NHS
East Midlands Radiotherapy
Operational Delivery Network

Radiotherapy Protocol for the management of RECTAL Cancer

This is radiotherapy protocol for the East Midlands RT Operational Delivery Network (ODN).
Tumour sites are: Colon, Rectum

Document revision History

Version Number	Date	Document History.
0.01	01/02/23	Initial Draft By PM
0.02	15/3/23	Amendments from email feedback from J.Branagan
0.03	17/4/23	Changes throughout following protocol review meeting In attendance: P.Das, K.Das Updated draft shared to clinician group
0.04	19/4/23	Comments and changes following feedback meeting with J.Mills
0.05	11/05/23	Shared with UHL and UHDB Radiographer and planning leads for feedback. M.Bland, K.Brocksopp, L.Kedziorek, V.M-Smith
0.06	27/2/24	Reviewed by Radiotherapy planning team. In attendance: D.Holmes, V.Ohlendorf, M.Bland, L.Martins.
0.07	01/03/24	Changes to indications following feedback from J.Branagan, R.Gabitass
0.08	24/04/24	Changes to indication table post colorectal away day. Changes added by KD/PM.
0.09	24/10/24	Re-circulated as requested from 13/09 RT NOG Addition of post local excision of polyp cancer- K.Jarral
1.0	25/10/24	Reviewed and ratified at ECAG 25/10
1.0	November 2024	Uploaded to Sharepoint
V1.1	January 2025	KD/PM- References improved as per Dec 2024 NOG action

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1. Indications for treatment

Radical treatment options:

- Pre-operative long course Radiotherapy +/- Chemotherapy (Capecitabine, 5FU)
- Pre-operative short course radiotherapy
- Post-operative radiotherapy
- Total neoadjuvant therapy (TNT)- chemotherapy in addition to radiotherapy in the neoadjuvant setting.

-Pre-operative treatment plans are managed according to the criteria below following MDT discussion:

	Criteria	Management
Low Risk	•cT1 or cT2 or cT3a and •No lymph node involvement	<u>As per clinician discretion, following local MDT discussion</u> Surgery Or Clinician choice to offer short-course pre-operative radiotherapy or chemo-radiotherapy to patients with low risk operable rectal cancer (surgery recommended choice). Or Contact Radiotherapy can be considered in select patients who are considered not suitable for surgery or choose not to have surgery
Moderate risk	•Any T3/T4, in which the potential surgical margin is not threatened or •Any suspicious lymph node not threatening the surgical resection margin or •The presence of extramural venous invasion(EMVI)	<u>As per clinician discretion, following local MDT discussion</u> Consider short course pre-operative radiotherapy followed by immediate surgery (surgery should be within 7 days of completion of Radiotherapy) or delayed surgery as per local MDT discussions. Or Consider pre-operative chemo-radiotherapy with an interval to allow tumour shrinkage before surgery for patients with tumours that are borderline between moderate and high risk. Or Consider total neo-adjuvant therapy (TNT)
High risk	•A threatened (<1mm) or breached circumferential resection margin(CRM) or •Low tumours encroaching onto the inter-sphincteric plane or with levator involvement •Certain lower 1/3 rectal patients -as per MDT discussion	Consider offering pre-operative chemo-radiotherapy with an interval before surgery to allow shrinkage to patients with high risk operable rectal cancer. Or Consider total neo-adjuvant therapy (TNT)

Postoperative radiotherapy

Consider postoperative radiotherapy:

- Close resection margins (less than or equal to 1mm) and nodal involvement and not received pre-operative radiotherapy.
- Post local excision of polyp cancer where there is R1 resection (+ consider Papillon boost) OR where there is high risk of nodal recurrence (Haggit[6]/ Kikuchi staging[7])

Total Neo-adjuvant Therapy (TNT)

TNT has been shown in multiple trials to reduce local recurrence rates (STELLAR[11]/Prodige 23[8]), reduce distant free metastasis (STELLAR[11], RAPIDO[10], Prodige 23[8]) and improve clinical and pathological complete response (RAPIDO[10], OPRA[9], Prodige 23[8]) for high-risk rectal cancers.[5]

Chemotherapy of 12-16 weeks can be used as:

- Induction (before Radiotherapy) or
- Consolidation (after Radiotherapy) or
- Sandwich (combination of before and after Radiotherapy)

The chemotherapy type would be up to clinician discretion, according to disease characteristics and patient factors. These could be either:

- Two (Oxaplatin, Capecitabine/5FU) or
- Three (FOLFIXIRI) drug regimens.

Radiotherapy options include:

- Long course concurrent chemo-radiation
- Short course Radiotherapy

2. Diagnostics

- Histological confirmation of malignancy
  -Low rectal tumours with squamous carcinoma histology should be treated as per anal cancer protocol

➢ Colonoscopy to exclude synchronous tumours/distance from anal verge.
➢ CT chest abdomen & pelvis for staging.
➢ MRI pelvis to assess local staging.
➢ *PET-CT in selected cases as per MDT*

- Full blood count, serum biochemistry, liver function tests, CEA

- Review of clinical history to include:

-Previous radiotherapy

- Special Circumstances to consider:

-Chronic conditions or disease that affects radiosensitivity
-Ongoing medication that may affect response to radiotherapy

- If clinically indicated:

-Digital rectal examination

3. Information given to patients

-General radiotherapy booklet
-Site specific treatment leaflet including long term side effects

4. Consent

-By IR(ME)R Practitioner at new patient / planning clinic
-By Entitled IR(ME)R Operator under delegated authority at new patient / planning clinic

5. Trials Open

-Consider current trials open in any of the radiotherapy centres in the East Midlands.
-[EMRTN TRIALS TRACKER LINK]
-If a patient is being treated in a clinical trial then the Trial Protocol overrides the departmental protocol.

