Techniques in Coloproctology (2018) 22:919–931
https://doi.org/10.1007/s10151-018-1908-9

REVIEW ARTICLE

Consensus Statement of the Italian Society of Colorectal Surgery (SICCR): management and treatment of complete rectal prolapse

G. Gallo[1,2] · J. Martellucci[3] · G. Pellino[4,5] · R. Ghiselli[6] · A. Infantino[7] · F. Pucciani[8] · M. Trompetto[1]

Received: 15 November 2018 / Accepted: 9 December 2018 / Published online: 15 December 2018

Abstract

Rectal prolapse, rectal procidentia, "complete" prolapse or "third-degree" prolapse is the full-thickness prolapse of the rectal wall through the anal canal and has a significant impact on quality of life. The incidence of rectal prolapse has been estimated to be approximately 2.5 per 100,000 inhabitants with a clear predominance among elderly women. The aim of this consensus statement was to provide evidence-based data to allow an individualized and appropriate management and treatment of complete rectal prolapse. The strategy used to search for evidence was based on application of electronic sources such as MEDLINE, PubMed, Cochrane Review Library, CINAHL and EMBASE. The recommendations were defined and graded based on the current levels of evidence and in accordance with the criteria adopted by the American College of Gastroenterology's Chronic Constipation Task Force. Five evidence levels were defined. The recommendations were graded A, B, and C.

Keywords External rectal prolapse · Rectal procidentia · Non-operative management · Surgical treatment · Abdominal approach · Perineal approach

Introduction

External rectal prolapse, rectal procidentia, or "complete" prolapse, can be defined as a circumferential, full-thickness intussusception of the rectal wall which protrudes outside the anal canal [1].

The incidence of rectal prolapse has been estimated to be approximately 2.5 per 100,000 inhabitants [2]. It can occur at the extremes of ages [3, 4] with a clear predominance in elderly woman [5], with a ratio of 9:1 [6], probably due to a history of chronic constipation, straining during defecation, pelvic floor dysfunction or perineal injury [7].

To date, although many theories have been proposed [8, 9], the precise etiology of rectal prolapse is not completely understood.

It can be associated with anatomical abnormalities such as a deep pouch of Douglas redundant sigmoid colon, deficient fixation of the rectum to the sacrum, diastasis of the levator ani muscle and patulous anus [8, 10].

Furthermore, neurological disease, connective tissue disorders and schistosomiasis [11, 12] are rare but should be considered in the medical history of patients with rectal prolapse.

Patients usually complain of a protruding mass following defecation together with mucous discharge and rectal

✉ M. Trompetto
trompetto.mario@libero.it

1 Department of Colorectal Surgery, Santa Rita Clinic, Vercelli, Italy

2 Department of Surgical and Medical Sciences, University "Magna Graecia" of Catanzaro, Catanzaro, Italy

3 Department of General, Emergency and Minimally Invasive Surgery, Careggi University Hospital, Florence, Italy

4 Department of Medical, Surgical, Neurological, Metabolic and Ageing Sciences, Unit of General Surgery, Università della Campania "Luigi Vanvitelli", Naples, Italy

5 Colorectal Unit, Hospital Universitario y Politecnico La Fe, University of Valencia, Valencia, Spain

6 Department of General Surgery, Università Politecnica delle Marche, Ancona, Italy

7 Department of Surgery, Santa Maria dei Battuti Hospital, San Vito al Tagliamento, Pordenone, Italy

8 Department of Surgery and Translational Medicine, University of Florence, Florence, Italy

bleeding due to a solitary ulcer or abrasion of the rectal mucosa. Constipation is found in up to 70% of patients while fecal incontinence depends on the patient's age and is reported in up to 88% of patients [2, 10, 13].

Other associated symptoms may include a feeling of incomplete defecation and urinary incontinence.

When rectal prolapse does not reduce spontaneously or with pressure from the patient or the surgeon, and is associated with incontinence or obstructed defecation symptoms surgery should be considered.

The goal of this consensus statement was to establish an evidence-based approach to external rectal prolapse.

Materials and methods

The strategy used to search for evidence was based on application of electronic sources such as MEDLINE, PubMed, Cochrane Review Library, CINAHL and EMBASE. The time periods searched were the 10-year period from January 1, 2008 to January 1, 2018. The search terms used were "rectal prolapse", "rectal procidentia", "rectogenital prolapse", "pelvic organ prolapse", "rectal prolapse diagnosis", "rectal prolapse evaluation", "rectal prolapse treatment" and "rectal prolapse surgery".

The criteria used to select evidence were study design [randomized controlled trial (RCT), prospective and retrospective observational studies, case series, systematic reviews], the presence of primary and secondary outcomes, study methodology (sampling, blinding, analytical methods), English language, and the evaluation of papers published only in indexed journals with impact factor.

The recommendations were defined and graded based on the current levels of evidence and in accordance with the criteria adopted by the American College of Gastroenterology's Chronic Constipation Task Force (Tables 1, 2) [14].

Five evidence levels were defined. The recommendations were graded A, B, and C.

Target users

The target users of guidelines are coloproctological surgeons, gastroenterologists, gynecologists, urologists, nurses and other medical specialists who treat anoperineal disease. The guidelines may be used to inform clinical decisions and standards of care. The guidelines are also intended to inform patients about the possible alternatives for the management of their condition.

Population

The target is a patient population with external rectal prolapse. The goal is to give useful clinical suggestions for diagnosis and management of rectal prolapse. The expected benefit is to have evidence-based medical data for a correct evaluation of rectal prolapse to provide tailored treatment. The severity and stage of disease, role of relevant comorbidities and clinical conditions are identified.

Recommendations

Clinical evaluation

The full history of the patient's symptoms may determine the surgical management strategy for rectal prolapse, especially if constipation/obstructed defecation and/or fecal incontinence occur (level of evidence: V; grading of recommendation: C).

Rectal prolapse is associated with a range of symptoms including pain, incomplete evacuation, bloody and/or mucous rectal discharge, and fecal incontinence or constipation [15]. When rectal prolapse is present, most patients

Table 1 Levels of evidence

Level I	Strong	RCTs with $p < 0.05$, adequate sample sizes and appropriate methodology
Level II	Moderate	RCTs with $p > 0.05$, or inadequate sample sizes and/or inappropriate methodology
Level III	Fair	Non-randomized trials with contemporaneous controls
Level IV	Limited	Non-randomized trials with historical controls
Level V	Consensus based	Case series

Table 2 Grading of recommendations

Grade A	Strong	Recommendations supported by two or more level I trials without conflicting evidence from other level I trials
Grade B	Moderate	Recommendations based on evidence from a single level I trial OR recommendations based on evidence from two or more level I trials with conflicting evidence from other level I trials OR supported by evidence from two or more level II trials
Grade C	Weak	Recommendations based on level III–V evidence

report whether it protrudes externally continuously or is able to be reduced, and whether it is reduced spontaneously or requires manual reduction.

Constipation/obstructed defecation is usually present for many years before the appearance of rectal prolapse and is present thereafter the duration of the prolapse. Constipation may result from the intussuscepting bowel in the rectum which creates a blockage that is exacerbated by straining, pelvic floor dyssynergia, and colonic dysmotility. It is very difficult to understand if symptoms are related to slow transit constipation or impaired rectal emptying and for this reason it is necessary to investigate further: anorectal manometry, defecography or dynamic magnetic resonance imaging(MRI) and colonic transit time are used [16].

Fecal incontinence appears late in the course of rectal prolapse. It is related to several factors: external rectal protrusion per se, patulous anus, continuous rectoanal inhibitory reflex with impaired rectoanal excitatory reflex and pudendal neuropathy act all together. Any kind of fecal incontinence may occur: urge incontinence, passive incontinence, fecal soiling and mixed incontinence may be present in varying degrees from patient to patient, combined with symptoms of constipation.

Regardless of the type of fecal incontinence it is necessary to investigate with endoanal ultrasound and anorectal manometry. In fact, different surgical techniques can be chosen depending on the morphological and functional findings [16].

