The Role of Synthetic and Biologic Materials in the Treatment of Pelvic Organ Prolapse

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Abstract

Pelvic organ prolapse is a significant medical problem that poses a diagnostic and management dilemma. These diseases cause serious morbidity in those affected and treatment is sought for relief of pelvic pain, rectal bleeding, chronic constipation, obstructed defecation, and fecal incontinence. Numerous procedures have been proposed to treat these conditions; however, the search continues as colorectal surgeons attempt to find the procedure that would optimally treat these conditions. The use of prosthetics in the repair of pelvic organ prolapse has become prevalent as the benefits of their use are realized. While advances in biologic mesh and new surgical techniques promise improved functional outcomes with decreased complication rates without de novo symptoms, the debate concerning the best prosthetic material, synthetic or biologic, remains controversial. Furthermore, laparoscopic ventral mesh rectopexy has emerged as a procedure that could potentially fill this role and is rapidly becoming the procedure of choice for the surgical treatment of pelvic organ prolapse.

Keywords

- pelvic organ prolapse
- ventral mesh rectopexy
- biologic mesh

CME Objectives: On completion of this article, the reader should be able to summarize the role of synthetic and biologic materials in the operative management of pelvic organ prolapse.

Pelvic organ prolapse is a spectrum of anatomical abnormalities associated with pelvic floor dysfunction and abnormal descent of the rectum and other abdominal structures into the pelvis. It results from the loss of support to the structures contained within the bony pelvis: from anterior to posterior, the bladder, uterus, vagina, and rectum. Frequently, diastasis of the levator ani, an abnormally deep cul-de-sac, a redundant sigmoid colon, a patulous anal sphincter, and/or the loss of rectal sacral attachments are present.^{1–4} Enterocoele, rectocoele, rectal prolapse, and total pelvic organ prolapse are benign conditions, which cause significant morbidity including pelvic discomfort, chronic drainage of blood, and/or mucous from the

anus as well fecal incontinence and constipation and obstructed defecation symptoms.^{5–9}

The development of pelvic organ prolapse is multifactorial. A combination of genetic and acquired factors, including pregnancy, increased parity, hormonal deficiencies, myopathy, neuropathy, obesity, smoking, pulmonary disease, and obstipation, contributes to the weakening of the pelvic floor.¹⁰ Several studies have demonstrated that these factors disturb the pelvic floor tissues at a molecular level, altering the composition, quantity, and organization of collagen, elastin, and smooth muscle in the urogenital tissues.^{11,12} Several studies have demonstrated a total decrease in the overall collagen content within the supportive pelvic tissues of patients with pelvic organ prolapse. Additionally, the ratio of collagen III/I is altered favoring an increase in collagen III, which is more compliant and distensible. The increased turnover of immature collagen and decreased elastin levels

lead to increased flexibility and decreased tensile strength of the tissues that support the pelvic floor.¹³

While there are multiple risk factors for pelvic organ prolapse,¹⁴ up to 30% of patients with prolapse of a pelvic organ will have no risk factors.¹⁵ While these diseases affect approximately 0.5% of the U.S. population,⁶ the Women's Health Initiative demonstrated that 41% of women age 50 to 79 years showed some degree of symptomatic pelvic organ prolapse.^{15,16} Women older than 50 years are six times as likely as men to present with rectal prolapse.⁵ Regardless of the etiology, approximately 400,000 procedures are performed annually and 11% of women have an operative procedure for a defect of pelvic support before the age of 80.¹⁴

The assessment of this condition requires an understanding of urinary, defecatory, and sexual function to achieve optimal outcomes. The posterior components of this entity can include rectocele, enterocele, and rectal intussusception or overt rectal prolapse. Symptoms attributed to pelvic organ prolapse include obstructed defecation, pelvic pain and pressure, and incontinence plus the genitourinary symptoms of urinary incontinence and incomplete emptying of the bladder. Evaluation of patients with prolapse of the pelvic organs is difficult due to the wide spectrum of functional, anatomical, neurological, and hormonal abnormalities associated with these diseases. Thus, clinical evaluation instruments, such as the Birmingham Bowel and Urinary Symptoms Questionnaire (BBUSQ), have been developed to simultaneously assess the subjective observations of women with regard to their dysfunctional micturition and defecation. The BBUSQ assesses the severity of the symptoms of the patient via a questionnaire. This questionnaire has been validated against robust objective clinical data measuring four specific factors. Constipation and incontinence as well as dysfunctional evacuation are assessed and can reliably reflect the current severity of each symptom (→Table 1). By creating clinically

valid and reliable tools that can be used to assess these patients' symptoms throughout the evaluation and treatment process, a means of measuring the success of interventions can be achieved.^{17,18}

Physical examination may reveal prolapse of some or all of the pelvic organs or excessive perineal descent. Proctoscopic examination may demonstrate hyperemia and edema of the anterior rectal wall, colitis cystica profunda, or a solitary rectal ulcer.¹⁹ Solitary rectal ulcer syndrome is a difficult clinical problem that is associated with pelvic organ prolapse.

