Geertje Noë

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“DISTANCE”

- A mnemonic recently introduced
- Simplify reporting rectal cancer staging MRI

Overview

- MR imaging sequences
- The report for MR rectal cancer staging and “DISTANCE”
- Primary rectal cancer staging cases
- Post CRT staging and cases

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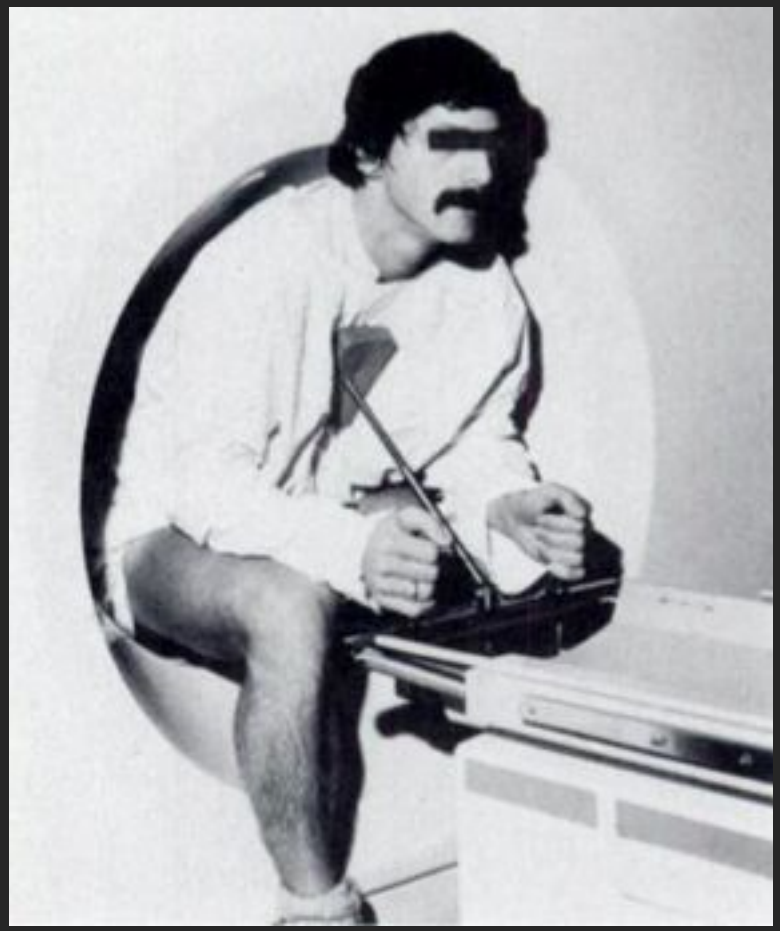
We have come such a long way…

Courtesy Dr. Stephen Esler



CT tomogram from the 1980's

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- The radiologist plays a central role in the multidisciplinary approach to rectal cancer
- MRI can accurately stage rectal cancer
- Pre-operative staging with MRI important to select the appropriate therapy
- Rectal cancer staging with MRI remains a challenge for many radiologists

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Technique and sequences

- No need for bowel preparation, filling of rectum with contrast/air
- Antispasmodic agents can be helpful but are not mandatory
- Only sequence that is required is a T2 –weighted fast spin echo sequence (high resolution)
- IV contrast is not recommended as it does not improve diagnostic quality

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Additional sequences to consider:

- DWI
- T2 fat sat
- T1

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Austin protocol:

- Three Plane Localiser
- Coronal T2 3D SPACE Whole Pelvis
- Axial T1 Whole Pelvis

- Axial T2 FS Whole Pelvis
- Axial DWI

Modifications Reformat 3D in 3 planes

- Coronal Oblique - Angled parallel to the long axis of the rectum
- Sagittal
- Axial Oblique – Angled perpendicular to the long axis of the rectum

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4 critical questions need to be answered

1. Location of the tumor (high, middle, low)

   (you can use a specific staging for low rectal tumours describing the involvement of the sphincters)

2. The T-stage of the tumour

3. Free resection margin for TME (CRM)

4. N-stage

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Other things that need to go in the report:

- Tumor length, tumor description/morphology (polypoid, ulcerative etc.)
- Distance of tumour to anal verge (+/- anorectal junction)
- Circumferential?
- Involvement of pelvic side wall nodes
- Extramural vascular invasion (EMVI)
- Metastasis

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- Pedersen et al. reported in 2011 that the report quality overall could be significantly improved
- There is a need for standardisation of reports and Taylor et al from Brown's group created a form based reporting tool in 2008
- Brown's group also created the mnemonic "DISTANCE"

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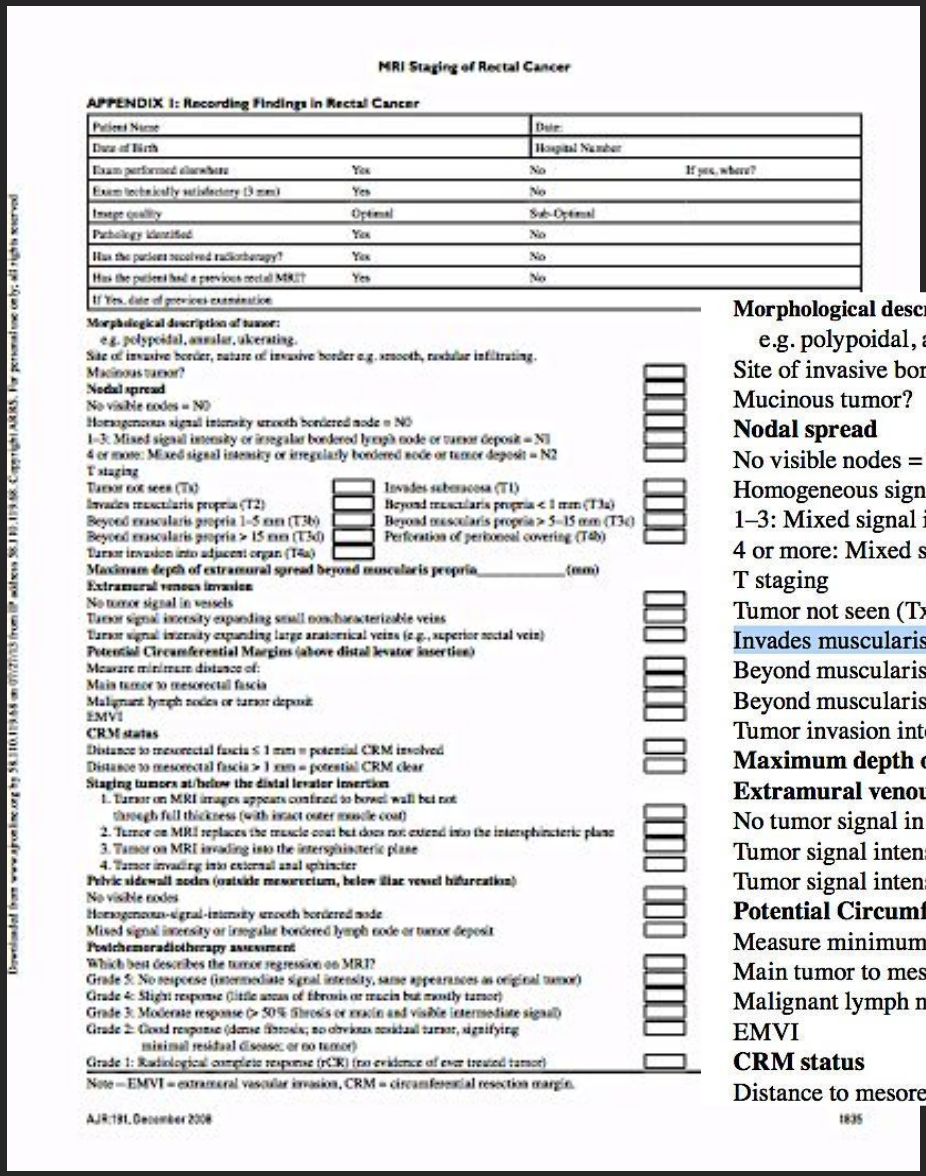

MRI Staging of Rectal Cancer

APPENDIX 1: Recording Findings in Rectal Cancer

Patient Name		Date:	
Date of Birth		Hospital Number	
Exam performed elsewhere	Yes	No	If yes, where?
Exam technically satisfactory (3 mm)	Yes	No	
Image quality	Optimal	Sub-Optimal	
Pathology identified	Yes	No	
Has the patient received radiotherapy?	Yes	No	
Has the patient had a previous rectal MRI?	Yes	No	
If Yes, date of previous examination			

