

Longitudinal changes in bowel function and quality of life after restorative rectal cancer surgery in a Moroccan cohort

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Abstract

Background

Bowel dysfunction following restorative rectal cancer surgery can persist despite improvement over time. We examined within-patient changes in bowel function and health-related quality of life at recorded 3-, 6- and 12-month assessments in a Moroccan cohort.

Methods

This single-centre observational analysis included 50 patients with endoscopically recorded rectal adenocarcinoma from a 78-patient colorectal dataset. The remaining 28 rectosigmoid cases were described separately. Low anterior resection syndrome (LARS), Wexner incontinence and European Organisation for Research and Treatment of Cancer QLQ-C30 scores were calculated from individual items. The primary endpoint was the paired change in LARS score between 3 and 12 months. Mean changes were estimated with participant-level bootstrap 95% confidence intervals (CIs). Associations between 12-month LARS and quality of life were exploratory.

Results

Mean age was 58.3 years; 25 patients were women. Forty-five received chemoradiotherapy and 42 underwent protective ileostomy. LARS scores were available for 42, 43 and 43 patients at 3, 6 and 12 months. Among 40 patients with paired assessments, mean LARS decreased from 34.1 to 23.5, a change of -10.6 points (95% CI -12.8 to -8.3). Major LARS decreased from 31/40 (77.5%) to 10/40 (25.0%). Mean paired Wexner score decreased by 4.9 points (95% CI 3.8–6.0 improvement). Among 49 paired respondents, global health status/quality of life increased by 12.1 points (95% CI 9.5–14.6). At 12 months, higher LARS scores correlated with lower global quality of life (Spearman rho -0.66 ; 95% CI -0.81 to -0.45 ; $n = 43$).

Conclusions

Bowel function and global quality of life improved between the recorded 3- and 12-month assessments, but major LARS persisted in one quarter of paired respondents. These findings support repeated functional assessment while requiring cautious interpretation because of missing questionnaires, heterogeneous treatment and the absence of preoperative measurements.

Background

Restorative surgery for rectal cancer preserves intestinal continuity but may leave patients with urgency, clustering, altered stool frequency and incontinence. The international consensus definition of low

anterior resection syndrome (LARS) places these symptoms alongside their consequences for daily life, emphasizing that bowel function is an essential component of survivorship care [1]. The five-item LARS score provides a practical measure of symptom severity, although a numerical score cannot capture every aspect of postoperative bowel dysfunction [2].

The timing of assessment matters. An early postoperative score may reflect a different stage of adaptation from a score obtained after a year of restored continuity. In a recent prospective study, Lauwereins and colleagues followed patients for two years and observed the largest reduction in major LARS during the first six months, with no statistically detectable subsequent change [3]. Such findings provide a useful reference for longitudinal assessment, but trajectories may differ with tumour location, treatment, time since stoma closure and questionnaire completion.

Quality of life should also be measured directly. In a 2024 study of patients with lower rectal tumours, Homma and colleagues reported an association between LARS severity and fecal incontinence-related quality of life [4]. However, symptom scores do not necessarily describe all determinants of well-being. Recent work on patient activation suggests that patients' ability to manage their health may contribute information beyond bowel symptom severity [5]. Evaluating bowel function and quality of life together therefore provides a broader account of recovery than either outcome alone.

The Moroccan Arabic LARS questionnaire has been validated, supporting its use in the local setting [6]. The present study addresses a different question from instrument validation: how bowel function and quality of life change within individual patients across three recorded follow-up assessments. We focused the primary analysis on rectal tumours and retained rectosigmoid cases as a separate contextual group. The primary objective was to estimate the paired change in LARS score between 3 and 12 months. Secondary objectives were to describe changes in continence and quality of life, persistence of major LARS and associations between bowel symptoms and quality of life at 12 months.

Methods

Study design and setting

This single-centre retro-prospective study was conducted in the Department of Visceral Surgery B at Hassan II University Hospital, Fez, Morocco, between January 2019 and December 2023. Retrospective clinical information was combined with prospective functional follow-up. Clinical information was collected from medical records, and patient-reported outcomes were obtained during routine follow-up consultations.

