# User’s Guide for the Synoptic MRI Report for Rectal Cancer

## INSTRUCTIONS

- This User’s Guide accompanies the synoptic MRI report and provides a rationale and detailed explanation of how to report each item on the synoptic MRI report.

- Key points are summarized in text boxes at the start of each section. It is recommended that these text boxes are read prior to using the synoptic MRI report.

- After each text box a detailed explanation is provided and can be used for your reference as necessary.

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1. CURRENT TREATMENT GUIDELINES FOR RECTAL CANCER

- Current CCO guidelines recommend preoperative chemoradiation for Stage II (T3-T4N0) and Stage III (T1-4N1-2) primary rectal cancer.
- PreRT and preCRT significantly reduce the risk of local recurrence but have little effect on overall survival.

Current Cancer Care Ontario (CCO) guidelines recommend preoperative chemoradiation for Stage II (T3-T4N0) and Stage III (T1-4N1-2) primary rectal cancer. These recommendations are based on large randomized controlled trials (RCTs) published in the surgical literature (Table 1) that show preoperative radiotherapy (preRT) and chemoradiotherapy (preCRT) for Stage II and III rectal cancer significantly reduce the risk of local recurrence but have little effect on overall survival.

Although an earlier Swedish RCT did show a significant improvement in survival with preRT, the local recurrence rate was 27% in the surgery alone arm, suggesting that total mesorectal excision (TME) or high quality surgery was not performed in all patients. Due to this finding, it is thought that the preRT compensated for the sub-optimal surgery and led to a survival benefit that has not been reproduced in the other RCTs published subsequently.

Table 1

<table>
<thead>
<tr>
<th>Trial</th>
<th>N</th>
<th>Description</th>
<th>Local Recurrence (%)</th>
<th>Overall Survival (%)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pre-op RT</td>
<td>No RT</td>
</tr>
<tr>
<td>Dutch (NEJM, 2001)</td>
<td>1861</td>
<td>Clinical Stage I-III Pre-op RT vs No Pre-op RT 2 yr follow up</td>
<td>2*</td>
<td>8*</td>
</tr>
<tr>
<td>MRC CR07 NCIC-CTG C016 (Lancet, 2009)</td>
<td>1350</td>
<td>Clinical Stage I-III Pre-op RT vs selective Post op CRT 5 yr follow up</td>
<td>5.0*</td>
<td>12.0*</td>
</tr>
<tr>
<td>German (NEJM, 2004)</td>
<td>823</td>
<td>Stage II and III Pre-op CRT vs Post-op CRT 5 yr follow up</td>
<td>6*</td>
<td>13*</td>
</tr>
<tr>
<td>Polish (BJS, 2006)</td>
<td>312</td>
<td>Stage II and III Pre-op RT vs Pre-op CRT 4 yr follow up</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>Swedish (NEJM, 1997)</td>
<td>1168</td>
<td>Stage I-III Pre-op RT vs No Pre-op RT 5 yr follow up</td>
<td>11*</td>
<td>27*</td>
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</table>

Pre-op RT = preoperative radiation = 25 Gy = 5 fractions X 5 Gy
Pre-op CRT = preoperative chemoradiation = 50.4 Gy = 28 fractions X 1.8 Gy + continuous 5-FU infusion
* denotes p<0.05
Both pre-operative understaging and overstaging significantly affect patient outcomes.

While preRT and preCRT decrease the risk of local recurrence, these modalities also lead to poorer bowel and sexual function compared with surgery alone. Therefore, while understaging leads to omission of preRT or preCRT and an increased risk of local recurrence, overstaging leads to unnecessary treatment with preRT or preCRT and results in poorer bowel and sexual function compared to surgery alone.

2. OVERVIEW OF METHODS USED TO DEVELOP THE SYNOPTIC MRI REPORT

A systematic review of the published literature on the diagnostic accuracy of MRI for staging rectal cancer was performed using Medline, EMBASE and Cochrane databases. The inclusion criteria for the review were: (i) original papers with primary data collection, (ii) use of the pathologic specimen as the gold standard, (iii) published between January 2000 and May 2010, and (iv) English language. The literature search yielded 1145 articles and of these 109 articles met the inclusion criteria and were reviewed in full by 2 GI radiologists and 2 colorectal surgeons. The main findings of the literature review were: (i) involvement of the CRM appeared to be most accurately reported (ii) distinguishing between T2 and T3 tumours is very difficult and (iii) lymph node size was not an accurate predictor of lymph node involvement.

