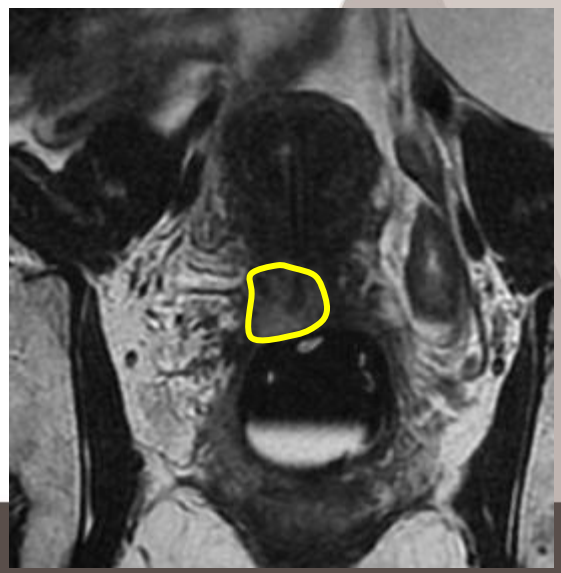




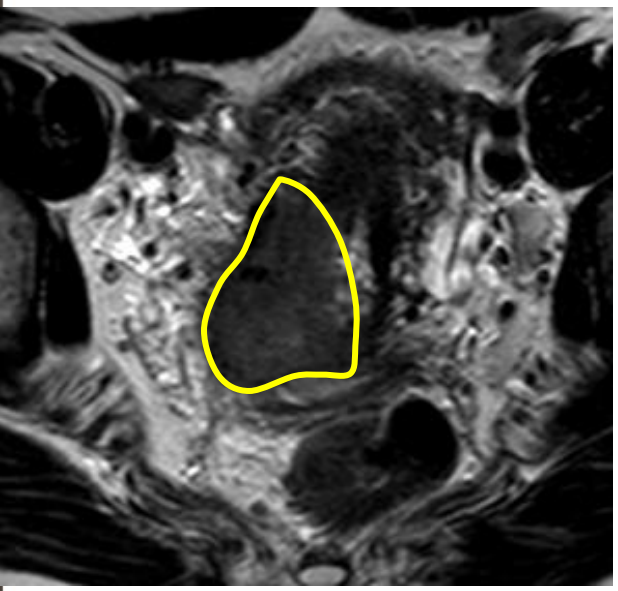
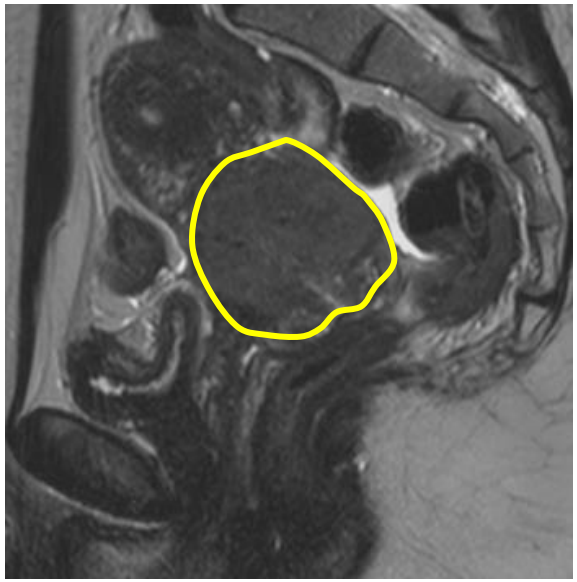
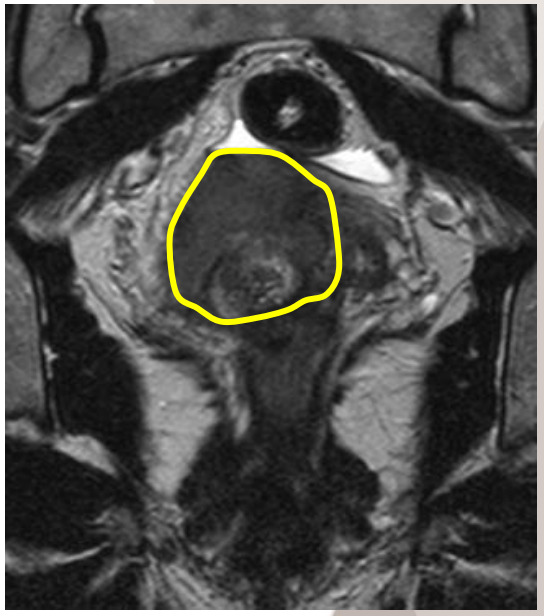
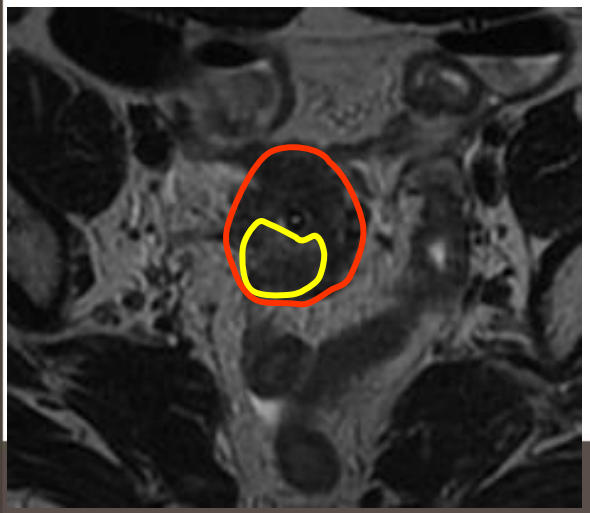
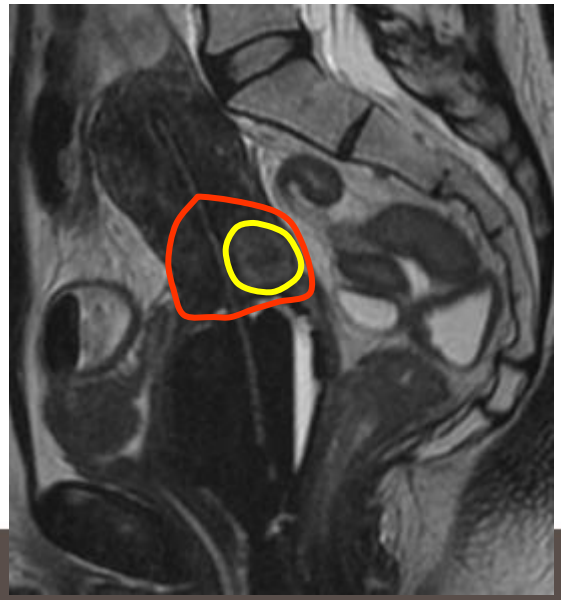
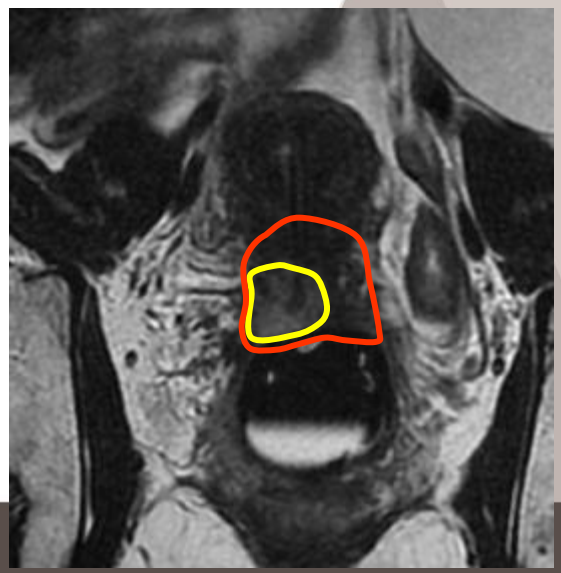




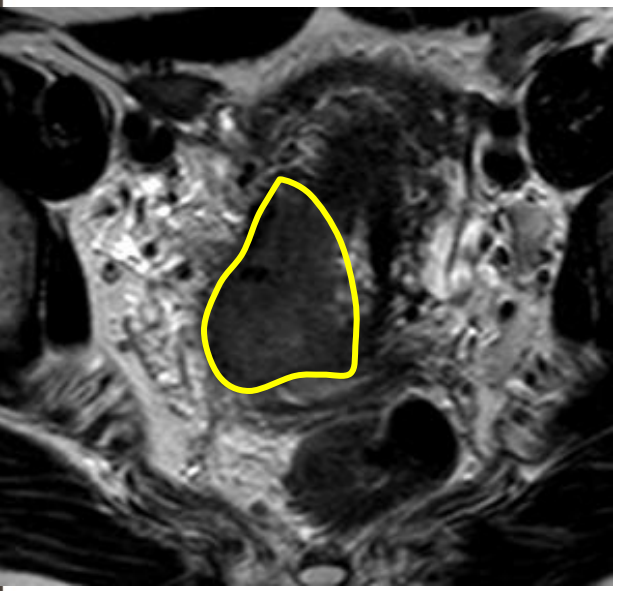
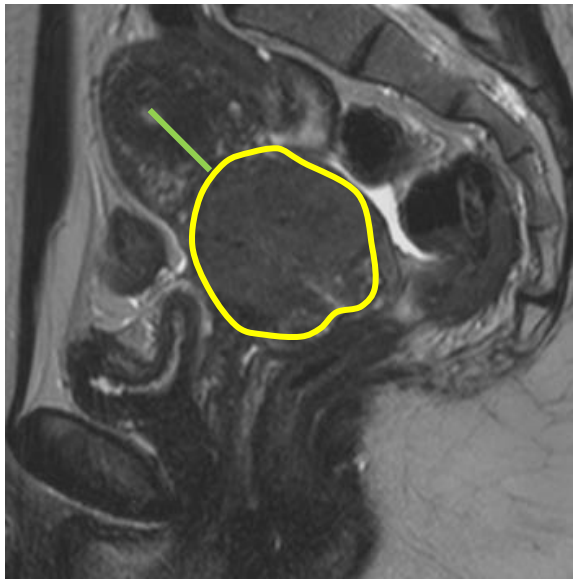
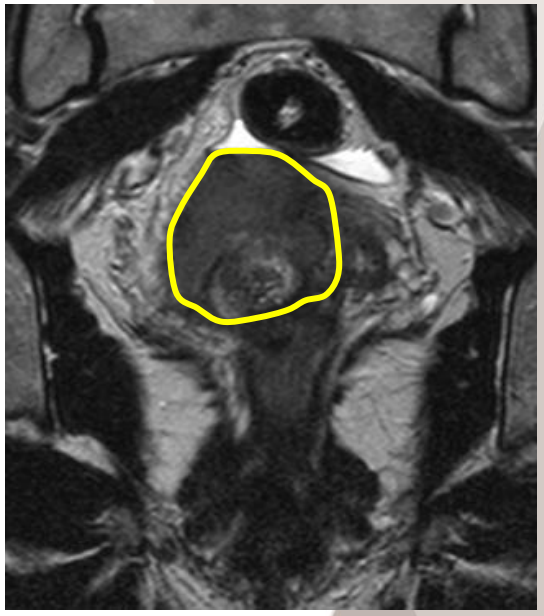
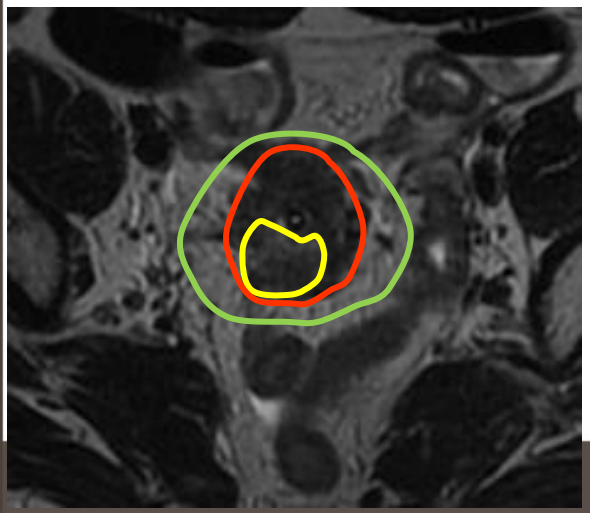
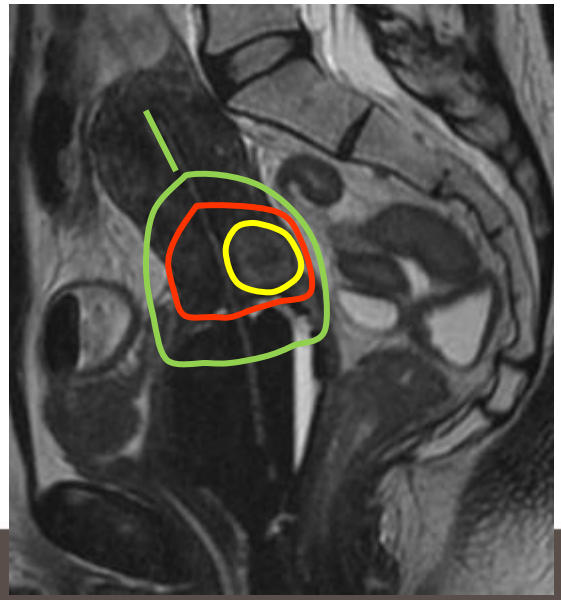
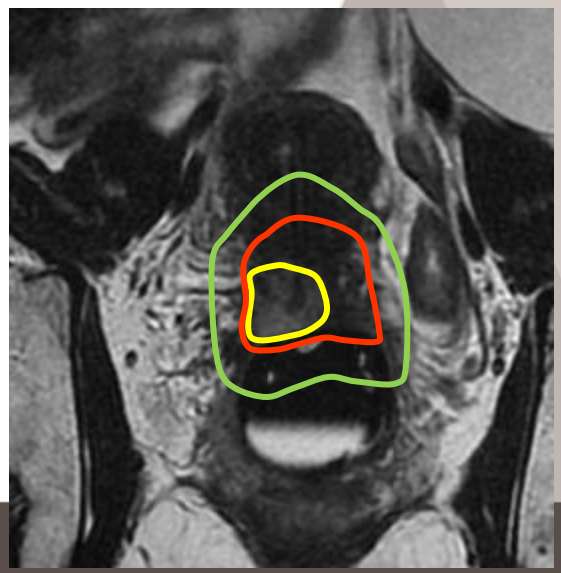




Stage IB2

Stage IB2

Target volume concepts

High Risk CTV (IIB):

Residual GTV at time of brachytherapy
Residual pathologic tissue
at time of brachytherapy

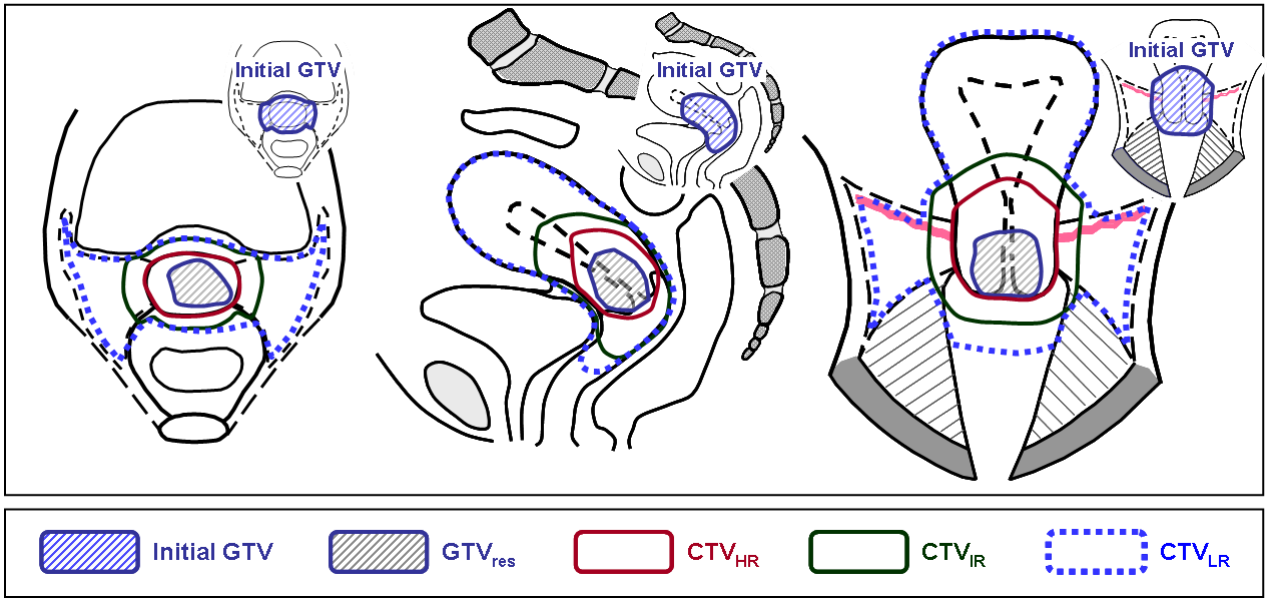
In all cases includes:

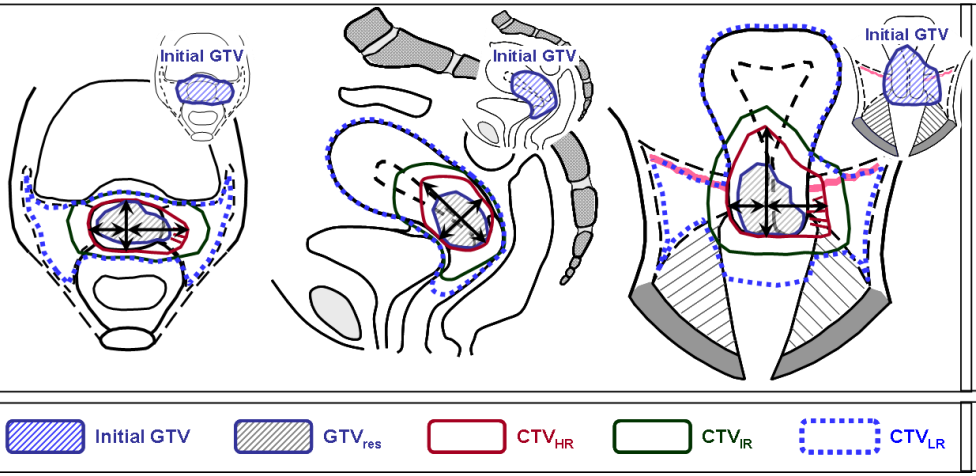
- Whole cervix
- residual GTV (clinical and MRI)
- residual pathologic tissue
  (clinical and MRI (grey zones))
  located within the initial GTV

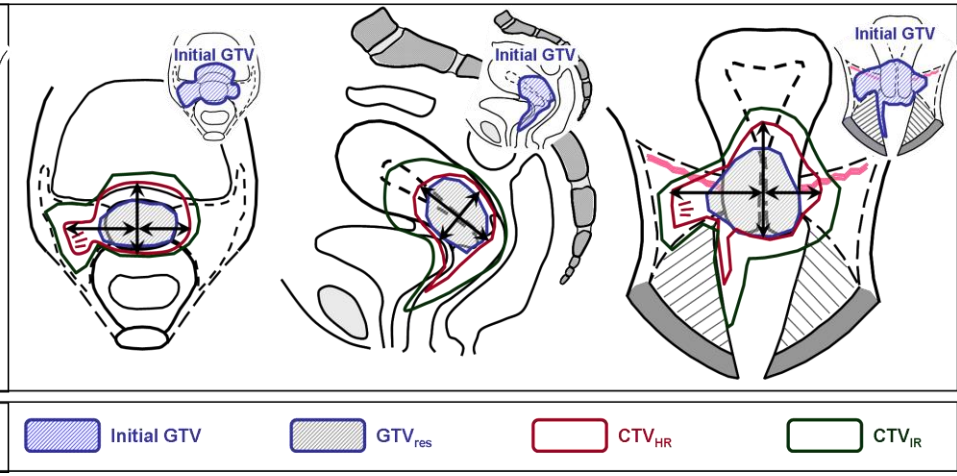
NO SAFETY MARGINS

Overview of adaptive target concept in cervix cancer

ICRU/GEC ESTRO
report 89
Fig. 5.9-11

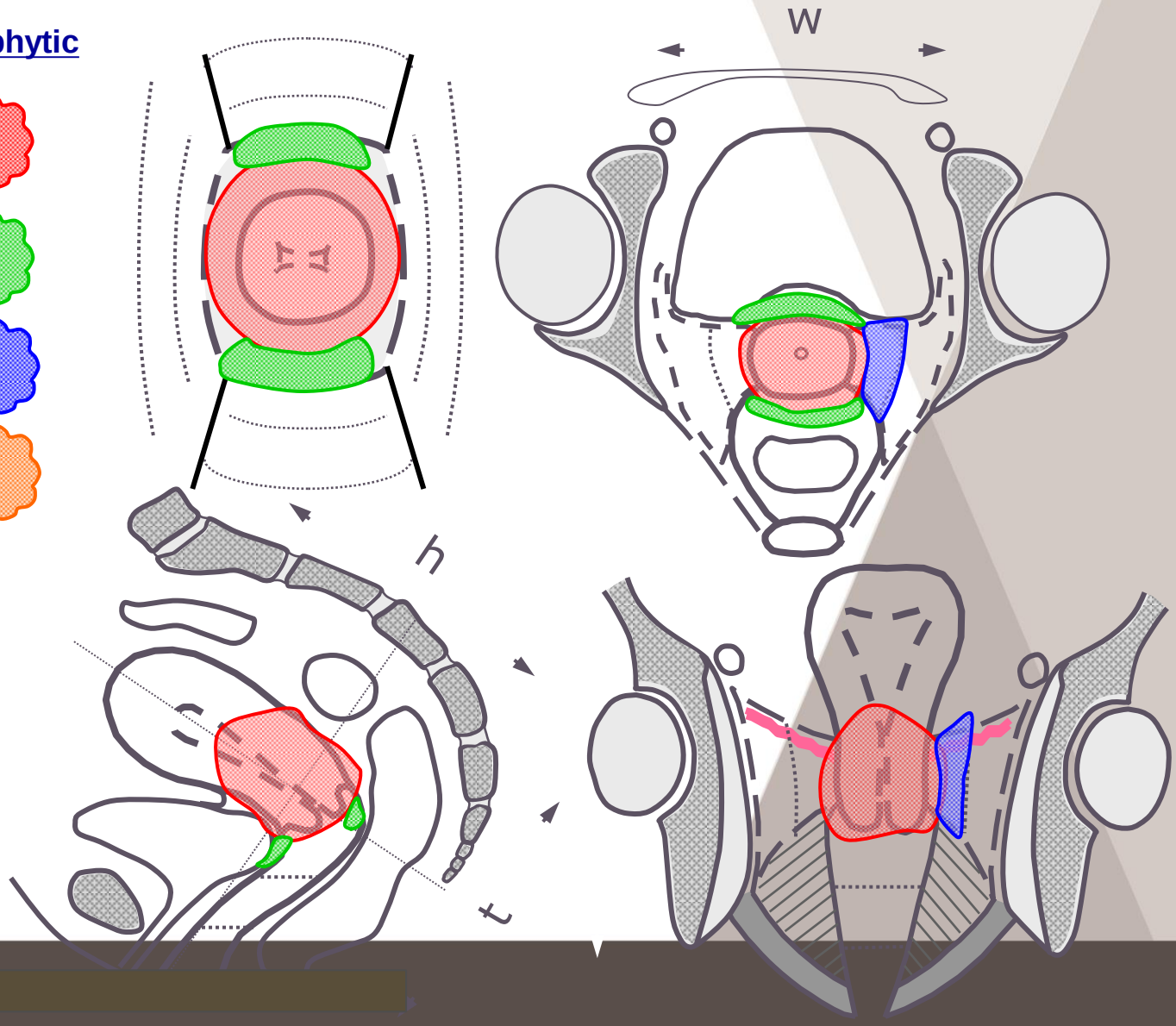






Stage IIB : initial clinical examination

	Infiltrating	Exophytic
Cervix		
Vagina		
Parametrium		
Rectum or Bladder		



Dimensions (cm):