The manuscript was organized with reference to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations [7]. This analysis used the corrected study workbook containing 78 unique patients. No treatment was assigned for the purposes of the present analysis. The analytical focus and statistical methods were developed after review of the available dataset; they were not prospectively registered.

Participants and anatomical groups

Patients undergoing curative sphincter-preserving surgery for histologically confirmed colorectal adenocarcinoma at the study centre were eligible. Exclusion criteria were anal cancer, palliative surgery, surgery performed at another centre, tumours of adjacent organs invading the colorectum, neuropsychiatric disorders precluding assessment, and refusal to participate. The analytical dataset contained 78 eligible patient records. The total number screened and counts excluded for each reason were not available in this dataset.

For this manuscript, rectal location was defined by the endoscopic categories recorded in the database: lower, middle or upper rectum. These categories identified 50 patients for the primary analysis. Twenty-eight patients with a rectosigmoid junction location formed a separate descriptive group. Exact tumour distances in centimetres and a standardized radiological definition of the rectosigmoid boundary were not available. Therefore, the anatomical classification reflects the recorded endoscopic assessment rather than a retrospectively imposed distance threshold.

All patients in the corrected dataset had adenocarcinoma. Procedures comprised anterior resection or intersphincteric resection with total or partial mesorectal excision. The surgical approach was chosen at the surgeon's discretion, and protective ileostomy was performed selectively according to anastomotic height and surgeon preference. The corrected anastomotic categories were high colorectal, low colorectal, supra-anal and coloanal; a hand-sewn technique was not inferred from the anatomical code alone. Treatment characteristics included chemoradiotherapy, protective ileostomy, adjuvant chemotherapy and postoperative anastomotic fistula. The dataset did not provide a standardized fistula severity grade or sufficient patient-level information to classify all resections by the extent of mesorectal excision.

Follow-up and outcome assessment

Functional outcomes were assessed at 3, 6 and 12 months during routine follow-up consultations. For patients with a protective ileostomy, evaluation was performed after stoma reversal, with the protocol specifying the same assessment intervals after restoration of continuity. For patients without diversion, the index operation defined the start of follow-up. The questionnaires were administered by the treating surgeon. Exact operation, closure and questionnaire dates were not retained in the analysis file; the analyses therefore used the recorded visit labels rather than individually recalculated elapsed times.

LARS scores were recomputed from the five recorded weighted item scores, producing totals from 0 to 42. Scores of 0–20, 21–29 and 30–42 were categorized as no, minor and major LARS, respectively [2]. The study documentation reports use of the validated Moroccan Arabic version [6]. The Wexner score was calculated as the sum of five items scored from 0 to 4, yielding a total from 0 to 20, with higher scores indicating worse incontinence [8]. No total was calculated when one or more constituent items were missing.

Health-related quality of life was assessed using the EORTC QLQ-C30 version 3.0 translated into Moroccan Arabic [9]. Global health status/quality of life, five functional scales and nine symptom or financial difficulty scales/items were calculated using the standard linear transformations to a 0–100 scale [10]. Higher global and functional scores indicate better outcomes; higher symptom scores indicate greater burden. Multi-item scales required at least half their items to be answered. No unvalidated sum of all 30 items was used.

Data verification

The source workbook was preserved. Investigator-directed corrections to coding and specified clinical entries were documented in an accompanying correction log. Endoscopic location was used to define the analytical groups. Some examination and computed tomography location entries had been harmonized to endoscopy during correction; these variables were therefore not treated as independent anatomical measurements or used for an agreement analysis. Questionnaire item ranges were checked, and all recorded LARS and Wexner totals were verified against recomputed totals. These procedures establish internal arithmetic consistency but do not replace verification against source questionnaires and clinical records.

Statistical analysis

The primary endpoint was the within-patient change in LARS score from the recorded 3-month to 12-month assessment. Continuous variables are reported as mean and standard deviation (SD), with medians and interquartile ranges where informative. Categorical variables are reported with explicit denominators. Available-case summaries at each visit were distinguished from paired analyses, which included only participants with both required assessments.

