

Sigmoid take-off as an anatomical landmark for rectal cancer reclassification: impact on multimodal treatment and long-term oncological outcomes. A multicenter retrospective national cohort study (MOLINO study collaborative work)

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Abstract

Background.

The sigmoid take-off (STO) is the internationally agreed anatomical landmark to distinguish rectal from sigmoid cancer on MRI. Its systematic application may reclassify tumors previously managed as rectal cancer, reducing unnecessary neoadjuvant therapy, but its validation in large multicenter cohorts is still lacking. The main aim was to assess the reclassification rate and its impact on treatment and oncological outcomes.

Methods.

Multicenter retrospective cohort study (MOLINO) across 12 Spanish tertiary colorectal units. Patients with rectal adenocarcinoma (stage I-III) who underwent elective curative-intent resection (2017–2023) were included. Preoperative MRI was reviewed by surgeons and radiologists, ambiguous cases were adjudicated by a central radiology panel. Tumors were reclassified as new sigmoid, mid-upper rectum or lower rectum.

Results.

Of 1441 patients, STO was identifiable on MRI in 1411 (97.4%); 328 (22.7%) were reclassified as sigmoid cancer. Neoadjuvant therapy was used in 45.2% of new sigmoid, but was less frequent than rectal cancer ($p < 0.001$). Postoperative complications (29.9%; $p = 0.010$), anastomotic leakage (4.5%; $p < 0.001$), and length of stay (median 5 days; $p < 0.001$) were lower in the new sigmoid group compared to upper and lower rectum. Despite reduced neoadjuvant exposure, disease-free ($p = 0.831$) and overall survival ($p = 0.653$) were comparable between new sigmoid and rectal cancer.

Conclusion.

Systematic STO application reclassified 22.7% of tumors previously managed as rectal cancer as sigmoid cancer, avoiding unnecessary neoadjuvant therapy without compromising perioperative safety or oncological outcomes. These findings support uniform international adoption of the STO in rectal cancer guidelines and multidisciplinary settings.

1. Introduction

Rectal cancer represents approximately one-third of new colorectal cancer cases and remains therapeutically challenging due to its anatomical location, the complexity of surgical resection, and the central role of multidisciplinary decision-making^(1, 2). Its management and molecular features differs from that of colon cancer, with distinct treatment strategies and a different profile of postoperative complications and functional outcomes^(3–5).

Algorithms for rectal cancer treatment are based on the accurate definition of the tumor's anatomical location, however the boundary between the rectum and the sigmoid colon remains inconsistently defined across clinical guidelines ^(6–9). Major international guidelines rely on variable landmarks, including distance from the anal verge, the anterior peritoneal reflection, or the sacral promontory ^(8–12). This heterogeneity has direct clinical consequences on the inclusion and overtreatment of sigmoid tumors as rectal cancers (with neoadjuvant chemoradiotherapy) and potentially diluting treatment effects and complicating outcome comparisons ^(13, 14).

To address this problem, an international Delphi consensus proposed the sigmoid take-off (STO) as the preferred anatomical landmark to define the rectum ⁽⁶⁾. The STO corresponds to the radiological point where sigmoid mesocolon transitions into the mesorectum, identifiable on MRI as the site where the sigmoid moves horizontally away from the sacrum on sagittal views and ventrally on axial views ⁽⁶⁾. Retrospective series have shown that systematic use of the STO reclassifies approximately 11–13% of previously diagnosed rectal tumors as sigmoid cancers, with potential implications for both neoadjuvant and adjuvant therapy ^(13, 15, 16). However, the STO has not been uniformly incorporated into international guidelines. Variability in its application remains substantial, and validation in different healthcare systems is still limited ^(17, 18).

The MOLINO study was designed to evaluate the clinical and prognostic impact of systematic STO application in a large multicenter Spanish cohort. The primary objective was to quantify the proportion of tumors previously managed as rectal cancer that would be reclassified as sigmoid cancer according to the STO. Secondary objectives were to describe differences in multimodal treatment, surgical approach, perioperative outcomes, and long-term oncological results between reclassified sigmoid tumors and STO-confirmed rectal tumors.

2. Methods

2.1. Study design

This was a nationwide multicenter, retrospective, observational cohort study conducted across 12 Spanish tertiary referral colorectal units. Consecutive adult patients (≥ 18 years) with histologically confirmed rectal adenocarcinoma who underwent elective curative-intent resection between January 1st, 2017 and December 31st, 2023 were included and follow-up was extended until December 31st 2025. Eligible procedures comprised high anterior resection, low anterior resection, and abdominoperineal excision, with either total or partial mesorectal excision depending on tumor location.

Exclusion criteria were: tumors located more than 20 cm from the anal verge on endoscopy (as these do not pose the rectosigmoid classification dilemma); synchronous distant metastases at diagnosis (stage IV); emergency or palliative resections; absent preoperative MRI or MRI of insufficient diagnostic quality to assess the STO; tumor not visible on preoperative MRI (e.g., after previous endoscopic resection); resections performed for local regrowth after a watch-and-wait strategy or for locoregional recurrence;

and anal canal tumors. Patients with a previous diagnosis of rectal tumors in whom the STO was not identifiable were classified as mid–high or low rectal tumors, as appropriate. The study was reported in accordance with the STROBE statement for observational studies⁽¹⁹⁾. The protocol was approved by the Research Ethics Committee of Ramon y Cajal University Hospital and by the local institutional review boards of all participating centers. Individual informed consent was waived due to the retrospective design.

