Imaging for Staging Colorectal Cancer

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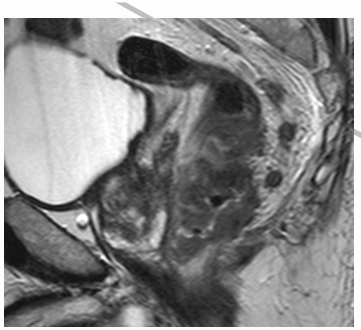
ANTONI VAN LEEUWENHOEK

Prof. Dr. Regina GH Beets-Tan, MD PhD
Chair Dept of Radiology
The Netherlands Cancer Institute, Amsterdam
The Netherlands

Rectal cancer

MRI



TME

ChemoRT + resection

ASCRS management rectal cancer revised guidelines 2013
EURECCA multidisc consensus guidelines EJC 2014
ESGAR consensus guidelines Eur Radiology 2013

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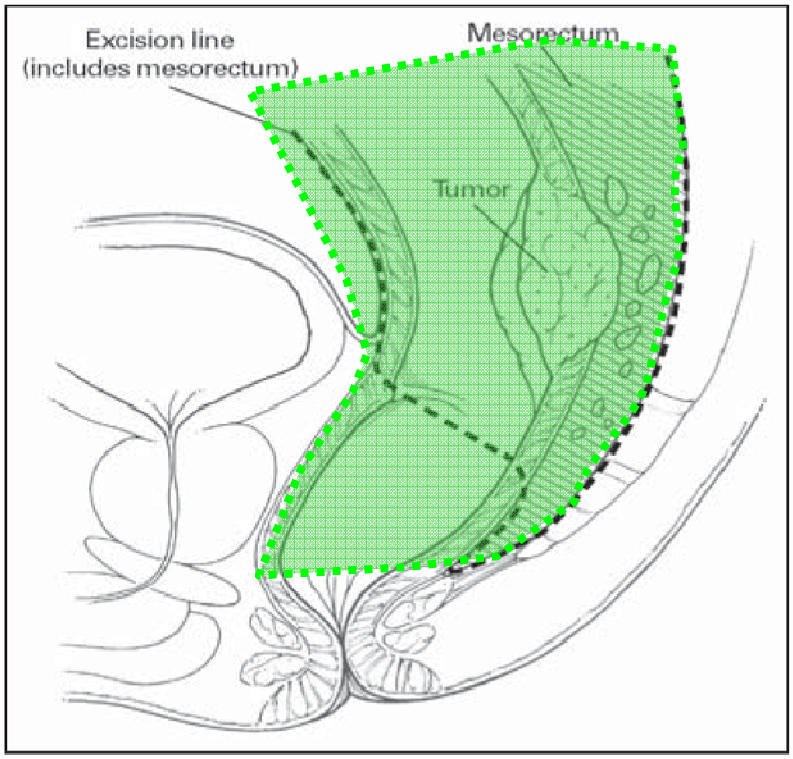
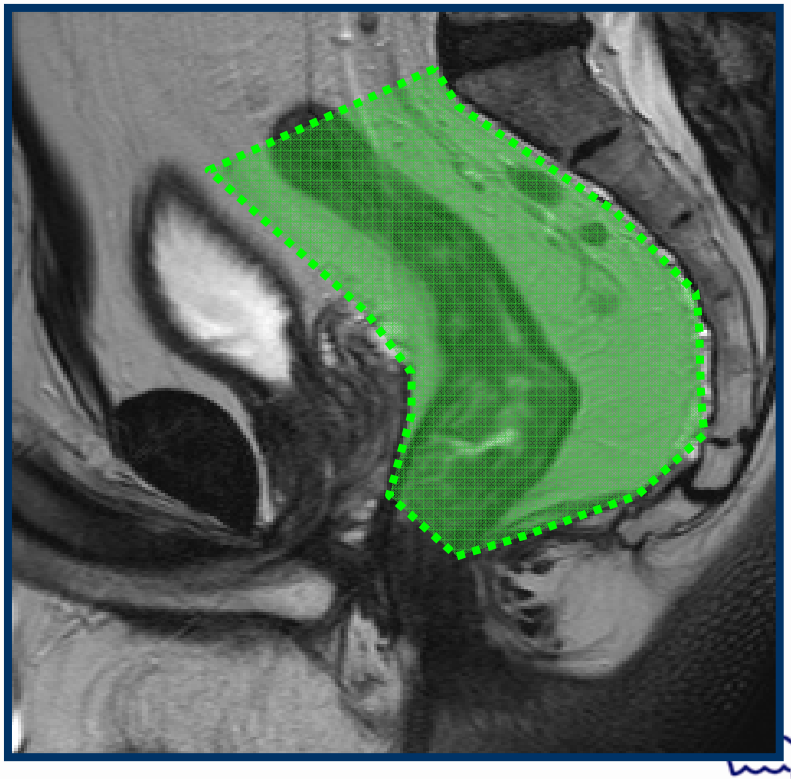
Mesorectum





Heald et al. The Lancet 1986

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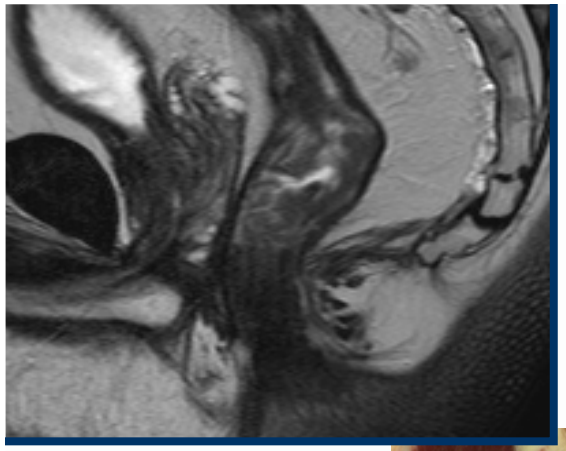
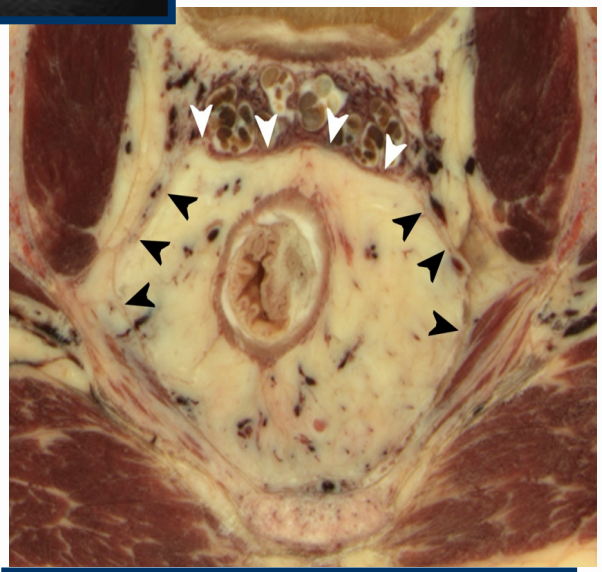
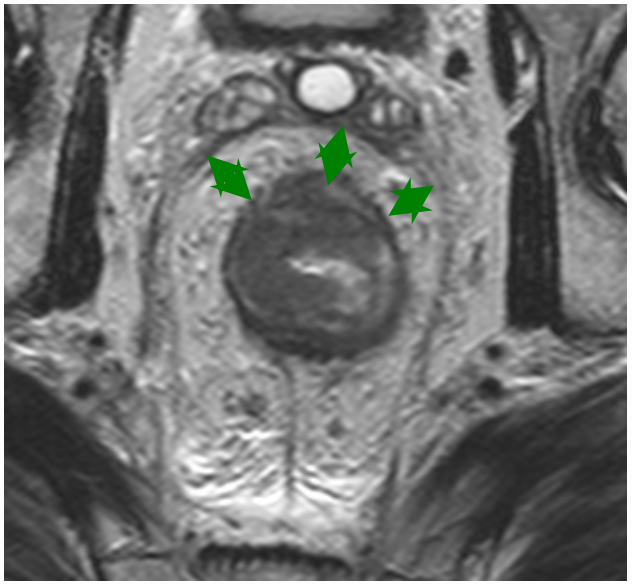


Mesorectal fascia involvement





Sens 80%, spec 80%

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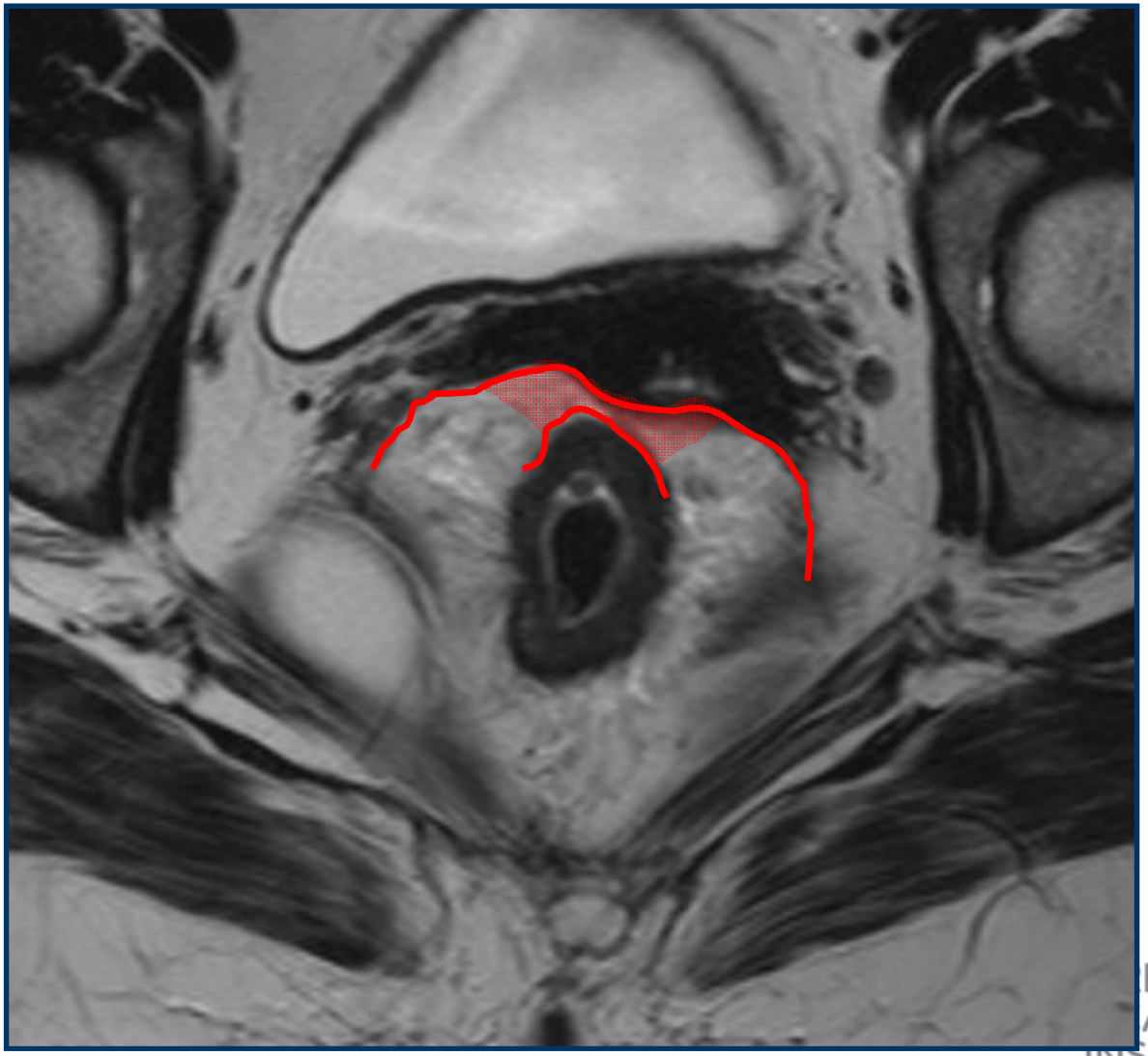
Lahaye et al, meta analysis Semin US,CT,MR 2005

What you see is what you get



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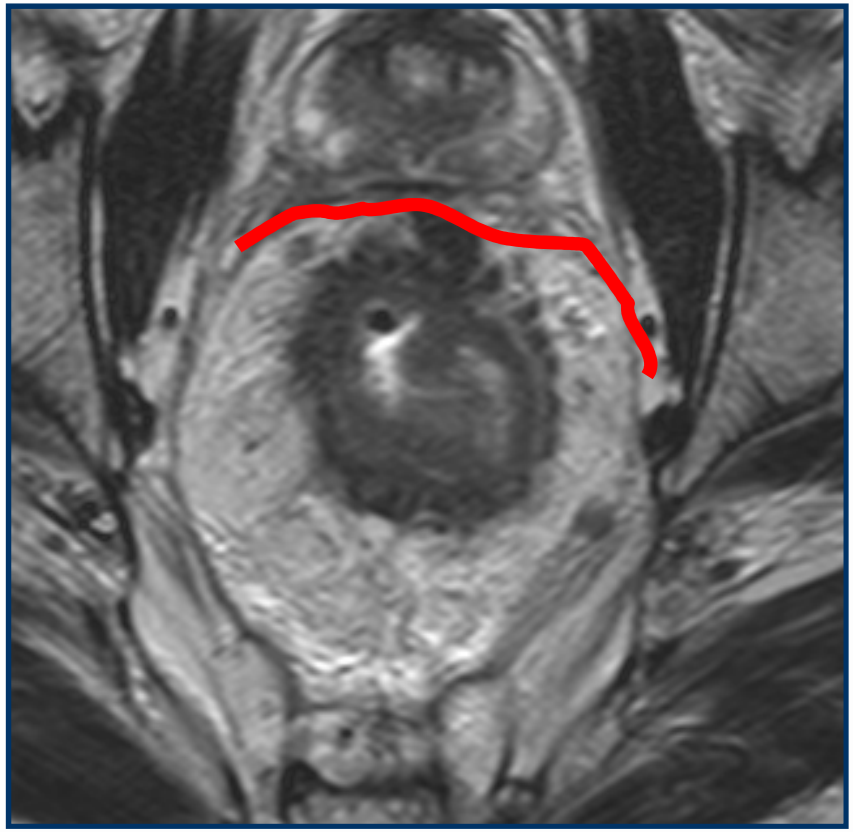
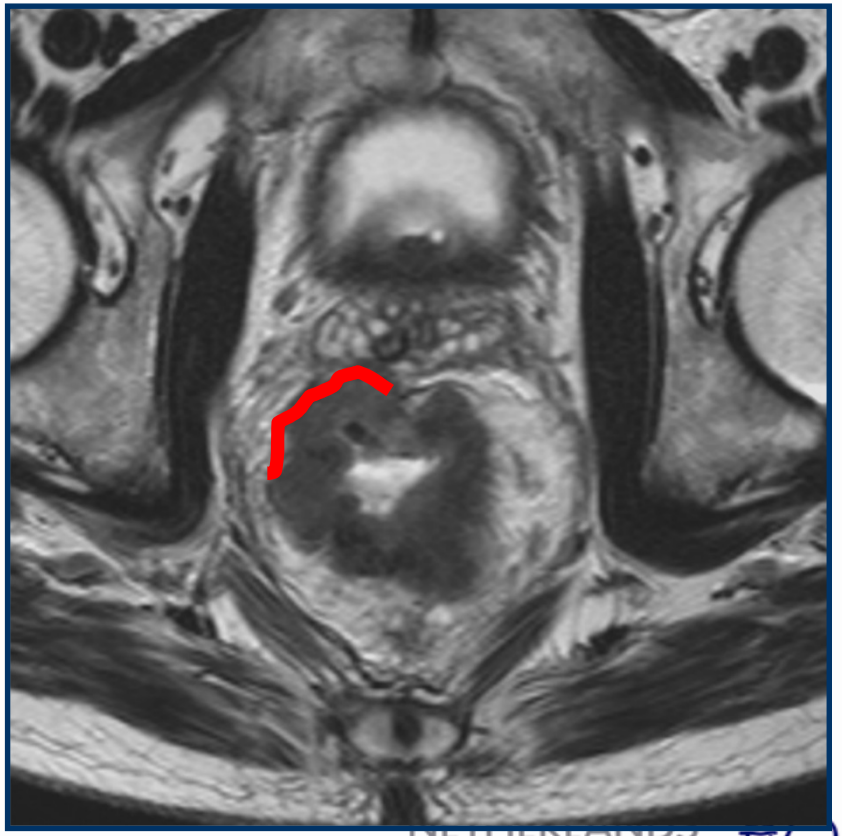
Beets-Tan et al. The Lancet 2001





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CT & MRF invasion

	High tumor	Low tumor
Sensitivity	70	**53**
Specificity	96	75
PPV	85	53
NPV	**92**	75

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Wolberink et al. Dis Col Rect 2009

CT & MRF invasion

	High tumor	Low tumor
Sensitivity	70	**53**
Specificity	96	75
PPV	85	53
NPV	**92**	75

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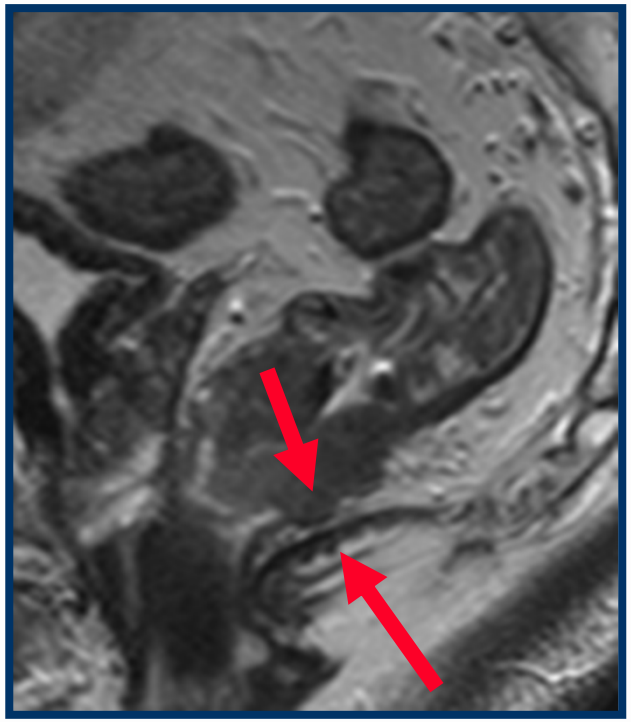
Wolberink et al. Dis Col Rect 2009

Low rectal ca	MRI	CT
POSTERIOR extension	**Acc 83**	**AUC 0.58**



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Vliegen et al. Abd Ima 2008

Peschaud DCR 2005

Low rectal ca	MRI	CT
POSTERIOR extension	**Acc 83**	**AUC 0.58**
ANTERIOR extension	**Acc 22**	**AUC 0.31**

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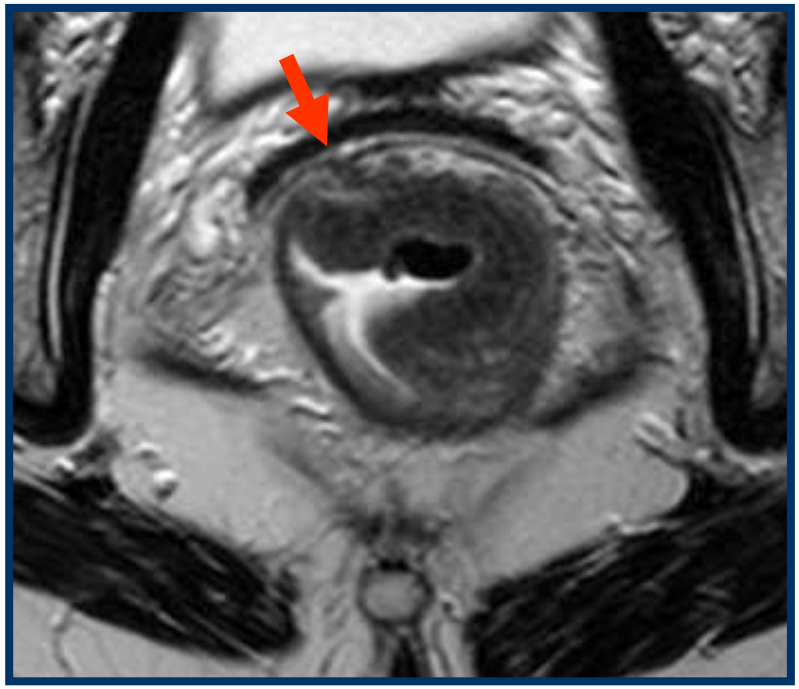
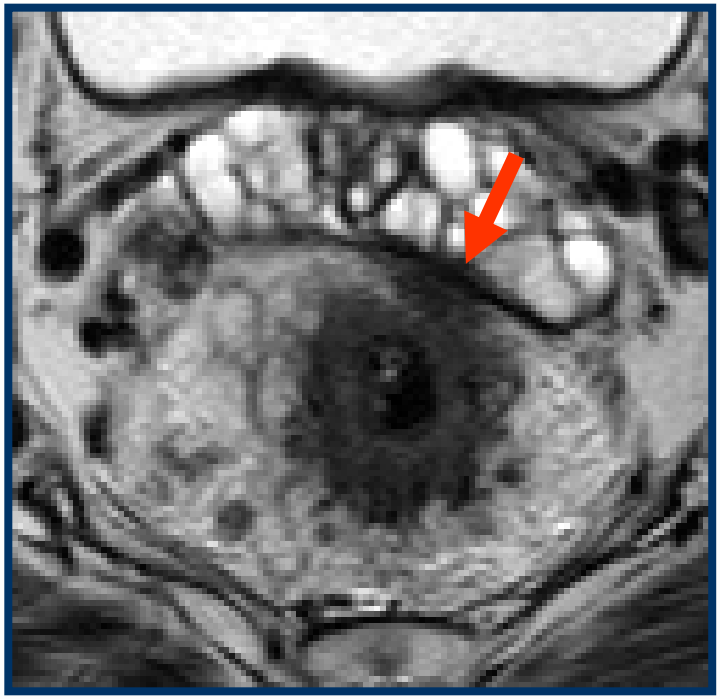
Vliegen et al. Abd Ima 2008

Peschaud DCR 2005

Pitfall - anterior invasion





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Rectal wall invasion

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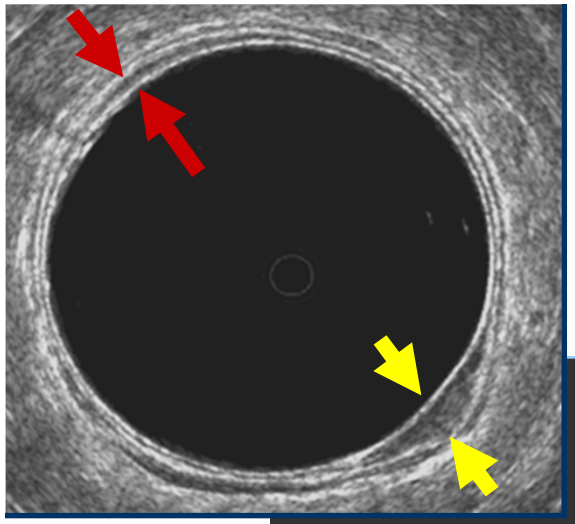

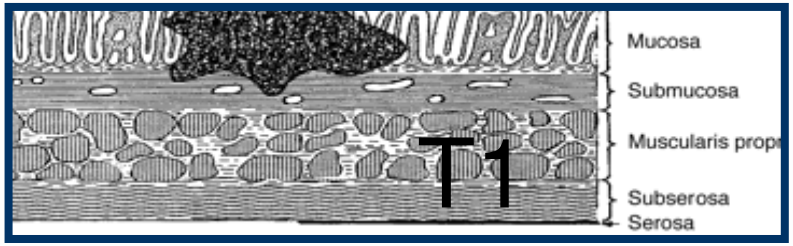

EUS		Sens	Spec
Bipat Radiology 04 Puli Ann S Onc 09	1985-2002 1984-2006	0.94 0.88	0.86 0.98

