


Suture rectopexy *versus* ventral mesh rectopexy for complete full-thickness rectal prolapse and intussusception: systematic review and meta-analysis

H. S. Lobb ^{1*}, C. C. Kearsley², S. Ahmed³ and R. Rajaganesan²

¹University of Liverpool, Liverpool, UK

²St Helen's and Knowsley Teaching Hospitals NHS Trust

³Royal Liverpool and Broadgreen University Hospitals NHS Trust, Liverpool, UK

*Correspondence to: 12 Midway Drive, Truro TR1 1NG, UK (e-mail: hslobb@gmail.com)

Abstract

Background: This systematic review and meta-analysis aimed to compare recurrence rates of rectal prolapse following ventral mesh rectopexy (VMR) and suture rectopexy (SR).

Methods: MEDLINE, Embase, and the Cochrane Library were searched for studies reporting on the recurrence rates of complete rectal prolapse (CRP) or intussusception (IS) after SR and VMR. Results were pooled and procedures compared; a subgroup analysis was performed comparing patients with CRP and IS who underwent VMR using biological *versus* synthetic meshes. A meta-analysis of studies comparing SR and VMR was undertaken. The Methodological Items for Non-Randomized Studies score, the Newcastle–Ottawa Scale, and the Cochrane Collaboration tool were used to assess the quality of studies.

Results: Twenty-two studies with 976 patients were included in the SR group and 31 studies with 1605 patients in the VMR group; among these studies, five were eligible for meta-analysis. Overall, in patients with CRP, the recurrence rate was 8.6 per cent after SR and 3.7 per cent after VMR ($P < 0.001$). However, in patients with IS treated using VMR, the recurrence rate was 9.7 per cent. Recurrence rates after VMR did not differ with use of biological or synthetic mesh in patients treated for CRP (4.1 *versus* 3.6 per cent; $P = 0.789$) and or IS (11.4 *versus* 11.0 per cent; $P = 0.902$). Results from the meta-analysis showed high heterogeneity, and the difference in recurrence rates between SR and VMR groups was not statistically significant ($P = 0.76$).

Conclusion: Although the systematic review showed a higher recurrence rate after SR than VMR for treatment of CRP, this result was not confirmed by meta-analysis. Therefore, robust RCTs comparing SR and biological VMR are required.

Introduction

Complete rectal prolapse (CRP) is defined as full-thickness protrusion of the rectal wall through the anus¹. It begins as intussusception (IS) which may or may not be symptomatic². It is a common condition worldwide, which can be difficult to treat successfully and causes significant psychosocial problems for the patient. The aim of treatment is to control the prolapse and relieve incontinence while preventing constipation or obstructive defaecation^{3,4}. Plication of the redundant bowel and/or fixation of the rectum to the sacrum was originally achieved by SR, but has evolved to the use of synthetic, non-absorbable mesh. Recently, mesh rectopexy has been associated with a rise in chronic pain and morbidity⁵ and, as a result, a change to more expensive biological mesh has become the standard⁶.

SR can be performed laparoscopically or via a laparotomy. First described by Cutait⁷ in 1959, SR involves mobilization and fixation of the rectum with a non-absorbable suture. The act of mobilization, suture, and fibrosis keeps the rectum fixed in position as adhesions form, attaching the rectum to the presacral fascia. Although SR is considered a good option for the cure of rectal

prolapse/IS in both men and women, some reviews of this procedure noted a better overall clinical outcome in men⁸. This may be due to occult sphincter defects in women, and failure to detect these defects before surgery owing to the lack of routine endoanal ultrasonography in the earlier years of prolapse surgery⁹.

The mesh rectopexy operation was first described by Ripstein¹⁰ in 1952. Again, after mobilization of the rectum, an anterior sling of synthetic material (either absorbable or non-absorbable) is placed in front of the rectum and sutured to the sacral promontory. The rationale for this is to restore the natural curve of the rectum, which reduces the effect of downward abdominal pressure. The use of a non-elastic synthetic graft provides a firm anterior fascial support even in patients with significant pelvic floor descent, returning the rectum to a normal anatomical position¹¹. However, there were long-term complications associated with the use of synthetic mesh for ventral mesh rectopexy (VMR)⁵, so a shift to biological mesh was made.

There is little hard evidence for the use of biological mesh compared with historical techniques. This systematic review and meta-analysis aimed to identify the evidence and compare recurrence rates for SR with those of VMR for patients with CRP or IS.

Received: July 26, 2020. Accepted: October 08, 2020

© The Author(s) 2021. Published by Oxford University Press on behalf of BJS Society Ltd.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted reuse, distribution, and reproduction in any medium, provided the original work is properly cited.

Methods

Data sources and search strategy

Two literature searches were carried out using MEDLINE, Embase, and the Cochrane Library databases. No limitation on study period was set and searches were set for studies on SR and VMR—using either biological or synthetic mesh—using the following criteria: '(suture OR sutured) AND rectopex*' (SR, search 1) and '(ventral OR anterior OR mesh) AND rectopex*' (VMR, search 2). The reference lists from systematic reviews or meta-analyses were reviewed and relevant studies included. Titles and abstracts were screened by two reviewers, and full-text copies were subsequently obtained. Any discrepancies in screening were settled by a third reviewer.

Studies included were randomized and non-randomized studies using open or laparoscopic techniques that reported either symptomatic, anatomical or radiological recurrence of CRP (full-thickness) or IS as outcome measure, as it is the most standardized way of assessing the efficacy of the procedures. Studies were included only if indication and specific data were available for extraction.

Case reports, duplicates, non-English articles, and those reporting follow-up of less than 12 months were excluded. Studies that focused on robotic rectopexy were excluded owing to the novelty of the technique and absence of a SR robotic group. Other exclusion criteria were: SR in children, rectocele, volvulus or mucosal prolapse; and studies that involved posterior rectopexy, concomitant resections, sacrocolpopexy or other abdominal or pelvic procedures directly related to the prolapse or IS. Studies pertaining to VMR were excluded if they used the Ripstein procedure/sling rectopexy, Well's procedure or the Orr-Loygue procedure, concomitant sacrocolpopexy, or any other concomitant abdominal or pelvic procedures.

Non-randomized studies were assessed for methodological quality using the Methodological Index for Non-Randomized Studies score¹², and RCTs were assessed independently for risk of bias using the Cochrane Collaboration tool¹³, by two reviewers; discrepancies were discussed and resolved mutually.

Data extraction and outcome measures

The following information was extracted: study design, title, authors, publication year, study type, number of patients undergoing rectopexy, population characteristics, type of mesh used (VMR), duration of follow-up, and number of patients with recurrence of CRP or IS (primary outcome). Secondary outcomes included incontinence and constipation data, and postoperative complications reported by the studies. Secondary procedures and secondary recurrence were excluded, and partial recurrence was not considered an outcome of interest. In calculation of the complication rate, only studies that reported complications were included in the denominator.

Constipation and incontinence data varied among studies, as various scoring methods (Cleveland and Wexner scores, and Faecal Incontinence Severity Index) were reported. Data extraction for these outcomes included type of scoring system used if available, values from each scoring system, raw figures for patients with incontinence or constipation before and after operation if available, and whether the study reported a change in symptoms to be statistically significant.

Statistical analysis

Data extracted from the studies were pooled for the overall rates of recurrence and complications. The significance of recurrence

and complication rates was assessed using Pearson's χ^2 test in SPSS® (IBM, Armonk, New York, USA); $P < 0.050$ was considered statistically significant. Constipation and incontinence data were considered for qualitative analysis. Randomized and non-randomized studies comparing SR and VMR were eligible for meta-analysis and statistical comparison of recurrence rates. The quality of non-randomized studies was assessed using the Newcastle–Ottawa Scale¹⁴ and risk of bias of randomized studies using the Cochrane Collaboration tool¹³. Meta-analysis was performed using Review Manager 5.3 (Nordic Cochrane Centre, Copenhagen Denmark). Risk ratio was the effect measure used (with 95 per cent confidence interval) and statistical heterogeneity was assessed using the I^2 test. A random-effects model was to be used if heterogeneity was high (I^2 over 50 per cent) and a fixed-effect model if heterogeneity was low. Results were represented visually in a forest plot. $P < 0.050$ indicated statistical significance.