In the absence of a surgical option, patients with a 4-year duration of rectal prolapse and with mild fecal incontinence have no chance of improvement, when compared to patients who underwent surgical treatment [17]. These findings may be taken into account when surgery of rectal prolapse is not chosen.

Anoperineal examination

The anoperineal examination, in addition to highlighting the prolapse, will provide indications regarding the severity of the disease and the choice of appropriate surgical treatment (level of evidence: III; grading of recommendation: B).

The external protrusion is determinant in the diagnosis of rectal prolapse. It can be directly seen outside the anus or can be sought with straining maneuvers, bearing down using the Sims and/or squatting position [15]. The outflow of the rectum is telescopic: circumferential radial folds of the rectal wall with concentric rings emerge from anal margin for several centimeters. At this point two maneuvers are necessary: the first is to measure the maximal external protrusion in centimeters and the second is to replace the protruded rectum inside. The first maneuver, according to the length of protrusion, will suggest which perineal surgical technique to perform: Altemeier's procedure or rectopexy usually manages external prolapse > 5 cm of length, while the Delorme procedure is usually reserved for smaller prolapses [18].

If the second maneuver fails to replace the rectal prolapse, it means that the prolapse is irreducible and may become the substrate for rectal incarceration and, sometimes, for rectal strangulation [19].

Proctoscopy reveals a solitary rectal ulcer on the anterior surface of the rectum in 10–15% of cases [10]. The presence of solitary ulcers suggests that, due to the patient's poor response to conservative treatments, surgery may be the best option [20]. The ulcer reflects a reaction to repeated trauma due to friction between the mucosa and the anal verge during the outflow of the rectum [21], and/or a self-digitation maneuver to reduce rectal prolapse [22].

Finally, genital prolapse or pelvic organ prolapse (POP) may be associated with rectal prolapse in up to 30% of patients [23] and vaginal examination is essential in the assessment of women with POP. The anterior, superior, and posterior vaginal segments should be evaluated. Several systems for POP evaluation and classification may be used but the oldest "half-way system" [24] has been replaced by the "POP-Q system" [25].

Urodynamic studies may be used for the evaluation of bladder function, which is often impaired in the presence of POP [26, 27].

Diagnostic tools

- Knowledge of anal sphincter complex through anal ultrasound might guide surgical management (level of evidence: III; grading of recommendation: C).

Anal hypotonia is most severe with a patulous anus without endoanal pressures, as a consequence of the mechanical effects of intussusception while defective anal squeezing suggests an impaired function of the external anal sphincter and puborectalis muscle [28]. Both signs are usually reported in rectal prolapse suggesting that sphincter integrity should be investigated by endoanal ultrasound [29, 30]. Endoanal ultrasound can map several changes in the anal canal [30–32], and should be considered in case of previous vaginal delivery, previous proctologic surgery or impairment of fecal continence. Alterations of the anal sphincter complex such as elliptical morphology, anterior/posterior submucosal distortion, greater thickness of internal anal sphincter and submucosa, sphincteric discontinuity or scars may predict an incomplete recovery of continence.

- Treatment programs of patients with a concomitant POP can be influenced by dynamic MRI (level of evidence: IV; grading of recommendation: C).

In case of concomitant anterior or middle pelvic compartment alterations MRI should be considered. The rectum, anal canal, urethra, uterus, vagina, pelviperineal muscles, perineal body, and supportive elements of the endopelvic fascia are all easily identified by dynamic MRI in a safe and noninvasive manner [33]. This assessment is optimal for studying the pelvis, especially when rectal prolapse and POP coexist: the HMO classification system provides quantification of pelvic floor relaxation and visceral prolapse on sagittal images [34]. The structures responsible for the pelvic floor hiatal area (fat recesses, muscles, fascia) are easily displayed and the major role of dynamic MRI is to provide images of anatomic defects underlying the rectal prolapse [33, 35].

Findings associated with diagnosis of rectal prolapse on sagittal MRI include: (1) anterior displacement of the rectum with folding upon itself due to poor posterior mesorectal fixation. (2) Anterior, posterior or lateral bulging (rectocele). (3) Stretching and attenuation of the perineal body. (4) Descent of the anorectal junction relative to the pubococcygeal line greater than 2 cm. (5) Descent and caudal angulation of the levator plate such that its anterior projection does not cross the pubic bone [35].

- Anorectal manometry may be used only in a reducible rectal prolapse, in patients with symptoms of both constipation and/or fecal incontinence (level of evidence: III; grading of recommendation: C).

Functional weakness of the external and internal anal sphincters, abnormal rectal sensation and impaired rectal compliance are detected, but manometric data must be supplementary to those from other anorectal morphological and functional techniques to make a diagnosis [36, 37]. In patients with rectal prolapse, manometric signs of anal hypotonia are usually reported, joined with those of impaired maximal voluntary contraction (MVC). Preoperative anal manometry seems to be able to predict fecal continence rates after perineal proctectomy, because patients with maximal squeeze pressures > 60 mmHg have significantly improved outcomes [38].

- Neurophysiological testing is useful when anorectal disorders are present in patients with central and peripheral neurological diseases (level of evidence: V; grading of recommendation: C).

In these cases neurophysiological testing discriminates between bowel dysfunction and neurological disease since anorectal disorders in these patients are not necessarily due to a neurological pathology. Pelvic floor electromyography, sacral reflex latency, motor-evoked potentials and somatosensory-evoked potentials are used [39].

Rectal prolapse in pediatric patients necessitates neurophysiological testing when paraplegia or cauda equina lesions are present [40] to determine any possible neurological interference in the disease due to alteration of the pelvic floor muscles. Myelomeningocele and other neurological disorders result in paralysis of the levator ani muscle and therefore increased intra-abdominal pressure that often leads to complete rectal prolapse [41, 42].

Conversely, the instrumental diagnosis of pudendal neuropathy has no definite significance in non-neurological patients with rectal prolapse: opposing observations are proposed and there is no universally accepted and shared conclusion regarding the influence of pudendal neuropathy on surgical results [43, 44].

Non-operative management

- Non-operative management in external rectal prolapse is useful as preoperative treatment for the reducible form or can be reserved for poor surgical candidates and those refusing surgery. Some of the symptoms associated with rectal prolapse may benefit from medical/conservative treatment. (level of evidence: V; grading of recommendation: C).

Management is usually aimed at treating constipation. All patients have a long history of impaired defecation. A high-fiber diet, laxative therapy, and methods to prevent straining are commonly used. Table sugar has been used to reduce incarcerated rectal prolapse by absorbing the edema, thus making it easier to reduce [45]. There are not trials on this matter and single reports do not give reliable indications. Recently, the administration of a tricyclic antidepressant has been proposed for the treatment of tenesmus associated with rectal prolapse: good results have been achieved (69%) with the absence of tenesmus or sporadic episodes after treatment. It is likely that a centrally mediated reduction in rectal hypersensitivity, possibly in addition to peripheral suppression of neuropathic pathways through b2-adrenoceptors, may explain the observed favorable response [46].

There are few published case series on rehabilitative treatment of rectal prolapse. All reports agree that rehabilitation does not play any role in the treatment of rectal prolapse. Constipated patients with reducible rectal prolapse do not show any improvement after rehabilitation: the Fecal Incontinence Severity Index score and the patients' assessment of constipation symptoms do not significantly change in patients with high-grade rectal prolapse. Nor does fecal incontinence show significant improvement after rehabilitation: the post-rehabilitation score is not different when compared to the pre-rehabilitation incontinence score [47].

Indications

Perineal vs abdominal approaches

In expert hands and with adequate indications, perineal and abdominal procedures may achieve similar results in terms of perioperative complications, bowel function, recurrence rate, and quality of life (level of evidence: II; grading of recommendation: B).

Studies collecting longer term follow-up report higher rates of recurrences with perineal procedures, ranging between 14% and 27% within 4 years after surgery [48–52].