2.2. Sigmoid take-off definition and reclassification process

The sigmoid take-off was defined following the international Delphi consensus as the anatomical transition between the mesorectum and the sigmoid mesocolon^(6, 18). On MRI, the STO (Fig. 1) was identified as the point where the sigmoid colon moves horizontally away from the sacrum on sagittal views and ventrally on axial views, corresponding to the junction between the rectal and sigmoid mesenteries^(6, 18). Tumors were classified in three categories according to the location of their lower border on MRI:

- New sigmoid: lower tumor border completely above the STO.
- Mid-upper rectum: lower tumor starting at or below STO and and >5cm from the anal verge by MRI.
- Lower rectum: lower tumor border $\leq$ 5cm from the anal verge by MRI.

At each participating center, preoperative MRI was jointly reviewed by colorectal surgeons and radiologists with specific experience in pelvic oncological imaging. When local evaluation was inconclusive or when disagreement persisted, anonymized MRI studies were forwarded to the central radiology panel of the coordinating institution, composed of three abdominal radiologists with dedicated expertise in rectal cancer imaging, for final adjudication. Reclassification was performed blinded to perioperative and oncological outcomes. Prior to the start of data collection, participating teams received an online standardized training document on STO identification, as recommended in previous implementation studies⁽¹⁷⁾.

2.3. Data and outcomes

Variables were collected from institutional electronic records and entered into a standardized electronic case report form hosted on the REDCap® platform. Data were pseudonymized at source, and only the local principal investigator retained the link to original data. Collected variables included patient demographics (age, sex, body mass index, ASA score, Charlson Comorbidity Index), tumor characteristics (distance from the anal verge on MRI and colonoscopy, clinical TNM stage, mesorectal fascia status, extramural vascular invasion), neoadjuvant treatment modality and toxicity, surgical approach and procedure, intraoperative and postoperative complications graded by Clavien–Dindo classification⁽²⁰⁾, length of stay, pathological findings (tumor grade, tumor budding, lymphovascular invasion, perineural invasion, tumor deposits, pCRM status, tumor regression grade, pTNM, and

mesorectal specimen quality according to Nagtegaal–Quirke criteria ⁽²¹⁾), adjuvant therapy, and oncological follow-up (local recurrence, distant recurrence, disease-free survival, overall survival). Patients with missing follow-up data for the disease-free survival or overall survival endpoints were excluded from the survival analysis.

The primary outcome was the proportion of patients reclassified from rectal to sigmoid cancer according to the STO. Secondary outcomes were differences in baseline characteristics, neoadjuvant and adjuvant treatment exposure, perioperative morbidity, pathological quality, and long-term oncological endpoints between new sigmoid group, upper rectum and lower rectum. A positive circumferential resection margin was defined as tumor ≤ 1 mm from the circumferential margin.

2.4. Statistical analysis

Continuous variables are presented as median (interquartile range, IQR) and compared using the Kruskal–Wallis test. Categorical variables are expressed as frequency (percentage) and compared using the chi-square test or Fisher's exact test, as appropriate. Kaplan–Meier curves were used to estimate overall and disease-free survival and compared using the log-rank test. A two-sided p-value < 0.05 was considered statistically significant. Given the retrospective and descriptive nature of the study, no formal sample size calculation was performed; all consecutive eligible patients from the participating centers were included. Analyses were performed using SPSS v.22.0 (IBM Corp., Armonk, NY, USA).

3. Results

3.1. Demographics and tumor characteristics

A total of 1441 patients met the inclusion criteria across the 12 participating centers. The STO was identifiable on preoperative MRI in 1411 patients (97.4%). The main reasons for non-identification were previous abdominal or pelvic surgery and anatomical alterations of pelvic structures, whether functional or structural. Application of the STO resulted in the reclassification of 328 tumors (22.7% of the total cohort) previously managed as rectal cancer as sigmoid cancer. Three groups were subsequently analyzed: new sigmoid (n = 332, 23.0%), mid-upper rectum (n = 802, 55.7%), and lower rectum (n = 307, 21.3%).

Baseline patient characteristics are summarized in Table 1. Median age was higher in the lower rectum group (72 years, IQR 61–77) than in the new sigmoid and mid-upper rectum groups (both 69 years; p = 0.022). No significant differences were observed in body mass index, sex distribution, ASA score or Charlson Comorbidity Index between groups. Tumor height differed markedly, as expected from the definition itself: the median distance of the lower tumor border from the anal verge was 12 cm (IQR 11–14) in the new sigmoid group, 8 cm (IQR 7–10) in the mid-upper rectum, and 3 cm (IQR 2–4) in the lower rectum on MRI, with similar findings on endoscopy (p < 0.001 for both measurements). Clinical T stage distribution differed significantly (p < 0.001): cT4a tumors were more frequent in the new sigmoid group

(21.3%), whereas cT4b tumors were concentrated in the lower rectum group (13.1%). No differences were found between Clinical nodal stage and mesorectal fascia involvement on MRI between groups.