Morphological description of tumor:
e.g. polypoidal, annular, ulcerating.
Site of invasive border, nature of invasive border e.g. smooth, nodular infiltrating.
Mucinous tumor?
Nodal spread
No visible nodes = N0
Homogeneous signal intensity smooth bordered node = N0
1–3: Mixed signal intensity or irregular bordered lymph node or tumor deposit = N1
4 or more: Mixed signal intensity or irregularly bordered node or tumor deposit = N2
T staging
Tumor not seen (Tx)
Invades muscularis propria (T2)
Beyond muscularis propria 1–5 mm (T3b)
Beyond muscularis propria > 15 mm (T3d)
Tumor invasion into adjacent organ (T4a)
Invades submucosa (T1)
Beyond muscularis propria < 1 mm (T3a)
Beyond muscularis propria > 5–15 mm (T3c)
Perforation of peritoneal covering (T4b)
Maximum depth of extramural spread beyond muscularis propria_____(mm)
Extramural venous invasion
No tumor signal in vessels
Tumor signal intensity expanding small noncharacterizable veins
Tumor signal intensity expanding large anatomical veins (e.g., superior rectal vein)
Potential Circumferential Margins (above distal levator insertion)
Measure minimum distance of:
Main tumor to mesorectal fascia
Malignant lymph nodes or tumor deposit
EMVI
CRM status
Distance to mesorectal fascia ≤ 1 mm = potential CRM involved
Distance to mesorectal fascia > 1 mm = potential CRM clear
Staging tumors at/below the distal levator insertion
1. Tumor on MRI images appears confined to bowel wall but not through full thickness (with intact outer muscle coat)
2. Tumor on MRI replaces the muscle coat but does not extend into the intersphincteric plane
3. Tumor on MRI invading into the intersphincteric plane
4. Tumor invading into external anal sphincter
Pelvic sidewall nodes (outside mesorectum, below iliac vessel bifurcation)
No visible nodes
Homogeneous-signal-intensity smooth bordered node
Mixed signal intensity or irregular bordered lymph node or tumor deposit
Postchemoradiotherapy assessment
Which best describes the tumor regression on MRI?
Grade 5: No response (intermediate signal intensity, same appearances as original tumor)
Grade 4: Slight response (little areas of fibrosis or mucin but mostly tumor)
Grade 3: Moderate response (> 50% fibrosis or mucin and visible intermediate signal)
Grade 2: Good response (dense fibrosis; no obvious residual tumor, signifying minimal residual disease; or no tumor)
Grade 1: Radiological complete response (rCR) (no evidence of ever treated tumor)

Note—EMVI = extramural vascular invasion, CRM = circumferential resection margin.

AJR:191, December 2008

1835

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CRM status
Distance to mesorectal fascia ≤ 1 mm = potential CRM involved

Taylor FG et al. A sytematic approach to the interpretation pre-operative staging MRI for rectal cancer. Am J Roentgenol. 2008 Dec;191(6):1827-35

DIS – distance from inferior part of tumor to transitional skin

T – T-staging

A - Anal complex, sphincters and puborectalis muscles

N - Nodal staging

C - CRM

E - Extramural vascular invasion

Nougaret S et al. The use of MR imaging in treatment planning for patients with rectal carcinoma: Have you checked the "DISTANCE". *Radiology*. 2013 Aug;268(2):330-44

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Overview

- MR imaging sequences
- The report for MR rectal cancer staging and "DISTANCE"
- Primary rectal cancer staging cases
- Post CRT staging

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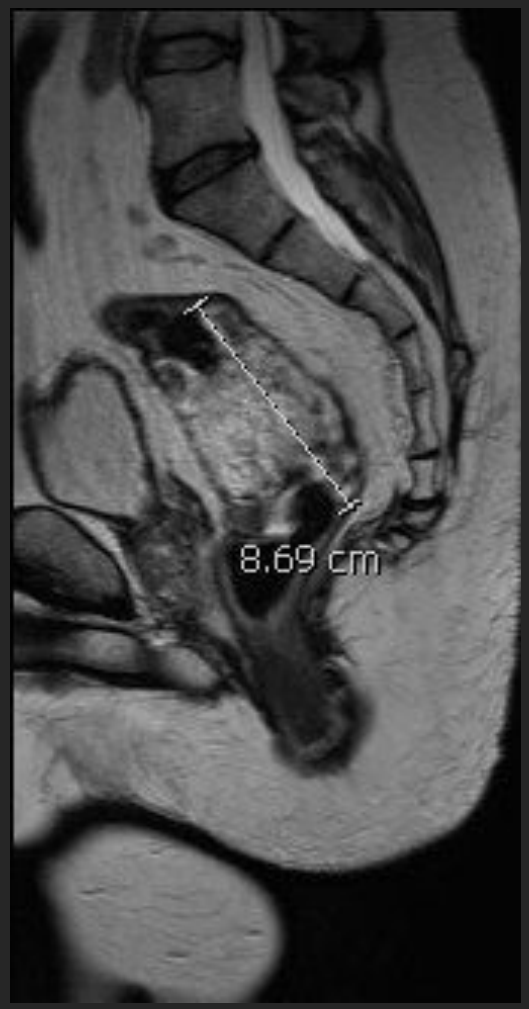
CASE 1



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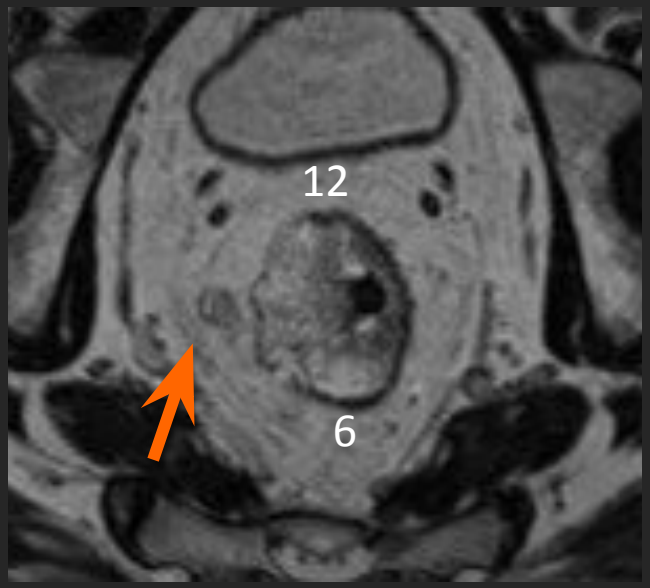

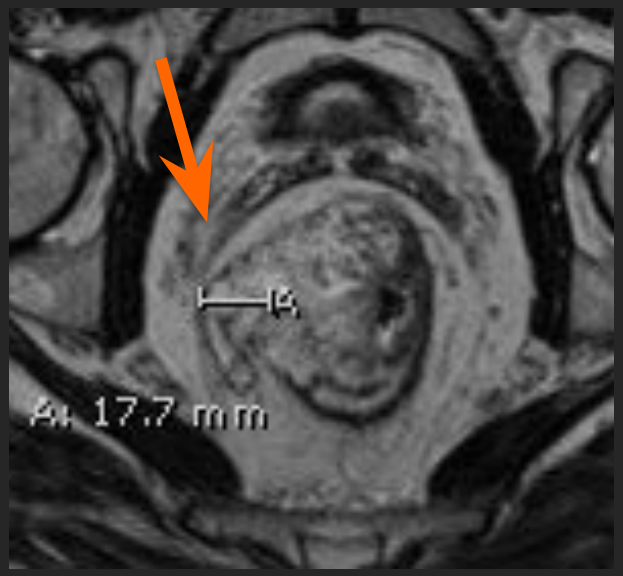

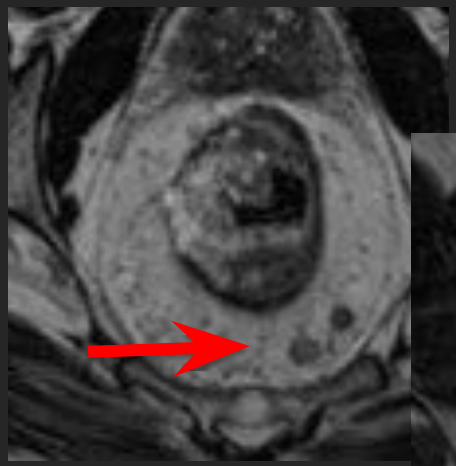

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Report conclusion:

T3 N2 mid rectal tumour with a length of approximately 8.6 cm which reaches 7.8 cm above the anal verge and has a positive CRM.