Mean paired changes were accompanied by percentile bootstrap 95% confidence intervals (CIs), using 20,000 resamples of participants and a fixed random seed of 20260919. Resampling preserved each participant's paired measurements. The same method was used for changes in the proportion with major LARS. Changes over 3–6 and 6–12 months were described in patients with all three LARS assessments. A two-sided exact McNemar test assessed the paired change in major LARS status. Estimates and uncertainty were emphasized over significance testing.

The primary estimand was the mean observed change among participants with both measurements, rather than recovery in every eligible patient. As an additional post hoc robustness analysis, the median of individual LARS changes was estimated with a percentile bootstrap CI (20,000 participant resamples; seed 20260920). Characteristics of patients with complete three-visit LARS data and those without complete data were compared descriptively, without significance-based variable selection (Additional file 2). These checks were specified after the main results were known. Bootstrap intervals quantify sampling variability among respondents; they do not correct selection bias or measurement error.

Wexner and global quality-of-life changes were secondary outcomes. Physical and social functioning and the remaining QLQ-C30 domains were exploratory; their CIs were not adjusted for multiple comparisons and should not be interpreted as confirmatory evidence across all domains. Spearman correlations between 12-month LARS and global quality of life, physical functioning and social functioning were calculated using one observation per participant. Their percentile bootstrap CIs used 5,000 participant resamples. These cross-sectional correlations were not interpreted as causal effects.

Missing outcomes were not imputed. For 12-month major LARS, extreme-case bounds were calculated across all 50 rectal patients by assuming that every missing response represented either non-major or major LARS. These bounds are sensitivity scenarios, not confidence intervals. The rectosigmoid group was described separately without a formal comparison intended to estimate a treatment or anatomical effect. The sample comprised all available records; no prospective sample-size calculation for the present primary endpoint was available. Given the small cohort and only 10 observed major LARS outcomes at 12 months, no multivariable prediction model was fitted. Analyses were performed locally using Python with NumPy, pandas and openpyxl.

Use of artificial intelligence

OpenAI ChatGPT/Codex assisted with manuscript drafting, literature retrieval and generation of local analysis code. No individual patient records were supplied to external literature-search services. The tool is not listed as an author. Responsibility for verification and approval of the submitted content rests with the human authors.

Results

Cohort characteristics and questionnaire availability

The corrected dataset contained 78 patients, of whom 50 had a rectal and 28 a rectosigmoid location. The rectal cohort had a mean age of 58.3 years (SD 10.9), and 25 patients (50.0%) were women. Twenty tumours were recorded in the lower rectum, 20 in the middle rectum and 10 in the upper rectum. Anterior resection was performed in 41 patients and intersphincteric resection in nine. Chemoradiotherapy was recorded in 45 patients (90.0%), protective ileostomy in 42 (84.0%) and postoperative anastomotic fistula in 17 (34.0%) (Table 1).

LARS and Wexner scores were available for 42/50 patients at 3 months and 43/50 at both 6 and 12 months. Forty patients had LARS assessments at all three visits and formed the 3-to-12-month paired group. EORTC QLQ-C30 global quality-of-life scores were available for 50, 49 and 49 patients, respectively; 49 had paired 3- and 12-month measurements. Reasons for missing questionnaires were not documented in the analysis file. Accordingly, these denominators represent questionnaire availability rather than verified survival or stoma-closure rates.

Changes in bowel function

In available-case analyses, mean LARS scores were 33.5 at 3 months, 27.6 at 6 months and 23.5 at 12 months. Major LARS was present in 32/42 (76.2%), 18/43 (41.9%) and 10/43 (23.3%), respectively (Table 2). These proportions involved partially different sets of respondents.

Among the 40 paired respondents, mean LARS decreased from 34.1 (SD 6.0) to 23.5 (SD 8.8), corresponding to a mean change of -10.6 points (95% CI -12.8 to -8.3). Thirty-seven patients had a lower score, one an unchanged score and two a higher score at 12 months. In this same group, the mean change was -6.6 points between 3 and 6 months (95% CI -8.2 to -5.0) and -4.0 points between 6 and 12 months (95% CI -5.9 to -2.1).

Major LARS decreased from 31/40 (77.5%) to 10/40 (25.0%), a paired reduction of 52.5 percentage points (95% CI 35.0–70.0; exact McNemar $p < 0.001$). Of the 31 initially classified as major LARS, 10 moved to no LARS, 12 to minor LARS and nine remained in the major category. One initially minor case progressed to major LARS. Thus, improvement was common but was neither uniform nor equivalent to complete symptom resolution.