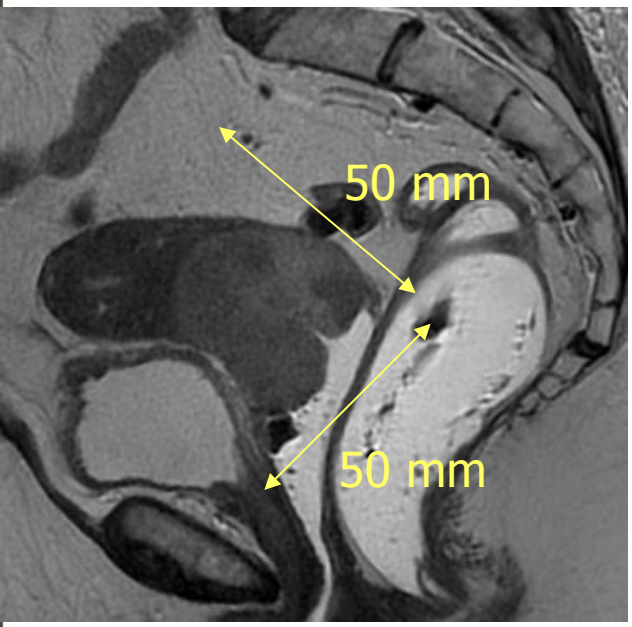
Width : 5

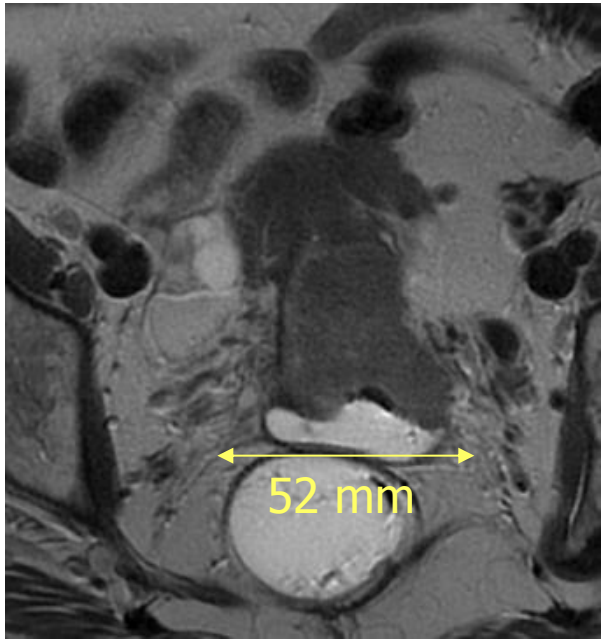
Thickness:5

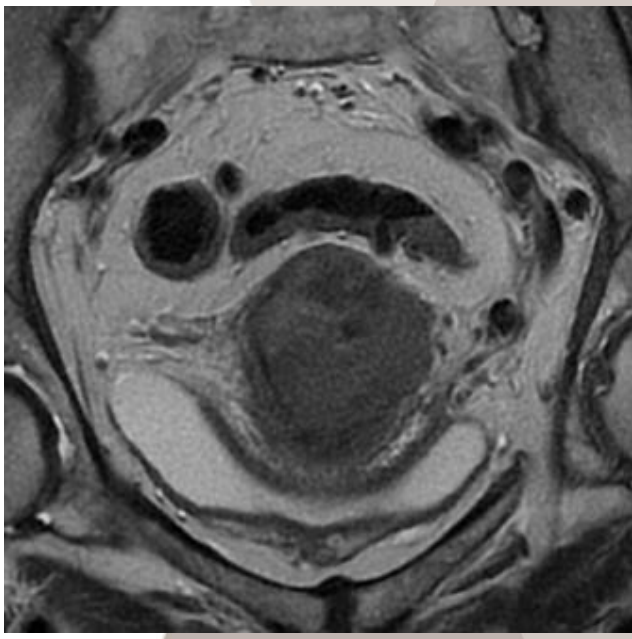
Height : 5

Fornix involv 1

Stage IIB : initial MRI

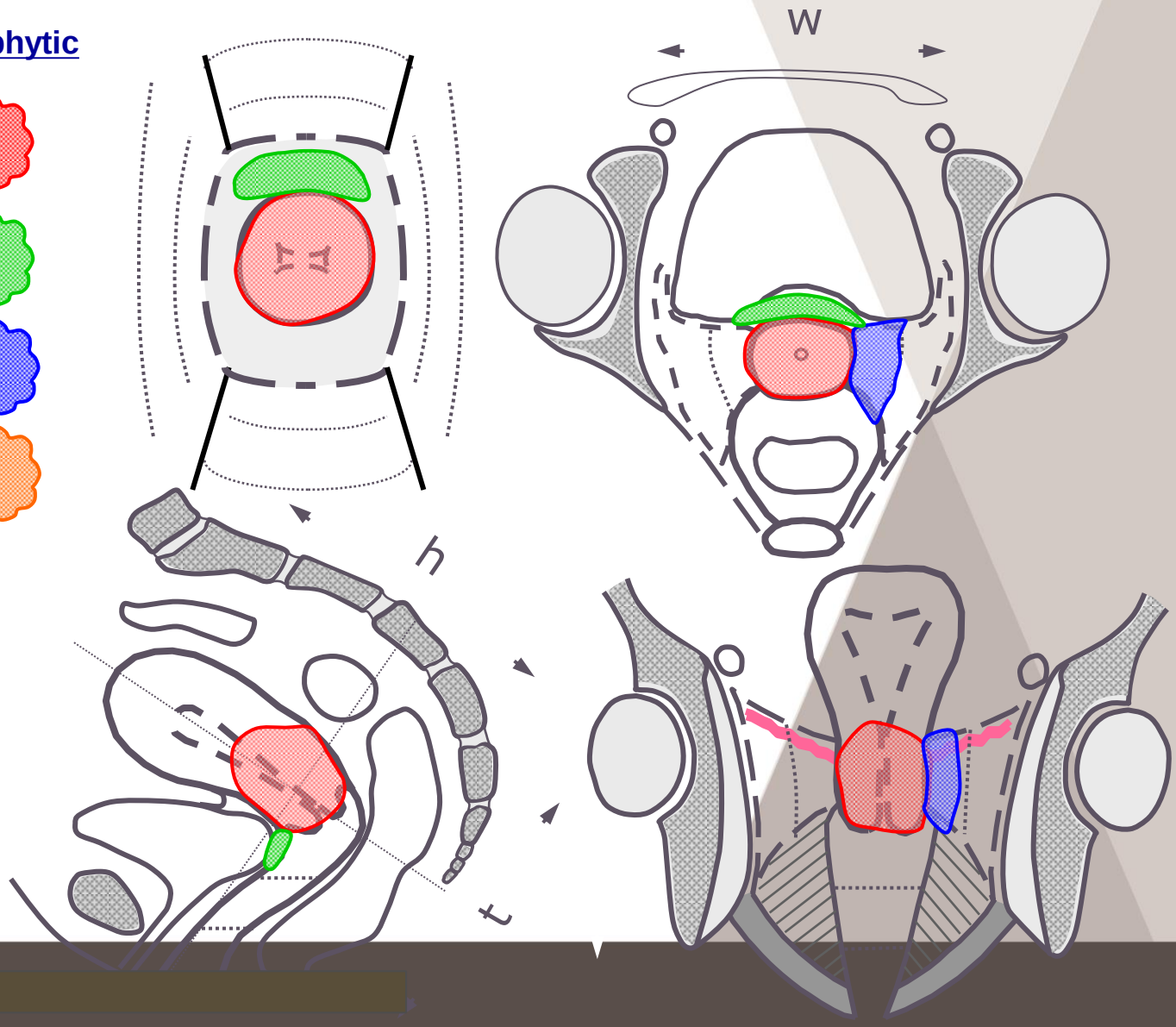






Stage IIB : at the time of brachytherapy

	Infiltrating	Exophytic
Cervix		
Vagina		
Parametrium		
Rectum or Bladder		



Dimensions (cm):

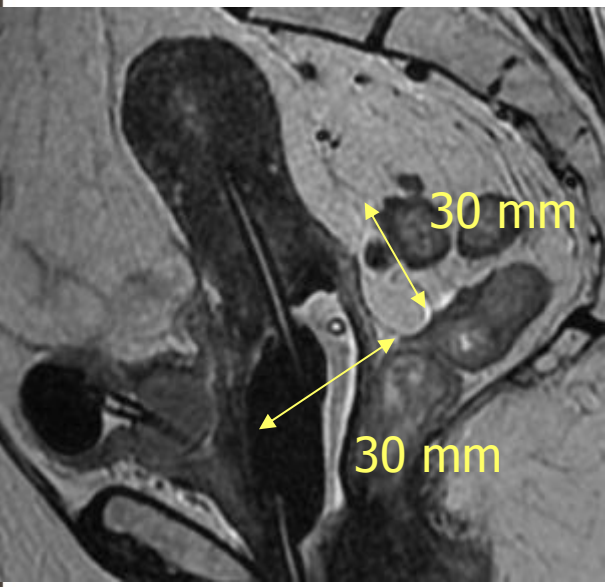
Largeur : 3

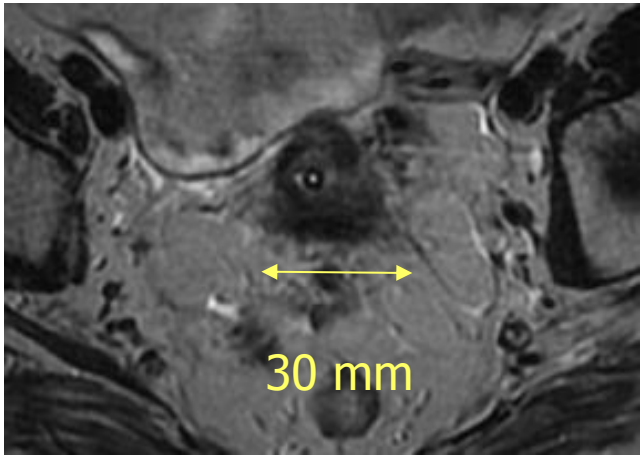
Epaisseur : 3

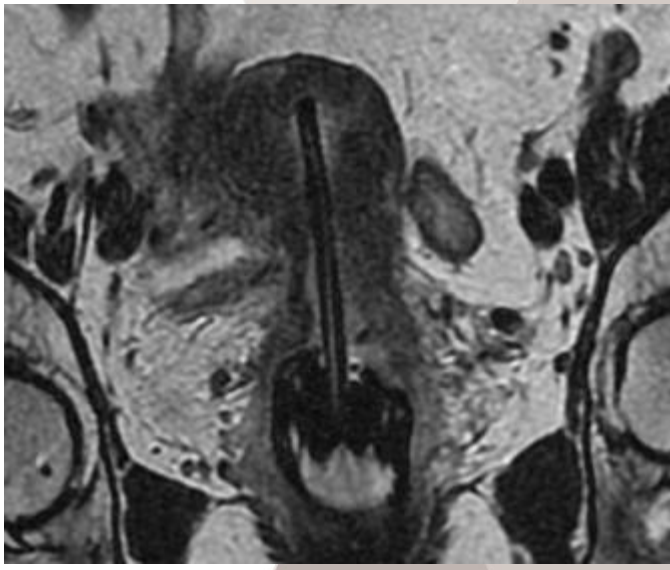
Hauteur : 3

Env. vaginal : 1

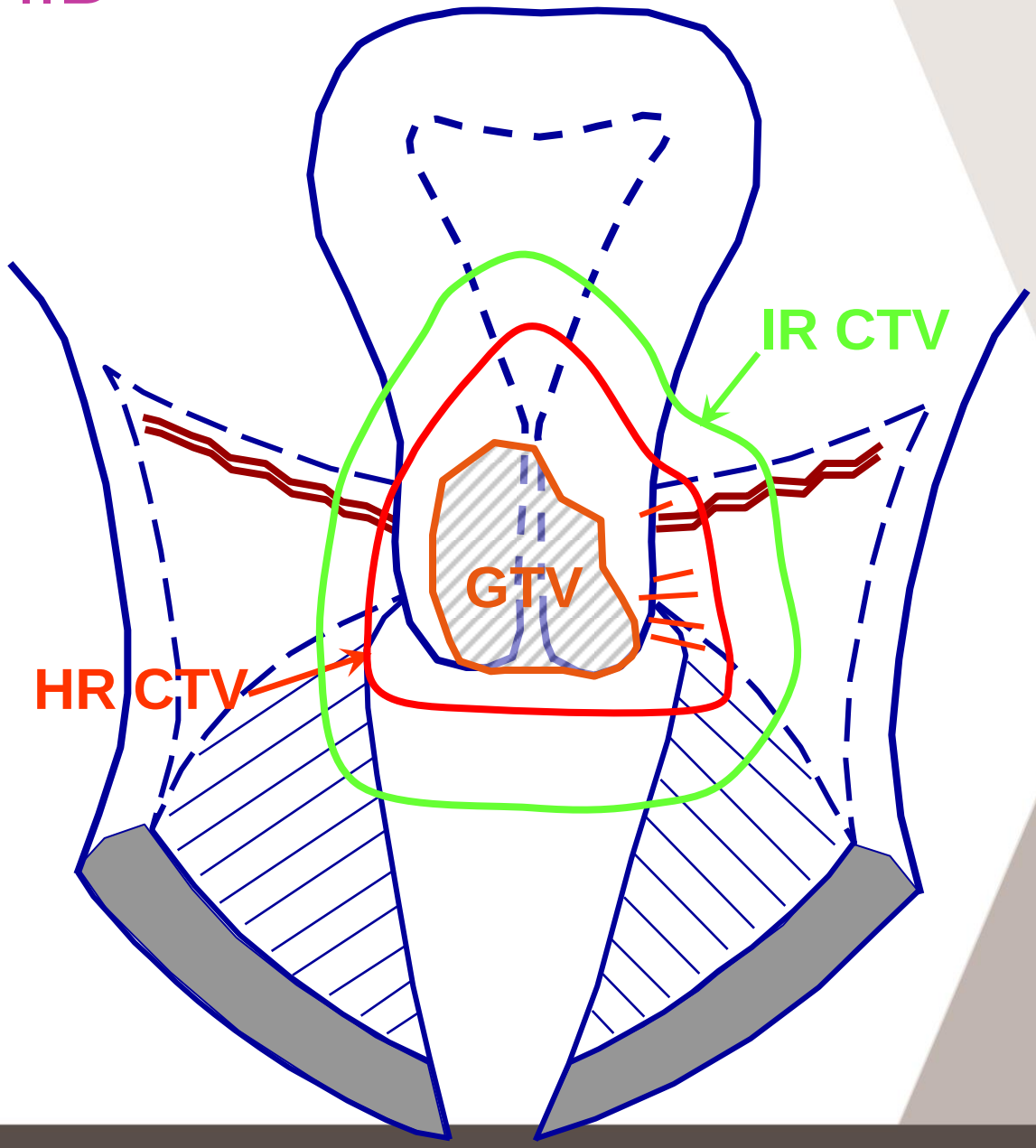
Stage IIB : MRI at the time of brachytherapy

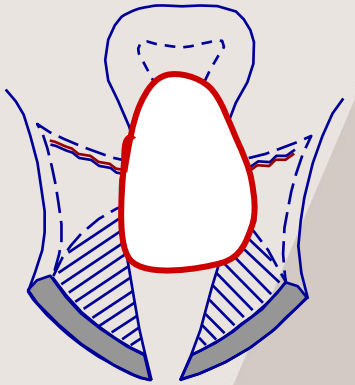






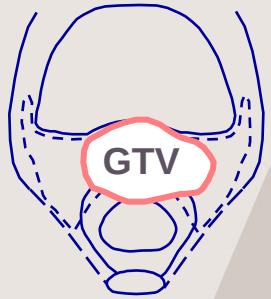
Stage IIB



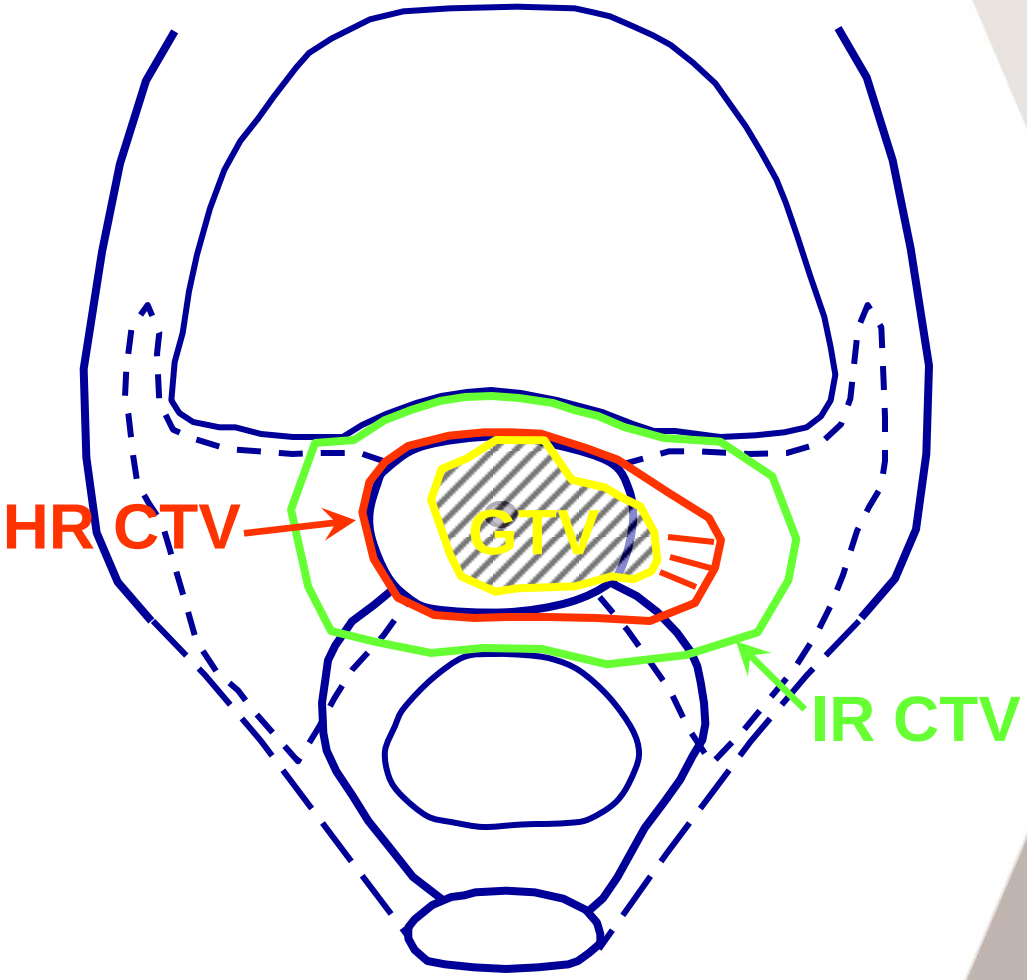


Tumor at time of diagnosis

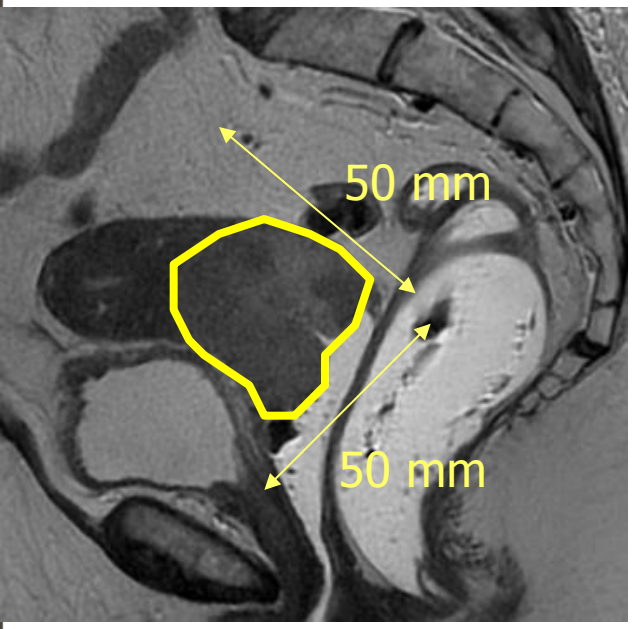
Stage IIB

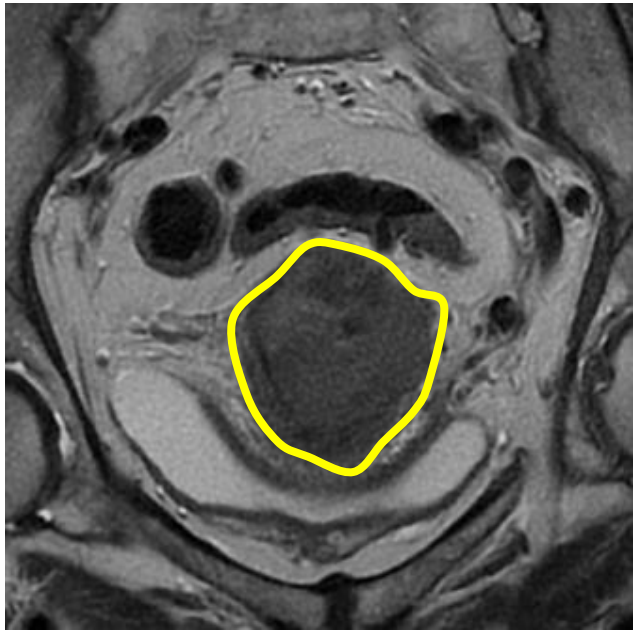


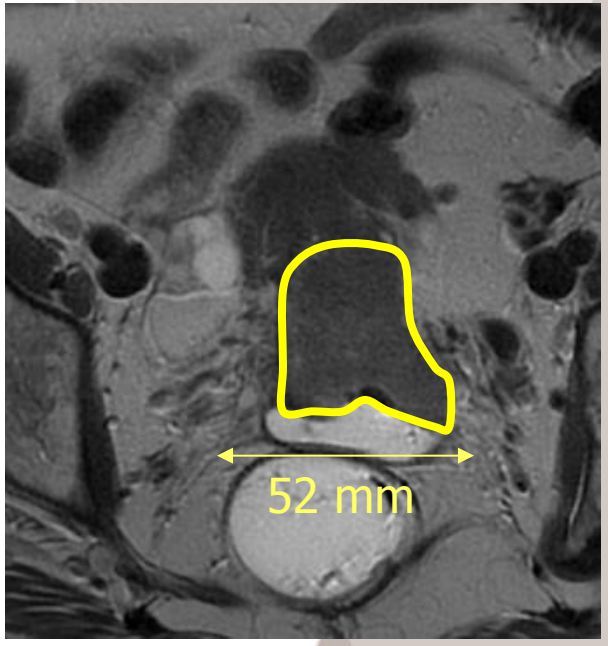
Tumor at time of diagnosis.

