Quality of life in restorative versus non-restorative resections for rectal cancer: systematic review

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Abstract

Background: Low rectal cancers could be treated using restorative (anterior resection, AR) or non-restorative procedures with an end/permanent stoma (Hartmann’s, HE; or abdominoperineal excision, APE). Although the surgical choice is determined by tumour and patient factors, quality of life (QoL) will also influence the patient’s future beyond cancer. This systematic review of the literature compared postoperative QoL between the restorative and non-restorative techniques using validated measurement tools.

Methods: The review was registered on PROSPERO (CRD42020131492). Embase and MEDLINE, along with grey literature and trials websites, were searched comprehensively for papers published since 2012. Inclusion criteria were original research in an adult population with rectal cancer that reported QoL using a validated tool, including the European Organization for Research and Treatment of Cancer QLQ-CR30, QLQ-CR29, and QLQ-CR38. Studies were included if they compared AR with APE (or HE), independent of study design. Risk of bias was assessed using the Risk Of Bias In Non-Randomized Studies of Interventions (ROBINS-I) tool. Outcomes of interest were: QoL, pain, gastrointestinal (GI) symptoms (stool frequency, flatulence, diarrhoea and constipation), and body image.

Results: Nineteen studies met the inclusion criteria with a total of 6453 patients; all papers were observational and just four included preoperative evaluations. There was no identifiable difference in global QoL and pain between the two surgical techniques. Reported results regarding GI symptoms and body image documented similar findings. The ROBINS-I tool highlighted a significant risk of bias across the studies.

Conclusion: Currently, it is not possible to draw a firm conclusion on postoperative QoL, pain, GI symptoms, and body image following restorative or non-restorative surgery. The included studies were generally of poor quality, lacked preoperative evaluations, and showed considerable bias in the data.

Introduction

The treatment for rectal cancer has changed significantly over the past 20 years with the introduction of MRI-based, multidisciplinary team-directed, individualized patient care and the selective use of neoadjuvant therapies1. For most patients with rectal cancer, surgery continues to be mainstay of curative treatment. Surgical techniques are based on total mesorectal excision (TME), and comprise either a restorative rectal resection (anterior resection, AR) with anastomosis or an excisional rectal technique with an end/permanent stoma (Hartmann’s, HE; or abdominoperineal excision, APE)2. Over the past 100 years, debate has existed regarding which surgical technique (restorative or excisional) provides the best outcome for the patient, with trends towards restorative surgery3. It is recognized that each operative approach is different and both techniques are not suitable for all patients4. Tumour stage, morphology, and clinical presentation all influence patient outcomes, and identifying the true impact of individual operations can be difficult. Clinical research, systematic reviews, and meta-analyses of rectal cancer outcomes have concentrated on the technical elements and technology used to perform the procedure. These include reviews on robotic versus laparoscopic5,6, open versus laparoscopic7,8, and transanal TME9,10 surgery, most of which focused on demonstrating surgical and oncological equivalence or cost–benefit of the procedural approach. There has been little focus on comparing quality of life (QoL) or patient-reported outcome measures (PROMs).

A number of tools, such as EQ-5D™ (EuroQol Group, Rotterdam, the Netherlands), Short Form 36, Functional Assessment of Cancer Therapy—Colorectal (FACT-C), and European Organization for Research and Treatment of Cancer (EORTC) QLQ-CR29, QLQ-CR30, and QLQ-CR38, have all been validated to accurately reflect changes in patients’ QoL11–15.
Some of these tools are generic and global; EQ-5D™ measures overall health status and is applicable in any condition. EORTC QLQ-CR29 and QLQ-CR30 questionnaires are global QoL tools specific for colorectal cancer. These tools have been shown offer validity and reliability in population groups to ensure that the results reflect true patient experience. A paucity of high-quality comparative PROM and QoL data following rectal cancer surgery was reported in 2012. Comparison of these two surgical techniques is challenging, and there is currently no one PROM that can aid this. Indeed, social interaction, body image, and overall QoL influence the patient’s future in living with and beyond cancer and, when obtaining informed consent, patients should be advised objectively about the treatment options available. This systematic review of the literature on low rectal cancer compared restorative with non-restorative resection, focusing on validated QoL measures.

### Methods

This systematic review was registered on PROSPERO (CRD42020131492), and complies with PRISMA and AMSTAR guidelines. Using a PICO search, the population of interest comprised patients with low rectal cancer undergoing an intervention of AR or restorative bowel resection compared with those who had APE or non-restorative bowel resection, with an outcome measured using a validated QoL tool. The review question was established a priori, with inclusion and exclusion criteria, and the risk-of-bias tool chosen before completion of the search. A comprehensive search of Embase and MEDLINE was completed. The search strategy is available in supplementary material (Appendix S1). This built on the published Cochrane systematic review, using only papers published from this date. References of included articles were screened for suitable papers. Grey literature was searched in the British Library Thesis repository and Grey Literature search engine. ISRCTN and ClinicalTrials.gov were screened for suitable trials. The search was completed on 20 June 2020. Published data comparing validated QoL outcomes in adults undergoing radical surgery for rectal cancer were included. Transabdominal surgical techniques with curative intent were included. There was no limit based on follow-up time. Randomized and observational studies were included, although randomization between the two groups was thought to be unlikely.

Inclusion criteria were: surgical intervention for rectal cancer in adults aged over 18 years; surgery performed with curative intent; comparison of different surgical techniques (without restorative) versus APE/TME or Hartmann’s (non-restorative resection with permanent/end stoma); QoL data provided by means of a validated tool; and published since last Cochrane review in 2012. Exclusion criteria were: lack of specific rectal cancer data (mixed data with colonic cancers but no subgroup data provided); unresectable disease or palliative surgery; local excision techniques; inclusion of surgery for inflammatory or benign growth; and not available in the English language.