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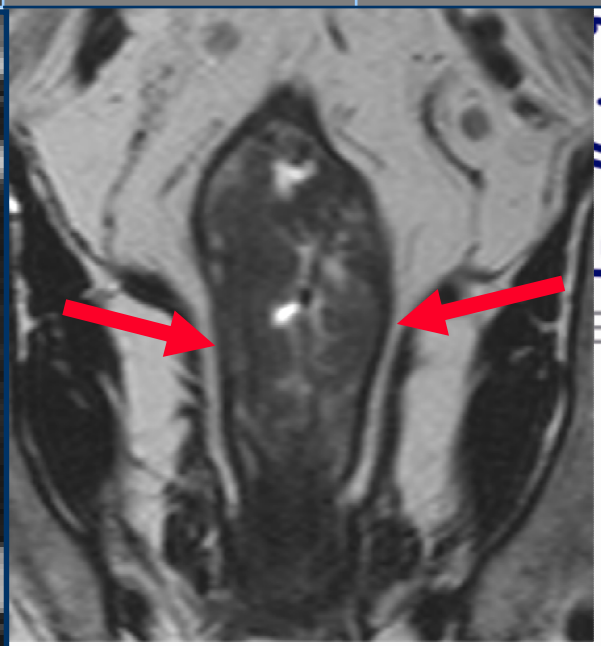
PPV 80%

T2	EUS	MRI
sens	94	94
spec	86	69



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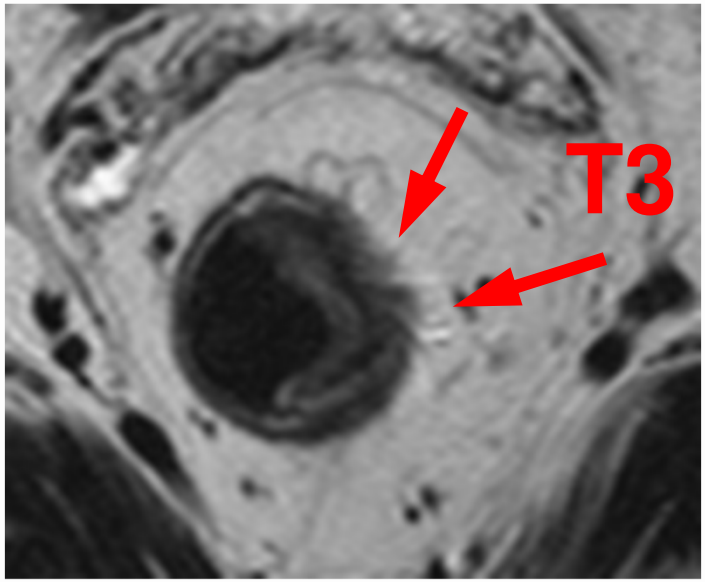
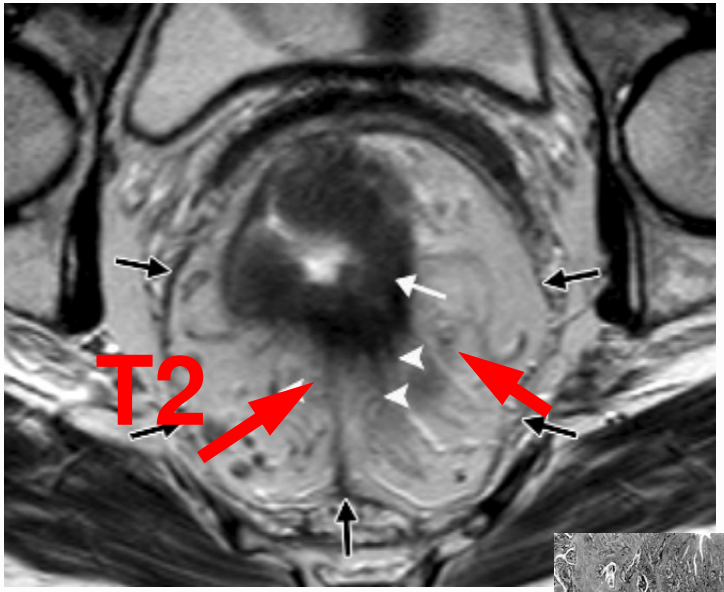
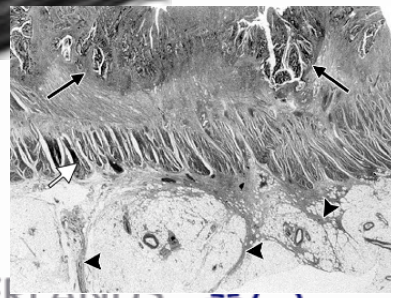
Bipat et al. Rad 2010







Overstaging 15 -20%

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Beets Tan et al. Rad 2004

MRI feature	Good prognosis	Poor prognosis
CRM	>1mm clear	<1mm involved
Low rectal <5cm	intersphincteric plane clear of tumor	intersphincteric plane involved by tumor
T stage	T1/T2, T3a<1mm, T3b, 1-5mm extramural spread	T3c>5mm extramural spread, T4
EMVI	negative	positive
N stage	any	any

T2, T3ab≤5mm

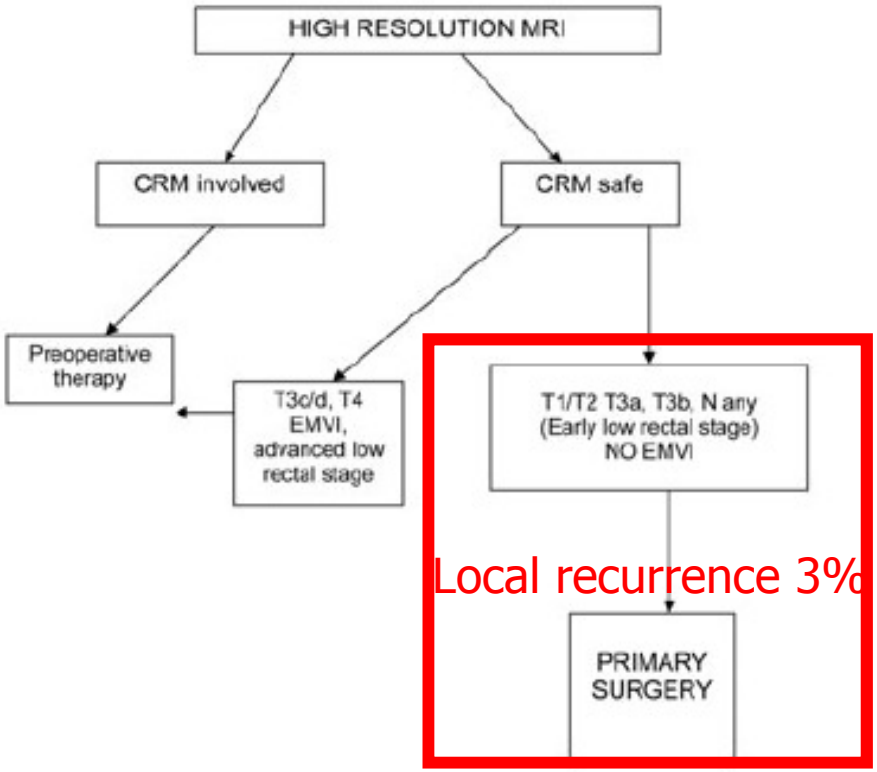

FIGURE 2. Treatment plans according to MRI prognosis.

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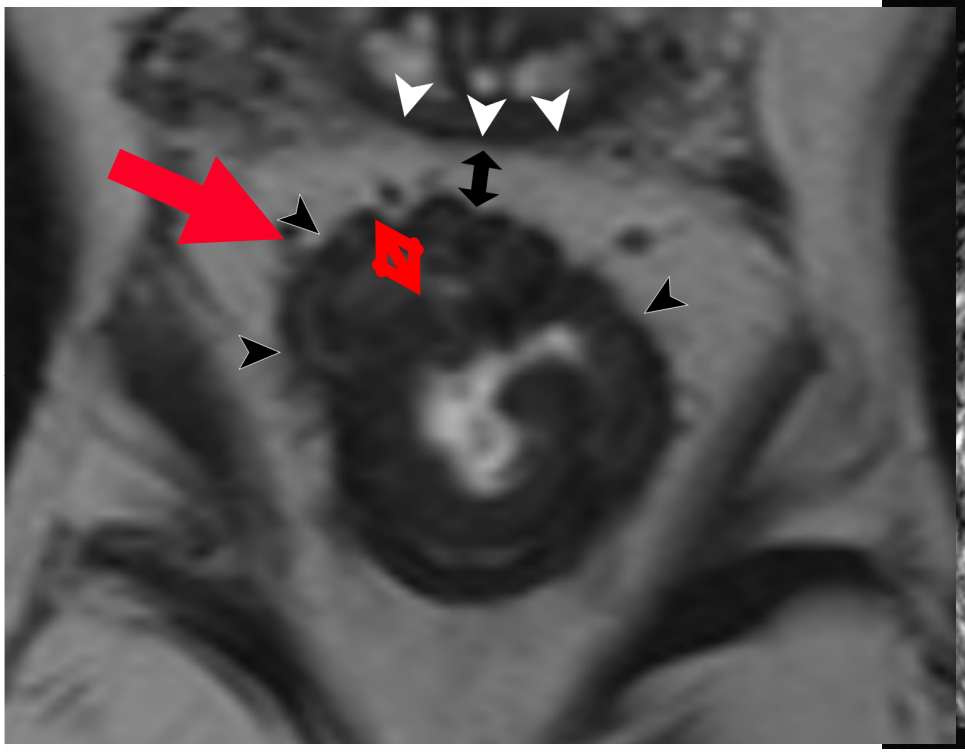
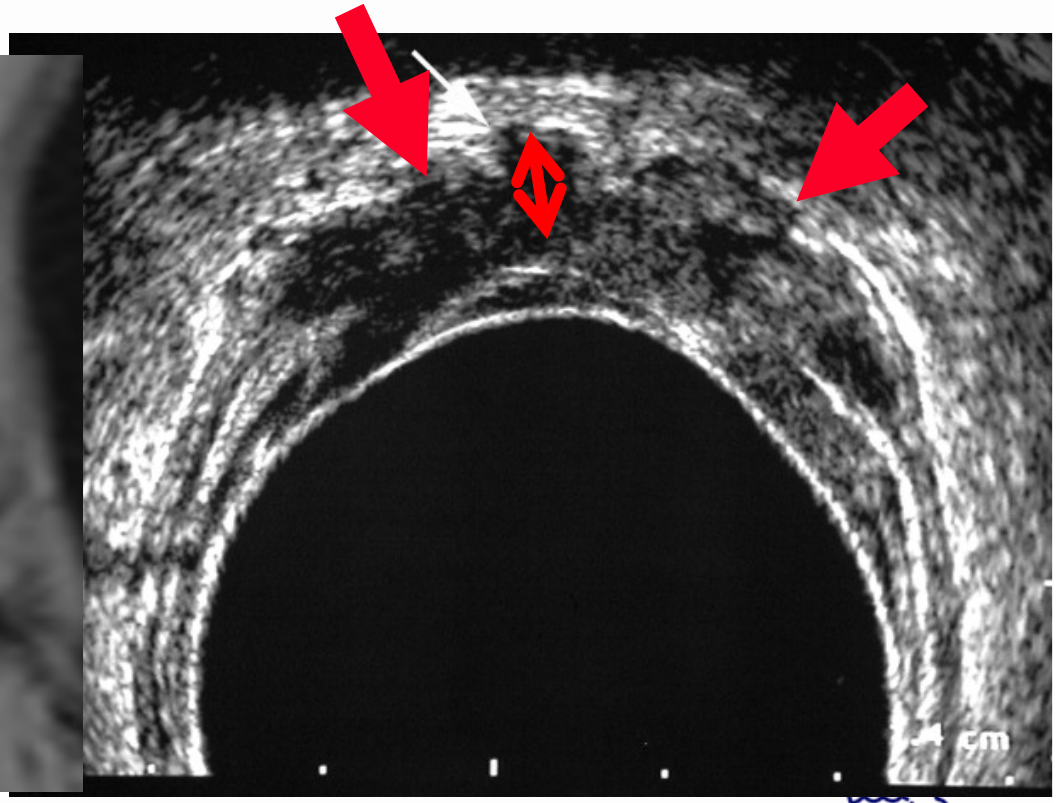
Taylor et al. Annals of Surgery 2011

T3 a,b (< 5mm)





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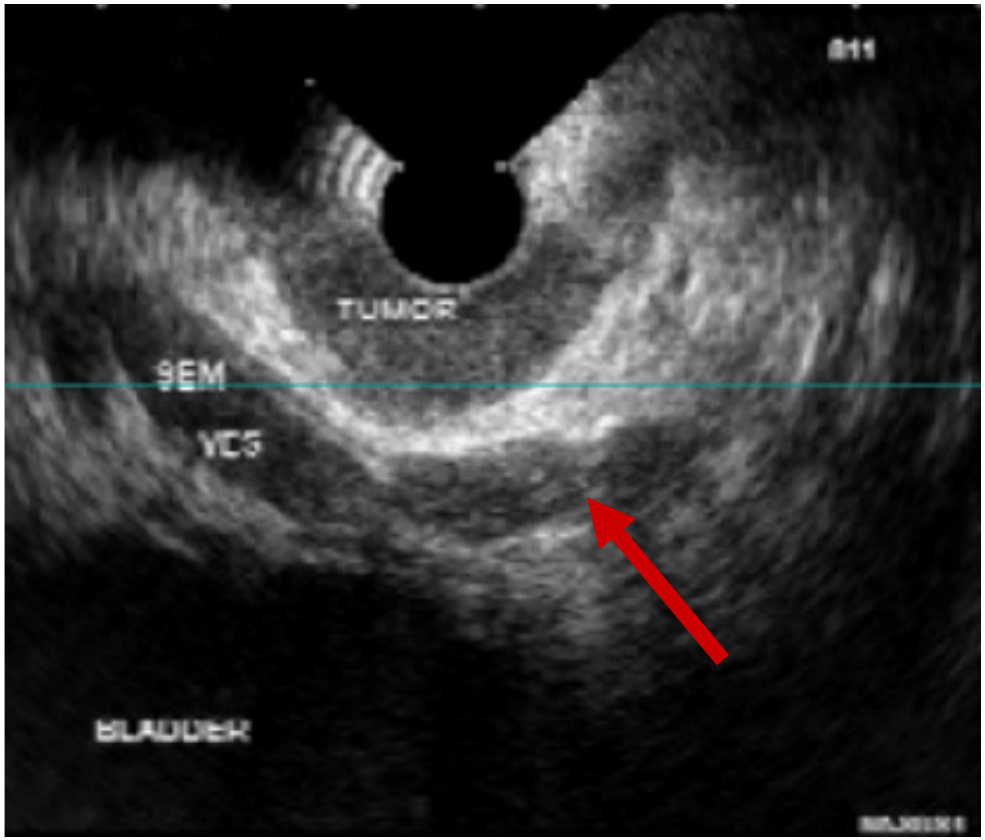
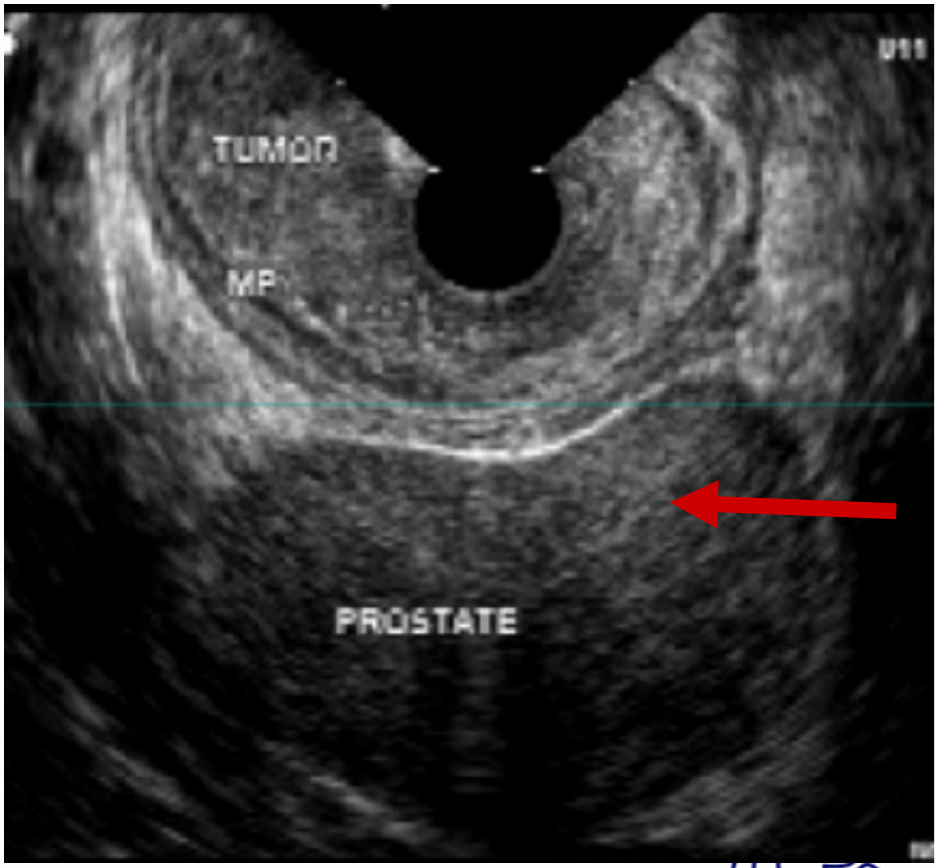
T4	sens	spec
MRI	74	96
CT	72	96
EUS	70	97

Bipat et al. meta analysis
Radiology 04

Pelvic Organ invasion





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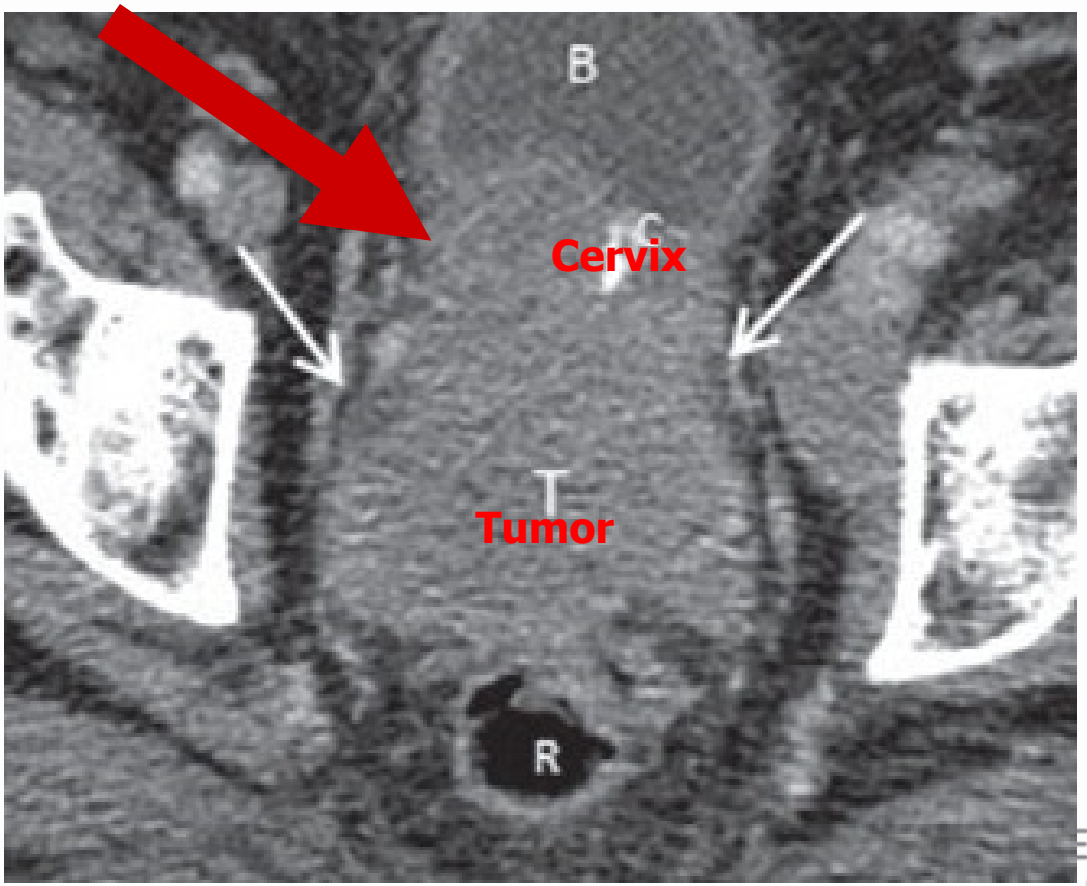
Pelvic Organ invasion



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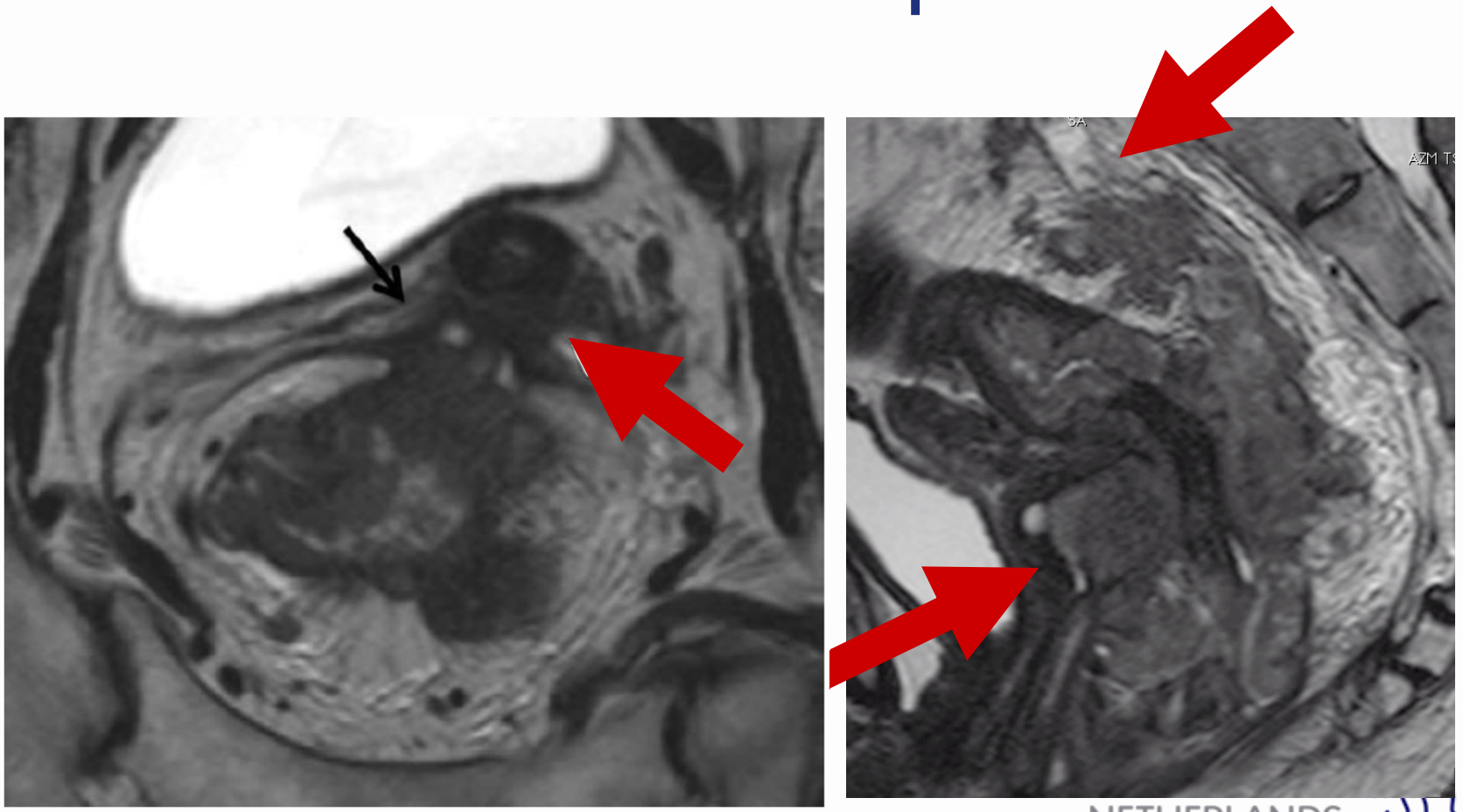
Roadmap