Results

Of 378 citations retrieved from the SR search, 22^{8,9,15–34} were included in the review including 976 patients. Of 1419 citations retrieved from the VMR search, 31 studies^{15,21,23,27,30,35–60} were included in analysis reporting on 1608 patients with CRP and 399 patients with IS (Fig. 1). All studies in the SR group included patients with CRP. Data for CRP and IS were therefore compared separately. Studies and their characteristics are summarized in Tables 1 and 2.

In the VMR group, 27 of the 31 studies reported on patients with a median or mean age of more than 50 years, and in 25 studies the study population included more than 80 per cent women. Similarly, in the SR group, median or mean age exceeded 50 years in 17 of 21 studies in which age was reported, and in 16 reports women comprised more than 80 per cent of the included patients.

Follow-up and recurrences

Follow-up ranged from 12 to 74 months in the VMR group and from 12 to 162 months in the SR group; it was reported using median values in 41 studies and as a mean value in seven. Follow-up data were missing from one VMR study⁴³, although this was an update of a previous publication that reported a median follow-up of 61 months⁶¹. Among patients treated for CRP, the recurrence rate was 8.8 per cent in the SR group and 3.8 per cent in the VMR group ($P < 0.001$) (Table 3). However, among 402 patients with IS treated using VMR, the recurrence rate was 9.7 per cent.

Twenty-one studies of VMR reported the use of synthetic mesh, whereas the use of biological mesh was reported in seven (Table 4). The remaining VMR studies either did not report the type of mesh used, or used both types and did not specify which mesh was used in patients who had recurrence. Synthetic mesh was used in 1362 patients with CRP across 17 studies, of whom 49 (3.6 per cent) had a recurrence, and in 209 patients with IS across four studies, of whom 23 (11.0 per cent) developed recurrence. Biological mesh was used in 97 patients with CRP across five studies, of whom four (4.1 per cent) had a recurrence, and in 140 patients with IS across two studies, of whom 16 (11.4 per cent) developed recurrence. There was no significant difference in recurrence rates between synthetic or biological mesh for CRP ($P = 0.789$) or IS ($P = 0.902$),

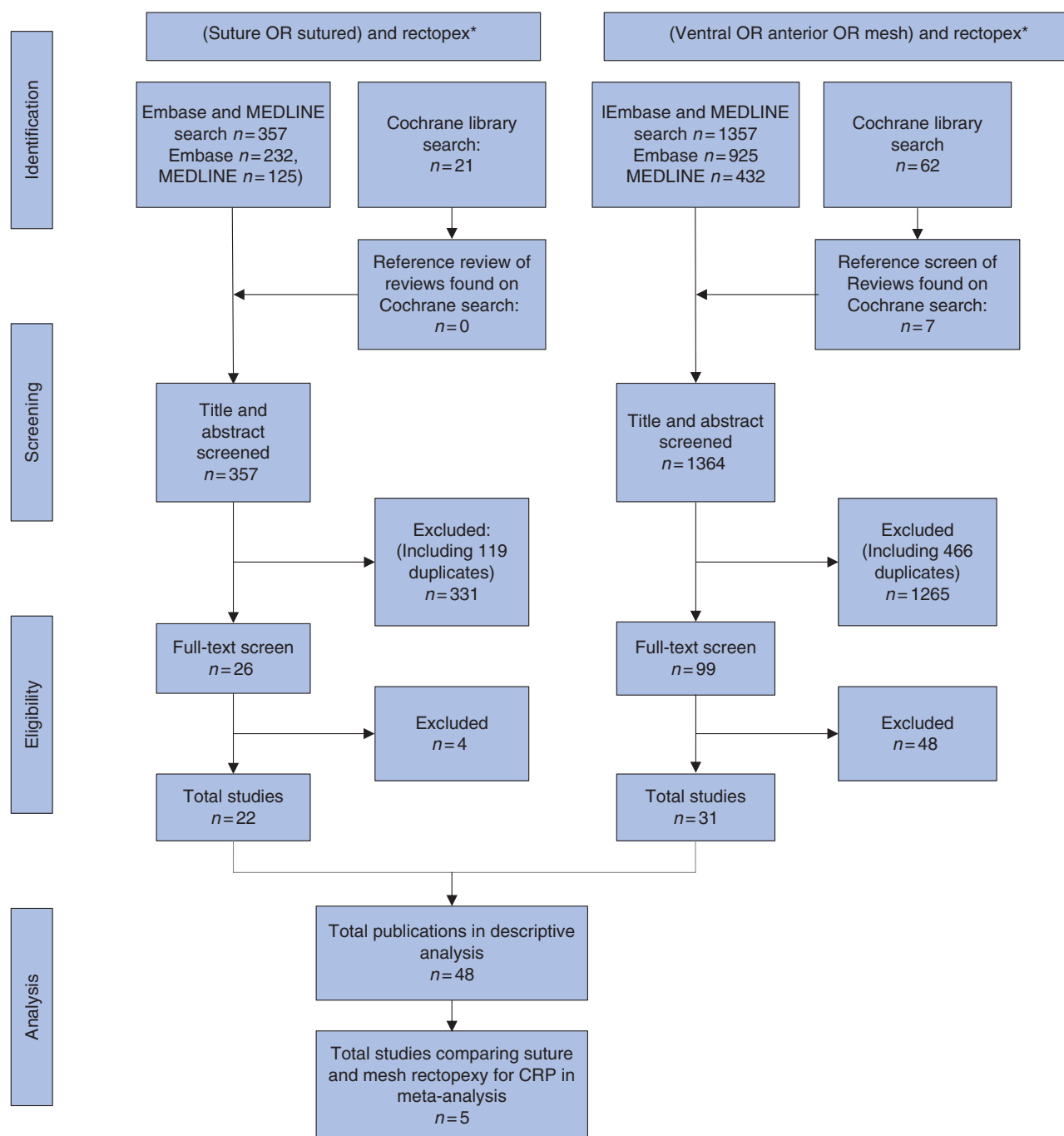


Fig. 1 PRISMA flow diagram showing selection of studies for review

CRP, complete rectal prolapse.

Constipation and incontinence

In the VMR group, 27 studies reported data on incontinence and 21 found a statistically significant improvement after surgery (Table 5). In the SR group, 17 studies reported data on incontinence, eight of which found a statistically significant improvement after operation. One study⁵⁴ in the VMR group and five^{19,25,28,29,31} in the SR group did not report statistical significance testing, but suggested an improvement in incontinence. No studies reported an overall worsening of incontinence.

In the VMR group, 24 studies reported data on constipation and 14 found a statistically significant improvement after operation (Table 5). In the SR group, 14 studies reported data on

constipation, two of which found a statistically significant post-operative improvement. Nine further studies^{18,25,31,34,42,44,51,52,56} did not report statistical significance testing, but suggested an improvement in constipation. One study showed a significant worsening of constipation after SR.

Of five studies that compared SR and VMR, three^{15,23,27} reported a comparison of incontinence and constipation (Table 6). Regarding incontinence, two studies found no statistical difference between VMR and SR, although one²⁷ reported a significant difference favouring VMR. With respect to constipation, two studies^{23,27} reported a statistical difference between VMR and SR, both favouring VMR; however, one of these studies²⁷ included