### Data analysis

Titles and abstracts of each article were screened before the whole paper being requested. Included papers underwent review. Patients who had undergone resection with bowel continuity restored were included in the AR group. The inclusion of patients with a temporary ileostomy varied between papers, but this group included patients with a temporary ileostomy and those who had the ileostomy reversed. The APE group included all patients who had undergone non-restorative resection, including APE and HE.

Authors of articles with data presented in graphical form were contacted in an attempt to obtain numerical data; if there was no response from the corresponding author, the data were included in a summative analysis but not in the tables.

One reviewer extracted data into an electronic data collection sheet. A second independent reviewer checked this, with discrepancies resolved by consensus. Data extracted included: study-related data (first author, year of publication, journal, study design, duration of follow-up, outcomes measured, funding), patient characteristics (surgical technique, tumour site, neoadjuvant therapy) and outcome data (validated QoL measure results). Risk of bias was assessed using the Risk Of Bias In Non-Randomized Studies of Interventions (ROBINS-I) tool; differences were resolved by consensus.

Narrative summary and qualitative analysis were planned, with comparison of the results between studies both during short- and long-term follow-up. Quantitative analysis through meta-analysis was considered inappropriate owing to clinical heterogeneity in interventions, the non-normal distribution of results, study design, and the variety of validated QoL outcome measures used.

### Outcome measures

The primary measure was difference in average global QoL. Other health-related items investigated were: gastrointestinal (GI) symptoms (stool frequency, flatulence, diarrhoea, and constipation), pain, and body image.

### Results

Of 21 074 abstracts screened, 76 full papers were scrutinized and 19 included in the final review (Fig. 1). Nineteen studies met the inclusion criteria (Table 1) with a total of 6453 patients (range 43–1608). All articles described observational studies, although one study included patients from the National Surgical Adjuvant Breast and Bowel Project randomized trial (NSABP-R-04) from the USA. No patients were randomized between surgical techniques. Patient follow-up varied from 6 months to 5 years. Only four of the included studies provided preoperative QoL data and then followed patients up; two other papers provided serial QoL measurements, but not preoperative data. Thirteen studies provided only one measure of postoperative QoL, with no preoperative data. Fourteen studies used QLQ-CR30, eight used QLQ-CR29, and seven used QLQ-CR38 (Table 1). All studies compared outcomes for patients with rectal cancer; seven studies considered only rectal cancer within 2–6 cm of the anal verge, although it was not always stated how this was measured (Table S1). Surgical approaches and main findings are summarized in Table 2. Quantitative analysis was not completed because of the skewed data distribution, variety of QoL tools used, use of median (range), and the lack of standard deviation reporting.
Global quality of life

Only two studies included in the review identified a statistically significant difference in global QoL between restorative/AR and non-restorative/APE surgery. A single-centre study identified better QoL in patients who had undergone AR with colonic pouch formation at 13 months ($P = 0.009$), although no preoperative data were available. A population-based, cross-sectional study identified better global QoL in patients who had undergone APE ($P = 0.026$) at a median of 4.4 years after surgery, but again there were no preoperative QoL data. Extracted global QoL data are reported in Table 3. A difference of 10 on the EORTC 1–100 scale was used to compare the two surgical approaches; with the exception of one study, no difference in global QoL between the two groups was noted. Direction-of-effect analysis (based on whether a score at any time point after baseline favours AR or APR) found that four studies demonstrated better global QoL in patients who had undergone APE, four favoured AR, and three identified no difference. No link was identified when patients were separated by length of follow-up.

Pain

Extracted data for the pain domain of the validated QoL scores are presented in Table 4. Two studies identified a statistically significant reduction in pain after APE among patients who had follow-up longer than 2 years. Other studies with a clinically relevant difference on long-term follow-up also demonstrated reduced pain in the APE group. In long-term direction-of-effect analysis, five of the seven studies found reduced pain in the APE group. One study demonstrated increased pain in the APE group during follow-up of less than 12 months, but presented no preoperative data. No other studies identified a statistically significant or clinically relevant difference between the two groups. Direction-of-effect analysis showed that three studies identified no difference, although two with follow-up of less than 12 months favoured AR. Others with no numerical data available also showed no difference in postoperative pain. In one study, multiple logistic regression showed that both AR (odds ratio (OR) 1.39, 95 per cent c.i. 1.01 to 1.90) and APE (OR 1.71, 1.19 to 2.44) were associated with chronic pelvic pain at a median of 4.2 years of compared with partial mesorectal excision.

Gastrointestinal symptoms

GI symptoms were measured using a variety of tools (EORTC QLQ-CR30, QLQ-CR30, QLQ-CR30) alongside the Faecal Incontinence Quality of Life Scale and Wexner scale after restorative surgery (Table 5). The use of specific tools to
Table 1 Details of included studies