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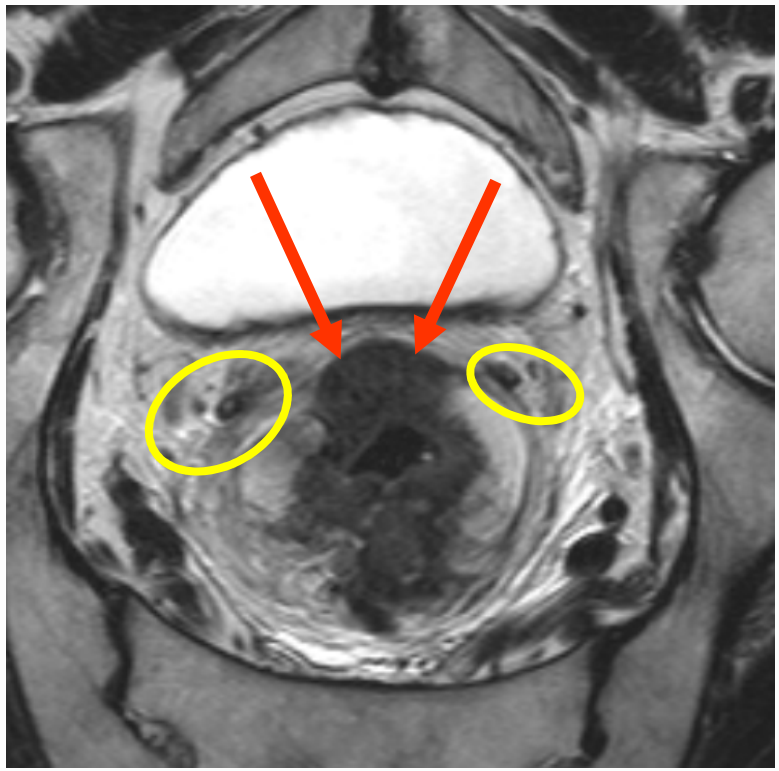
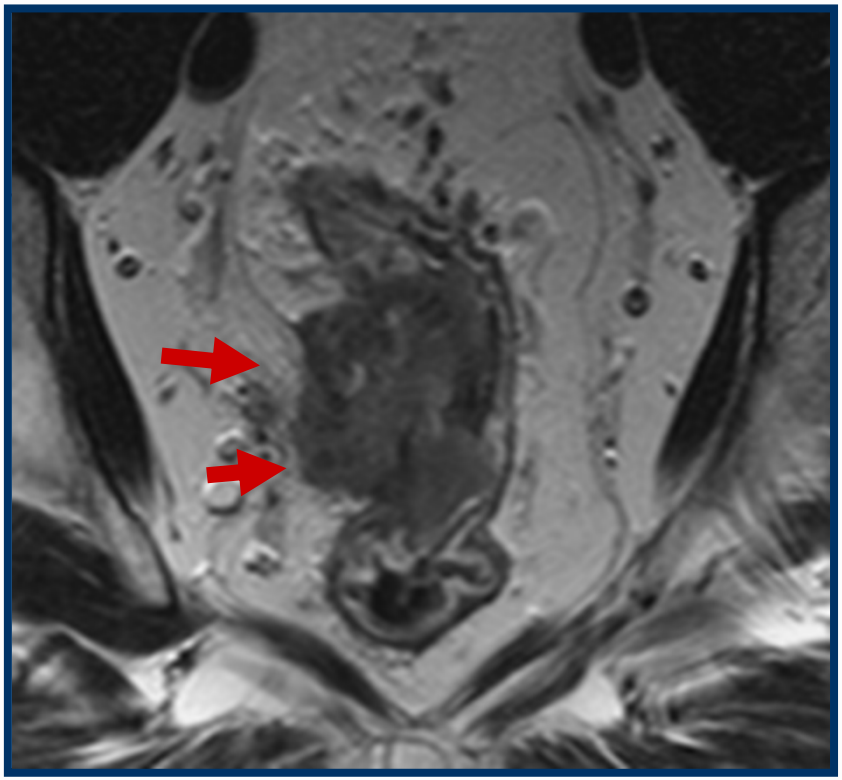
What you see is what you get





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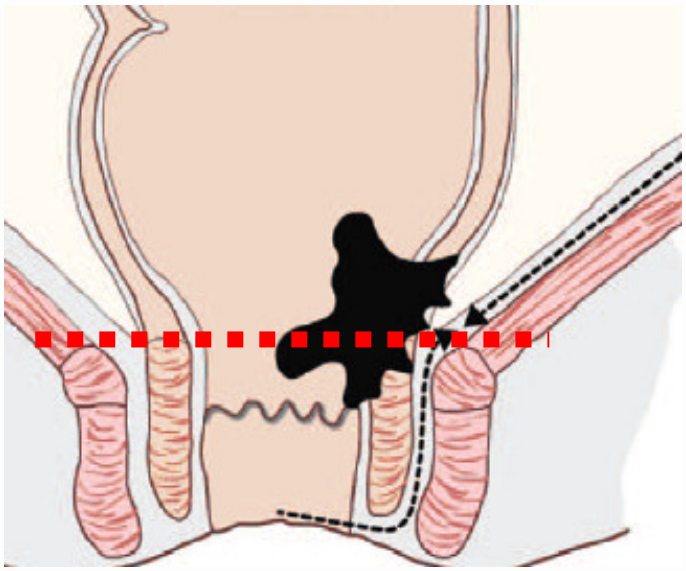
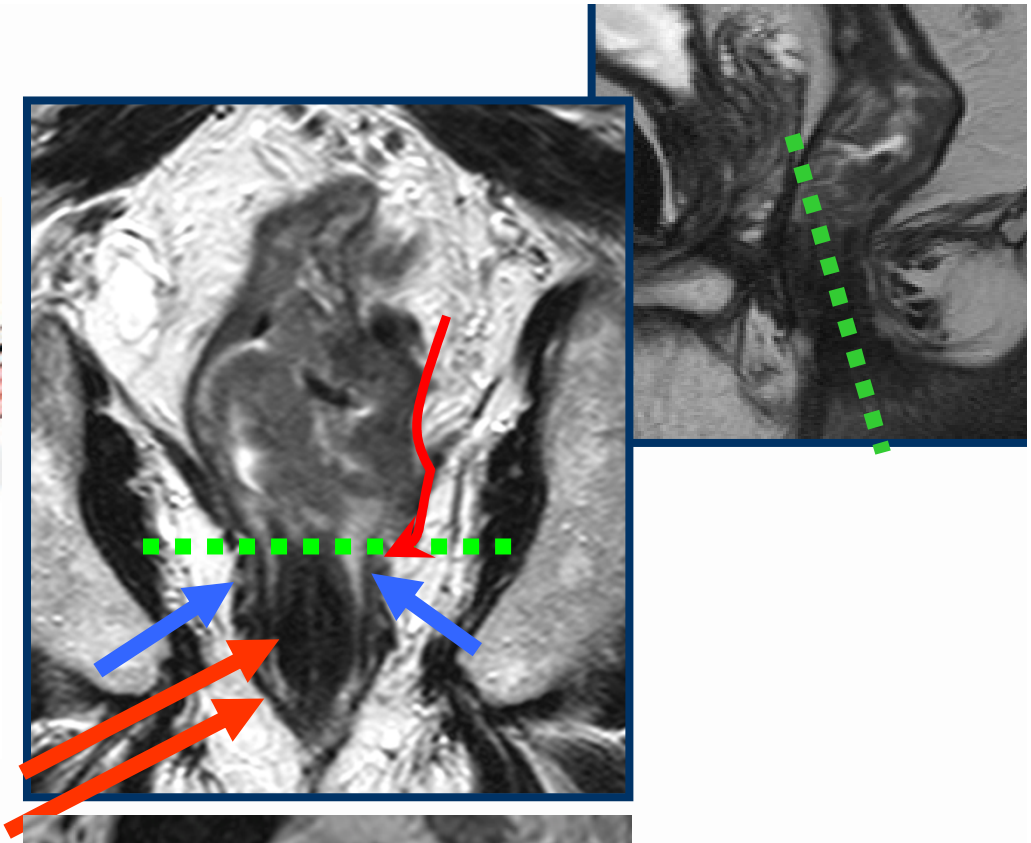
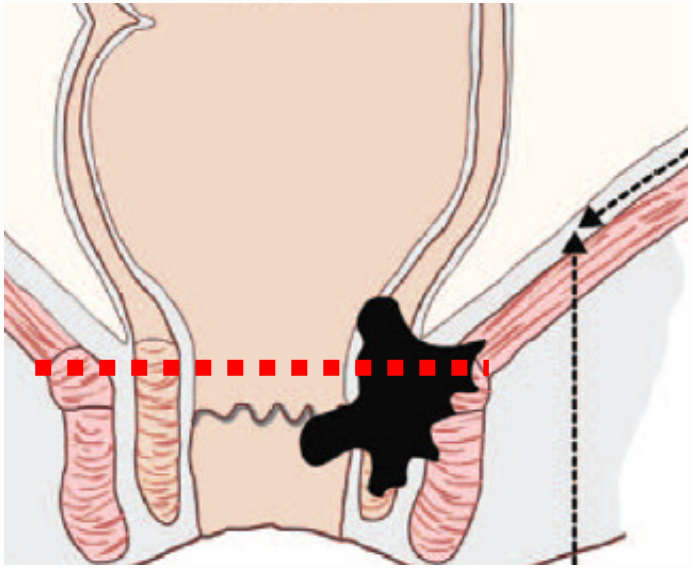
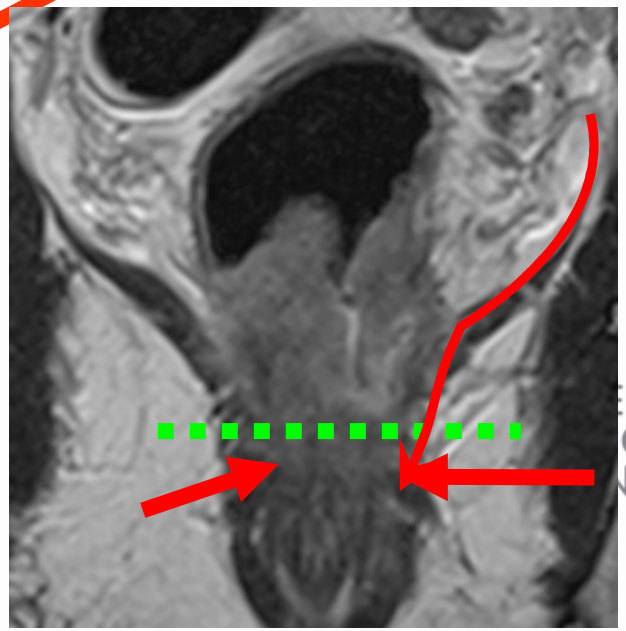
Distal margin









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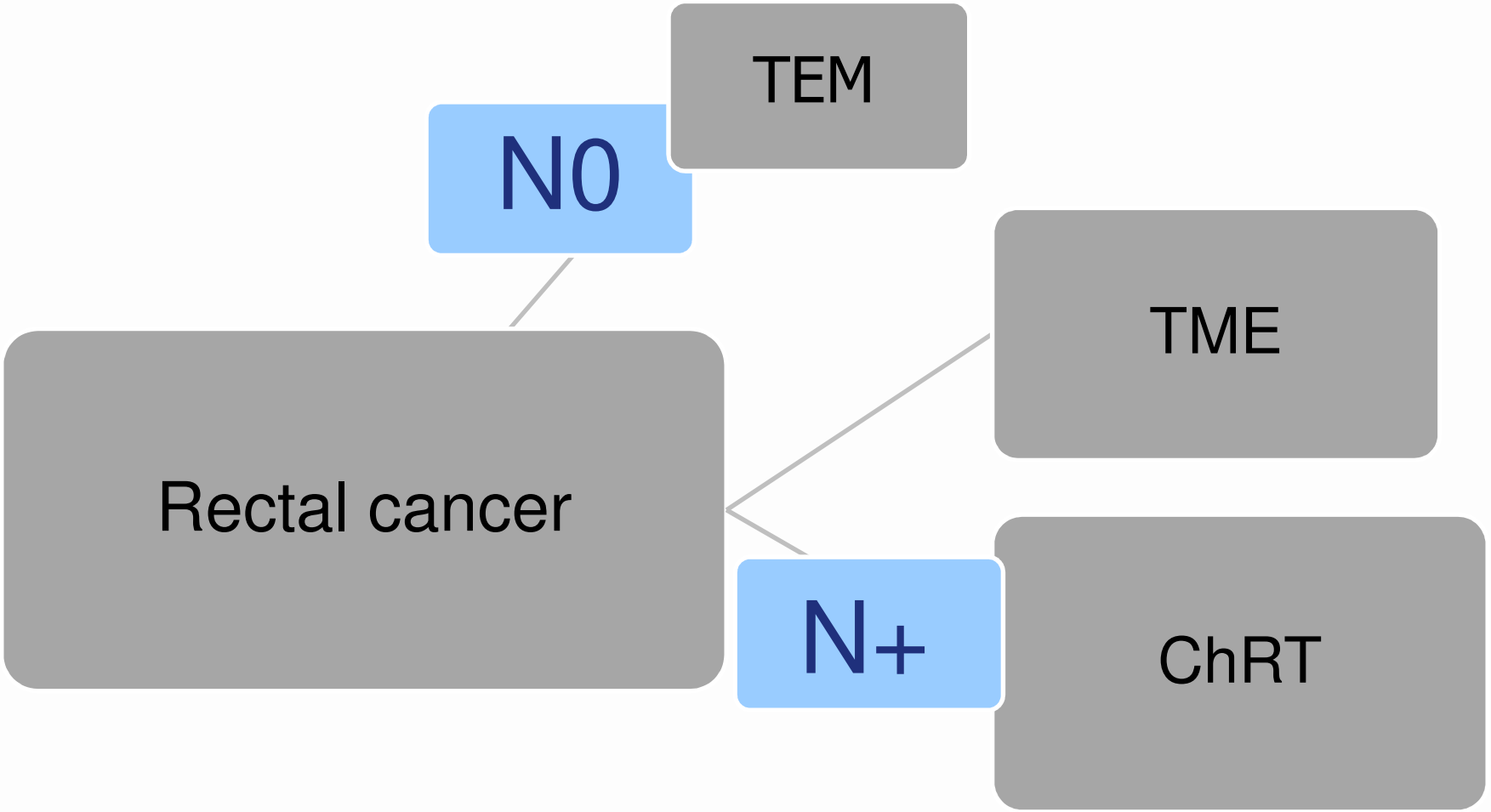

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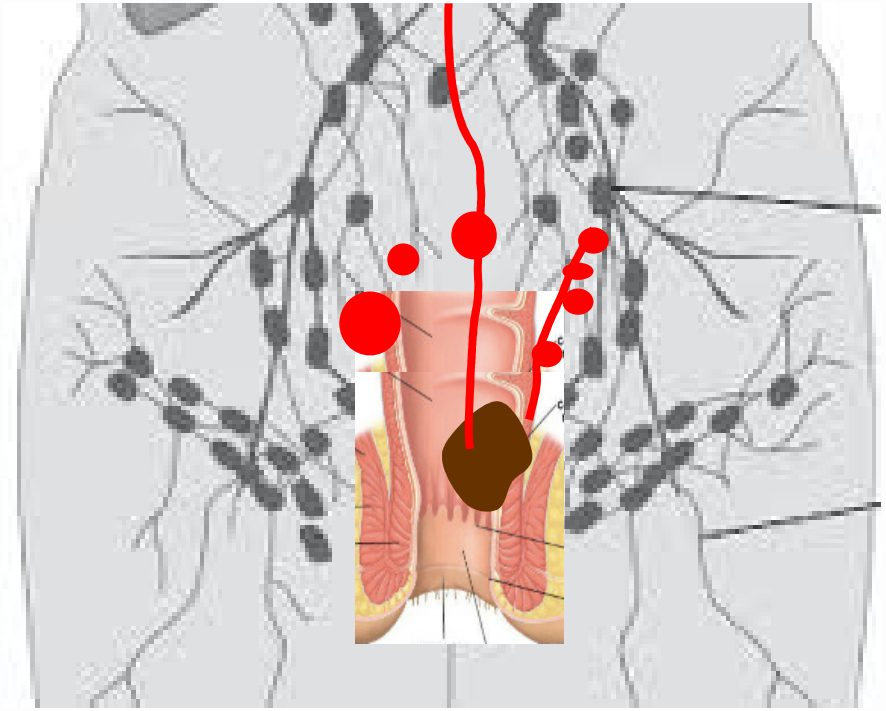
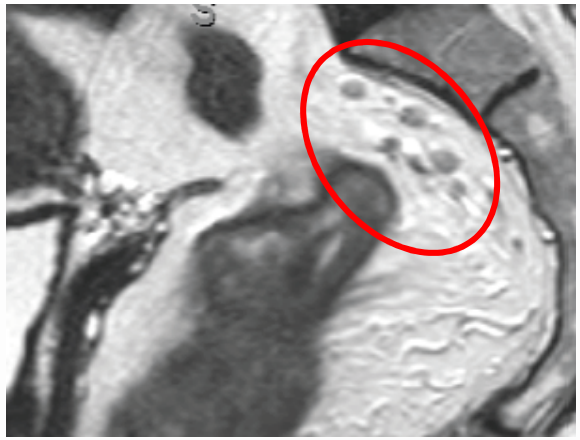
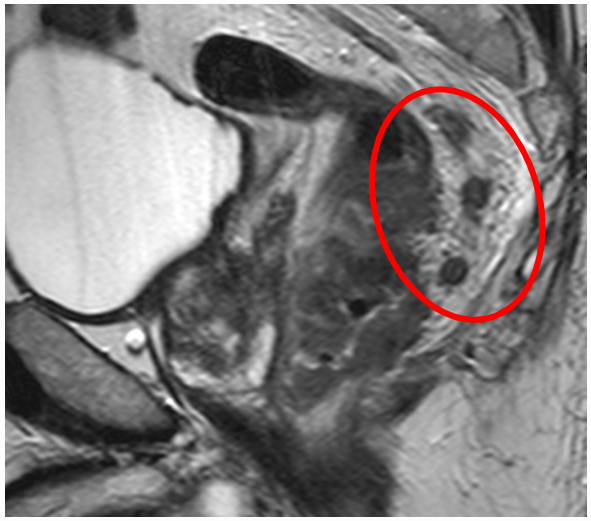
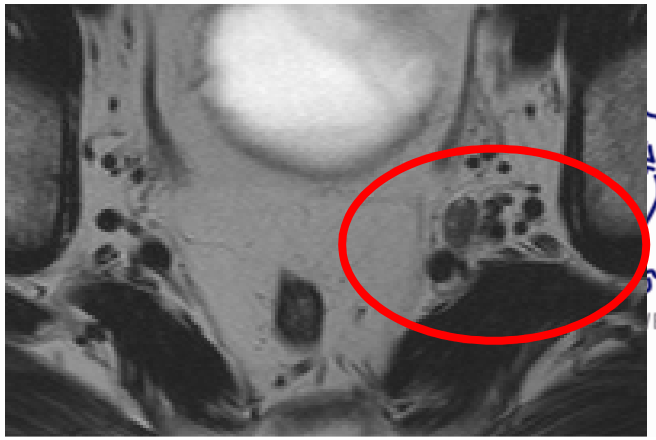
Rectal Cancer









	pN+
T1	**10%**
T2	**20%**
T3	**>30%**
T4	**>50%**

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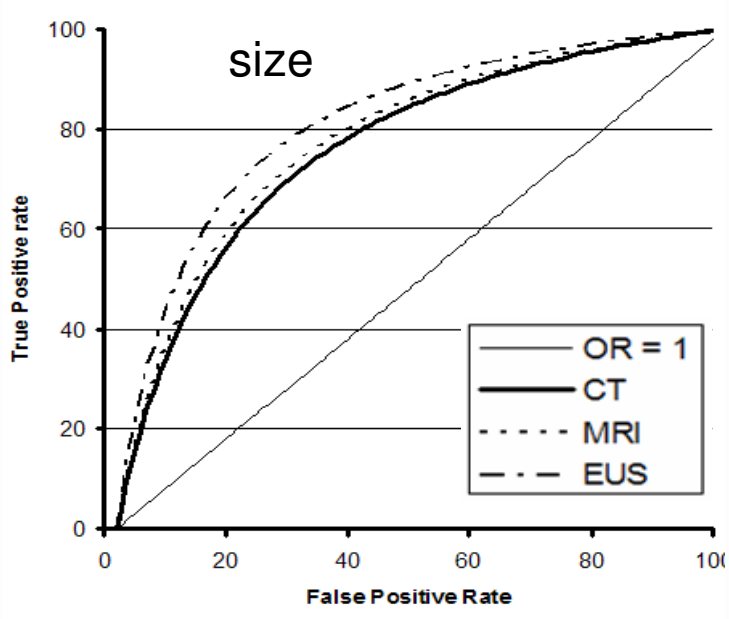
Rectal ca nodal staging



Lahaye et al.
Sem US, CT,MR 2005

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Rectal ca Nodes

	<0.5 mm	<1 mm	<2 mm	<5 mm	<10 mm	⩾10 mm	Sum
Negative LN	165	138	245	270	26	0	844
Positive LN	4	7	23	57	28	9	128
Sum	169	145	268	327	54	9	972
Percent	17.39%	14.92%	27.57%	33.64%	5.56%	0.93%	100.00%

71%

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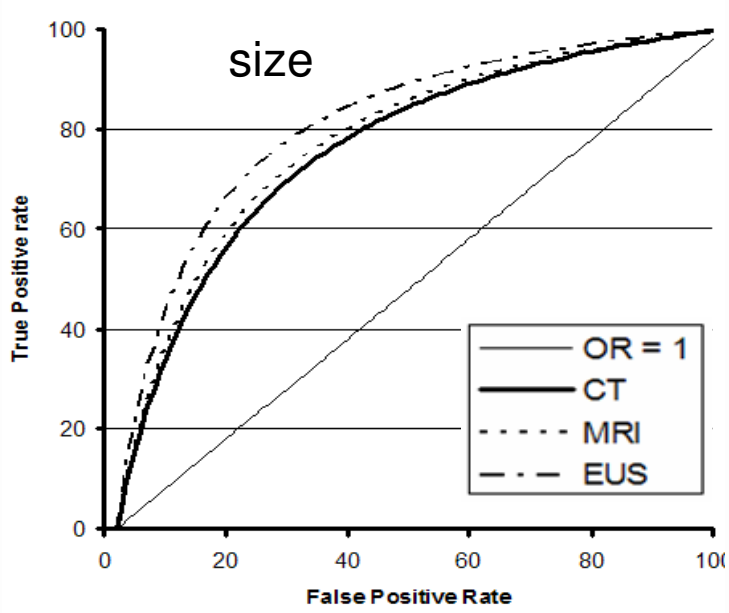
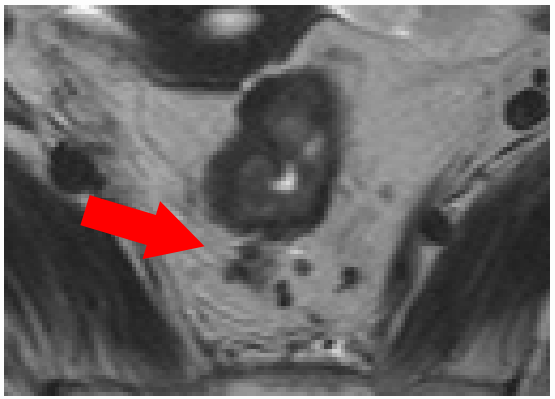
Wang et al. Langenbecks Arch Surg 2005