A meta-analysis was then performed using 21 of the studies reviewed to determine the sensitivity, specificity and diagnostic odds ratio for involvement of the CRM, T-category (T1/T2 vs T3/T4) and lymph node status. MRI specificity was significantly higher for CRM involvement (94%, 95%CI 88-97) than for T-category (75%, 95%CI 68-80) and lymph node metastases (71%, 95%CI 59-81). There was no significant difference in sensitivity between the three elements due to wide overlapping confidence intervals. DOR was significantly higher for CRM (56.1, 95%CI 15.3-205.8) than for lymph node metastases (8.3, 95%CI 4.6-14.7) but did not differ significantly from T-category DOR (20.4, 95%CI 11.1-37.3).

Table 2: Sensitivity, specificity, and DOR of MRI for T-category, lymph node metastases and CRM involvement

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>DOR</th>
</tr>
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<tbody>
<tr>
<td>CRM involvement</td>
<td>77 (95%CI 57-90)</td>
<td>94 (95%CI 88-97)</td>
<td>56.1 (95%CI 15.3-205.8)</td>
</tr>
<tr>
<td>T-category</td>
<td>87 (95%CI 81-92)</td>
<td>75 (95%CI 68-80)</td>
<td>20.4 (95%CI 11.1-37.3)</td>
</tr>
<tr>
<td>Lymph node metastases</td>
<td>77 (95%CI 69-84)</td>
<td>71 (95%CI 59-81)</td>
<td>8.3 (95%CI 4.6-14.7)</td>
</tr>
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CI, confidence interval; CRM, circumferential resection margin; DOR, diagnostic odds ratio

Based on the results of the literature review, meta-analysis and expert opinion, a synoptic MRI report for primary rectal cancer was developed (Appendix A). The following sections provide a rationale for the items included on this synoptic report. In addition, the TNM classification has been included as a reference in Appendix B.
3. SYNOPTIC MRI REPORT

A. MRI PROTOCOL

- High resolution, T2-weighted sequences perpendicular to the long axis of the rectum using phased array coil are required in order to acquire appropriate images for rectal cancer.

To achieve optimal visualization of the rectum and surrounding structures for staging of rectal tumours, the protocol utilized by the MERCURY study group is recommended (Table 3).

**Hardware**

Different field strengths may be used with equally good results but require adjustment of imaging parameters to obtain an adequate signal-to-noise ratio. Although endoluminal coil MRI may provide superior imaging resolution, due to its limited usefulness in stricturing rectal tumours and increased cost, it is less widely used across Ontario. On this basis, the evidence and recommendations outlined in this document are intended specifically to guide the use of pelvic phased array coil MRI.

**Patient Preparation**

There is some evidence that rectal distension may improve the accuracy of T-category assessment while having little effect on CRM or lymph node assessment. Other forms of bowel preparation, enemas, anti-peristaltic agents, and intravenous contrast have not been shown to improve staging accuracy significantly and are not endorsed by the MERCURY study group. For the purpose of the synoptic MRI report, these maneuvers are considered optional and are left to the discretion of the individual radiologist and/or centre.

**Sequences**

Four fast-spin echo, T2-weighted sequences without fat saturation are recommended, as summarized below (Table 3). Sequences 1 and 2 give a crude visualization of the primary tumour, possible sites of nodal involvement, and orientation of the tumour. They are used to plan sequences 3 and 4, which are the high-resolution sequences. These sequences enable characterization of nodes and detailed staging of the extent of the primary tumour. T1-weighted sequences are not mandatory as they prolong the study and do not provide additional information.