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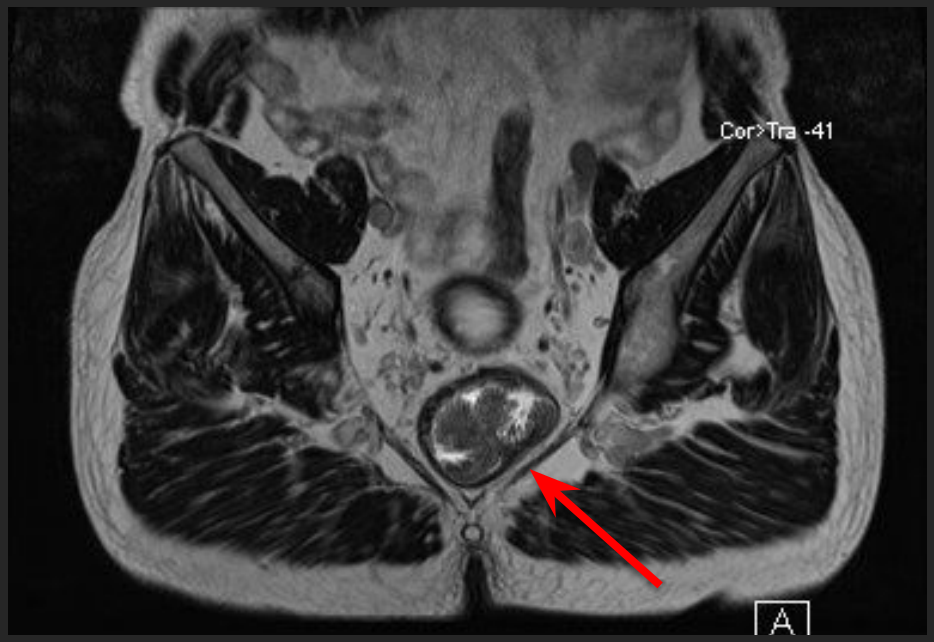
CASE 2



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Austin Health

Report conclusion:

T2 N0 low rectal tumour with a length of 5.1 cm and reaches approximately 4.1 cm above the anal verge.

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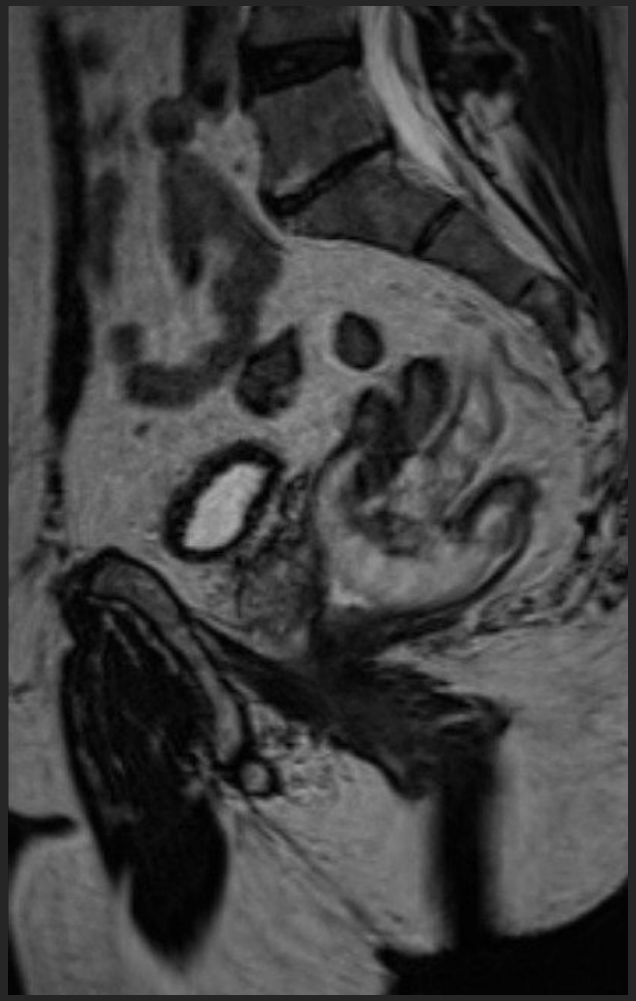
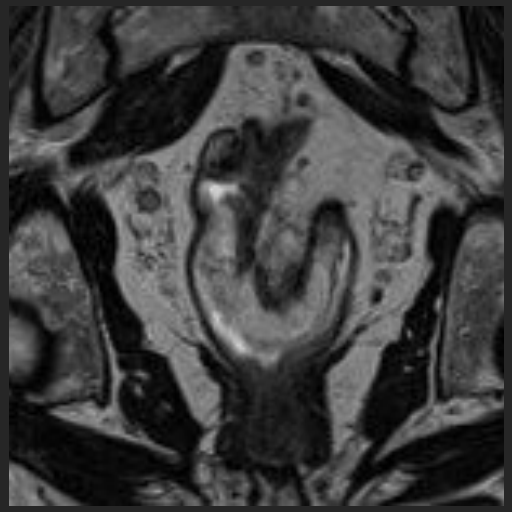
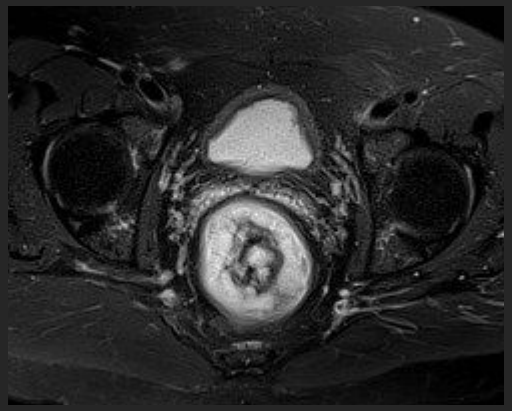
CASE 3







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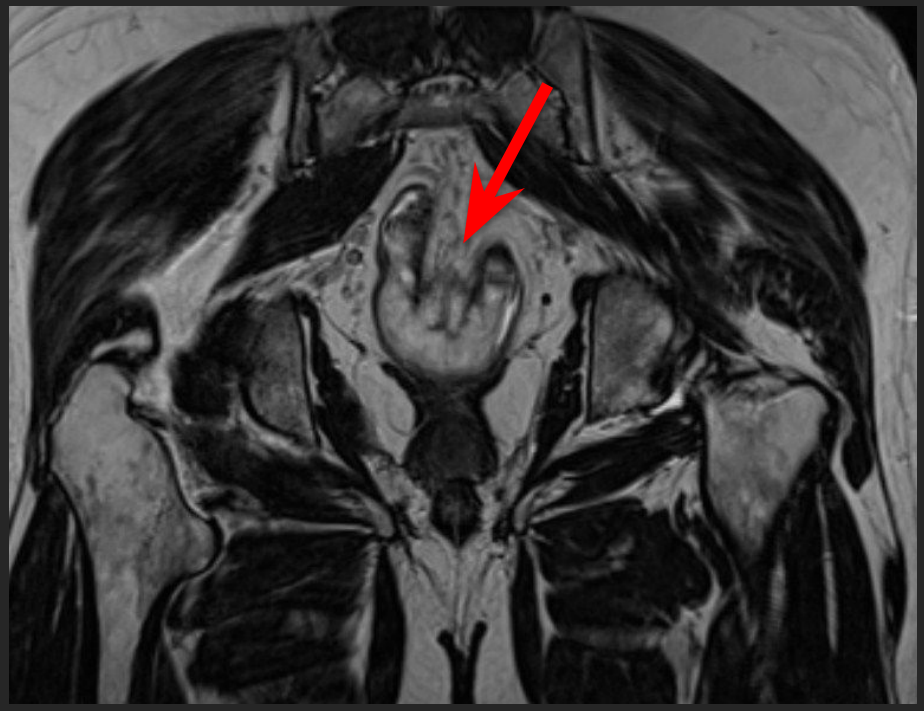

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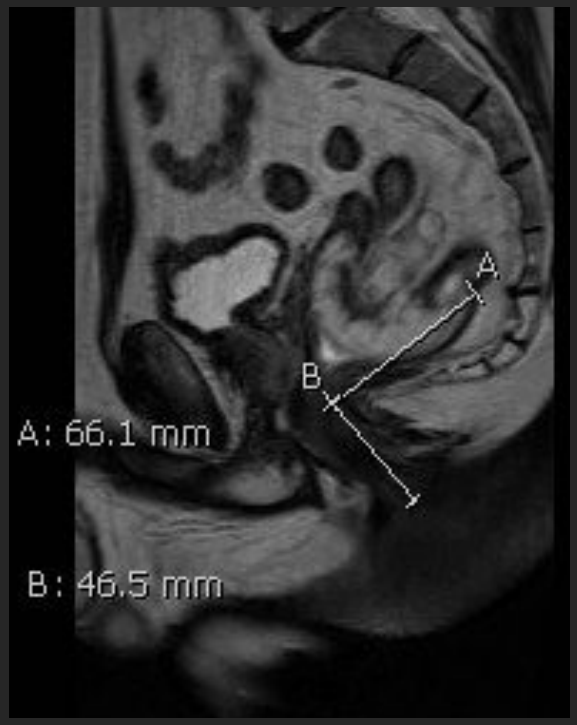

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Report conclusion:

T3 N1 mid rectal tumour with a length of 6.7 cm with a distance of 10 cm from the anal verge. The CRM is negative.