Colpocystodefecography is useful in evaluating the full anatomic scope of the problem but may be oversensitive with as many as 30% of asymptomatic women having abnormalities of the pelvic floor identified by defecography. Frequently, descent of the anorectal junction below a line drawn from the lower border of the pubic symphysis to the tip of the coccyx during defecation is present and may be associated with significant disease.²⁰ This abnormal perineal descent is a result of longstanding, excessive straining to defecate.^{21,22} Dynamic MRI, EMG, and urodynamic studies may also be useful in evaluating these patients, and colonic transit studies should be performed if colonic hypomotility cannot be excluded.^{23,24}

Initial management of patients with pelvic organ prolapse is usually nonoperative, utilizing increased dietary fluid and fiber and pelvic floor strengthening and retraining using biofeedback. Surgery is typically indicated once nonoperative treatment measures fail to result in adequate symptom reduction.^{8,25} Though surgery offers the only chance of cure for pelvic organ prolapse, the optimal operative strategy remains nebulous.²⁶ To date, more than 100 techniques have been described in the repair of pelvic organ prolapse, indicating the optimal technique has yet to be determined.²⁷ Furthermore, there has been a lack of consensus or generally accepted guidelines on the best treatment of these conditions and, until recently, no prospective randomized trials comparing operative strategies.^{26,28}

Given the characteristics of the connective tissues in patients with pelvic organ prolapse described above, prosthetic materials have been introduced in the surgical management of these conditions as a means of augmenting the surgical repair to correct anatomic defects and restore function within the pelvis. The prosthesis acts as a scaffold into which new host tissue in-growth occurs as a result of revascularization and subsequent collagen deposition.^{29,30} The use of prosthetics and biologic materials has a critical role in the repair of pelvic organ prolapse. However, the optimal prosthetic material is highly debated as the complications associated with the use of synthetic meshes have become a national concern.³¹ The placement of synthetic mesh in the pelvis, which has resulted in cases of bowel obstruction, vaginal and bowel erosion as well as fistualization,^{32–36} has led to the increasing use of the newer biologic materials in the repair of pelvic floor disease.^{30,37} The use of biologic mesh has undergone an evolution as advances in biomaterials technology and new surgical techniques have emerged.³⁸ While biologic meshes are costly and are more difficult to handle in laparoscopic procedures, leading to

Table 1 BBUSQ-22 questions related to bowel function

Symptoms	Questions
Evacuation	Do you strain to have bowel movements?
	Do you feel that you cannot completely empty your bowels?
	Do you use a finger or pressure to help open your bowels?
	Do you have the urge to have a bowel movement but you are unable to do so?
	Do you find it painful to have bowel movements?
	Do you use laxatives?
Incontinence	Can you hold your bowel movements for more than 5 minutes?
	Do you leak stool before you can get to the toilet?
	Do you leak stool without feeling that you want to go to the toilet?

Note: There are four possible responses to each question: never (1 point), occasionally (2 points), most of the time (3 points), and always (4 points).

longer procedure times, they are durable, incorporate quickly, and are associated with decreased rates of erosion, pain, sexual dysfunction, fistulization, and infection.³⁹ However, to date there have been no randomized controlled trials comparing the use of biologic to synthetic mesh in the repair of pelvic organ prolapse.⁴⁰ Subsequently, there is no substantive evidence indicating that there is a superiority of one prosthetic material in the repair of pelvic organ prolapse.

The purpose of this manuscript will be to discuss the surgical correction of pelvic organ prolapse with special attention paid to the use and effectiveness of biologic and synthetic mesh in the repair of these conditions.

Surgical Management of Pelvic Organ Prolapse

Transvaginal, Transrectal, and Perineal Repairs

As stated previously, there are numerous procedures described for the surgical management of pelvic organ prolapse. Transvaginal, transrectal, and perineal procedures will be considered separately from transabdominal procedures for the correction of pelvic prolapse. These procedures have been widely used in the past but are rapidly falling out of favor given the renewed interest in transabdominal techniques. However, the local approaches will remain the procedures of choice for patients who are unable, due to their health status, to undergo either an open or laparoscopic transabdominal procedure.

Transvaginal approaches have the advantage of providing adequate access for the repair of coexistent enteroceles, cystoceles, and apical vaginal vault prolapse. A vaginal hysterectomy can also be performed if necessary for uterine prolapse or other problems.⁴¹ However, satisfactory surgical treatment for posterior vaginal prolapse is elusive as failure rates ranging from 30 to 70% and reoperation rates of 30% have been reported.⁴² The transvaginal placement of a polypropylene mesh in the rectovaginal plane with the goal of increasing durability of transvaginal repairs was widely adopted to achieve a tension-free repair. In 2010, approximately 75,000 transvaginal mesh procedures were performed for prolapse. However, transvaginal mesh implantation has undergone increased scrutiny due to statements in 2008 and 2011 by the United States Food and Drug Administration concerning the frequency of complications associated with polypropylene transvaginal mesh placement, including erosion and exposure.⁴³ While risk factors for these complications have been identified, including concurrent hysterectomy, diabetes mellitus, and smoking, the routine use of mesh in transvaginal repairs is not recommended.^{44–47}

As an alternative, native tissue repair has been advocated due to similar outcomes when compared with mesh placement without the risks associated with its use.⁴⁸ Additionally, two studies have demonstrated decreased failure rates with the utilization of biological grafts extracted from small intestinal submucosa. It should be noted, however, that there were no significant short-term differences between the augmented and native tissue repairs in terms of perioperative and postoperative mor-

bidity, functional outcomes, quality of life, and bowel and sexual function.^{42,49}

Transrectal Repair

Randomized studies comparing transvaginal to transrectal rectocele repair have shown the incidence of postoperative dyspareunia to be significantly less with the transanal repair.⁵⁰ However, transvaginal repair was associated with a significant reduction in recurrent prolapse compared with transanal techniques.⁴⁷ Regardless, transanal repair provides the necessary exposure to address coexistent anorectal pathology, including hemorrhoids, anterior mucosal prolapse, and fissures, that may be present in up to 80% of patients.¹