Table 1 Characteristics of studies of suture rectopexy

| Reference | Study type | No. of patients | Age (years)* | % women | Follow-up method | Duration of follow-up (months)* | MINORS score | Cochrane Collaboration tool score |
|---|---------------|-----------------|-------------------|---------|---|---------------------------------|--------------|--|
| Benoist <i>et al.</i> ¹⁵ | Retrospective | 16 | 76.2 [†] | 100 | Clinical examination | 24 [†] | 15 of 24 | – |
| Blatchford <i>et al.</i> ¹⁶ | Retrospective | 42 | 61 [†] | 88 | Office visits/telephone interviews | 28 | 11 of 16 | – |
| Briel <i>et al.</i> ⁹ | Retrospective | 24 | 71 | 88 | Hospital records and prospective telephone interview | 67 | 10 of 16 | – |
| Bruch <i>et al.</i> ¹⁷ | Prospective | 32 | 62 [†] | 94 | Clinic appointment, continence score, anorectal manometry | 30 [†] | 12 of 16 | – |
| Chaudhry Vsm ¹⁸ | Prospective | 36 | 43.5 [†] | 72 | Not-specified | 12 | 11 of 16 | – |
| De Oliveira <i>et al.</i> ¹⁹ | Retrospective | 16 | 82 | 88 | Examination/patient complaint | 29 [†] | 16 of 24 | – |
| Foppa <i>et al.</i> ²⁰ | Prospective | 172 | 62 | 97.2 | Telephone interview and office appointment | 162 | 13 of 16 | – |
| Gleditsch <i>et al.</i> ²¹ | Retrospective | 49 | 72 | 83 | Interview, endoscopy and examination | 84 | 15 of 24 | – |
| Heah <i>et al.</i> ²² | Retrospective | 25 | 72 [†] | 88 | Outpatient appointment or telephone review | 26 | 11 of 16 | – |
| Hidaka <i>et al.</i> ²³ | RCT | 30 | 48.5 | 90 | Clinical examination | 72 | – | 3 unclear 4 low risk |
| Kellokumpu <i>et al.</i> ²⁴ | Prospective | 16 | 57 | 91 | Appointment at hospital and endoscopy | 24 | 14 of 24 | – |
| Kessler <i>et al.</i> ⁸ | Retrospective | 28 | 51.5 | 84 | Telephone interview | 33 | 9 of 16 | – |
| Khanna <i>et al.</i> ²⁵ | Prospective | 65 | n.a. | n.a. | n.a. | 65 | 10 of 16 | – |
| Liyanaige <i>et al.</i> ²⁶ | Prospective | 70 | 37 | 30 | Outpatient appointment or telephone/postal review | 56 | 12 of 16 | – |
| Luglio <i>et al.</i> ²⁷ | RCT | 11 | 68 | 100 | Questionnaire, endoscopy and defaecography | 12 | – | 5 unclear 2 low risk |
| McKee <i>et al.</i> ²⁸ | RCT | 8 | 70 [†] | 50 | Examination | 20 | – | 5 unclear 2 low risk |
| Novell <i>et al.</i> ²⁹ | RCT | 32 | 76 | 98 | Outpatient appointment or telephone/postal review | 50 | – | 3 unclear 3 low risk 1 high risk |
| Raftopoulos <i>et al.</i> ³⁰ | Retrospective | 163 | 53 | 70.9 | Patient data | 43 | 16 of 24 | – |
| Sahoo <i>et al.</i> ³¹ | Retrospective | 32 | 42.5 [†] | n.a. | Hospital records | 12 | 15 of 24 | – |
| Senapati <i>et al.</i> ³² | RCT | 35 | 58 [†] | 84 | Clinic appointment and questionnaire | 36 | – | 4 unclear 3 low risk |
| Wilson <i>et al.</i> ³³ | Prospective | 59 | 72 | 99 | Telephone interview | 48 | 9 of 16 | – |
| Yasukawa <i>et al.</i> ³⁴ | Case series | 15 | 72.5 [†] | 93 | Telephone interview | 16 | 10 of 16 | – |

*Values are median unless indicated otherwise; values are [†]mean and [‡]average. MINORS, Methodological Index for Non-Randomized Studies; n.a., not available.

some patients who had concurrent sigmoid resection with SR. The third study¹⁵ did not perform significance testing on constipation data, but reported a similar worsening after VMR and SR.

Complications

Twelve studies in the SR group reported complications, including 616 patients with 54 complications overall (8.8 per cent) (Table 7). Twenty-two VMR studies reported complications including 1232 patients and 97 complications overall (7.9 per cent) ($P=0.509$ for SR versus VMR). The most common postoperative complications reported were surgical-site infection after SR (1.9 per cent) and urinary tract infection after VMR (2.4 per cent).

Meta-analysis

Of the 48 studies, five (2 RCTs and 3 non-randomized studies) compared recurrence of CRP after SR versus VMR and were therefore eligible for meta-analysis (Table 8). Of the randomized studies, risk of bias assessed using the Cochrane Collaboration tool was considered to be low in one²³ and unclear in the other²⁷. Of the three non-randomized studies, one was considered to be of fair quality (4 of 7)¹⁵ and the other two^{21,30} of high quality (7 of 7 and 6 of 7) (Tables S1 and S2).

Length of follow-up varied between the studies ranging from 12 to 84 months. The method of assessing recurrence of CRP was

robust in all five studies, which reported the use of clinical examination with or without questionnaires, endoscopy or defaecography.

Across the five studies, 269 patients had SR, of whom 26 had a recurrence (9.7 per cent) and 215 had VMR, of whom 16 developed recurrence (7.4 per cent). Statistical heterogeneity was high ($I^2=73$ per cent) and the difference in recurrence rates was not statistically significant ($P=0.66$; 3 d.f.) (Fig. 2).

Discussion

The concept of fixing the rectum to the sacrum has been a mainstay in the treatment of rectal prolapse for 35 years. The original Orr–Loygue procedure, which involves fully mobilizing the rectum circumferentially down to the levator ani muscle, and fixing an anterior and posterior mesh from the sacrum to the anterolateral rectal wall, has been modified over the years⁶². The D'Hoore modified method performed laparoscopically demands only that Denonvilliers fascia is dissected around the anterior rectal wall and a single mesh is sutured to the anterior aspect of the distal rectum. Owing to possible complications of neurological damage, posterior dissection is avoided in the modified procedure and is limited only to clear the sacral promontory sufficiently for mesh fixation to the periosteum⁴³.

Table 2 Characteristics of studies of mesh rectopexy

| Reference | Study type | No. of patients | | Age (years) [*] | % women | Follow-up method | Duration of follow-up (months) [*] | Type of mesh | MINORS score | Cochrane Collaboration tool score |
|---------------------------------------|---------------|-----------------|----|--------------------------|---------|--|---|-------------------------|--------------|-----------------------------------|
| | | CRP | IS | | | | | | | |
| Albayati et al. ³⁵ | Retrospective | 9 | 42 | 57 | 100 | Questionnaire and telephone call | 22 | Biological | 8 of 16 | – |
| Benoist et al. ¹⁵ | Retrospective | 14 | 0 | 76.2 [†] | 100 | Clinical examination | 24 [†] | n.a. | 15 of 24 | – |
| Bjerke and Mynster ³⁶ | n.a. | 40 | 0 | 83 | 100 | n.a. | 18 | Synthetic | 7 of 16 | – |
| Boons et al. ³⁷ | Prospective | 65 | 0 | 72 | 92 | Clinic appointment and telephone call | 19 | Synthetic | 11 of 16 | – |
| Brunner et al. ³⁸ | Prospective | 13 | 0 | 64.7 [†] | 94 | Clinical examination and questionnaire | 29 | Biological | 11 of 16 | – |
| Byrne et al. ³⁹ | Prospective | 126 | 0 | 56.2 [†] | n.a. | Telephone interview and contacted GP | 60 | Synthetic | 10 of 16 | – |
| Chandra et al. ⁴⁰ | Prospective | 15 | 0 | 50 | 60 | Examination and long-term telephone consultation | 22 | Synthetic | 10 of 16 | – |
| Collinson et al. ⁴¹ | Prospective | 0 | 75 | 58 | 92 | Outpatient clinic | 12 | Synthetic | 11 of 16 | – |
| Consten et al. ⁴² | Retrospective | 242 | 0 | 55.8 [†] | 94.6 | Outpatient clinic | 40 | Synthetic | 11 of 16 | – |
| D'Hoore and Penninckx ⁴³ | Prospective | 109 | 0 | F: 50 M: 32 | 91.7 | n.a. | n.a. | Synthetic | 9 of 16 | – |
| Emile et al. ⁴⁴ | RCT | 25 | 0 | 39.7 [†] | 62 | Consultation and examination | 18 [†] | Synthetic | – | 3 unclear 4 low risk |
| Faucheron et al. ⁴⁵ | Prospective | 175 | 0 | 58 [†] | 90.3 | Examination | 74 | Synthetic | 12 of 16 | – |
| Franceschilli et al. ⁴⁶ | Prospective | 0 | 98 | 63 [†] | 100 | Outpatient clinic | 20 | Biological | 13 of 16 | – |
| Gleditsch et al. ²¹ | Retrospective | 22 | 0 | 72 | 83 | Interview, endoscopy, and examination | 29 | Biological or synthetic | 16 of 24 | – |
| Gosselink et al. ⁴⁷ | Prospective | 41 | 50 | CRP: 63 IS: 59 | 93 | Questionnaire and outpatient clinic | 12 | Synthetic | 10 of 16 | – |
| Hidaka et al. ²³ | RCT | 34 | 0 | 56.5 | 91 | Clinical examination | 72 | n.a. | – | 3 unclear 4 low risk |
| Hiltunen and Matikainen ⁴⁸ | Prospective | 54 | 0 | 53 [†] | 82 | Outpatient clinic | 36 | Synthetic | 12 of 16 | – |
| Lechaux et al. ⁴⁹ | Retrospective | 35 | 0 | 53 | 92 | Clinical review and postal questionnaire | 36 | Synthetic | 9 of 16 | – |
| Luglio et al. ²⁷ | RCT | 20 | 0 | 68 | 100 | Questionnaire, endoscopy and defaecography | 12 | n.a. | – | 5 unclear 2 low risk |
| Madbouly and Youssef ⁵⁰ | Retrospective | 41 | 0 | 55 [†] | 81 | Clinical review and postal questionnaire | 46 [†] | n.a. | 18 of 24 | – |
| Maggiori et al. ⁵¹ | Prospective | 20 | 0 | 64 [†] | 88 | Examination or telephone consultation | 42 | Synthetic | 10 of 16 | – |
| Mantoo et al. ⁵² | Prospective | 23 | 0 | 62 [†] | n.a. | Outpatient clinic | 16 | Synthetic | 19 of 24 | – |
| Mehmood et al. ⁵³ | Prospective | 34 | 0 | 59 | 94 | Questionnaire | 12 | Biological | 17 of 24 | – |
| Ogilvie et al. ⁵⁴ | Prospective | 33 | 0 | 72.3 [†] | 100 | Clinic/examination | 16 | Synthetic | 16 of 24 | – |
| Owais et al. ⁵⁵ | Prospective | 18 | 50 | 34.5 | 0 | Questionnaire | 42 | Mostly synthetic | 9 of 16 | – |
| Portier et al. ⁵⁶ | Prospective | 0 | 40 | 60.6 [†] | 100 | Outpatient clinic, examination and questionnaire | 22 [†] | Synthetic | 9 of 16 | – |
| Raftopoulos et al. ³⁰ | Retrospective | 125 | 0 | 53 | 70.9 | Examination in outpatient clinic or telephone interview | 43 | Synthetic | 16 of 24 | – |
| Randall et al. ⁵⁷ | Prospective | 190 | 0 | 69 | 87.4 | Appointment | 29 | Synthetic | 11 of 16 | – |
| Tsunoda et al. ⁵⁸ | Prospective | 0 | 44 | 76 | 100 | Questionnaires and proctography | 26 | Synthetic | 9 of 16 | – |
| Tsunoda et al. ⁵⁹ | Retrospective | 58 | 0 | 80 | 90 | Outpatient clinic, telephone interview, mail questionnaire | 49 | Synthetic | 10 of 16 | – |
| Wahed et al. ⁶⁰ | Prospective | 27 | 0 | 62 | 95 | examination and proctogram | 12 | Biological | 11 of 16 | – |