Mean Wexner score among the 40 paired respondents decreased from 13.5 (SD 4.5) to 8.5 (SD 5.7), a mean change of -4.9 points (95% CI -6.0 to -3.8) (Table 3). Thirty-eight patients had a lower Wexner score and two had a higher score at 12 months.

Quality of life and its association with bowel dysfunction

Among 49 paired respondents, mean global health status/quality of life increased from 51.2 (SD 18.2) to 63.3 (SD 22.1), a change of 12.1 points (95% CI 9.5–14.6). Physical functioning increased by 14.1 points (95% CI 6.8–21.1). The estimated improvement in social functioning was 8.5 points, with wider uncertainty spanning no change (95% CI -1.0 to 17.7) (Table 3). Exploratory results for all QLQ-C30 domains are provided in Additional file 1.

At 12 months, higher LARS scores were associated with lower global quality of life ($\rho -0.66$; 95% CI -0.81 to -0.45), physical functioning ($\rho -0.51$; 95% CI -0.73 to -0.23) and social functioning ($\rho -0.50$; 95% CI -0.71 to -0.23); each analysis included 43 patients. These associations describe concurrent symptom burden and functioning and do not establish which changes preceded the others.

Sensitivity analysis and rectosigmoid observations

Seven rectal patients lacked a 12-month LARS score. If all seven had non-major LARS, the proportion with major LARS across the full rectal cohort would be 10/50 (20.0%); if all seven had major LARS, it would be 17/50 (34.0%). This range illustrates the uncertainty introduced by missing questionnaires beyond the observed 10/43 estimate.

The median individual LARS change was -12.0 points (95% bootstrap CI -13.5 to -8.5), supporting a reduction beyond the change in the mean alone. Patients with complete three-visit LARS data (n=40) and those without complete data (n=10) differed in recorded characteristics: women accounted for 17/40 and 8/10, respectively, protective ileostomy for 36/40 and 6/10, and intersphincteric resection for 9/40 and 0/10. Mean ages were 58.5 and 57.4 years. These descriptive differences caution against assuming that questionnaire completion was unrelated to clinical characteristics (Additional file 2).

Among the 28 rectosigmoid patients, 25 had paired LARS assessments. Their mean score decreased from 13.6 to 1.7, a mean change of -12.0 points (95% CI -15.4 to -8.5). Major LARS was recorded in one of 25 available respondents at 3 months and none of 26 at 12 months. These observations are presented for context and were not pooled with the primary rectal estimates because anatomical and treatment differences could influence bowel function.

Discussion

Principal findings

This longitudinal analysis found an improvement in bowel function between the recorded 3- and 12-month assessments after restorative rectal cancer surgery. The paired mean LARS reduction was accompanied by lower Wexner incontinence scores and higher global quality of life. Nevertheless, one quarter of patients with paired LARS assessments remained in the major category at 12 months. The improvement in group averages therefore coexisted with persistent difficulties for a clinically relevant subset of respondents.

The paired design is central to interpretation. Comparing successive available-case means can confuse individual change with changes in who completes a questionnaire. Here, the primary result followed the same 40 patients, while separate available-case estimates described the information available at each occasion. Both analyses showed lower symptom burden over time. Neither approach resolves possible selection bias among patients without paired data, and the extreme-case bounds show why missing responses should not be treated as symptom-free outcomes.

Comparison with recent longitudinal evidence

Lauwereins and colleagues reported 87 complete longitudinal responders from 180 recruited patients after total mesorectal excision. Major LARS decreased from 75.9% at one month to 58.6% at six months, with no statistically significant further reduction at 12 or 24 months [3]. Our paired cohort showed improvement during both the 3–6- and 6–12-month intervals. These findings should not be interpreted as evidence of superior recovery: the initial assessment occurred later in our dataset, the extent of mesorectal excision was not consistently documented, and treatment profiles and response patterns differed. Differences in the timing of stoma reversal and the lack of exact assessment dates in our analytical file further limit direct comparison of the two trajectories.