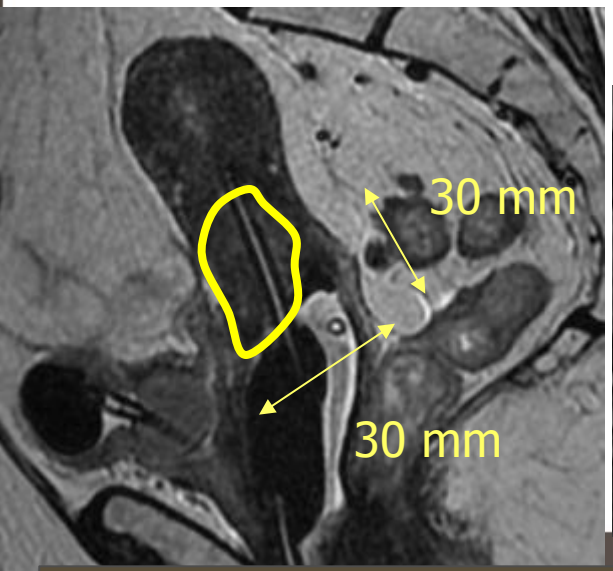


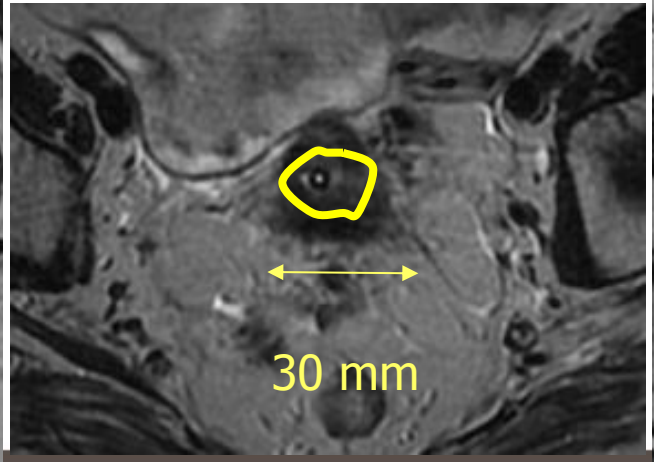
Stage IIB

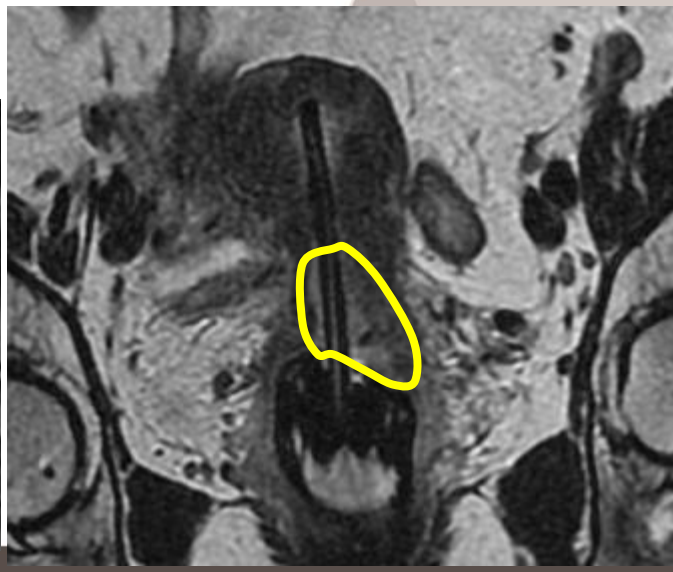




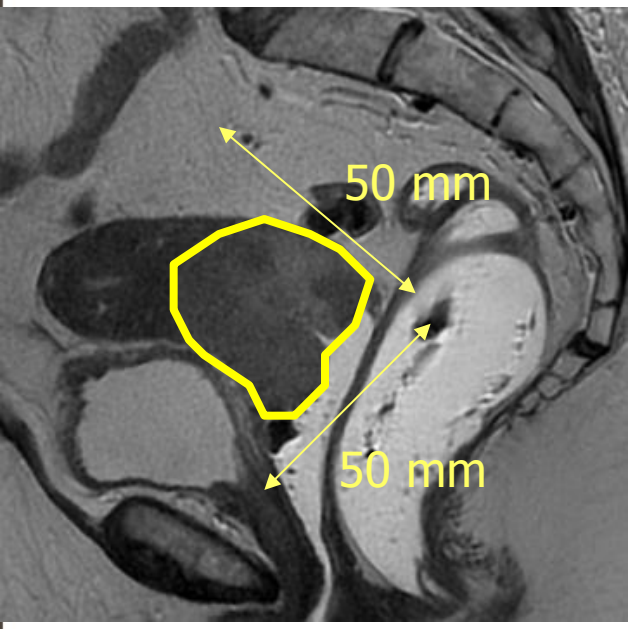


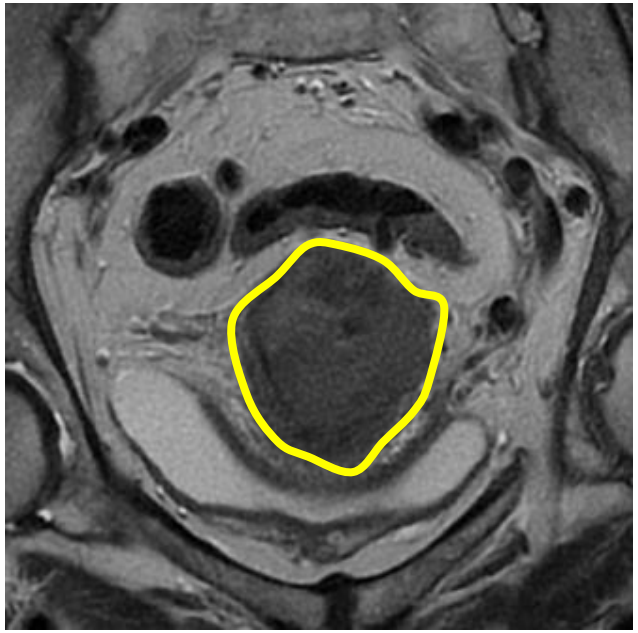


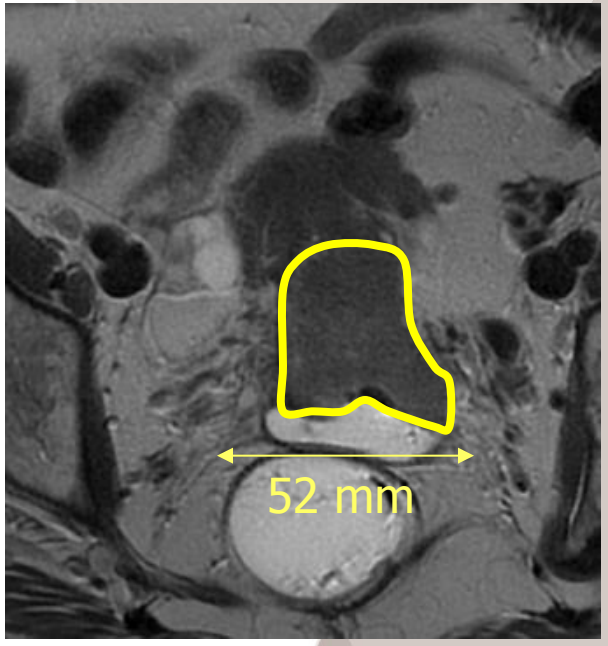


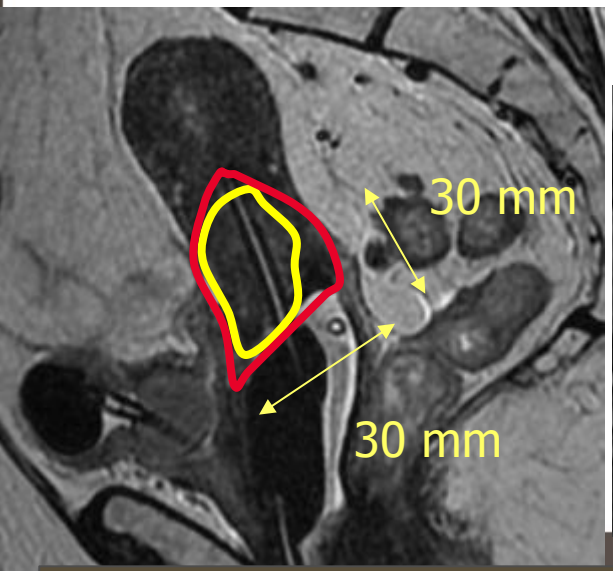


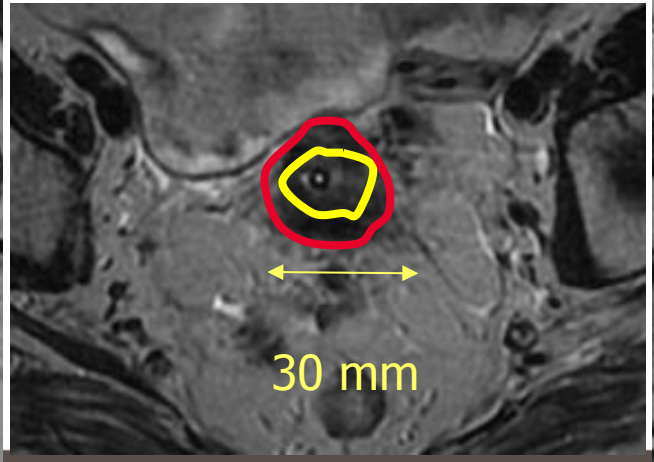
Stage IIB

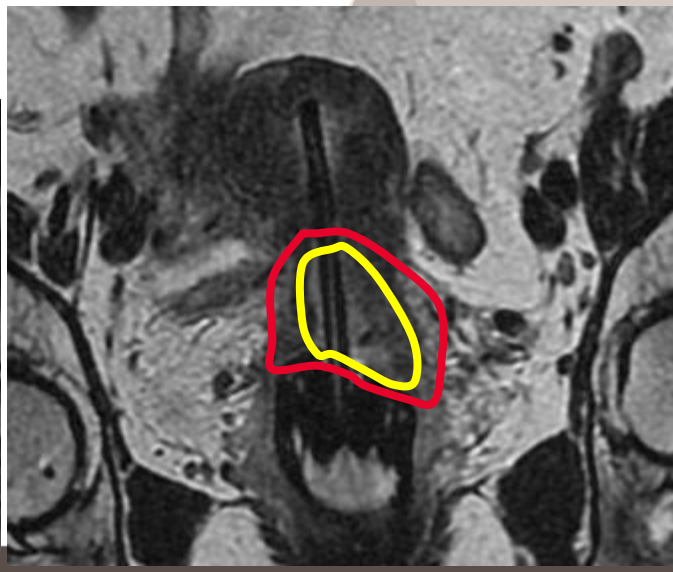




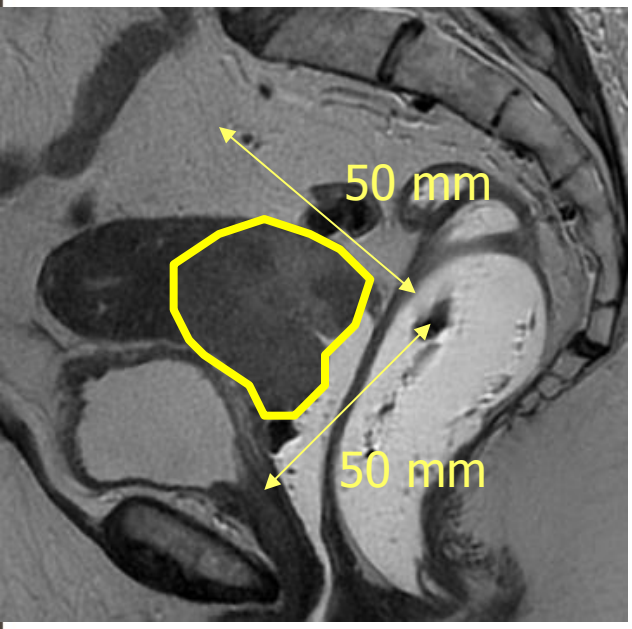


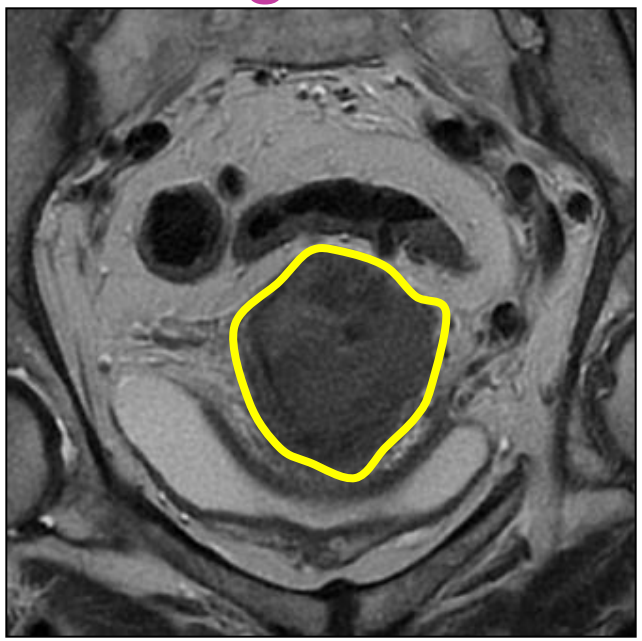


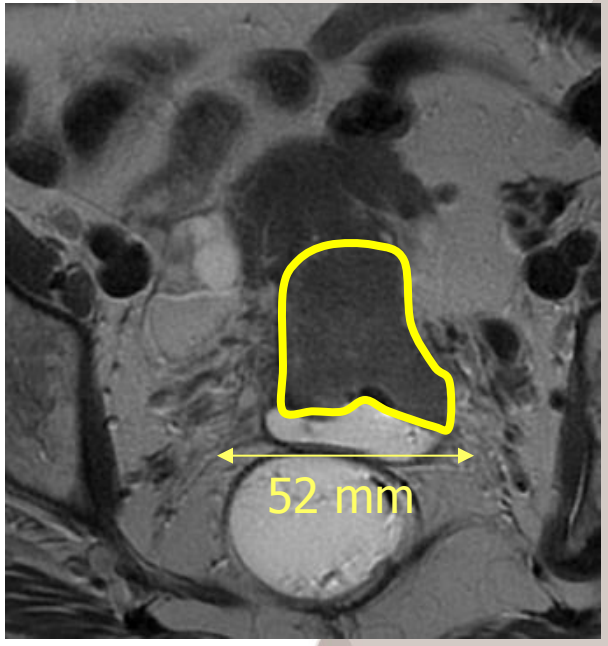


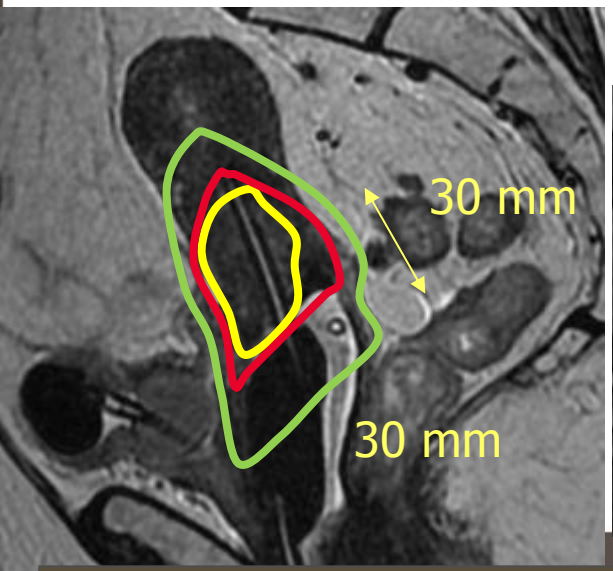


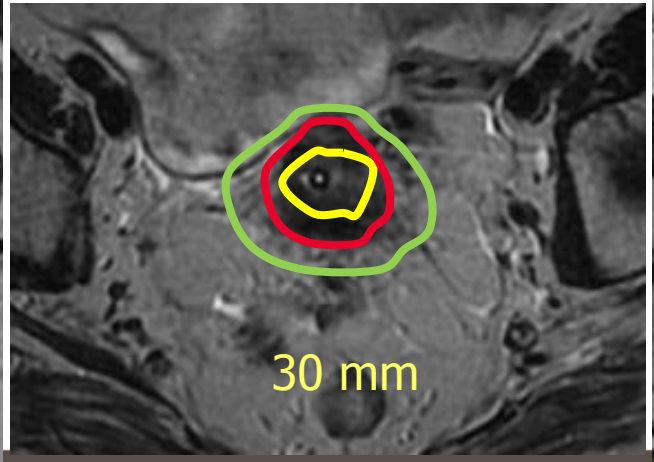
Stage IIB

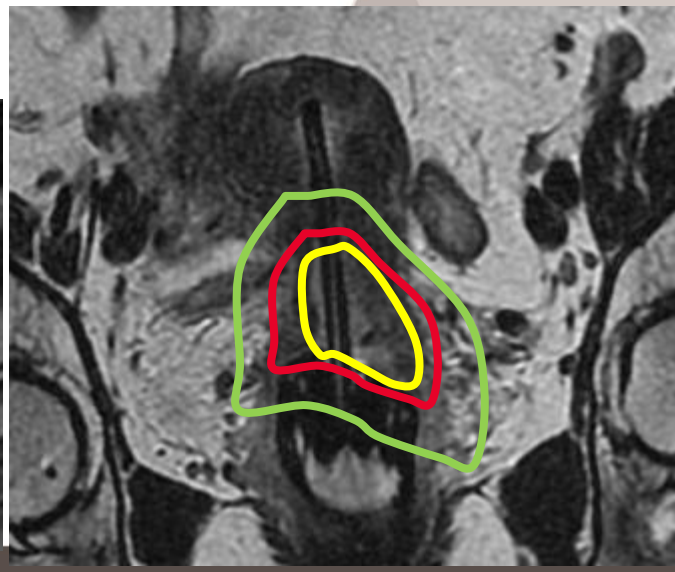












Target volume concepts

High Risk CTV (IIIB):

Residual GTV and
Residual pathologic tissue
at time of brachytherapy

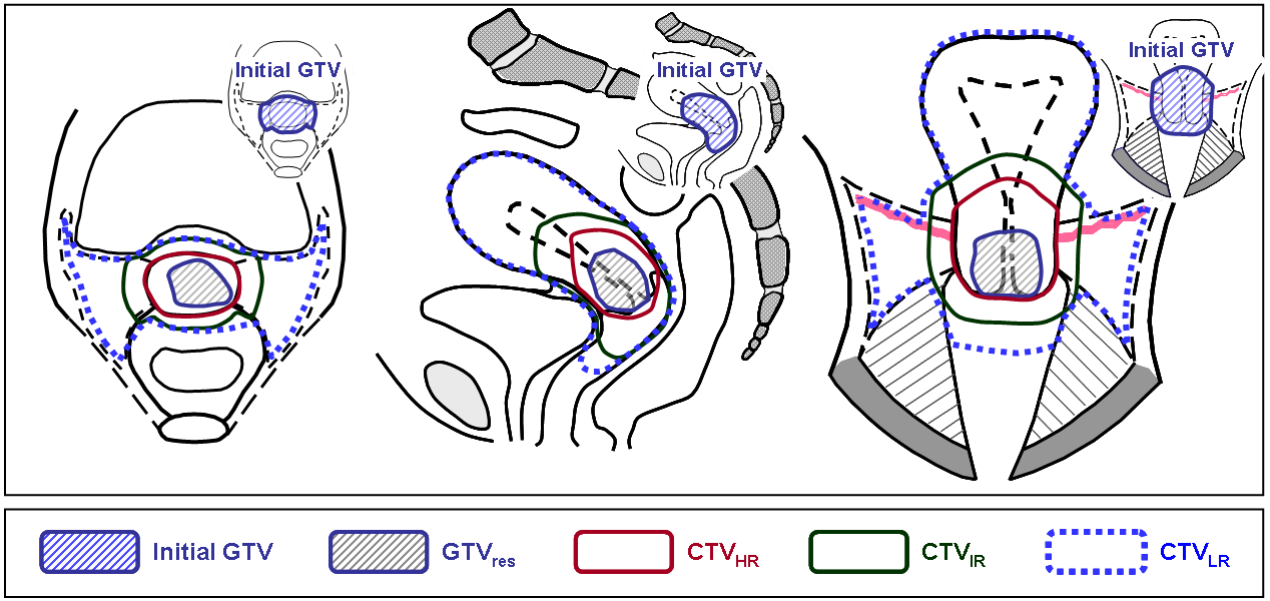
In all cases includes:

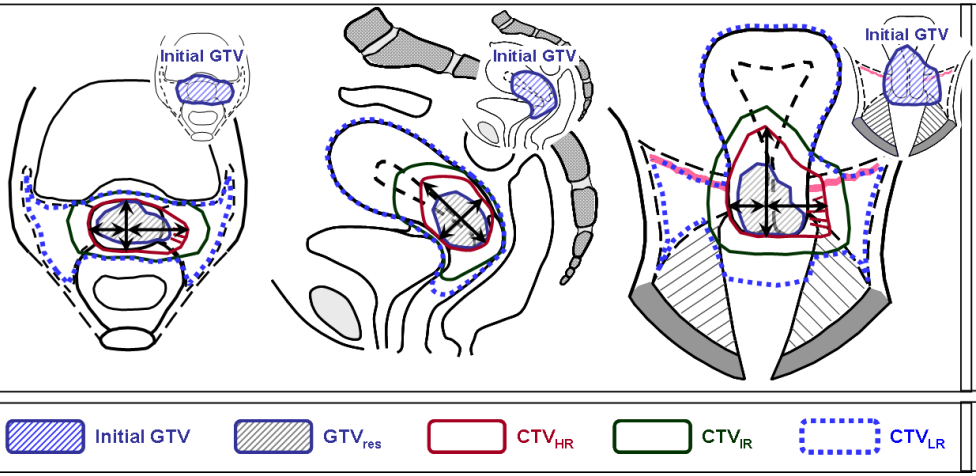
- Whole cervix
- residual GTV (clinical and MRI)
- residual pathologic tissue
  (clinical and MRI (grey zones))
  located within the initial GTV

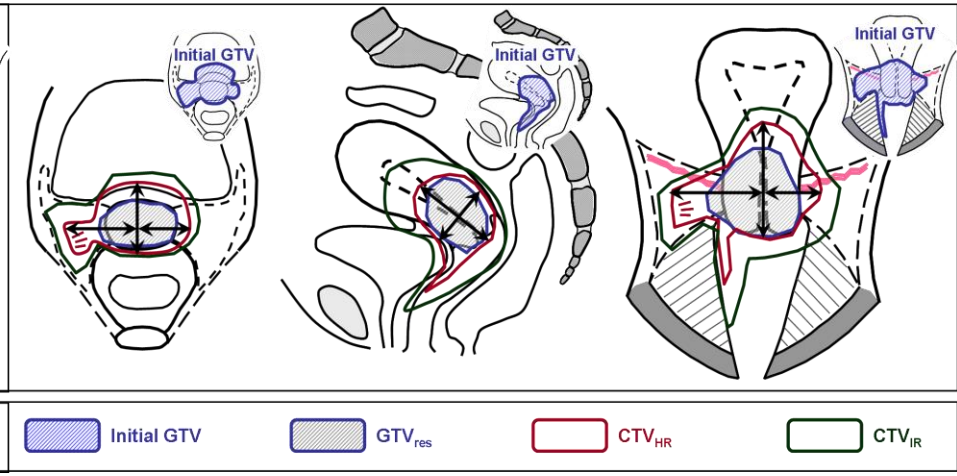
NO SAFETY MARGINS

Overview of adaptive target concept in cervix cancer

ICRU/GEC ESTRO
report 89
Fig. 5.9-11

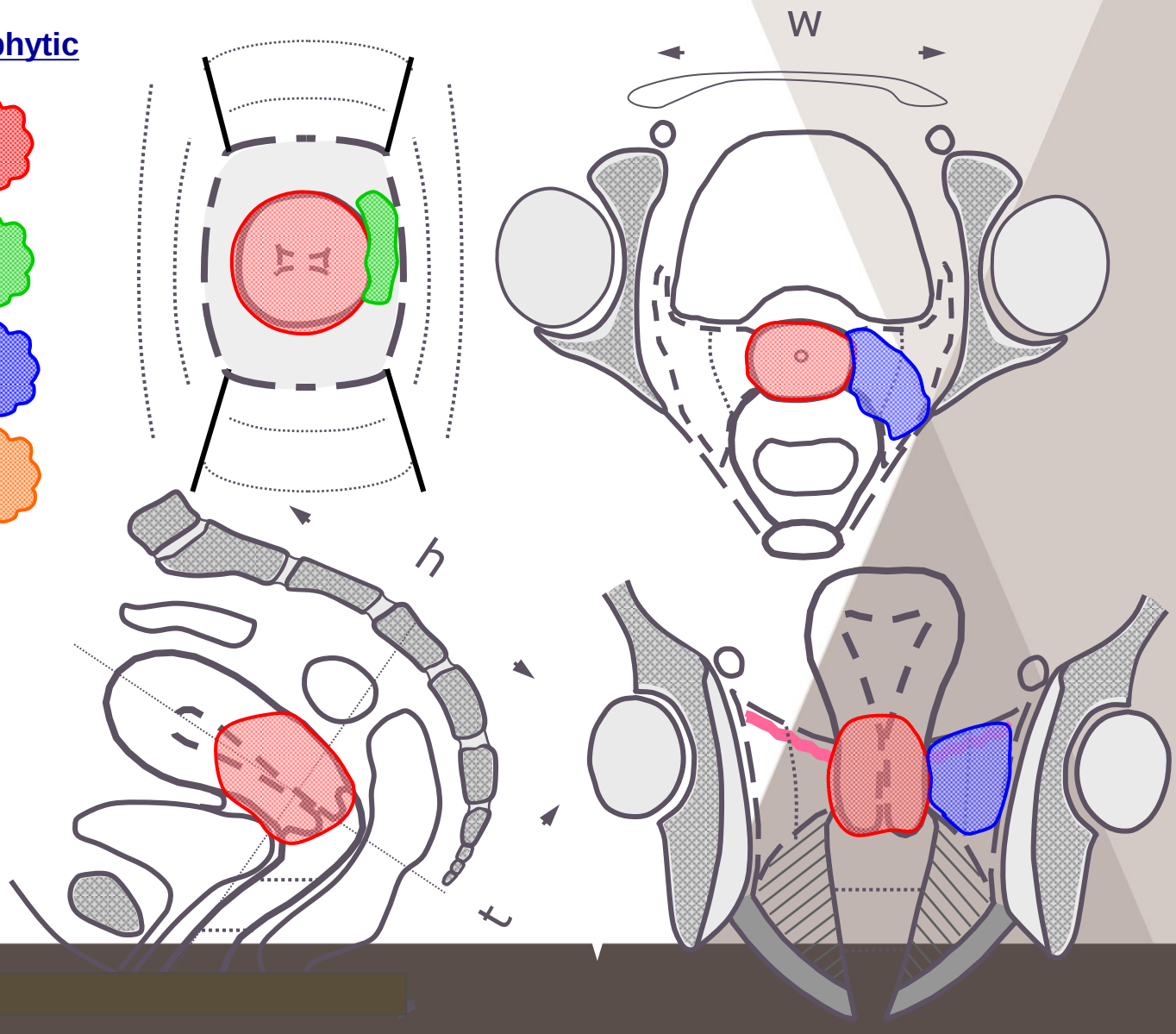






Stage IIIB : initial clinical examination

	Infiltrating	Exophytic
Cervix		
Vagina		
Parametrium		
Rectum or Bladder		



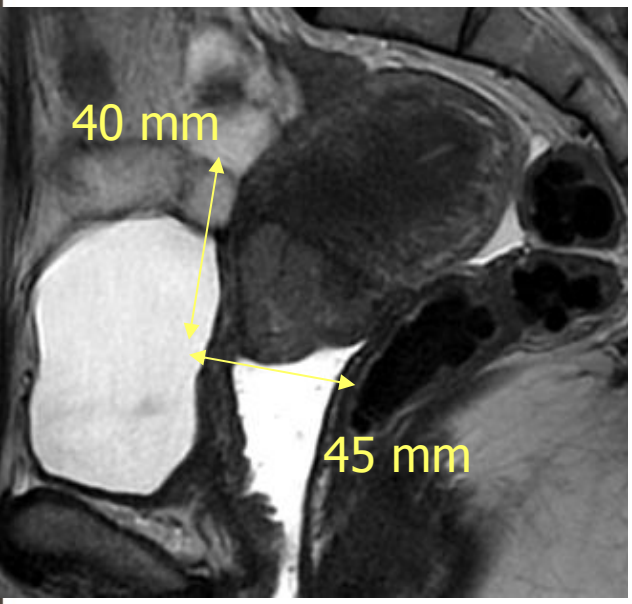
Dimensions (cm):

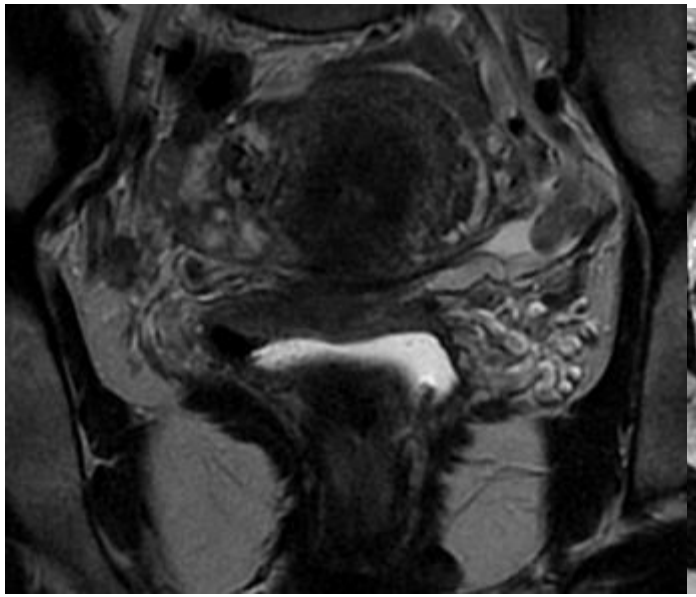
Width : 6

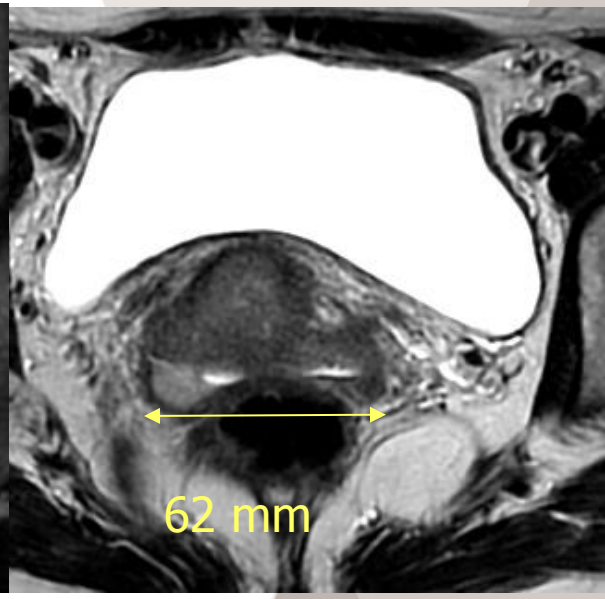
Thickness :4

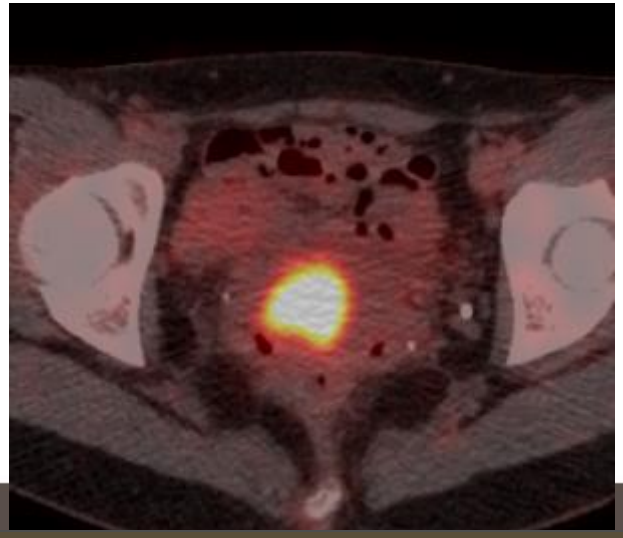
Height : 4

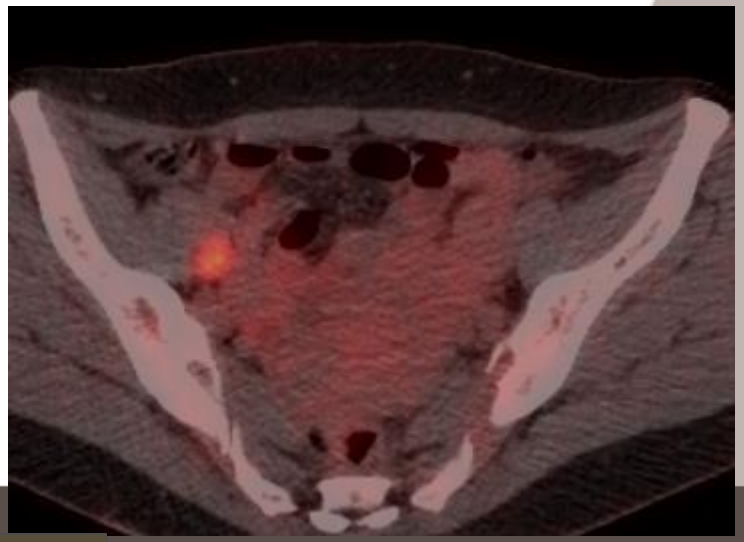
Stage IIIB : initial MRI





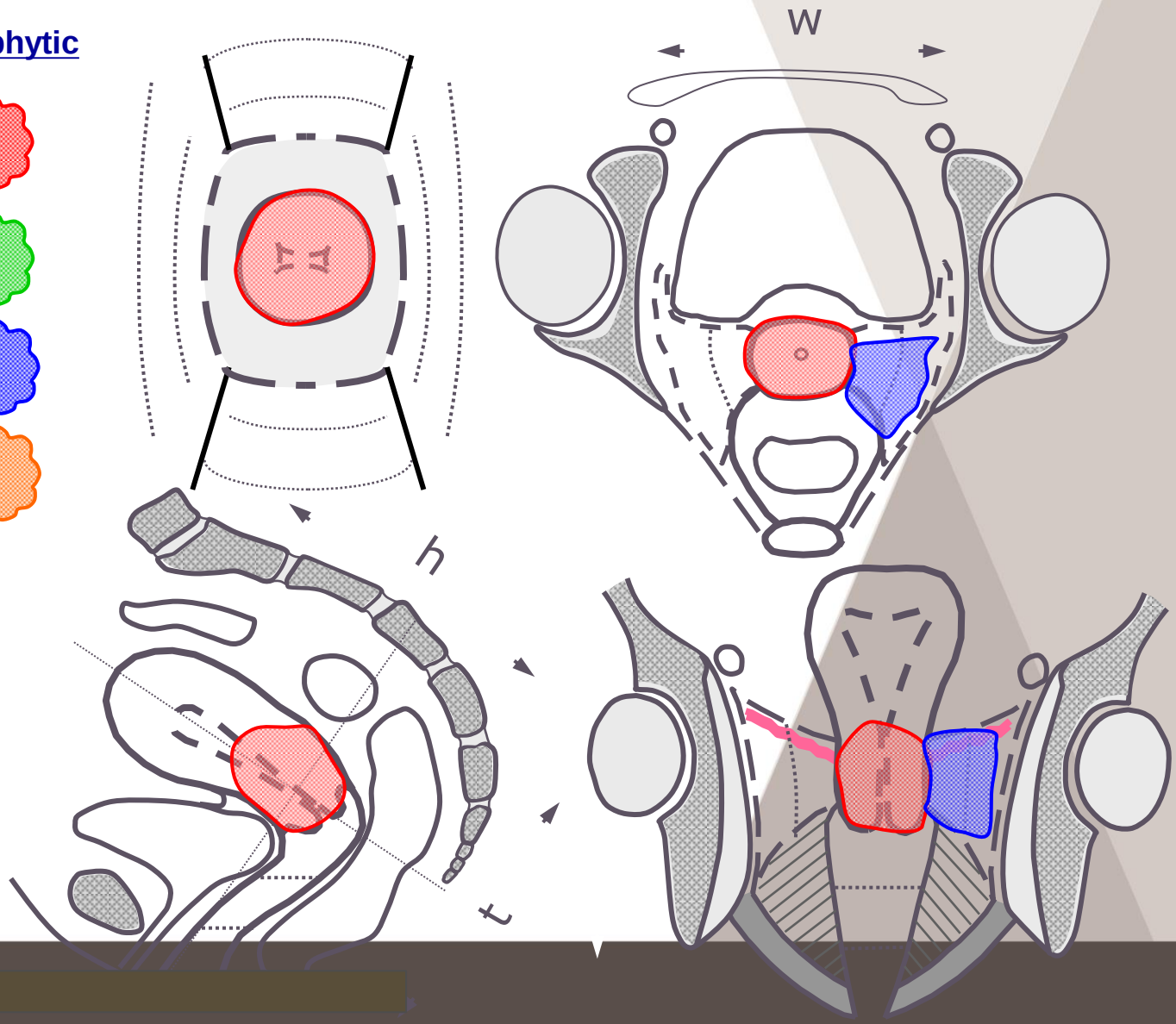






Stage IIIB : at the time of brachytherapy

	Infiltrating	Exophytic
Cervix		
Vagina		
Parametrium		
Rectum or Bladder		



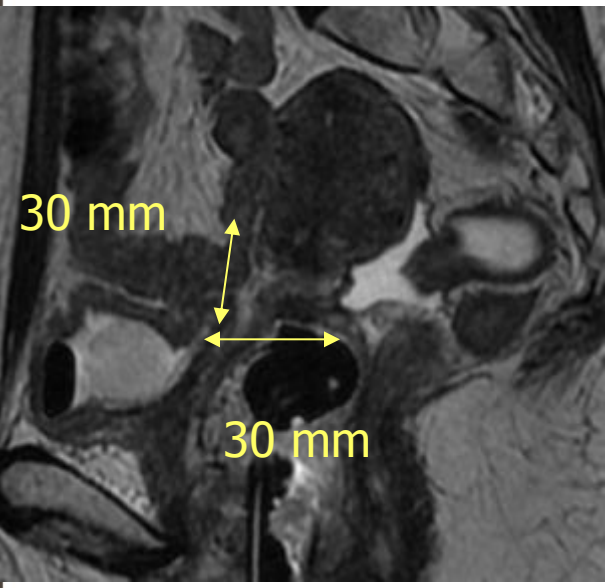
Dimensions (cm):

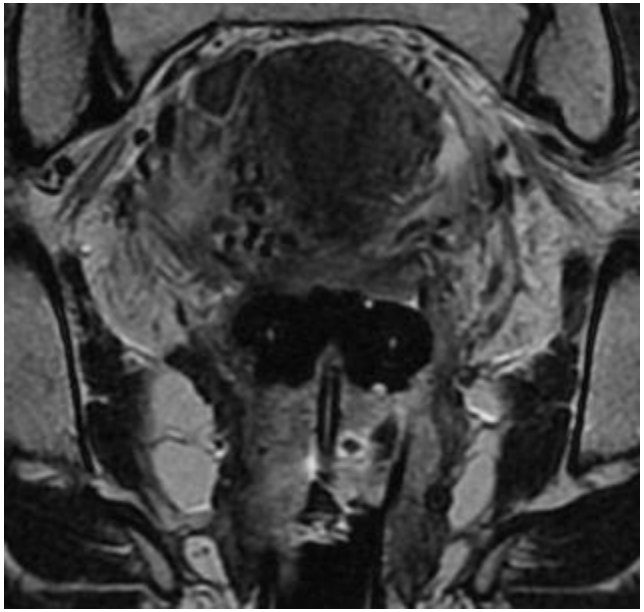
Width: 4.5

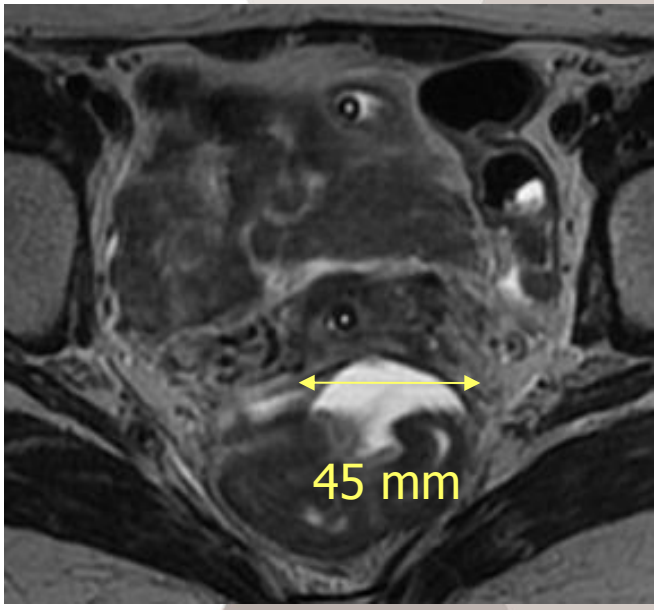
Thickness : 3

Height : 3

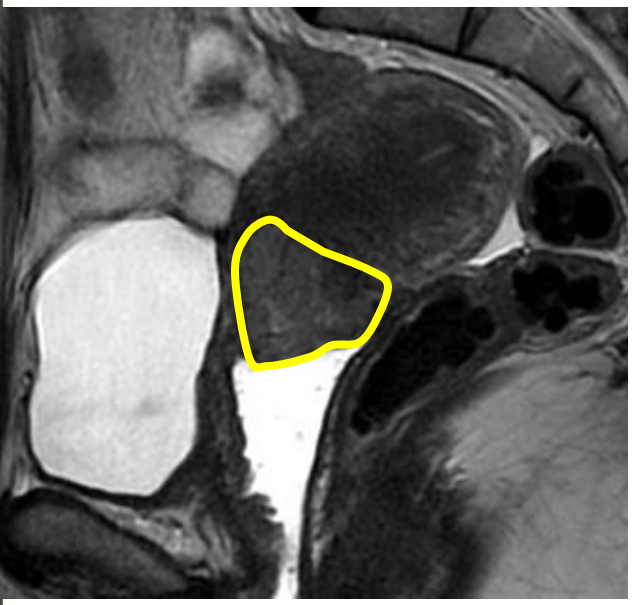
Stage IIIB : MRI at the time of brachytherapy