*Values are median unless indicated otherwise; values are [†]mean. CRP, complete rectal prolapse; IS, intussusception; MINORS, Methodological Index for Non-Randomized Studies; n.a., not available.

When considering synthetic mesh as a material for rectal fixation, the tensile strength of most synthetic materials usually exceeds the physiological demand. This excess tensile strength

can lead to an increased local inflammatory response and loss of elasticity of the mesh. On the other hand, biological meshes are made from human, bovine or porcine tissue that has been

Table 3 Recurrences according to surgical approach

| Reference | No. of patients | No. of recurrences (%) |
|---|-----------------|------------------------|
| Suture rectopexy | 976 | 86 (8.8) |
| Benoist <i>et al.</i> ¹⁵ | 16 | 0 (0) |
| Blatchford <i>et al.</i> ¹⁶ | 42 | 1 (2) |
| Briel <i>et al.</i> ⁹ | 24 | 0 (0) |
| Bruch <i>et al.</i> ¹⁷ | 32 | 0 (0) |
| Chaudhry Vsm ¹⁸ | 36 | 1 (3) |
| De Oliveira <i>et al.</i> ¹⁹ | 16 | 2 (13) |
| Poppa <i>et al.</i> ²⁰ | 172 | 30 (17.4) |
| Gleditsch <i>et al.</i> ²¹ | 49 | 15 (31) |
| Heah <i>et al.</i> ²² | 25 | 0 (0) |
| Hidaka <i>et al.</i> ²³ | 30 | 7 (23) |
| Kellokumpu <i>et al.</i> ²⁴ | 16 | 2 (13) |
| Kessler <i>et al.</i> ⁸ | 28 | 2 (7) |
| Khanna <i>et al.</i> ²⁵ | 65 | 0 (0) |
| Liyanage <i>et al.</i> ²⁶ | 70 | 5 (7) |
| Luglio <i>et al.</i> ²⁷ | 11 | 3 (27) |
| McKee <i>et al.</i> ²⁸ | 8 | 0 (0) |
| Novell <i>et al.</i> ²⁹ | 32 | 1 (3) |
| Raftopoulos <i>et al.</i> ³⁰ | 163 | 1 (0.1) |
| Sahoo <i>et al.</i> ³¹ | 32 | 0 (0) |
| Senapati <i>et al.</i> ³² | 35 | 9 (26) |
| Wilson <i>et al.</i> ³³ | 59 | 6 (10) |
| Yasukawa <i>et al.</i> ³⁴ | 15 | 1 (7) |
| Ventral mesh rectopexy | | |
| Recurrence of complete rectal prolapse | 1608 | 61 (3.8) |
| Albayati <i>et al.</i> ³⁵ | 9 | 1 (11) |
| Benoist <i>et al.</i> ¹⁵ | 14 | 0 (0) |
| Bjerke and Mynster ³⁶ | 40 | 2 (5) |
| Boons <i>et al.</i> ³⁷ | 65 | 1 (2) |
| Brunner <i>et al.</i> ³⁸ | 13 | 1 (8) |
| Byrne <i>et al.</i> ³⁹ | 126 | 5 (4.0) |
| Chandra <i>et al.</i> ⁴⁰ | 15 | 0 (0) |
| Consten <i>et al.</i> ⁴² | 242 | 13 (5.4) |
| D'Hoore and Penninckx ⁴³ | 109 | 4 (3.7) |
| Emile <i>et al.</i> ⁴⁴ | 25 | 2 (8) |
| Faucheron <i>et al.</i> ⁴⁵ | 175 | 2 (1.1) |
| Gleditsch <i>et al.</i> ²¹ | 22 | 3 (14) |
| Gosselink <i>et al.</i> ⁴⁷ | 41 | 1 (2) |
| Hidaka <i>et al.</i> ²³ | 34 | 3 (9) |
| Hiltunen and Matikainen ⁴⁸ | 54 | 1 (2) |
| Lechaux <i>et al.</i> ⁴⁹ | 35 | 1 (3) |
| Luglio <i>et al.</i> ²⁷ | 20 | 1 (5) |
| Madbouly and Youssef ⁵⁰ | 41 | 1 (2) |
| Maggiori <i>et al.</i> ⁵¹ | 20 | 0 (0) |
| Mantoo <i>et al.</i> ⁵² | 23 | 2 (9) |
| Mehmood <i>et al.</i> ⁵³ | 34 | 0 (0) |
| Ogilvie <i>et al.</i> ⁵⁴ | 33 | 5 (15) |
| Owais <i>et al.</i> ⁵⁵ | 18 | 0 (0) |
| Raftopoulos <i>et al.</i> ³⁰ | 125 | 9 (7.2) |
| Randall <i>et al.</i> ⁵⁷ | 190 | 1 (0.5) |
| Tsunoda <i>et al.</i> ⁵⁹ | 58 | 1 (2) |
| Wahed <i>et al.</i> ⁶⁰ | 27 | 1 (4) |
| Recurrence of intussusception | 399 | 39 (9.8) |
| Albayati <i>et al.</i> ³⁵ | 42 | 2 (5) |
| Collinson <i>et al.</i> ⁴¹ | 75 | 4 (5) |
| Franceschilli <i>et al.</i> ⁴⁶ | 98 | 14 (14.3) |
| Gosselink <i>et al.</i> ⁴⁷ | 50 | 3 (6) |
| Owais <i>et al.</i> ⁵⁵ | 50 | 0 (0) |
| Portier <i>et al.</i> ⁵⁶ | 40 | 1 (3) |
| Tsunoda <i>et al.</i> ⁵⁸ | 44 | 15 (34) |

Values in parentheses are percentages. $P < 0.001$, suture rectopexy versus ventral mesh rectopexy for complete rectal prolapse (Pearson's χ^2 test).

decellularized to leave a collagen matrix for native tissue to infiltrate. The characteristics of each material are unique and depend on the tissue source, the method used to remove the cells, and the method of sterilization. However, it is in terms of the safety

profile that biological mesh has become superior to synthetic mesh⁶³.