6. Position and immobilisation

All patients will be CT scanned **as per local protocol** and should consider including the following:

- Patient should be scanned from superior aspect of L2/3 to 4 cm below the lesser trochanters
- Suitable pelvic patient Immobilisation should consider: Knee rest, foot stocks, head support and vacuum cushions if appropriate.
- Patients should be supine with a full bladder as per local protocol
- Prone positioning to be considered in special circumstances
- Use of IV contrast to aid delineation of pelvic vessels is strongly recommended unless contraindicated.
- Following the CT scan, the size of the rectum is reviewed. If it is larger than local protocol requirements and cannot be rectified, the patient should be sent away with advice and return for a rescan.
- If the patients bladder is also outside local protocol and unable to be rectified, the patient should be sent away with advice and return for a rescan
- Use of oral contrast may aid delineation of small bowel.

7. Planning

- IMRT/VMAT is the primary choice of planning technique for radical patients.
- Conformal Radiotherapy may be considered on a case by case basis
- There will be situations where individual anatomy and other special conditions require that the coverage of the PTV may need to be compromised. In these cases the Practitioner is required to exercise his/her clinical judgement and to clearly indicate the clinical priorities to the treatment planning team
- The GTV is to be outlined by the clinical oncologist/registrar or other appropriately trained and approved clinician (e.g. consultant radiographer)
- If the treatment is off protocol this should be noted and the correct local procedure for recording off protocol treatments followed.

Boost

- The indication and rationale for boost, will vary on an individual patient basis depending on, for example, the extent of disease, planned extent of surgery or whether further treatment will be delivered. As such, this is at the discretion of the treating clinician.
- Guidance should be taken from the national IMRT Rectal guidelines[4] and combined with the local centres practice
- For patients treated with SIB, the primary prescription is to the boost volume

Volume definition: IMRT[4]

GTV

GTVp: Macroscopic primary tumour, areas of adjacent extramural vascular invasion or postoperative macroscopic disease identified on imaging.

GTVn: All nodes involved with tumour.

Optional GTV volumes

GTVp_Boost: The areas of GTVp the clinician wishes to boost (which may be identical to the GTVp).

GTVn_Boost: All the areas of GTVn the clinician wishes to boost (which may be identical to the GTVn).
GTVn: is all involved nodes. Involved lymph nodes are defined by the local MDT using all available imaging.

GTVp_Boost: is the areas of tumour that would benefit from a boost. The indication and rationale for doing this will vary on an individual patient basis depending on, for example, the extent of disease, planned extent of surgery or whether further treatment will be delivered. As such, this is at the discretion of the treating clinician.

GTVn_Boost: is the area of nodes that would benefit from a boost. As above, this will differ in each case and will be at the discretion of the treating clinician.

Internal clinical target volume (ICTV)

ICTV is a CTV that includes a margin for motion according to the American Association of Physicists in Medicine (AAPM) and the International Commission on Radiation Units and Measurements (ICRU)

Required in all cases-

ICTVp (primary ICTV): GTVp + 10 mm in all directions except anteriorly where 15 mm can be considered for tumours that may be more mobile anteriorly (eg, upper rectal tumours above the peritoneal reflection).

ICTVn (any grossly involved nodes): GTVn + 5 mm in all directions.

ICTV_elec: All elective nodal groups combined.
ICTV_final: ICTVp + ICTVn + ICTVsb (if present) + ICTV_Elec

Required in selected cases-

ICTVp_Boost: GTVp_Boost + 10mm in all directions except anteriorly where 15 mm can be considered for tumours that may be more mobile anteriorly (eg, upper rectal tumours).

ICTVn_Boost: GTVn_Boost + 5 mm in all directions.

ICTVsb: Area around surgical bed at risk for microscopic disease (for postoperative radiotherapy only).

ICTV_high: ICTVp_Boost + ICTVn_Boost

- ICTVp is GTVp with a margin for microscopic disease and motion. While there is some literature on the motion of primary tumours, there is limited literature on microscopic disease spread hence these are pragmatic margins which are likely to cover both these uncertainties and be usable in clinical practice. ICTVp should be edited off bone in all directions other than posteriorly towards the sacrum and edited off muscles unless there are obturator nodes, in which case the obturator internus muscle should be included on that side.

- ICTVn is GTVn with a margin for microscopic disease and motion. Although mesorectal nodes may move more than 5 mm, to limit the complexity of the guidelines and due to the fall-off dose that will be present in practice, a 5 mm margin is suggested. ICTVn should be edited off bone in all directions other than posteriorly towards the sacrum and edited off muscles unless there are obturator nodes, in which case the obturator internus muscle should be included on that side.

- ICTV_elec covers all elective nodal groups. This volume should always include the nodal compartments of: mesorectum, presacral, obturator nodes and internal iliac nodes.

  – The ICTV_Elec includes a 1 cm margin anterior to the mesorectum to incorporate the motion of the anterior border of the mesorectum as the bladder reduces in size over the treatment in LCRT.

  – If neo-adjuvant chemotherapy has been used, the ICTV_Elec must cover all compartments that contained nodal disease at the outset. Where there was previously disease, superiorly the ICTV_Elec should be 2 cm above the most superior node at outset.