A 12-month assessment should not be interpreted as a definitive functional endpoint. In a longitudinal follow-up of 178 FOWARC trial participants, He and colleagues observed a reduction in mean LARS from 29.5 to 18.6 between assessments at median 39 and 83 months; some patients nevertheless required a new stoma for severe dysfunction [11]. This later improvement and the earlier plateau reported by Lauwereins et al. concern different populations and observation windows. Our data cannot predict whether individual patients will improve, remain symptomatic or deteriorate after the first year.

Homma and colleagues found major LARS in 48% of 82 respondents with lower rectal tumours [4]. That proportion exceeds our observed 12-month estimate, but the cohorts are not directly equivalent. Our rectal group included middle and upper rectal tumours, and the studies differed in design and follow-up timing. Their reported association between LARS and incontinence-related quality of life is directionally consistent with our inverse association between LARS and global QLQ-C30 quality of life. The instruments assess different constructs, so their coefficients should not be treated as interchangeable effect estimates.

The Wexner findings also have a relevant recent comparator. Jia and colleagues prospectively assessed 75 patients undergoing intersphincteric resection at 3, 6 and 12 months after ileostomy closure [12]. In the transverse colectomy subgroup, mean Wexner scores were 11.04, 9.92 and 7.32, respectively. The direction of change is consistent with our observations, but direct numerical benchmarking would be inappropriate: our cohort included several rectal levels and mainly anterior resections, whereas that study concerned ultralow tumours and compared reconstruction techniques. Our results describe continence over time and do not establish the superiority of a reconstruction method.

Our results add repeated within-patient observations from a Moroccan clinical setting where a locally validated LARS instrument is available [6]. The contribution is the joint description of symptom change and quality-of-life change with explicit anatomical groups and denominators. It is not a new questionnaire validation or proof that the observed course is specific to Morocco. Multicentre studies with harmonized timing and baseline measurements would be needed to examine regional differences.

Interpreting persistent symptoms and quality of life

A lower LARS category does not establish an absence of bowel dysfunction. Koneru and colleagues studied 248 patients after rectal or sigmoid resection and found evacuatory dysfunction in 44.5% of patients classified as having no LARS [13]. Our use of the Wexner score adds information on incontinence but does not comprehensively assess difficult evacuation. Consequently, patients moving below the major LARS threshold may still need symptom-directed evaluation.

The distinction between a score-defined category and a broader syndrome is reinforced by the 2026 multicentre study by Atsumi and colleagues. Among 343 respondents, consensus-defined LARS affected 72.5%, and one quarter of those classified as no LARS by the score still met the consensus definition [14]. Our prevalence estimates refer specifically to score-defined major LARS and should not be

compared directly with prevalence based on the consensus definition. Future follow-up could combine a brief score with assessment of the consequences that matter to the patient.

The concurrent association between higher LARS and lower global quality of life supports measuring both outcomes. However, bowel symptoms cannot be assumed to explain the entire quality-of-life trajectory. Grou-Boileau and colleagues reported an association between patient activation and bowel-related quality-of-life impairment after proctectomy, beyond LARS severity [5]. Patient activation was not measured in our study. The result provides a rationale for considering self-management and psychosocial dimensions in future research, rather than attributing all variation in global quality of life to bowel function.

The uncertainty surrounding social functioning also warrants attention. Although its mean improved, the paired CI included no change and individual responses varied. Improvement in a physical symptom measure should therefore not be used as a substitute for asking about participation in daily activities and social life. The exploratory nature of the domain analyses and lack of multiplicity adjustment further limit claims about individual QLQ-C30 scales.

Domain-specific interpretation is supported by the prospective Dutch PLCRC cohort reported by Pennings and colleagues [15]. Among 1,294 patients, those diagnosed in 2019 had better physical, role and social functioning two years after diagnosis than those diagnosed in 2014, whereas LARS scores did not differ by diagnosis year. This was a comparison between calendar-year cohorts, not the same within-person change estimated here. It nevertheless illustrates why QLQ-C30 functioning domains and bowel symptom scores should be reported separately. Our improvement in global quality of life does not establish recovery in every domain, and the observed 12.1-point mean change should not be equated with a validated individual responder threshold for this cohort.