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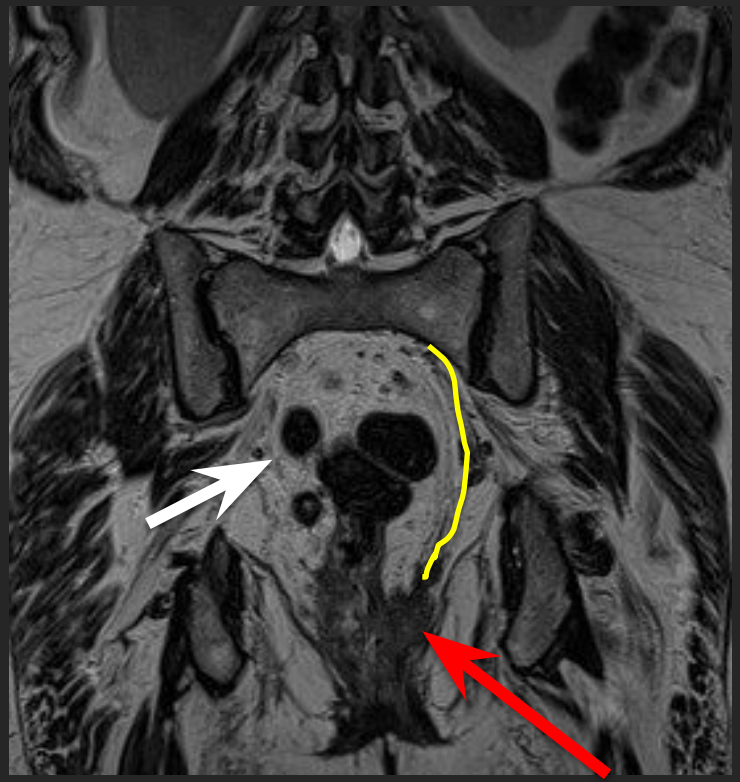
CASE 4



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Austin Health

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Report conclusion:

Low rectal tumour with a length of 5.5 cm with extension to and involvement of the left levator muscle. It reaches 2.7 cm above the anal verge and there are 5 abnormal lymph nodes. An enlarged left pelvic side wall node is present.

Staging in keeping with T4 N2 M1

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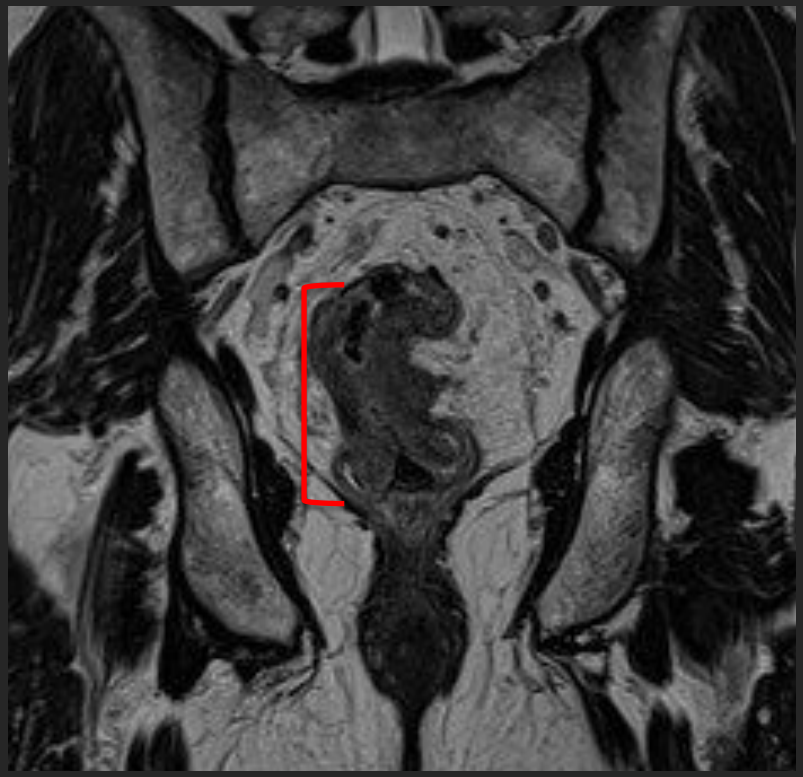
CASE 5



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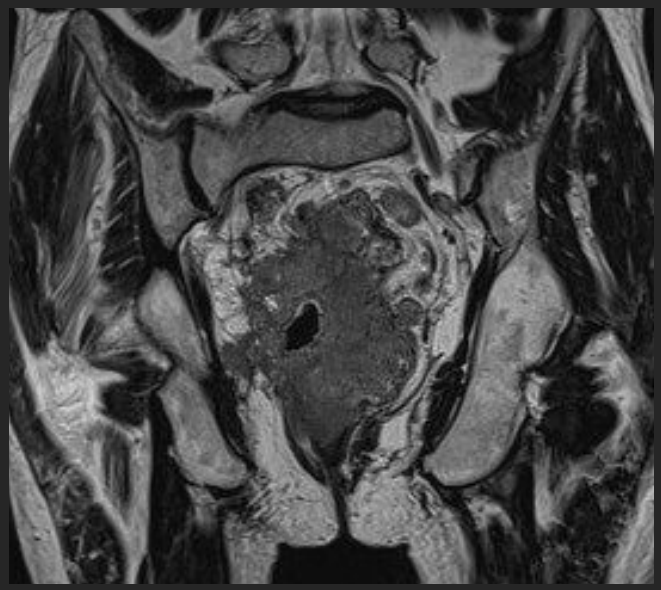
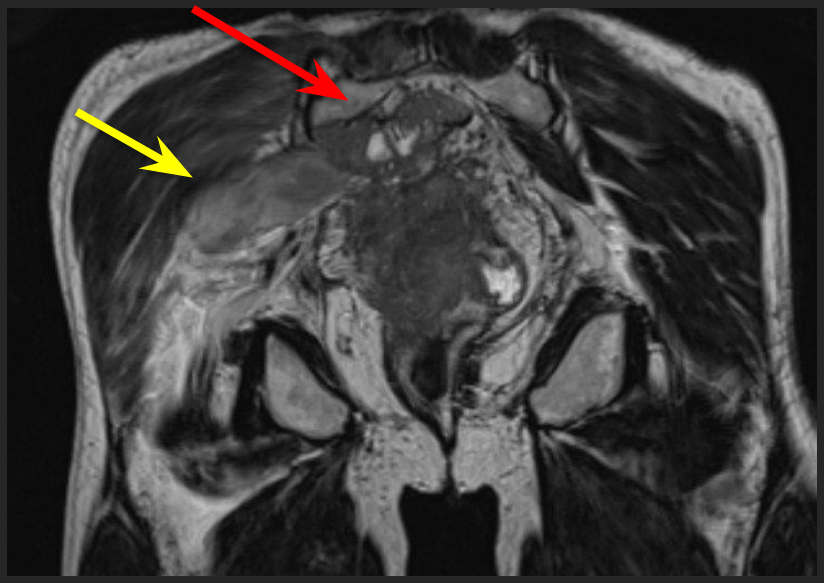
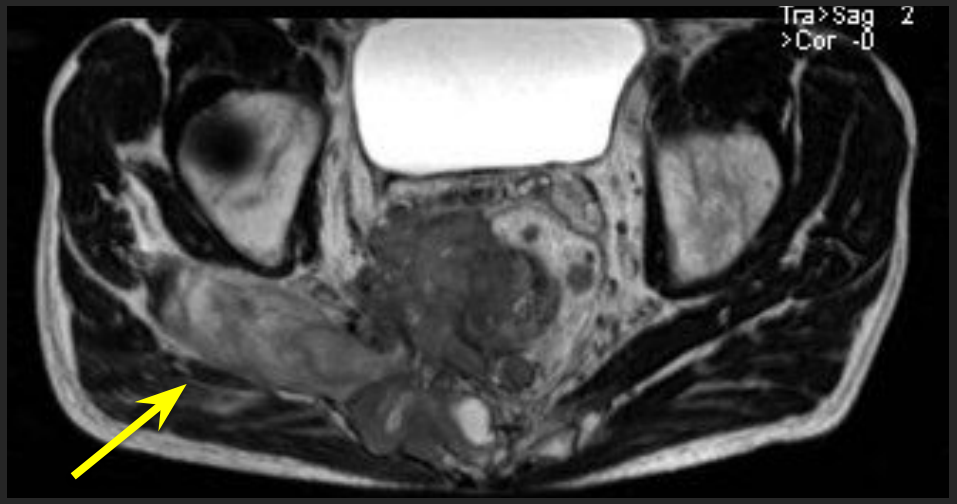
CASE 6







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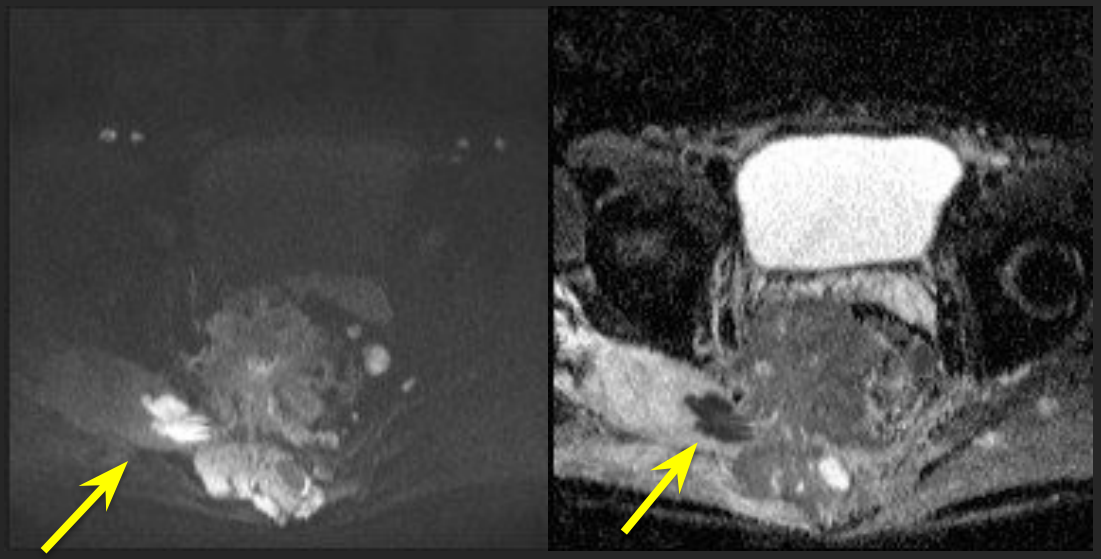