Table 1

Baseline demographics and tumor characteristics by sigmoid take-off (STO) reclassification group.

n	New sigmoid (STO) n (%)	Upper rectum n (%)	Lower rectum n (%)	p value
	332	802	307	
Age, years – median (IQR)	69 (61–77)	69 (61–77)	72 (61–77)	0.022
BMI, kg/m ² – median (IQR)	26 (23–29)	26 (24–29)	26 (24–29)	0.796
Sex				0.123
Male	205 (61.7)	536 (66.8)	212 (69.1)	
Female	127 (38.3)	266 (33.2)	95 (30.9)	
ASA score				0.063
I	27 (8.1)	38 (4.7)	15 (4.9)	
II	178 (53.6)	395 (49.3)	152 (49.5)	
III	115 (34.6)	341 (42.6)	124 (40.4)	
IV	12 (3.6)	27 (3.4)	19 (4.9)	
V	0	0	1 (0.3)	
CCI				0.292
0–3	89 (30.8)	200 (29.3)	92 (34.5)	
4–8	164 (56.7)	415 (60.9)	147 (55.1)	
9–12	33 (11.4)	60 (8.8)	28 (10.5)	
> 12	3 (1.0)	7 (1.0)	0	
Tumor height by MRI, cm – median (IQR)	12 (11–14)	8 (7–10)	3 (2–4)	< 0.001
Tumor height by colonoscopy, cm – median (IQR)	12 (10–15)	9 (6–10)	3 (1–4)	< 0.001
Tumor characteristics				
cT stage (MRI)				< 0.001
T1	3 (0.9)	12 (1.5)	5 (1.6)	
<i>Abbreviations: STO, sigmoid take-off; IQR, interquartile range; BMI, body mass index; ASA, American Society of Anesthesiologists; CCI, Charlson Comorbidity Index; MRI, magnetic resonance imaging; CRM, circumferential resection margin.</i>				
☒ Among patients who received neoadjuvant treatment.				

n	New sigmoid (STO) n (%)	Upper rectum n (%)	Lower rectum n (%)	p value
	332	802	307	
T2	67 (20.7)	172 (21.7)	72 (23.6)	
T3	177 (54.6)	489 (61.8)	153 (50.2)	
T4a	69 (21.3)	99 (12.5)	35 (11.5)	
T4b	8 (2.5)	19 (2.4)	40 (13.1)	
cN stage (MRI)				0.384
N0	102 (31.3)	253 (31.9)	98 (32.1)	
N1	128 (39.3)	262 (33.1)	98 (32.1)	
N1c	3 (0.9)	11 (1.4)	3 (1.0)	
N2a	75 (23.0)	197 (24.9)	75 (24.6)	
N2b	18 (5.5)	69 (8.7)	31 (10.2)	
CRM (MRI)				0.061
Positive	96 (36.4)	235 (35.7)	101 (44.3)	
Negative	168 (63.6)	424 (64.3)	127 (55.7)	
Neoadjuvant treatment				< 0.001
No	181 (54.8)	244 (30.7)	55 (18.1)	
Yes	149 (45.2)	550 (69.3)	249 (81.9)	
Chemoradiotherapy toxicity[‡]				0.643
No	109 (71.2)	383 (68.9)	165 (66.8)	
Yes	44 (28.8)	173 (31.3)	82 (33.2)	
<i>Abbreviations: STO, sigmoid take-off; IQR, interquartile range; BMI, body mass index; ASA, American Society of Anesthesiologists; CCI, Charlson Comorbidity Index; MRI, magnetic resonance imaging; CRM, circumferential resection margin.</i>				
[‡] Among patients who received neoadjuvant treatment.				

Use of neoadjuvant treatment differed substantially according to STO-based classification: 45.2% in the new sigmoid group, 69.3% in the mid-upper rectum group, and 81.9% in the lower rectum group ($p < 0.001$). Among patients who received neoadjuvant chemoradiotherapy, the incidence of treatment toxicity was similar across groups (28.8% vs 31.3% vs 33.2%; $p = 0.643$).

3.2. Postoperative outcomes

Surgical and postoperative outcomes are detailed in Table 2. A minimally invasive approach was used in the majority of cases (> 92% in all groups) with no significant between-group differences ($p = 0.268$). Operative time was shortest in the new sigmoid group (median 217 min) and longest in the lower rectum group (245 min; $p < 0.001$). Primary anastomosis was performed in 94.0% of new sigmoid patients, in 82.6% of upper rectum patients, and in only 30.7% of lower rectum patients ($p < 0.001$). Defunctioning ileostomy was most frequent in the upper rectum group (54.5%; $p < 0.001$) but the rate of ileostomy remained high in new sigmoid patients 31,3%.