  – If there is radiological evidence suggestive of nodal involvement in any nodal compartment, other than those outlined above (for example, external iliac node or inguinal node) or in the ischiorectal fossa, these complex cases should be discussed at a multidisciplinary team meeting (MDTM). If radiotherapy is planned to these nodes, the entire compartment should also be included. For guidance on delineation of ischiorectal fossa, inguinal nodes or external iliac nodal compartments see anal cancer guidance.1

ICTV_Final: is the combination of ICTVp, ICTVn and ICTV_Elec.

ICTVp_Boost: is GTVp_Boost with a margin for microscopic disease and motion.

ICTVn_Boost: is GTNn_Boost with a margin for microscopic disease and motion.

ICTVsb: is only relevant when treating patients with post-operative radiotherapy. This should include all areas of potential microscopic disease post-operatively, using surgical clips if present. It should cover all areas of disease present on preoperative imaging. These complex cases will likely require thorough MDT discussion before making decisions on target volumes.

ICTV_High: is the area for boosting including a margin for microscopic disease and movement.

Planning target volumes (PTV)

The exact PTV margins used will depend on the centre-specific set-up error but the minimum recommended CTV-PTV margins are outlined below. As shown, two possible margins are suggested for those using two different verification protocols (for example, use of daily imaging versus no daily online imaging). Note that none of the margins below incorporate outlining uncertainties.

With daily online volumetric imaging-

PTV (In patients with one dose level only**)**: ICTV_Final + 5 mm in all directions.

PTV_High: ICTV_High + 5mm in all directions.

PTV_Low (Elective dose level for patients treated with SIB): ICTV_Final + 5 mm in all direct

W**ith offline imaging (verification protocol that does not include daily online imaging)-**

PTV (In patients with one dose level only)**:** ICTV_Final + 10 mm in all directions.

PTV_High: ICTV_High + 10 mm in all directions.

PTV_Low (Elective dose level for patients treated with SIB)**:** ICTV_Final + 10 mm in all directions.

***Option- Volume definition: Standard large field pelvis/ conformal**

GTV = gross tumour

GTV-CTV margins: Tumour with draining lymph nodes including pre-sacral, para-rectal, internal & external iliac. Margin around tumour for sub-mucosal spread.

CTV-PTV margins: Superior border at L5/S1, laterally 1cm from pelvic sidewalls. Inferior border 3.5 cms margin to tumour.
For post abdomino-perineal resection (**APR**) include the scar

Organs at risk (OARs) [4]

The use of bowel loops is recommended due to the Radiation Therapy Oncology Group (RTOG) guidance and the evidence base correlating toxicity and constraints.

The RTOG pelvic normal tissue consensus atlas suggests a bowel cavity for use with gynaecological and urological malignancies, favouring small bowel loops in GI malignancies. However, acknowledging centres may prefer the bowel cavity we provide contouring guidance and constraints should centres wish to use this OAR.

Organ	Suggested treatment planning system (TPS) name	Definition
Small bowel loops	Bowel_Small	Contouring should include all individual small bowel loops to at least 20 mm above the superior extent of both PTVs. It may be helpful to initially delineate the large bowel +/- endometrium to exclude these from subsequent delineation of small bowel.
Bladder	Bladder	Contour outer wall of bladder, inferiorly from its base and superiorly to the dome.
Right and left proximal femurs*	Femur_Head_R Femur_Head_L	Contour femoral ball, neck, greater and lesser trochanters and proximal femoral shaft as a single structure. Superiorly, cranial edge of femoral ball; inferiorly, caudal aspect of lesser trochanter. Tips: Auto-contouring threshold parameters with bone can facilitate this process but requires editing any auto-contouring artefacts.
Bowel cavity (optional)	Spc_Bowel	Contour abdominal contents. Inferiorly from the most inferior small or large bowel loop (excluding rectum), whichever is most inferior. Contour to 2 cm superior to PTV. Exclude: CTV, muscles and major vasculature (common, internal and external iliac vessels) and subtract bladder and uterus (if relevant) from structure.

*Not required in short-course radiotherapy.

Optional in low rectal cancer treated with LCRT:

Organ	Suggested treatment planning system (TPS) name	Definition
External genitalia – female/male	Female_genitalia Male_genitalia	Delineation of the male genitalia should include the penis and scrotum. In a woman, it should include the clitoris, labia majora and minora. The lateral extent of the volume is the inguinal creases. Cranially this will extend to the level of the mid symphysis pubis. Note: this structure is optional in low rectal cancers including the anus or individuals with external iliac or inguinal nodes at risk of toxicity

ICTV_Elec nodal compartment borders[4]

	Superior	Inferior	Lateral	Medial	Anterior	Posterior
Presacral Nodes	Anterior border of the S1/2 junction*, or 2 cm above the highest superior involved node (including those present prior to neo-adjuvant chemo).	Caudal border of the mesorectum	Sacroiliac joints		10 mm anterior to the anterior aspect of the vertebrae or sacrum or 7 mm anterior to the superior rectal artery or inferior mesenteric artery, whichever is more anterior.	Anterior wall of the vertebrae. Include the sacral nerve root notch, exclude iliopsoas.
Mesorectal Nodes	Either the anterior border of the S2/3 junction or, if it can be identified, the bifurcation of the inferior mesorectal artery into the superior mesorectal artery and the sigmoid artery.	Insertion of the levator ani muscle into the external sphincter muscles (disappearing of the mesorectal fat around the rectum). The inferior border should be 2 cm below the inferior GTVp slice, therefore if appropriate continue the ICTV_Elec into the anal canal.	Upper/mid: Mesorectal fascia if visible or medial border of the internal iliac nodes/obturator nodes. Lower: lateral edge of levator ani muscle		Superior: 7 mm anterior to the superior rectal artery or inferior mesorectal artery. This may match with 1 cm presacral anterior margin at S1/2. Mid/inferior: 1 cm anterior to the mesorectal fascia	Anterior surface of the sacrum and coccyx to the level of ischio-rectal fossae (including the medial part of the presacral space).