| Reference | Year | Setting | Country | Research design | Duration of follow-up | No. of patients | QoL measure used |
|-----------|------|---------|---------|-----------------|-----------------------|----------------|-----------------|
| 1. Mrak et al. | 2011 | Single centre | Austria | Observational, prospectively maintained database | Minimum 3 years | 59 | EORTC QLQ-C30, EORTC QLQ CR29 |
| 2. How et al. | 2012 | Single centre | UK | Observational, prospective | 2 years | 62 | EORTC QLQ-C30, EORTC QLQ CR29 |
| 3. Konanz et al. | 2013 | Single centre, university-affiliated hospital | Germany | Observational, prospective database | Minimum 12 months | 124 | EORTC QLQ-C30, EORTC QLQ CR29 |
| 4. Digennaro et al. | 2013 | Multicentre | Italy | Observational, retrospective | Median 26.5 months (APE), 52.5 months (AR) | 60 | EORTC QLQ-C30, EORTC QLQ CR29, Short Form 36 |
| 5. Arraras et al. | 2013 | Single centre | Spain | Observational, prospective | Minimum 12 months | 84 | EORTC QLQ-C30, EORTC QLQ CR29 |
| 6. Penchev et al. | 2014 | Single centre, complex cancer centre | Bulgaria | Observational | Minimum 6 months | 71 | EORTC QLQ-C30, EORTC QLQ CR29 |
| 7. Russell et al. | 2015 | Multicentre | USA | Observational, patients recruited to chemotherapy RCT | 12 months | 1608 | FACT-C, EORTC QLQ CR38 |
| 8. Feddern et al. | 2015 | Population database | Denmark | Observational, cross-sectional survey | Minimum 4.2 years | 1369 | Brief Descriptive, Danish Pain Questionnaire (McKIll) |
| 9. Honda et al. | 2016 | Single centre, cancer institute hospital | Japan | Observational, cross-sectional survey | Minimum 2 years | 291 | EORTC QLQ-C30, EORTC QLQ CR29, modified FIQL |
| 10. Monastyrska et al. | 2016 | Single centre, oncology centre | Poland | Observational, prospective | 6 months | 100 | EORTC QLQ-C30, EORTC QLQ CR29 |
| 11. Klose et al. | 2017 | Single centre, university-affiliated hospital | Germany | Observational, prospectively maintained database | 58 months | 143 | EORTC QLQ-C30, EORTC QLQ CR29 |
| 12. Wani et al. | 2017 | Single centre, Kashmir | India | Observational, prospective | 12 months | 130 | EORTC QLQ-C30, EORTC QLQ CR29, International Index of Erectile Function |
| 13. Costa et al. | 2018 | Single centre | Portugal | Observational, retrospective | 21 months | 43 | EORTC QLQ-C30, EORTC QLQ CR29, International Index of Erectile Function |
| 14. Koeter et al. | 2018 | Population database | the Netherlands | Observational, longitudinal, prospective population-based survey | 5.1 years | 905 | EORTC QLQ-C30, EORTC QLQ CR38 |
| 15. Trenti et al. | 2018 | Two centres | Spain | Observational, prospective | 4.5 years | 224 | EORTC QLQ-C30, EORTC QLQ CR29 |
| 16. Silva et al. | 2018 | Single centre | Brazil | Observational, prospective | 3.84 years | 125 | EORTC QLQ-C30, EORTC QLQ CR29 |
| 17. Du et al. | 2019 | Single centre | China | Observational, retrospective | 12 months after surgery | 43 | EORTC QLQ-C30, EORTC QLQ CR29 |
| 18. Feddern et al. | 2019 | Single centre | China | Observational, cross-sectional survey | Median 4.4 years | 898 | EORTC QLQ-C30, EORTC QLQ CR38 |
| 19. Ding et al. | 2020 | Single centre | China | Observational, prospective | 12 months | 114 | FIQL |

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| Reference      | Surgical intervention                     | Conclusions/recommendations                                      | Global QoL                              | Symptoms                                    |
|----------------|-------------------------------------------|------------------------------------------------------------------|-----------------------------------------|---------------------------------------------|
| Mrak et al.    | Ultralow TME anterior resection and colonic J-pouch anastomosis | QoL better after AR than APE in several respects                  | QoL better after AR than APE in several respects | After AR, patients had better physical, role, cognitive, and social functioning with better body image. After APE, patients had significantly higher urinary frequency and were significantly more embarrassed by their condition |
| How et al.     | AR                                        | No difference in global QoL                                      | No difference in global QoL             | There was more diarrhoea after AR and more pain at 2 years after operation. Better sexual and social functioning after AR. Physical functioning significantly better after AR. Symptom scores for diarrhoea and constipation worse after AR. APE group had worse sexual function, whereas most patients in AR group had faecal incontinence and sometimes obstructed defaecation, with an important impact on QoL |
| Konanz et al.  | ISR or LAR                                 | No difference in global QoL                                      | No difference in global QoL             | APE group had worse sexual function, whereas most patients in AR group had faecal incontinence and sometimes obstructed defaecation, with an important impact on QoL |
| Digennaro et al.| CAA (sewn and stapled)                     | No difference in global QoL                                      | No difference in global QoL             | Higher stool frequency and incontinence in AR group, but better emotional functioning |
| Arraras et al. | LAR (with colorectal anastomosis or CAA)  | No difference in global QoL                                      | No difference in global QoL             | AR group had better body image, male sexual enjoyment, and micturition symptoms. APR group had better GI tract symptoms and less weight loss. No difference in FACT-C | Sexual dysfunction worse in men after APE than AR |
| Penchev et al. | AR                                        | Not compared                                                    | Not compared                           | No association between pain intensity and type of surgery |
| Russell et al. | Sphincter-sparing surgery                  | No difference in global QoL                                      | No difference in global QoL             | Worse constipation, defaecation problems and anxiety in ISR group |
| Feddern et al. | AR (with TME or PME)                      | Not compared                                                    | Not compared                           | No association between pain intensity and type of surgery |
| Honda et al.   | Very low AR or ISR                        | No difference in global QoL                                      | No difference in global QoL             | Worse constipation, defaecation problems and anxiety in ISR group |
| Monastyrska et al. | LAR (without stoma)                  | No difference in global QoL                                      | No difference in global QoL             | Physical, cognitive, and emotional functioning better in AR group. ISR group had better cognitive functioning and weight gain, and less nausea and |
| Klose et al.   | ISR                                       | No difference in global QoL                                      | No difference in global QoL             | (continued) |
compare the two groups is challenging because of the difference in symptoms experienced by patients in the AR and APE groups. Long-term follow-up of greater than 2 years demonstrated favourable outcomes for APE over AR. In the domains of stool frequency, flatulence, GI symptoms, diarrhoea, and constipation, patients in the AR group had worse symptoms than those in the APE group. Only one study, at 6 months but with no preoperative comparator, demonstrated better outcomes in the AR group; all the other studies either showed no difference or reported better outcomes in patients who had undergone APE.