Given the reduced rates of complications associated with perineal surgery compared with abdominal surgery, the former has been usually used and is more indicated in frail patients with multiple comorbidities [52, 53]. However, authors of a case-matched study using data from the American College of Surgeons National Surgical Quality Improvement Program with 2188 patients (848 abdominal, 38.8% vs 1340 perineal, 61.2%) used preoperative variables predictive of complications to identify 563 risk-matched pairs; there were no difference in terms of complications between the matched cohorts [54]. The authors suggest that more patients could undergo more durable (i.e., abdominal) approaches. Patients who underwent perineal approaches more frequently had multiple predictors of complications, confirming the conservative attitude justifying the use of perineal approaches in frail patients [54]. Moreover, the assumption that abdominal procedures reduce the risk of recurrence has been recently been challenged by two RCTs [55, 56].

Senapati et al. [55] randomized in a pragmatic, factorial 2 × 2 design, 293 patients with rectal prolapse to receive abdominal versus perineal surgery.

Recurrence occurred in 20% of patients after perineal vs 26% after abdominal procedures ($p = 0.8$). Differences in recurrence were not statistically significant even after non-randomized, combined abdominal vs perineal comparison (19% vs 28%, $p = 0.2$). Vaizey score and quality of life measured with EQ-5D improved compared with baseline in both arms, with no significant differences.

Emile et al. [56] randomized 50 patients with complete rectal prolapse to undergo laparoscopic ventral rectopexy with mesh or Delorme's procedure (1:1). Data of interest included recurrent prolapse at 18 months, and 6-month evaluation of continence, constipation, changes in anal pressures, complications, quality of life and bowel function.

Clinical recurrence of full-thickness prolapse occurred in 8% of patients after abdominal and 16% after perineal procedures ($p = 0.66$). Quality of life as assessed by Fecal Incontinence Quality of Life Scale (FIQL) and the Gastrointestinal Quality of Life Index (GIQIL) improved similarly in both group at 6-month follow-up. Minor complications occurred in five patients after abdominal surgery and three patients after Delorme's procedure ($p = 0.69$). There were no major complications, but length of stay was longer by a mean of 2 days after perineal procedures. Abdominal surgery required longer operative time.

Moreover, Senapati et al. [55] reported more visits by a social worker at 6 weeks (40% vs 0, $p = 0.004$) and more patients visiting a general practitioner at 1 year or spending time in the hospital (71.4% vs 15.4%, $p = 0.01$ for both) in patients in the abdominal arm.

Age itself should not be used to guide treatment choice, as the median survival of patients > 90 years old after perineal surgery for prolapse has been reported to be longer than 4 years, which is approximately the mean length of longer follow-ups available in the literature [57]. Hence, the benefits could offset the operative risk [57]. The results of a prospective observational study on patients 80 years of age or older demonstrated no differences between abdominal and perineal approach regarding morbidity, mortality, and hospital stay [58]. Moreover, it has been suggested that patients under 50 years of age have lower rates of recurrences after Delorme's procedure compared with their older counterparts (8% younger vs 14% overall) [59]. Predictive models of procedure-specific complications could rather guide the choice between perineal and abdominal surgery better [54].

Considering functional results, Emile et al. [56] observed an increase in resting and squeeze anal pressures in both groups (perineal and abdominal). The differences were not statistically significant. These findings are consistent with previous studies on perineal procedures [50, 51], but authors also observed a reduction of rectal compliance after Altemeier's procedure [50].

Postoperative straining after perineal repair could be lower when compared with patients who underwent resection rectopexy and suture rectopexy, but not with ventral non-resection rectopexy. Similar improvements in incontinence might be observed with ventral non-resection rectopexy and Delorme's procedure [56].

Senapati et al. [55] reported an increased number of patients who underwent surgery with an abdominal approach who experienced straining 1 and 3 years after surgery (abdominal vs perineal; 5/7 vs 3/14, $p = 0.03$ and 5/11 vs 0/9, $p = 0.02$, respectively). In the study comparing ventral rectopexy with Delorme's there was no difference in increasing or new onset constipation (none in both groups), and a similar fall in Wexner scores.

In case of recurrent rectal prolapse the approach may be related to the first technique used: (level of evidence: IV; grading of recommendation B).

The perineal approach is contraindicated after sacral rectocolpopexy due to the fixation of the net to the vagina; in case of previous abdominal resection rectopexy or Altemeier procedure a repeated colorectal resection via the perineal

approach can be chosen to remove the previous anastomosis; thus avoiding the risk of a double suture with a possible ischemic sequelae [60].

After the redo perineal rectosigmoidectomy the anastomotic complications are low (2.3%) but the relapse rate is double than after the primary resection (39% vs 18%; $p < 0.007$) [61, 62].

Perineal procedures

Perineal rectosigmoidectomy is indicated when the abdominal approach is not feasible due to anesthesia risks (level of evidence: I; grading of recommendation C).

Perineal rectosigmoidectomy, known as the Altemeier procedure, was popularized by Miles at St. Mark's Hospital, London, who reported excellent results with a 3% recurrence rate in 1933. However, in the same institution other surgeons described a recurrence rate ranging between 50 and 60%, as described by Cirocco [63].

Recurrence rates at the Cleveland Clinic Foundation were time-related and after 10 years of follow-up the recurrence rate was 18.5% [52].

The great variations of results continue: recently low recurrence rates of 0–10% have been reported [60]. This rate increased to 18% in long-term follow-up studies [51]; while no recurrence was registered after at least a 1-year follow-up in another study [64]. It is argued that the incomplete mobilization of the rectum from the peritoneal pouch of the Douglas may explain the high rate of relapse in some reports [65, 66].

Regarding the functional point of view a retrospective comparison of Altemeier's versus abdominal suture rectopexy demonstrated that the patients undergoing laparoscopic suture rectopexy had higher incidence of constipation postoperatively and patients undergoing Altemeier's had higher incidence of incontinence postoperatively [64].

An improvement of anal continence has been described with the association of levatorplasty [38, 51, 67].

Lastly, a further use of the Altemeier procedure has been recently described as treatment of strangulated rectal prolapse unresponsive to conservative treatment or complicated by necrosis.

Unfortunately, in these cases a combined diverting ileostomy is required [68, 69].

Perineal stapled prolapse resection may be a possible alternative to other perineal procedures (level of evidence: IV; grading of recommendation C).

Perineal stapled prolapse resection (PSPR) may be faster and easier to perform than other conventional perineal prolapse procedures and is suitable for elderly, high-risk patients for whom an abdominal approach under general anesthesia is not advisable [70]. However, the poor long-term functional outcome and the recurrence rate of 14–44% warrant cautious patient selection. In patients with recurrence, a high rate of early recurrence was reported (within 3 months) [71–74]. Techniques consisting of inspecting the abdominal cavity laparoscopically or opening the anterior half of the rectum prior to stapling it off for fear of a trapped enterocele may be used for added safety [75].

A mucosal sleeve resection (Delorme) may be used in case of short prolapse (level of evidence: 3; grading of recommendation B).

Historically, Delorme's procedure has been associated with reduced morbidity but increased recurrence rates [76]. In a study with 75 patients with rectal prolapse treated with Altemeier's procedure ($n = 22$) or Delorme's procedure ($n = 53$), postoperative complications seemed lower with the latter (22 vs 7%, $p = 0.04$), even if recurrence at a mean follow-up of 1 year seemed higher (9 vs 16%, $p = 0.071$) [76]. Single-center series with large sample sizes reported a rate of immediate and late complications of 5–7% and 3.5%, respectively [48, 58]. Similar results are reported at the Cleveland Clinic Foundation: no differences in postoperative complications, mortality, length of hospital stay, time of diet resumption, readmission and reoperation rates. Nevertheless, the recurrence rate was double for the Delorme procedure even though not statistically significant: 18.5% vs. 36.4% ($p = 0.16$). Functional outcomes, including incontinence score, constipation score, and antidiarrheal medication and laxative use, were similar in the two groups [77]. There are no prospective studies comparing the Altemeier and Delorme techniques [59].

Previous studies reported an improvement of fecal continence after Delorme's procedure [78].