Clinical implications

The persistence of major LARS at the final recorded visit supports repeated questioning about bowel symptoms throughout follow-up. The MANUEL management guidance describes a structured approach that includes assessment, supportive care and escalation according to symptoms and response [16]. Our data did not record rehabilitation, medication, irrigation or other symptom-directed treatments and cannot estimate their effectiveness. The practical implication is to identify ongoing difficulties and assess the need for management, rather than assume that improvement in the cohort mean makes further follow-up unnecessary.

The high proportions of chemoradiotherapy, diversion and recorded fistula describe a selected clinical population. These features may be relevant to the observed symptom burden, but the small sample and limited covariate detail do not support causal attribution or a reliable multivariable risk model. The study should therefore inform discussion of the possible course of recovery without being used as an individualized prediction tool.

Anastomotic complications deserve particular attention when interpreting this case mix. Emile and colleagues synthesized 20 retrospective studies including 4,764 patients and found that anastomotic leak was associated with more LARS and higher Wexner scores, with low to moderate certainty of evidence [17]. Our recorded fistula frequency of 34% therefore merits source-record verification of the event definition and ascertainment period before external benchmarking. The ungraded binary entry cannot distinguish clinical severity or establish that fistula caused the observed dysfunction. Similarly, the predominance of chemoradiotherapy leaves little internal exposure contrast, and diversion was selected clinically. Neither treatment can be evaluated as an independent determinant from these descriptive trajectories.

Strengths and limitations

Strengths include repeated assessments, item-level verification of scoring, complementary bowel-function and quality-of-life instruments, and explicit separation of rectal and rectosigmoid cases. Reporting paired estimates and questionnaire denominators avoids assuming that different sets of responders represent a single complete longitudinal cohort. The correction log also preserves the distinction between recorded clinical information and later harmonization.

Several limitations constrain inference. First, this was a small single-centre analysis, and the complete screening denominator and exclusion counts were unavailable in the analytical file. The original study combined retrospective and prospective components, which may introduce differences in data completeness. Second, preoperative bowel function and quality of life were unavailable, preventing assessment of return to baseline or attribution of all postoperative symptoms to surgery. Third, missing questionnaires could be related to symptoms, ongoing diversion or health status. Complete-case analyses do not correct such informative missingness, and the sensitivity bounds address only the binary 12-month outcome. Differences in the observed characteristics of complete and incomplete responders reinforce this concern; the median-based analysis addresses sensitivity to the outcome distribution, not attrition bias.

Fourth, exact dates linking surgery, stoma closure and assessment were absent from the analysis file. Although the protocol defined follow-up after restoration of continuity for diverted patients, the precision of the recorded visit timing could not be independently checked. Fifth, potentially important details, including mesorectal excision extent, exact anastomotic height, fistula grade, recurrence, symptom-directed treatment and patient activation, were unavailable or insufficiently characterized. Sixth, questionnaires were administered by the treating surgeon, which may have introduced interviewer or social desirability bias. Finally, some anatomical entries were harmonized during data correction. Endoscopic location was therefore used for grouping, and agreement between examination, endoscopy and imaging cannot be inferred from this corrected dataset.

The exact Moroccan Arabic QLQ-C30 translation used was reported by the investigators, but documentation of its psychometric validation in this population was not available for this analysis.

Validation of the Moroccan Arabic LARS questionnaire cannot be transferred to the QLQ-C30. This limits cross-cultural comparison of absolute quality-of-life scores.

The analytical strategy was developed after inspection of the available data. Secondary domain and correlation analyses are exploratory, and their CIs were not adjusted for multiplicity. The observed mean changes demonstrate an association with follow-up occasion; they do not establish a treatment effect, spontaneous recovery independent of care, or a universally applicable threshold for clinically important improvement.

Conclusions

In this Moroccan rectal cancer cohort, paired bowel-function scores improved between recorded 3- and 12-month assessments, alongside improvement in global quality of life. Major LARS nevertheless persisted in one quarter of paired respondents, and greater bowel dysfunction was associated with poorer concurrent quality of life. Repeated assessment using both symptom and quality-of-life measures can identify patients with ongoing difficulties. Larger cohorts with verified follow-up timing, preoperative measurements and documented reasons for missing data are needed to establish more generalizable recovery trajectories.