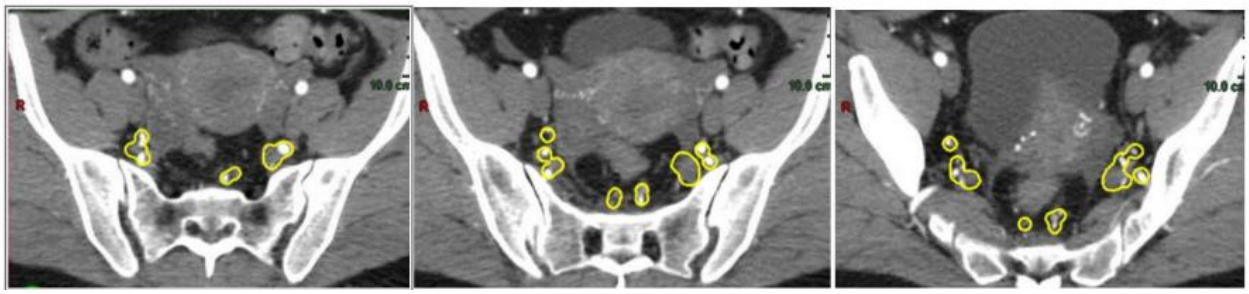
Internal iliac nodes	Anterior border of the S1/2 junction* , or 2 cm above the highest superior involved node (including those present prior to neo-adjuvant chemo).	Superior border of the obturator nodes at the most superior part demonstrating the obturator internus.	7 mm lateral to internal iliac vessels excluding normal anatomical structures (eg, Iliopsoas muscle).	In the upper pelvis, 7 mm medial to internal iliac vessels.	Upper: 7 mm anterior to the internal iliac vessels, excluding normal anatomic structures. Mid/lower: Mesorectal fascia, pelvic organs.	Sacro-iliac bone, Pyriformis muscle or Pre-sacral nodal volume
Obturator Nodes	At the most superior slice demonstrating the obturator internus, the inferior border of the internal iliac nodes	At the point the obturator artery exits the pelvis. This is identified by the obturator artery moving lateral to the obturator internus.	The obturator internus muscle (unless there are pelvic side-wall nodes where the bony sidewall should be used).	Anterior: 17 mm from obturator internus muscle, include areas of bladder if present. Posterior: The mesorectal volume	The anterior extent of the obturator internus muscle.	The sacroiliac joint or the pyriformis.

Creation of ICTV_Elec[4]

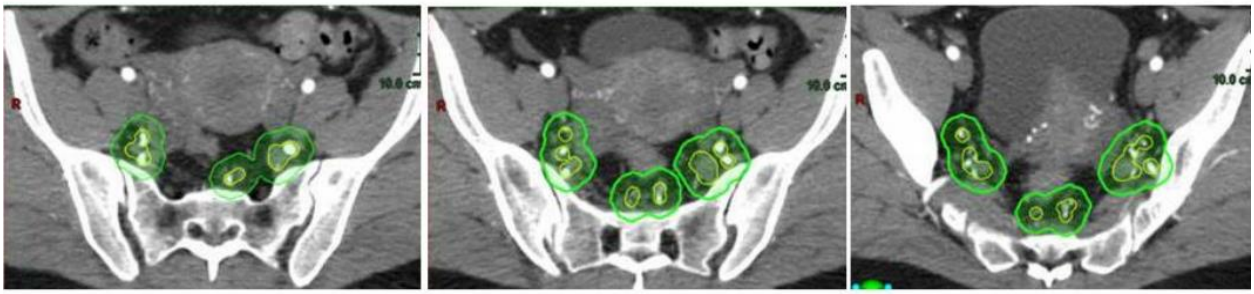
Internal iliac and presacral nodes-

1. Identify the superior most level of ICTVE – this will be either at the junction of S1/S2 or 2 cm above GTV, whichever is most superior.

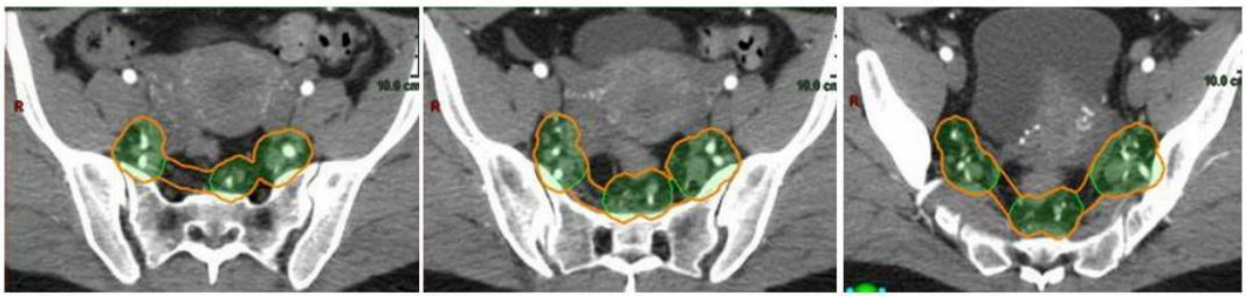
2. Starting at this level outline the internal iliac vessels (artery and vein combined), the inferior mesenteric artery and the superior rectal vessels. Tracing them inferiorly and posteriorly until reaching the level of the obturator internus muscle.