Body image and sexual function

Five studies identified higher rates of negative body image in the APE group than the AR group, although preoperative data were not available. The other studies reported no difference; none reported better body image in the APE group (Table 6). Sexual function was worse in the APE group, but most studies that measured this did not have preoperative data (Table 7). Nine papers reported worse sexual functioning and/or interest in the APE group; five identified no difference between the two groups. One study identified worse functioning in the APE group, but this difference was present before operation and may reflect a difference in patient and tumour characteristics.

Risk of bias

The ROBINS-I risk-of-bias assessment was completed for all studies. All bar one had at least a low/moderate risk of bias. Twelve had a serious risk of bias in at least one domain and five had a critical risk of bias in at least one domain (Fig. 2). Two had a low risk of bias in more than six domains, both of which found no difference in global QoL. The reason for high risk of bias varied between studies. Recurring themes included the non-reporting of patient characteristics including co-morbidities, different disease profiles, different preoperative chemoradiotherapy

Table 2. (continued)

| Reference | Surgical intervention | Conclusions/recommendations | Symptoms |
|-----------|-----------------------|-------------------------------|----------|
| Wani et al. | LAR APE and end colostomy | No difference in global QoL | Nausea and vomiting worse in AR group, but urinary frequency, abdominal pain and embarrassment worse in APE group |
| Costa et al. | AR APE and end colostomy | Not compared | APE and not AR is a risk factor for de novo ED |
| Koeter et al. | LAR APE and end colostomy | Not compared | No differences in physical activity between the two groups. Physical and role functioning seemed worse in APE group |
| Trenti et al. | AR APE and Hartmann’s | No difference in global QoL | Faecal incontinence worse in AR group and body image worse in APE group |
| Silva et al. | Sphincter-saving surgery with closure of temporary ileostomy APE and end colostomy | No difference in global QoL | APE group had significantly better functional and symptom scale scores |
| Du et al. | AR with anal reconstruction APE and end colostomy | No difference in global QoL | Emotional and social functioning better in AR group |
| Feddern et al. | LAR APE and end colostomy | Global health status worse in AR group | AR group had worse problems with diarrhoea and constipation |
| Ding et al. | Ultralow AR (Dixon) and modified CAA (modified Parks) Miles APE and end colostomy | Not compared | At 12 months, AR group had better scores in all four criteria of FIQL score |

AR, anterior resection; APE, abdominoperineal excision; QoL, quality of life; TME, total mesorectal excision; ISR, intersphincteric resection; LAR, low anterior resection; CAA, coloanal anastomosis; GI, gastrointestinal; FACT-C, Functional Assessment of Cancer Therapy—Colorectal; PME, partial mesorectal excision; ED, Erectile Dysfunction; FIQL, Faecal Incontinence Quality of Life Scale.
no difference in global QoL between the two surgical techniques. Another documented significant impact on postoperative outcomes. Two studies included in the review had a low risk of bias in 6 or more domains. One report found no difference in global QoL, but reported better cognitive and social functioning with fewer symptoms of pain, diarrhoea, sleep disturbance, and constipation in patients who had undergone APE. Another documented no difference in global QoL between the two surgical techniques; however, no raw data were included in the publication and it was not therefore included in any Tables. The same authors identified worse sexual function and micturition symptoms in patients who had undergone APE, but they had better GI symptom profiles.

Postoperative differences in QoL measures may have been present before surgery and therefore cannot be explained simply by differences in surgical technique. The importance of ensuring that the disease profile is matched should be highlighted; controlling for tumour height and neoadjuvant therapy is important as these have an impact on patient QoL. This may explain the results of many of the studies included in this review. The lack of preoperative QoL measures to identify any possible differences being caused by variation in surgical indication rather than surgical technique introduces significant potential bias into most studies included in the review. It is therefore challenging to identify whether disease location, preoperative differences in QoL or operative approach is the reason for a difference in postoperative QoL. Variation in duration of follow-up may reflect different aspects of the patient journey. Long-term follow-up may miss significant short-term variation in QoL and will miss patients with short postoperative survival; however, longer follow-up allows good assessment of function. The variability of follow-up and grouping of patients across these time brackets may mean a mixed picture is provided across the included studies. Many studies included patients with a large range of follow-up times and it is therefore difficult to draw specific conclusions regarding changes in QoL over time.

The high search volume reflects the large amount of work being done regarding QoL outcomes after rectal cancer surgery. Many articles were excluded, as they did not offer a comparison between restorative and non-restorative rectal procedures.

### Discussion

Overall, there was no improvement in global QoL across the studies; restorative surgery was not found to improve QoL compared with a permanent stoma. However, some caution is required in interpretation of the research because published data were at significant risk of bias and no high-quality papers existed to allow accurate analysis of the difference in QoL. Different symptom profiles were identified; when studies existed to allow accurate analysis of the difference in QoL.

The ROBINS-I assessment of all the studies reflected this high risk of bias and demonstrated the paucity of good-quality studies aimed at assessing this clinically relevant question. This should be considered when assessing the conclusions of the review. The risk of bias was contributed to by the paucity of preoperative QoL data, the use of single-point QoL scores, and failure to control for the location of the rectal cancer. The distance of the cancer from the anal verge is paramount in deciding surgical and neoadjuvant treatments, and therefore has a significant impact on postoperative outcomes. Two studies included in the review had a low risk of bias in 6 or more domains. One report found no difference in global QoL, but reported better cognitive and social functioning with fewer symptoms of pain, diarrhoea, sleep disturbance, and constipation in patients who had undergone APE. Another documented no difference in global QoL between the two surgical techniques; however, no raw data were included in the publication and it was not therefore included in any Tables. The same authors identified worse sexual function and micturition symptoms in patients who had undergone APE, but they had better GI symptom profiles.