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Imaging plane</th>
<th>TR/TE (ms)</th>
<th>FOV (cm)</th>
<th>Section thickness (mm)</th>
<th>Matrix size</th>
<th>ETL</th>
<th>NSA</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sagittal</td>
<td>2500-5000/85</td>
<td>24</td>
<td>5-0</td>
<td>512x256</td>
<td>8</td>
<td>2</td>
<td>Allow visualization of the tumour</td>
</tr>
<tr>
<td>2</td>
<td>Axial</td>
<td>4000/85</td>
<td>24</td>
<td>5-0</td>
<td>512x256</td>
<td>8</td>
<td>2</td>
<td>Pelvic sidewall to sidewall, from iliac crest to symphysis pubis</td>
</tr>
<tr>
<td>3</td>
<td>Oblique axial</td>
<td>4000/85</td>
<td>16</td>
<td>3-0</td>
<td>256x256</td>
<td>8</td>
<td>4</td>
<td>Through tumour and perirectal tissues, perpendicular to long axis of rectum</td>
</tr>
<tr>
<td>4</td>
<td>Coronal oblique</td>
<td>4000/85</td>
<td>16</td>
<td>3-0</td>
<td>256x256</td>
<td>8</td>
<td>4</td>
<td>For low rectal tumours (at or below origin of levators)</td>
</tr>
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B. LOCAL STAGING

(1) T-category

- A range for T-category should be reported (i.e., T2/early T3) if a definitive T-category cannot be accurately assessed.

The review of the literature found that in studies including T1 to T4 tumours, overstaging and understaging resulted most often between T2 and T3 tumours (i.e., the threshold for treatment decision-making for preRT and preCRT) \(^{14-20}\).

In cases where a specific T-category cannot be assigned with certainty, we recommend reporting a range of possible T-categories. Although this is not expected to change the actual accuracy of T-category reporting (which is a limitation of MRI technology), it is anticipated that reporting a range of categories will emphasize that diagnostic uncertainty exists and thereby improve communication between the radiologist and clinical team and assist with treatment decision-making.

*Spiculation of the perirectal fat*

- Spiculation of the perirectal fat should be reported as a “T2/early T3 tumour”.

There is controversy as to whether the pattern of spiculation of the tumour into the perirectal fat should be considered as benign desmoplastic reaction or malignant extension. The MERCURY group, led by Dr Gina Brown, considers this pattern of spiculation into the perirectal fat to represent a T2 tumour \(^{21}\), whereas another leading group from the Netherlands, led by Dr Regina Beets-Tan, considers this pattern to represent a T3 tumour \(^{14}\).

To improve consistency in reporting on the synoptic MRI report (not accuracy), it is recommended that the pattern of spiculation of the perirectal fat be reported as “T2/early T3”.

(2) Local invasion beyond the rectum

**Definite invasion:** loss of intervening fat plane and corresponding T2 signal abnormality within the organ.

**Possible invasion:** loss of intervening fat plane and no corresponding T2 signal abnormality within the organ.

**No invasion:** preservation of the intervening fat plane.
The structures listed on the synoptic report are structures that, if involved, would change approach to management.

**Invasion of adjacent organs**  
Bladder, ureter, prostate, uterus/vagina, sacrum and/or internal and external iliac vessels.

**Invasion of the Levator Ani**  
Puborectalis, pubococcygeus and/or iliococcygeus.

**Invasion of the Pelvic Side Wall**  
Pelvic side wall muscles (obturator internus, piriformis and coccygeus) and/or internal iliac artery and vein. In general, tumours invading the pelvic side wall are considered unresectable.

(3) Low rectal cancer

Clinically, low rectal cancer is defined as rectal cancer located 0 to 5 cm from the anal verge. Generally, the literature shows that the risk of perforation and local recurrence is increased for low rectal cancers.

For the purpose of the synoptic MRI report, low rectal cancers have been classified on MRI into two categories relative to the top border of puborectalis as suggested by the MERCURY group. These categories are: (i) tumours in which the lower extent of the tumour is clearly above the top border of puborectalis and (ii) tumours in which the lower extent of the tumour at or below the top border of puborectalis (See Figure 1).

Low rectal tumours in which the lower extent of the tumour is above the top border of puborectalis may be amenable to sphincter sparing surgery and are to be reported similarly to upper and mid rectal tumours on the synoptic MRI report.

- Low rectal tumours in which the lower extent of the tumour is above the top border of puborectalis should be reported similarly to upper and mid rectal tumours on the synoptic MRI report.