Table 2

Surgical, pathological, and oncological outcomes by sigmoid take-off (STO) reclassification group.

n	New sigmoid (STO) n (%)	Upper rectum n (%)	Lower rectum n (%)	p value
	332	802	307	
Operative time, min – median (IQR)	217 (130–255)	230 (135–292)	245 (180–300)	< 0.001
Surgical approach				0.268
Open	16 (4.9)	57 (7.3)	24 (7.9)	
Minimally invasive	309 (95.1)	729 (92.7)	279 (92.1)	
Primary anastomosis	311 (94.0)	662 (82.6)	94 (30.7)	< 0.001
Defunctioning ileostomy ^(*)	103 (31.3)	431 (65.2)	74 (78.7)	< 0.001
Intraoperative complications	14 (4.3)	44 (15.7)	13 (4.4)	0.511
Conversion to open surgery	22 (6.7)	44 (5.7)	13 (4.3)	0.423
Postoperative global complications	99 (29.9)	295 (37.1)	125 (41.3)	0.010
Anastomotic leakage ^(*)	15 (4.8)	77 (11.7)	7 (7.5)	< 0.001
Length of stay, days – median (IQR)	5 (4–9)	6 (4–11)	8 (5–13)	< 0.001
Clavien–Dindo classification				0.210
I	32 (32.3)	77 (26.2)	31 (24.8)	
II	37 (37.4)	102 (34.7)	62 (49.6)	
IIIa	8 (8.1)	19 (6.5)	8 (6.4)	
IIIb	17 (17.2)	67 (22.8)	16 (12.8)	
IVa	3 (3.0)	19 (5.8)	6 (4.8)	
IVb	1 (1.0)	4 (1.4)	0	
V	1 (1.0)	8 (2.7)	2 (1.6)	
<i>Abbreviations: STO, sigmoid take-off; IQR, interquartile range; LVEI, lymphovascular and extramural venous invasion; CRM, circumferential resection margin; TRG, tumor regression grade (Mandard); ypT/ypN, pathological staging after neoadjuvant treatment.</i>				
<i>(*)Excluding Hartmann procedure and abdominoperineal resections.</i>				

n	New sigmoid (STO) n (%)	Upper rectum n (%)	Lower rectum n (%)	p value
	332	802	307	
Pathological outcomes				
Tumor grade				0.818
Well differentiated	65 (22.0)	141 (21.8)	51 (19.7)	
Moderately differentiated	212 (71.6)	474 (73.1)	191 (73.7)	
Poorly differentiated	19 (6.4)	33 (5.1)	17 (6.6)	
Budding	101 (44.5)	170 (33.2)	66 (32.4)	0.007
LVEI	65 (21.3)	114 (15.2)	57 (20.7)	0.023
Perineural invasion	80 (25.2)	135 (17.9)	70 (24.6)	0.007
Tumor deposits	32 (12.2)	76 (12.0)	42 (16.8)	0.146
ypCRM positive	16 (5.1)	37 (5.0)	31 (11.0)	0.001
TRG				0.746
TRG 0	22 (15.3)	110 (20.4)	42 (17.6)	
TRG 1	49 (34.0)	183 (34.0)	82 (34.3)	
TRG 2	54 (37.5)	170 (31.5)	78 (32.6)	
TRG 3	19 (13.2)	76 (14.1)	37 (15.5)	
pT stage				< 0.001
T0	22 (6.8)	110 (14.0)	42 (14.1)	
T1	26 (8.0)	87 (11.1)	21 (7.1)	
T2	77 (23.8)	234 (29.8)	86 (29.0)	
T3	179 (55.2)	333 (42.4)	130 (43.8)	
T4	20 (6.2)	22 (2.8)	18 (6.1)	
pN stage				0.007
N0	205 (63.1)	553 (71.4)	206 (71.3)	
Abbreviations: STO, sigmoid take-off; IQR, interquartile range; LVEI, lymphovascular and extramural venous invasion; CRM, circumferential resection margin; TRG, tumor regression grade (Mandard); ypT/ypN, pathological staging after neoadjuvant treatment.				
(*)Excluding Hartmann procedure and abdominoperineal resections.				

n	New sigmoid (STO) n (%)	Upper rectum n (%)	Lower rectum n (%)	p value
	332	802	307	
N1a	38 (11.7)	93 (12.0)	32 (11.1)	
N1b	40 (12.3)	49 (6.3)	14 (4.8)	
N1c	14 (4.3)	33 (4.3)	18 (6.2)	
N2	28 (8.6)	47 (6.1)	19 (6.6)	
Mesorectal quality assessment				< 0.001
Complete	248 (89.5)	598 (82.0)	186 (66.4)	
Near complete	19 (5.4)	77 (10.6)	48 (17.1)	
Incomplete	14 (5.1)	55 (7.4)	46 (16.4)	
Oncological follow-up				
Adjuvant therapy	171 (52.1)	423 (53.9)	183 (61.8)	0.030
Relapse	55 (18.0)	144 (19.5)	82 (29.5)	0.001
Site of recurrence				0.507
Local	7 (3.0)	24 (2.9)	7 (2.3)	
Distant	40 (17.2)	97 (12.1)	46 (14.9)	
<i>Abbreviations: STO, sigmoid take-off; IQR, interquartile range; LVEI, lymphovascular and extramural venous invasion; CRM, circumferential resection margin; TRG, tumor regression grade (Mandard); ypT/ypN, pathological staging after neoadjuvant treatment.</i>				
<i>(*)Excluding Hartmann procedure and abdominoperineal resections.</i>				