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Overview

- MR imaging sequences
- The report of MR rectal cancer staging and "DISTANCE"
- Primary rectal cancer staging cases
- Post CRT staging

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Post chemoradiation therapy (CRT) staging

- Main indications for CRT:
  - Locally advanced rectal tumor T3 with > 5mm of extramural spread
  - EMVI
  - Tumor within 1mm of mesorectal fascia (node, tumor, EMVI)
  - Threatened or involved anal sphincter
  - Nodal involvement

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- Locally advanced rectal cancer has a poor prognosis

- Benefits of downstaging and downsizing with neoadjuvant CRT:

    1. improves resectability
    2. sphincter preservation
    3. reduced local recurrence
    4. improved overall survival

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- MRI is developing a central role in identifying good and poor responders
- Can provide a basis to further fine tune treatment
- In the future MRI may be used to select patients that will just receive CRT (wait and see approach)

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- Tumour volume reduction of at least 70% predicts disease free survival and good histologic regression.

  Nougaret et al MR volumetric measurement of low rectal cancer helps predict tumour response and outcome after combined chemotherapy and radiation therapy. Radiology May 2012.

- Post CRT MRI assessment of tumour regression grade correlated with disease free survival.

  Patel et al MRI-detected tumour response for locally advanced rectal cancer predicts survival outcomes JCO 2011

- A pathological complete response following neoadjuvant CRT is associated with excellent long-term survival, with low rates of local recurrence and distant failure.

  Martin et al. Br J Surg 2012 Systematic review and meta analysis of outcomes following pathological complete response to neoadjuvant chemoradiotherapy for rectal cancer.

- Tumour volume regression grade of less than 45% is predictive of a poor tumour outcome.

  Yeo et al, Tumour volume reduction rate after preoperative chemoradiotherapy as a prognostic factor in locally advanced rectal cancer, Int J Radioation Oncolo Biol Phys 2012.

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Post CRT MRI interpretation

- Predicting the stage prior to CRT ~ 85%, after CRT ~ 50% (fibrosis vs tumour?)
- Need primary rectal cancer staging MRI
- “DISTANCE” comes into play first again (ymr added to the abbreviations e.g. ymrT)
- Followed by MR Tumour Response Grading (mrTRG)
- Research has shown that ymrT and mrTRG predict the corresponding histopathological parameters and can identify good and poor responders to CRT

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Post CRT T-staging and Tumour Response Grading

- Difficult to differentiate between tumour and post-therapeutic changes on T2 images
- DWI can be useful
- Some tumours have a “colloid” response > mucin production bright on T2

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Morphologic descriptions used in T-staging and Tumour Response Grading

- Fibrosis within tumour and rectal wall: low signal.
- Desmoplastic reaction: low intensity spicules.
- Residual tumour: Intermediate signal and nodular margin.
- Mucinous change: mucinous response in non-mucinous tumours suggests treatment response

1. Uniform mucinous change in tumours exhibiting baseline mucinous heterogeneity suggests treatment response
2. Persistent heterogeneous mucinous signal unchanged post treatment no response.

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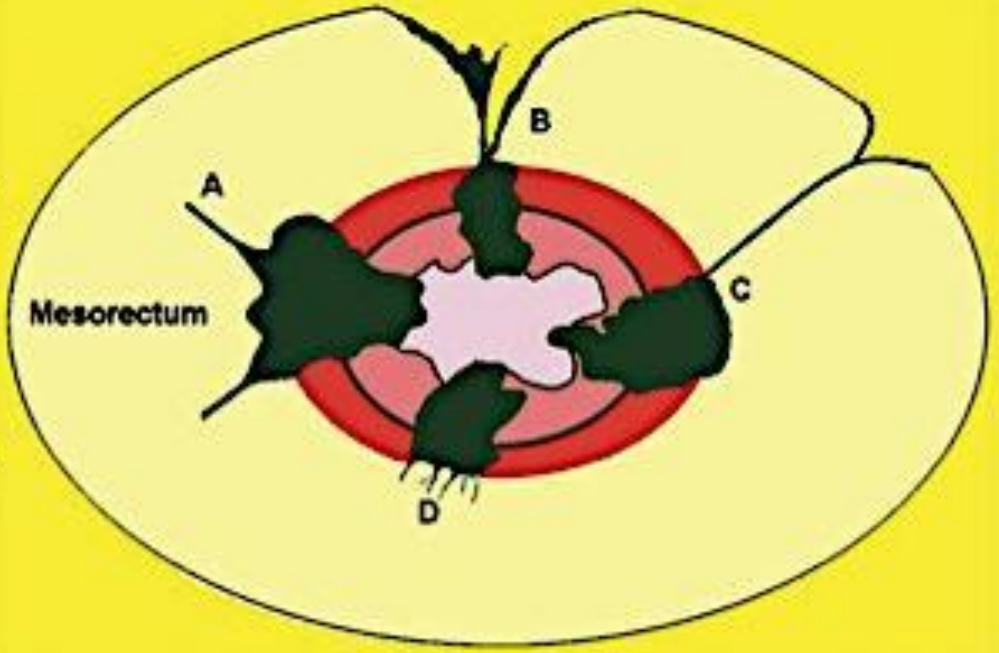
Post CRT changes

A: Tumor remains with mainly gross nodular pattern

B: Scarring contiguous to mesorectal fascia, a thick scar cannot exclude residual tumor, careful evaluation of signal intensity can be helpful

C: Thin, linear scar extending to mesorectal fascia can be interpreted as fibrotic reaction

D: Multiple linear thin scars in the mesorectum can be interpreted as fibrosis, if they demonstrate very low signal intensity



Nougaret S et al. The use of MR imaging in treatment planning for patients with rectal carcinoma: Have you checked the "DISTANCE". *Radiology*. 2013 Aug;268(2):330-44

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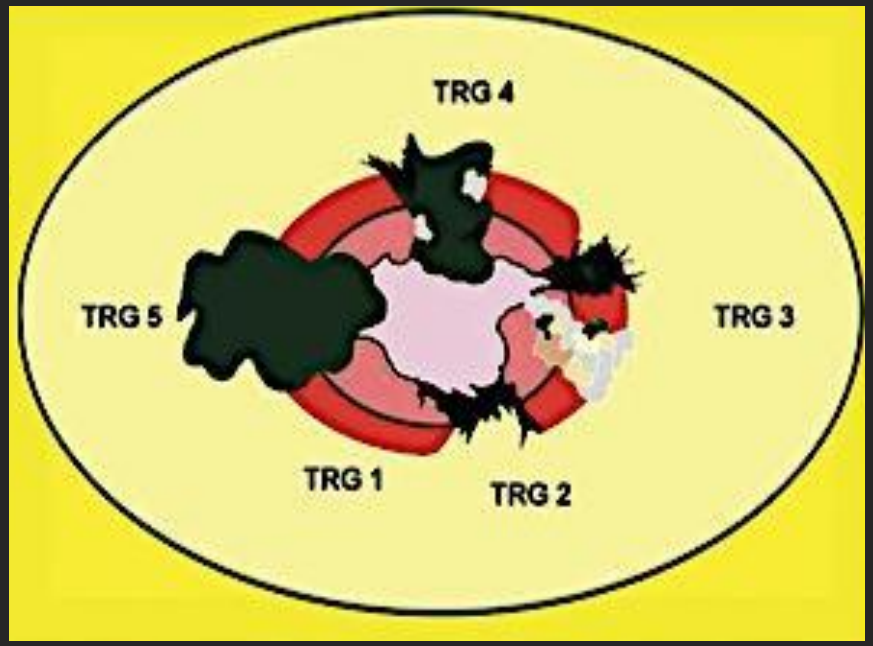
TRG 1: Complete radiologic response: no evidence of abnormalities

TRG 2: Good response: dense fibrosis (>75%) no obvious residual tumour or minimal residual tumour