There is a paucity of data regarding transanal placement of mesh, either synthetic or biologic, in the treatment of pelvic organ prolapse. Native tissue repairs are most frequently described and are associated with poor long-term outcomes including recurrence rates as high as 50% at 5.5 years.⁵¹

Perineal Repair

There is also limited data regarding the use and outcomes of transperineal surgery for rectoceles. The technique has been recommended in combination with a conventional sphincteroplasty and/or levatorplasty for the patient with a symptomatic rectocele and incontinence secondary to a sphincter defect.⁴¹ Short-term results of this combined procedure show an improvement in evacuation and continence in 75% of patients.⁵² The transperineal insertion of a prosthetic mesh for the anatomic restoration of a disrupted rectovaginal septum has been described with a significant reduction in the need for digital assistance of defecation and in the size and amount of barium retained in rectoceles.⁵³ In one study of 88 patients whose rectocele was repaired using a bioprosthesis, significantly fewer wound dehiscences (0%) were reported compared with those repaired with transanal techniques (9%). At 1-year follow-up, there were no recurrent rectoceles in either group.⁵⁴ Other studies have reported mesh infection or erosion in up to 20% and recurrence of the rectocele in as many as 41% of patients when synthetic meshes were utilized during perineal repair.⁵⁵

In our department, bioprosthetics were used in 38 women for the transperineal repair of rectoceles. Final follow-up occurred at a mean of 54 (range, 36–68) months. Women whose rectocele was repaired using bioprosthetics had functional outcomes at final follow-up comparable to those previously reported after 12 months and improvement compared with preoperatively in four of five obstructed defecation parameters and one of three continence parameters as measured by the BBUSQ. There have been no mesh-related complications or detriment in any parameter compared with preoperative assessments.⁵⁴

Transabdominal Repair

In patients deemed suitable, the abdominal approach is most popular in the United States to surgically manage prolapse of the pelvic organs.⁵⁶ When compared with the perineal approach, multiple studies have demonstrated that transabdominal surgery is associated with lower recurrence rates and

improved functional outcome.^{56–58} Historically, the abdominal approach for correction of pelvic organ prolapse is based on the tenets of rectal mobilization, with or without resection of the sigmoid colon, and fixation of the rectum.⁶ The use of minimally invasive techniques, both laparoscopic and robotic, has been widely implemented in transabdominal procedures given the association with reduced short-term morbidity without detrimental effect on the long-term outcomes.^{59,60} Recently, the dogma of circumferential mobilization of the rectum distally to the level of the pelvic floor muscles as the preferred approach to mobilization has been questioned. Combined anterior and posterior mobilization of the rectum has been associated with *de novo* constipation symptoms postoperatively. This is believed to be due to autonomic denervation incurred during posterior mobilization as well as division/ligation of the lateral stalks.⁶¹ While dissection of the lateral stalks of the rectum has been associated with decreased recurrence rates, Varma et al recommends preservation of the rectal stalks. This recommendation came with the caveat that an increase in recurrence rates would be expected with this practice.⁵

While fixation of the rectum to the sacral promontory is standard in the abdominal approach, the material used for fixation has been widely debated. The use of suture, sponges, synthetic, and biologic meshes has each been described. The use of the Ivalon (polyvinyl alcohol) sponge was once popular in Europe, but has been abandoned due to its high complication profile.^{5,62}

Suture Rectopexy

Suture rectopexy includes posterior and anterior mobilization of the rectum with or without preservation of the lateral stalks distally to the level of the levator musculature. The rectum is then retracted cephalad to reduce any redundant bowel and attached to the sacral promontory using sutures or tacks.⁶³ This procedure can be performed via open technique or laparoscopically. A meta-analysis by Cadeddu et al evaluating the treatment of full-thickness rectal prolapse demonstrated that laparoscopic suture rectopexy resulted in equivalent outcomes with the open technique. The study demonstrated similar recurrence rates (3–9%), statistically significant improvements in fecal incontinence symptoms, and no statistically significant improvement in constipation symptoms postoperatively for both procedures.² Suture rectopexy can cause *de novo* constipation in approximately 15%, and in those who had constipation preoperatively, 50% will demonstrate subjective worsening of constipation symptoms.^{64,65}

The advantage of suture rectopexy is that it can be combined with sigmoid resection for those patients with redundant sigmoid colons whose constipation symptoms are the primary concern. In these instances, suture rectopexy is preferred, as placement of synthetic mesh in a field where the gastrointestinal tract has been violated increases the likelihood of infectious complications.^{8,66} Some evidence suggests suture rectopexy and resection rectopexy have similar outcomes, thus negating the need for sigmoid resection in patients who do not report significant constipation

symptoms and whose predominant complaint was fecal incontinence preoperatively.^{63,67}

Posterior Mesh Rectopexy

Posterior mesh rectopexy is performed by mobilizing the pelvic peritoneum followed by circumferential dissection of the rectum distally to the levator ani musculature. The sacral promontory is exposed and a biologic or synthetic mesh is sutured in place. The rectum is retracted proximally reducing redundancies in the rectum. The mesh is then used to encircle the rectum leaving approximately one-third of the circumference free anteriorly. This prevents stricture formation and ensures appropriate distention of the rectum. The mesh is carefully sutured to the lateral rectum without taking full-thickness bites. The fibrosis induced by the placement of the mesh is intended to restore the anatomic location of the rectum in the pelvis in an effort to restore optimal function.⁶⁸