Postoperative complications were less common in the new sigmoid group (29.9%) than in the mid-upper (37.1%) and lower rectum groups (41.3%; $p = 0.010$). Anastomotic leakage excluding Hartmann procedure and abdominoperineal resections occurred in 4.8% of new sigmoid patients, 11.7% of mid-upper rectum patients, and 7.5% of lower rectum patients ($p < 0.001$). Median length of stay was shorter in the new sigmoid group (5 days, IQR 4–9) than in the mid-upper (6 days) and lower rectum (8 days) groups ($p < 0.001$). The distribution of Clavien–Dindo severity grades were not different between groups ($p = 0.210$).

3.3. Oncological implications

Pathological findings and oncological outcomes are detailed in Table 2. Tumor grade distribution was comparable between groups ($p = 0.818$). Tumor budding (44.5% vs 33.2% vs 32.4%; $p = 0.007$),

lymphovascular and extramural venous invasion (21.3% vs 15.2% vs 20.7%; $p = 0.023$) and perineural invasion (25.2% vs 17.9% vs 24.6%; $p = 0.007$) were more frequent in the new sigmoid group, likely reflecting the absence of neoadjuvant downstaging in most of these patients. A positive pCRM was more common in lower rectum tumors (11.0%; $p = 0.001$). Mesorectal specimen quality was complete in 89.5% of new sigmoid cases and decreased to 82.0% and 66.4% in the mid-upper and lower rectum groups, respectively ($p < 0.001$). The pT stage distribution differed significantly ($p < 0.001$) showing that pT3 was the most frequent category in the new sigmoid group (55.2%) and less frequent in the upper and lower rectum groups (42.4% and 43.8%, respectively), consistent with the lower use of neoadjuvant downstaging.

Adjuvant therapy was administered more frequently in the lower rectum group (61.8%) than in the new sigmoid and upper rectum groups (52.1% and 53.9%; $p = 0.030$). The median follow-up was 42 months (IQR 27–61). During follow-up, relapse occurred in 18.0%, 19.5%, and 29.5% of new sigmoid, mid-upper rectum, and lower rectum patients, respectively ($p = 0.001$). The site of recurrence (local vs distant) did not differ significantly between groups ($p = 0.507$).

Despite receiving neoadjuvant therapy less frequently, patients in the new sigmoid group showed disease-free (Fig. 2) and overall survival (Fig. 3) comparable to those of the combined rectum group (Figs. 1 and 2). Disease-free survival were similar between new sigmoid and rectum patients ($p = 0.831$). Overall survival was also comparable between groups over the available follow-up period, with no statistically significant difference ($p = 0.653$).

4. Discussion and conclusion

In this large multicenter Spanish cohort, systematic application of the sigmoid take-off reclassified 22.7% of tumors previously managed as rectal cancer as sigmoid cancer. The STO was identifiable on preoperative MRI in 97.4% of cases, confirming its feasibility in routine practice by colorectal surgeons. A substantial proportion of patients with sigmoid tumors received neoadjuvant therapy (45.2%), suggesting potential overtreatment when compared with lower rectal cancer indications. New sigmoid tumors had also fewer postoperative complications, lower anastomotic leakage rates, and shorter length of stay than rectal cancer. Critically, despite considerably less neoadjuvant exposure, oncological outcomes (both disease-free and overall survival) were not inferior compared with STO-confirmed rectal tumors. These findings support the central clinical value of the STO: it identifies a patient subgroup in whom multimodal treatment can be safely reduced.

The reclassification rate observed in our cohort (22.7%) is higher than those reported by Hazen et al. in a Dutch nationwide cross-sectional study (11%)⁽¹⁵⁾ and by Burghgraef et al. in the MIRECA multicenter cohort (13.1%)⁽¹³⁾. This discrepancy likely reflects the heterogeneity of pre-STO definitions used across different healthcare systems. In the Netherlands, a distance of 15 cm from the anal verge on endoscopy was most commonly used^(7, 15), whereas in Spain heterogeneous definitions combining anal verge distance and anatomical landmarks such as the anterior peritoneal reflection or sacral promontory were

frequent used ⁽⁷⁾. Spanish centers may therefore have previously classified a greater proportion of proximal tumors as rectal cancer in the pre-STO time. Bogveradze et al. similarly reported that a substantial proportion of tumors previously considered upper rectal or rectosigmoid were relocated above the STO upon reassessment (28.4%) ⁽¹⁸⁾. The interhospital variability in reclassification rates reported elsewhere (0–36% across Dutch hospitals) ⁽²²⁾ underscores the need for uniform application of the STO and for structured training in its identification ⁽¹⁷⁾.