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Figure 1:  
Low rectal cancers in which the lower extent of the tumour is at or below the top border of puborectalis generally will require an abdominal perineal resection (T1 and early T2), extralevator APR (advanced T2 and T3) or pelvic exenteration (T4).

- For low rectal cancers in which the lower extent is at or below the top border of puborectalis, the depth of invasion for this portion of the tumour should be reported according to the categories shown on the synoptic MRI report.

For these tumours, the depth of invasion for the portion of the tumour at, straddling or below the top border of the puborectalis should be reported according to the following categories on the synoptic MRI report.

- Possible confinement to the submucosa; no definite involvement of internal sphincter (suspected T1)
- Confined to the internal sphincter; no involvement of intersphincteric fat or external sphincter (early T2)
- Through the internal sphincter and intersphincteric fat; possible or definite involvement of the external sphincter (advanced T2)
- Through the external sphincter and into surrounding soft tissue; no organ involvement (T3)
- Through external sphincter and possible involvement of the adjacent organs (i.e., prostate, vagina) (T3/T4)
- Through external sphincter and definite involvement of adjacent organs (i.e., prostate, vagina) (T4)

(4) Distance to the mesorectal fascia (MRF)

- The CRM is a pathologic term that refers to the surgically dissected surface of the specimen and corresponds to the non-peritonealized aspect of the rectum.

The CRM is a pathologic term that refers to the surgically dissected surface of the specimen and corresponds only to the non-peritonealized aspect of the rectum. The anterior peritoneal reflection is the transition between the peritonealized and non peritonealized portion of the rectum (Figure 2).

Visceral peritoneum and mesentery

BLUE Line = CRM (non-peritonealized rectum)
RED Line = Peritonealized Rectum (not CRM)

Figure 2:
With permission from Dr. Mahmoud Khalifa, Joint Chief, Anatomic Pathology, Sunnybrook Health Sciences Centre and University Health Network Professor, University of Toronto
Based on this pathologic definition, the CRM is only circumferential for rectal tumours below the anterior peritoneal reflection. For upper rectal tumours the CRM is located posteriorly and for upper-mid rectal tumours the CRM is posterior-lateral. Therefore, the CRM does not apply to upper, anterior and anterolateral tumours above the peritoneal reflection where the rectum is peritonealized.

Since the CRM is determined by the extent of the surgical resection which cannot be predicted on MRI, the term mesorectal fascia or MRF is more appropriate for MRI based staging. Therefore, for the purpose of the synoptic MRI report, the term MRF will be used. Similar to the pathological CRM, the MRF is only circumferential for rectal tumours below the anterior peritoneal reflection and does not apply to upper, anterior and anterolateral tumours above the peritoneal reflection where the rectum is peritonealized.

While Beets-Tan has reported that a minimum distance of 5 mm to the MRF results in a 2 mm CRM, more recently Brown has prospectively demonstrated that a minimum CRM of 1 mm on MRI results in a negative CRM in patients who have had surgery alone or pre-op chemoradiation followed by surgery 14, 22-23.

This is clinically relevant since a negative CRM (defined as ≥ 1 mm) is associated with a significantly lower risk of local recurrence than a positive CRM (defined as < 1 mm) 24.

For the synoptic report, the minimum distance to the MRF refers to the shortest distance of the most penetrating component of the definitive tumour border to the MRF, where the definitive tumour border is the nodular or pushing border of the tumour and does not include spiculations or perirectal haziness in the fat.

The minimum distance to the MRF should be reported for all T2 or higher stage tumours where the MRF can be adequately seen or reasonably estimated (i.e. at the level of the prostate and seminal vesicles).

The distance to the MRF should be reported as “not applicable” for any tumour above the peritoneal reflection that involves the peritonealized portion of the rectum (i.e., upper, anterior and anterolateral tumours). This includes T4 tumours involving the peritonealized portion of the rectum (i.e., T4a tumours). For T4 tumour involving adjacent structures (i.e., T4b), the distance to the MRF should be reported as “0”.  

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- The MRF is only circumferential for rectal tumours below the anterior peritoneal reflection.
- The MRF does not apply to anterior, peritonealized surface of the anterior rectum above the anterior peritoneal reflection.