With the aim of verifying any difference between laparoscopic ventral rectopexy and the Delorme technique a prospective, randomized study was designed with a cohort of 50 operated and well distributed patients. The results demonstrated no statistical difference in morbidity and recurrence, similar improvement of constipation and fecal incontinence and significantly comparable improvement of quality of life. Neither procedure demonstrated to be superior on clinical and functional outcome at 18 months of follow-up [56].

As for the Altemeier technique, the length of hospital stay was shorter and the complication rate lower than with the abdominal approach [70].

Anal encirclement (Thiersch procedure) or mucosal plication are rarely performed and are reserved for selected patients (level of evidence: 4; grading of recommendation B).

The different and more inert materials used to improve the erosion due to the silver wire implanted by Thiersch [79] were not able to reduce the high rate of complications, including: erosion, wound infection, sepsis, strangulation and fecal impaction, and a recurrence rate of up to 44% [80]. A biological mesh, called Bio-Thiersch, seems to

reduce the recurrence when applied after perineal resection for full-thickness rectal prolapse but the complications still remain numerous [81].

Mucosal plication was first described by Gant in 1923 and was popularized by Miwa in 1962. The technique, more frequently used in Japan, is simple but a high recurrence rate of approximately 30% has been reported. Often it is associated with anal encirclement to reduce complications and relapse [82]. A new variant of two or three longitudinal transanally full-thickness plications of the rectal wall in case of rectal prolapse has been described with only 3.3%(1/30 patients)recurrence after 2- year follow-up and positive results as regards fecal incontinence [83].

Abdominal procedures for rectal prolapse

Rectopexy is a key component in the abdominal approach to rectal prolapse (level of evidence: I; grading of recommendation A).

One of the recommendations of the Cochrane review is that the rectum should be fixed rather than simply mobilized [19].

One multicenter trial examined this comparison [84]. The only primary outcome measured was recurrence of rectal prolapse.

There were two cases of this in the rectopexy group and ten in the no rectopexy group, and the difference was statistically significant. There was a non-significant difference in other complications.

However, other non-randomized studies suggested that fixation might not be necessary, and rectal mobilization alone results in recurrence rates similar to fixation [85, 86].

Moreover, age, sex, surgical technique, means of access, and rectopexy method seem to have no impact on recurrence rates [86].

Suture rectopexy with posterior rectal mobilization can worsen constipation (in about 50% of patients) or produce de novo constipation (about 15% of patients) [87]. The precise etiology of constipation is unclear, but it is thought to be attributable to posterior mobilization of the rectum.

The association between rectal mobilization and anterior resection (without rectopexy) is not typically recommended, due to the lack of functional advantages, the high recurrence and complication rates, and the availability of options that can achieve better outcomes with lower risk.

Sigmoid resection may be added to rectopexy in patients with prolapse and preoperative constipation (level of evidence: I; grading of recommendation B).

Resection rectopexy seems to result in reduced constipation if compared to preoperative and non-resectional rectopexy [19].

The addition of sigmoidectomy to the rectopexy lowers the recurrence rate and improves functional outcome with a minimal increase in morbidity [55, 88–90].

No differences were reported in incontinence scores between the resection and no-resection groups.

Division of the lateral ligaments during posterior rectal dissection may worsen postoperative constipation but is associated with decreased recurrence rates (level of evidence: II; grading of recommendation B).

During rectal mobilization in rectopexy, the lateral ligaments may be preserved or divided, and evidence from non-randomized studies suggests division may result in denervation of the rectum due to damage to the parasympathetic component of the inferior hypogastric plexus [91, 92]. On the other hand, preservation may result in increased recurrence, presumably due to incomplete mobilization of the rectum. The evidence is limited due to small numbers, but there appears to be more constipation among those with division of the lateral ligaments [93]. However, none of the effects of rectal mobilization or division of the lateral ligaments on anorectal function reached statistical significance in other studies [94].

There is insufficient evidence to identify the best fixation method used for rectopexy (level of evidence: I; grading of recommendation C).

Fixation of the rectum to the sacrum is designed to restore the physiological position of the rectum and thereby also correct the descensus of the pelvic floor. Fixation can be achieved by simple suturing, using natural ligaments or fasciae or using mesh. Mesh can be placed anteriorly, posteriorly, laterally or around the rectum.

Suture rectopexy was first described by Daher Cutait in 1959 [95]. The rationale of using sutures has been to keep the rectum in its new position to allow its eventual fixation to the sacrum by scar tissue.

The Ripstein rectopexy (and its further variations) involves an anterior wrapping with a prosthetic mesh around the mobilized rectum and attaching the mesh to the presacral fascia below the sacral promontory. In the literature, the recurrence rate is 0–13%, and the mortality rate is 0–2.8%; however, complication rates are high (about 33%). Complications included large bowel obstruction, erosion of the mesh through the bowel, ureteral injury or fibrosis, small-bowel obstruction, rectovaginal fistula, fecal impaction [96].

The Wells procedure, as originally described, involved fixation of the rectum using an Ivalon (polyvinyl alcohol) sponge and transection of the lateral ligaments. Despite the good results reported by Wells, a randomized trial of Ivalon sponge versus suture rectopexy found increased complication rates and postoperative constipation in the Ivalon group, with no improvement in recurrence rates. As a result, the study recommended that this technique be abandoned [97]. For this reason, instead of a non-absorbable sponge,

absorbable materials, such as vicryl or dexon, have been used. When absorbable materials are used, the recurrence rate is not higher, and complications, such as pelvic sepsis, are reported to be slightly lower. The recurrence rate is 3–10%, and mortality caused by pelvic sepsis is approximately 1–2%.

Many other rectopexy techniques have been described (for instance Orr-Loygue, Sudek, McMahan, Cutait, Miles) without the evidence of better outcomes.

Ventral mesh rectopexy is the only technique for rectal prolapse repair that does not require rectal mobilization, and includes only a limited anterior rectal preparation. Ventral rectosacropexy is performed using a synthetic or biologic mesh.

The hypothesis that avoiding complete rectal mobilization could improve postoperative constipation was supported by a systematic review [98] and other studies [99] that suggest that its correction of preoperative constipation and avoidance of de novo constipation appear superior to historical functional results of posterior rectopexy with a similar recurrent prolapse rate.

Despite these interesting results for ventral mesh rectopexy, long-term results are still lacking, and comparative studies between the various rectopexy techniques are still inconclusive.

Given the paucity of high-quality data, the choice of technique needs to be driven by the surgeon's preference and expertise as well as by the patient's surgical history, comorbidities.

There were no detectable differences between meshes used for fixation during rectopexy (level of evidence: II; grading of recommendation B).

Based on the principle of rectopexy by adhesion and fibrosis, on the assumption that fixation using a mesh would be more effective than that using a simple suture, meshes and other prostheses have been developed. Materials such as fascia lata, nylon, polypropylene, marlex, polyvinylalchol, polytape and others are used.

Two small trials compared different mesh materials for open abdominal rectopexy: polyglycolic acid mesh versus polyglactin mesh, and polyglycolic acid mesh versus polypropylene mesh. Absorbable mesh was found to be a suitable material for abdominal rectopexy [100] and no significant differences were found between absorbable and not absorbable meshes [101].

Studies on different meshes in animal models did not find one mesh superior to the others, considering macroscopical, histological, and biochemical properties [102].

Biological meshes appear to be as effective as synthetic meshes in the short term for laparoscopic ventral rectopexy. Complication rates are low for both types of mesh [103]. The incidence of mesh-related erosion after laparoscopic ventral rectopexy is low and is more common after the placement of synthetic mesh compared to biological mesh [104].

Minimally invasive approaches

Minimally invasive procedures (laparoscopic/robotic) have been found to be as safe and effective as open surgery, and should be considered when feasible (level of evidence: II; grading of recommendation B).

Minimally invasive management of rectal prolapse was first described by Berman in 1992 [105]. A laparoscopic approach can provide the same results as traditional open abdominal procedures.