Anecdotally, the complication rate associated with biological mesh appears to be lower than that for synthetic mesh, probably related to its lower tensile strength, but its cost for VMR remains a problem. Before the development of VMR, simple sutures were used for rectopexy. Historically, there have been numerous subtle variations of this technique, but the general consensus was to use two or three non-absorbable sutures for fixation of the rectum to the sacrum⁷.

This review aimed to compare recurrence rates following CRP and IS. However, the SR group did not include any patients with IS and so a subgroup analysis was performed in the VMR group. The recurrence rate was higher after SR than VMR in patients treated for CRP, whereas the subgroup analysis of patients who underwent VMR showed higher rates in patients with IS than those with CRP.

Given that biological VMR is the current standard treatment for CRP and IS, it is important to note that, of the seven studies (237 patients) that reported the use of biological mesh, the recurrence rate was similar to that of SR (recurrence rate of IS and CRP combined 8.4 per cent after VMR versus 8.8 per cent for CRP after SR) (Tables 3 and 4). The small number of studies reporting recurrence following biological VMR highlights the need for further research. Comparison of the two groups using meta-analysis showed no statistical difference in recurrence of CRP between synthetic VMR and SR.

It appears that constipation and incontinence improved more after VMR. However, poor consistency of reporting, variation in methods of measuring constipation and incontinence across studies, and varying interpretation of these methods made comparison of studies challenging in this study and reduces the reliability of these results.

Few studies reported postoperative complications and, although complication rates were similar after both procedures, heterogeneity between studies will have had a considerable impact. Surgical-site infection was by far the most common postoperative complication after SR.

The main limitation of this review is the difficulty in comparing a modern technique with a historical technique owing to a lack of comparative evidence and standardization of methods, inequality of reporting, and variation in follow-up. Notably, the population characteristics in terms of age, sex, and indication for surgery were similar in the two groups.

Significant variation in duration of follow-up across studies in both literature searches limited the validity of comparison. Follow-up varied from 12 to 162 months in the SR studies, and from 12 to 74 months in the VMR studies, which may have had a significant effect on the results. Variation in methods of measuring constipation and incontinence across studies, as well as varying interpretation of these methods, made comparison of studies challenging.

This review has highlighted that the recurrence rates and safety of SR and VMR are comparable; however, a robust RCT in this field is highly advocated.

Disclosure. The authors declare no conflict of interest.

Supplementary material

Supplementary material is available at BJS Open online.

Table 4 Comparison between biological and synthetic mesh for mesh rectopexy

| Type of mesh | No. of studies | | Recurrence | | |
|--------------|----------------|----|------------------|------------------|------------------|
| | CRP | IS | CRP | IS | Total |
| Biological | 5 | 2 | 4 of 97 (4) | 16 of 140 (11.4) | 20 of 237 (8.4) |
| Synthetic | 17 | 4 | 49 of 1362 (3.6) | 23 of 209 (11.0) | 72 of 1571 (4.6) |
| <i>P</i> * | | | 0.789 | 0.902 | |

Values in parentheses are percentages. CRP, complete rectal prolapse; IS, intussusception. *Pearson's χ^2 test.

Table 5 Constipation and incontinence reported in included studies

| | Incontinence | | Constipation | |
|--|---|--|---|---|
| | Method of measurement | Statistically significant improvement | Method of measurement | Statistically significant improvement |
| Suture rectopexy (CRP) | | | | |
| Benoist et al. ¹⁵ | Raw figures | n.s. | Raw figures | n.s. |
| Blatchford et al. ¹⁶ | Graded 0–4 and raw figures | Yes | Raw figures | No, significantly worse constipation |
| Briel et al. ⁹ | Browning and Parks | Unclear | n.a. | n.a. |
| Bruch et al. ¹⁷ | Luebeck continence score | Yes | Raw figures | Yes, but includes some patients who had resection rectopexy |
| Chaudhry Vsm ¹⁸ | Browning and Parks | Yes | Raw figures | n.s. but 9 of 15 patients improved |
| De Oliveira et al. ¹⁹ | Wexner score | n.s. but 9 of 11 patients improved | n.a. | n.a. |
| Foppa et al. ²⁰ | Wexner score | Yes | Wexner score | No |
| Gleditsch et al. ²¹ | n.a. | n.a. | n.a. | n.a. |
| Heah et al. ²² | Browning and Parks | Yes | Raw figures | No |
| Hidaka et al. ²³ | CCIS | n.s. | CCCS, PAC-QOL, PAC-SYM | n.s. |
| Kellokumpu et al. ²⁴ | Browning and Parks | Yes | Numerical symptom score | Yes |
| Kessler et al. ⁸ | n.a. | n.a. | n.a. | n.a. |
| Khanna et al. ²⁵ | Raw figures | n.s. but 12 of 16 patients improved | Raw figures | n.s. but 5 of 6 patients improved |
| Liyanage et al. ²⁶ | Wexner score, and Browning and Parks | Yes, but includes some patients who had resection rectopexy | Rome II criteria | n.s. |
| Luglio et al. ²⁷ | Wexner score | n.s. | Wexner score | n.s. |
| McKee et al. ²⁸ | Saline solution infusion test (raw figures) | n.s. but only 1 of 5 patients had postoperative incontinence | Raw figures | No |
| Novell et al. ²⁹ | Browning and Parks, raw figures | n.s. but 7 of 10 regained continence to solid and liquid | n.a. | n.a. |
| Raftopoulos et al. ³⁰ | n.a. | n.a. | n.a. | n.a. |
| Sahoo et al. ³¹ | Wexner score | n.s. but 19 of 21 patients improved | Wexner score | n.s. but 11 of 18 patients improved |
| Senapati et al. ³² | Vaizey score | Yes | n.a. | n.a. |
| Wilson et al. ³³ | n.a. | n.a. | n.a. | n.a. |
| Yasukawa et al. ³⁴ | n.a. | n.a. | Raw figures | n.s. but 4 of 10 patients improved |
| Ventral mesh rectopexy (CRP and IS) | | | | |
| Albayati et al. ³⁵ (CRP) | Raw figures | No | Raw figures | No |
| Albayati et al. ³⁵ (IS) | Raw figures | Yes | Raw figures | Yes |
| Benoist et al. ¹⁵ (CRP) | Raw figures | n.s. | Raw figures | n.s. |
| Bjerke and Mynster ³⁶ (CRP) | Wexner score | Yes | Laxatives use (raw figures) | No |
| Boons et al. ³⁷ (CRP) | FISI | Yes | Wexner score | Yes |
| Brunner et al. ³⁸ (CRP) | CCIS | Yes | CCIS | Yes |
| Byrne et al. ³⁹ (CRP) | St Mark's incontinence score | Yes | Visual analogue constipation score and perceived change (raw figures) | No |
| Chandra et al. ⁴⁰ (CRP) | FISI | Yes | Wexner score | Yes |
| Collinson et al. ⁴¹ (IS) | FISI | Yes | Wexner score | Yes |

(continued)