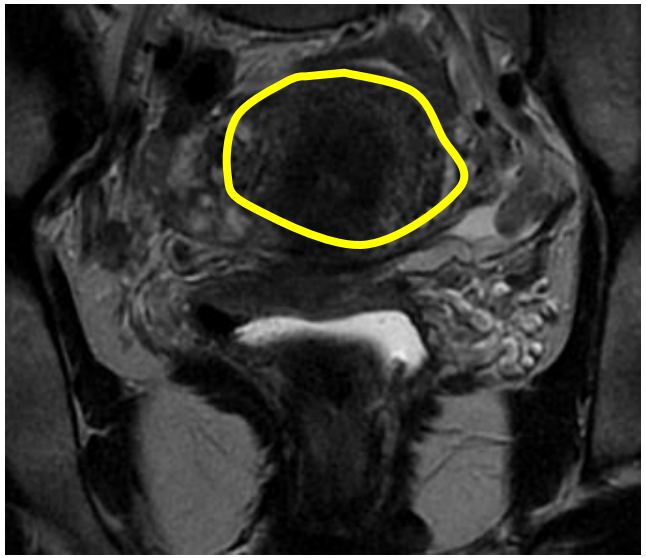


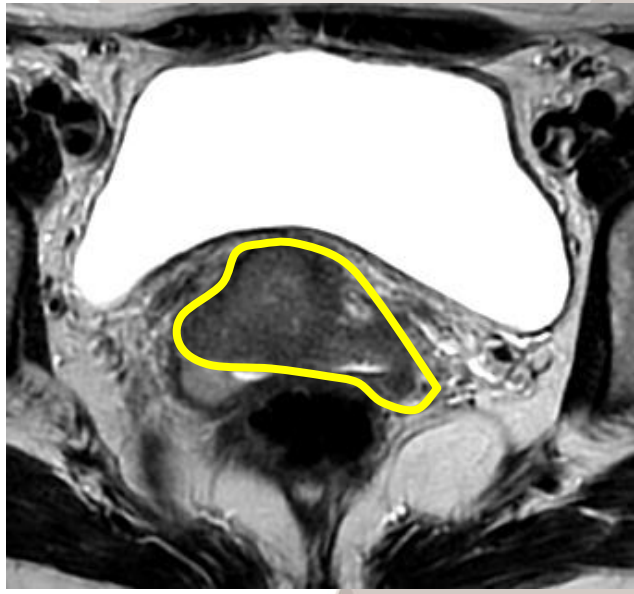


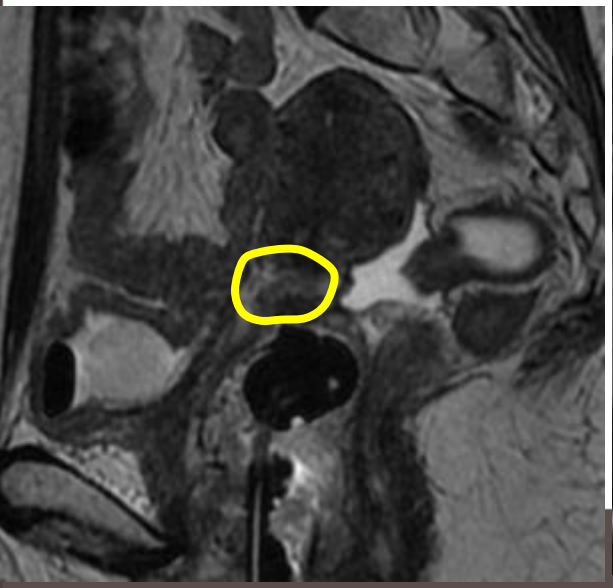


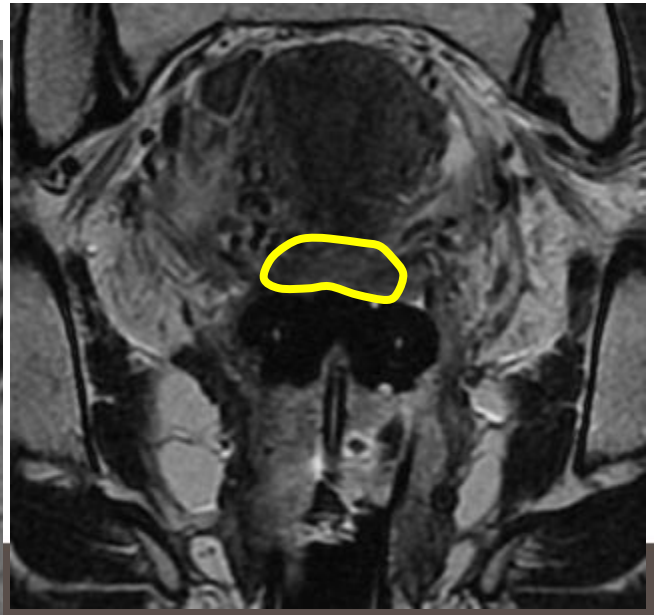
Stage IIIB

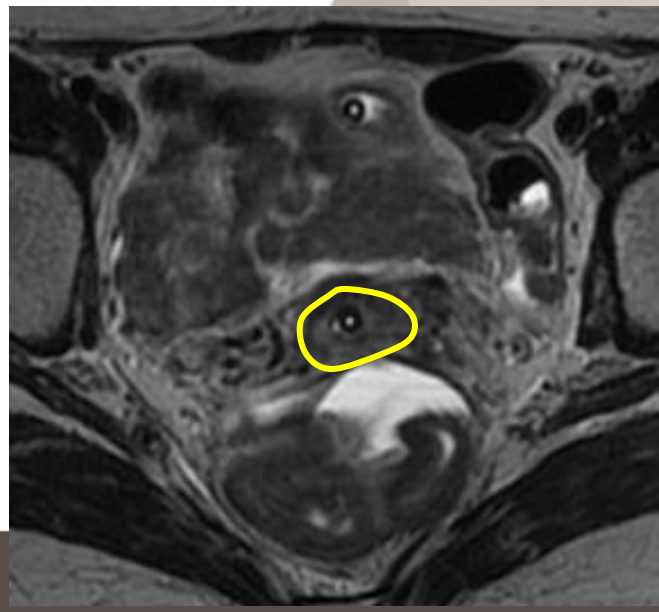




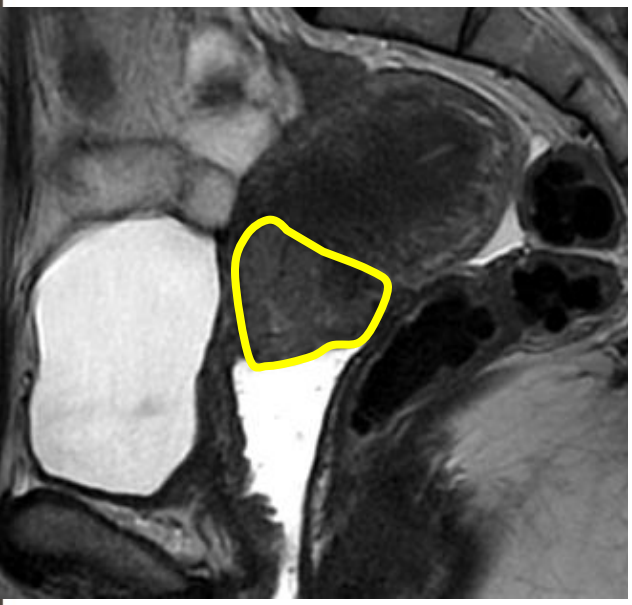


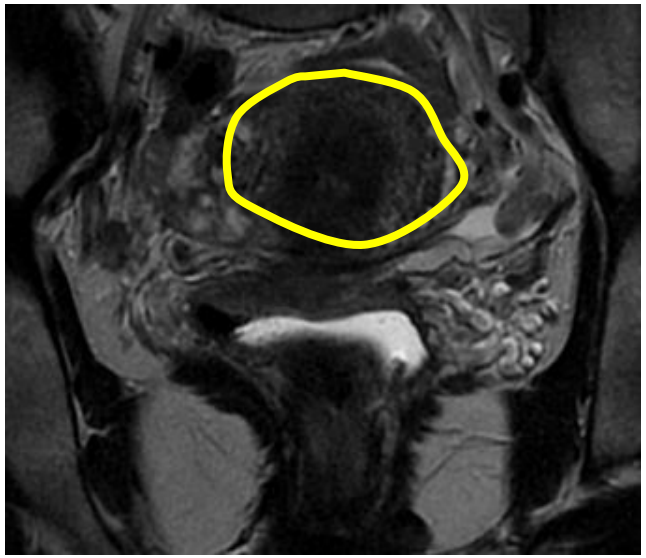


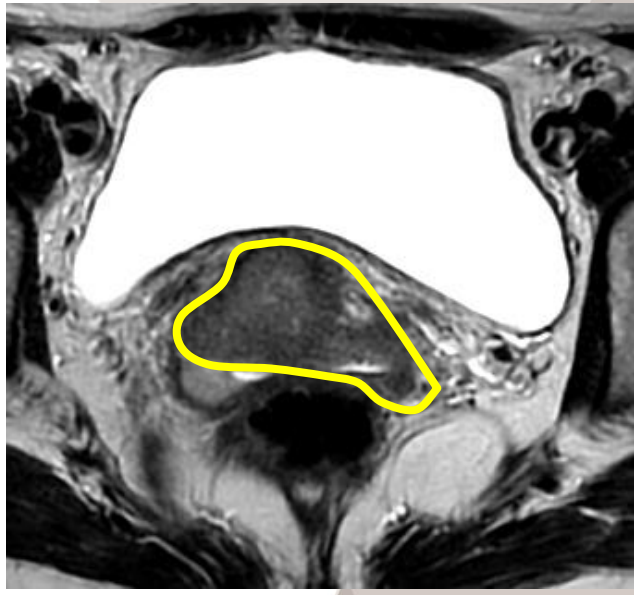


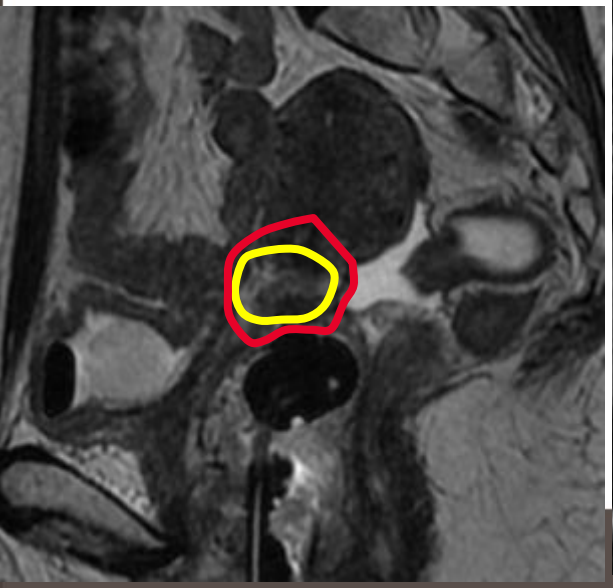


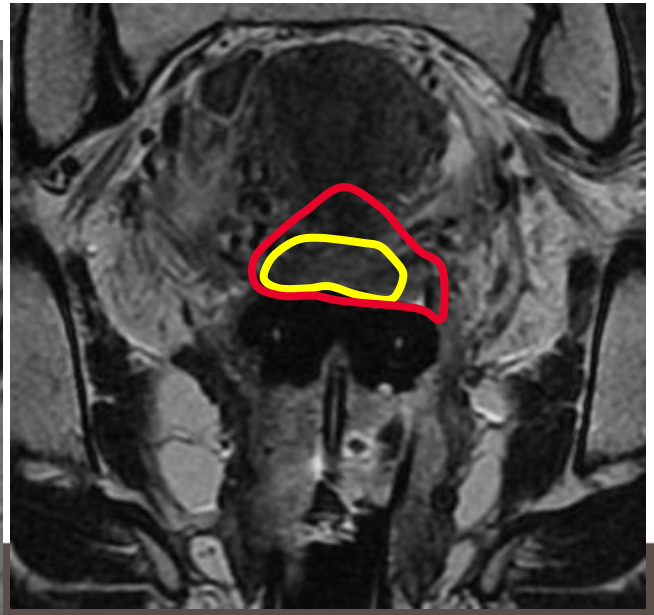
Stage IIIB

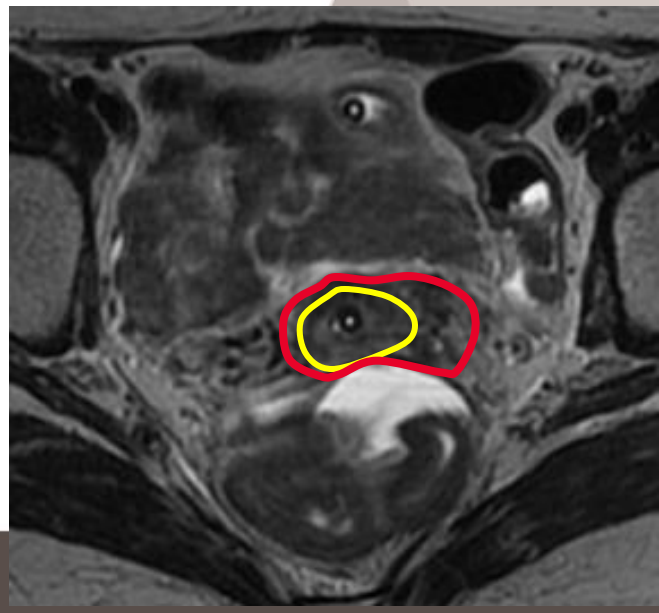




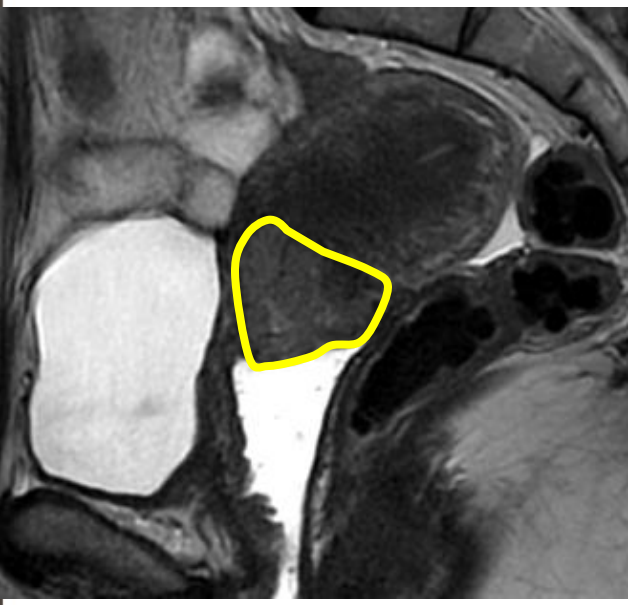


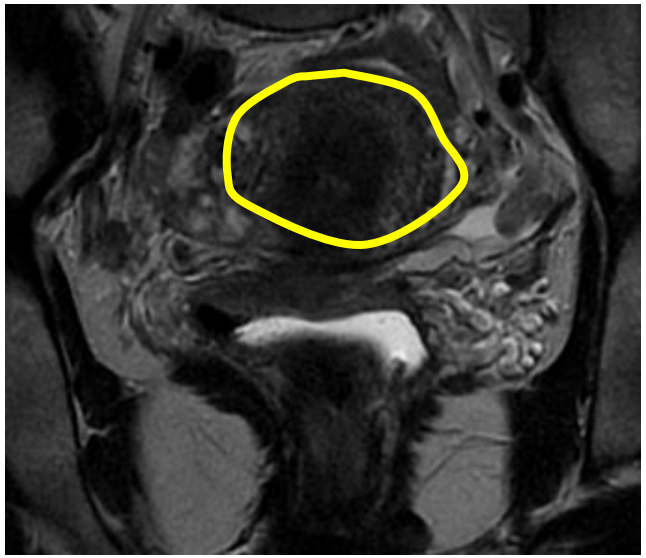


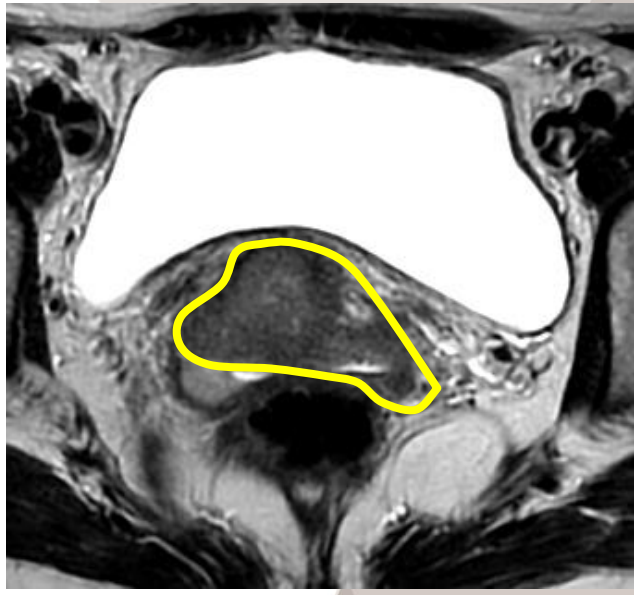


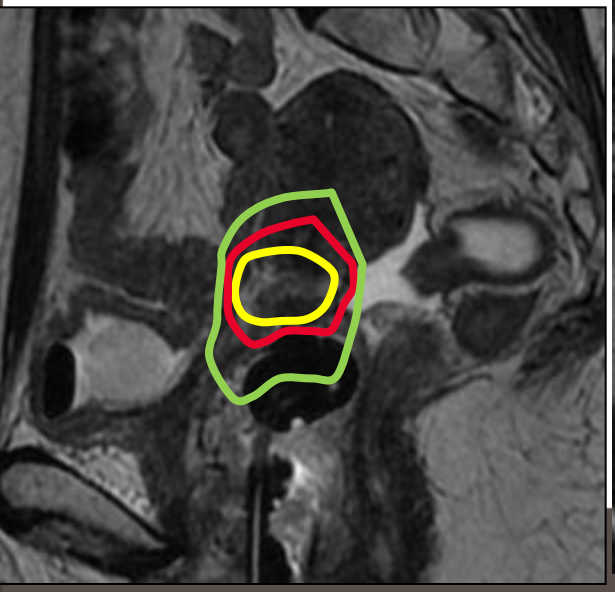


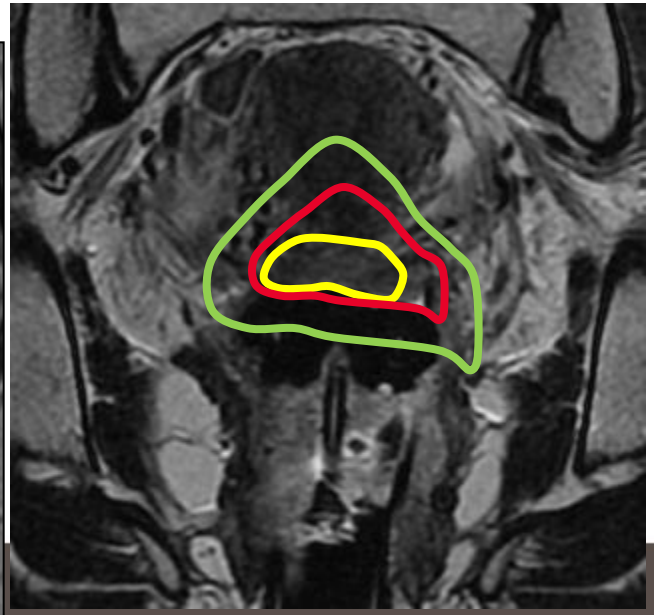
Stage IIIB

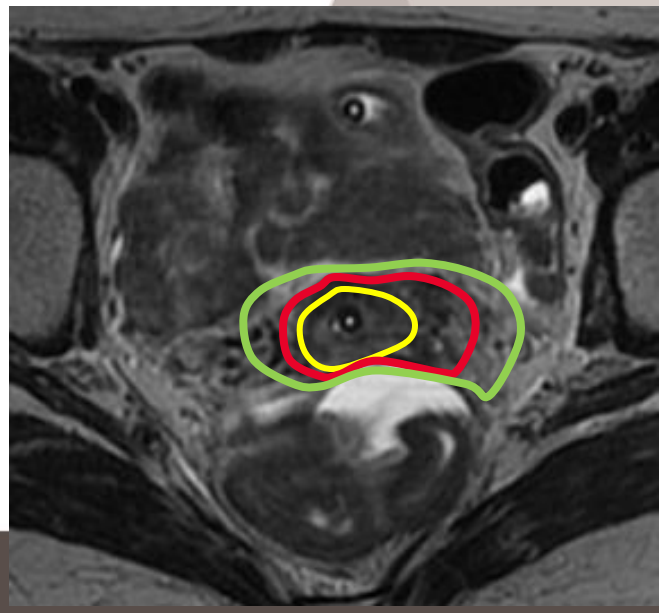




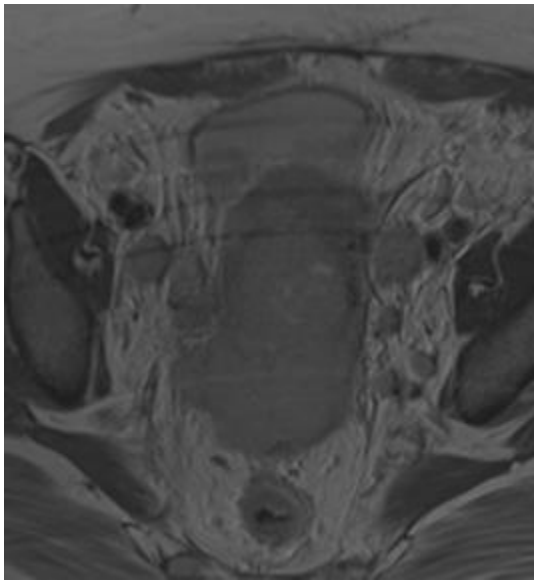
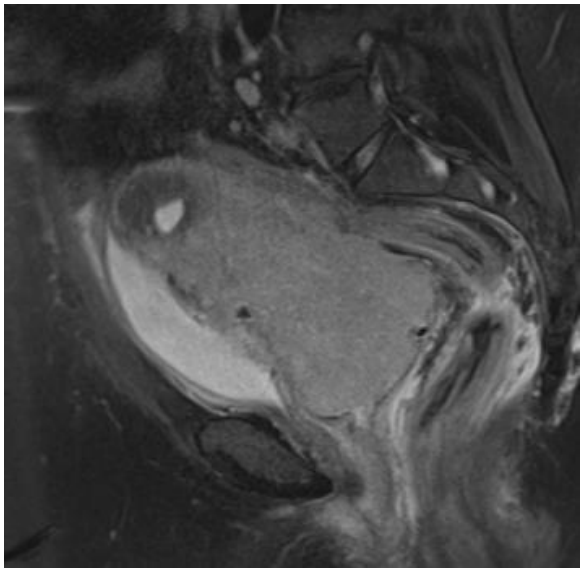
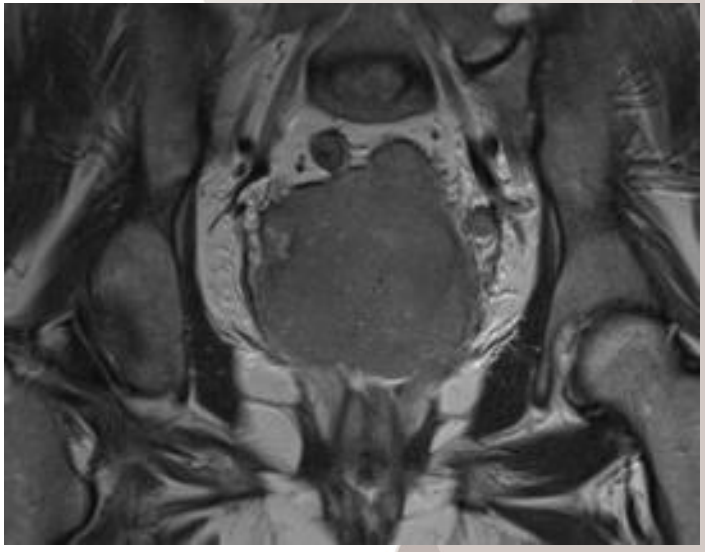
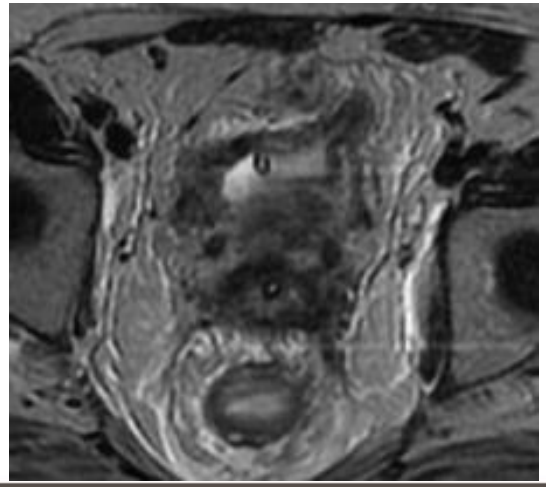
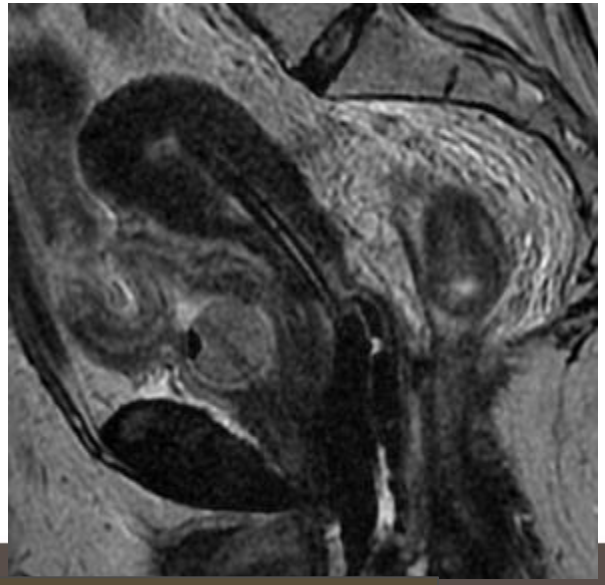
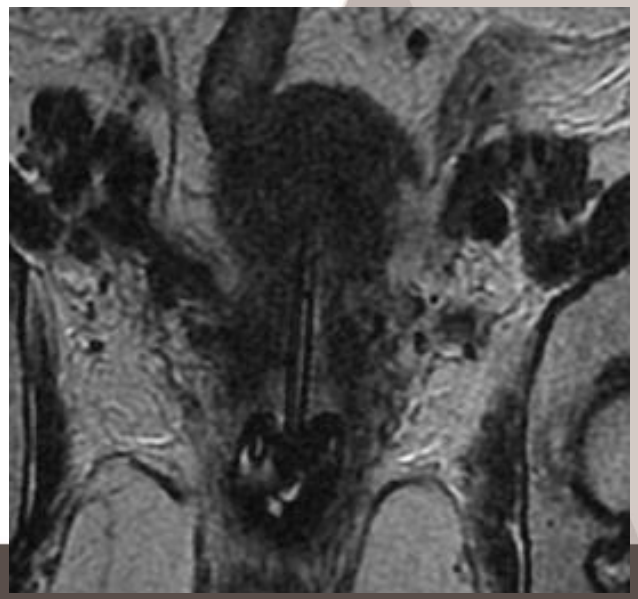