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### Table 3 Global quality-of-life measure using EORTC QLQ-CR30

| n  | Surgical procedure | Baseline | 0–5 months | 6–11 months | 1–2 years | > 2 years | Direction of effect |
|----|--------------------|----------|------------|-------------|-----------|-----------|---------------------|
| 62 | APE                | 83 (39–100) | 79 (17–100) | 79 (33–100) | 71 (33–100) | 75 (33–100) | Trend favours APE but n.s. |
| 59 | APE                | 60.4 (20.1) | 75.7 (20.1) | 59.2        | 65.9       | 58.1       | Trend favours AR but n.s. |
| 124| APE                | 59.2      | 65.9       | 58.1        |           |           |                     |
| 100| APE                | 51.7      | 61.3       | 60.5        | 69         |           | Trend favours AR but n.s. |
| 130| APE                | 67.9(21.2) | 59.3(23.7) | 71.8(25.7)  | 70.9(28.0) |           | Trend favours APE but n.s. |
| 84 | APE                | 69.0(6.3) | 69.4(6.4)  | 70.8(10.9)  | 70.9(8.9)  |           | Trend favours AR but n.s. |
| 43 | APE                | 74.3(7.9) | 75.4(8.9)  | 75.9(8.9)   |           |           |                     |
| 224| APE                | 67.3(21.4) | 69.8(24.6) | 65.6(23.4)  |           |           | No difference |
| 125| APE                | 75(0–100)  | 75(0–100)  | 75(0–100)   |           |           | No difference |
| 60 | APE                | 66.6(50–100) | 66.6(16.7–100) |           |           |           | No difference |

*Values are mean(s.d.) unless indicated otherwise. †values are median (range). The European Organization for Research and Treatment of Cancer (EORTC) QLQ-CR30 score has a range of 1–100, where 0 represents the best quality of life attainable. A score difference or change of 10 is claimed to be clinically important. Values are rounded to one decimal place. Articles with data represented graphically are not included in this table. ‡
The comparison of observational data between single-arm studies further increases the risk of bias, which was therefore avoided by exclusion of papers with no direct comparison between groups. Selection bias in observational studies in the review will have been increased further owing to patient selection for different techniques. The use of non-validated tools for postoperative QoL was also commonplace and did not allow accurate and reliable conclusions to be drawn from the data. An example is the use of QoL questions that had not been assessed to demonstrate validity, reliability or to ensure that they provided a true reflection of the patient experience. There was variation between studies, with heterogeneity in results identified. The variety of inclusion criteria, differing levels of neoadjuvant therapy, differences in follow-up time, and range of surgical techniques is likely to be reflected in the differences in results.

Most studies did not specify location of the rectal cancer as an inclusion criterion; higher rectal tumours suitable for AR and not for APE will create selection bias because of a lower risk of developing low anterior resection syndrome, and produce more favourable outcomes in the AR group. The cohort of patients who underwent AR in the included studies often excluded those who had not undergone ileostomy reversal. The non-closure rate of defunctioning ileostomies 18 months after AR was 25.1–30 per cent and these patients are considered to have permanent loop ileostomies. The exclusion of these patients, therefore, is not reflective of clinical practice. These patients may have had their QoL improved by having an end colostomy at initial operation rather than living with a loop ileostomy and its attendant challenges of dietary restrictions, skin irritation, and renal impairment, although this was not addressed in the present analysis. Some studies excluded patients who had a postoperative anastomotic leak. Such leaks have a significant impact on long-term QoL and therefore introduce significant bias into the relevant studies. The exclusion of patients with a permanent ileostomy, patients at higher risk of low anterior resection syndrome, and those who had an anastomotic leak may reflect favourably on patients who have

Table 4 Validated measures of pain

| Surgical procedure | Pain score* | Direction of effect |
|--------------------|-------------|---------------------|
|                    | Baseline    | 0–5 months | 6–11 months | 1–2 years | > 2 years |
| QLQ-CR30: pain     |             |           |             |           |           |
| How et al.†        | APE         | 0 (0–67)   | 0 (0–67)    | 0 (0–33)  | Favours APE (P < 0.050)‡ |
|                    | AR          | 0 (0–100)  | 17 (0–89)   | 33 (0–67) | Trend favours |
| Mrak et al.         | APE         | 24.4       | 17.5        | 25.3      | Trend favours |
|                    | AR          |            |            | 17.5      | AR but n.s. |
| Konanz et al.       | APE         |            |            | 22.7      | AR but n.s. |
|                    | AR          |            |            |           |           |
|                    | AR (ISR)   |            |            |           |           |
| Monastyrnska et al. | APE         | 27         | 2          |           | Trend favours |
|                    | AR          | 23         | 9          |           | APE but n.s. |
| Wani et al.         | APE         | 18.5 (21.9)| 26.3 (29.9)| Trend favours |
|                    | AR          | 23.8 (26.1)| 17.9 (25.5)| AR but n.s. |
| Arraras et al.      | APE         | 10.3 (4.3) | 10.1 (4.7) | 9.1 (4.7) | No difference |
|                    | AR          | 10.0 (4.0) | 10.6 (4.5) |           |           |
| Du et al.           | APE         | 12.1 (21.6)| 13.5 (20.9)| Trend favours |
|                    | AR          | 14.9 (21.1)| 16.7 (0–100)| APE but n.s. |
| Trenti et al.       | APE         | 32.1 (26.4)| 9.3 (22.2) | Trend favours |
|                    | AR          | 12.7 (24.7)| 12.5 (21.6)| AR but n.s. |
| Silva et al.†       | APE         | 25.0 (28.1)| 12.1 (18.0)| Trend favours |
|                    | AR          | 15.9 (27.2)| 16.7 (24.6)| AR but n.s. |
| QLQ-CR29: abdominal pain |      |           |             |           |           |
| Wani et al.         | APE         | 32.1 (26.4)| 9.3 (22.2) | Trend favours |
|                    | AR          | 12.7 (24.7)| 12.5 (21.6)| AR but n.s. |
| Arraras et al.      | APE         | 11.7 (21.9)| 17.2 (27.5)| Trend favours |
|                    | AR          | 18.9 (27.2)| 18.9 (27.2)| APE but n.s. |
| Trenti et al.       | APE         | 0 (0–66.7)| 0 (0–100)  | No difference |
|                    | AR          | 0 (0–100)  | 0 (0–100)  |           |
| Silva et al.†       | APE         |           |             |           |           |
|                    | AR          |            |            |           |           |
| QLQ-CR29: buttock pain |      |           |             |           |           |
| Wani et al.         | APE         |           |             |           |           |
|                    | AR          |           |             |           |           |
| Arraras et al.      | APE         |           |             |           |           |
|                    | AR          |           |             |           |           |
| Trenti et al.       | APE         |           |             |           |           |
|                    | AR          |           |             |           |           |
| Silva et al.†       | APE         |           |             |           |           |
|                    | AR          |           |             |           |           |