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- The minimum distance to the MRF should be reported for all T2 or higher stage tumours where the MRF can be adequately seen or can be reasonably estimated.
- The minimum distance to the MRF refers to the shortest distance of the definitive tumour border to the MRF, where the definitive tumour border is the nodular or pushing border of the tumour and does not include spiculations or haziness of the perirectal fat.
- If it is not possible to reasonably estimate the MRF, the minimum distance to the MRF should be reported as “unable to assess”.
- The distance to the MRF should be reported as “not applicable” for tumours above the peritoneal reflection involving the peritonealized portion of the rectum (including T4a tumours).
- For T4 tumours invading adjacent structures, the distance to the MRF should be reported as “0”.

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Special Cases

(i) Spiculation into the perirectal fat

For the purpose of the synoptic report, when spiculation into the perirectal fat is present, the minimum distance from the MRF for the definitive tumour border and the spiculations are to be reported separately. This represents a compromise between the MERCURY approach in which distance to the MRF would be reported from the definitive tumour border not the spiculations (considered T2) and the approach reported by Beets-Tan in which the distance to the MRF is reported from the most penetrating spiculation rather than the definitive tumour border.

- The minimum distance to the MRF for the definitive tumour border and the spiculations are to be reported separately.

(ii) Other part of tumour closer to the MRF than most penetrating part of the tumour

In select cases, a different component of the tumour (other than the most penetrating component of the tumour) may be closer to the MRF. This is mostly likely to occur with anterior tumours that straddle the peritoneal reflection that have a T3 component above the peritoneal reflection and a T2 component is below the peritoneal reflection. In this circumstance, the minimum distance to the MRF from the most penetrating part of the tumour or T3 component is above the peritoneal reflection and would be reported as “not applicable”. However, the T2 component below the peritoneal reflection may only be 2 or 3 mm from the MRF and may be particularly close to the prostate or vagina. This information is clinically relevant as pre-operative chemoradiation may be considered for a threatened MRF even though the tumour is only T2.

- If a component of the tumour other than the most penetrating component is closer to the MRF, the minimum distance to the MRF for this other component of the tumour should be reported.
Interpretation of the Anterior Peritoneal Reflection

Interpretation of the anterior peritoneal reflection is challenging. To properly assess the anterior peritoneal reflection, it is important that T2 weighted, axial and sagittal images are reviewed (Figure 3 and Figure 4).

On axial imaging, the apex of the peritoneum attaches to the anterior rectal wall in a V-shaped configuration. In men this is generally at a point just above the tip of the seminal vesicles; in women the point of attachment is more variable.

On sagittal imaging, the peritoneal reflection may be identified as a low signal linear structure that can be seen extending from the posterior aspect of the dome of the bladder to the ventral aspect of the rectum.

Figure 3:
Extramural depth of invasion (EMD) should be reported for all upper, mid and low T3 and T4 tumours.

- EMD is measured for the definitive tumour border only and does not include spiculations into the perirectal fat.
- For T1 and T2 tumours, EMD should be recorded as “0”.

Extramural depth of invasion (EMD) is defined as the extension of tumour into the perirectal fat beyond the muscularis propria and applies to all T3 and T4 tumours. Several retrospective studies have shown that T3 tumours with EMD < 5 mm have improved rates of local recurrence and survival compared to T3 tumours with EMD > 5 mm. Based on this rationale, the MERCURY trial showed that EMD on MRI is extremely accurate with a mean difference of only -0.05 mm (95% CI: -0.49-0.40 mm) between EMD reported on MRI and the pathologic specimen.

Therefore, EMD is included on the synoptic MRI report. This measurement should be reported for all upper, mid and low T3 and T4 tumours. As per the MERCURY study group, EMD is measured for the definitive tumour border only and does not include spiculations or haziness in the perirectal fat. For T1 and T2 tumours, the EMD should be reported as “0”.

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(6) Extramural vascular invasion (EMVI)

Extramural vascular invasion (EMVI) is a pathologic, microscopic feature that refers to invasion of large vessels deep to the muscularis propria and has consistently been shown to be an independent, negative prognostic factor in terms of survival.