An international survey published in 2013 on the method preferred by surgeons for the treatment of rectal prolapse highlighted that in 60% of cases laparoscopic abdominal surgery was used, in 20% an open approach and in 20% a perineal one. Ventral laparoscopic rectopexy is the most frequently performed operation in Europe for treatment of rectal prolapse [106].

Studies comparing laparoscopic with open techniques for treatment of rectal prolapse have shown similar morbidity, recurrence rates and functional results [107, 108]. In 2008 a Cochrane systematic review showed that laparoscopic patients presented minor complications and had a reduced hospital stay [109]. A meta-analysis published in 2010 on 688 patients showed no statistically significant differences between open and minimally invasive surgery regarding recurrence, functional outcomes, complications and mortality except for a reduced hospital stay in the laparoscopic group [110]. Analogous results were reported on a more recent meta-analysis by Cadeddu in 2012 [111].

In the past, the patient's age was considered an important element in making a decision about which intervention to propose to a patient with rectal prolapse, in particular when deciding between an abdominal or perineal approach. Perineal procedures could have a lower operative risk and be particularly recommended for older or high-risk patients. However, recent studies in the elderly suggested a low complication and recurrence rate in patients ≥ 80 years of age [112, 113]. Multivariate analysis found no statistically significant differences when patients were stratified according to age [114].

A robotic platform for rectopexy can facilitate anatomical dissection and mesh fixation. The disadvantages include higher costs and increased operating time [115]. In 2014 systematic review and meta-analysis demonstrated a similar conversion, reoperation and recurrence rate between robotic versus laparoscopic rectopexy [116]. A retrospective study by Iersel in 2017 reported that robotic ventral rectopexy is effective and safe to treat external rectal prolapse providing

a 12.9% recurrence rate [117]. Robotic rectopexy is easier to learn, the plateau phase of the learning curve is approximately 20 procedures [118].

Discussion

At the time of clinical evaluation a full history of the patient's symptoms should be obtained, including fecal incontinence versus constipation/obstructed defecation symptoms as well as stool consistency. Since the rectum protrudes outside the anus, the only possibility of highlighting rectal prolapse is through objective examination. The use of diagnostic tests will add other details necessary to help in the selection of tailored therapy.

Historically, perineal surgical approaches have been recommended for elderly or frail patients to avoid general anesthesia and laparotomy.

With the progress in anesthesiology and the advent of minimally invasive surgical techniques the abdominal approach has regained general favor, mainly because of the lower rate of recurrence associated with it [62, 119].

Nevertheless, in a study in the USA of 1972 patients, from a database in the USA, the reoperation rate for recurrence was similar after abdominal and perineal approaches: 11% [120]. Similarly, no difference in recurrence rates was demonstrated in the PROSPER study [56]; and again, no differences have been showed in the last Cochrane review on this topic [19].

In contrast with the aforementioned data, other studies showed that recurrence was ten times more frequent after the perineal approach than after the abdominal one [57]; but younger patients after abdominal repair for full-thickness rectal prolapse complained of higher rate of relapse in respect to those who underwent perineal repair [62].

Moreover, looking at morbidity, in a retrospective cohort in the American College of Surgeon's National Surgical Quality Improvement Program (NSPQI) conducted from January 2005 through December 2008 on 1485 patients who underwent surgery for rectal prolapse, multivariate analysis showed that both abdominal approach and an American Society of Anesthesiologists (ASA) class 4 were significant predictors of infectious complications [121].However, the analysis of the period 2008–2009 on 1469 patients showed that with the perineal approach a higher number of class 3–4 ASA and ≥ 80-year-old patients were included; in particular, after the perineal procedures the relative mortality risk for the highest risk group (ASA 3–4) was 4 times greater than in case of the abdominal procedure [122].

It is thought that the type of intervention, and not the patients, is associated with an increase in the risk of complications; in a study on 1275 patients from the NSQIP database, the patients in the perineal group ($n = 706$, 55%) was older, with more comorbidities, than those undergoing an abdominal procedure; nevertheless, they had fewer minor ($p = 0.0038$) and major complications ($p = 0.0038$) compared with the abdominal cohort.

In women with POP the perineal approach is associated with a higher recurrence rate of rectal prolapse so an abdominal rectopexy of the central and posterior compartments should be planned by a multidisciplinary team [123].

A survey in over 50 countries on the preferred surgical technique for full-thickness rectal prolapse demonstrated that the perineal approach is preferred by only 20% of surgeons [124].

An online survey promoted by the Association of Coloproctology of Great Britain and Ireland (ACPBGI) was circulated among the society's members before and after the publication of the first RCT on the topic which showed no difference between abdominal and perineal surgery [55, 125]. The authors observed that surgeons tended to favor a perineal procedure for unfit/elderly patients, but they also observed a steep increase in abdominal approaches, which they believed were due to a wider use of laparoscopy for ventral mesh rectopexy [125]. However, they acknowledged that the results of the survey and the attitude of colorectal surgeons towards the choice of a perineal versus abdominal approach are still strongly influenced by the lack of solid and convincing evidence [19].

Although 2 RCTs compared these approaches in a homogenous population, the risk exists that one could have been underpowered [53, 55, 56]. These trials were not designed as non-inferiority studies, therefore readers should pay attention in drawing definitive conclusions.

There is a need for further high-quality studies. It is likely that multicenter, randomized trials may obtain results similar to those of Senapati et al. [55], and, as the authors reported in their discussion—this could be due to results not being as good as those reported in retrospective case series by advocates of a particular procedure. At the same time, individualization of treatment is of key importance, and might justify these discrepancies among RCTs and expected findings in a context where randomization has driven the choice of surgical approach. Laparoscopic rectopexy has introduced further variability, and appears to be feasible in elderly patients. Future studies should incorporate what has been learned from previous RCTs, they should assess in detail the safety of the procedures, and ideally include patient advocates in the steering panel, to detect outcomes relevant to patients.

Currently, the available evidence does not allow us to draw definitive conclusions about which approach to prefer in patients with complete rectal prolapse. Patient history and clinical features, the surgeon's experience and the hospital equipment available must be considered to select the best treatment for a patient with rectal prolapse.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all participants included in the study.