Rectal ca nodal staging





	sens	spec
EUS	0.70	0.75
MRI	0.70	0.70

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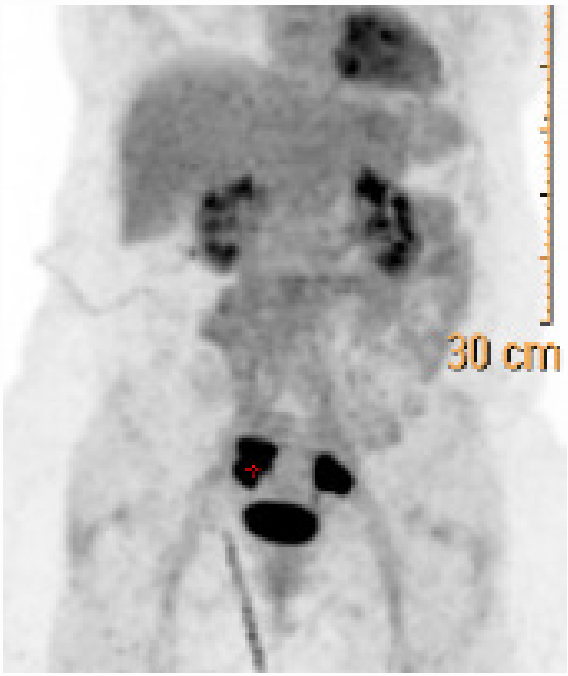
Studies 2009 – 2011

FDG PET/CT

pN+	sens	spec
	0.30	0.80



Lambregts et al. Eur Rad 2010
Heijnen et al. Eur Rad 2013
Kosugi Hepato gastro 2008
Kim JCAT 2011
Ono JMRI 2009
Heriot 2004
Sakurada et al. Eur Rad 09

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Meta analysis CRC Livermetastases
(n=3391)

Sensitivity Estimates for Each Subgroup on a Per-Lesion Basis

Subgroup	Mean Sensitivity (%)	
	MR Imaging	CT
Lesion size		
<1 mm	60.2 (54.4, 65.7) [*n* = 8]	47.3 (40.1, 54.5) [*n* = 5]
≥10 mm	89.0 (81.7, 93.7) [*n* = 8]	86.7 (77.6, 92.5) [*n* = 5]
Study year		
Before January 2004	70.2 (63.2, 76.3) [*n* = 34]	73.4 (61.0, 83.0) [*n* = 20]
After January 2004	84.9 (79.3, 89.2) [*n* = 27]	74.9 (69.1, 79.9) [*n* = 18]

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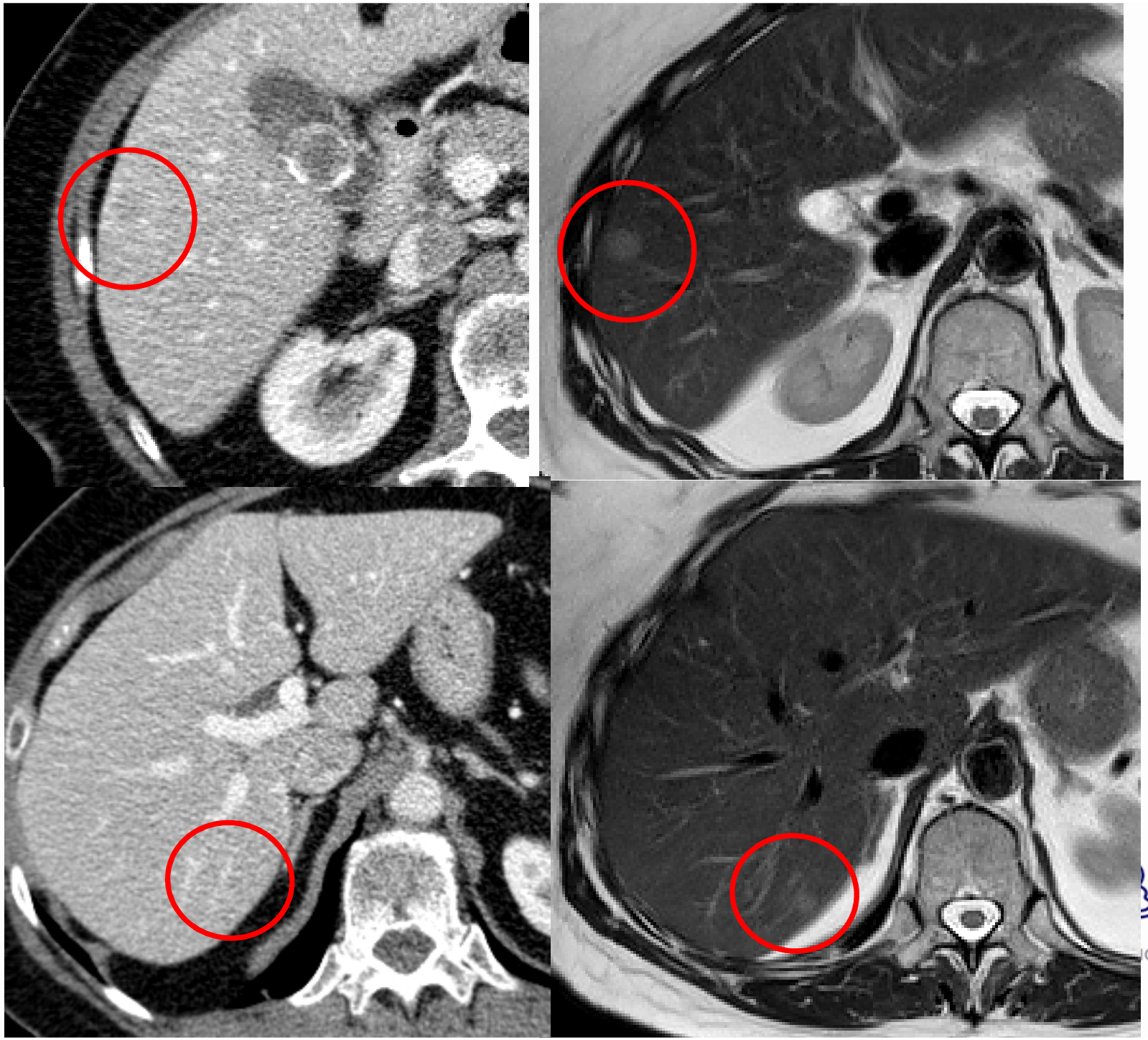
Niekel et al. Radiology 2010



FDG PET

- ✓ Not as upfront staging tool

Wiering et al. Ann Surg Onc 2007
Selzner et al. Ann Surg 2004

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FDG PET

- ✓ Not as upfront staging tool
- ✓ Role before liver surgery

Wiering et al. Ann Surg Onc 2007
Selzner et al. Ann Surg 2004

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FDG PET

- ✓ Not as upfront staging tool
- ✓ Role before liver surgery
- ✓ Extrahepatic mets (bones, nodes)
- ✓ 20-30% alteration of management

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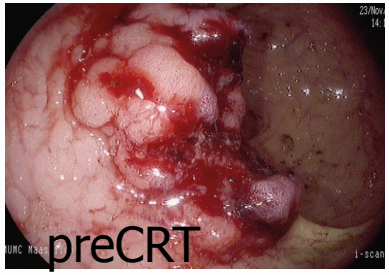
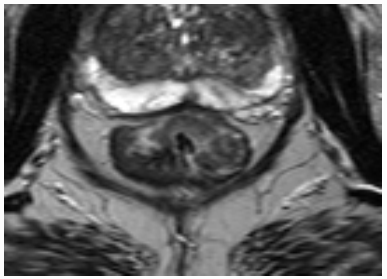
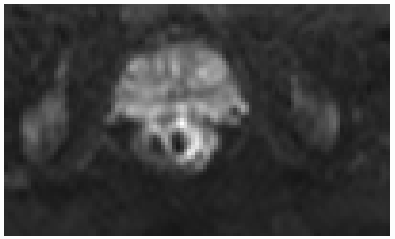
Wiering et al. Ann Surg Onc 2007
Selzner et al. Ann Surg 2004

Restaging





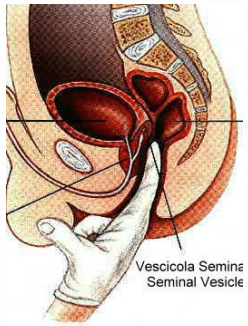


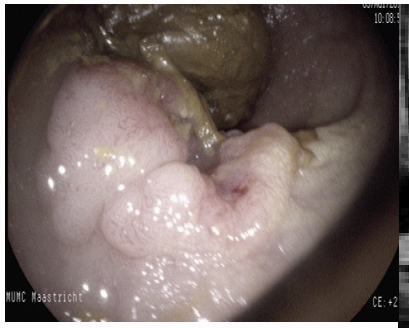
CRT

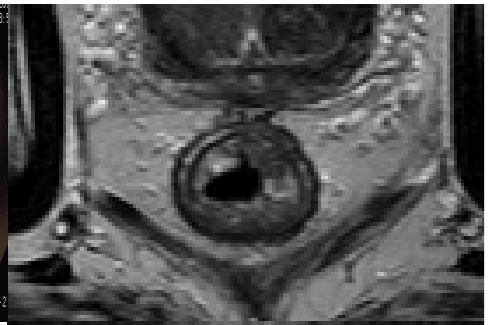
8 wks

Assess

Resection







Why should we assess response?

- ✓ Alter surgical approach

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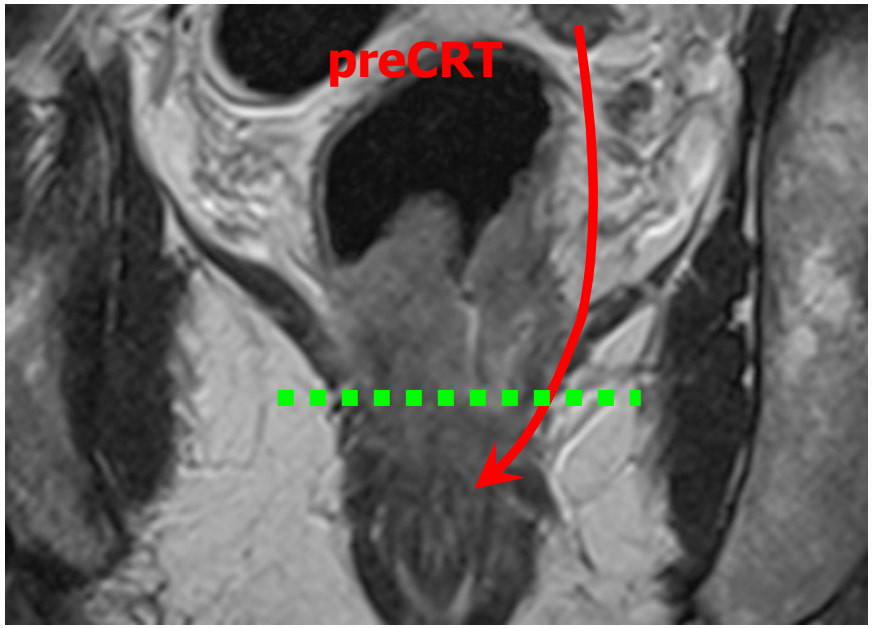
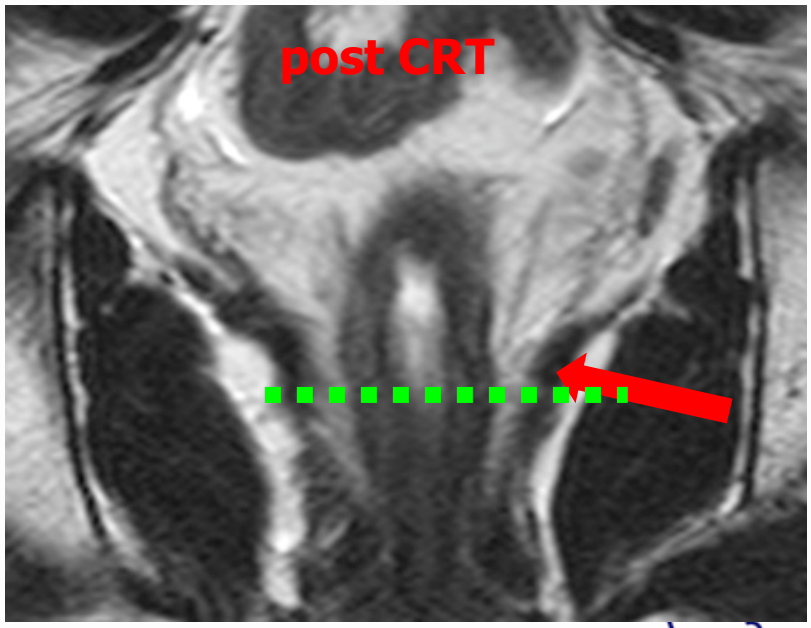
Tumor Regression

PPV 90%



Rectal amputation



TME

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Vliegen et al. Radiology 2008

Why should we assess response?

- ✓ alter surgical approach
- ✓ non operative management

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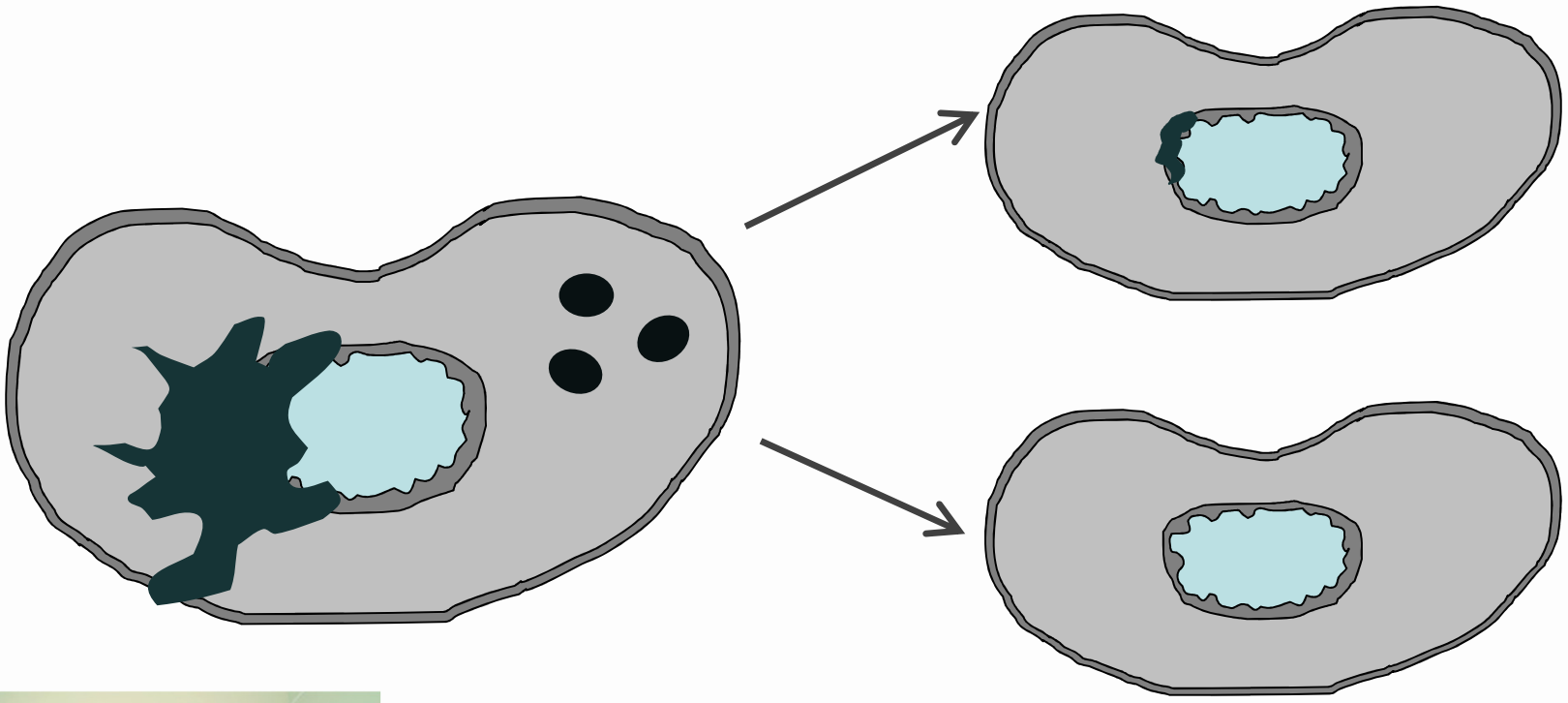
Paradigm shift
Non operative management



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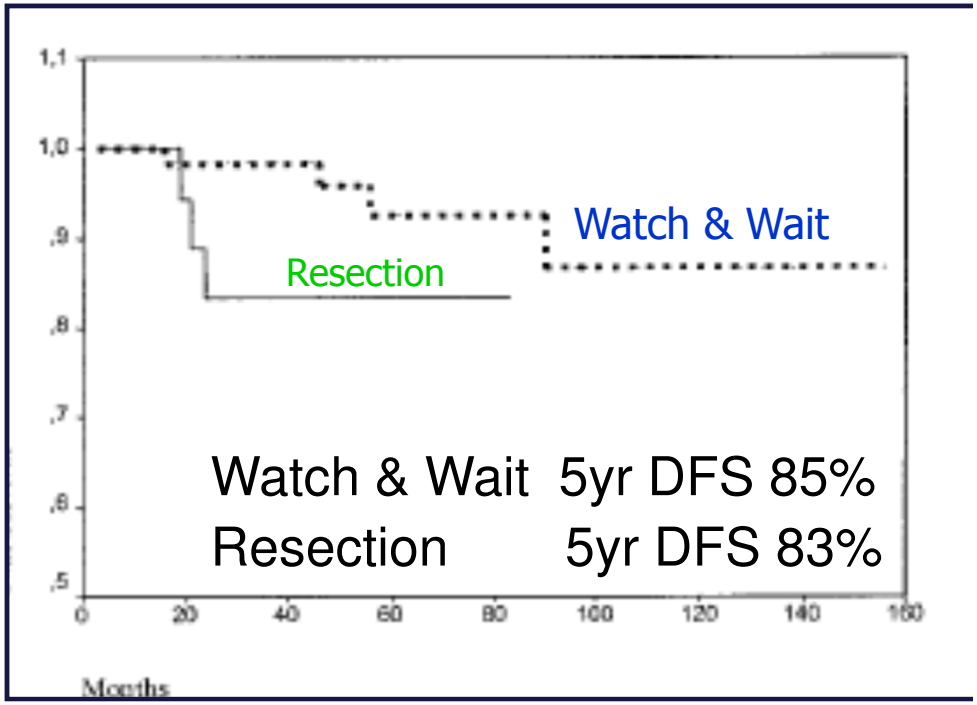
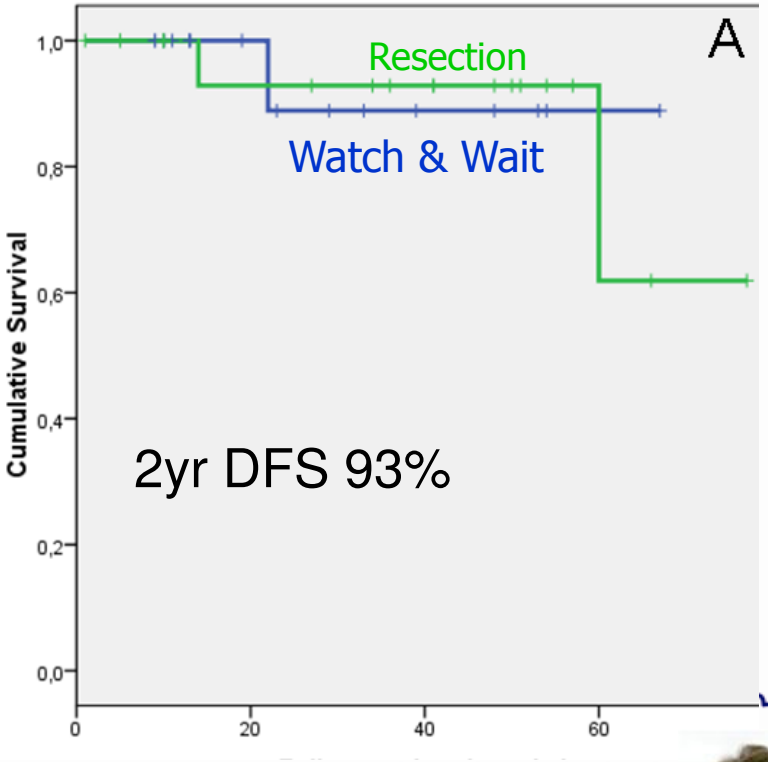
Watch & Wait for Rectal Ca





Sao Paolo
Habr-Gama, Ann Surgery 2004

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Amsterdam
Beets, JCO 2011

Watchful Waiting. An Observational Study o

This study is currently recruiting participants.

ember 2012 by Vejle Hospital

Operative Versus Nonoperative Treatment for Stage 0 Distal Rectal Cancer Following Chemoradiation Therapy

Long-term Results

Angelita Habr-Gama, MD,* Rodrigo Oliva Perez, MD,* Wladimir Nadalin, MD,†

JOURNAL OF CLINICAL ONCOLOGY

Wait-and-See Policy for Clinical Complete Responders After Chemoradiation for Rectal Cancer

Monique Maas, Regina G.H. Beets-Tan, Doenja M.J. Lambregts, Guido Lammering, Patty J. Nelemans, Sanne M.E. Engelen, Ronald M. van Dam, Rob L.H. Jansen, Meindert Sosef, Jeroen W.A. Leijtens, Karel W.E. Hulsewé, Jeroen Buijsen, and Geerard L. Beets

NCRN National Cancer Research Network

CANCER RESEARCH UK

PELICAN cancer foundation

National Cancer Research Institute

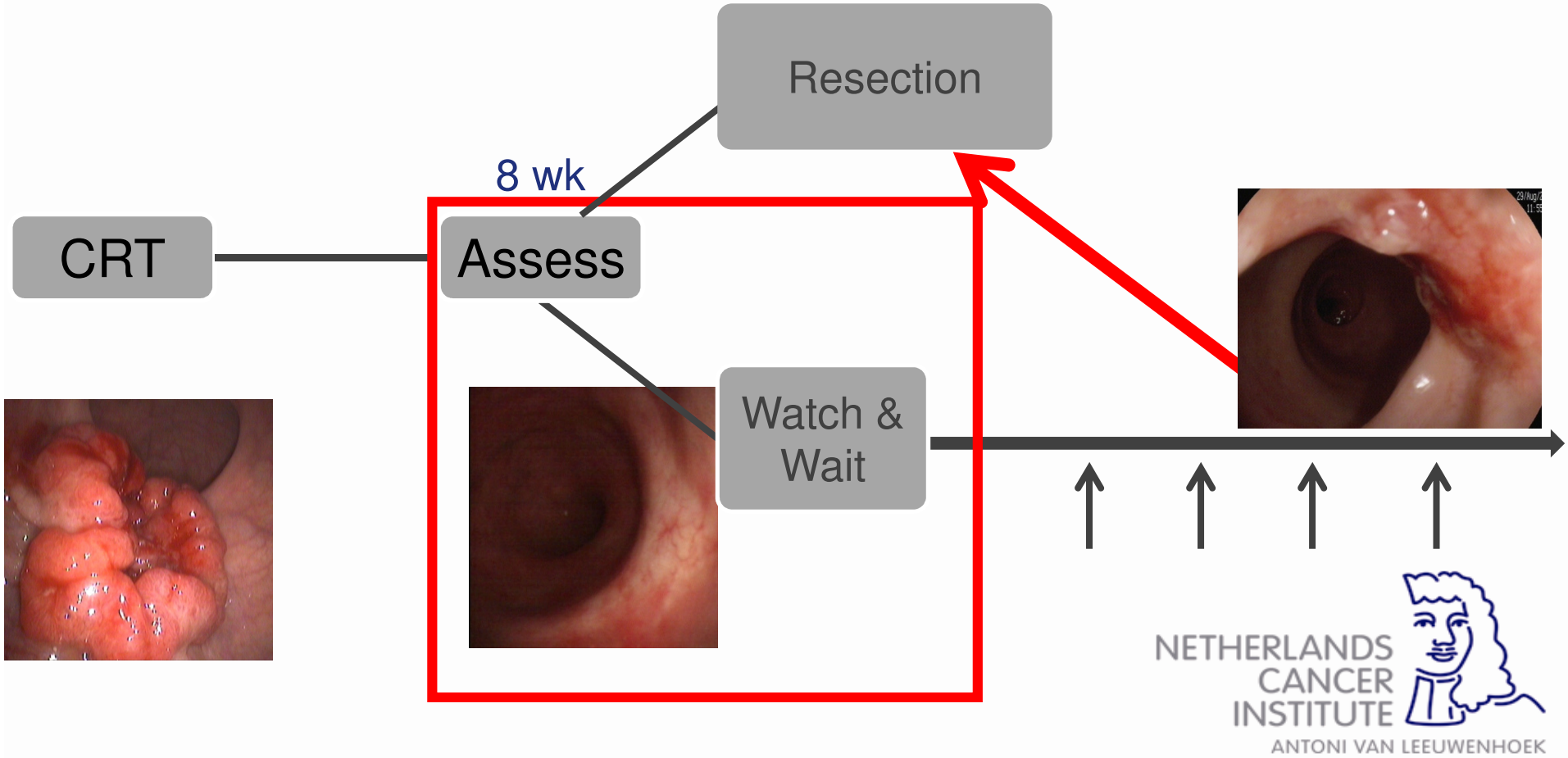
Timing and Deferral of Rectal Surgery Following a Continued Response to Pre-operative Chemoradiotherapy

Nonoperative Management of Rectal Cancer With Comple

Clinical Response After Neoadjuvant Therapy

James D. Smith, MD,* Jeannine A. Ruby, MD,* Karyn A. Goodman, MD,† Leonard B. Saltz, MD,
José G. Guillem, MD,* Martin R. Weiser, MD,* Larissa K. Temple, MD,* Garrett M.
and Philip B. Paty, MD*

Clinical Complete Response



New questions for radiologists

- Tumor remnant in bowel wall ?