TRG 3: Moderate response >50% fibrosis or mucin and visible tumour

TRG 4: Slight response: small areas of fibrosis or mucin, but mostly tumour

TRG 5: No response, same appearance as original tumour



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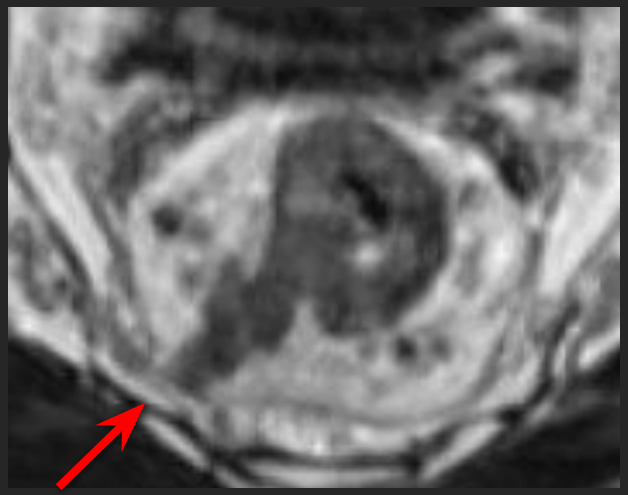
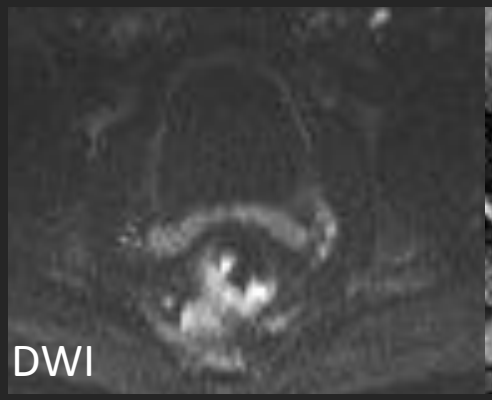
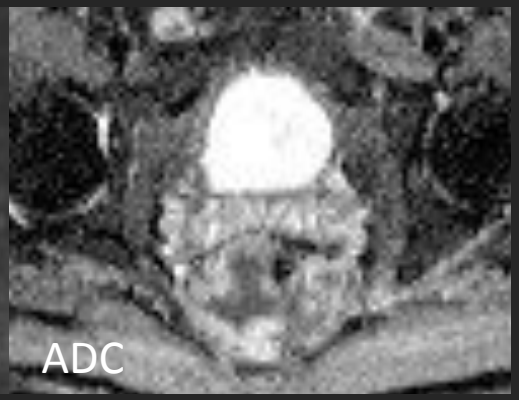
CASE 1 – PRE CRT







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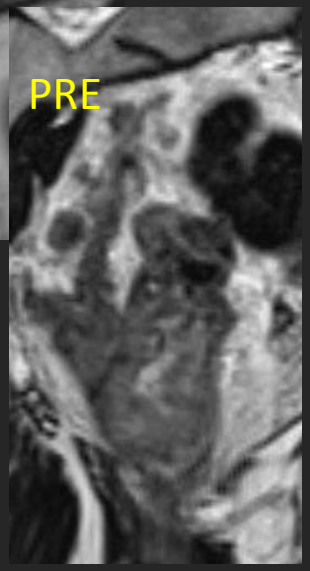
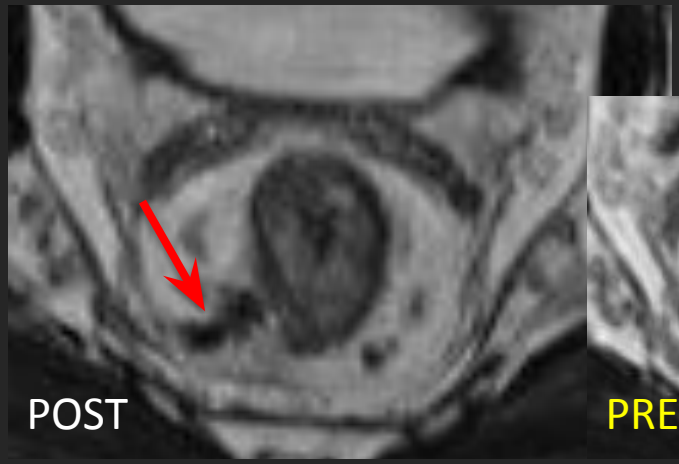
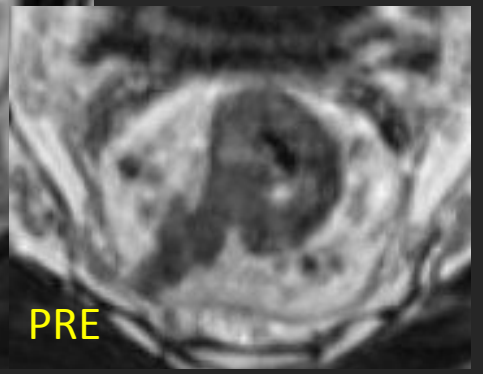
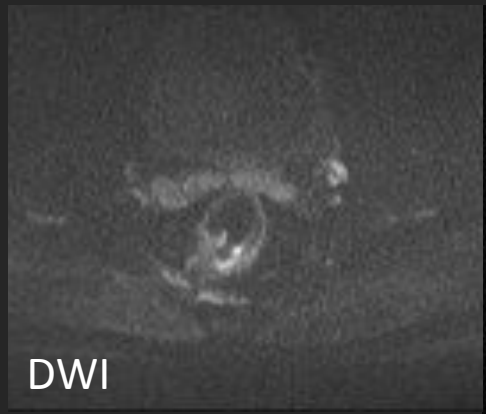
CASE 1 – POST CRT









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mrTRG2

Good response with tumour replaced by dense fibrosis with no obvious tumour left.

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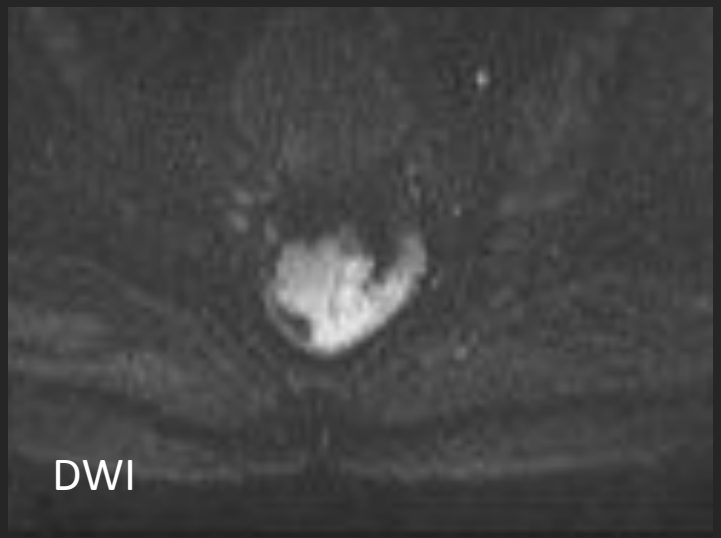
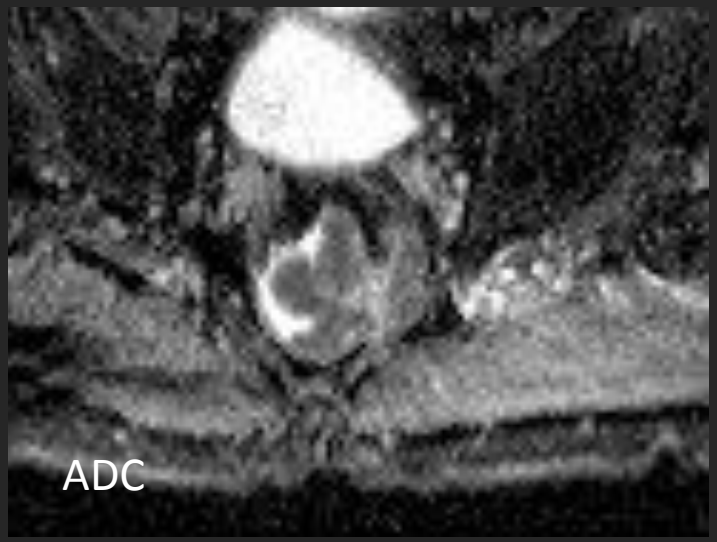
CASE 2 - PRE





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- Rectal cancers may exhibit restricted or increased diffusion dependant on tumour cellularity, intra-tumoral oedema, and presence of cystic/necrotic areas.

- Low ADC value is predictive of good treatment response.