*Values are mean(s.d.) unless indicated otherwise; †values are median (range). The European Organization for Research and Treatment of Cancer (EORTC) QLQ-CR30 and QLQ-CR29 scores have a range of 1–100, where 0 represents the lowest symptom burden. A score difference or change of 10 is claimed to be clinically important. Values are rounded to one decimal place. Articles with data represented graphically are not included in this table. ‡P < 0.050 was considered statistically significant. APE, abdominoperineal excision; AR, anterior resection; n.s., not statistically significant; ISR, intersphincteric resection; CAA, coloanal anastomosis.
Table 5 Validated scores for gastrointestinal symptoms

| Surgical procedure | Score* Direction of effect | Baseline | 0–5 months | 6–11 months | 1–2 years | > 2 years |
|--------------------|-----------------------------|----------|------------|-------------|-----------|----------|
| QLQ-CR29: flatulence | Trenti et al. 39 | APE 39 31.5 (26.8) | 31.5 (26.8) | Favours APE | (P < 0.050)‡ | AR 42.1 (30.0) |
|                    | AR (CAA)                  | 56.7 (30.5) |            |             |           |          |
|                    | Wani et al. 40            | APE 39 32.1 (27.9) | 32.1 (26.6) | No difference | identified | AR 42.1 (30.0) |
|                    | AR                        | 33.7 (28.3) |            |             |           |          |
|                    | Arraras et al. 24         | APE 39 33.3 (26.5) | 31.6 (25.5) | No difference | identified | AR 42.1 (30.0) |
|                    | AR                        | 34.0 (26.5) |            |             |           |          |
| QLQ-CR29: stool frequency | Trenti et al. 39 | APE 39 21.8 (22.3) | 21.8 (22.3) | Trend favours | (P < 0.050)‡ | AR 31.8 (25.1) |
|                    | AR (CAA)                  | 40.0 (26.5) |            |             |           |          |
|                    | Wani et al. 40            | APE 39 29.8 (26.6) | 29.8 (26.6) | No difference | identified | AR 42.1 (30.0) |
|                    | AR                        | 32.1 (27.9) |            |             |           |          |
|                    | Arraras et al. 24         | APE 39 14.3 (18.5) | 14.3 (18.5) | No difference | identified | AR 42.1 (30.0) |
|                    | AR                        | 33.3 (23.6) |            |             |           |          |
| QLQ-CR28: GI tract symptoms | Du et al. 26 | APE 26 20.1 (8.4) | 18.3 (7.4) | 15.1 (5.5) | No difference | identified | AR 22.9 (25.8) |
|                    | AR                        | 15.9 (4.0) |            |             |           |          |
|                    | Russell et al. 37         | APE 37 21.4 | 18.9 | 15.2 | No difference | identified | AR 22.9 (25.8) |
|                    | AR                        | 16.8 |            |             |           |          |
|                    | Konanz et al. 33          | APE 33 14.3 (18.5) | 14.3 (18.5) | No difference | identified | AR 22.9 (25.8) |
|                    | AR                        | 33.3 (23.6) |            |             |           |          |
|                    | AR (ISR)                  | 37.8 |            |             |           |          |
| EORTC QLQ-CR30: nausea/vomiting | How et al. 30† | APE 30 0 (0–33) | 0 (0–33) | 0 (0–33) | No difference | identified | AR 0 (0–33) |
|                    | AR                        | 0 (0–33) |            |             |           |          |
|                    | Mrak et al. 35            | APE 35 5.7 | 6.7 | 6.7 | No difference | identified | AR 6.7 |
|                    | AR                        | 5.7 |            |             |           |          |
|                    | Konanz et al. 33          | APE 33 2.3 | 2.3 | 2.3 | No difference | identified | AR 6.7 |
|                    | AR                        | 2.3 |            |             |           |          |
|                    | AR (ISR)                  | 6.7 |            |             |           |          |
|                    | Monastyrkska et al. 34    | APE 34 11.3 | 13.7 | 13.7 | Favours AR | (P < 0.050)‡ | AR 13.7 |
|                    | AR                        | 4.7 | 7.4 | 7.4 | Favours AR | (P < 0.050)‡ | AR 7.4 |
|                    | Wani et al. 40            | APE 40 8.1 (18.1) | 7.3 (17.2) | No difference | identified | AR 6.1 (33.3) |
|                    | AR                        | 7.4 (18.2) |            |             |           |          |
|                    | Arraras et al. 24         | APE 24 5.2 (17.5) | 4.9 (17.3) | No difference | identified | AR 4.9 (17.3) |
|                    | AR                        | 5.2 (17.5) |            |             |           |          |
|                    | Du et al. 26              | APE 26 7.5 (5.6) | 7.5 (5.5) | 5.8 (5.9) | No difference | identified | AR 5.8 (5.9) |
|                    | AR                        | 6.2 (5.4) | 6.1 (4.4) | 5.0 (5.6) | No difference | identified | AR 5.0 (5.6) |
|                    | Trenti et al. 39          | APE 39 4.5 (15.3) | 4.5 (15.3) | No difference | identified | AR 4.5 (15.3) |
|                    | AR                        | 2.8 (4.4) | 2.3 (4.4) | 2.3 (4.4) | No difference | identified | AR 2.3 (4.4) |
|                    | AR (CAA)                  | 4.6 |            |             |           |          |
|                    | Silva et al. 38†          | APE 38 11.3 | 13.7 | 13.7 | Favours AR | (P < 0.050)‡ | AR 13.7 |
|                    | AR                        | 4.7 | 7.4 | 7.4 | Favours AR | (P < 0.050)‡ | AR 7.4 |
| EORTC QLQ-CR30: diarrhoea | How et al. 30† | APE 30 33 (0–67) | 0 (0–67) | 0 (0–67) | No difference | identified | AR 33 (0–67) |
|                    | AR                        | 0 (0–100) | 0 (0–100) | 0 (0–100) | No difference | identified | AR 0 (0–100) |
|                    | Mrak et al. 35            | APE 35 26.1 26.1 | 26.1 | 26.1 | No difference | identified | AR 26.1 |
|                    | AR                        | 26.1 | 26.1 | 26.1 | No difference | identified | AR 26.1 |
|                    | Konanz et al. 33          | APE 33 16.7‡| 16.7‡| 16.7‡| Favours AR | (P < 0.050)‡| AR 16.7‡|
|                    | AR                        | 34.1‡| 45.5‡| 45.5‡| Favours AR | (P < 0.050)‡| AR 45.5‡|
|                    | AR (ISR)                  | 45.5‡|            |             |           |          |
|                    | Monastyrksa et al. 34     | APE 34 30.7 | 38.7 | 38.7 | Favours AR | (P < 0.050)‡ | AR 38.7 |
|                    | AR                        | 32 | 0.7 | 0.7 | Favours AR | (P < 0.050)‡ | AR 0.7 |
|                    | Wani et al. 40            | APE 40 15.0 (25.1) | 15.0 (25.1) | No difference | identified | AR 15.0 (25.1) |
|                    | AR                        | 15.0 (25.1) |            |             |           |          |
|                    | Arraras et al. 24         | APE 24 11.1 (19.2) | 11.1 (19.2) | No difference | identified | AR 11.1 (19.2) |
|                    | AR                        | 21.4 (27.3) |            |             |           |          |
|                    | Du et al. 26              | APE 26 9.8 (8.0) | 8.9 (7.8) | 8.7 (7.8) | No difference | identified | AR 8.7 (7.8) |
|                    | AR                        | 12.3 (9.4) | 11.8 (7.3) | 9.3 (6.5) | No difference | identified | AR 9.3 (6.5) |
|                    | Trenti et al. 39          | APE 39 17.1 (24.6) | 17.1 (24.6) | Trend favours | identified | AR 22.9 (25.8) |
|                    | AR                        | 22.9 (25.8) |            |             |           |          |
|                    | AR (CAA)                  | 27.8 (27.8) |            |             |           |          |
|                    | Silva et al. 38†          | APE 38 9.8 | 0 (0–66.7) | 0 (0–66.7) | No difference | identified | AR 0 (0–66.7) |
|                    | AR                        | 0 (0–100) | 0 (0–100) | 0 (0–100) | No difference | identified | AR 0 (0–100) |