Abbreviations

CI: confidence interval; EORTC: European Organisation for Research and Treatment of Cancer; LARS: low anterior resection syndrome; QLQ-C30: Quality of Life Questionnaire Core 30; SD: standard deviation; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology.

Declarations

Ethics approval and consent to participate

The study received a favourable opinion from the Comité d'Éthique Hospitalo-Universitaire de Fès, reference 27/20, dated 18 January 2021. All participants provided written informed consent.

Consent for publication

Not applicable. This manuscript presents aggregate results without identifiable individual information.

Availability of data and materials

Aggregate results are provided in the manuscript and Additional files 1 and 2. The datasets and statistical analysis scripts are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no relevant financial or non-financial competing interests.

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Authors' contributions

IT and KA contributed to conceptualization and methodology. AAA collected the data. KIMH, TS and KM performed surgical procedures on patients included in the study. AAA and IT contributed to formal analysis and preparation of the original draft. IT and KA contributed to manuscript review and editing. All six authors reviewed the final manuscript, approved the submitted version and agree to be accountable for all aspects of the work.

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Not applicable.

Patient and public involvement

Patients were not involved in the design, conduct or reporting of the study. Patient-reported outcomes were collected during routine clinical follow-up.

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Tables

Table 1 Characteristics of the rectal cohort

Characteristic	Rectal cohort (N=50)
Age, years	58.3 (10.9)
Women	25 (50.0)
Men	25 (50.0)
Lower / middle / upper rectum	20 / 20 / 10
Anterior / intersphincteric resection	41 / 9
Laparoscopic / open / converted approach	40 / 6 / 4
High / low colorectal anastomosis	1 / 23
Supra-anal / coloanal anastomosis	10 / 16
Chemoradiotherapy	45 (90.0)
Protective ileostomy	42 (84.0)
Adjuvant chemotherapy	23 (46.0)
Recorded anastomotic fistula	17 (34.0)

Values are n (%) unless otherwise specified. Age is mean (SD). Slash-separated counts follow the stated category order. Converted approach denotes conversion from laparoscopy to laparotomy. Fistula severity was not available.

Table 2 Available outcomes at each recorded assessment

Outcome	3 months	6 months	12 months
LARS score	33.5 (7.0); n=42	27.6 (6.7); n=43	23.5 (8.5); n=43
Wexner score	13.4 (4.5); n=42	10.9 (5.1); n=43	8.3 (5.7); n=43
Global quality of life	51.8 (18.6); n=50	58.8 (17.7); n=49	63.3 (22.1); n=49
Physical functioning	59.6 (19.7); n=50	69.5 (20.9); n=49	72.9 (22.7); n=49
Social functioning	69.7 (27.5); n=50	79.6 (24.4); n=49	77.6 (27.5); n=49
No LARS	3/42 (7.1%)	11/43 (25.6%)	17/43 (39.5%)
Minor LARS	7/42 (16.7%)	14/43 (32.6%)	16/43 (37.2%)
Major LARS	32/42 (76.2%)	18/43 (41.9%)	10/43 (23.3%)

Scores are mean (SD), with available n. Respondents differ between visits. LARS range 0–42 and Wexner range 0–20: higher is worse. QLQ-C30 global and functional scales range 0–100: higher is better.

Table 3 Paired changes from 3 to 12 months

Outcome	Paired n	3-month mean	12-month mean	Mean change (95% CI)
LARS	40	34.1	23.5	-10.6 (-12.8 to -8.3)
Wexner	40	13.5	8.5	-4.9 (-6.0 to -3.8)
Global quality of life	49	51.2	63.3	12.1 (9.5 to 14.6)
Physical functioning	49	58.8	72.9	14.1 (6.8 to 21.1)
Social functioning	49	69.0	77.6	8.5 (-1.0 to 17.7)

Change is 12 months minus 3 months. Percentile bootstrap CIs use 20,000 paired participant resamples. Negative LARS and Wexner changes indicate improvement; positive QLQ-C30 functional/global changes indicate improvement. Secondary and exploratory intervals are not multiplicity-adjusted.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Additionalfile1.csv](#)
- [Additionalfile2.csv](#)