An MRI based classification of EMVI proposed by Brown is illustrated below. This classification of EMVI Negative and EMVI Positive will be used for the synoptic MRI report. Using this MRI classification of EMVI, Brown et al. detected EMVI with 62% sensitivity and 88% specificity. In this study, MRI EMVI-positive rectal cancers were found to be associated with advanced pT, pN, and pCRM, synchronous distance metastases and significantly lower recurrence-free survival than MRI EMVI-negative rectal cancers.

In a recent MERCURY study, interobserver agreement on detection of EMVI on MRI among 18 experienced radiologists was fair to moderate (k=0.41, 95% CI 0.31-0.49).

**EMVI Negative (Figure 5)**
- Pattern of tumour extension through muscularis propria is not nodular or no tumour extension in the vicinity of any vascular structure.
- If stranding is demonstrated near extramural vessels, these vessels are of normal caliber with no definite tumour signal within.

Figure 5:
EMVI Positive (Figure 6)

- Intermediate signal intensity within vessels in the vicinity of the tumour or obvious irregular vessel contour.

![Image](36x39)  
**Figure 6:**  

C. MESORECTAL LYMPH NODES

Our literature review showed that MRI has relatively poor accuracy for assessing nodal status (sensitivity 77.0 [95% CI 59-81] and specificity 71 [95% CI 69-84]).

Only three studies have specifically investigated optimal MRI criteria to detect nodal involvement including size, border and signal intensity\(^1\)\(^2\)\(^9\)\(^10\)\(^11\).

The results of these studies suggest that any lymph node or tumour deposit with an irregular border, mixed signal intensity and/or size $\geq 8$ mm should be reported as “suspicious”.

- Any mesorectal lymph node or tumour deposit with an irregular border, mixed signal intensity and/or size $\geq 8$ mm in the short axis should be reported as “suspicious”.

1) Lymph Node Size

Although a size cut-off of 5 mm is commonly used by clinicians to assess nodal status, there is no evidence in the literature to support this size cut-off (see Table 4). In fact, in one study, 15% of lymph nodes $\leq 5$ mm were involved with metastatic disease\(^1\(^9\)\(^10\)\(^11\), suggesting that there is no size limit below which nodal metastasis can be ruled out. On the other hand, very large lymph nodes ($\geq 8$ mm) are highly specific for nodal metastasis\(^1\(^2\)\(^9\)\(^10\)\(^11\). Therefore, it seems that no matter what size cut off is used, the overall predictive value of size is poor due to the substantial overlap in size between benign and malignant lymph nodes.

Both Kim and Brown have reported a 100% specificity to detect lymph node metastasis using the size criteria, 8 mm in the short axis and 1 cm “maximal” diameter, respectively (Table 4). Therefore, for the purpose of the synoptic MRI report, a size criteria of equal to or greater than 8 mm in the short axis has been selected.
Table 4

<table>
<thead>
<tr>
<th>Author</th>
<th>N</th>
<th>Criteria</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matsuoka, 2004</td>
<td>51 patients</td>
<td>6 mm long axis</td>
<td>77.8</td>
<td>78.3</td>
</tr>
<tr>
<td>Kim (Beets-Tan), 2004</td>
<td>75 patients</td>
<td>8 mm short axis</td>
<td>45.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Brown, 2003</td>
<td>284 lymph nodes</td>
<td>1 cm “maximal diameter”</td>
<td>3.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

(2) Border and signal characteristics

- **Irregular border and mixed signal intensity are better predictors of lymph node metastasis than size.**

Lymph node border and signal properties appear to be more specific predictors of lymph node metastasis than size criteria. Notably, irregular borders and mixed signal intensity on T2-weighted imaging are individually highly specific and, in combination, are sensitive and specific to predict lymph node metastasis (sensitivity 85%, specificity 98%) \(^{12, 29-30}\) (Figure 7).

**Smooth Borders and High Signal Intensity**
Pathology shows a benign lymph node. Note that there is a low signal band on the left side of the lymph node on the MRI. This is consistent with chemical shift artifact (not mixed signal intensity).

**Mixed Signal Intensity**
A focus of low signal intensity (arrow) is demonstrated within a predominantly intermediate signal intensity lymph node. Pathology shows tumour with widespread necrosis in the area corresponding to the low signal intensity on MRI (arrow).
The rim of the lymph node is low signal intensity (arrowhead) and represents chemical shift artifact not heterogeneity or mixed signal intensity. This corresponds to normal lymph node capsule on pathology (arrowhead).