References

1. Lowry AC, Simmang CL, Boulos P et al (2001) Consensus statement of definitions for anorectal physiology and rectal cancer, Washington DC May 1, 1999. Dis Colon Rectum 44:915–919
2. Kairaluoma MV, Kellokumpu IH (2005) Epidemiologic aspects of complete rectal prolapse. Scand J Surg 94:207–210
3. Rentea RM, St Peter SD (2018) Pediatric rectal prolapse. Clin Colon Rectal Surg 31:108–116
4. Michalopoulos A, Papadopoulos VN, Panidis S et al (2011) Surgical management of rectal prolapse. Tech Coloproctol 15(Suppl 1):S25–S28
5. Wilson J, Engledow A, Crosbie J, Arulampalam T, Mot-son R (2011) Laparoscopic non resectional suture rectopexy in the management of full-thickness rectal prolapse: substantive retrospective series. Surg Endosc 25:1062–1064
6. Corman ML (ed) (2004) Rectal prolapse, solitary rectal ulcer, syndrome of the descending perineum, and rectocele. In: Colon and rectal surgery, 5th edn. Lippincott Williams & Wilkins, Philadelphia, pp 1408
7. Goldstein SD, Maxwell PJ 4th (2011) Rectal prolapse. Clin Colon Rectal Surg 24:39–45
8. Moschvowitz AV (1912) The pathogenesis, anatomy and cure of prolapseof the rectum. Surg Gynecol Obstet 15:7
9. Devadhar DSC (1965) A new concept of mechanism and treatment of rectal procidentia. Dis Colon Rectum 8:75–78
10. Madiba TE, Baig MK, Wexner SD (2005) Surgical management of rectal prolapse. Arch Surg 140:63–73
11. Madden MV, Kamm MA, Nicholls RJ, Santhanam AN, Cabot R, Speakman CT (1992) Abdominal rectopexy for complete prolapse: prospective study evaluating changes in symptoms and anorectal function. Dis Colon Rectum 35:48–55
12. Blumberg D, Wald A (2002) Other diseases of the colon and rectum. In: Feldman M, Friedman LS, Sleisenger MH (ed) Sleisenger and Fordtran's gastrointestinal and liver disease. 7th edn. WB Saunders, Philadelphia, pp. 2294–2295
13. Tjandra JJ, Fazio VW, Church JM, Milsom JM, Oakley JR, Lavery IC (1993) Ripstein procedure is an effective treatment for rectal prolapse without constipation. Dis Colon Rectum 36:501–507
14. American College of Gastroenterology Chronic Constipation Task Force (2005) An evidence-based approach to the management of chronic constipation in North America. Am J Gastroenterol 100(Suppl 1):S1–S4
15. Bordeianou L, Hicks CW, Kaiser AM, Alavi K, Sudan R, Wise PE (2014) Rectal prolapse: an overview of clinical features, diagnosis, and patient-specific management strategies. J Gastrointest Surg 18:1059–1069
16. Zbar AP, Nguyen H (2008) Management guidelines for full-thickess rectal prolapse. In: Altomare DF, Pucciani F (eds) Rectal prolapse. Diagnosis and clinical management. Springer, Milan, pp 201–206
17. Cunin D, Siproudhis L, Desfourneaux V et al (2013) No surgery for full-thickness rectal prolapse: what happens with continence? World J Surg 37:1297–1302
18. Varma M, Rafferty J, Buie WD (2011) Practice parameters for the management of rectal prolapse. Dis Colon Rectum 54:1339–1346
19. Tou S, Brown SR, Nelson RL (2015) Surgery for complete (full-thickness) rectal prolapse in adults. Cochrane Database Syst Rev 11:CD001758
20. Evans C, Ong E, Jones OM, Cunningham C, Lindsey I (2014) Laparoscopic ventral rectopexy is effective for solitary rectal ulcer syndrome when associated with rectal prolapse. Colorectal Dis 16:O112–O116
21. Kang YS, Kamm MA, Engel AF, Talbot IC (1996) Pathology of the rectal wall in solitary rectal ulcer syndrome and complete rectal prolapse. Gut 38:587–590
22. Rao SS, Ozturk R, De Ocampo S, Stessman M (2006) Pathophysiology and role of biofeedback therapy in solitary rectal ulcer syndrome. Am J Gastroenterol 101:613–618
23. Gonzalez-Argente FX, Jain A, Nogueras JJ, Davila GW, Weiss EG, Wexner SD (2001) Prevalence and severity of urinary incontinence and pelvic genital prolapse in females with anal incontinence or rectal prolapse. Dis Colon Rectum 44:920–926
24. Baden WF, Walker T (1972) Genesis of the vaginal profile: a correlated classification of vaginal relaxation. Clin Obstet Gynecol 15:1048–1054
25. Bump RC, Mattiasson A, Bø K et al (1996) The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. Am J Obstet Gynecol 175:10–17
26. Abrams P, Andersson KE, Birden L et al (2009) Recommendation of the International Scientific Committee: evaluation and treatment of urinary incontinence, pelvic organ prolapse and faecal incontinence. In Abrams P, Cardozo L, Koury S, Wein A (eds), Incontinence: 4th international consultation on incontinence, 4 edn. Health Publications Ltd, Paris
27. Araki I, Haneda Y, Mikami Y, Takeda M (2009) Incontinence and detrusor dysfunction associated with pelvic organ prolapse: clinical value of preoperative urodynamic evaluation. Int Urogynecol J 20:1301–1306
28. Hill J, Corson RJ, Brandon H, Redford J, Faragher EB, Kiff ES (1994) History and examination in the assessment of patients with idiopathic fecal incontinence. Dis Colon Rectum 37:473–477
29. Dvorkin LS, Chan CL, Knowles CH, Williams NS, Lunniss PJ, Scott SM (2004) Anal sphincter morphology in patients with full-thickness rectal prolapse. Dis Colon Rectum 47:198–203
30. Woods R, Voyvodic F, Schloithe AC, Sage MR, Wattchow DA (2003) Anal sphincter tears in patients with rectal prolapse and faecal incontinence. Colorectal Dis 5:544–548
31. Osman MM, Abd El Maksoud WM, Gaweesh YS (2015) Delorme's operation plus sphincteroplasty for complete rectal prolapse associated with traumatic fecal incontinence. J Biomed Res 29:326–331
32. Chun SW, Pikarsky AJ, You SY et al (2004) Perineal rectosigmoidectomy for rectal prolapse: role of levatorplasty. Tech Coloproctol 8:3–8
33. Pannu HK, Kaufman HS, Cundiff GW, Genadry R, Bluemke DA, Fishman EK (2000) Dynamic MR imaging of pelvic organ prolapse: spectrum of abnormalities. Radiographics 20:1567–1582
34. Comiter CV, Vasavada SP, Barbaric ZL, Gousse AE, Raz S (1999) Grading pelvic prolapse and pelvic floor relaxation using dynamic magnetic resonance imaging. Urology 54:454–457
35. Piloni VL, Bazzocchi A, Golfieri R (2008) Functional imaging in rectal prolapse. In: Altomare DF, Pucciani F (eds) Rectal