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New questions for radiologists

- Tumor remnant in bowel wall ?
- Nodes sterilized ?

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New questions for radiologists

- Tumor remnant in bowel wall ?
- Nodes sterilized ?
- Regrowth during Fup?

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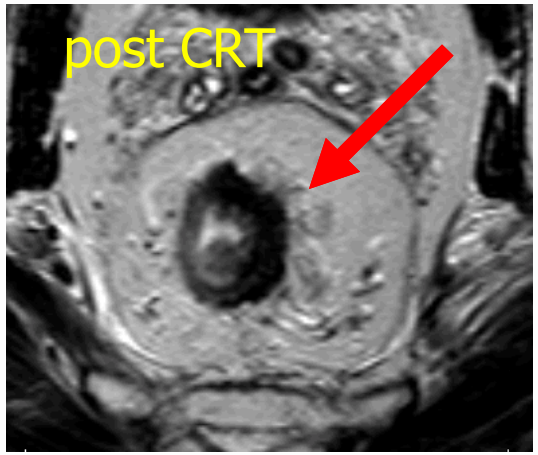
Meta analysis MRI

ypT0	sens	spec
	19%	**95%**



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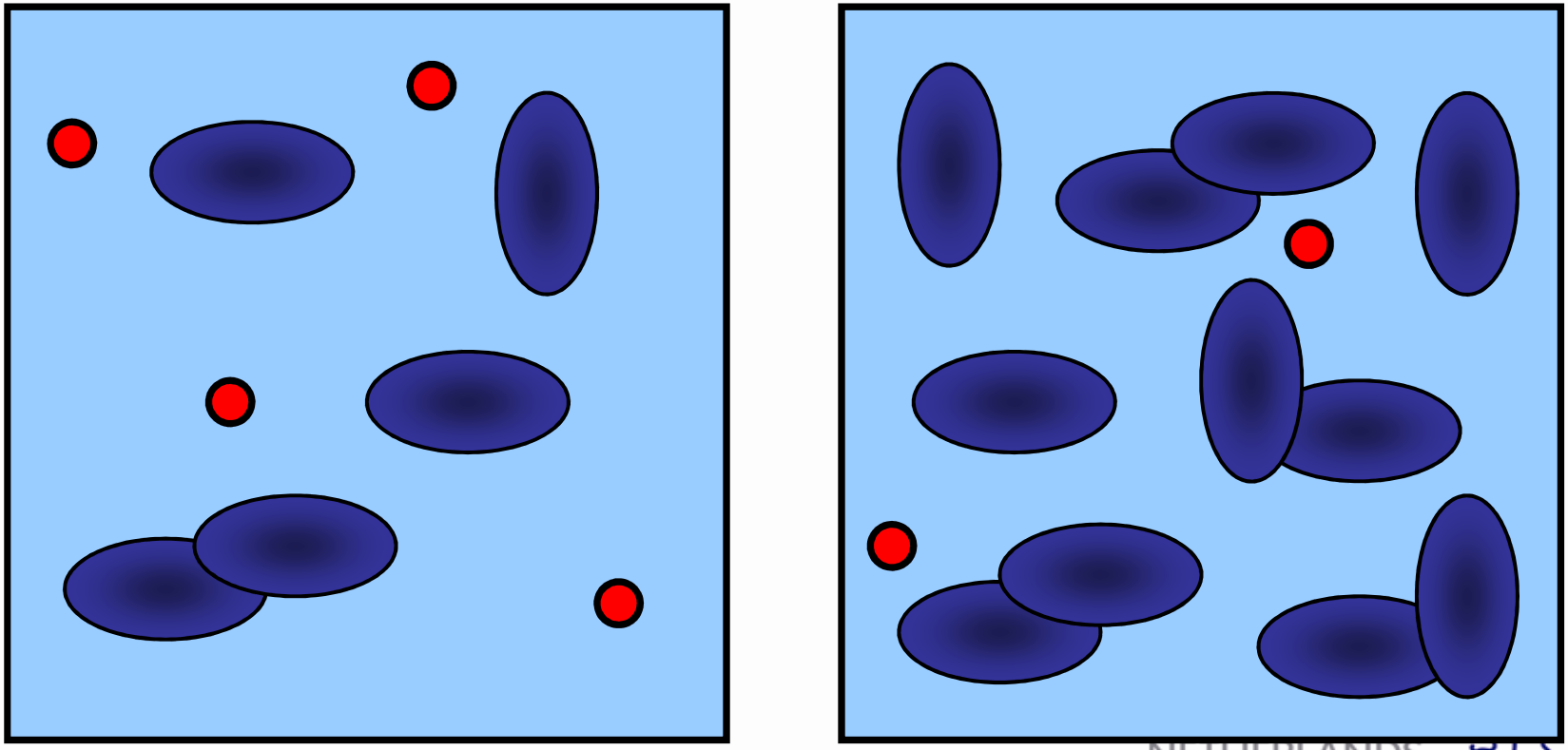
v.d. Paardt et al. Radiology 2013

Diffusion MRI



Normal Tissue

Tumor

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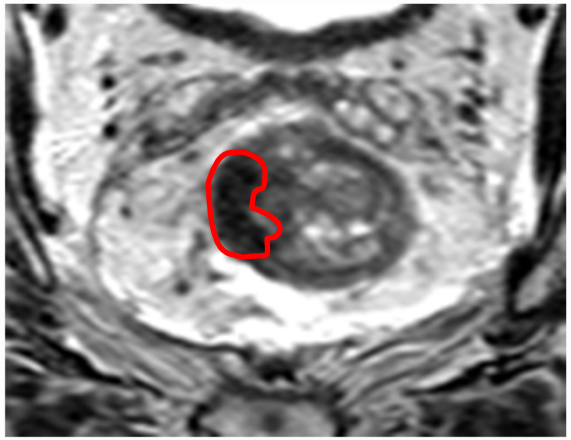
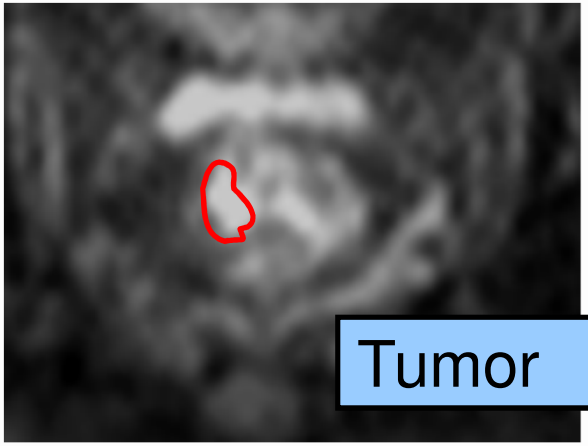
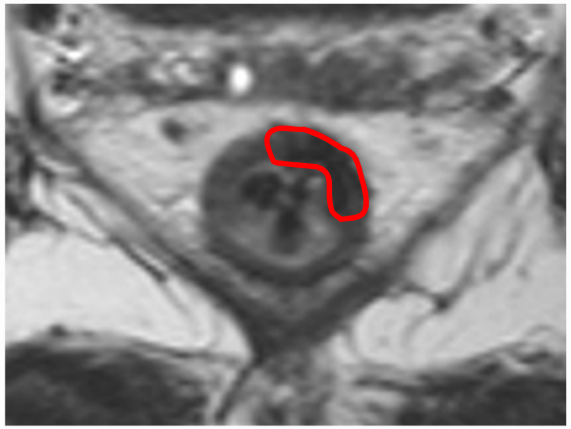
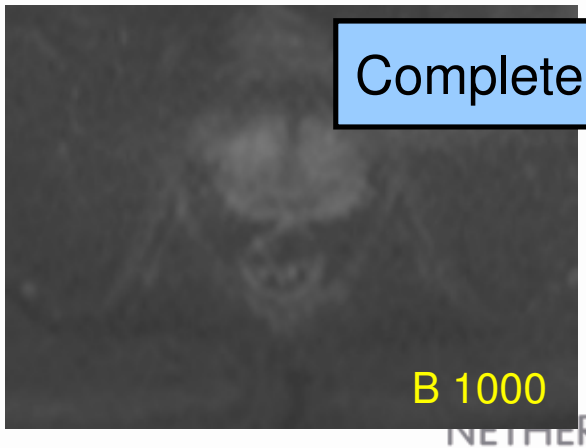
DWI





Tumor





Complete response

B 1000

STANDARD MRI

DIFFUSION MRI

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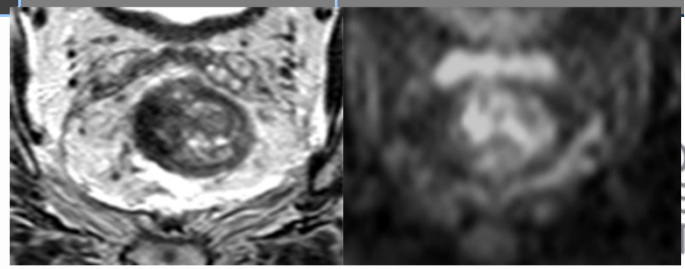
DWI for pCR

pCR	MRI	MRI+DWI
Sensitivity	**38** →	**77**
Specificity	89	86
PPV	50	63
NPV	83	93



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Lambregts et al. Ann Surg Oncol 2011

DWI for pCR

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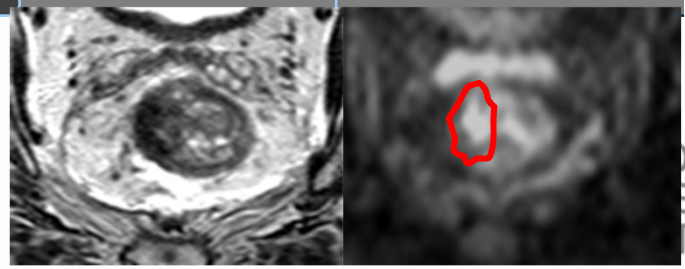

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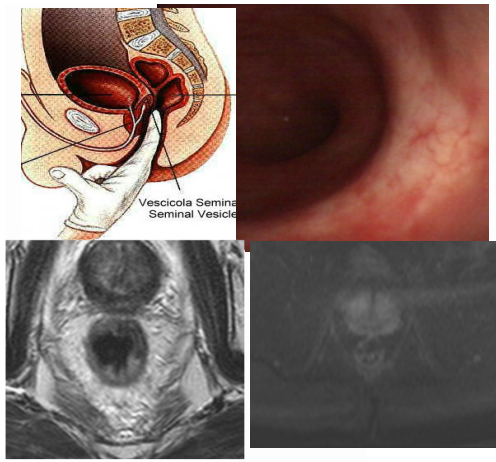
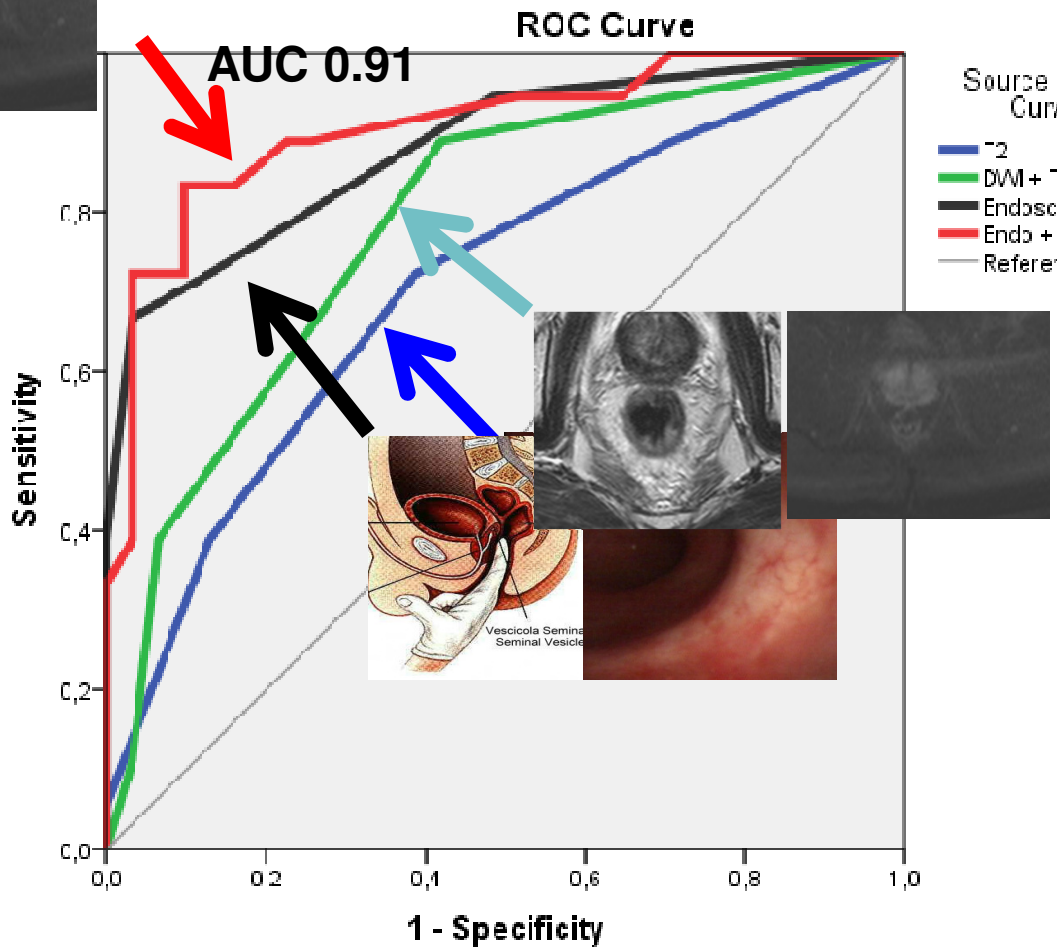
Lambregts et al. Ann Surg Oncol 2011

Endoscopy or DWI?





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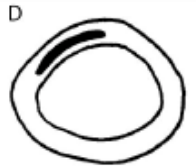
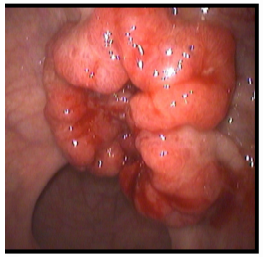
Maas et al Annals Surg Oncol 2015

Clinical Complete Response

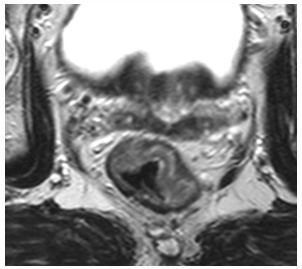


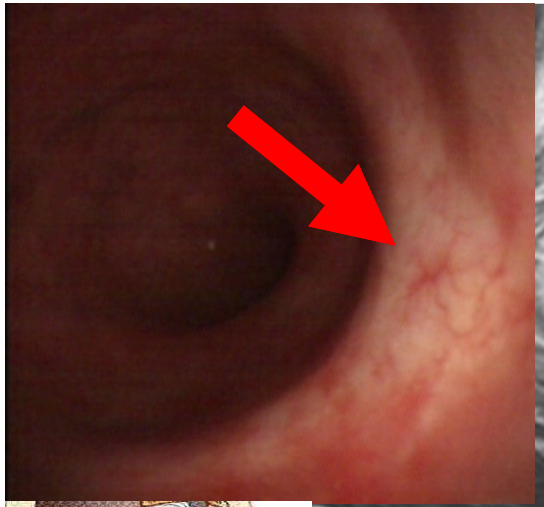


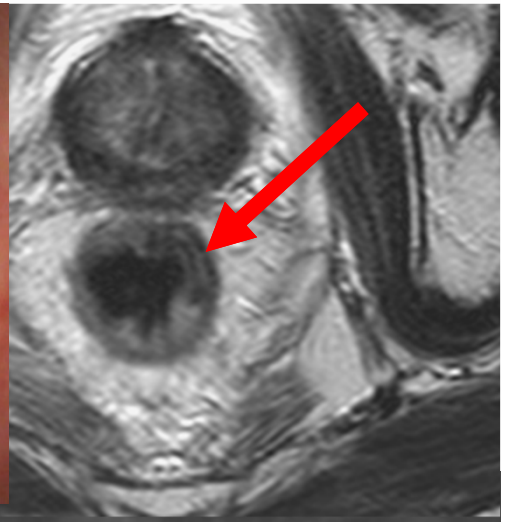
CRT

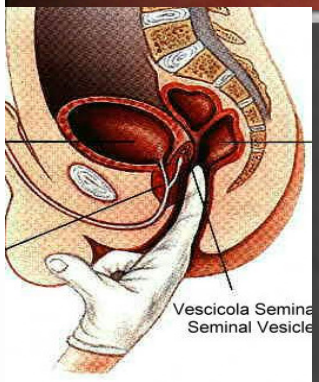
8 w

Assess









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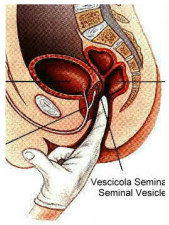
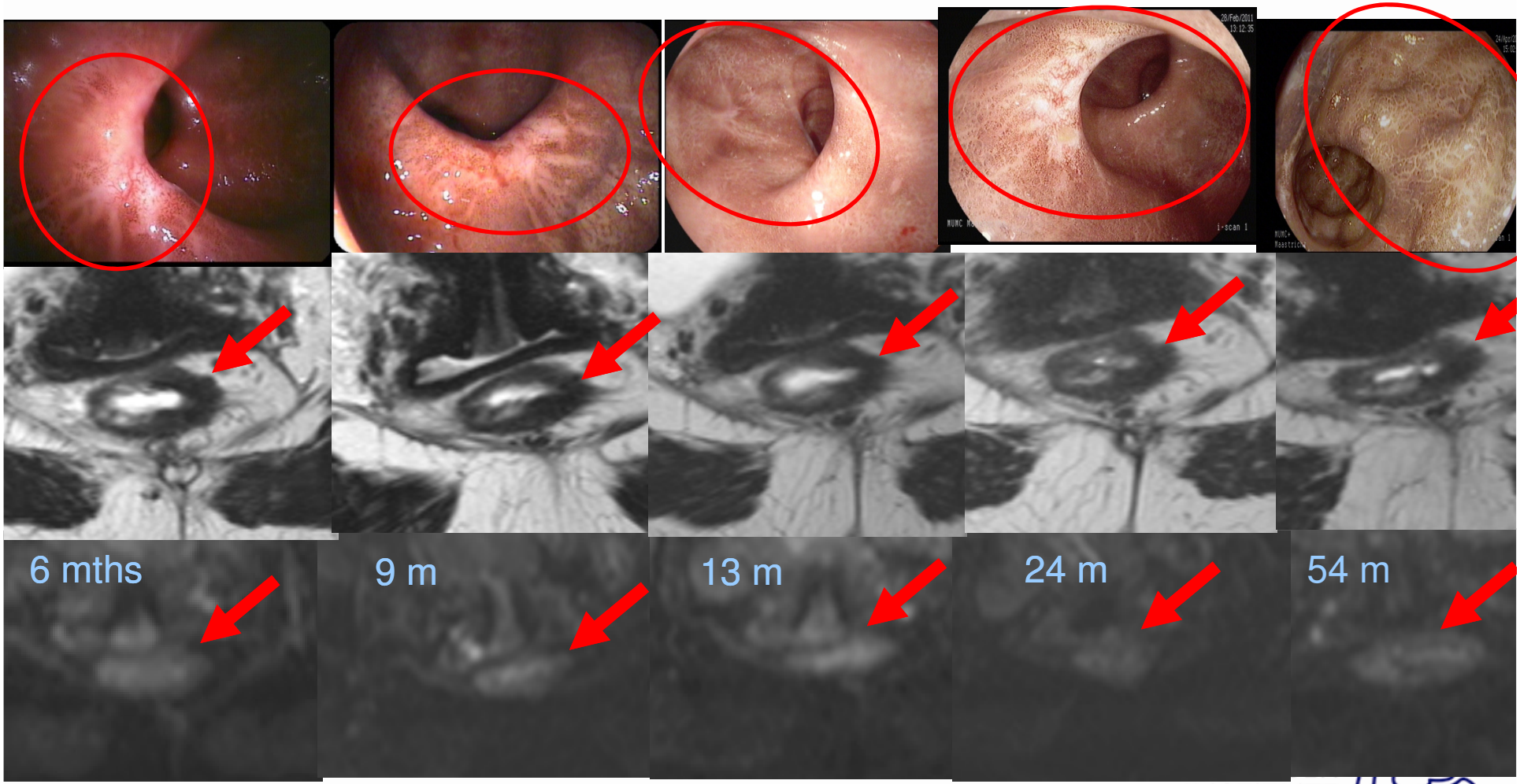
Lambregts et al.
Dis Colon Rectum 2011



cComplete Response



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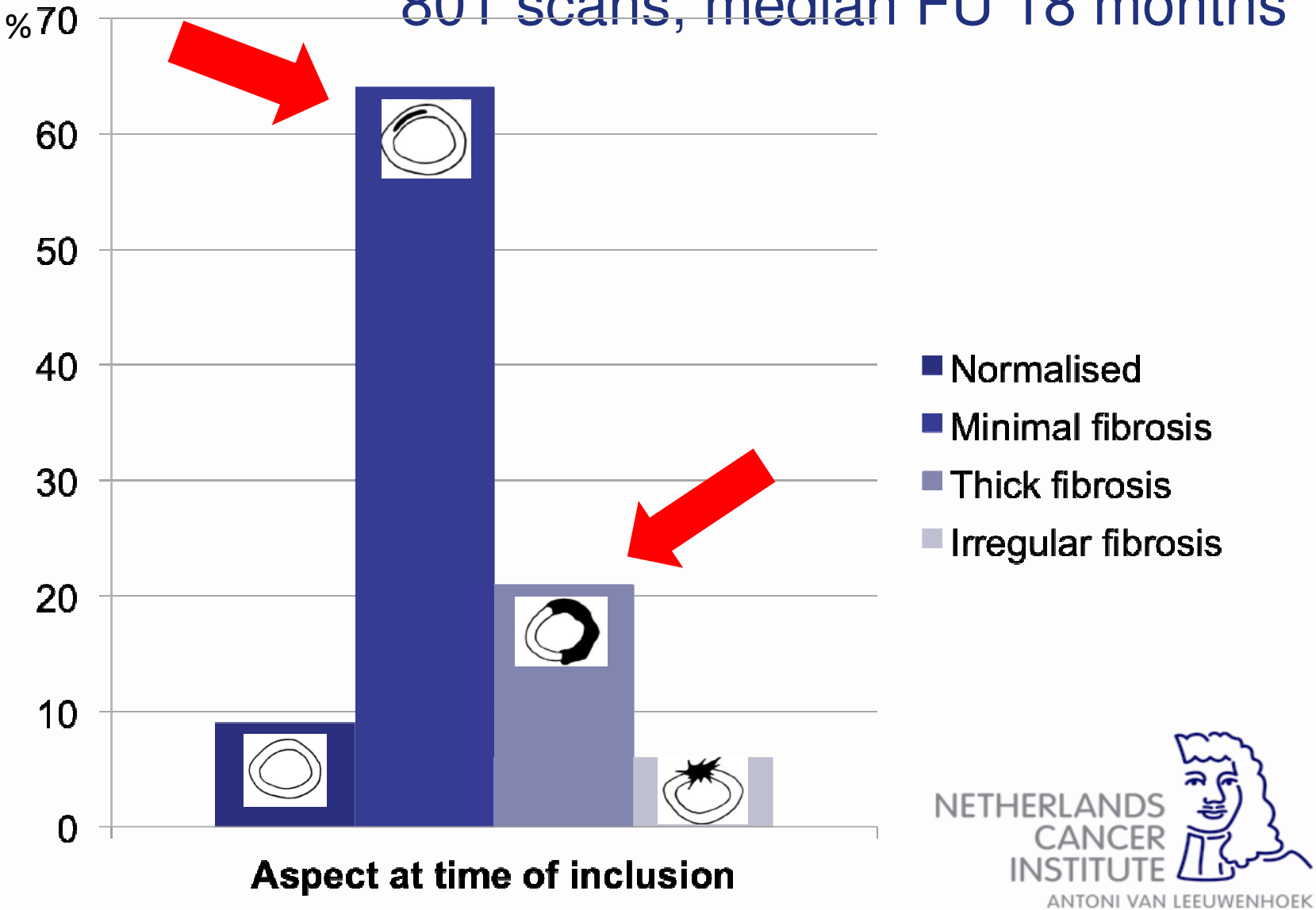
MRI of clinical Complete Response