**Irregular Border and Mixed Signal Intensity**
Pathology shows extracellular mucin corresponding to the low signal intensity on MRI.
**D. EXTRAMESORECTAL LYMPH NODES**

- Any extramesorectal lymph node with an irregular border, mixed signal intensity and/or size ≥ 1 cm in the short axis should be reported as “suspicious”.

Among published series where pelvic side wall dissection was employed, extramesorectal lymph node metastasis has been reported in up to 17% of patients and is most commonly found in association with locally advanced, low rectal cancers. There is no evidence that treatment of these nodes (with surgery and/or radiation) improves clinical outcomes. Overall, the optimal imaging criteria for identifying extramesorectal lymph nodes have been less well studied than for mesorectal nodes.

<table>
<thead>
<tr>
<th>Author</th>
<th>N</th>
<th>Criteria</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arii, 2006</td>
<td>53 patients</td>
<td>7 mm in diameter</td>
<td>56%</td>
<td>97%</td>
</tr>
<tr>
<td>Matsuoka, 2007</td>
<td>51 patients</td>
<td>5 mm short axis</td>
<td>67%</td>
<td>83%</td>
</tr>
</tbody>
</table>

Therefore, for the purpose of the synoptic report, we have recommended what is currently being used in clinical practice and consider suspicious extramesorectal lymph nodes to be those with irregular border, mixed signal intensity and/or size ≥ 1 cm in the short axis.

**E. FREE TEXT**

This section is available to record additional items not captured or sufficiently described by the synoptic MRI report.

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**Irregular Border and Low Signal Intensity**
Pathology shows no visible nodal tissue and is consistent with a tumour deposit.
F. REFERENCES


1. MRI PROTOCOL
Overall image quality:  □ Adequate  □ Suboptimal  □ Non-diagnostic

2. TUMOUR LOCATION
Tumour location (from anal verge):  □ Low (0-5.0 cm)
□ Mid (5.1-10.0 cm)
□ High (10.1-15.0 cm)

Distance of the lowest extent of tumour from anal verge: _________ cm
Distance of lowest extent of tumour from top of the anal sphincter: _________ cm
Relationship to anterior peritoneal reflection:  □ Above  □ At or straddles  □ Below  □ Not able to assess

3. TUMOUR CHARACTERISTICS
Circumferential extent/location (clock face): _________
Craniocaudad extent: _________ cm
Mucinous:  □ No  □ Yes

4. T-CATEGORY
i) T-category:
□ T1 or T2
□ T2/early T3 [includes spiculation of the perirectal fat]
□ T3
□ T3/possible T4*
□ T4*
*Please indicate structures with possible invasion: ___________________________ (see list below)

<table>
<thead>
<tr>
<th>GU</th>
<th>PELVIC SIDE WALL</th>
<th>BONE/VASCULAR</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>bladder</td>
<td>Obturator internus</td>
<td>sacrum (specify level)</td>
<td>Anterior peritoneal reflection</td>
</tr>
<tr>
<td>left ureter; right ureter</td>
<td>Piriformis</td>
<td>left internal iliac vessels; right internal iliac vessels</td>
<td></td>
</tr>
<tr>
<td>prostate</td>
<td>Pubococcygeus</td>
<td>left external iliac vessels; right external iliac vessels</td>
<td></td>
</tr>
<tr>
<td>uterus</td>
<td>Ileococcygeus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vagina</td>
<td>Coccygeus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ii. For low rectal tumours (0 - 5 cm) only:
Is the lower extent of the tumour at or below the top border of the puborectalis?  □ No  □ Yes*
*If yes, please complete the following section for the most penetrating component of the tumour below the top border of puborectalis:

□ Possible confinement to the submucosa; no definite involvement of internal sphincter (suspected T1)
□ Confined to the internal sphincter; no involvement of intersphincteric fat or external sphincter (early T2)
□ Through the internal sphincter and intersphincteric fat; possible or definite involvement of the external sphincter (advanced T2)
□ Through the external sphincter and into surrounding soft tissue; no organ involvement (T3)
□ Through external sphincter and possible involvement of the adjacent organs (i.e., prostate, vagina) (T3/T4)
□ Through external sphincter and definite involvement of adjacent organs (i.e., prostate, vagina) (T4)
5. DISTANCE TO THE MRF AND EXTRAMURAL DEPTH OF INVASION (EMD)

i) Shortest distance of the definitive tumour border to the MRF = ________ mm
   [or ☐ unable to estimate or ☐ not applicable (involving the peritonealized portion of the rectum or T4a)]

ii) Extramural depth of invasion (EMD) at this level = ________ mm
    [Record 0 mm for T1 and T2 tumours]

iii) Are there any tumour spiculations closer to the MRF? ☐ No ☐ Yes*
    *If yes, please specify distance = ________ mm and location ________________ (on clock face)

iv) Is there any other component of the tumour (any T1-3) closer to the MRF? ☐ No ☐ Yes*
    *If yes, please specify distance = ________ mm and location ________________ (on clock face)

6. EXTRAMURAL VASCULAR INVASION (EMVI)

   EMVI: ☐ Absent ☐ Equivocal ☐ Present

7. MESORECTAL LYMPH NODES AND TUMOUR DEPOSITS

   Any suspicious mesorectal lymph nodes and/or tumour deposits? ☐ No ☐ Yes*
   (suspicious = irregular border, mixed signal intensity and/or ≥ 8 mm)
   *If yes: (please complete a and b)

   (a) Shortest distance of any suspicious mesorectal lymph node/tumour deposit to MRF = ________

   (b) Please indicate location of the lymph node/deposit closest to the MRF:

      ☐ At level of tumour; at ___________ o’clock
      ☐ Above tumour; at ___________ o’clock
      ☐ Below tumour; at ___________ o’clock

8. EXTRAMESORECTAL LYMPH NODES

   Any extramesorectal lymph node(s) with suspicious morphology or signal? ☐ No ☐ Yes*
   (suspicious = irregular border, mixed signal intensity and/or ≥ 1 cm)

   * If yes, please specific location (free text):

9. FREE TEXT/ADDITIONAL COMMENTS
APPENDIX B

TNM Staging Classification

<table>
<thead>
<tr>
<th>Primary Tumour (T)</th>
<th>TX</th>
<th>Primary tumor cannot be assessed.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T0</td>
<td>No evidence of primary tumor.</td>
</tr>
<tr>
<td></td>
<td>Tis</td>
<td>Tis Carcinoma in situ: intraepithelial or invasion of lamina propria.</td>
</tr>
<tr>
<td></td>
<td>T1</td>
<td>Tumor invades submucosa.</td>
</tr>
<tr>
<td></td>
<td>T2</td>
<td>Tumor invades muscularis propria.</td>
</tr>
<tr>
<td></td>
<td>T3</td>
<td>Tumor invades through the muscularis propria into pericolorectal tissues.</td>
</tr>
<tr>
<td></td>
<td>T4a</td>
<td>Tumor penetrates to the surface of the visceral peritoneum.</td>
</tr>
<tr>
<td></td>
<td>T4b</td>
<td>Tumor directly invades or is adherent to other organs or structures.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Regional Lymph Nodes (N)</th>
<th>NX</th>
<th>Regional lymph nodes cannot be assessed.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N0</td>
<td>No regional lymph node metastasis.</td>
</tr>
<tr>
<td></td>
<td>N1</td>
<td>Metastases in 1-3 regional lymph node.</td>
</tr>
<tr>
<td></td>
<td>N2</td>
<td>Metastases in ≥4 regional lymph nodes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distant Metastasis (M)</th>
<th>M0</th>
<th>No distant metastasis.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M1</td>
<td>Distant metastasis.</td>
</tr>
</tbody>
</table>

Stage Prognostic Groups

<table>
<thead>
<tr>
<th>Stage</th>
<th>T</th>
<th>N</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Tis</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>I</td>
<td>T1-T2</td>
<td>N0</td>
<td>M0</td>
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<tr>
<td>II</td>
<td>T3-T4</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>III</td>
<td>Any T</td>
<td>N1-N2</td>
<td>M0</td>
</tr>
<tr>
<td>IV</td>
<td>Any T</td>
<td>Any N</td>
<td>M1</td>
</tr>
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