  Dzik_Jurasz et al DWI-MRI for prediction of response of rectal carcinoma to chemoradiation. Lancet 2002

- An early increase in the ADC after commencing treatment is predictive of better treatment outcome. *Hein et al DWI-MRI for monitoring diffusion changes in rectal carcinoma during combined chemoradiation. EJR 2003*

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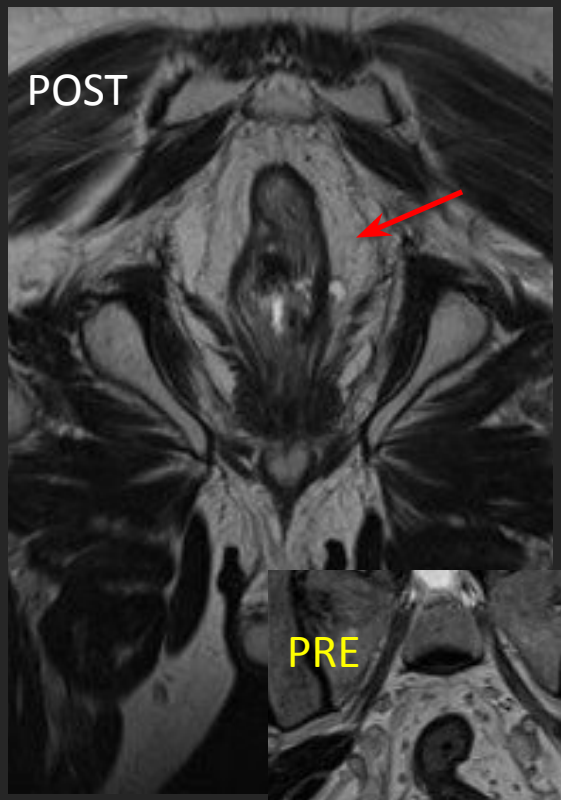
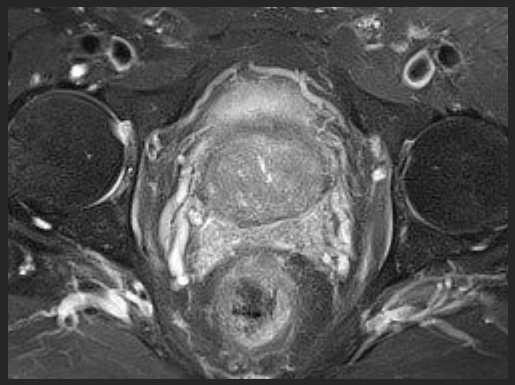
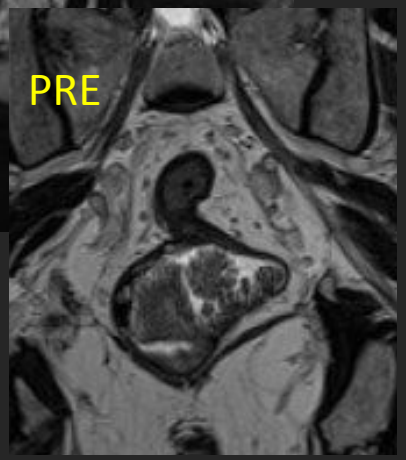
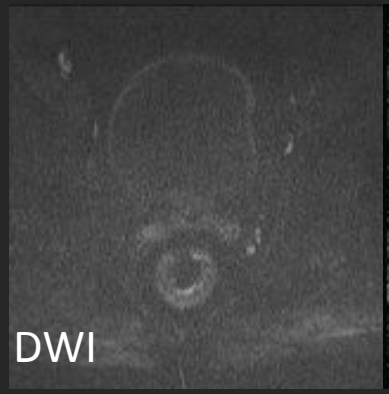
CASE 2-POST CRT









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mrTRG 1

Complete radiological response

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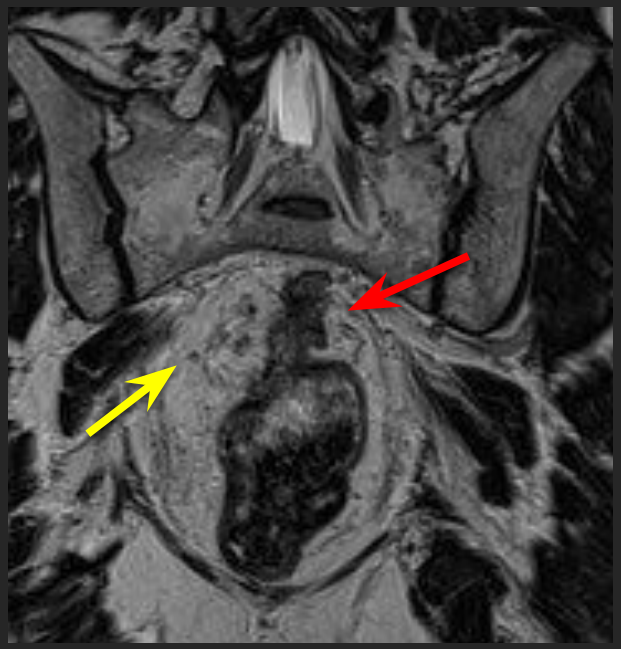
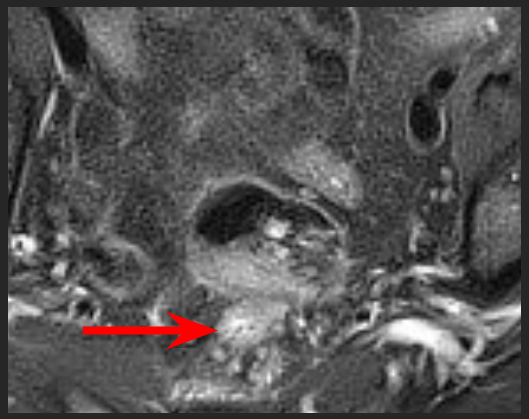
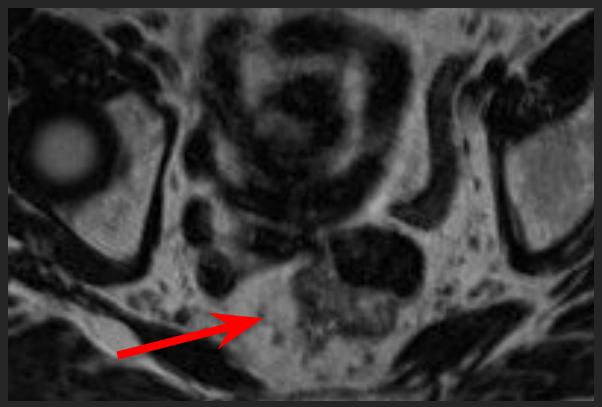
CASE 3 – PRE CRT







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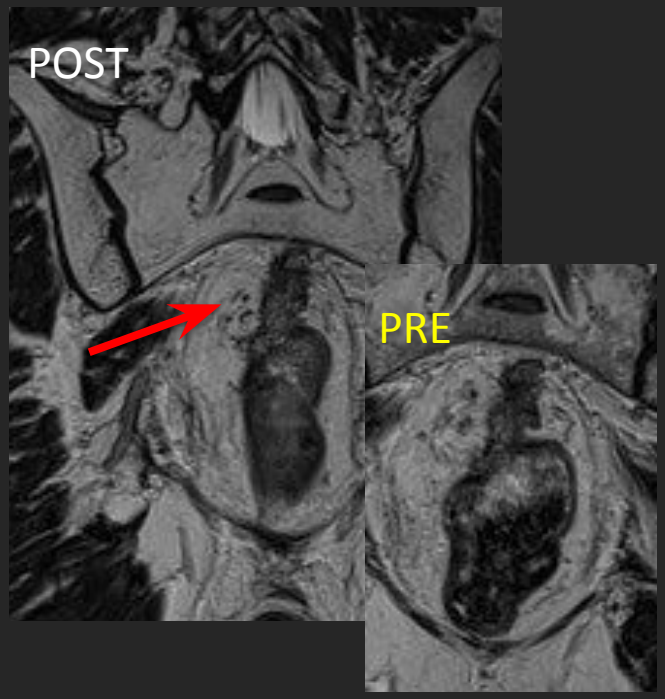
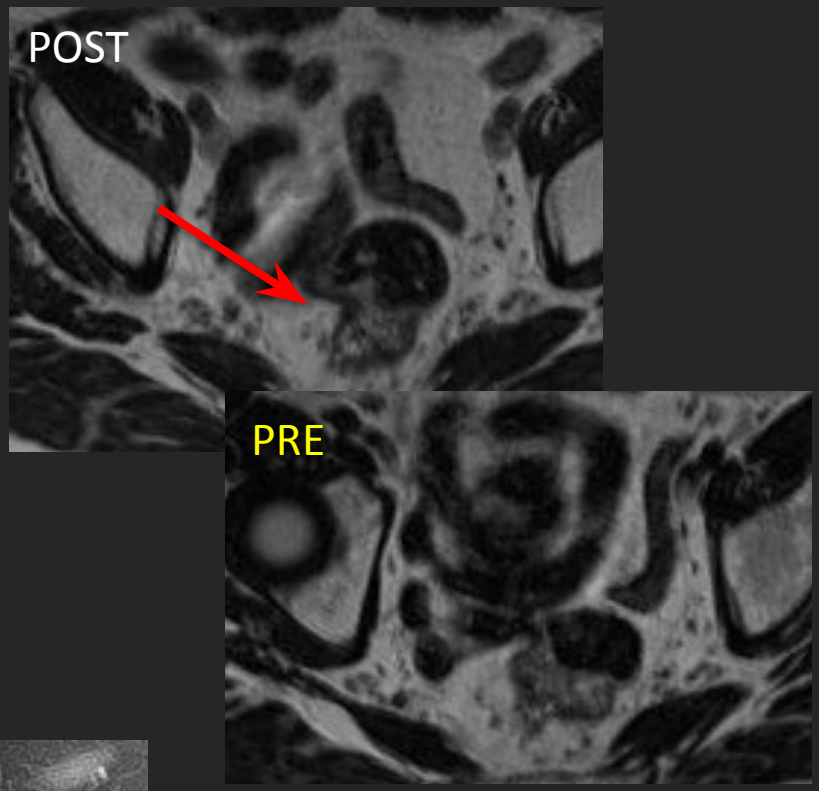
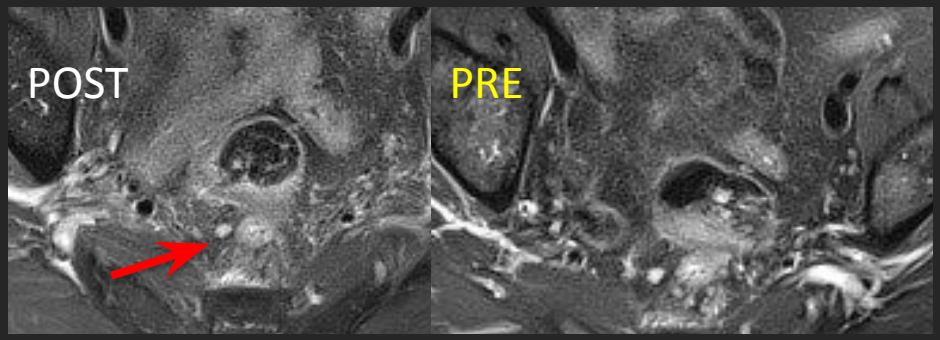
CASE 3 – POST CRT