(continued)
undergone AR and not reflect clinical practice. This, therefore, does not allow surgeons to provide patients with accurate information.

The results of this systematic review are in keeping with previously published work. The Cochrane review published in 2012 found equipoise in QoL outcomes and was also unable to recommend AR over APE. A previous meta-analysis from 2007 also identified no difference in QoL outcomes after AR versus APE for rectal cancer. The present systematic review supports these findings in studies that have been published since the Cochrane review in 2012. Data published since this date should also allow for the introduction of enhanced recovery after surgery protocols, the use of preoperative MRI, and should not include the laparoscopic learning curve. These subsequent studies may therefore be more relevant to current practice.

Table 5. (continued)

| Surgical procedure | Baseline | 0–5 months | 6–11 months | 1–2 years | >2 years | Direction of effect |
|--------------------|----------|------------|-------------|-----------|----------|--------------------|
| How et al.30†      | APE      | 0 (0–100)  | 0 (0–67)‡   | 0 (0–33)  | No difference identified |
|                    | AR       | 0 (0–100)‡ | 0 (0–67)‡   | 14        | No difference identified |
| Mrak et al.35       | APE      | 12‡        | 25.2‡       | P < 0.050‡ | Favours APE         |
|                    | AR       | 12‡        | 21.6        |           | identified           |
| Konanz et al.33     | APE      | 12‡        | 25.2‡       | P < 0.050‡ | Favours APE         |
|                    | AR       | 12‡        | 21.6        |           | identified           |
| Monastyrskas et al.34 | APE      | 36.67      | 16‡        | P < 0.050‡ | Favours AR          |
|                    | AR       | 23.3       | 0‡          |           | identified           |
| Wani et al.40       | APE      | 15.5 (27.9)| 15.4 (27.2) | No difference identified |
|                    | AR       | 20.6 (24.7)| 26.8 (33.9) | No difference identified |
| Arraras et al.24    | APE      | 21.6       | 25.2‡       | P < 0.050‡ | Favours APE         |
|                    | AR       | 21.6       | 25.2‡       | P < 0.050‡ | Favours APE         |
| Trenti et al.39     | APE      | 13.9 (9.0) | 13.7 (7.1)  | 12.1 (4.8)| No difference identified |
|                    | AR       | 15.8 (8.9) | 14.5 (6.5)  | 13.0 (5.2)| No difference identified |
| Silva et al.38†     | APE      | 8.1 (19.2)‡| 28.4 (32.1)‡| P < 0.050‡ | Favours APE         |
|                    | AR       | 0 (0–100)  | 20.0 (24.1)‡| P < 0.050‡ | Favours APE         |

Values are mean(s.d.) unless indicated otherwise; † values are median (range). The European Organization for Research and Treatment of Cancer (EORTC) QLQ-CR30, QLQ-CR38, and QLQ-CR29 scores have a range of 1–100, where 0 represents the lowest symptom burden. A score difference or change of 10 is claimed to be clinically important. Values are rounded to one decimal place. P < 0.050 was considered statistically significant. APE, abdominoperineal excision; AR, anterior resection; ISR, intersphincteric resection; CAA, coloanal anastomosis; n.s., not statistically significant.