Posterior mesh rectopexy can be performed via open or laparoscopic technique. Laparoscopic technique is preferred as it is associated with decreased postoperative pain and decreased hospital length of stay as well as decreased intraoperative blood loss. Laparoscopic repair produces similar outcomes to open repair. Recurrence rates are frequently cited at approximately 3%. Additionally, improvement of fecal incontinence postoperatively occurs in 3 to 40% of patients with low mortality rates.⁶³

Posterior mesh rectopexy is fraught with high rates of *de novo* constipation as well as worsening of preexistent constipation postoperatively. When compared with suture rectopexy, the procedures demonstrate similar outcomes with a nonstatistically significant trend toward lower rates of constipation with suture rectopexy alone.⁶⁸

The concern for erosion of pelvic mesh and pelvic sepsis, with rates being cited at 2 to 16%, has encouraged the increased use of biologic mesh in this and other pelvic floor procedures.^{36,69} The relative resistance to infection of the biologic meshes allows mesh rectopexy to be combined with sigmoid colectomy for patients with a redundant sigmoid colon and constipation.³⁷ The addition of the sigmoid colectomy greatly reduces preexistent constipation. One other concern is the risk of bowel adhesion to the mesh and resultant small bowel obstruction. Given the relative decrease in adhesiogenesis associated with biologic materials, this may be another reason to favor a biologic prosthetic in this circumstance.

Total Pelvic Mesh Repair

Sullivan et al described the use of synthetic mesh to resuspend and support prolapsing pelvic organs without the necessity of resection using a total pelvic mesh repair.²³ Total pelvic mesh repair involves the excision of the associated enterocele sac, with attachment of one end of a synthetic mesh to the perineal body, with the other end attached to the periosteum of the second sacral vertebrae. The vagina and rectum are sutured to this prosthesis. The rectovaginal septum is reinforced and any rectocele, enterocele, vaginal or rectal prolapse, or excessive perineal descent present is corrected. Additional strips can be secured between the

Fig. 1 Technique of total pelvic mesh repair.

sacroperineal prosthesis and iliopubic ligaments on either side to provide support for the bladder.

Results of pelvic restoration using this method showed improvement in symptoms of obstructed defecation and constipation in 83 and 89% of patients, respectively. Continence was improved in 85% of patients with preoperative fecal incontinence. Dyspareunia was reported in 3% of patients. Overall, 74% of patients were either satisfied or very satisfied with the surgical results after 6 years of follow-up.²³ Infection or erosion of the prosthesis is a major concern occurring in up to 11% of patients,^{23,70,71} necessitating either partial or complete removal of the mesh. Additional procedures for persistent, symptomatic low rectocele, or rectal mucosal prolapse are necessary for 28% of patients.²³ This high mesh-related complication rate and need for additional procedures limited the widespread use of this technique.

In our department, a modification of this technique was adopted in 2004. The modifications included the use of a bioprosthetic instead of a synthetic mesh and the addition of

either a sigmoid colectomy or, in the event of colonic hypomotility, a total abdominal colectomy (►Fig. 1). This modified total pelvic mesh repair was performed in 36 women: 28 with sigmoid colectomy and 8 with total abdominal colectomy. No patient had a mesh-related complication. Within 12 months, four patients, all after sigmoid colectomy, complained of continuing constipation. Repeat defecography revealed no recurrent or residual pelvic organ prolapse. All of these patients had abnormal transit studies and underwent total abdominal colectomy with ileorectostomy. An anastomotic leak with abscess formation occurred in one of these patients, requiring temporary fecal diversion. No other patients had any other surgical intervention related to pelvic floor prolapse. The BBUSQ results were obtained preoperatively and prior to any secondary surgical procedures or at 12 months for this cohort. Long-term follow-up (mean 52 months [range, 36–68 months]) was available for 24 patients. Both the 12-month and longer-term data are shown in ►Table 2. Overall, compared with preoperatively, there is improvement in all five obstructed defecation parameters without detriment in any of the continence parameters.⁷²

Ventral Mesh Rectopexy

Anterior placement of the mesh again gained popularity when advocated by D'Hoore et al as a means of reducing the morbidity associated with posterior mobilization. By abandoning posterior mobilization, preserving the lateral stalks, and performing a complete distal mobilization of the anterior rectum from the rectovaginal septum to the pelvic floor muscles with fixation to the sacral promontory, a reduction in postoperative constipation and improvement in fecal incontinence was demonstrated.⁷³ Furthermore, ventral mesh rectopexy has a comparable risk of recurrence of the prolapse. The addition of mesh and closure of the rectovaginal space provides the additional benefits of correcting coexistent rectoceles, vaginal prolapse, and enteroceles.^{74,75}

Ventral mesh rectopexy can be performed by open techniques using a low transverse Pfannenstiel incision, laparoscopically or using robotic surgery techniques. The patient is

Table 2 Average BBUSQ-22 scores in patients undergoing TPMR

Question	Average score $\pm$ SD (preoperative)	Average score $\pm$ SD (12-mo follow-up)	Average score $\pm$ SD (final follow-up)	p-Value (preoperative vs. final follow-up)
1	3.18 $\pm$ 0.48	1.68 $\pm$ 1.04	1.52 $\pm$ 0.73	< 0.01
2	3.01 $\pm$ 0.68	1.98 $\pm$ 0.97	1.57 $\pm$ 0.95	< 0.01
3	2.87 $\pm$ 0.70	1.88 $\pm$ 0.44	1.20 $\pm$ 0.12	< 0.01
4	3.76 $\pm$ 0.31	2.98 $\pm$ 1.24	2.42 $\pm$ 0.84	< 0.05
5	1.87 $\pm$ 1.09	1.76 $\pm$ 1.12	1.75 $\pm$ 1.38	NS
6	2.88 $\pm$ 1.17	1.96 $\pm$ 1.17	1.24 $\pm$ 0.64	< 0.05
7	2.21 $\pm$ 0.81	2.53 $\pm$ 1.11	1.76 $\pm$ 0.96	NS
8	2.13 $\pm$ 1.00	1.39 $\pm$ 1.27	2.55 $\pm$ 0.54	NS
9	2.07 $\pm$ 1.26	2.33 $\pm$ 1.47	1.97 $\pm$ 1.22	NS