prolapse. Diagnosis and clinical management. Springer, Milan, pp 21–32
36. Rao SS, Siddiqui J (2007) Diagnosis of fecal incontinence. In: Ratto C, Doglietto GB (eds) Fecal incontinence. Diagnosis and treatment. Springer, Milan, pp 95–105
37. Pucciani F (2017) Anorectal manometry. In: Ratto C, Parello A, Donisi L, Litta F (eds) Colon, rectum and anus: anatomic, physiologic and diagnostic bases for disease management. Springer, Cham, pp 277–283
38. Glasgow SC, Birnbaum EH, Kodner IJ, Fleshman JW, Dietz DW (2006) Preoperative anal manometry predicts continence after perineal proctectomy for rectal prolapse. Dis Colon Rectum 49:1052–1058
39. Leroi AM (2017) Electrophysiological study of the pelvic floor. In: Ratto C, Parello A, Donisi L, Litta F (eds) Colon, rectum and anus: anatomic, physiologic and diagnostic bases for disease management. Springer, Cham, pp 286–301
40. Nash DF (1972) Bowel management in spina bifida patients. Proc R Soc Med 65:70–71
41. Siafakas C, Vottler TP (1999) Rectal prolapse in pediatrics. Clin Pediatr 38:63–72
42. Cares K, El-Baba M (2016) Rectal Prolapse in children: significance and management. Curr Gastroenterol Rep 18:22
43. Birnbaum EH, Stamm L, Rafferty JF, Fry RD, Kodner IJ, Fleshman JW (1996) Pudendal nerve terminal motor latency influences surgical outcome in treatment of rectal prolapse. Dis Colon Rectum 39:215–1221
44. Schultz I, Mellgren A, Nilsson BY, Dolk A, Holmström B (1998) Preoperative electrophysiologic assessment cannot predict continence after rectopexy. Dis Colon Rectum 41:1392–1398
45. Myers JO, Rothenberger DA (1991) Sugar in the reduction of incarcerated prolapsed bowel: report of two cases. Dis Colon Rectum 34:416 – 418
46. Livovsky DM, Adler SN, Adar T, Bar-Gil Shitrit A, Lysy J (2015) Tricyclic antidepressants for the treatment of tenesmus associated with rectal prolapse. Colorectal Dis 17(12):1094–1099
47. Pucciani F, Iozzi L, Masi A, Cianchi F, Cortesini C (2003) Multimodal rehabilitation for faecal incontinence: experience of an Italian centre devoted to faecal disorder rehabilitation. Tech Coloproctol 7:139–147
48. Pescatori M, Zbar AP (2009) Tailored surgery for internal and external rectal prolapse: functional results of 268 patients operated upon by a single surgeon over a 21-year period*. Colorectal Dis 11(4):410–419. https://doi.org/10.1111/j.1463-1318.2008.01626.x
49. Pinheiro LV, Leal RF, Coy CS, Fagundes JJ, Martinez CA, Ayrizono ML (2016) Long-term outcome of perineal rectosigmoidectomy for rectal prolapse. Int J Surg 32:78–82. https://doi.org/10.1016/j.ijsu.2016.06.040
50. Ris F, Colin JF, Chilcott M, Remue C, Jamart J, Kartheuser A (2012) Altemeier's procedure for rectal prolapse: analysis of long-term outcome in 60 patients. Colorectal Dis 14(9):1106–1111. https://doi.org/10.1111/j.1463-1318.2011.02904.x
51. Altomare DF, Binda G, Ganio E et al (2009) Long-term outcome of Altemeier's procedure for rectal prolapse. Dis Colon Rectum 52(4):698–703. https://doi.org/10.1007/DCR.0b013e31819ecffe
52. Riansuwan W, Hull TL, Bast J, Hammel JP, Church JM (2010) Comparison of perineal operations with abdominal operations for full-thickness rectal prolapse. World J Surg 34(5):1116–1122. https://doi.org/10.1007/s00268-010-0429-0
53. Bordeianou L, Paquette I, Johnson E et al (2017) Clinical practice guidelines for the treatment of rectal prolapse. Dis Colon Rectum 60:1121–1131. https://doi.org/10.1097/DCR.0000000000000889
54. Mustain WC, Davenport DL, Parcells JP, Vargas HD, Hourigan JS (2013) Abdominal versus perineal approach for treatment of rectal prolapse: comparable safety in a propensity-matched cohort. Am Surg 79(7):686–692
55. Senapati A, Gray RG, Middleton LJ, Harding J, Hills RK, Armitage NC, Buckley L, Northover JM (2013) PROSPER: a randomised comparison of surgical treatments for rectal prolapse. Colorectal Dis 15(7):858–868. https://doi.org/10.1111/codi.12177
56. Emile SH, Elbanna H, Youssef M et al (2017) Laparoscopic ventral mesh rectopexy vs Delorme's operation in management of complete rectal prolapse: a prospective randomized study. Colorectal Dis 19(1):50–57. https://doi.org/10.1111/codi.13399
57. Tiengtianthum R, Jensen CC, Goldberg SM, Mellgren A (2014) Clinical outcomes of perineal proctectomy among patients of advanced age. Dis Colon Rectum 57(11):1298–1303. https://doi.org/10.1097/DCR.0000000000000225%5D
58. Wijffels N, Cunningham C, Dixon A, Greenslade G, Lindsey I (2011) Laparoscopic ventral rectopexy for external rectal prolapse is safe and effective in the elderly. Does this make perineal procedures obsolete? Colorectal Dis 13:561–566
59. Lieberth M, Kondylis LA, Reilly JC, Kondylis PD (2009) The Delorme repair for full-thickness rectal prolapse: a retrospective review. Am J Surg 197(3):418–423
60. Garely AD, Krieger BR, Ky AJ (2014) Rectal prolapse. In: Cameron JL, Cameron AM (eds) Current surgical therapy. Elsevier Saunders, Philadelphia, pp 190–194
61. Ding JH, Canedo J, Lee SH, Kalaskar SN, Rosen L, Wexner SD (2012) Perineal rectosigmoidectomy for primary and recurrent rectal prolapse: are the results comparable the second time? Dis Colon Rectum 55(6):666–670
62. Steele SR, Goetz LH, Minami S, Madoff RD, Mellgren AF, Parker SC (2006) Management of recurrent rectal prolapse: surgical approach influences outcome. Dis Colon Rectum 49(4):440–445
63. Cirocco WC (2014) Explaining the undulating outcomes of perineal rectosigmoidectomy (Altemeier procedure) for rectal prolapse over the last century: technique matters! Tech Coloproctol 18:979–980
64. Balakrishna NS, Sushrutha CS, Sathish O et al (2017) Comparison between laparoscopic suture rectopexy and Altemeier's procedure for the management of complete rectal prolapse—a single center retrospective observational study. J Evid Based Med Healthc 4(44):2685–2690
65. Yoshioka K, Ogunbiyi OA, Keighley MR (1998) Pouch perineal rectosigmoidectomy gives better functional results than conventional rectosigmoidectomy in elderly patients with rectal prolapse. Br J Surg 85(11):1525–1526
66. Baig MK, Galliano D, Larach JA, Weiss EG, Wexner SD, Nogueras JJ (2005) Pouch perineal rectosigmoidectomy: a case report. Surg Innov 2(4):373–375
67. Zbar AP, Takashima S, Hasegawa T et al (2002) Perineal rectosigmoidectomy (Altemeier's procedure): a review of physiology, technique and outcome. Tech Coloproctol 6:109–116
68. Cernuda RB, Ángel JP, Fernández NT, Sánchez-Farpón JH, Pérez JA (2016) Perineal rectosigmoidectomy (Altemeier procedure) as treatment of strangulated rectal prolapse. J Gastrointest Surg 20(12):2102–2103
69. Voulimeneas I, Antonopoulos C, Alifierakis E, Ioannides P (2010) Perineal rectosigmoidectomy for gangrenous rectal prolapse. World J Gastroenterol 7(21):2689–2691 16(
70. Raahave D, Jensen AK, Dammegaard L, Pedersen IK (2016) Primary and repeated perineal stapled prolapse resection. Tech Coloproctol 20:853–857. https://doi.org/10.1007/s10151-016-1557-9
71. Ram E, Krissi H, Zbar A, Atar E, Joubran S, Rath-Wolfson L (2014) Perineal stapled prolapse resection (PSPR) in elderly