Our oncological results are concordant with previous evidence. Li et al. demonstrated that the benefit of neoadjuvant chemoradiation is restricted to tumors located below the STO and that its effect is diluted when sigmoid tumors are included in rectal cancer series ⁽¹⁶⁾. Hazen et al. further reported that tumors above the STO had a lower locoregional recurrence rate and higher overall survival compared with tumors located below the STO ⁽²²⁾. Notably, they observed a higher locoregional recurrence rate in tumors below the STO (9%) compared with our series (2.3%), whereas no differences were identified for tumors located above the STO. In the MIRECA cohort, new sigmoid tumors showed fewer postoperative complications, lower anastomotic leakage, and comparable long-term oncological outcomes relative to rectal tumors ⁽¹³⁾. Furthermore, this evidence, now extended by our data in a large Spanish multicenter cohort, supports the hypothesis that routine neoadjuvant therapy in reclassified sigmoid tumors may constitute overtreatment. In our series, 45.2% of new sigmoid patients still received neoadjuvant therapy, a high rate that after full adoption of the STO, could be substantially reduced, reserving multimodal treatment for tumors with proper mesorectal involvement or locally advanced features.

Uniform adoption of the STO has direct clinical implications. On the one hand, it may avoid unnecessary neoadjuvant therapy in tumors unlikely to benefit, thereby reducing toxicity, functional disorders and the logistic burden associated with multimodal treatment. On the other hand, it facilitates a more appropriate application of adjuvant therapy recommendations in accordance with the biological profile of the primary tumor. New sigmoid tumors with positive pathological lymph nodes or poor features may qualify for adjuvant chemotherapy according to colon cancer guidelines, while the same nodal stage in true rectal cancer often does not receive adjuvant treatment under current European recommendations ⁽⁹⁾. A homogeneous definition facilitates comparability between rectal cancer trials, registries and auditing systems, a well establish source of heterogeneity in the literature^(6, 13). The STO has already been adopted into the Dutch national guideline and mandatory colorectal audit ⁽²²⁾, as well as into the updated ESGAR consensus for MRI-based primary staging ⁽²³⁾. Our data from a different healthcare system reinforce its generalizability and support its incorporation into European and international rectal cancer guidelines.

This study has several limitations. First, its retrospective nature introduces the risk of selection and information bias, although the standardized electronic data capture and the involvement of reference colorectal units mitigate this risk. Second, interobserver variability in identifying the STO on MRI has been previously documented even among experienced readers ⁽¹⁸⁾. We attempted to minimize this variability through joint surgeon – radiologist evaluation at each center and central adjudication of

ambiguous cases, but residual variability cannot be fully excluded. Third, the retrospective reassessment of preoperative imaging does not fully replicate the real-time application of the STO in a multidisciplinary team meeting, and prospective data are needed to confirm the impact of STO on contemporary treatment decisions. Finally, follow-up duration was variable and a limited number of patients were missed during this time. Longer follow-up is warranted to confirm the observed equivalence in long-term oncological outcomes. The strengths of the study include its multicenter design, the large sample size, the national representativeness of Spanish colorectal practice, the systematic STO reclassification supported by central radiological review, and the comprehensive assessment of perioperative, pathological, and oncological endpoints.

In conclusion, systematic application of the sigmoid take-off reclassified 22.7% of tumors previously managed as rectal cancer as sigmoid cancer in this large multicenter cohort. The reclassification may be associated with a substantial reduction in neoadjuvant therapy exposure and improved perioperative outcomes, without compromising long-term oncological results. Uniform adoption of the STO across international rectal cancer guidelines is warranted to standardize classification and may to prevent overtreatment.

Declarations

Conflicts of interest:

The authors declare no conflicts of interest.

Ethical approval:

The study protocol was approved by the Research Ethics Committee (CEIm) of Hospital Universitario Ramón y Cajal and by the local Institutional Review Boards of all participating centers. The requirement for individual informed consent was waived given the retrospective observational design.