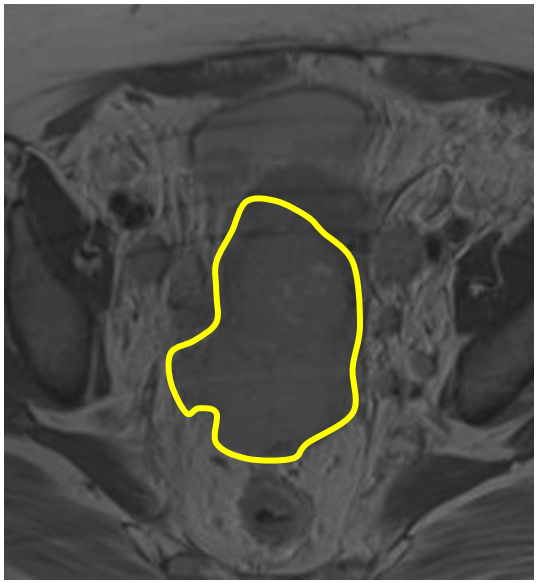


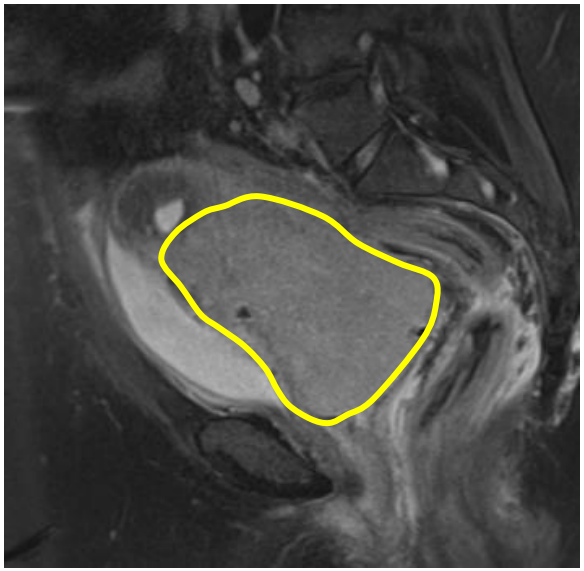


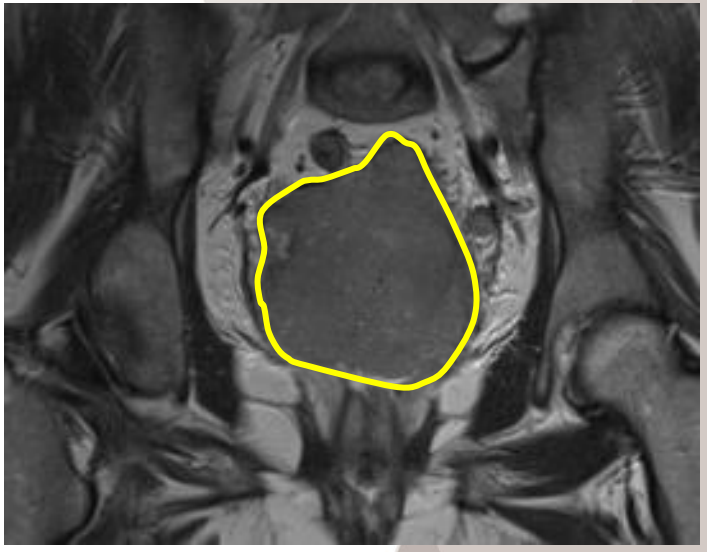
Stage IIIB

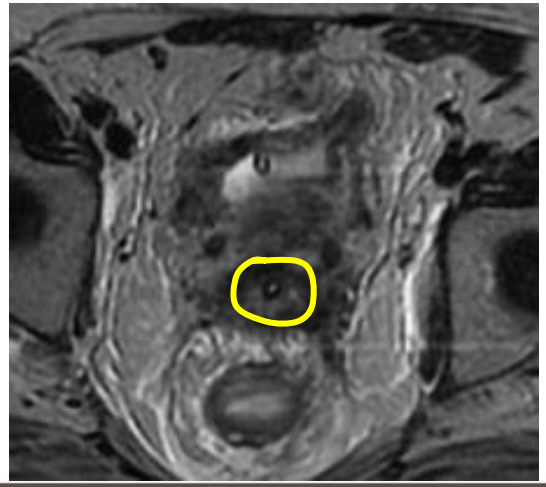







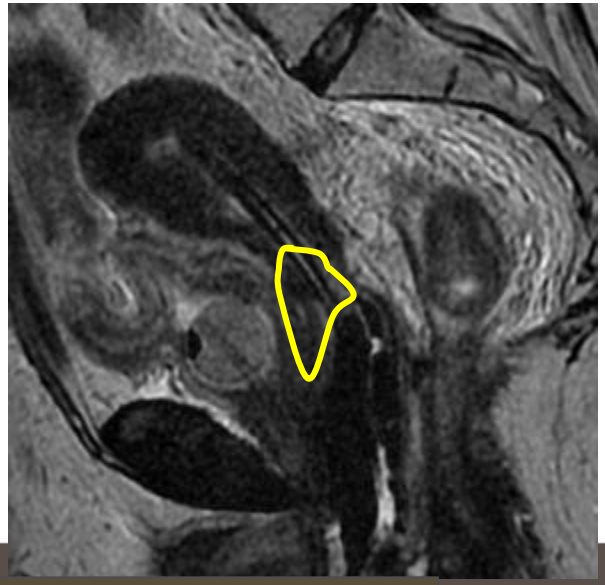
Stage IIIB

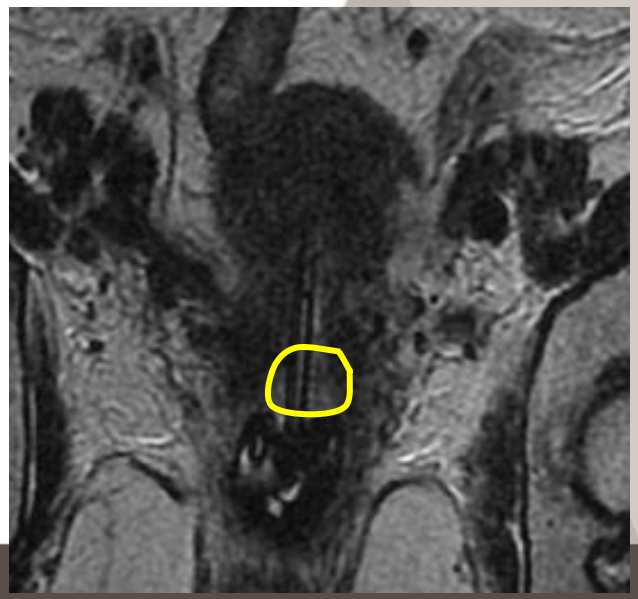




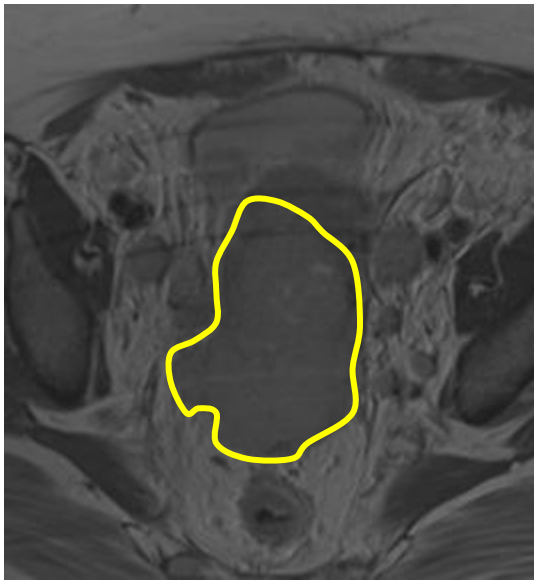


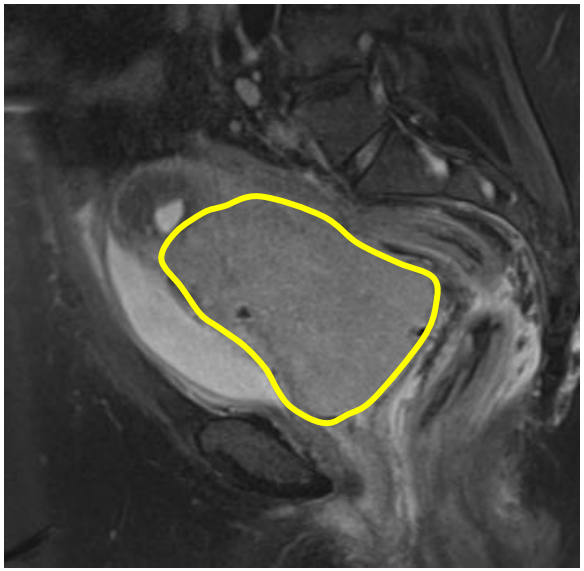


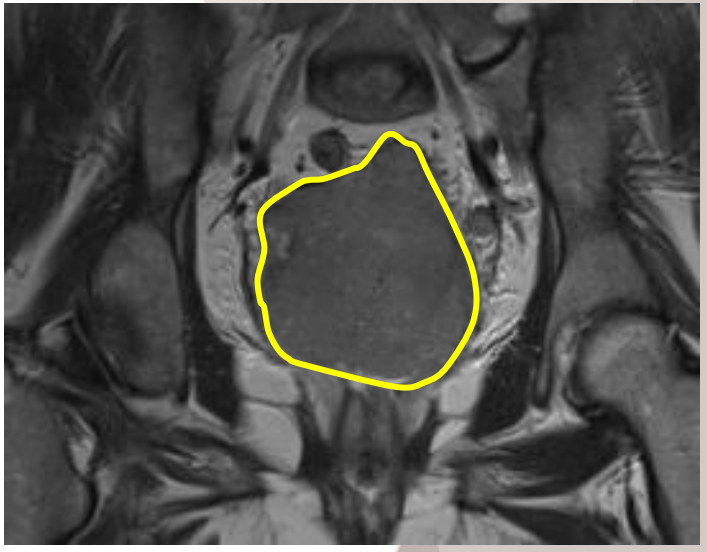


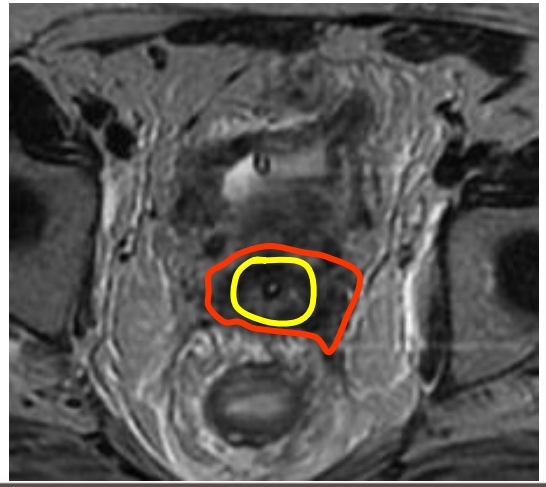


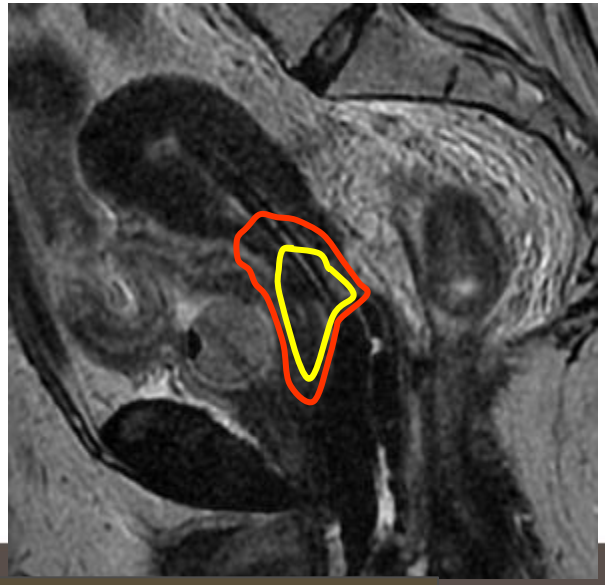
Stage IIIB

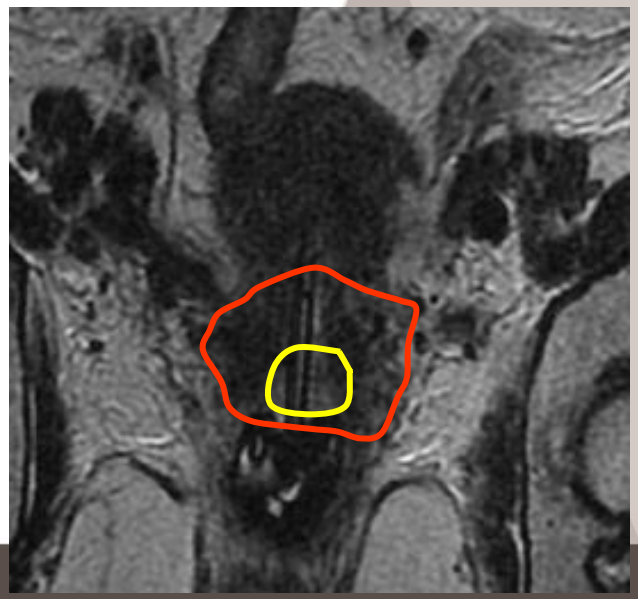




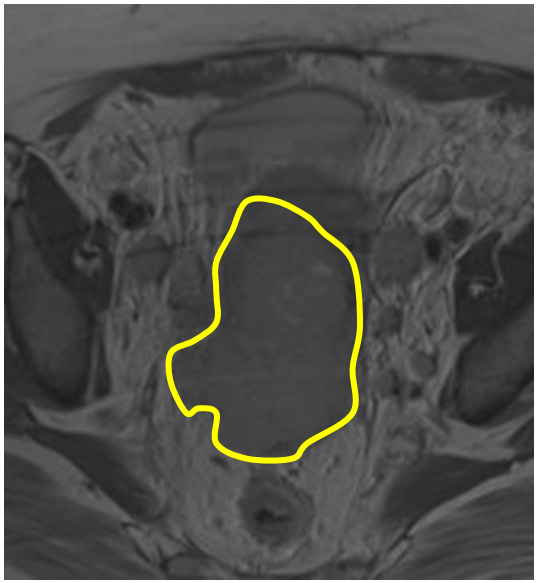


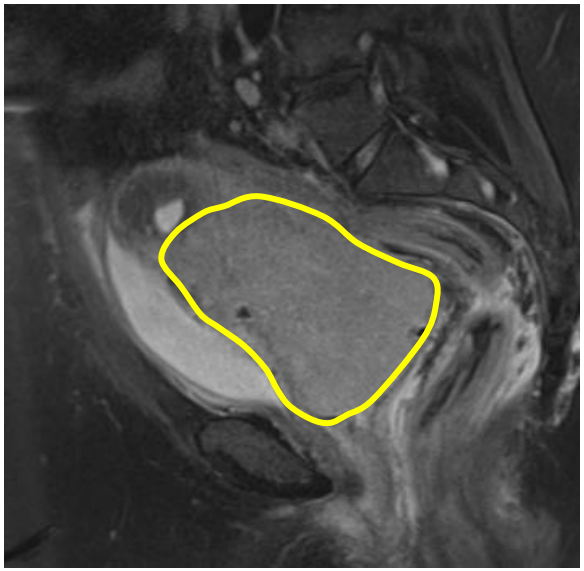


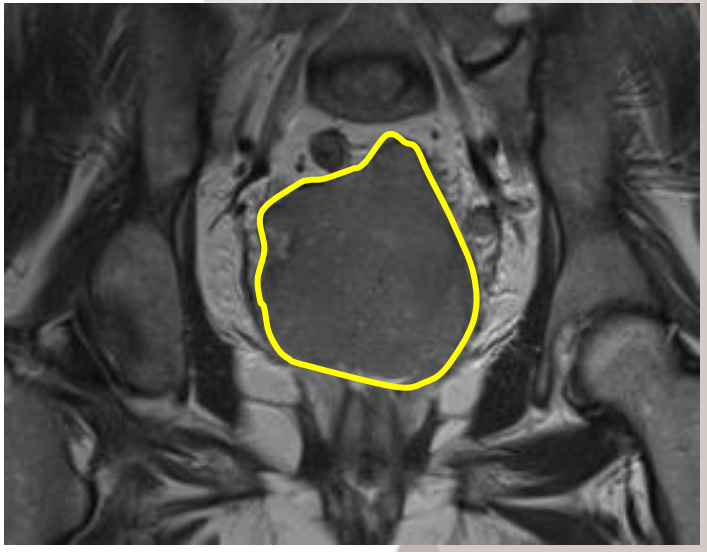


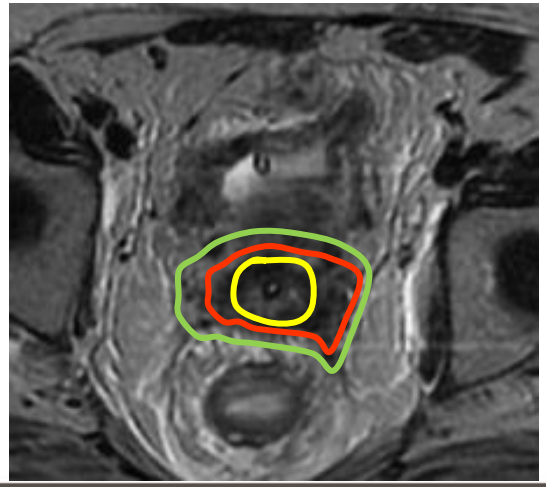


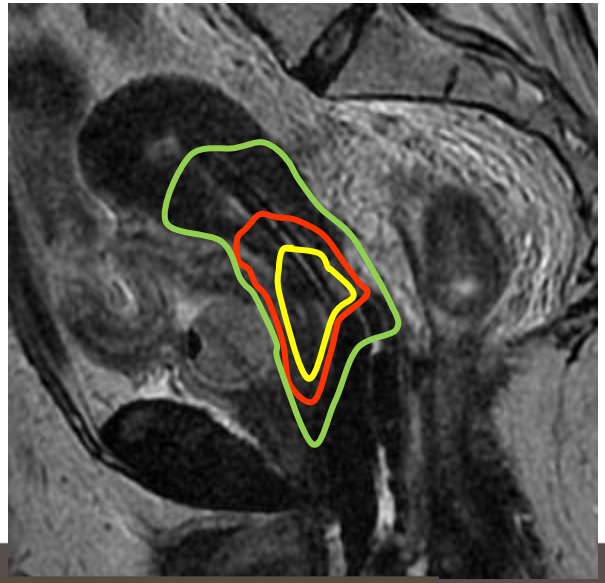
Stage IIIB

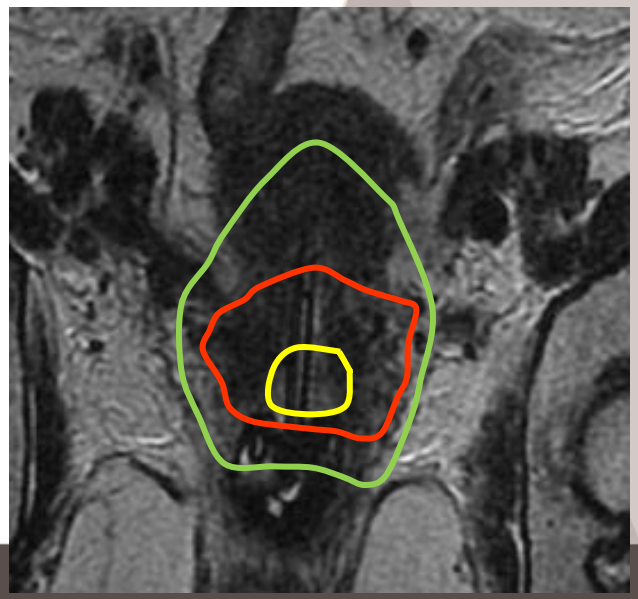




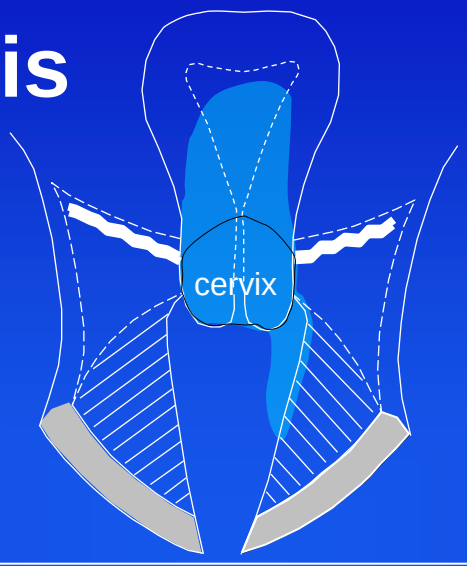








HR and IR-CTV Extent at diagnosis and degree of remission



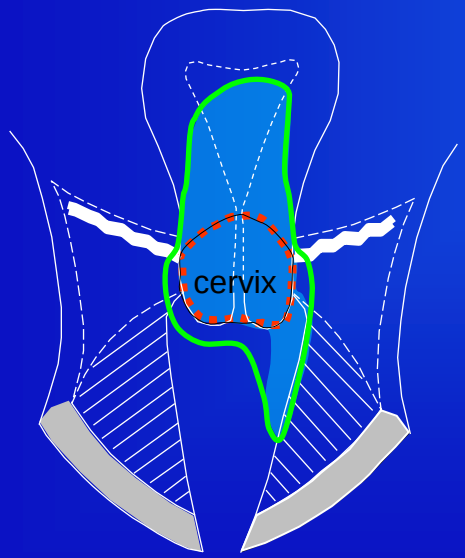
Initial tumour extension

Residual disease

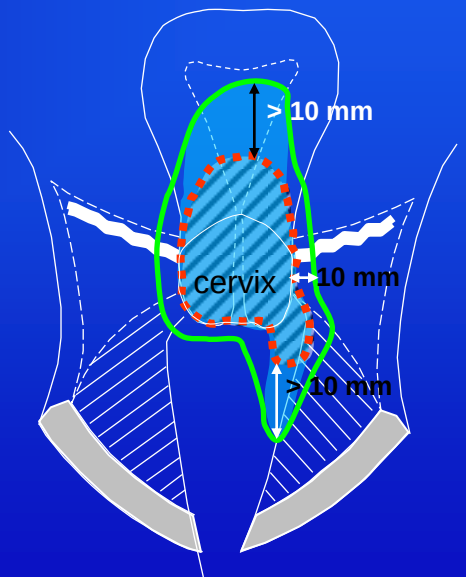
HR-CTV

IR-CTV

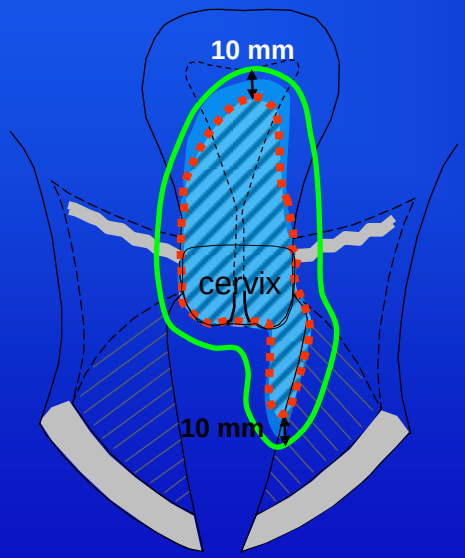
Complete remission



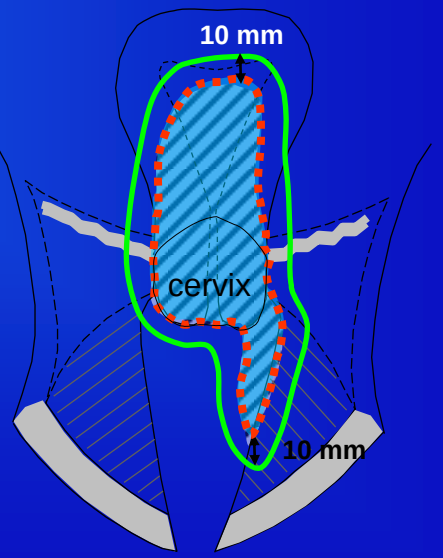
Good partial remission



Poor partial remission



No remission



Target volume concepts

High Risk CTV :

GTV at time of brachytherapy

In all cases includes:

- GTV + whole cervix
- Presumed tumour extension in adjacent tissues
  - **Clinical assessment**
  - **Residual grey zones on MRI**

NO SAFETY MARGINS

Intermediate Risk CTV :

GTV at time of diagnosis