Table 6 Validated measures of body image

| Surgical procedure | Body image score* | Direction of effect |
|--------------------|-------------------|--------------------|
| Du et al.26        | APE 75.1 (11.4)   | Favours AR         |
|                   | AR 81.1 (11.5)    | (P < 0.050)‡       |
| Mrak et al.35      | APE 63.7 (30.1)   | Trend favours AR   |
|                   | AR 79.2 (23.9)    | but n.s.           |
| How et al.30†      | APE 100 (50–100)  | No difference      |
|                   | AR 92 (33–100)    | identified         |
| Konanz et al.33    | APE 62.4          | No difference      |
|                   | AR (ISR) 75.3     | identified         |
| Arraras et al.24   | APE 92.1 (11.7)   | Identified         |
|                   | AR 85.4 (21.8)    | No difference      |
| Wani et al.40      | APE 84.1 (15.0)   | Identified         |
|                   | AR 83.6 (13.9)    | No difference      |
| Trenti et al.39    | APE 68.0 (27.8)‡  | Favours AR         |
|                   | AR (CAA) 81.9 (26.2)| P < 0.050‡       |
| Silva et al.38†    | APE 86.1 (0–100)  | No difference      |
|                   | AR 88.9 (0–100)   | identified         |

*Values are mean(s.d.) unless indicated otherwise; † values are median (range). The European Organization for Research and Treatment of Cancer (EORTC) QLQ-CR38 and QLQ-CR29 scores have a range of 1–100, where 0 represents the lowest symptom burden. A score difference or change of 10 is claimed to be clinically important. Values are rounded to one decimal place. Values with data represented graphically are not included in this table. P < 0.050 was considered statistically significant. APE, abdominoperineal excision; AR, anterior resection; CAA, coloanal anastomosis; n.s., not statistically significant; ISR, intersphincteric resection.
These results should be discussed with patients as part of shared decision-making and consenting for operative management of rectal cancer, although this review cannot recommend one surgical approach over another for improved QoL. Future studies should record detailed clinical factors alongside properly validated preoperative QoL measures used for patients undergoing both surgical approaches. These studies should include only patients with low rectal cancer, as previously defined in the literature, to allow direct comparison between techniques and reduce selection bias. Patients should be followed up adequately with the same QoL measures used after surgery, and both short- and long-term data collected. The use of the collaborative research model may provide a framework for this work. The Colostomy Impact Score (CIS) and the Low Anterior Resection Score (LARS) both now have validated convergence on the EORTC QLQ-C30, and may therefore be useful in allowing a direct comparison between the two surgical techniques. The impact of ileostomy on patients’ QoL should

| Surgical procedure | Baseline | 0-5 months | 6-11 months | 1-2 years | > 2 years | Direction of effect |
|--------------------|----------|------------|-------------|-----------|----------|---------------------|
| Sexual interest    |          |            |             |           |          |                     |
| Mrak et al.        | APE      |            |             |           |          |                     |
| QLQ-CR29           |          |            |             |           |          |                     |
| Wani et al.        | APE      |            |             |           |          |                     |
| QLQ-CR29           |          |            |             |           |          |                     |
| Trenti et al.      | APE      |            |             |           |          |                     |
| QLQ-CR29           |          |            |             |           |          |                     |
| Silva et al.       | APE      |            |             |           |          |                     |
| QLQ-CR29           |          |            |             |           |          |                     |
| Sexual enjoyment   |          |            |             |           |          |                     |
| How et al.         | APE      |            |             |           |          |                     |
| QLQ-CR38           |          |            |             |           |          |                     |
| Konanz et al.      | AR       |            |             |           |          |                     |
| QLQ-CR38           |          |            |             |           |          |                     |
| Penchev et al.     | APE      |            |             |           |          |                     |
| QLQ-CR38           |          |            |             |           |          |                     |
| Du et al.          | APE      |            |             |           |          |                     |
| QLQ-CR38           |          |            |             |           |          |                     |
| Sexual functioning |          |            |             |           |          |                     |
| How et al.         | APE      |            |             |           |          |                     |
| QLQ-CR38           |          |            |             |           |          |                     |
| Konanz et al.      | AR       |            |             |           |          |                     |
| QLQ-CR38           |          |            |             |           |          |                     |
| Arraras et al.     | APE      |            |             |           |          |                     |
| QLQ-CR29           |          |            |             |           |          |                     |
| Penchev et al.     | APE      |            |             |           |          |                     |
| QLQ-CR38           |          |            |             |           |          |                     |
| Du et al.          | APE      |            |             |           |          |                     |
| QLQ-CR38           |          |            |             |           |          |                     |

*Values are mean(s.d.) unless indicated otherwise; †values are median (range). The European Organization for Research and Treatment of Cancer (EORTC) QLQ-C38 and QLQ-CR29 scores have a range of 1–100, where 0 represents the lowest symptom burden. A score difference or change of 10 is claimed to be clinically important. Values are rounded to one decimal place. Articles with data represented graphically are not included in this table. ‡P < 0.050 was considered statistically significant. APE, abdominoperineal excision; AR, anterior resection; n.s., not statistically significant; ISR, intersphincteric resection.
be considered, and may not be assessed accurately by the CIS and LARS. Additional work is required to understand the process by which surgeons decide which operations to offer the individual patient.

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Supplementary material
Supplementary material is available at BJS Open online.

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