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mrTRG 4

Slight response with some fibrosis but mostly tumour.

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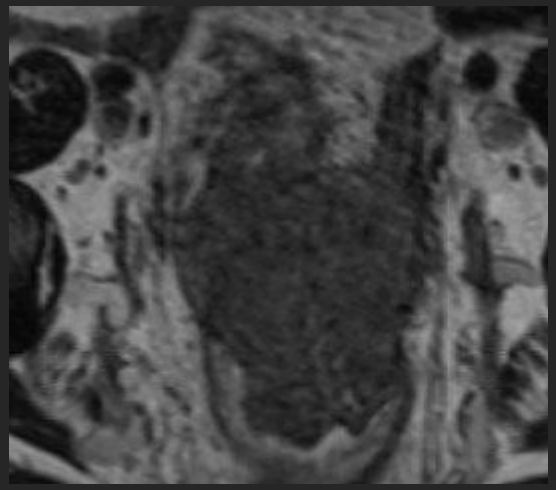
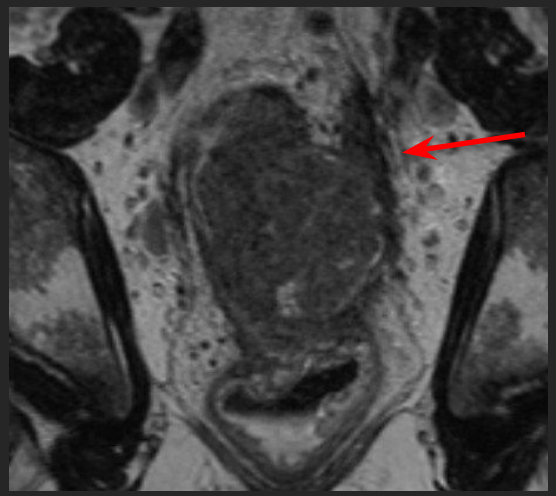
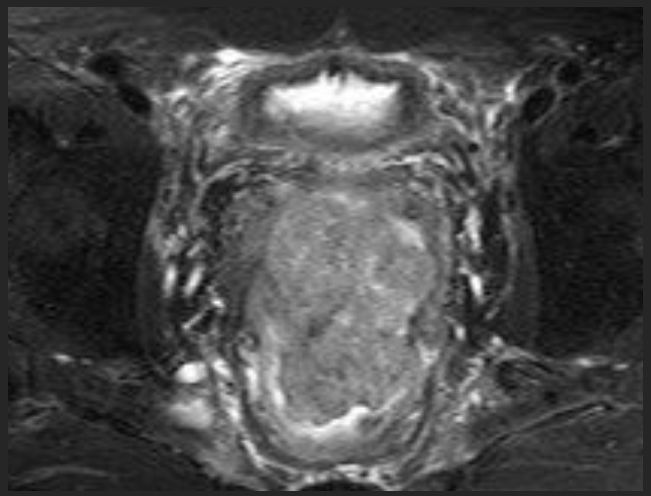
CASE 4 PRE-CRT







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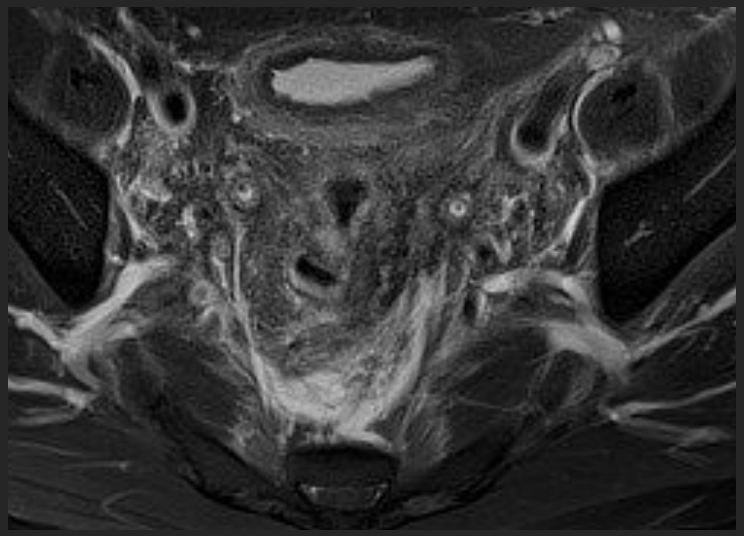
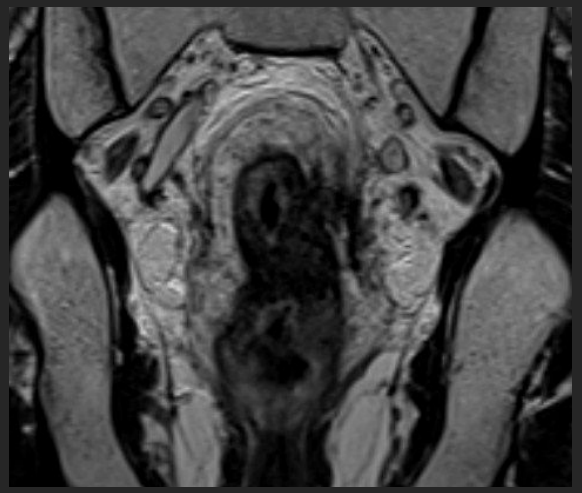
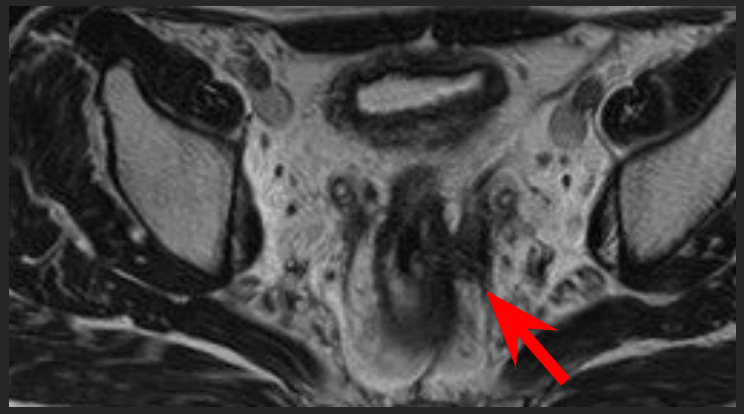
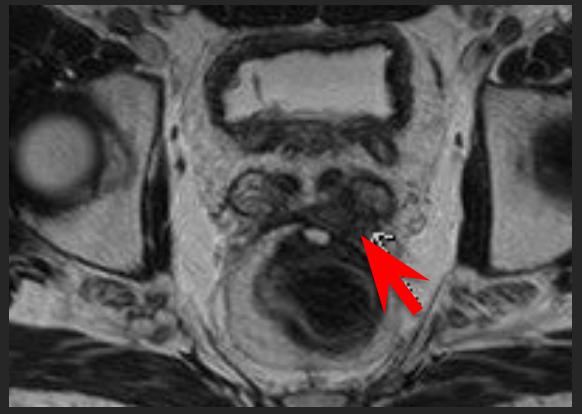
CASE 4 POST-CRT









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mrTRG 2-3

Moderate - good response with > 50% fibrosis and minimal remaining visible tumour.

T4 stage

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Summary

- Imaging techniques
- DISTANCE easy mnemonic to help us remember what to report on
- Some example cases and reports of primary staging
- Brief discussion of post CRT staging and some cases

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Now… challenge yourself to report rectal staging!

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