801 scans, median FU 18 months



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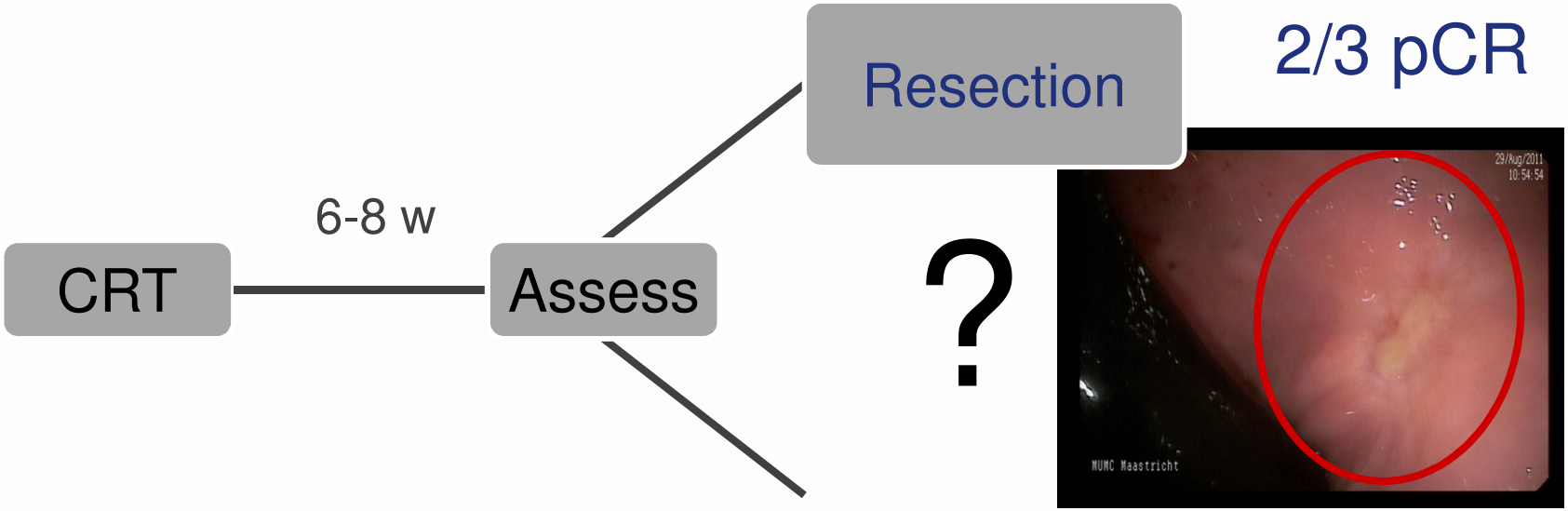

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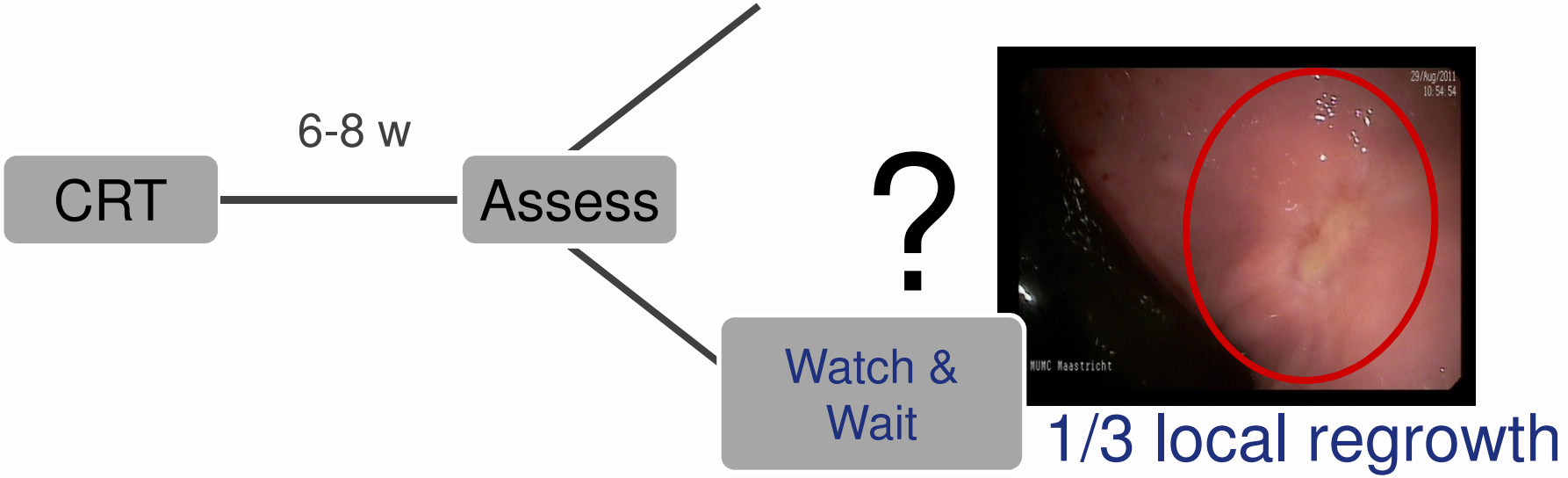

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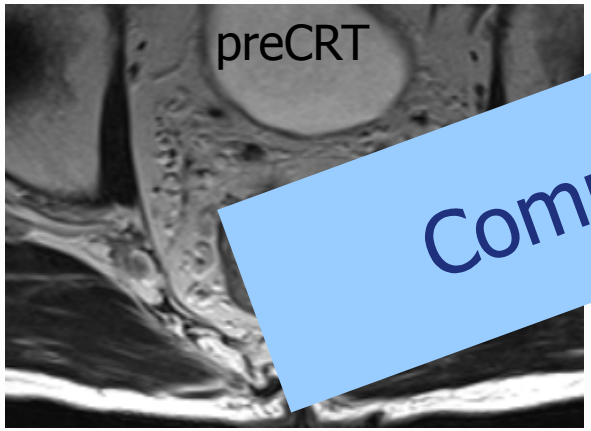
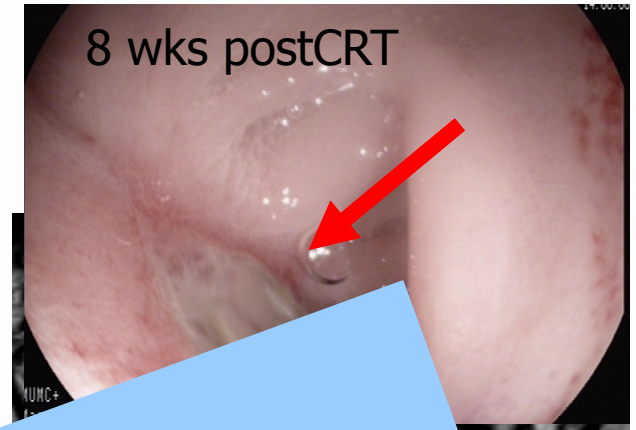
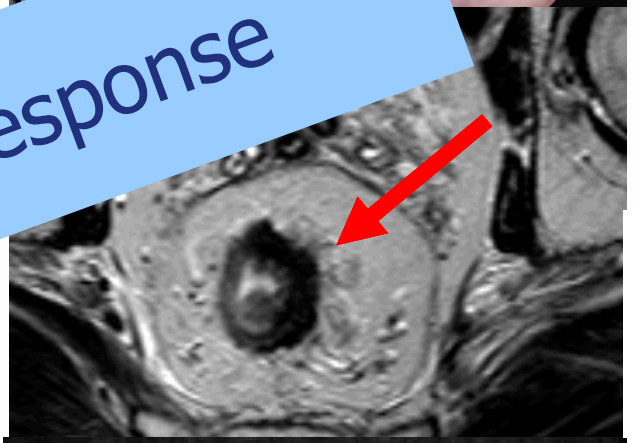
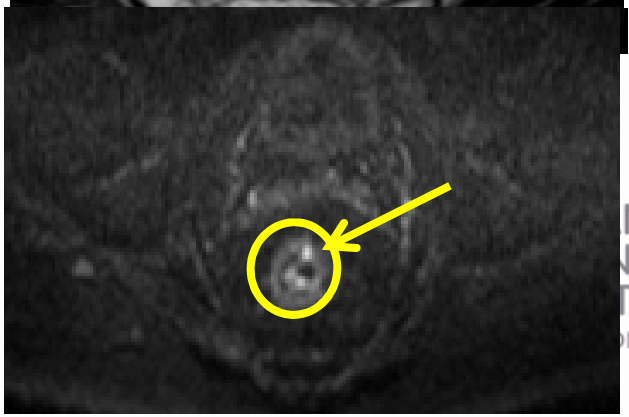
Tumor remnant ?

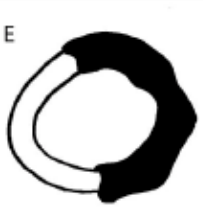




Complete response







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NCER
TUTE
NI VAN LEEUWENHOEK

Diffusion MRI

- ✓ learning curve

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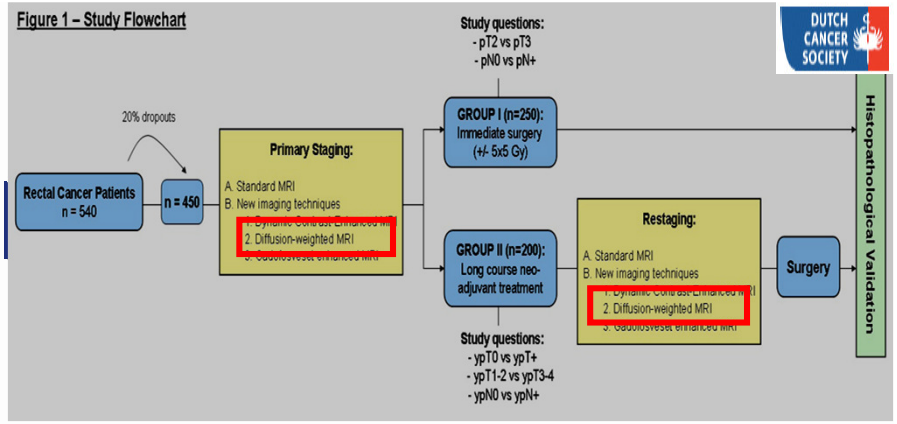
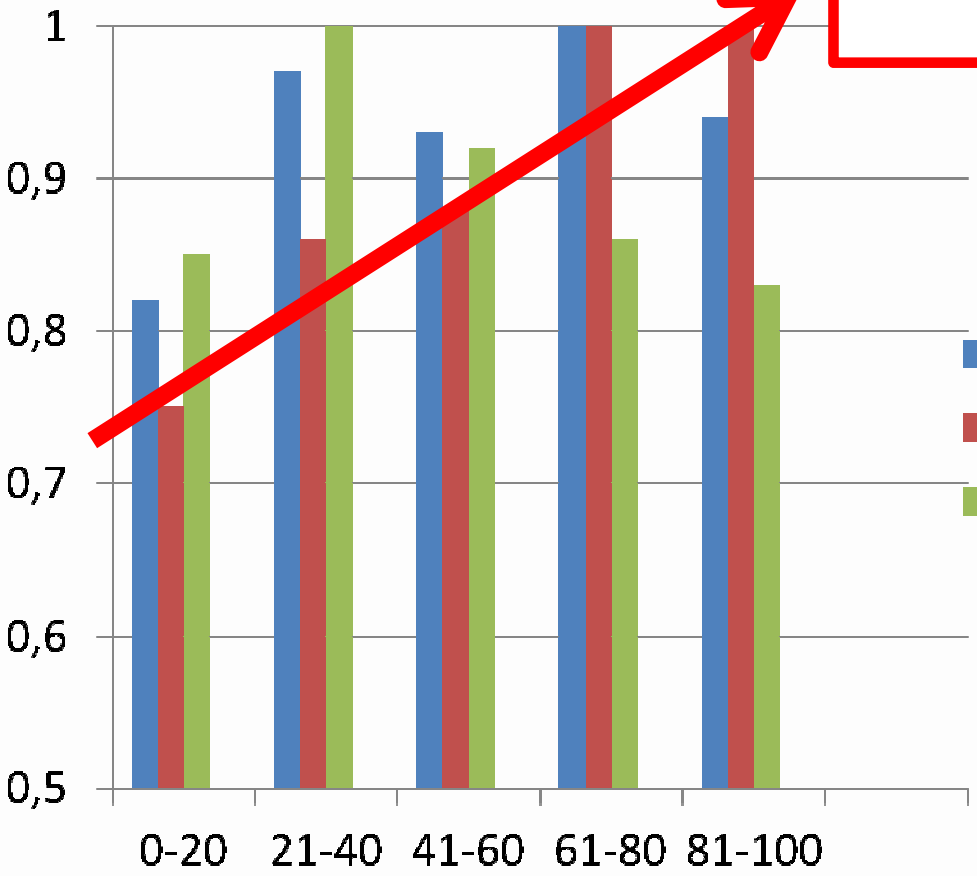
DWI multicenter trial learning curve



Sensitivity 75% → 100%
AUC 0.82 → 0.94



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Diffusion MRI

- ✓ learning curve
- ✓ pitfalls

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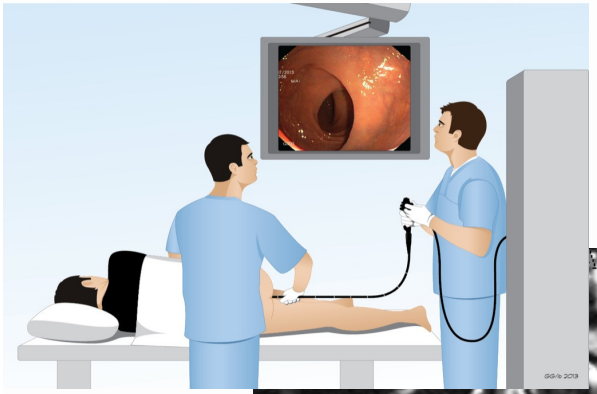

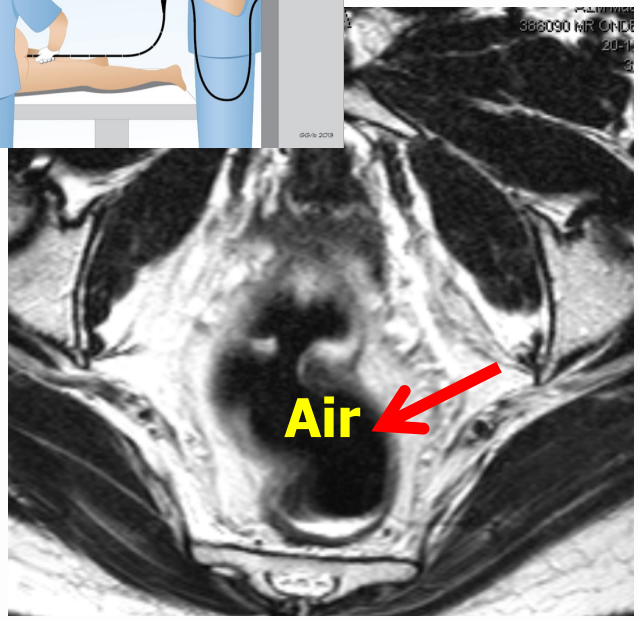

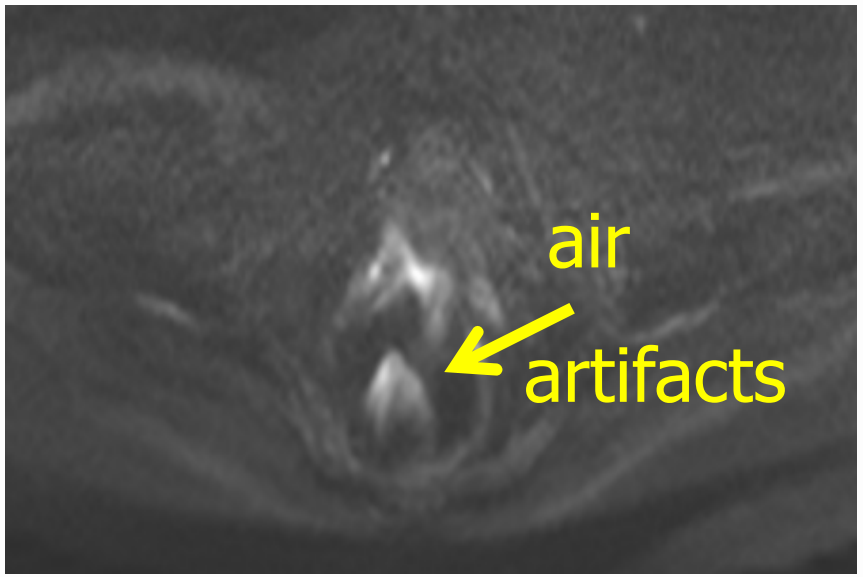

- ✓MRI after endoscopy
- ✓Rectal enema 15 min before MRI

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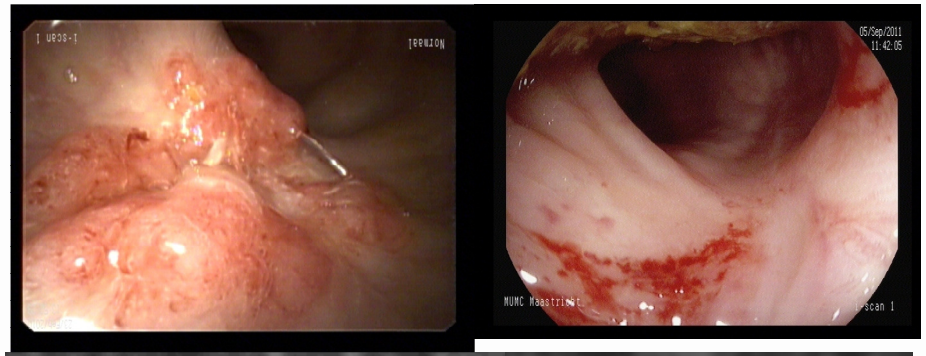
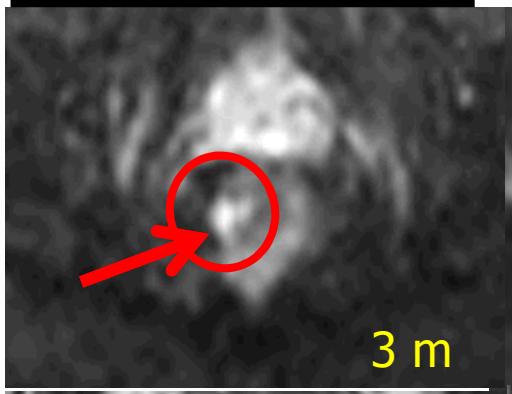
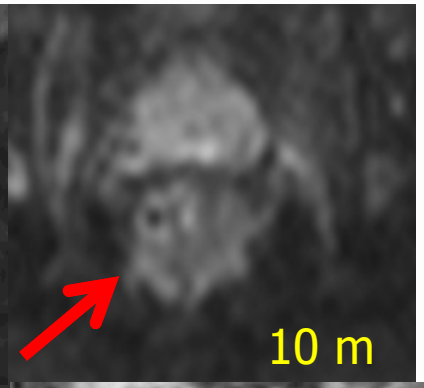
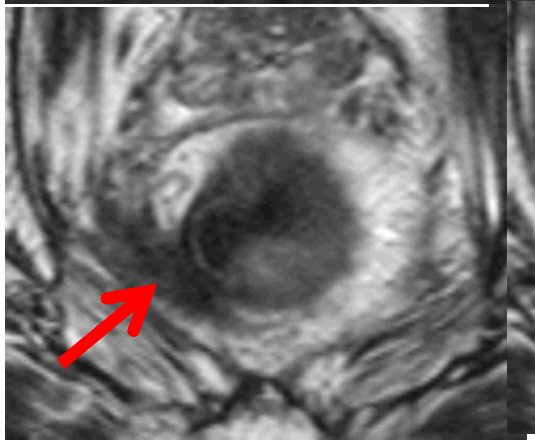
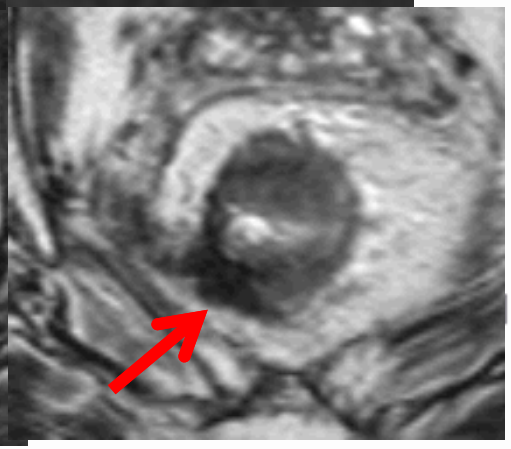
Inflammation