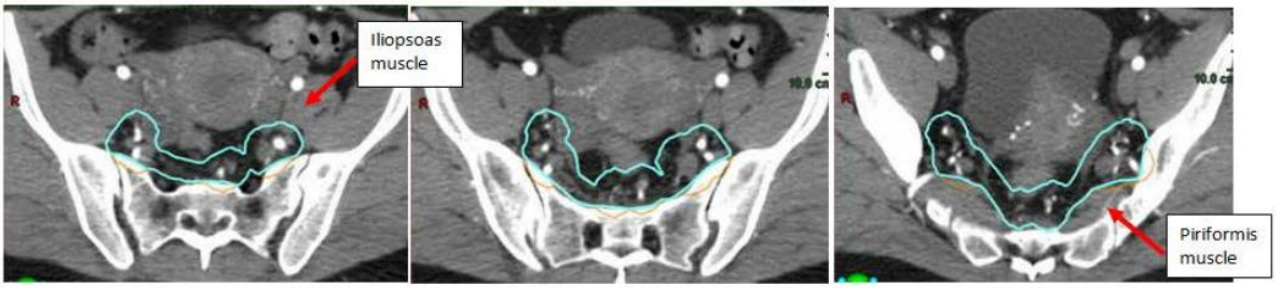
3. Add a 7 mm margin around the vessels, in all directions except in the superior-inferior direction.



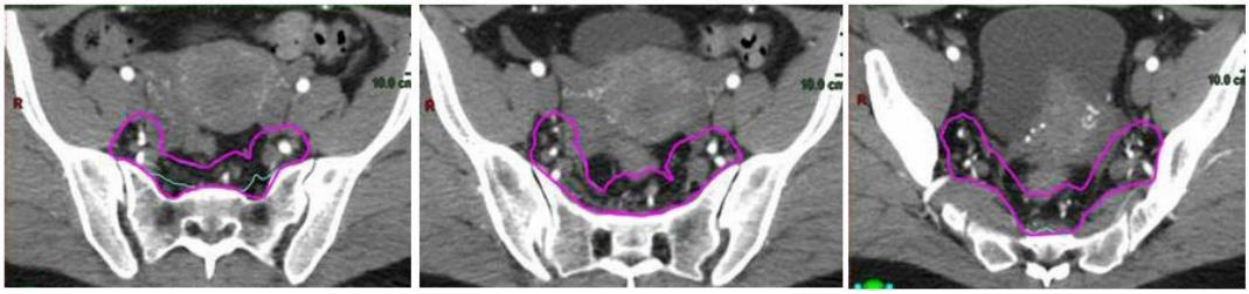
4. Using a 10 mm 'rollerball', join both volumes together along the anterior wall of the vertebra and sacrum to include the remaining pre-sacral nodes



5. Manually edit the volume to exclude bone (unless there is infiltration into bone), piriformis muscles (posteriorly) and iliopsoas muscle (anterolaterally).