Table 5. (continued)

| | Incontinence | | Constipation | |
|--|-----------------------|--|------------------------|--|
| | Method of measurement | Statistically significant improvement | Method of measurement | Statistically significant improvement |
| Consten <i>et al.</i> ⁴² (CRP) | Browning and Parks | Yes, but includes patients with IS/symptomatic rectocele not included in recurrence data | Rome II criteria | n.s. but 50 of 82 improved |
| D'Hoore and Penninckx ⁴³ (CRP) | n.a. | n.a. | n.a. | n.a. |
| Emile <i>et al.</i> ⁴⁴ (CRP) | Wexner score | Yes | Wexner score | n.s. but large improvement in Wexner score |
| Faucheron <i>et al.</i> ⁴⁵ (CRP) | n.a. | n.a. | n.a. | n.a. |
| Franceschilli <i>et al.</i> ⁴⁶ (IS) | FISI | Yes | Wexner score | Yes |
| Gleditsch <i>et al.</i> ²¹ (CRP) | n.a. | n.a. | n.a. | n.a. |
| Gosselink <i>et al.</i> ⁴⁷ (CRP) | FISI | Yes | Wexner score | Yes |
| Gosselink <i>et al.</i> ⁴⁷ (IS) | FISI | Yes | Wexner score | Yes |
| Hidaka <i>et al.</i> ²³ | CCIS | n.s. | CCCS, PAC-QOL, PAC-SYM | n.s. |
| Hiltunen and Matikainen ⁴⁸ (CRP) | Raw figures | Yes | n.a. | n.a. |
| Lechaux <i>et al.</i> ⁴⁹ (CRP) | Wexner score | No | Wexner score | n.s. |
| Luglio <i>et al.</i> ²⁷ (CRP) | Wexner score | n.s. | Wexner score | n.s. |
| Madbouly and Youssef ⁵⁰ (CRP) | Wexner score | Yes | Wexner score | Yes |
| Maggiori <i>et al.</i> ⁵¹ (CRP) | Wexner score | Yes | Rome II criteria | n.s. but 13 of 18 improved |
| Mantoo <i>et al.</i> ⁵² (CRP) | Wexner score | Unclear | ODS score | n.s. but improvement in mean score |
| Mehmood <i>et al.</i> ⁵³ (CRP) | FISI | Yes | Wexner score | Yes |
| Ogilvie <i>et al.</i> ⁵⁴ (CRP) | CCIS | n.s. but large improvement in mean CCIS scores | n.a. | n.a. |
| Owais <i>et al.</i> ⁵⁵ (IS and CRP) | CCIS | Yes | ODS score | Yes |
| Portier <i>et al.</i> ⁵⁶ (IS) | CCIS | Yes | Raw figures | n.s. but 13 of 20 improved |
| Raftopoulos <i>et al.</i> ³⁰ | n.a. | n.a. | n.a. | n.a. |
| Randall <i>et al.</i> ⁵⁷ (CRP) | CCIS | Yes | n.a. | n.a. |
| Tsunoda <i>et al.</i> ⁵⁸ (IS) | FISI | Yes | CSS | Yes |
| Tsunoda <i>et al.</i> ⁵⁹ (CRP) | FISI | Yes | CSS | Yes |
| Wahed <i>et al.</i> ⁶⁰ (CRP) | Wexner score | Yes | Wexner score | Yes |

CRP, complete rectal prolapse; n.s., not stated; n.a., not available; CCIS, Cleveland Clinic Incontinence Score; CCIS, Cleveland Clinic Constipation Score; PAC-QOL, Patient Assessment of Constipation Quality of Life questionnaire; PAC-SYM, Patient Assessment of Constipation Symptom score; IS, intussusception; FISI, Faecal Incontinence Severity Index; ODS, obstructive defaecation syndrome; CSS, Constipation Scoring System.

Table 6 Constipation and incontinence in comparative studies

| Reference | Incontinence | | Constipation | |
|-------------------------------------|-----------------------|----------------------------------|-----------------------------------|--|
| | Method of measurement | Results | Method of measurement | Results |
| Benoist <i>et al.</i> ¹⁵ | Raw figures | No significant difference | Raw figures | n.s., but similar worsening in constipation following VMR and SR |
| Hidaka <i>et al.</i> ²³ | CCIS | No significant difference | ODS score, CCCS, PAC-QOL, PAC-SYM | VMR statistically better than SR in all parameters |
| Luglio <i>et al.</i> ²⁷ | Wexner score | VMR statistically better than SR | Wexner score, Rome III criteria | VMR statistically better than SR; however, some patients who had resection rectopexy were included in SR group |

n.s., Not stated; VMR, ventral mesh rectopexy; SR, suture rectopexy; CCIS, Cleveland Clinic incontinence Score; CCCS, Cleveland Clinic Constipation Score; PAC-QOL, Patient Assessment of Constipation Quality of Life questionnaire; PAC-SYM, Patient Assessment of Constipation Symptom score.

Table 7 Summary of complications by procedure

| | Suture rectopexy (n = 616) | Mesh rectopexy (n = 1232) |
|------------------------------|----------------------------|---------------------------|
| Atelectasis | 0 (0) | 1 (0.1) |
| Atrial fibrillation | 1 (0.2) | 0 (0) |
| Bladder injury | 0 (0) | 1 (0.1) |
| Bleeding from port site | 1 (0.2) | 0 (0) |
| Deep vein thrombosis | 4 (0.6) | 0 (0) |
| Enterocutaneous fistula | 0 (0) | 0 (0) |
| Faecal impaction | 0 (0) | 1 (0.1) |
| Fluid overload | 0 (0) | 1 (0.1) |
| Haematoma | 1 (0.2) | 10 (0.8) |
| Hypertension | 1 (0.2) | 0 (0) |
| Incisional/port-site hernia | 3 (0.5) | 7 (0.6) |
| Infective diarrhoea | 2 (0.3) | 0 (0) |
| Intestinal obstruction | 4 (0.6) | 2 (0.2) |
| Lumbar discitis | 0 (0) | 1 (0.1) |
| Myocardial infarction | 0 (0) | 1 (0.1) |
| Non-specific bleeding | 1 (0.2) | 1 (0.1) |
| Non-specific infection | 0 (0) | 2 (0.2) |
| Pain | 0 (0) | 6 (0.5) |
| Pelvic abscess | 2 (0.3) | 0 (0) |
| Pelvic collection | 1 (0.2) | 0 (0) |
| Perforated bowel | 2 (0.3) | 3 (0.2) |
| Peritonitis | 1 (0.2) | 0 (0) |
| Pneumonia | 3 (0.5) | 3 (0.2) |
| Presacral vein injury | 2 (0.3) | 0 (0) |
| Prolonged ileus | 1 (0.2) | 12 (1.0) |
| Pulmonary oedema | 0 (0) | 0 (0) |
| Respiratory failure | 0 (0) | 0 (0) |
| Retrograde ejaculation | 0 (0) | 0 (0) |
| Sphincterismus | 0 (0) | 0 (0) |
| Subcutaneous emphysema | 1 (0.2) | 3 (0.2) |
| Surgical-site infection | 12 (1.9) | 5 (0.4) |
| Upper gastrointestinal bleed | 0 (0) | 0 (0) |
| Ureteric injury | 2 (0.3) | 1 (0.1) |
| Urinary incontinence | 0 (0) | 2 (0.2) |
| Urinary retention | 6 (1.0) | 4 (0.3) |
| Urinary tract infection | 3 (0.5) | 29 (2.4) |
| Wound abscess | 0 (0) | 1 (0.1) |
| Total | 54 (8.8) | 97 (7.9)* |

Values in parentheses are percentages. *P = 0.509 versus suture rectopexy (Pearson's χ^2 test).

Table 8 Characteristics of studies included in meta-analysis

| Reference | Study design | No. of patients | | Comparators | Inclusion criteria | Exclusion criteria | Method of measuring recurrence | Outcome measures | Duration of follow-up (months)* |
|--------------------------------|--|-----------------|-----|--|---|--|---|--|---------------------------------|
| | | SR | VMR | | | | | | |
| Benoist et al. ¹⁵ | Retrospective, observational (1993–1995) | 16 | 14 | VMR versus SR with and without sigmoid resection | Patients who had surgery for full-thickness rectal prolapse | Patients who had a hand-assisted procedure | Clinical examination or long-term telephone interview | Complications, constipation, incontinence, recurrence | 24 [†] |
| Gleditsch et al. ²¹ | Retrospective, observational (1998–2017) | 49 | 22 | Laparoscopic posterior SR versus VMR | Patients who had surgery for external rectal prolapse | Patients with internal rectal prolapse | Clinical examination and endoscopy | Complications, recurrence | SR: 84 VMR: 29 |
| Hidaka et al. ²³ | RCT (2006–2014) | 30 | 34 | Laparoscopic posterior SR versus VMR | Patients with rectal prolapse | n.a. | Clinical examination and questionnaires | CCGS, CCIS, ODS score, PAC-QOL, PAC-SYM, prolapse recurrence, mesh | 72 |

(continued)

Table 8. (continued)

| Reference | Study design | No. of patients | | Comparators | Inclusion criteria | Exclusion criteria | Method of measuring recurrence | Outcome measures | Duration of follow-up (months)* |
|---|--|-----------------|-----|---|--|----------------------------|--|--|---------------------------------|
| | | SR | VMR | | | | | | |
| Luglio <i>et al.</i> ²⁷ | RCT (2013–2015) | 11 | 20 | VMR versus SR | ODS, persistent bleeding, full-thickness rectal prolapse, squeeze pressure > 60 mmHg | n.a. | Questionnaire, endoscopy, and defaecography | complications Rome III criteria, Wexner incontinence and constipation scores, endoscopy and defaecography | 12 |
| Raftopoulos <i>et al.</i> ³⁰ | Retrospective, observational (1979–2001) | 122 | 117 | Mobilization only, mobilization–resection–pexy, or mobilization–pexy Means of access: open or laparoscopic Rectopexy method: suture or mesh | Patients who had abdominal surgery for full-thickness rectal prolapse | Patients without follow-up | Physical examination in outpatient clinic or telephone interview | Recurrence | 43 |

*Values are median unless indicated otherwise; †values are mean. SR, suture rectopexy; VMR, ventral mesh rectopexy; n.a., not available; CCIS, Cleveland Clinic Incontinence Score; CCCS, Cleveland Clinic Constipation Score; ODS, obstructive defaecation syndrome; PAC-QOL, Patient Assessment of Constipation Quality of Life questionnaire; PAC-SYM, Patient Assessment of Constipation Symptom score.