Abbreviations: NS, nonsignificant; SD, standard deviation; TPMR, total pelvic mesh repair.

placed in modified lithotomy position. Steep Trendelenburg positioning helps expose the pelvic organs and retract the small bowel cephalad. The rectosigmoid is retracted to the left to expose the peritoneum. The right ureter is identified along the right pelvic sidewall. The right-side peritoneum is incised at the level of the sacral promontory continuing downward at the midpoint between the rectum and sidewall to the level of the pelvic floor. Using dilators in the vagina and rectum, the rectovaginal septum is dissected and the peritoneum over the pouch of Douglas is excised to expose the anterior rectum to 2 to 3 cm above the dentate line, confirmed by digital rectal examination.^{3,76}

Synthetic or biologic mesh is secured to the pelvic floor muscle laterally and the anterior rectal wall using sutures. Care is taken to avoid full-thickness suture placement. The sacral promontory is exposed and sutures or tacks are used to secure the mesh to the sacrum. The peritoneum is then closed with running absorbable sutures.^{3,7,76}

By eliminating the dissection of the lateral stalks and the posterior rectum, the autonomic nerves supplying the rectum are theoretically preserved.⁷⁷ Additionally, if concomitant rectocele or enterocele is present, the posterior vaginal fornix can be elevated and the paracolpium fixed to the same mesh, allowing closure of the rectovaginal septum and correction of vaginal vault descent.^{75,78}

Ventral mesh rectopexy has gained momentum as the procedure of choice for the correction of pelvic organ prolapse. Samaranayake et al performed a systematic review of ventral mesh rectopexy and identified 12 non-randomized case series with a total of 728 patients. Recurrence rates for pelvic organ prolapse across all studies were estimated at 3.4% (95% CI, 2.0–4.8%). Complication rates varied from 14 to 47%, with urinary tract infection and incisional hernia most common. Studies that used ventral mesh rectopexy without posterior rectal mobilization reported a greater reduction in postoperative constipation and lower rates of new-onset constipation compared with studies that combined ventral mesh rectopexy with posterior rectal mobilization. The overall mean decrease in fecal incontinence after ventral rectopexy was 44.9% (CI, 6.4–22.3%). Perioperative morbidity was 4.8% with no mortality. At a median follow-up of 29 (4–59) months, there was a significant decrease in vaginal discomfort (86–20%) and obstructed defecation symptoms (83–46%) ($p < 0.001$). There was no worsening of preoperative symptoms or new complaints of constipation, dyspareunia, or fecal incontinence. Overall, 88% of patients reported an improvement in overall well-being.⁷⁹

Mesh-related complications occurred in 16% of patients and included mesh infection leading to sepsis, vaginal mesh erosion, and mesh detachment.⁴⁰ All mesh-related complications occurred in series that employed synthetic meshes. Another study by Smart et al performed a systematic review of 767 patients who had a repair with synthetic mesh and 99 with a biological implant. Their study demonstrated that there was no difference in recurrence (3.7 vs 4.0%, $p = 0.78$) or mesh complications (0.7 vs 0%, $p = 1.0$) between synthetic and biological mesh repair.⁴⁰

The conflicting data regarding the complications of mesh erosion and pelvic sepsis have intensified the debate over which mesh material would be best suited for use in ventral mesh rectopexy. Short-term evidence exists for the safety and efficacy of biological materials; however, there is no long-term evidence regarding the efficacy of biologic meshes in the treatment of pelvic floor disease.³⁹ Although long-term evidence and well-powered randomized trials are needed to fully define the roles of the various meshes in ventral mesh rectopexy, one consensus panel has recommended biologic implants for the patients described in ►Table 3.⁸⁰

Conclusion

In conclusion, the decision about the appropriate modality for the surgical management of pelvic floor disease is dependent on surgeon preference and appropriate patient selection. However, several trends have appeared as viable strategies for the operative treatment of pelvic organ prolapse. The transvaginal, transrectal, and transperineal methods are less attractive due to the high recurrence rates. The addition of synthetic mesh to reinforce the repair risks the dreaded complications of the mesh erosion and chronic pelvic pain. The abdominal approach in good risk patients has emerged as the preferred method of correction with the local approaches reserved for patients whose comorbidities or overall health precludes an abdominal procedure.