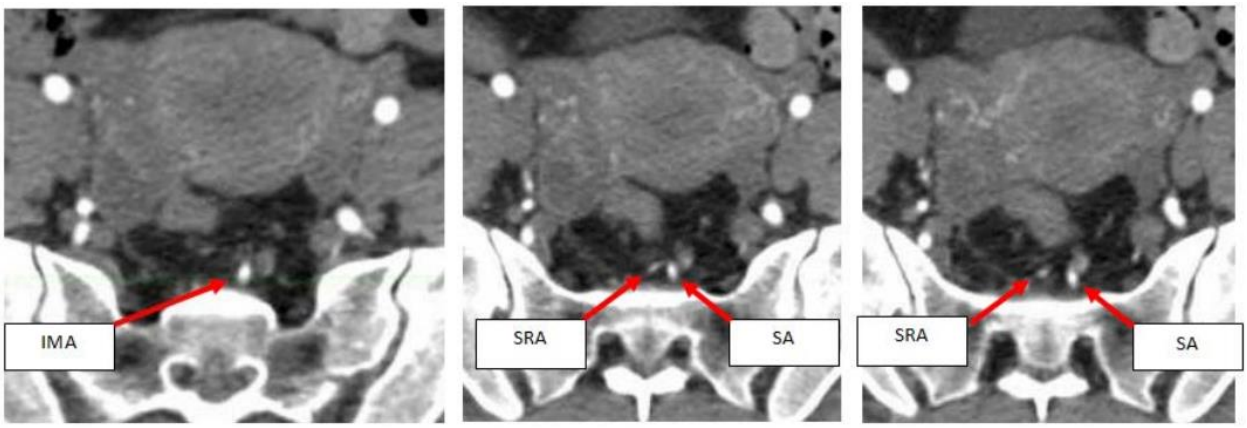


6. Manually edit volume to include sacral notch.

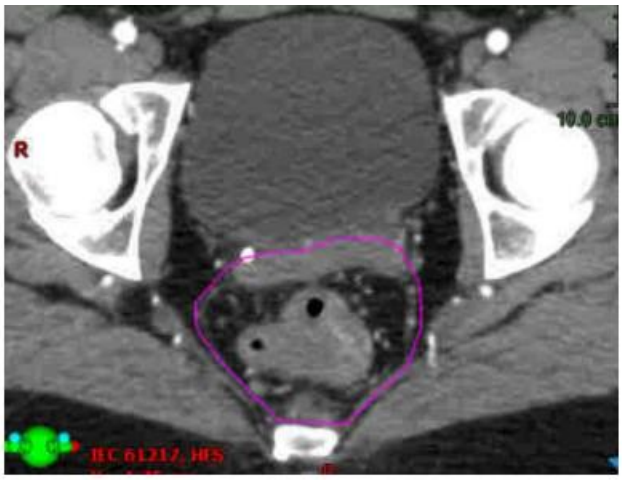


Mesorectum-

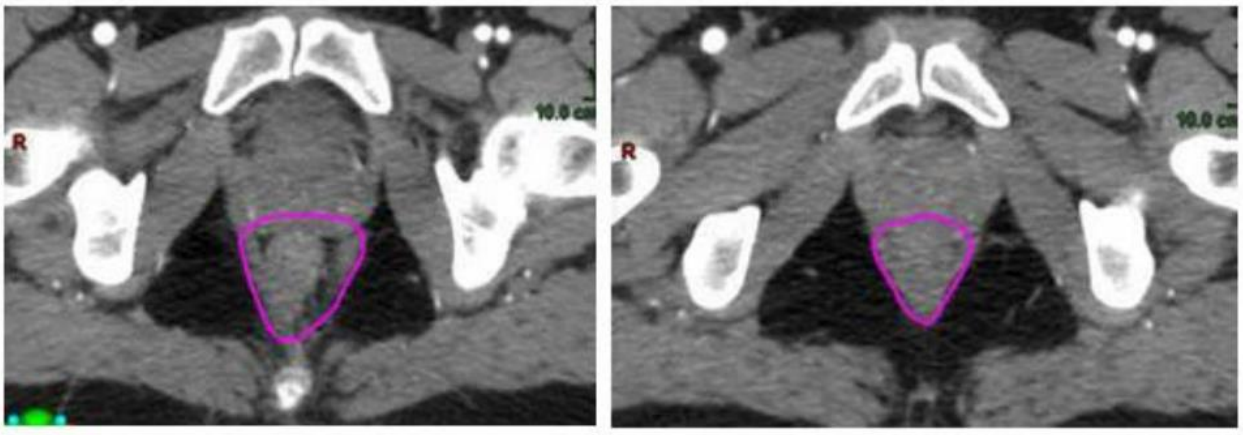
7. Identify the top of the mesorectum defined as either the bifurcation of the inferior mesenteric artery (IMA) into the sigmoid artery (SA) and superior rectal artery (SRA) OR if bifurcation of IMA to SA and SRA is difficult to identify, S2/3.



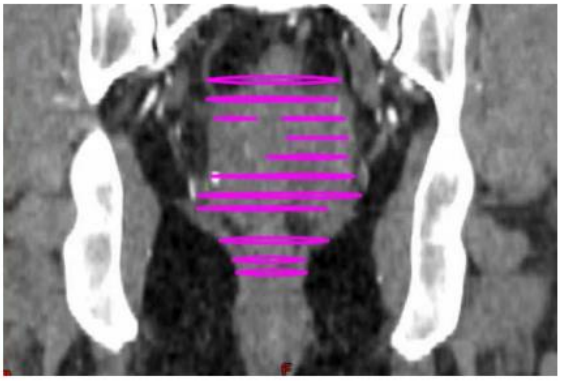
8. Delineate the whole mesorectum with an additional 1 cm anteriorly to allow for anterior motion. This will result in overlap of organs directly anterior to the mesorectum, for example, the uterus, prostate and so on.



9. The mesorectum continues inferiorly until insertion of the levator ani muscle into the external sphincter muscles (disappearing of the mesorectal fat around the rectum) or 2 cm below the inferior GTVp slice, therefore if appropriate continue the ICTV_Elec into the anal canal.. The levators should be included in the volume with the border being the outer wall of the levators .

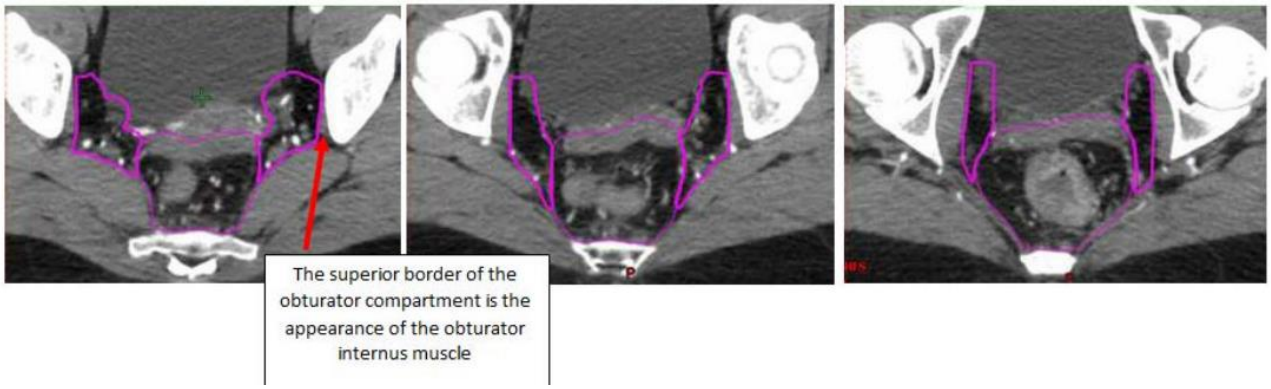


The inferior border can often be visualised more easily on coronal views.