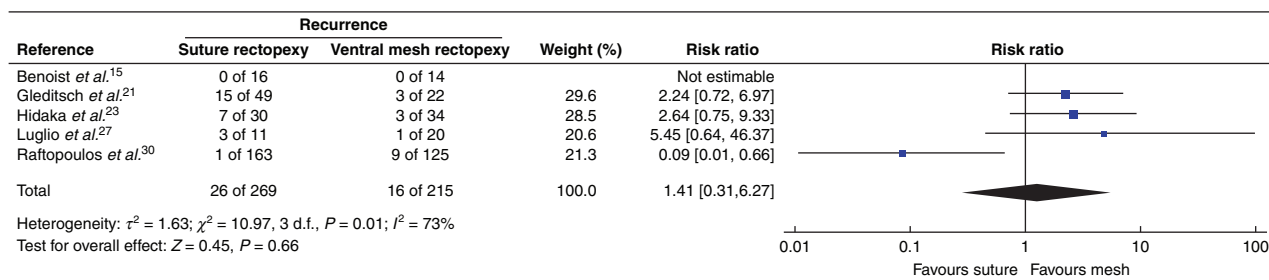


Fig. 2 Forest plot of recurrence after suture rectopexy versus ventral mesh rectopexy for complete rectal prolapse

A Mantel–Haenszel random-effects model was used for meta-analysis. Risk ratios are shown with 95 per cent confidence intervals.

References

- Balla A, Quaresima S, Smolarek S, Shalaby M, Missori G, Sileri P. Synthetic versus biological mesh-related erosion after laparoscopic ventral mesh rectopexy: a systematic review. *Ann Coloproctol* 2017;**33**:46–51
- Cannon JA. Evaluation, diagnosis, and medical management of rectal prolapse. *Clin Colon Rectal Surg* 2017;**30**:16–21
- Kuijpers HC. Treatment of complete rectal prolapse: to narrow, to wrap, to suspend, to fix, to encircle, to plicate or to resect? *World J Surg* 1992;**16**:826–830
- Yakut M, Kaymakçioğlu N, Simşek A, Tan A, Sen D *et al.* Surgical treatment of rectal prolapse: a retrospective analysis of 94 cases. *Int Surg* 1998;**83**:53–55
- Stevenson A. Erosion versus recurrence: is there a compromise using biologics for ventral rectopexy? *Tech Coloproctol* 2015; **19**: 199–200
- Galili Y, Rabau M. Comparison of polyglycolic acid and polypropylene mesh for rectopexy in the treatment of rectal prolapse. *Eur J Surg* 1997;**163**:445–448
- Cutait D. Sacro-promontory fixation of the rectum for complete rectal prolapse. *Proc R Soc Med* 1959;**52**(Suppl):105
- Kessler H, Jerby BL, Milsom JW. Successful treatment of rectal prolapse by laparoscopic suture rectopexy. *Surg Endosc* 1999;**13**: 858–861
- Briel JW, Schouten WR, Boerma MO. Long-term results of suture rectopexy in patients with fecal incontinence associated with incomplete rectal prolapse. *Dis Colon Rectum* 1997;**40**:1228–1232
- Ripstein CB. Treatment of massive rectal prolapse. *Am J Surg* 1952;**83**:68–71
- Madiba T, Baig M, Wexner S. Surgical management of rectal prolapse. *Arch Surg* 2005;**140**:63–73
- Slim K, Nini E, Forestier D, Kwiatkowski F, Panis Y, Chipponi J. Methodological index for non-randomized studies (minors):