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Figures

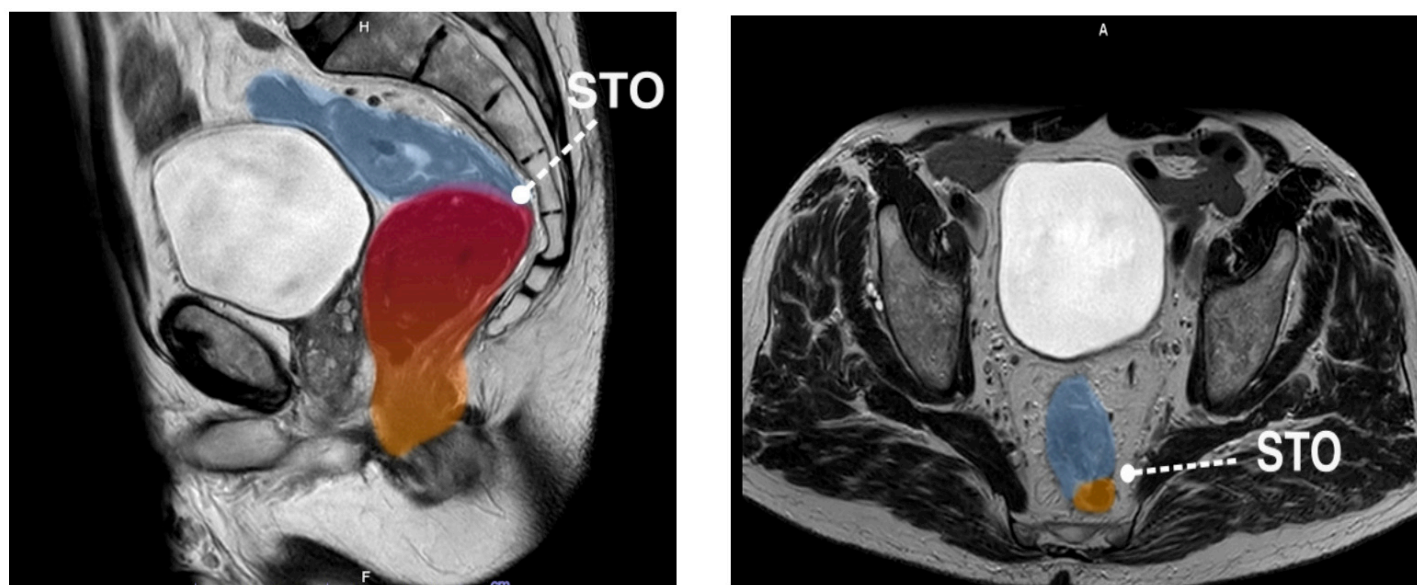
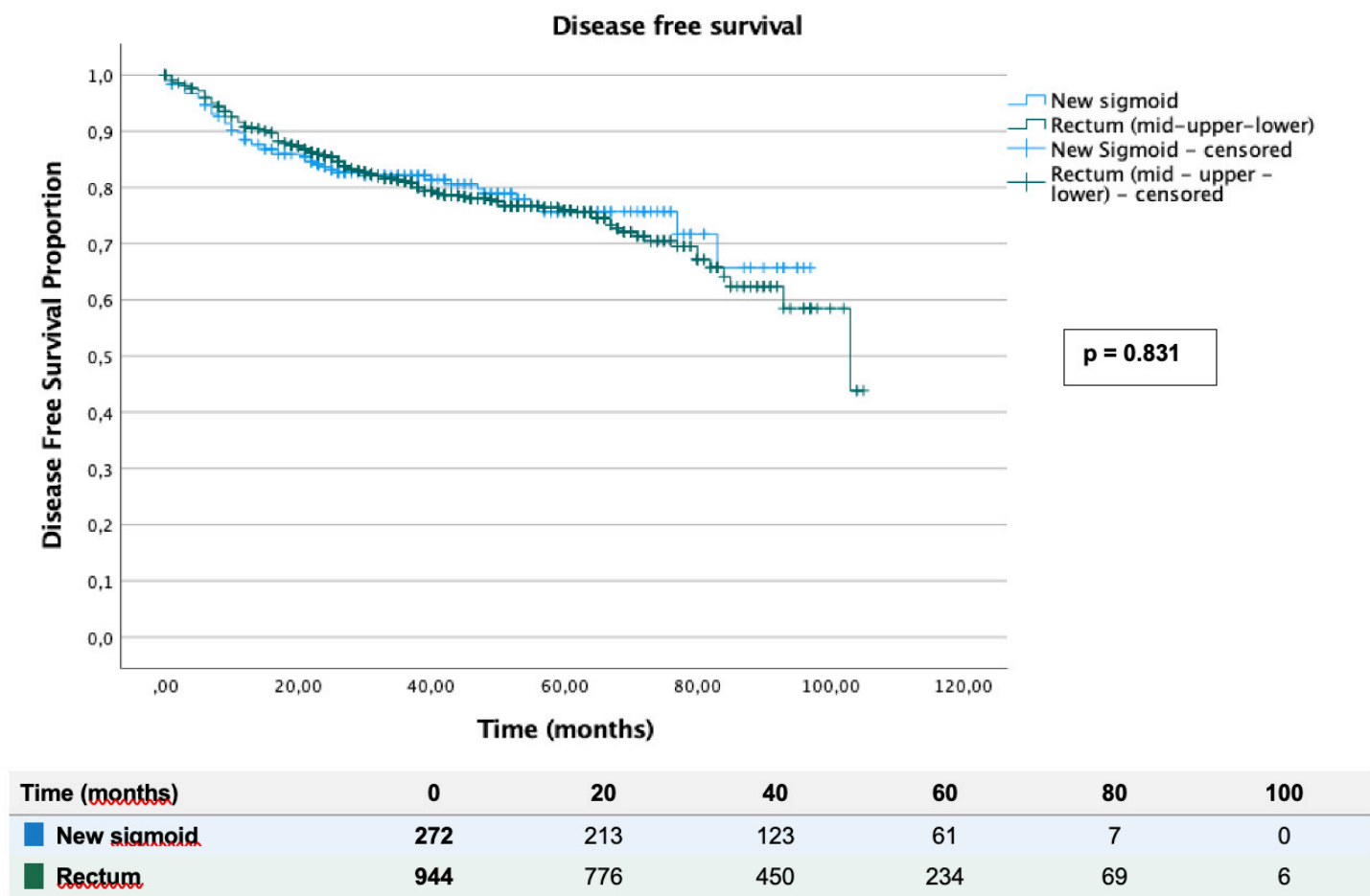


Figure 1

Sagittal and axial MRI images showing ST0

Figure 2. Disease-Free Survival. New sigmoid vs. Rectum (upper + lower rectum).