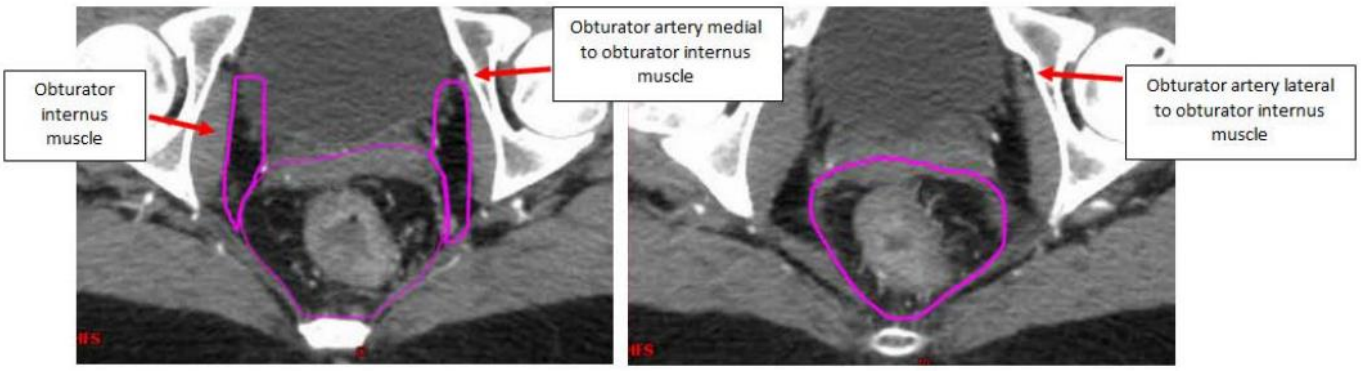


Obturator Nodes-

10. Identify the obturator internus muscle. Using a 17 mm ‘rollerball’ ensure the volume covers the medial aspect of this muscle until the obturator artery moves laterally to the muscle.



11. Where the obturator artery moves lateral to the obturator internus muscle, there are no more obturator nodes so the posterior border will take a large step from one slice to the other



8. Prescribed dose[5]

Criteria	Dose Fractionation
Pre-op short course radiotherapy	**25Gy in 5#** Daily (Grade A)
Pre-op / Down-staging long course radiotherapy (concurrently with chemotherapy)	**45Gy in 25#** Daily (Grade A) (+/- boost of 5.4Gy in 3# to small volumes (Grade C))
	50Gy in 25# + SIB* Daily (Grade C)
Radiotherapy alone / Not suitable for chemotherapy	**45 Gy-50 Gy** in 25 # daily (Grade A) (+/-integrated boost)
	For elderly or those with comorbidities: 25Gy in 5 # daily (Grade B)
Total neoadjuvant therapy (TNT)	**25Gy in 5#** Daily (Grade A)
	45Gy in 25# Daily (Grade A) (+/- boost of 5.4Gy in 3# to small volumes (Grade C))
	50Gy in 25# + SIB* Daily (Grade C)
*SIB	**52Gy in 25# daily-** *An SIB of >50Gy should only be considered in this setting, for example, organ preservation, post-operative with residual macroscopic disease or disease outside the resection margin. A boost volume of 52.0Gy in 25#s may also be considered (This is an equivalent dose to the 54.0Gy in 30 fractions used in the EXPERT trial).*

9. Prescription Point[12]

Prescribed to: Ref ICRU 50, ICRU 62 and ICRU 83 as appropriate for planning technique

10. Dose Constraints

Target Objectives[4]

Volume	OAR/Target	Optimal Constraints
PTV_High	D99%	>90%
	D95%	>95%
	D50%	=100% ± 2%
	D2%	<105%
PTV_Low/PTV	D99%	>90%
	D95%	>95%
	D50%	= 100% ± 2%
PTV_Low minus PTV_ High + 5 mm	V107%	<15%

Dose constraints for long-course radiotherapy:

Organ At Risk	OAR/Target	Objective	Mandatory
Bowel Cavity (optional)	D400cc	<20 Gy	
	D250cc	<30Gy	
	D200cc	<43 Gy	
Bowel Loops	D180cc	<35 Gy	
	D100cc	<40 Gy	
	D65cc	<45 Gy	
	D0.5cc	<52.5 Gy	<52.5 Gy
Femoral Heads*	D50%	<30 Gy	<45 Gy
	D35%	<40 Gy	<50 Gy
	D5%	<50 Gy	<52.5 Gy
Bladder*	D50%	<35 Gy	<45 Gy
	D35%	<40 Gy	<50 Gy
	D5%	<50 Gy	<52.5 Gy
Genitalia*	D50%	<20 Gy	<35 Gy
	D35%	<30 Gy	<40 Gy
	D5%	<40 Gy	<52.5 Gy

*Constraints from Anal cancer IMRT guidelines[13]

Dose constraints for short-course radiotherapy:[4]

Organ At Risk	OAR/Target	Objective
Bowel Cavity (optional)	D400cc	<10 Gy
	D250cc	<18 Gy
	D200cc	<23 Gy
Bowel Loops	D200cc	<20 Gy
	D150cc	<22 Gy
	D20cc	<25 Gy
Bladder	D45%	<21 Gy

11. Contact Radiotherapy (Papillon)

The table below follows the RCR dose dose fractionation (4th Ed)[5] for the management of patients referred for contact radiotherapy for rectal tumours:

Criteria	Details	Dose Fractionation
Post-operative	**pT1** or **pT2** with adverse pathological features	**60 Gy in 2#** Over 2 weeks followed by EBRT (Grade B)
Radical (< 3cm)	**cT1/cN0**	**90–110 Gy in 3–4#** **(30 Gy ×3 and final boost 20 Gy)** Over 3–6 weeks (Grade C)
	cT1/cN1 or **cT2–T3b cN0/cN1** (node <8 mm)	**90–110 Gy in 3–4# (30 Gy ×3)** **Optional final boost (20 Gy)** Over 3–6 weeks, followed by EBRT (Grade A)
Radical (> 3cm)	**cT1/cN1** or **cT2–T3b cN0/cN1** (node <8 mm): EBRT followed by contact radiotherapy or HDR boost if regression to <3 cm	**90 Gy in 3 fractions (30 Gy ×3)** **Optional final boost (20 Gy)** Over 3–6 weeks (Grade A)

-EBRT ideally should follow Contact Radiotherapy by 2/52. But primary EBRT may be necessary to reduce cancer size in which case Contact Radiotherapy should commence 6 weeks post EBRT.