patients for external rectal prolapse: early experience. Tech Coloproctol 18:1003–1007
72. Sehmer D, Marti L, Wolff K, Hetzer FH (2013) Midterm results after perineal stapled prolapse resection for external rectal prolapse. Dis Colon Rectum 56:91–96
73. Tschuor C, Limani P, Nocito A, Dindo D, Clavien PA, Hahnloser D (2013) Perineal stapled prolapse resection for external rectal prolapse: is it worthwhile in the long-term? Tech Coloproctol 17:537–540
74. Mistrangelo M, Tonello P, Brachet Contul R et al (2016) Perineal stapled prolapse resection for full-thickness external rectal prolapse: a multicentre prospective study. Colorectal Dis 18:1094–1100
75. Förster CE, Füglistaler I, Steinemann DC (2018) Intraoperative check for enterocele in perineal stapled prolapse resection. Tech Coloproctol 22:389–391. https://doi.org/10.1007/s10151-018-1796-z
76. Elagili F, Gurland B, Liu X, Church J, Ozuner G (2015) Comparing perineal repairs for rectal prolapse: Delorme versus Altemeier. Tech Coloproctol 19(9):521–525
77. Fleming FJ, Kim MJ, Gunzler D, Messing S, Monson JR, Speranza JR (2012) It's the procedure not the patient: the operative approach is independently associated with an increased risk of complications after rectal prolapse repair. Colorectal Dis 14(3):362–368
78. Tsunoda A, Yasuda N, Yokoyama N, Kamiyama G, Kusano M (2003) Delorme's procedure for rectal prolapse: clinical and physiological analysis. Dis Colon Rectum 46:1260–1265
79. Goldman J (1988) Concerning prolapse of the rectum with special emphasis on the operation by Thiersch. Dis Colon Rectum 31:154–155
80. Madsen MA (2008) Perineal approaches to rectal prolapse. Clin Colon Rectal Surg 21(2):100–105
81. Eftaiha SM, Calata JF, Sugrue JJ et al (2017) Bio-thiersch as an adjunct to perineal proctectomy reduces rates of recurrent rectal prolapse. Dis Colon Rectum 60(2):187–193
82. Yamana T, Iwadare J (2003) Mucosal plication (Gant-Miwa procedure) with anal encircling for rectal prolapse—a review of the Japanese experience. Dis Colon Rectum 46:S94–S99
83. Qaradaghy SHS, Hawram TAH, Nore BF et al (2014) Longitudinal plication—a surgical strategy for complete rectal prolapse management. BMC Surg 14:17
84. Karas JR, Uranues S, Altomare DF et al (2011) No rectopexy versus rectopexy following rectal mobilisation for full-thickness rectal prolapse: a randomised controlled trial. Dis Colon Rectum 54(1):29–34
85. Nelson R, Spitz J, Pearl RK, Abcarian H (2001) What role does full rectal mobilization play in the treatment of rectal prolapse? Tech Coloproctol 5(1):33–35
86. Raftopoulos Y, Senagore AJ, Di Giuro G, Bergamaschi R (2005) Recurrence rates after abdominal surgery for complete rectal prolapse: a multicenter pooled analysis of 643 individual patient data. Dis Colon Rectum 48:1200–1206
87. Aitola PT, Hiltunen KM, Matikainen MJ (1999) Functional results of operative treatment of rectal prolapse over an 11-year period: emphasis on transabdominal approach. Dis Colon Rectum 42:655–660
88. Luukkonen P, Mikkonen U, Järvinen H (1992) Abdominal rectopexy with sigmoidectomy vs. rectopexy alone for rectal prolapse: a prospective, randomized study. Int J Colorectal Dis 7:219–222
89. Sayfan J, Pinho M, Alexander-Williams J, Keighley MR (1990) Sutured posterior abdominal rectopexy with sigmoidectomy compared with Marlex rectopexy for rectal prolapse. Br J Surg 77:143–145
90. McKee RF, Lauder JC, Poon FW, Aitchison MA, Finlay IG (1992) A prospective randomized study of abdominal rectopexy with and without sigmoidectomy in rectal prolapse. Surg Gynecol Obstet 174:145–148
91. Varma JS (1992) Autonomic influences on colorectal motility and pelvic surgery. World J Surg 16(5):811–819
92. El Muhtaseb MS, Bartolo DC, Zayiae D, Salem T (2014) Colonic transit before and after resection rectopexy for full-thickness rectal prolapse. Tech Coloproctol 18(3):273–276
93. Speakman CTM, Madden MV, Nicholls RJ, Kamm MA (1991) Lateral ligament division during rectopexy causes constipation but prevents recurrence: results of a prospective randomized study. Br J Surg 78(12):1431–1433
94. Mollen RM, Kuijpers JH, Van Hoek F (2000) Effect of rectal mobilisation and lateral sphincter division on colonic and anorectal function. Dis Colon Rectum 43(9):1283–1287
95. Cutait D (1959) Sacro-promontory fixation of the rectum for complete rectal prolapse. Proc R Soc Med 52(suppl):105
96. Hrabe J, Gurland B (2016) Optimizing treatment for rectal prolapse. Clin Colon Rectal Surg 29(3):271–276
97. Novell JR, Osborne MJ, Winslet MC, Lewis AA (1994) Prospective randomized trial of Ivalon sponge versus sutured rectopexy for full-thickness rectal prolapse. Br J Surg 81(6):904–906
98. Samaranayake CB, Luo C, Plank AW, Merrie AE, Plank LD, Bissett IP (2010) Systematic review on ventral rectopexy for rectal prolapse and intussusception. Colorectal Dis 12:504–512
99. Boons P, Collinson R, Cunningham C, Lindsey I (2010) Laparoscopic ventral rectopexy for external rectal prolapse improves constipation and avoids de novo constipation. Colorectal Dis 12:526–532
100. Winde G, Reers B, Nottberg H, Berns T, Meyer J, Bunte H (1993) Clinical and functional results of abdominal rectopexy with absorbable mesh-graft for treatment of complete rectal prolapse. Eur J Surg 59(5):301–305
101. Galili Y, Rabau M (1997) Comparison of polyglycolic acid and polypropylene mesh for rectopexy in the treatment of rectal prolapse. Eur J Surg 163(6):445–448
102. Calişkan C, Denizli A, Makay O et al (2009) Experimental comparison of meshes for rectal prolapse surgery. Eur Surg Res 43(3):310–314
103. Smart NJ, Pathak S, Boorman P, Daniels IR (2013) Synthetic or biological mesh use in laparoscopic ventral mesh rectopexy—a systematic review. Colorectal Dis 15(6):650–654
104. Balla A (2017) Synthetic versus biological mesh-related erosion after laparoscopic ventral mesh rectopexy: a systematic review. Ann Coloproctol 33:46–51
105. Berman IR (1992) Suturless laparoscopic rectopexy for procidentia. Technique and implications. Dis Colon Rectum 35:689–693
106. Formijne HA (2013) Evaluation and surgical treatment of rectal prolapse proplapse: an international survey. Colorectal Dis 15:115–119
107. Kariv Y (2006) Long-term outcome after laparoscopic and open surgery for rectal prolapse: a case-control study. Surg Endosc 20:35–42
108. Solomon MJ (2002) Randomized clinical trial of laparoscopic versus open abdominal rectopexy for rectal prolapse. Br J Surg 89:35–39
109. Tou S (2008) Surgery for complete rectal prolapse in adults. Cochrane Database Sys Rev 4:123–135
110. Sajid MS (2010) Open versus laparoscopic repair of full-thickness rectal prolapse: a re-meta-analysis. Colorectal Dis 12:515–525
111. Cadeddu F (2012) Focus on abdominal rectopexy for full-thickness rectal prolapse: meta-analysis of literature. Tech Coloproctol 16:37–53

112. Sahoo MR (2014) A single centre comparative study of laparoscopic mesh rectopexy versus suture rectopexy. J Minim Access Surg 10:18–22
113. Mackenzie H (2014) Proficiency gain curve and predictors of outcome for laparoscopic ventral mesh rectopexy. Surgery 156:158–167
114. Gultekin FA (2015) Safety of laparoscopic ventral rectopexy in the elderly: results from a nationwide database. Dis Colon Rectum 58:339–343
115. Pierrenot C (2013) Long-term outcomes of robot-assisted laparoscopic rectopexy for rectal prolapse. Dis Colon Rectum 56:909–914
116. Rondelli F (2014) Robot-assisted or conventional laparoscopic rectopexy for rectal prolapse. Systematic review and meta-analysis. Int J Surg 12:S153–S159
117. Iersel JJ (2017) Robot-assistedventral mesh rectopexy for rectal prolapse: A 5 year experience at a tertiary referral center. Dis Colon Rectum 60:1215–1223
118. Makela-Kaikkonen J (2016) Robot-assisted vs laparoscopic ventral rectopexy for external or internal prolapse and enterocele: a randomized controlled trial. Colorectal Dis 18:1010–1015
119. Tomohide H, Daiki Y, Takafumi M et al (2018) Surgical options for full-thickness rectal prolapse: current status and institutional choice. Ann Gastroenterol 31:188–197
120. Ricciardi R, Roberts PL, Read TE, Hall JF et al (2014) Which operative repair is associated with a higher likelihood of reoperation after rectal prolapse repair? Am Surg 80(11):1128–1131
121. Russell MM, Read TE, Roberts PL et al (2012) Complications after rectal prolapse surgery: does approach matter? Dis Colon Rectum 55(4):450–458
122. Fang SH, Cromwell JW, Wilkins KB et al (2012) Is the abdominal repair of rectal prolapse safer than perineal repair in the highest risk patients? An NSQIP analysis. Dis Colon Rectum 55(11):1167–1172
123. Catanzarite T, Klaristenfeld DD, Tomassi MJ, Zazueta-Damian G, Alperin M (2018) Recurrence of rectal prolapse after surgical repair in women with pelvic organ prolapse. Dis Colon Rectum. https://doi.org/10.1097/DCR.0000000000001023
124. Jonkers HAF, Draaisma WA, Wexner SD et al (2013) Evaluation and surgical treatment of rectal prolapse: an international survey. Colorectal Dis 15:115–119
125. Gunner CK, Senapati A, Northover JM, Brown SR (2016) Life after PROSPER. What do people do for external rectal prolapse? Colorectal Dis 18(8):811–814