Ventral mesh rectopexy with avoidance of a posterior rectal dissection has emerged as a potentially favored trans-abdominal option for correction of pelvic organ prolapse. The procedure provides a single solution to several problems including rectal and vaginal prolapse, rectocele, enterocele, and abnormal perineal descent with a decreased risk of de novo constipation. Long-term evidence must be accumulated to further demonstrate the benefits of this technique. The choice of the prosthetic to be used in a ventral mesh rectopexy is the remaining area of controversy. The relative low costs of the synthetic prosthetics are attractive but there are serious safety concerns with these devices, while the long-term efficacy of biologic materials in pelvic floor repair has yet to be defined and the increased cost of the bioprosthesis is of concern. To assist in the selection from the available options, the concept of value has been developed. Value consist of three components: safety, efficacy, and cost. In

Table 3 Selection criteria for use of biologic implants

Patient characteristics
Young patients
Women of reproductive age
Diabetics
Smokers
Patients with a history of previous pelvic radiation and inflammatory bowel disease
Contaminated fields with intraoperative breach of the rectum or vagina

the value equation, safety is of utmost priority. If an acceptable safety profile cannot be achieved with a product or procedure, its use will not be justified. After safety concerns have been addressed, efficacy becomes important. Only after safety and efficacy have been demonstrated does cost become a factor. If you apply the value equation to the choice of a prosthetic, the safety profile of the bioprosthesis clearly gives them the advantage for the surgical management of pelvic organ prolapse. The questions relating to long-term efficacy remain and the increased cost is of concern but should not be barriers to the use these devices for the surgical management of pelvic organ prolapse.

References

- 1 Brodén B, Snellman B. Proctodentia of the rectum studied with cineradiography. A contribution to the discussion of causative mechanism. *Dis Colon Rectum* 1968;11(5):330–347
- 2 Cadeddu F, Sileri P, Grande M, De Luca E, Franceschilli L, Milito G. Focus on abdominal rectopexy for full-thickness rectal prolapse: meta-analysis of literature. *Tech Coloproctol* 2012;16(1):37–53
- 3 Cullen J, Rosselli JM, Gurland BH. Ventral rectopexy for rectal prolapse and obstructed defecation. *Clin Colon Rectal Surg* 2012; 25(1):34–36
- 4 Tou S, Brown SR, Malik AI, Nelson RL. Surgery for complete rectal prolapse in adults. *Cochrane Database Syst Rev* 2008; ((4): CD001758
- 5 Varma M, Rafferty J, Buie WD; Standards Practice Task Force of American Society of Colon and Rectal Surgeons. Practice parameters for the management of rectal prolapse. *Dis Colon Rectum* 2011;54(11):1339–1346
- 6 Bordeianou L, Hicks CW, Kaiser AM, Alavi K, Sudan R, Wise PE. Rectal prolapse: an overview of clinical features, diagnosis, and patientspecific management strategies. *J Gastrointest Surg* 2014; 18(5):1059–1069
- 7 Formijne Jonkers HA, van de Haar HJ, Draaisma WA, Heggelman BG, Consten EC, Broeders IA. The optimal strategy for proximal mesh fixation during laparoscopic ventral rectopexy for rectal prolapse: an ex vivo study. *Surg Endosc* 2012;26(8): 2208–2212
- 8 Laubert T, Kleemann M, Roblick UJ, et al. Obstructive defecation syndrome: 19 years of experience with laparoscopic resection rectopexy. *Tech Coloproctol* 2013;17(3):307–314
- 9 Jones OM, Cunningham C, Lindsey I. The assessment and management of rectal prolapse, rectal intussusception, rectocele, and enterocoele in adults. *BMJ* 2011;342:c7099
- 10 Bump RC, Norton PA. Epidemiology and natural history of pelvic floor dysfunction. *Obstet Gynecol Clin North Am* 1998;25(4): 723–746
- 11 Chen B, Wen Y, Zhang Z, Wang H, Warrington JA, Polan ML. Menstrual phase-dependent gene expression differences in periurethral vaginal tissue from women with stress incontinence. *Am J Obstet Gynecol* 2003;189(1):89–97
- 12 Poncet S, Meyer S, Richard C, Aubert JD, Juillerat-Jeanneret L. The expression and function of the endothelin system in contractile properties of vaginal myofibroblasts of women with uterovaginal prolapse. *Am J Obstet Gynecol* 2005;192(2):426–432