12. Palliative Intent

Patients with limited distant metastatic disease and good performance status may be considered for definitive CRT to maximise locoregional disease control. There may be options for small volume metastases outside of primary region e.g. resection of liver / lung metastases or SABR. Patients with locally advanced disease, but are unfit for CRT, or have metastatic disease, may be considered for palliative radiotherapy.
Dose fractionations are below:[5]
• 30Gy in 10 fractions over 2 weeks • 20Gy in 5 fractions over 1 week • 25Gy in 5 fractions over 1 week • 8Gy or 10Gy in single fraction

13. Treatment

- Final pre-treatment, Physics and 1st day checks should be carried out as per local protocol.
- These should ideally cover or take into account the following:
  -Monitoring and managing Radiotherapy delays to ensure patients start treatment according to national guidelines
  -Checking plan approval status and parameters as per local protocol
  -All prior preparatory and required patient information is available
  -Imaging requirements for the planned treatment are adequate according to patient plan and local protocol
  -Any prior In vivo dosimetry has been performed as per local protocol.

During treatment:

- Any other monitoring as specified in the local protocol should be performed e.g. dietician review, weight checks, weekly blood counts.
- On treatment imaging as per local protocols- **For all radical colorectal patients it is recommended to use IGRT utilising CBCT, unless otherwise contraindicated.**
- For gaps in treatment follow local policy and RCR guidelines
- On treatment and follow up reviews as per local protocols.

14. Late effects

Late effects will have been discussed as part of the initial discussions and counseling by the treating clinician and is dependent on the radiotherapy target volumes.

- Erectile dysfunction-can be supported by referral to Erectile Dysfunction Clinic
- Infertility
- Leg or groin lymphedema -depending on whether pelvic nodes are covered and if a pelvic nodal dissection has been completed
- Change in bladder or bowel habit/capacity
- Rectal bleeding requiring surgical investigation/intervention (in region of <5%)
- Pelvic bone thinning, insufficiency fractures or avascular necrosis is rare
- Bladder or bowel incontinence is rare
- Possible small, long-term increase in risk of rectal cancer is rare (<1%)

15. Peer Review[14]

- Peer Review will enable clinicians to provide high quality treatments despite potentially limited referrals. Documenting peer review is essential as per RCR Recommendation 10 + 11.

- In order to meet the RCR standards the review will cover patient selection, prescription and target / OAR delineation. For some cases it may be necessary to review the final treatment plan also.

- The reviewee must provide the reviewer with all relevant clinical information to peer review, which may include demographics, diagnosis and details of proposed treatment. Any relevant clinical tests or images must also be provided (see Table 1 above).
- Responsibility for the patient will remain with the clinician under whom the patient receives their care. If a peer review does not occur, whatever the reason may be, it is that clinician's responsibility to address this

16. Glossary

Abbreviation	Definition
#	Fraction (i.e. Fractions of treatment)
3DCT	Three dimensional computed tomography (standard CT scan)
CC	Cubic centimeters
CBCT	Cone Beam computed tomography
CEA	Carcinoembryonic antigen
ChemoRT	Chemotherapy with Radiotherapy
CT	Computed tomography
CTV	Clinical target volume
EMRTN	East Midlands Radiotherapy Network
GTV	Gross tumour volume
Gy	Gray (unit of measure for radiation dose)
ICRU	International commission on radiation units and measurements
ICTV	Internal clinical target volume
IGRT	Image guided Radiotherapy
IMA	Inferior mesenteric artery
IMRT	Intensity modulated radiotherapy
IR(ME)R	*Ionising Radiation (Medical Exposure) Regulations*
MDT	Multi-disciplinary team
MRI	Magnetic resonance imaging
NOG	Network oversight group
OAR	Organs at risk
PET (PET-CT)	Positron emission tomography (Positron emission tomography – computed tomography)
PRV	Planning organ at risk volume
PS	Performance status
PTV	Planning target volume
RCR	Royal college of radiologists
RT	Radiotherapy
SA	Sigmoid artery
SABR	Stereotactic ablative Radiotherapy
SRA	Superior mesenteric artery
TNT	Total neoadjuvant therapy
U+E	Urea and electrolytes
VMAT	Volumetric modulated arc therapy
STELLAR	(Clinical Trial)- Short-Term Radiotherapy Plus Chemotherapy Versus Long-Term Chemoradiotherapy in Locally Advanced Rectal Cancer
RAPIDO	(Clinical Trial)- Rectal cancer And Preoperative Induction therapy followed by Dedicated Operation
Prodige 23	(Clinical Trial)- Total neoadjuvant therapy with mFOLFIRINOX versus preoperative chemoradiation in patients with locally advanced rectal cancer
OPRA	(Clinical Trial)- Organ Preservation in Patients With Rectal Adenocarcinoma Treated With Total Neoadjuvant Therapy

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