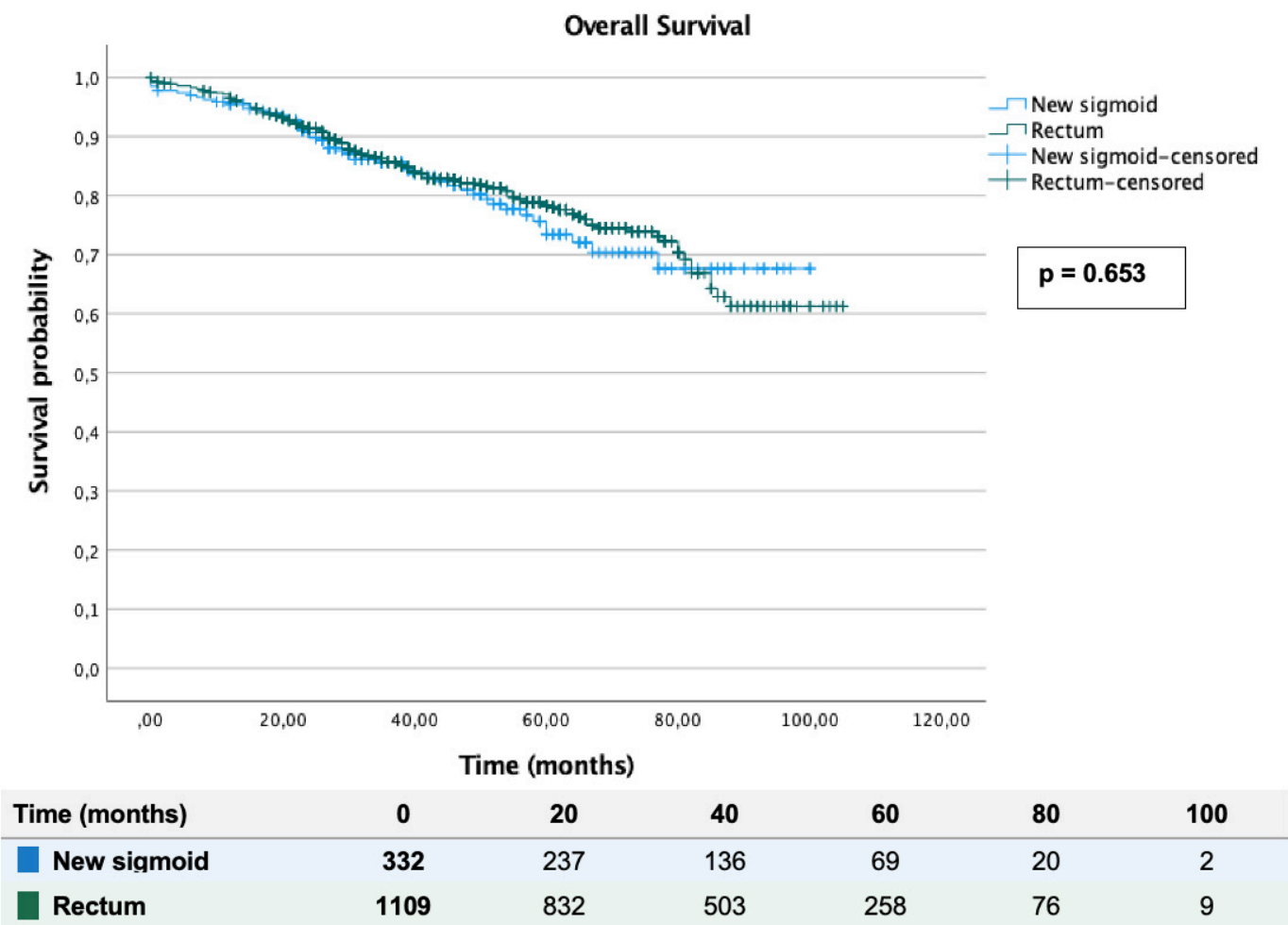


Abbreviations: N at risk derived: Rectum = upper rectum + lower rectum. Patients with missing disease-free survival data were excluded from the analysis (analyzed: new sigmoid n = 272; rectum n = 944). Maximum follow-up: 97 months (new sigmoid), 105 months (rectum). Log-rank p = 0.831.

Figure 2

Disease-free survival for new sigmoid versus rectum groups.

Figure 3. Overall survival for new sigmoid versus rectum groups.



Abbreviations: *N at risk*. Rectum = mid-upper rectum (n = 802) + lower rectum (n = 307).
Log-rank p = 0.653. Maximum follow-up 105 months== Patients with missing overall survival data were excluded from the analysis

Figure 3

Overall survival for new sigmoid versus rectum groups.