- 13 Kerkhof MH, Hendriks L, Brölmann HA. Changes in connective tissue in patients with pelvic organ prolapse—a review of the current literature. *Int Urogynecol J Pelvic Floor Dysfunct* 2009; 20(4):461–474
- 14 Hendrix SL, Clark A, Nygaard I, Aragaki A, Barnabei V, McTiernan A. Pelvic organ prolapse in the Women's Health Initiative: gravity and gravidity. *Am J Obstet Gynecol* 2002;186(6):1160–1166
- 15 Dietz HP, Wilson PD. Childbirth and pelvic floor trauma. *Best Pract Res Clin Obstet Gynaecol* 2005;19(6):913–924
- 16 Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. *Obstet Gynecol* 1997;89(4):501–506
- 17 Hiller L, Bradshaw HD, Radley SC, Radley S. A scoring system for the assessment of bowel and lower urinary tract symptoms in women. *BJOG* 2002;109(4):424–430
- 18 Hiller L, Radley S, Mann CH, et al. Development and validation of a questionnaire for the assessment of bowel and lower urinary tract symptoms in women. *BJOG* 2002;109(4):413–423
- 19 Rutter KRP. Solitary rectal ulcer syndrome; its relation to mucosal prolapse. *J Clin Gastroenterol* 1985;4:505–530
- 20 Oettle GJ, Roe AM, Bartolo DC, Mortensen NJ. What is the best way of measuring perineal descent? A comparison of radiographic and clinical methods. *Br J Surg* 1985;72(12):999–1001
- 21 Snooks SJ, Setchell M, Swash M, Henry MM. Injury to innervation of pelvic floor sphincter musculature in childbirth. *Lancet* 1984; 2(8402):546–550
- 22 Lubowski DZ, Jones PN, Swash M, Henry MM. Asymmetrical pudendal nerve damage in pelvic floor disorders. *Int J Colorectal Dis* 1988;3(3):158–160
- 23 Sullivan ES, Longaker CJ, Lee PYH. Total pelvic mesh repair: a ten-year experience. *Dis Colon Rectum* 2001;44(6):857–863
- 24 Lahr SJ, Lahr CJ, Srinivasan A, Clerico ET, Limehouse VM, Serbezov IK. Operative management of severe constipation. *Am Surg* 1999; 65(12):1117–1121, discussion 1122–1123
- 25 Brown AJ, Anderson JH, McKee RF, Finlay IG. Strategy for selection of type of operation for rectal prolapse based on clinical criteria. *Dis Colon Rectum* 2004;47(1):103–107
- 26 Formijne Jonkers HA, Draaisma WA, Wexner SD, et al. Evaluation and surgical treatment of rectal prolapse: an international survey. *Colorectal Dis* 2013;15(1):115–119
- 27 Senapati A, Gray RG, Middleton LJ, et al; PROSPER Collaborative Group. PROSPER: a randomised comparison of surgical treatments for rectal prolapse. *Colorectal Dis* 2013;15(7):858–868
- 28 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(5):826–830
- 29 Smart NJ, Bryan N, Hunt JA. A scientific evidence for the efficacy of biologic implants for soft tissue reconstruction. *Colorectal Dis* 2012;14(3, Suppl 3):1–6
- 30 Hübner M, Streit D, Hahnloser D. Biological materials in colorectal surgery: current applications and potential for the future. *Colorectal Dis* 2012;14(3, Suppl 3):34–39
- 31 Shah BC, Tiwari MM, Goede MR, et al. Not all biologics are equal!. *Hernia* 2011;15(2):165–171
- 32 Cornu JN, Peyrat L, Haab F. Update in management of vaginal mesh erosion. *Curr Urol Rep* 2013;14(5):471–475
- 33 Birch C. The use of prosthetics in pelvic reconstructive surgery. *Best Pract Res Clin Obstet Gynaecol* 2005;19(6):979–991
- 34 Huebner M, Hsu Y, Fenner DE. The use of graft materials in vaginal pelvic floor surgery. *Int J Gynaecol Obstet* 2006;92(3):279–288
- 35 Baessler K, Maher CF. Mesh augmentation during pelvic-floor reconstructive surgery: risks and benefits. *Curr Opin Obstet Gynecol* 2006;18(5):560–566
- 36 Mathew MJ, Parmar AK, Reddy PK. Mesh erosion after laparoscopic posterior rectopexy: A rare complication. *J Minim Access Surg* 2014;10(1):40–41
- 37 Ahmad M, Sileri P, Franceschilli L, Mercer-Jones M. The role of biologics in pelvic floor surgery. *Colorectal Dis* 2012; 14(3, Suppl 3):19–23
- 38 Smart NJ, Daniels IR. Biologic meshes in colorectal surgery. *Colorectal Dis* 2012;14(3, Suppl 3):iii–iv
- 39 Sileri P, Franceschilli L, de Luca E, et al. Laparoscopic ventral rectopexy for internal rectal prolapse using biological mesh: postoperative and short-term functional results. *J Gastrointest Surg* 2012;16(3):622–628