In all cases includes:

- HR-CTV
- integrates initial GTV

SAFETY MARGINS :

1-1.5 cm cranially

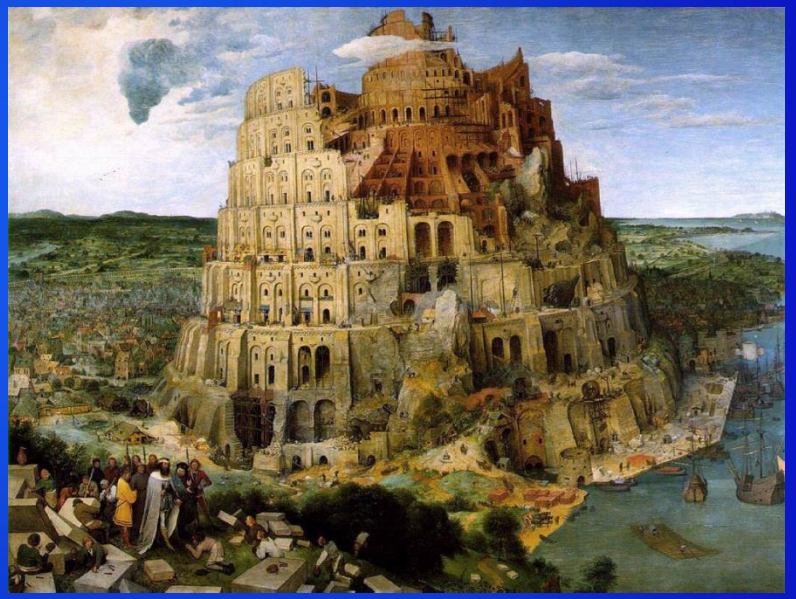
0.5cm antero-posteriorly

1cm laterally

GYN GEC ESTRO and ICRU RECOMMENDATIONS
From 2D to 3D/4D

Historical difficulties in communicating results of cervical BT
due to different traditions (60 Gy reference volume, point A…, midline block)

- CTV according to GTV at diagnosis: IR CTV
- CTV according to GTV at BT: HR CTV

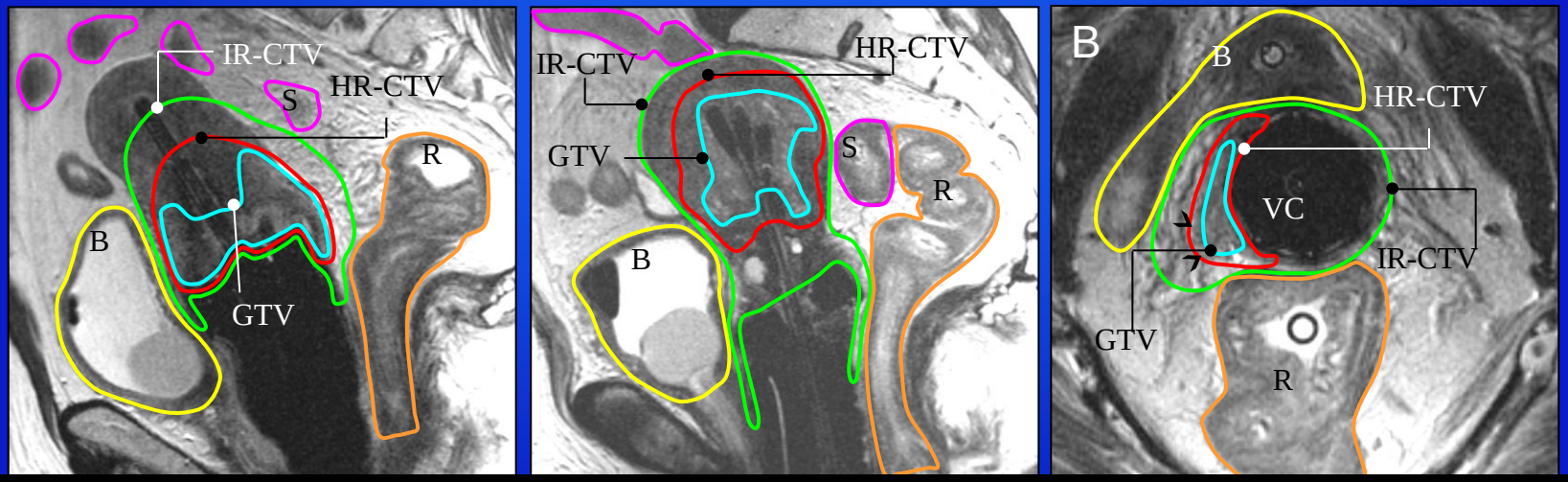


We have a common language: GEC ESTRO/ICRU

We should apply as much as possible

Gyn GEC ESTRO Recommendations are applicable for Gyn BT in general (vagina, endometrium, vulva, recurrent tumours)

cervix **endometrium** **vagina**



Petric, Pötter, van Limbergen, Haie-Meder: Adaptive Contouring of CTV and Organs at Risk in: Viswanathan, Erickson, Kirisits, Pötter (eds): Gynaecologic RadiationTherapy: Novel approaches to Image-Guidance and Management, 2010

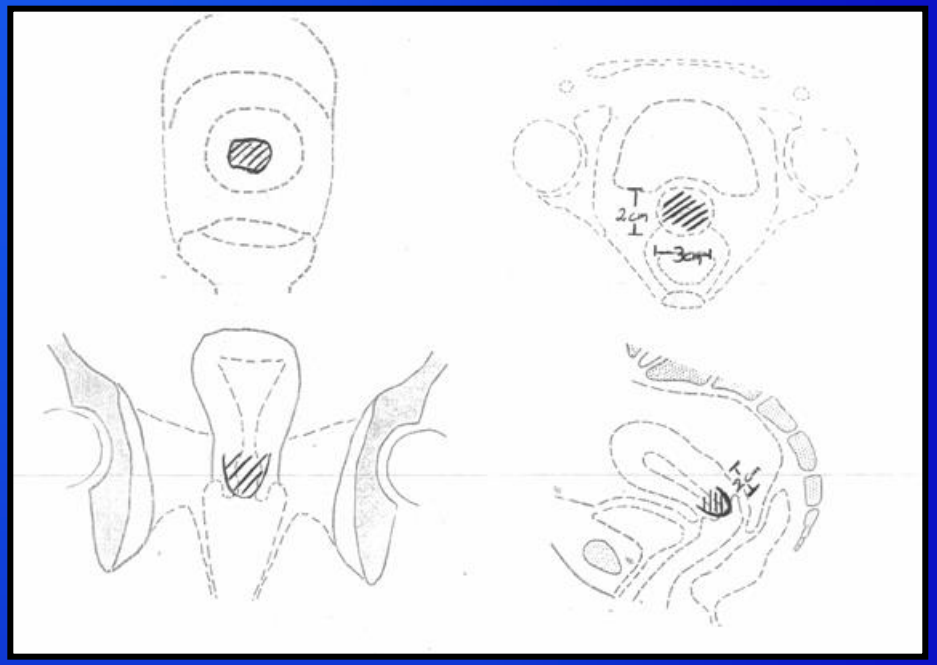
Clinical examples

1. Limited disease (tumour size < 4cm)
2. Large tumour, sufficient response
3. Large tumour, insufficient response

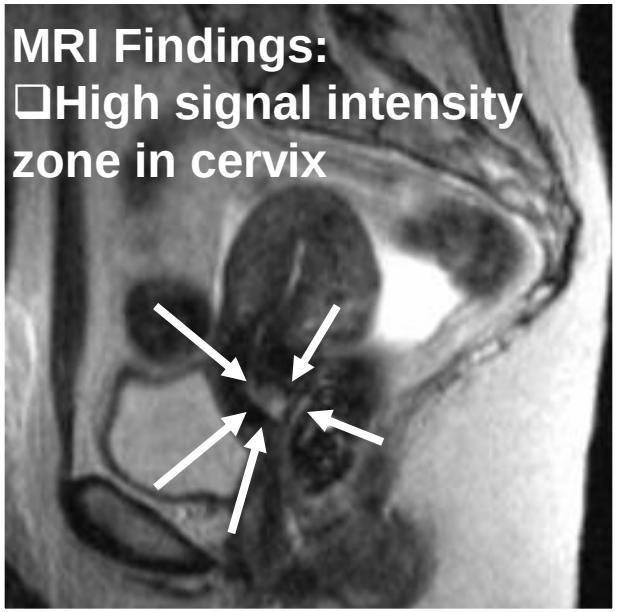
1. Limited disease (tumour size<4cm)

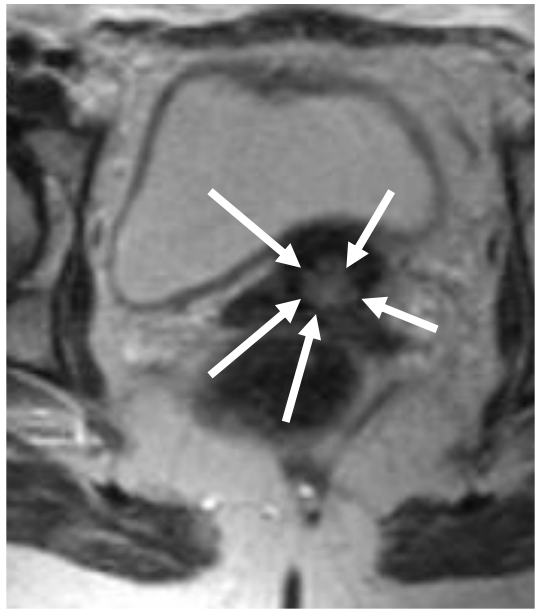
Definition of GTV

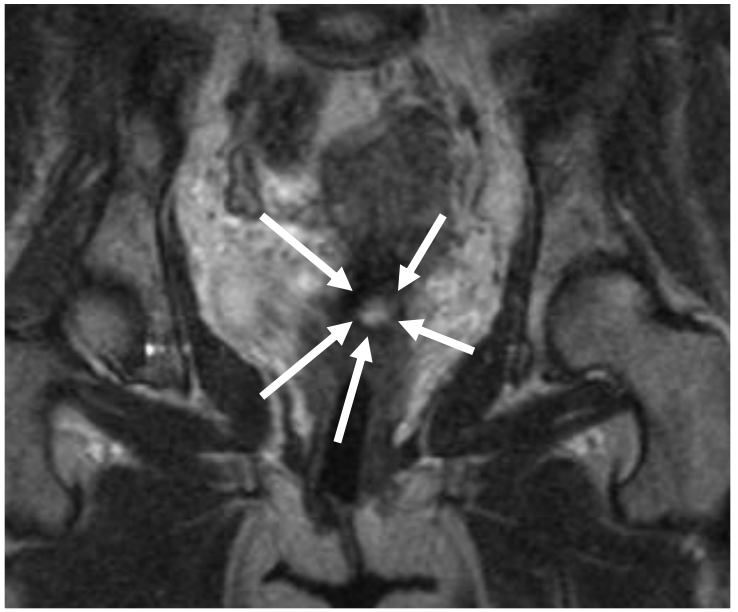
Clinical Examination:
macroscopic tumour



MRI Findings:
- **High signal intensity zone in cervix**



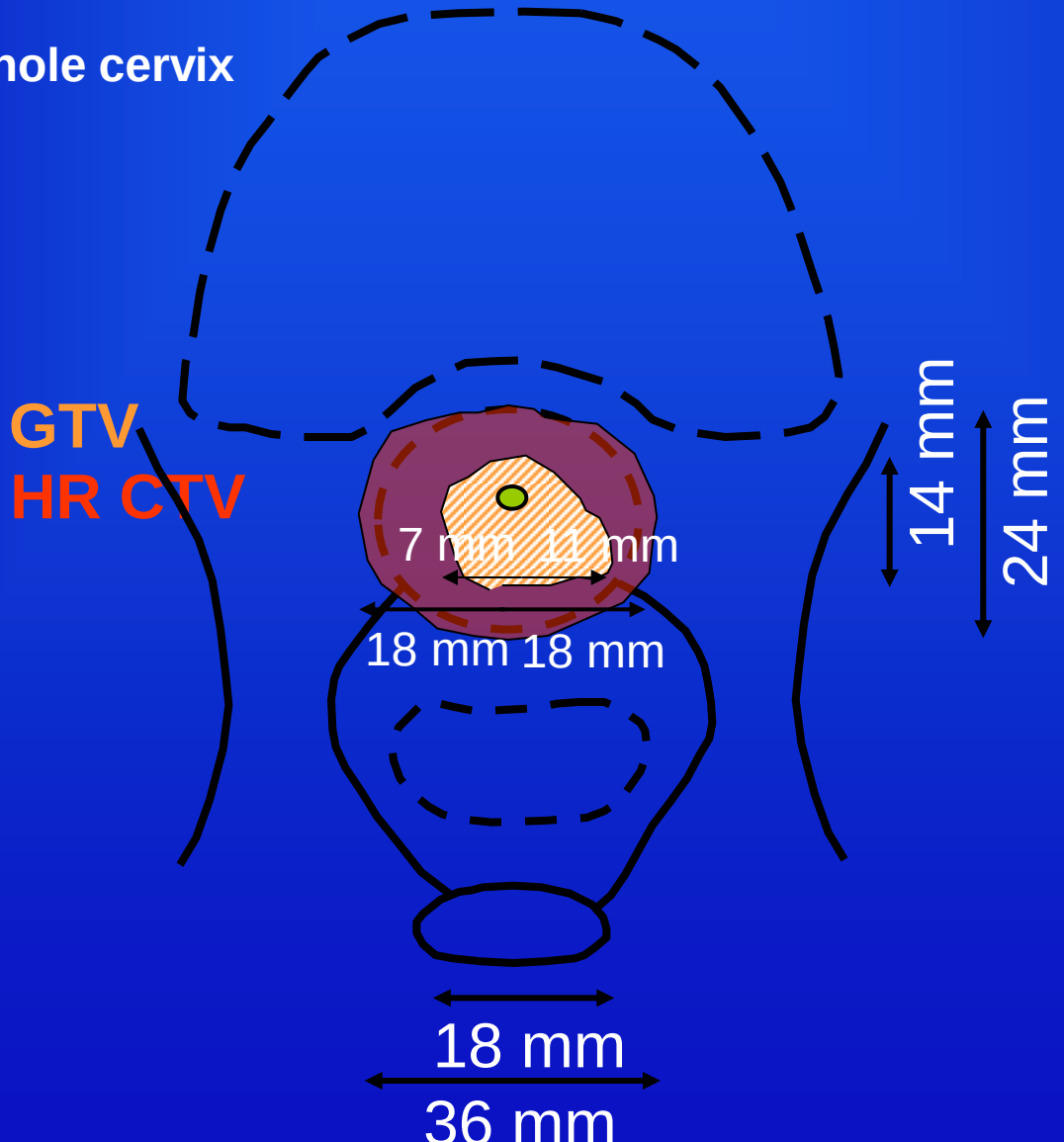




1. Limited disease (tumour size<4cm)

Definition of HR-CTV:

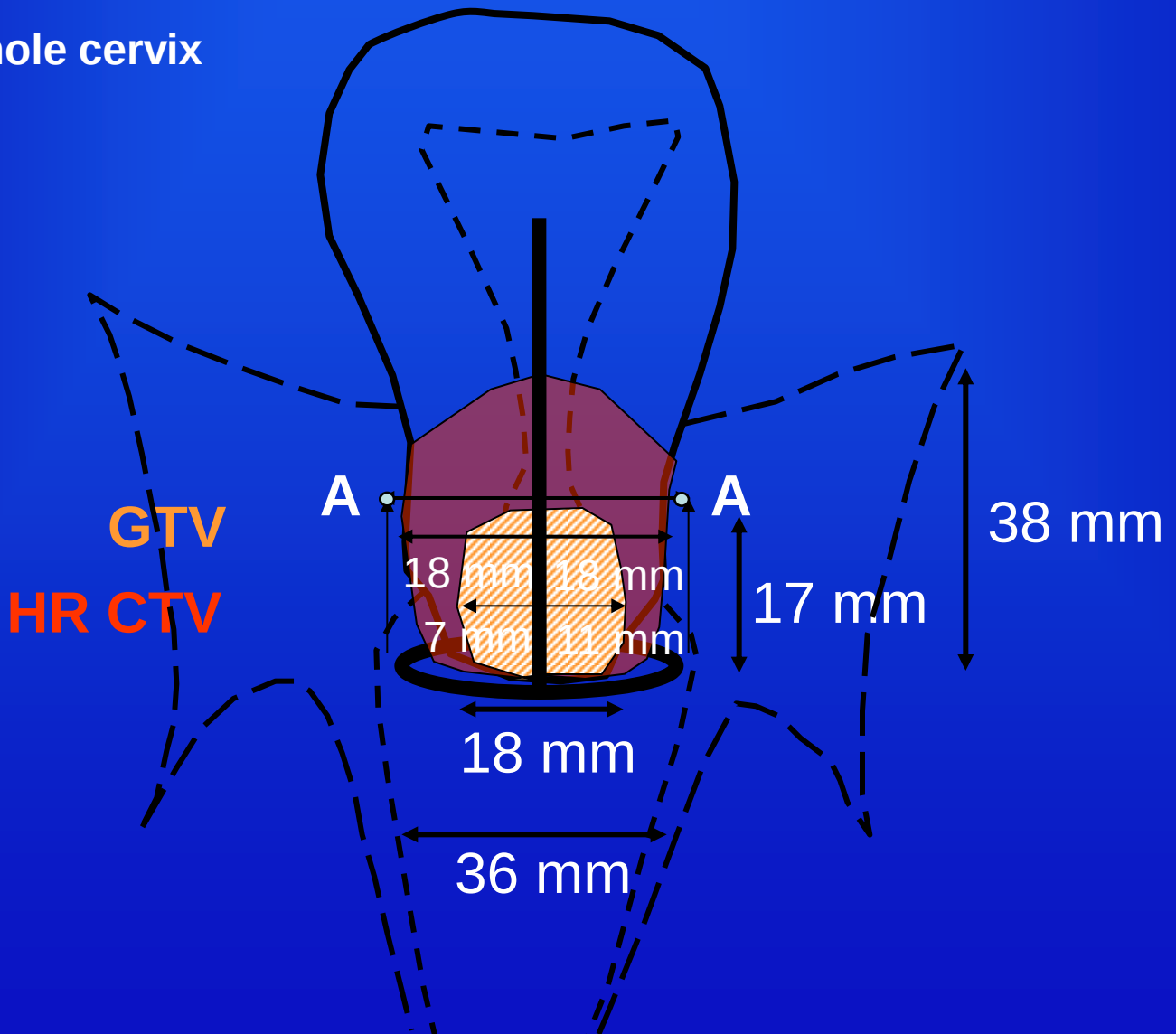
GTV + whole cervix



1. Limited disease (tumour size<4cm)

Definition of HR-CTV:

GTV + whole cervix



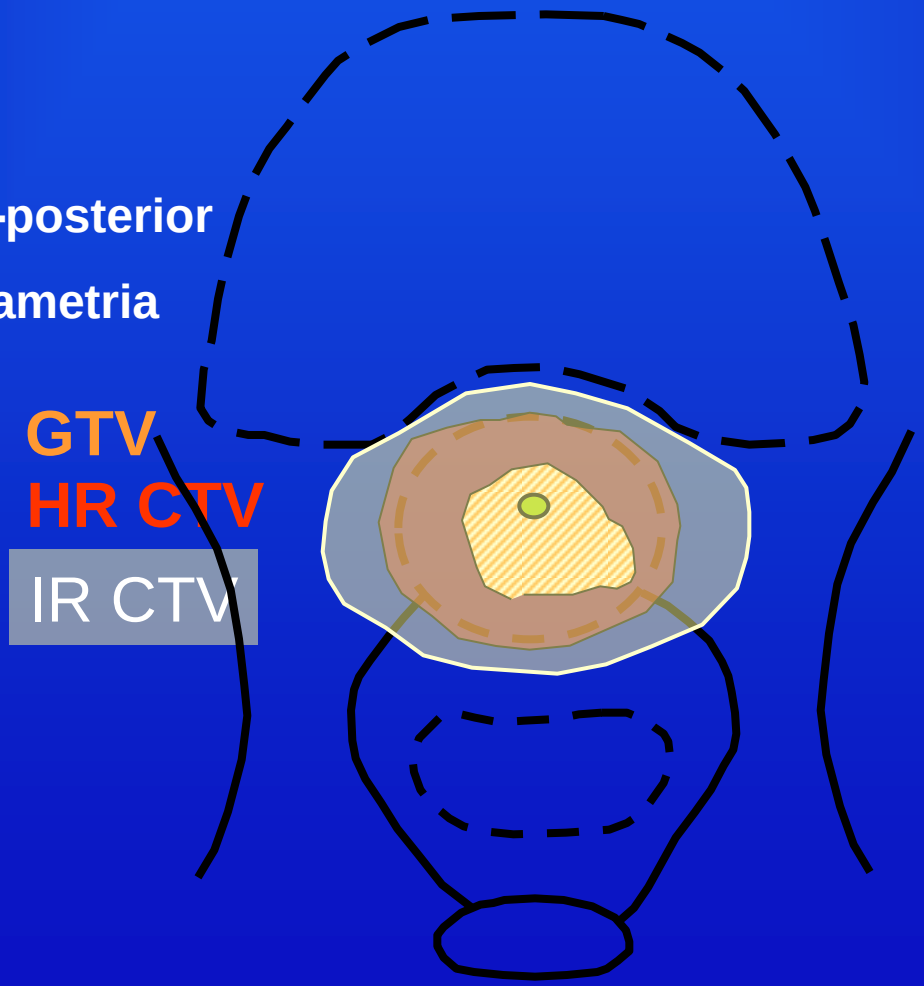
1. Limited disease (tumour size<4cm)

Definition of IR-CTV

HR CTV + safety margin
(area of adjacent significant microscopic tumour load)

5 mm anterior –posterior

10 mm into parametria



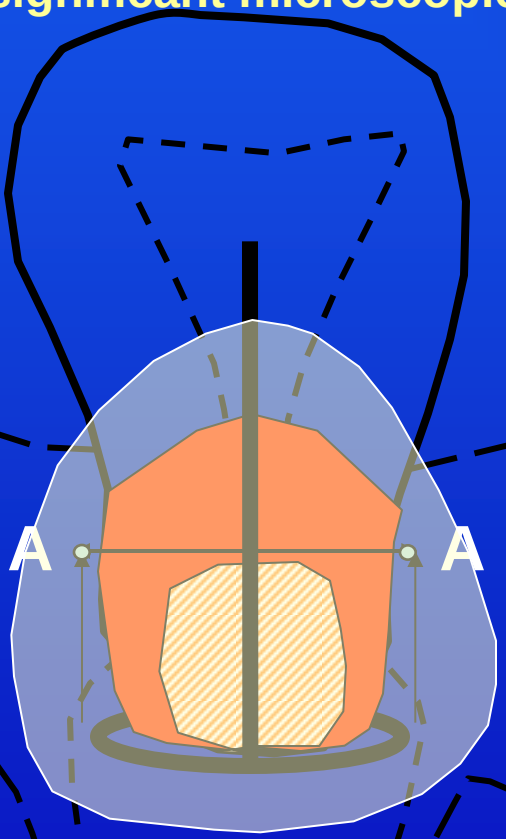
1. Limited disease (tumour size<4cm)

Definition of IR-CTV

HR CTV + safety margin
(area of potential adjacent significant microscopic tumour load)

5 mm anterior –posterior

10 mm into parametria



GTV

HR CTV

IR CTV

10 mm into the corpus

10 mm into the vagina

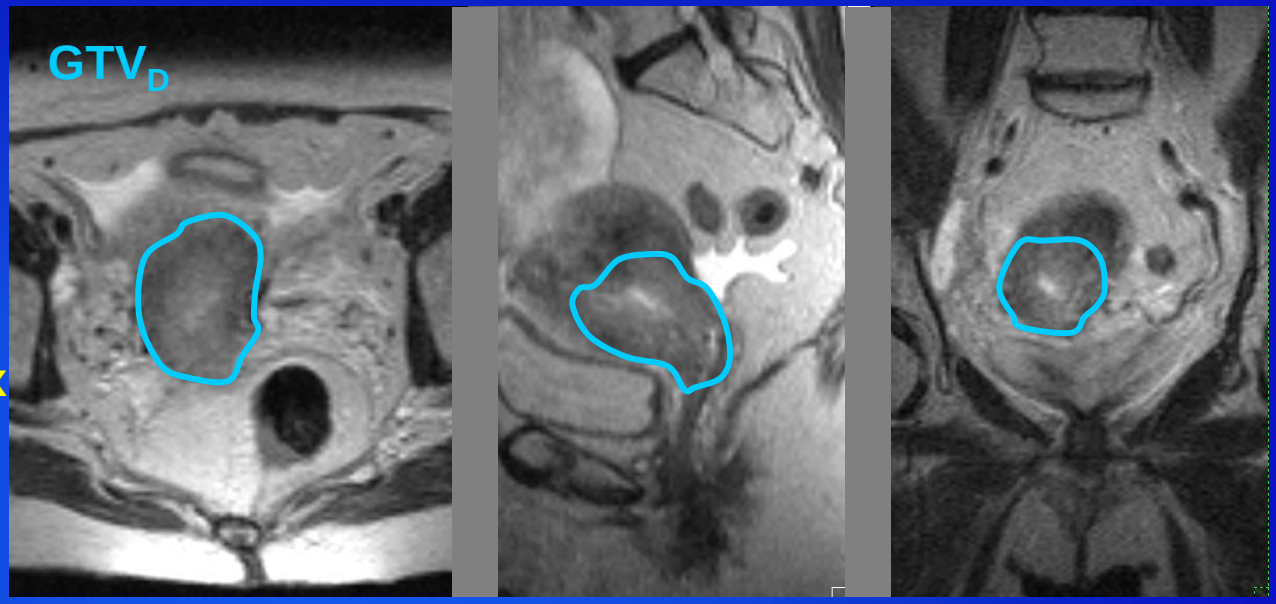
+/- additional 5 mm

Clinical examples

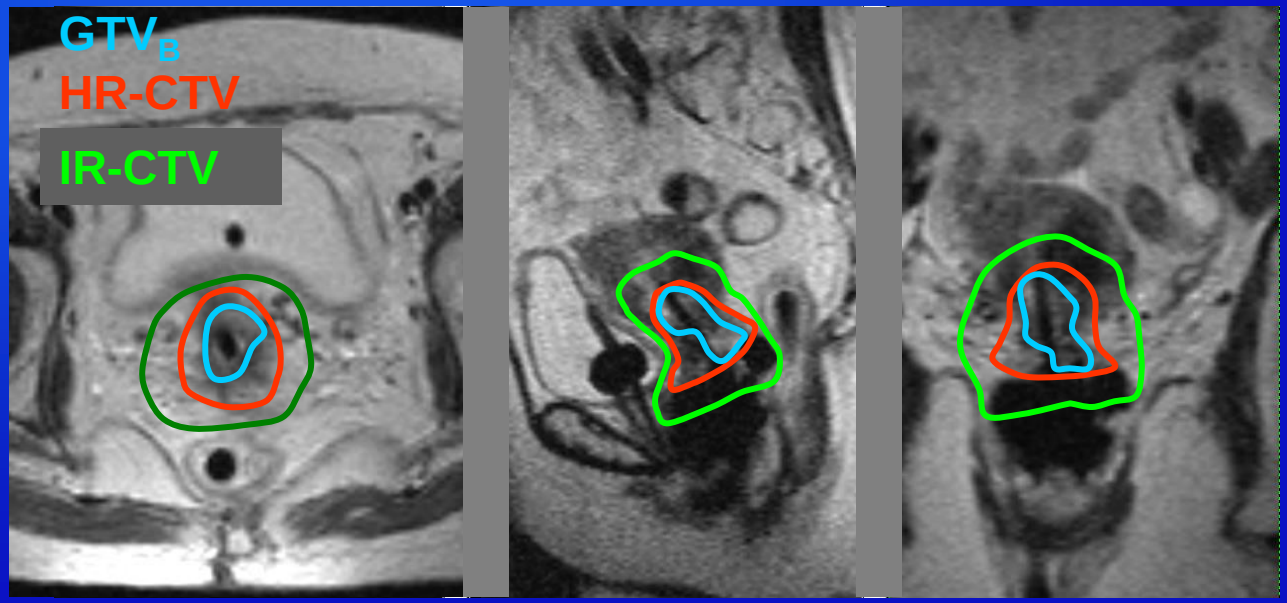
1. Limited disease (tumour size < 4cm)
2. Large tumour, sufficient response
3. Large tumour, insufficient response

2. Large tumour - sufficient response

- **INITIAL clinical findings:**
- St.p. Conisation, Cervix to the right
- Invasion of:
  - Right and dorsal fornix
  - Right PM to middle 1/3
- Left PM free



- **Clinical findings at BT:**
- No macroscopic residuum in vagina
- Residuum in:
  - Right PM - inner third



Clinical examples

1. Limited disease (tumour size < 4cm)
2. Large tumour, sufficient response
3. Large tumour, insufficient response

3. Large tumour-insufficient response

- Initial findings:

  -No invasion of vagina

  -Distal involvement of right parametrium (clinical)

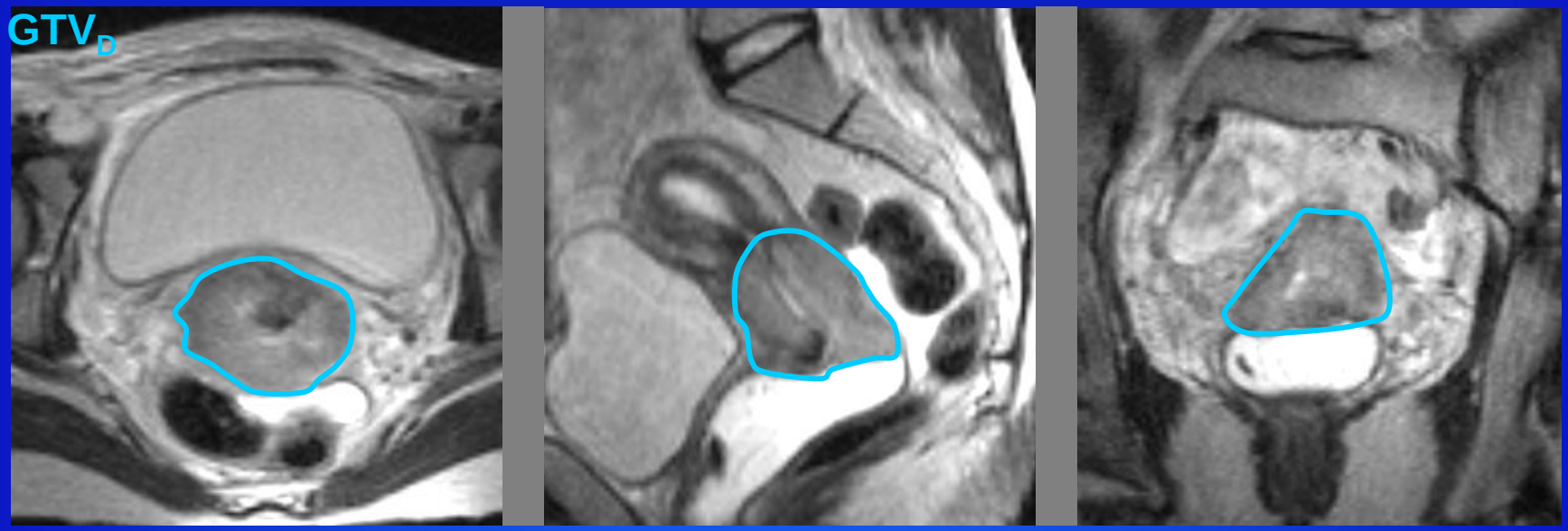
  -Proximal invasion of the left parametrium

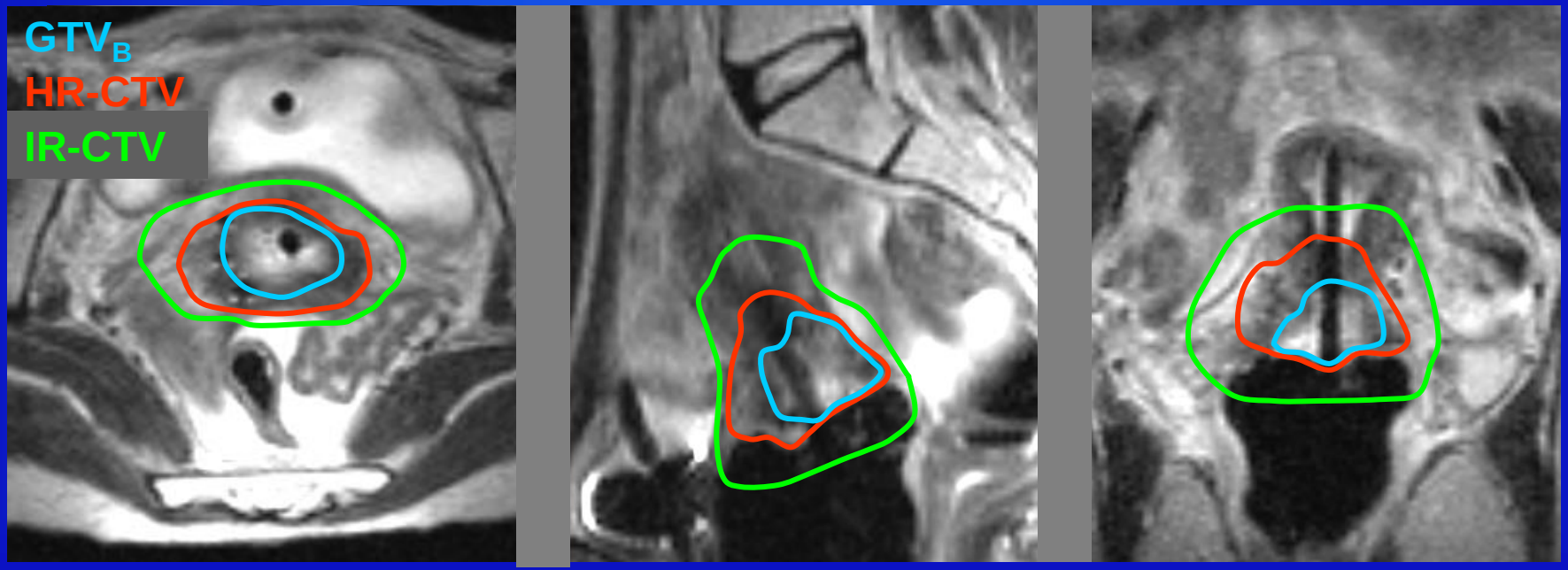
- Findings at brachytherapy:

  -Residual disease right parametrium middle third

  -No invasion of left parametrium

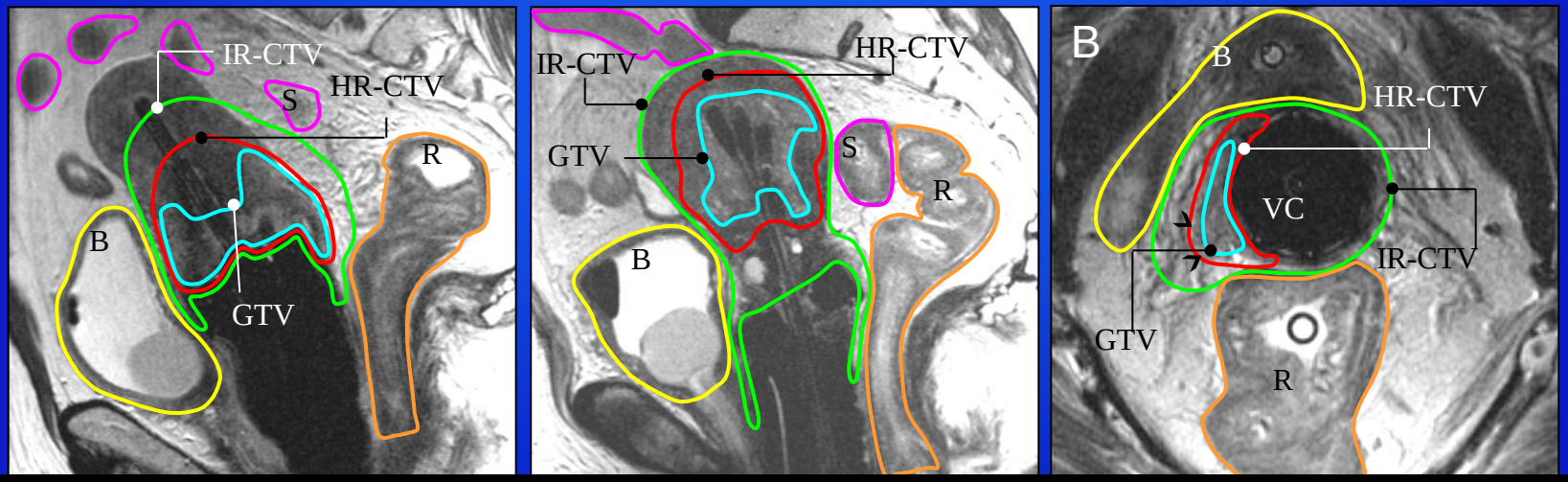
3. Large tumour-insufficient response





Gyn GEC ESTRO Recommendations are applicable for Gyn BT in general (vagina, endometrium, vulva, recurrent tumours)

cervix **endometrium** **vagina**



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