- development and validation of a new instrument. *ANZ J Surg* 2003;**73**:712–716
13. Higgins JPT, Altman DG, Gøtzsche PC, Jüni P, Moher D, Oxman AD et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ* 2011;**343**:d5928
 14. Ottawa Hospital Research Institute. *The Newcastle–Ottawa Scale for Assessing the Quality of Nonrandomized studies in Meta-analyses*. http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp (accessed 9 May 2020)
 15. Benoist S, Taffinder N, Gould S, Chang A, Darzi A. Functional results two years after laparoscopic rectopexy. *Am J Surg* 2001;**182**:168–173
 16. Blatchford GJ, Perry RE, Thorson AG, Christensen MA. Rectopexy without resection for rectal prolapse. *Am J Surg* 1989;**158**:574–576
 17. Bruch HP, Herold A, Schiedeck T, Schwandner O. Laparoscopic surgery for rectal prolapse and outlet obstruction. *Dis Colon Rectum* 1999;**42**:1189–1194
 18. Chaudhry Vsm R. Laparoscopic suture rectopexy: an effective treatment for complete rectal prolapse. *Med J Armed Forces India* 2010;**66**:108–112
 19. De Oliveira O Jr, Stein, SL, Trancheva KI, Sonoda T, Milsom JW, Lee SW. Comparative outcomes of elderly patients undergoing Altemeier procedure versus laparoscopic rectopexy for rectal prolapse. *Asian J Endosc Surg* 2010;**3**:28–32
 20. Foppa C, Martinek L, Arnaud JP, Bergamaschi R. Ten-year follow up after laparoscopic suture rectopexy for full-thickness rectal prolapse. *Colorectal Dis* 2014;**16**:809–814
 21. Gleditsch D, Wexels WA, Nesbakken A. Surgical options and trends in treating rectal prolapse: long-term results in a 19-year follow-up study. *Langenbecks Arch Surg* 2018;**403**:991–998
 22. Heah SM, Hartley JE, Hurley J, Duthie GS, Monson JRT. Laparoscopic suture rectopexy without resection is effective treatment for full-thickness rectal prolapse. *Dis Colon Rectum* 2000;**43**:638–643
 23. Hidaka J, Elfeki H, Duelund-Jakobsen J, Laurberg S, Lundby L. Functional outcome after laparoscopic posterior sutured rectopexy versus ventral mesh rectopexy for rectal prolapse: six-year follow-up of a double-blind, randomized single-center study. *EClinicalMedicine* 2019;**16**:18–22
 24. Kellokumpu IH, Vironen J, Scheinin T. Laparoscopic repair of rectal prolapse: a prospective study evaluating surgical outcome and changes in symptoms and bowel function. *Surg Endosc* 2000;**14**:634–640
 25. Khanna AK, Misra MK, Kumar K. Simplified sutured sacral rectopexy for complete rectal prolapse in adults. *Eur J Surg Acta Chir* 1996;**162**:143–146
 26. Liyanage CAH, Rathnayake G, Deen KI. A new technique for suture rectopexy without resection for rectal prolapse. *Tech Coloproctol* 2009;**13**:27–31
 27. Luglio G, Tarquini R, Giglio MC, Sollazzo V, Peltrini R, Sacco M et al. Ventral mesh rectopexy versus conventional suture technique: a single-institutional experience. *Aging Clin Exp Res* 2017;**29**(Suppl 1):79–82
 28. McKee RF, Lauder JC, Poon FW, Aitchison MA, Finlay IG. A prospective randomized study of abdominal rectopexy with and without sigmoidectomy in rectal prolapse. *Surg Gynecol Obstet* 1992;**174**:145–148
 29. Novell JR, Osborne MJ, Winslet MC, Lewis AA. Prospective randomized trial of Ivalon sponge versus sutured rectopexy for full-thickness rectal prolapse. *Br J Surg* 1994;**81**:904–906
 30. Raftopoulos Y, Senagore AJ, Di Giuro G, Bergamaschi R; Rectal Prolapse Recurrence Study Group. Recurrence rates after abdominal surgery for complete rectal prolapse: a multicenter pooled analysis of 643 individual patient data. *Dis Colon Rectum* 2005;**48**:1200–1206
 31. Sahoo MR, Thimmegowda AK, Gowda MS. A single centre comparative study of laparoscopic mesh rectopexy versus suture rectopexy. *J Minimal Access Surg* 2014;**10**:18–22
 32. Senapati A, Gray RG, Middleton LJ, Harding J, Hills RK, Armitage NCM et al. PROSPER: a randomised comparison of surgical treatments for rectal prolapse. *Colorectal Dis* 2013;**15**:858–868
 33. Wilson J, Engledow A, Crosbie J, Arulampalam T, Motson R. Laparoscopic nonresectional suture rectopexy in the management of full-thickness rectal prolapse: substantive retrospective series. *Surg Endosc* 2011;**25**:1062–1064
 34. Yasukawa D, Hori T, Machimoto T, Hata T, Kadokawa Y, Ito T et al. Outcome of a modified laparoscopic suture rectopexy for rectal prolapse with the use of a single or double suture: a case series of 15 patients. *Am J Case Rep* 2017;**18**:599–604
 35. Albayati S, Morgan MJ, Turner CE. Laparoscopic ventral rectopexy for rectal prolapse and rectal intussusception using a biological mesh. *Colorectal Dis* 2017;**19**:857–862
 36. Bjerke T, Mynster T. Laparoscopic ventral rectopexy in an elderly population with external rectal prolapse: clinical and anal manometric results. *Int J Colorectal Dis* 2014;**29**:1257–1262
 37. Boons P, Collinson R, Cunningham C, Lindsey I. Laparoscopic ventral rectopexy for external rectal prolapse improves constipation and avoids *de novo* constipation. *Colorectal Dis* 2010;**12**:526–532
 38. Brunner M, Roth H, Günther K, Grützmann R, Matzel KE. Ventral rectopexy with biological mesh: short-term functional results. *Int J Colorectal Dis* 2018;**33**:449–457
 39. Byrne CM, Smith SR, Solomon MJ, Young JM, Evers AA, Young CJ. Long-term functional outcomes after laparoscopic and open rectopexy for the treatment of rectal prolapse. *Dis Colon Rectum* 2008;**51**:1597–1604
 40. Chandra A, Kumar S, Maurya AP, Gupta V, Gupta V, Rahul. Laparoscopic ventral mesh rectopexy for complete rectal prolapse: a retrospective study evaluating outcomes in North Indian population. *World J Gastrointest Surg* 2016;**8**:321–325
 41. Collinson R, Wijffels N, Cunningham C, Lindsey I. Laparoscopic ventral rectopexy for internal rectal prolapse: short-term functional results. *Colorectal Dis* 2010;**12**:97–104
 42. Consten ECJ, van Iersel JJ, Verheijen PM, Broeders IAMJ, Wolthuis AM, D'Hoore A. Long-term outcome after laparoscopic ventral mesh rectopexy: an observational study of 919 consecutive patients. *Ann Surg* 2015;**262**:742–747
 43. D'Hoore A, Penninckx F. Laparoscopic ventral recto(colpo)pepy for rectal prolapse: surgical technique and outcome for 109 patients. *Surg Endosc* 2006;**20**:1919–1923
 44. Emile SH, Elbanna H, Youssef M, Thabet W, Omar W, Elshobaky A et al. Laparoscopic ventral mesh rectopexy vs Delorme's operation in management of complete rectal prolapse: a prospective randomized study. *Colorectal Dis* 2017;**19**:50–57
 45. Faucheron JL, Voirin D, Riboud R, Waroquet PA, Noel J. Laparoscopic anterior rectopexy to the promontory for full-thickness rectal prolapse in 175 consecutive patients: short- and long-term follow-up. *Dis Colon Rectum* 2012;**55**:660–665
 46. Franceschilli L, Varvaras D, Capuano I, Ciangola CI, Giorgi F, Boehm G et al. Laparoscopic ventral rectopexy using biologic mesh for the treatment of obstructed defaecation syndrome and/or faecal incontinence in patients with internal rectal prolapse: a critical appraisal of the first 100 cases. *Tech Coloproctol* 2015;**19**:209–219

47. Gosselink MP, Joshi H, Adusumilli S, van Onkelen RS, Fourie S, Hompes R *et al.* Laparoscopic ventral rectopexy for faecal incontinence: equivalent benefit is seen in internal and external rectal prolapse. *J Gastrointest Surg* 2015;**19**:558–563
48. Hiltunen KM, Matikainen M. Clinical results of abdominal rectopexy for rectal prolapse. *Ann Chir Gynaecol* 1991;**80**:263–266
49. Lechaux D, Trebuchet G, Siproudhis L, Campion JP. Laparoscopic rectopexy for full-thickness rectal prolapse: a single-institution retrospective study evaluating surgical outcome. *Surg Endosc* 2005;**19**:514–518
50. Madbouly KM, Youssef M. Laparoscopic ventral rectopexy versus laparoscopic Wells rectopexy for complete rectal prolapse: long-term results. *J Laparoendosc Adv Surg Tech A* 2018;**28**:1–6
51. Maggiori L, Bretagnol F, Ferron M, Panis Y. Laparoscopic ventral rectopexy: a prospective long-term evaluation of functional results and quality of life. *Tech Coloproctol* 2013;**17**:431–436
52. Mantoo S, Podevin J, Regenet N, Rigaud J, Lehur PA, Meurette G. Is robotic-assisted ventral mesh rectopexy superior to laparoscopic ventral mesh rectopexy in the management of obstructed defaecation? *Colorectal Dis* 2013;**15**:e469–e475
53. Mehmood RK, Parker J, Bhuvimanian L, Qasem E, Mohammed AA, Zeeshan M *et al.* Short-term outcome of laparoscopic versus robotic ventral mesh rectopexy for full-thickness rectal prolapse. Is robotic superior? *Int J Colorectal Dis* 2014;**29**:1113–1118
54. Ogilvie JW, Stevenson ARL, Powar M. Case-matched series of a non-cross-linked biologic versus non-absorbable mesh in laparoscopic ventral rectopexy. *Int J Colorectal Dis* 2014;**29**:1477–1483
55. Owais AE, Sumrien H, Mabey K, McCarthy K, Greenslade GL, Dixon AR. Laparoscopic ventral mesh rectopexy in male patients with internal or external rectal prolapse. *Colorectal Dis* 2014;**16**:995–1000
56. Portier G, Kirzin S, Cabarrot P, Queralto M, Lazorthes F. The effect of abdominal ventral rectopexy on faecal incontinence and constipation in patients with internal intra-anal rectal intussusception. *Colorectal Dis* 2011;**13**:914–917
57. Randall J, Smyth E, McCarthy K, Dixon AR. Outcome of laparoscopic ventral mesh rectopexy for external rectal prolapse. *Colorectal Dis* 2014;**16**:914–919
58. Tsunoda A, Takahashi T, Ohta T, Kusanagi H. Quality of life after laparoscopic ventral rectopexy. *Colorectal Dis* 2016;**18**:O301–O310
59. Tsunoda A, Takahashi T, Matsuda S, Oka N, Kusanagi H. Midterm functional outcome after laparoscopic ventral rectopexy for external rectal prolapse. *Asian J Endosc Surg* 2020;**13**:25–32
60. Wahed S, Ahmad M, Mohiuddin K, Katory M, Mercer-Jones M. Short-term results for laparoscopic ventral rectopexy using biological mesh for pelvic organ prolapse. *Colorectal Dis* 2012;**14**:1242–1247.
61. D'Hoore A, Cadoni R, Penninckx F. Long-term outcome of laparoscopic ventral rectopexy for total rectal prolapse. *Br J Surg* 2004;**91**:1500–1505
62. Loygue J, Nordlinger B, Cunci O, Malafosse M, Huguet C, Parc R. Rectopexy to the promontory for the treatment of rectal prolapse. Report of 257 cases. *Dis Colon Rectum* 1984;**27**:356–359
63. Novitsky YW, Rosen MJ. The biology of biologics: basic science and clinical concepts. *Plast Reconstr Surg* 2012;**130**(Suppl 2):9S–17S