- 40 Smart NJ, Pathak S, Boorman P, Daniels IR. Synthetic or biological mesh use in laparoscopic ventral mesh rectopexy—a systematic review. *Colorectal Dis* 2013;15(6):650–654
- 41 Zbar AP, Lienemann A, Fritsch H, Beer-Gabel M, Pescatori M. Rectocele: pathogenesis and surgical management. *Int J Colorectal Dis* 2003;18(5):369–384
- 42 Armitage S, Seman EI, Keirse MJ. Use of surgisis for treatment of anterior and posterior vaginal prolapse. *Obstet Gynecol Int* 2012; 2012:376251
- 43 Frankman EA, Alperin M, Sutkin G, Meyn L, Zyczynski HM. Mesh exposure and associated risk factors in women undergoing transvaginal prolapse repair with mesh. *Obstet Gynecol Int* 2013; 2013:926313
- 44 Maher C, Feiner B, Baessler K, Adams EJ, Hagen S, Glazener CM. Surgical management of pelvic organ prolapse in women. *Cochrane Database Syst Rev* 2010;18(4):CD004014
- 45 Maher C, Baessler K, Glazener CM, Adams EJ, Hagen S. Surgical management of pelvic organ prolapse in women: a short version Cochrane review. *Neurourol Urodyn* 2008;27(1):3–12
- 46 Maher C, Baessler K. Surgical management of posterior vaginal wall prolapse: an evidence-based literature review. *Int Urogynecol J Pelvic Floor Dysfunct* 2006;17(1):84–88
- 47 Bako A, Dhar R. Review of synthetic mesh-related complications in pelvic floor reconstructive surgery. *Int Urogynecol J Pelvic Floor Dysfunct* 2009;20(1):103–111
- 48 Marks BK, Goldman HB. What is the gold standard for posterior vaginal wall prolapse repair: mesh or native tissue? *Curr Urol Rep* 2012;13(3):216–221
- 49 Paraiso MFR, Barber MD, Muir TW, Walters MD. Rectocele repair: a randomized trial of three surgical techniques including graft augmentation. *Am J Obstet Gynecol* 2006;195(6):1762–1771
- 50 Kahn MA, Stanton SL, Kumar DA. Randomized prospective trial of posterior colporrhaphy vs transanal repair of rectocele: preliminary findings. *Int Urogynecol J* 1997;8:246–247
- 51 Roman H, Michot F. Long-term outcomes of transanal rectocele repair. *Dis Colon Rectum* 2005;48(3):510–517
- 52 Ayabaca SM, Zbar AP, Pescatori M. Anal continence after rectocele repair. *Dis Colon Rectum* 2002;45(1):63–69
- 53 Watson SJ, Loder PB, Halligan S, Bartram CI, Kamm MA, Phillips RK. Transperineal repair of symptomatic rectocele with Marlex mesh: a clinical, physiological and radiologic assessment of treatment. *J Am Coll Surg* 1996;183(3):257–261
- 54 Ellis CN. Outcomes after the repair of rectoceles with transperineal insertion of a bioprosthetic graft. *Dis Colon Rectum* 2010;53(2): 213–218
- 55 Altman D, Zetterström J, Mellgren A, Gustafsson C, Anzén B, López A. A three-year prospective assessment of rectocele repair using porcine xenograft. *Obstet Gynecol* 2006;107(1):59–65
- 56 Wijffels N, Cunningham C, Dixon A, Greenslade G, Lindsey I. Laparoscopic ventral rectopexy for external rectal prolapse is safe and effective in the elderly. Does this make perineal procedures obsolete? *Colorectal Dis* 2011;13(5):561–566
- 57 Schiedeck THK, Schwandner O, Scheele J, Farke S, Bruch HP. Rectal prolapse: which surgical option is appropriate? *Langenbecks Arch Surg* 2005;390(1):8–14
- 58 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(10): 1242–1247
- 59 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(8):e469–e475
- 60 Kairaluoma MV, Viljakka MT, Kellokumpu IH. Open vs. laparoscopic surgery for rectal prolapse: a case-controlled study assessing short-term outcome. *Dis Colon Rectum* 2003;46(3): 353–360
- 61 Cullen J, Rosselli JM, Gurland BH. Ventral rectopexy for rectal prolapse and obstructed defecation. *Clin Colon Rectal Surg* 2012; 25(1):34–36
- 62 Novell JR, Osborne MJ, Winslet MC, Lewis AAM. Prospective randomized trial of Ivalon sponge versus sutured rectopexy for full-thickness rectal prolapse. *Br J Surg* 1994;81(6):904–906
- 63 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(4):1062–1064
- 64 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(5):638–643
- 65 Aitola PT, Hiltunen KM, Matikainen MJ. Functional results of operative treatment of rectal prolapse over an 11-year period: emphasis on transabdominal approach. *Dis Colon Rectum* 1999; 42(5):655–660
- 66 Luukkonen P, Mikkonen U, Järvinen H. Abdominal rectopexy with sigmoidectomy vs. rectopexy alone for rectal prolapse: a prospective, randomized study. *Int J Colorectal Dis* 1992;7(4):219–222
- 67 Hsu A, Brand MI, Saclarides TJ. Laparoscopic rectopexy without resection: a worthwhile treatment for rectal prolapse in patients without prior constipation. *Am Surg* 2007;73(9):858–861
- 68 Sahoo MR, Thimmegowda AK, Gowda MS. A single centre comparative study of laparoscopic mesh rectopexy versus suture rectopexy. *J Minim Access Surg* 2014;10(1):18–22
- 69 Athanasiadis S, Weyand G, Heiligers J, Heumüller L, Barthelmes L. The risk of infection of three synthetic materials used in rectopexy with or without colonic resection for rectal prolapse. *Int J Colorectal Dis* 1996;11(1):42–44
- 70 Visco AG, Weidner AC, Barber MD, et al. Vaginal mesh erosion after abdominal sacral colpopexy. *Am J Obstet Gynecol* 2001;184(3): 297–302
- 71 Iglesia CB, Fenner DE, Brubaker L. The use of mesh in gynecologic surgery. *Int Urogynecol J Pelvic Floor Dysfunct* 1997;8(2):105–115
- 72 Ellis C. Functional outcomes with a total pelvic mesh repair using bioprosthesis for management of pelvic floor prolapse. *Dis Colon Rectum* 2011;54:5
- 73 D'Hoore A, Cadoni R, Penninckx F. Long-term outcome of laparoscopic ventral rectopexy for total rectal prolapse. *Br J Surg* 2004; 91(11):1500–1505
- 74 Wong M, Meurette G, Abet E, Podevin J, Lehur PA. Safety and efficacy of laparoscopic ventral mesh rectopexy for complex rectocele. *Colorectal Dis* 2011;13(9):1019–1023
- 75 D'Hoore A, Penninckx F. Laparoscopic ventral recto(colpo)pepy for rectal prolapse: surgical technique and outcome for 109 patients. *Surg Endosc* 2006;20(12):1919–1923
- 76 Sileri P, Capuano I, Franceschilli L, Giorgi F, Gaspari AL. Modified laparoscopic ventral mesh rectopexy. *Tech Coloproctol* 2014; 18(6):591–594
- 77 Portier G, Kirzin S, Cabarro 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(8):914–917
- 78 D'Hoore A, Vanbeckevoort D, Penninckx F. Clinical, physiological and radiological assessment of rectovaginal septum reinforcement with mesh for complex rectocele. *Br J Surg* 2008;95(10):1264–1272
- 79 Samaranyake CB, Luo C, Plank AW, Merrie AEH, Plank LD, Bissett IP. Systematic review on ventral rectopexy for rectal prolapse and intussusception. *Colorectal Dis* 2010;12(6):504–512
- 80 Mercer-Jones MA, D'Hoore A, Dixon AR, et al. Consensus on ventral rectopexy: report of a panel of experts. *Colorectal Dis* 2014;16(2): 82–88