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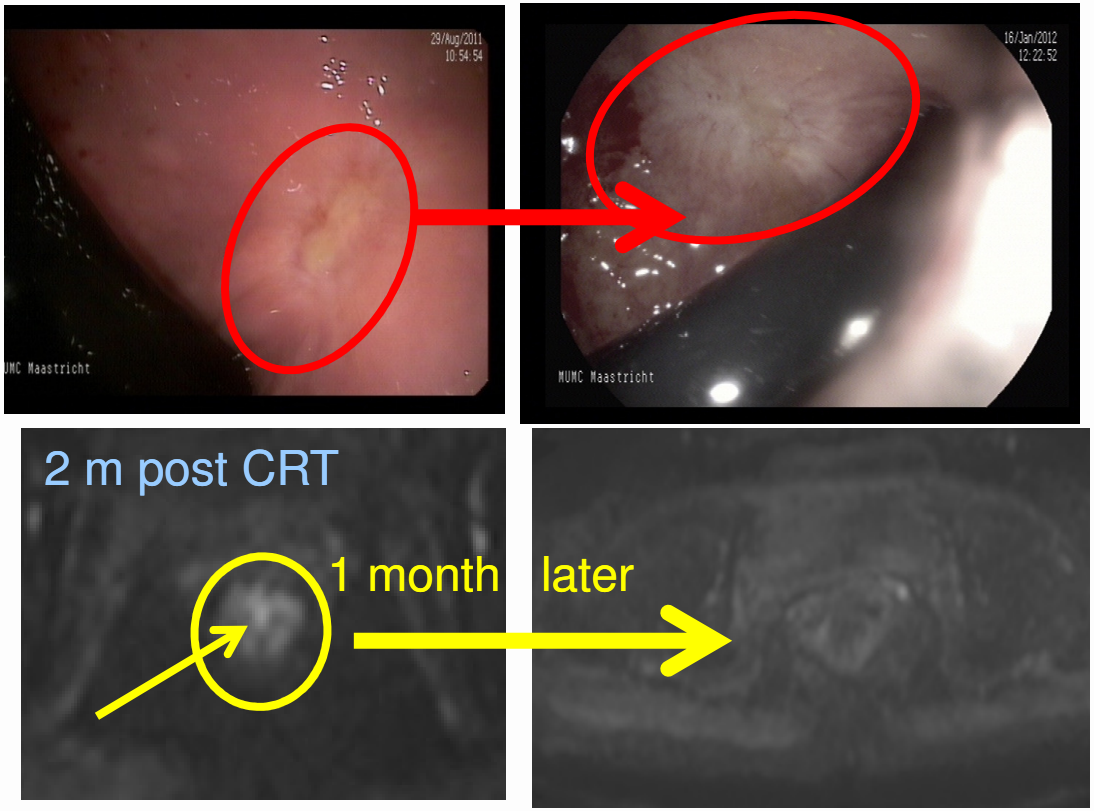
Healing ulcer



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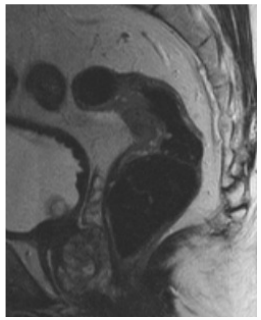

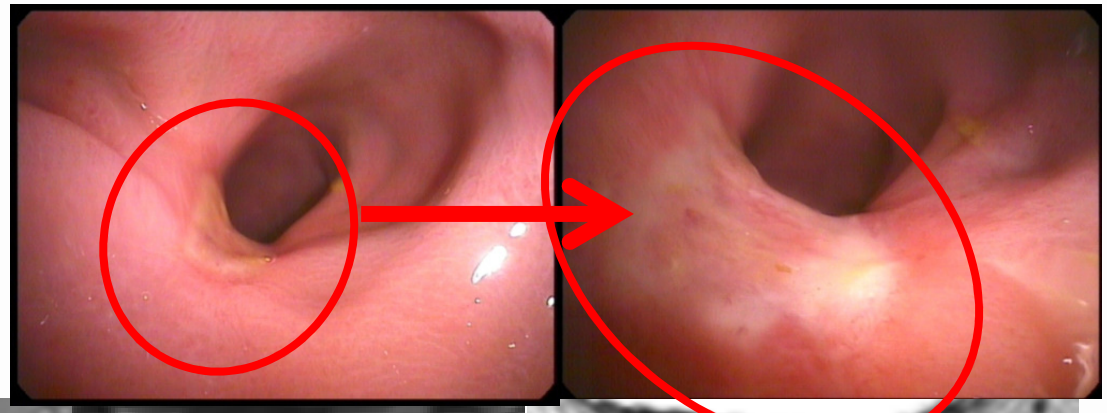

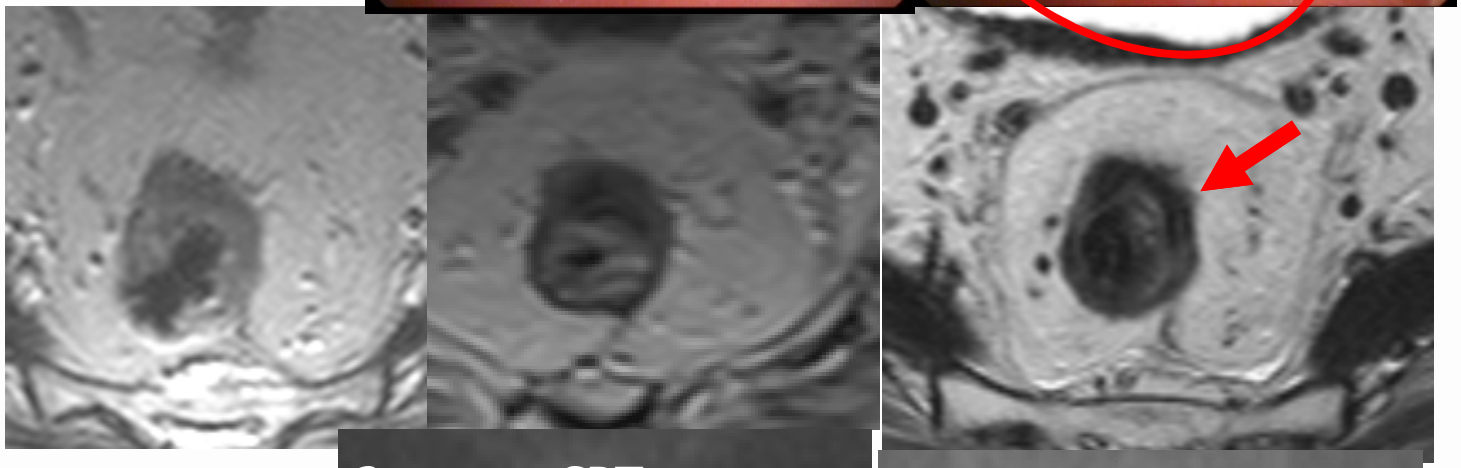

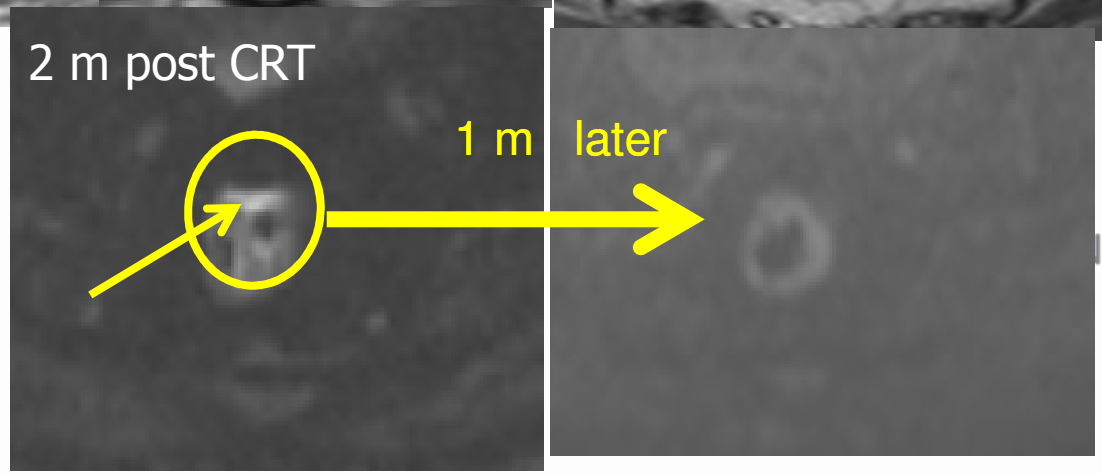

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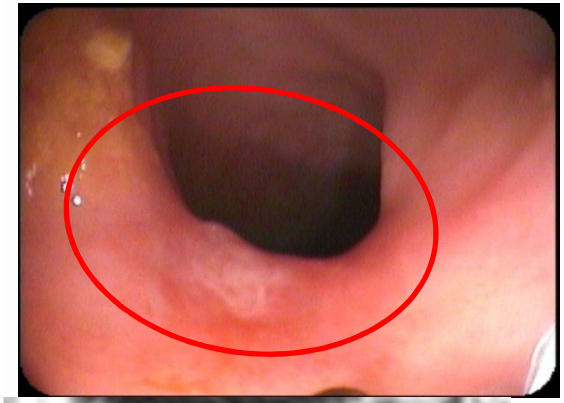
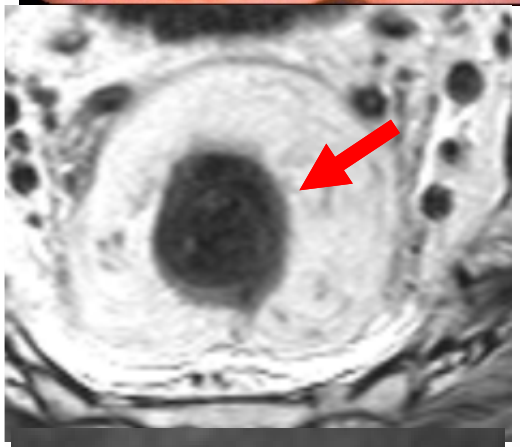
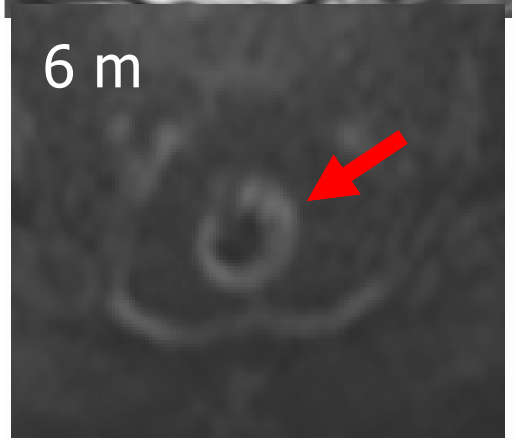
DWI detects regrowth







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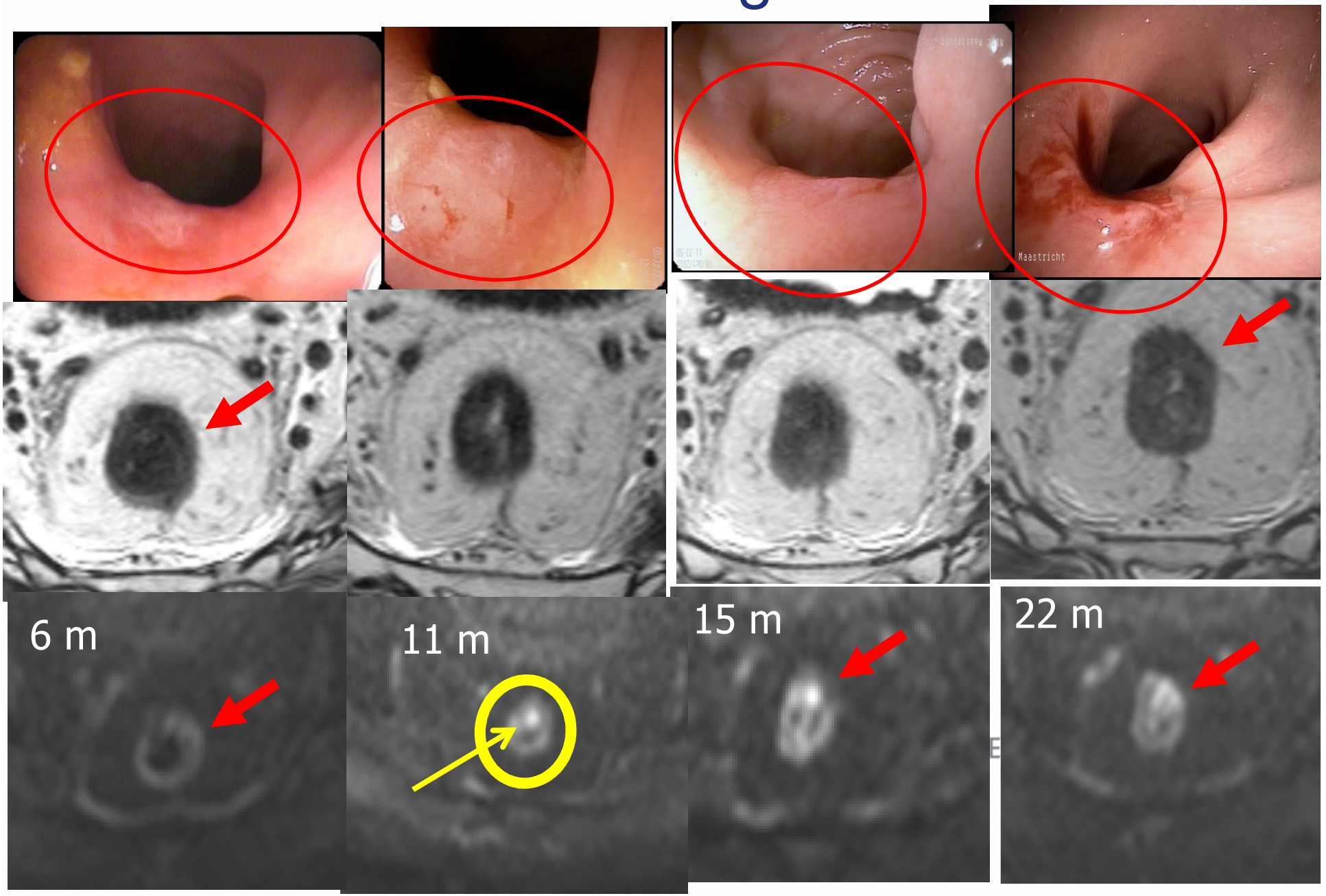

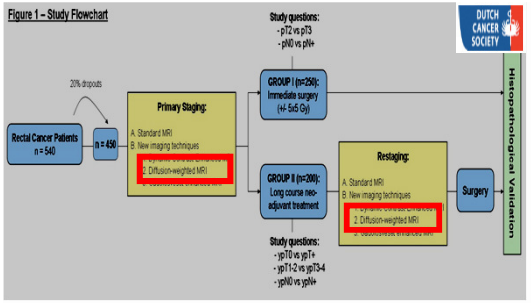

DWI

ypT0	T2W	+DWI
Sens	47%	71%
Spec	82%	78%
PPV	53%	60%
NPV	78%	85%

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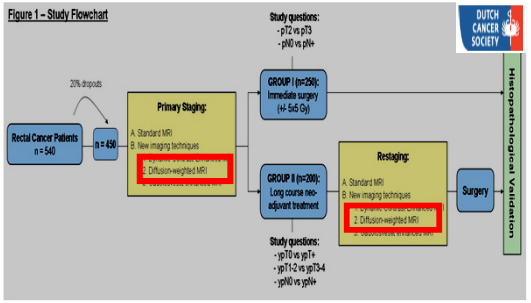

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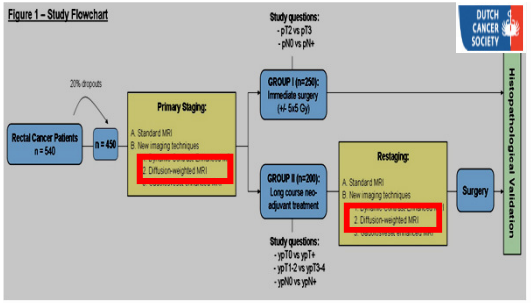

DWI

ypT0	T2W	+DWI
Sens	47%	71%
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PPV	53%	60%
NPV	78%	85%
# equivocal scores	9% →	4%

NDS
CER
UTE
II VAN LEEUWENHOEK

DWI for detection of tumor regrowth

	MRI	+ DWI
sens	**57** →	**86**
spec	100	100

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Lambregts et al. Eur Radiology 2015

DWI for detection of tumor regrowth

	MRI	+ DWI
sens	57	86
spec	100	100
# equivocal scores	**22** →	**7**

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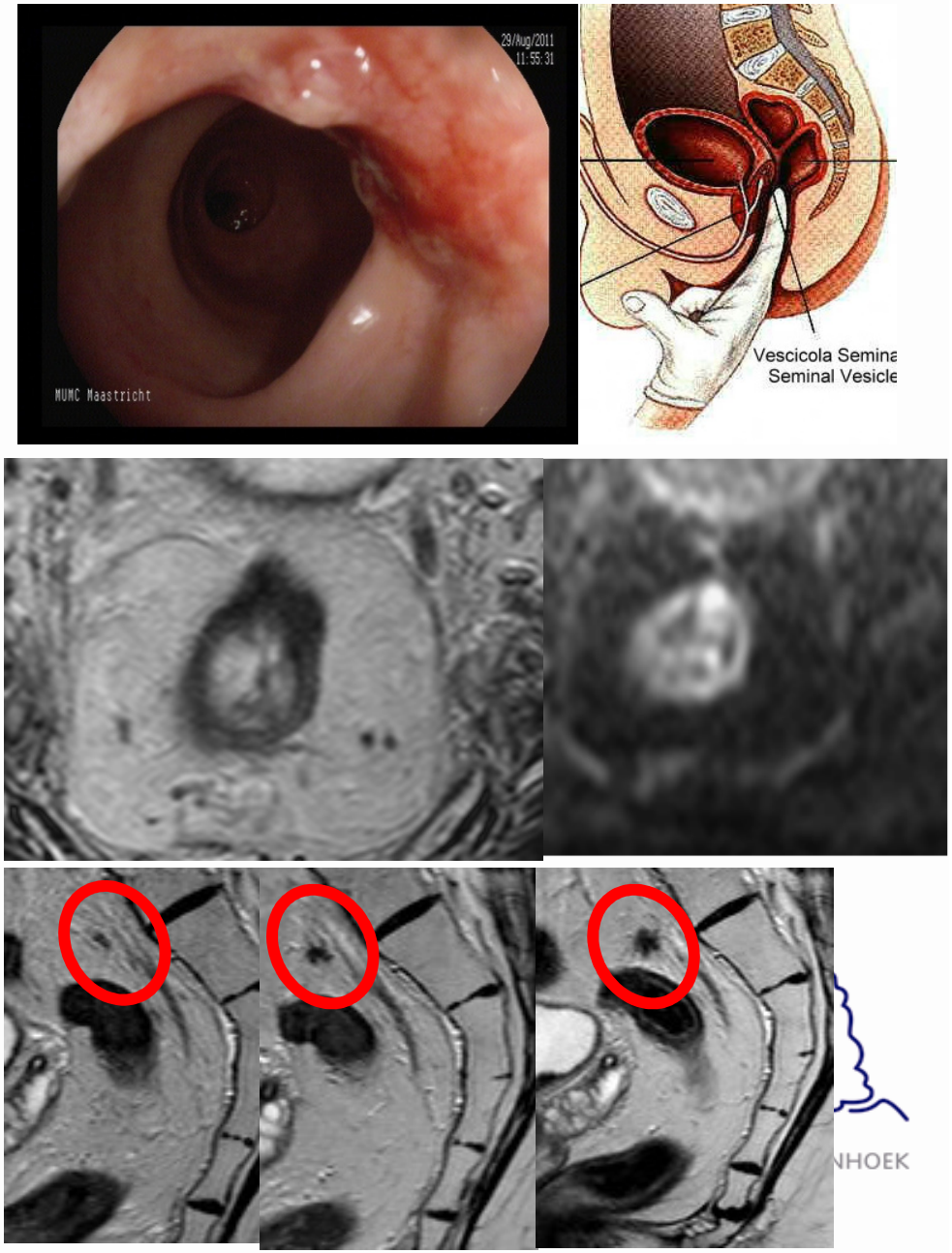
Lambregts et al. Eur Radiology 2015

Where regrowth?

- Luminal 80-90%
- Bowel wall 5-10%
- Nodal 5-10%



	ypN+
ypT0	**5%**
ypT1	13%
ypT2	19%
ypT3	41%
ypT4	48%

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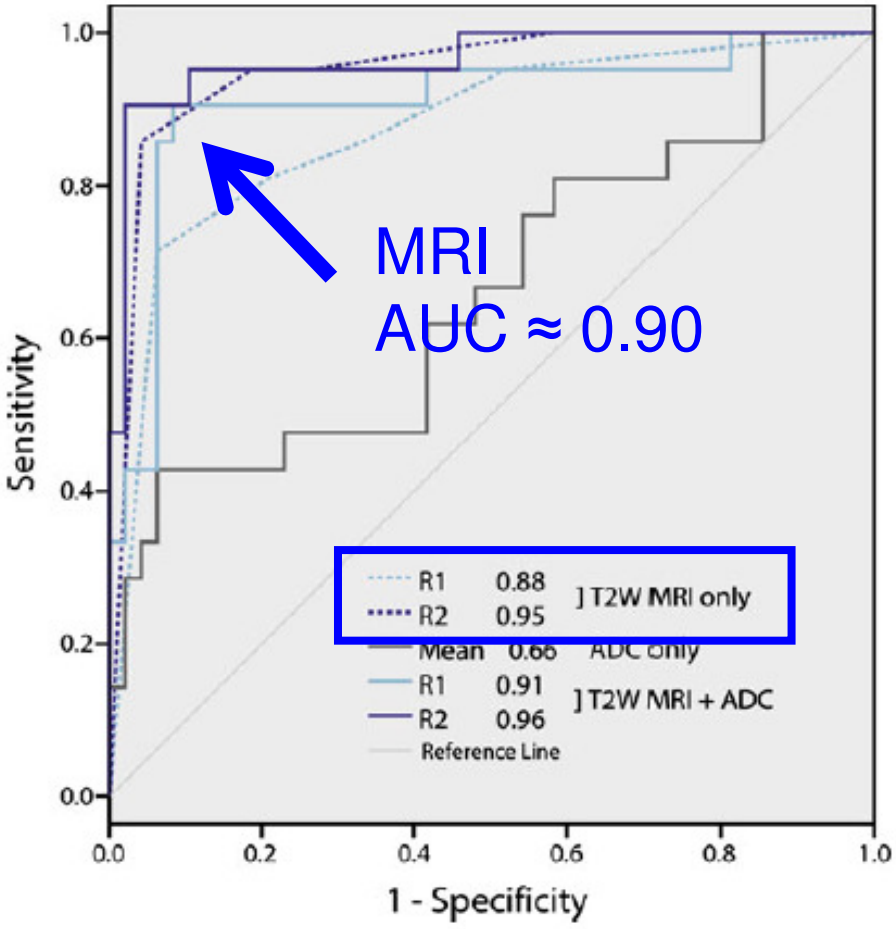
Maas et al. Lancet oncology 2010

MR nodal restaging



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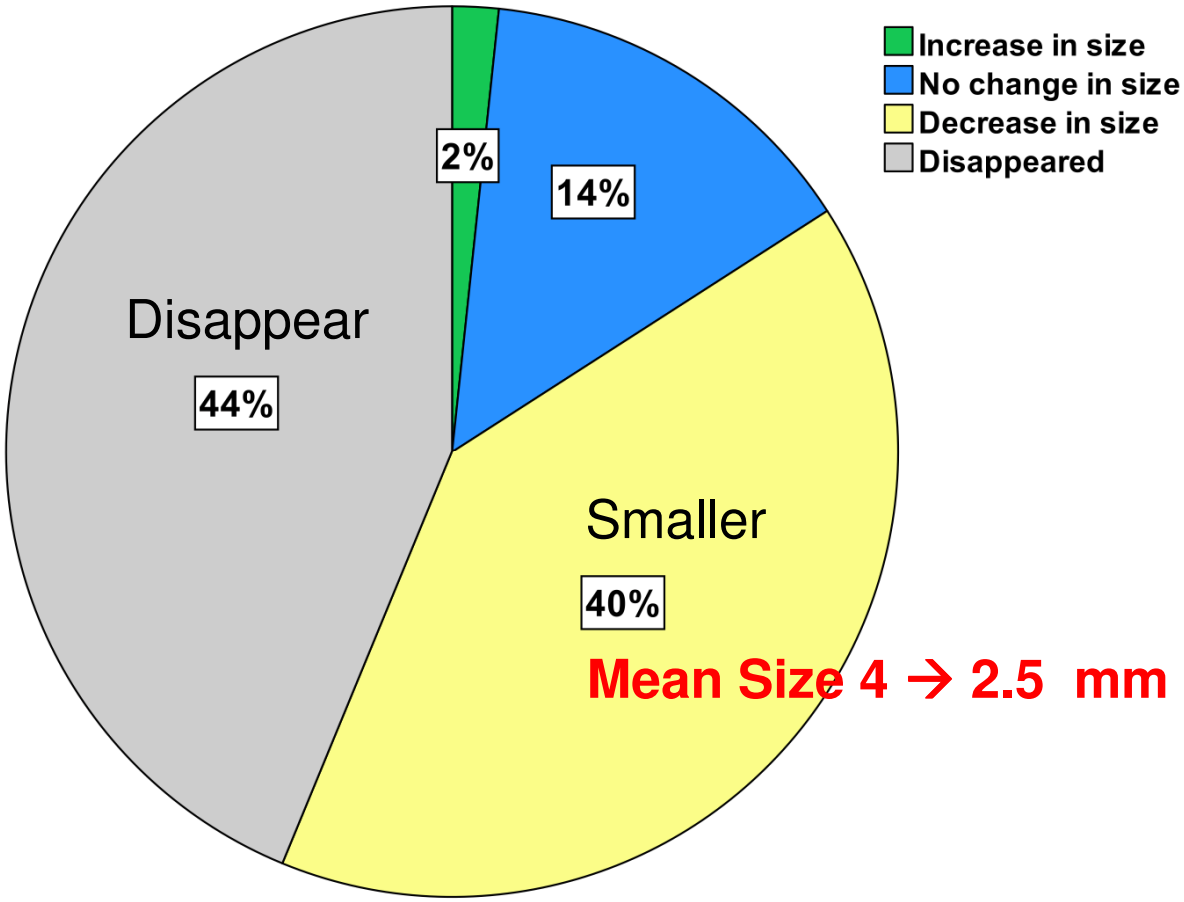
Lambregts et al. Eur Rad 2010

Know how nodes behave after CRT



ANDS CANCER INSTITUTE
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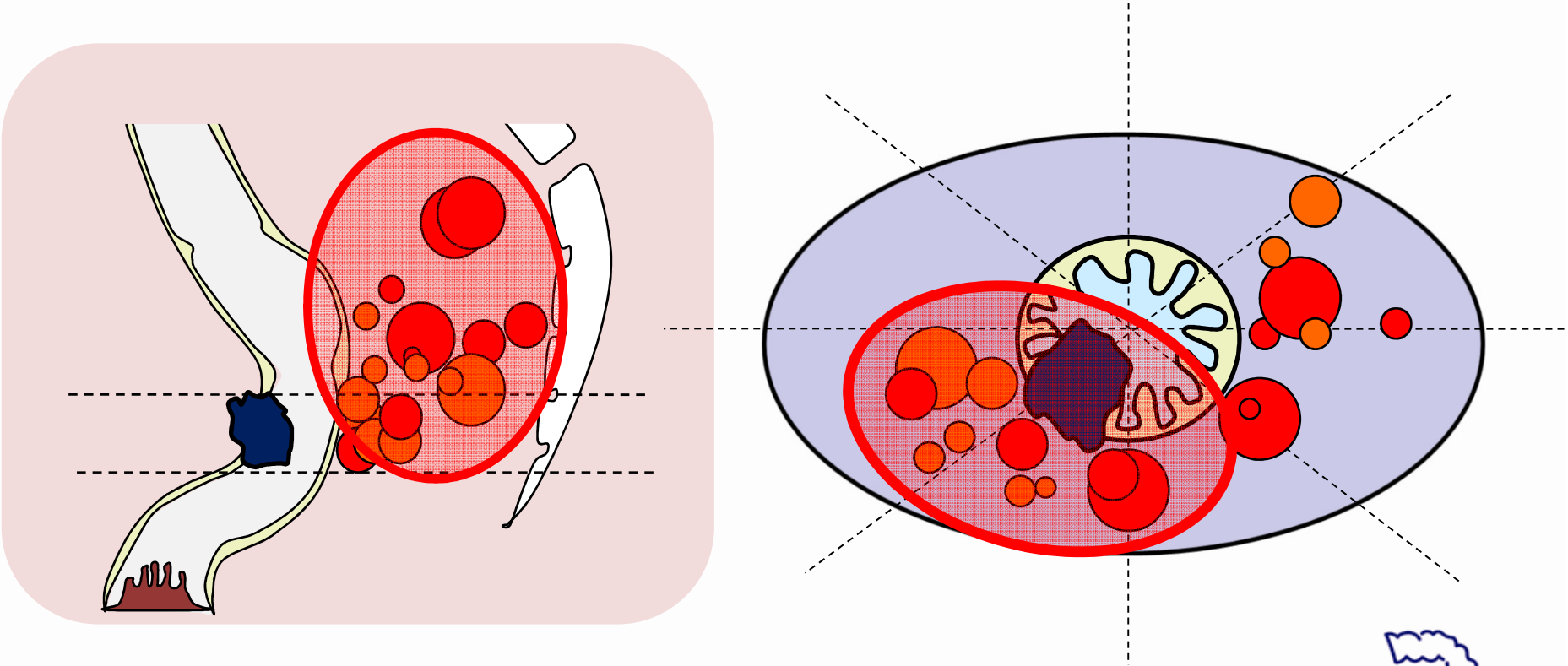
Heijnen et al. Int J Colorectal Disease 2016

ypN+	**>= 5 mm nodes**
unpublished data n=512	**40%** (18/45)
Perez at al DCR 09 n=201	**40%** (6/14)

EUWENHOEK

Persistent node positives



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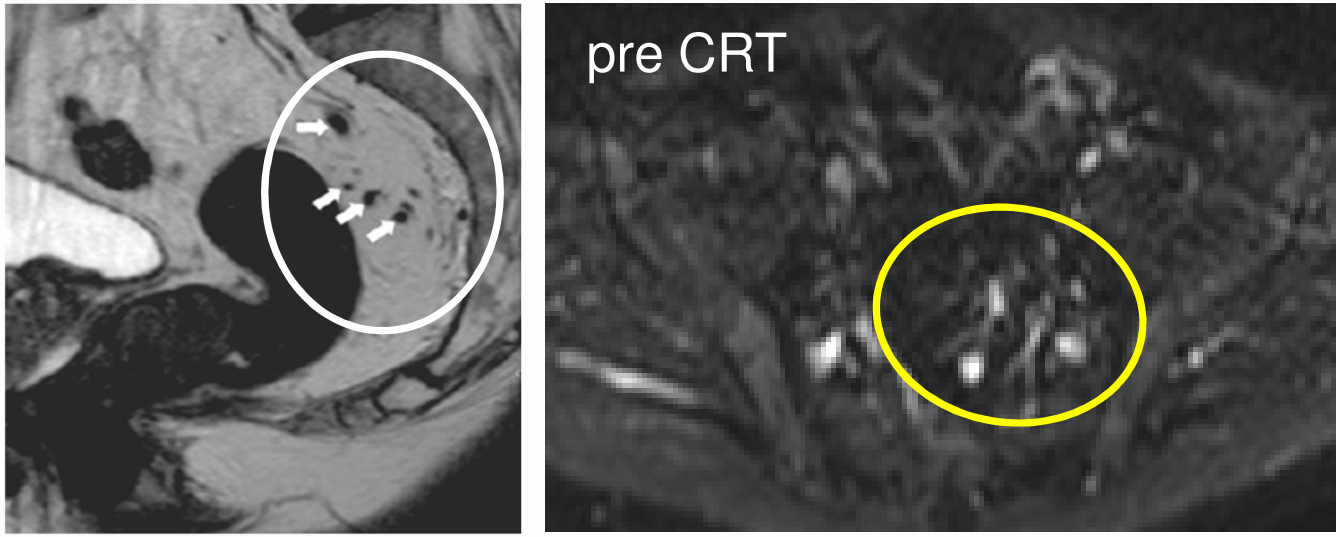
Heijnen et al, Abdominal Radiology jan 2016

Vanishing nodes



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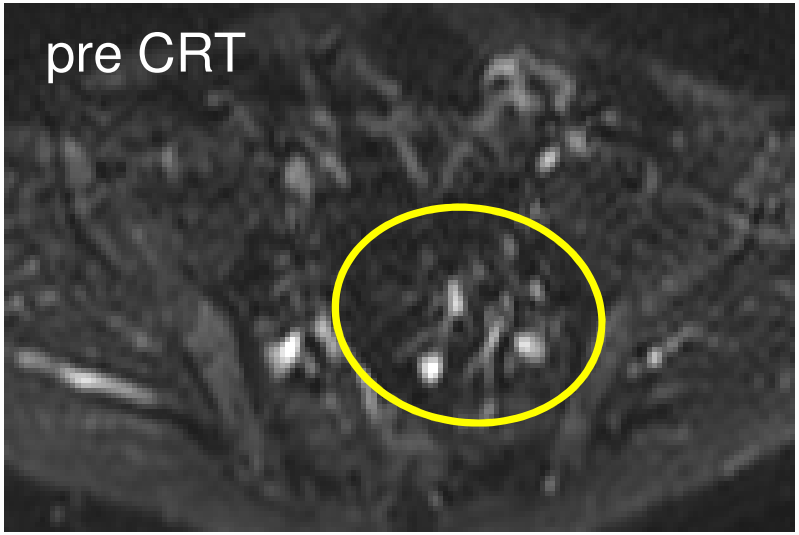
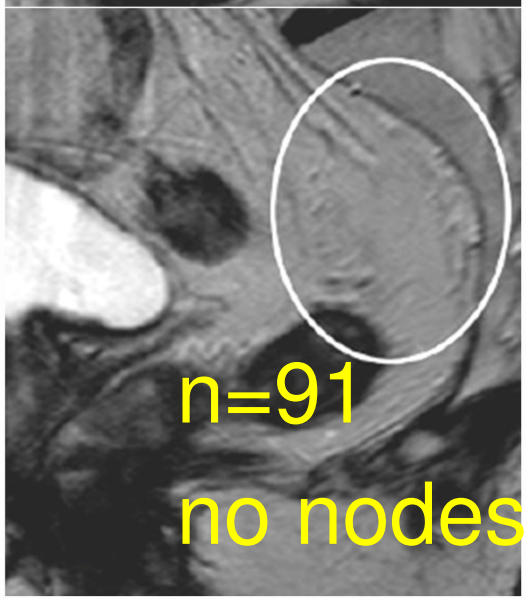
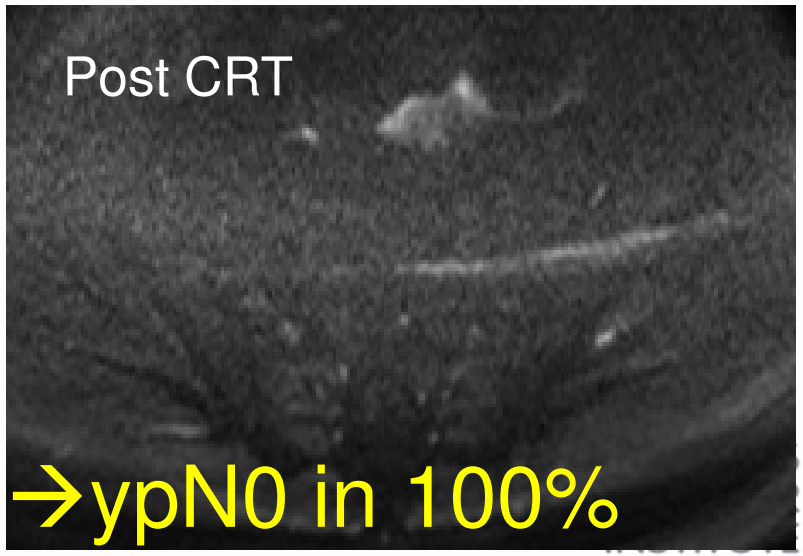
Heeswijk van et al , AJR 2017

Vanishing nodes







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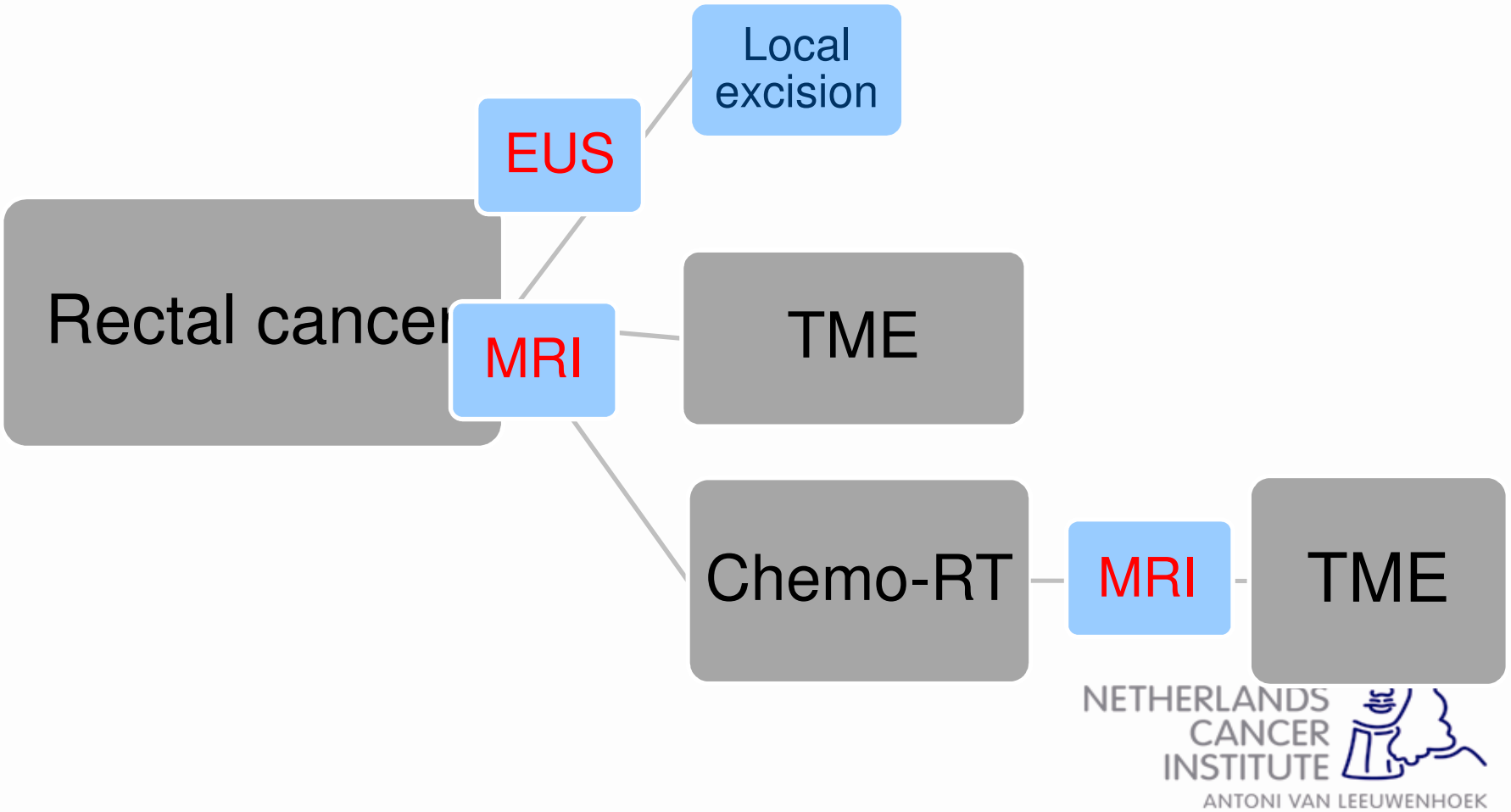
Heeswijk van et al , AJR 2017

TAKE HOME MESSAGES



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EURECCA-CC3 guidelines. Eur J Cancer 2013
ESGAR consensus guidelines. Eur Radiol 2013

Take Home Messages

- EUS for T1
- MRI = EUS for T2,early T3

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- Distant staging CT chest/abdomen
- liver MRI>CT
- FDG PET not as upfront staging tool

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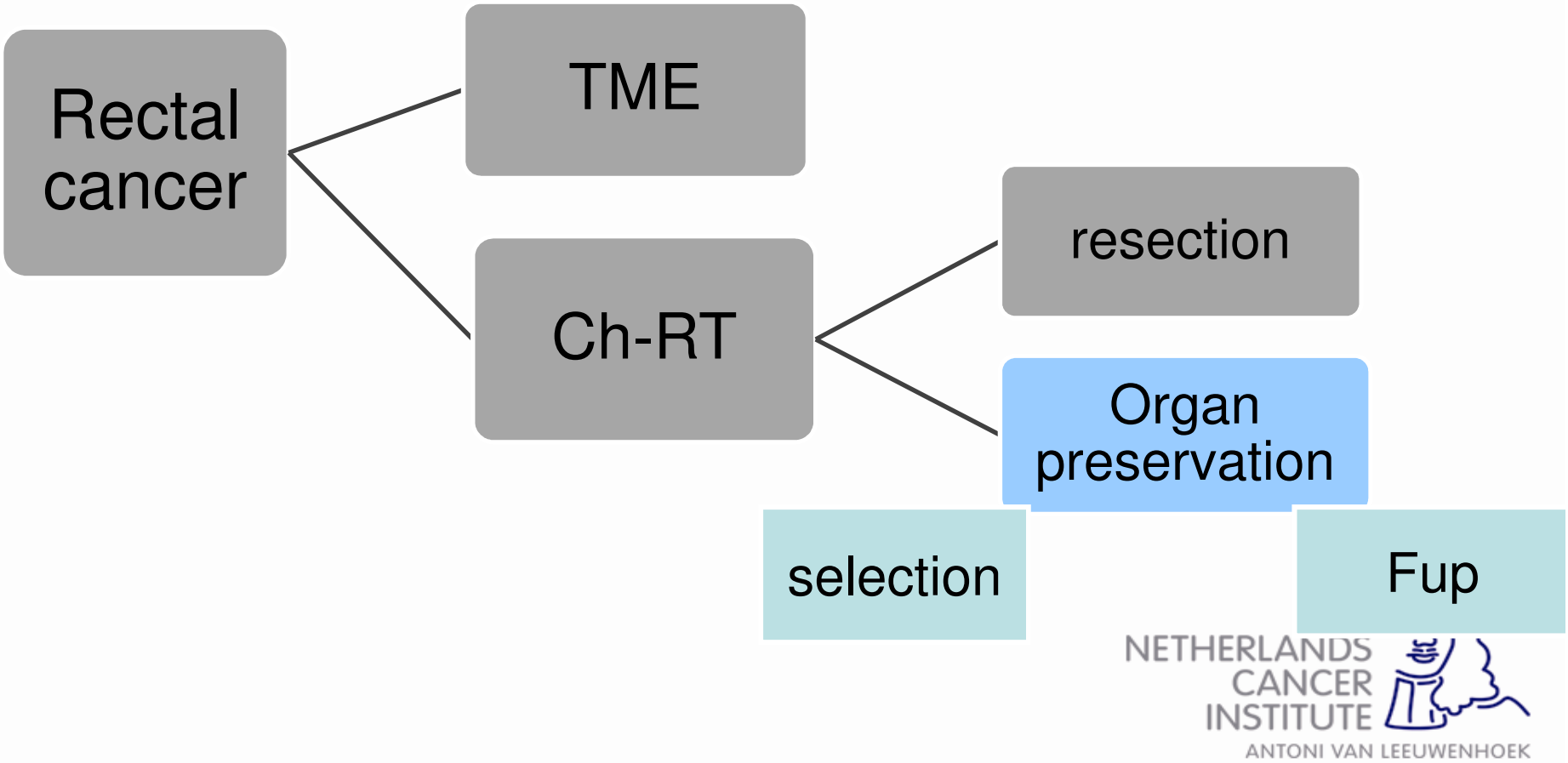
TAKE HOME MESSAGES
Future



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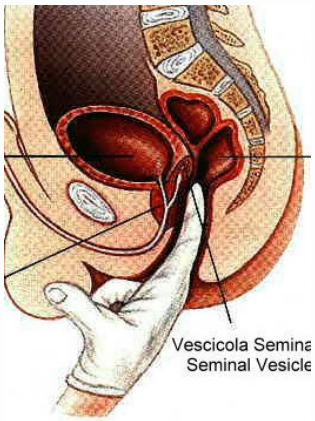

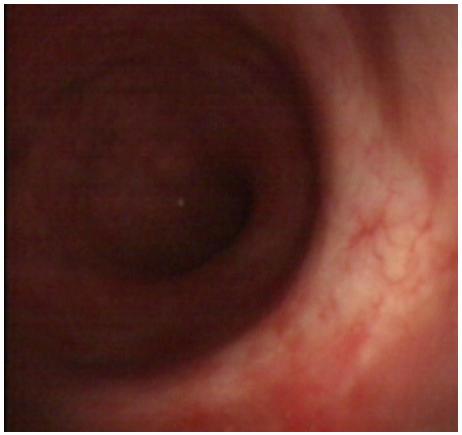

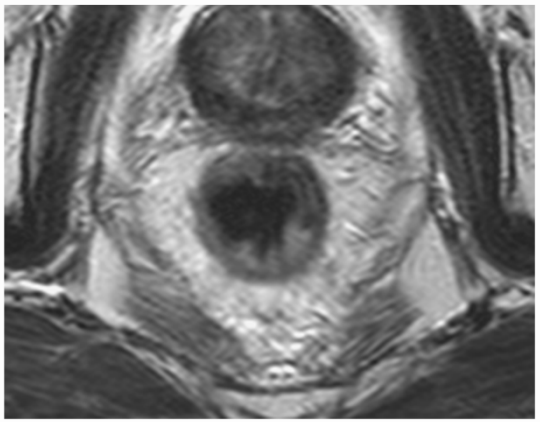

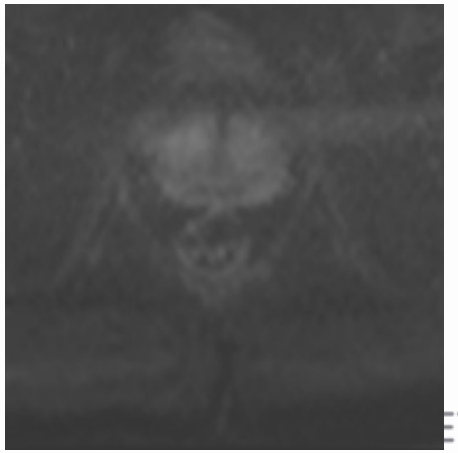

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Rectal cancer research team