

# Familial Adenomatous Polyposis: Challenges and Pitfalls of Surgical Treatment

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## Abstract

### Keywords

- ▶ familial adenomatous polyposis
- ▶ total proctocolectomy
- ▶ colorectal surgery

Surgical management of familial adenomatous polyposis (FAP) is complex and requires both sound judgment and technical skills. Because colorectal cancer risk approaches 100%, prophylactic colorectal surgery remains a cornerstone of management. Both patient factors and disease characteristics influence surgical decision-making regarding the timing of prophylactic surgery, the extent of resection, and types of reconstruction. Making appropriate choices can be challenging and there is continued debate regarding optimal strategies. This chapter reviews the controversies in colorectal surgery for FAP.

**Objectives:** On completion of this article, the reader should be able to rationalize surgical decisions for colorectal neoplasia in patients with familial adenomatous polyposis.

Familial adenomatous polyposis (FAP) is an autosomal dominant disease caused by a germline mutation in the APC gene.<sup>1</sup> Prophylactic colorectal surgery aims to reduce the future risk of colorectal carcinoma (CRC), which is guaranteed to develop without surgical intervention.<sup>2</sup> Various aspects of surgical decision-making are driven by both surgeon and patient factors. Key questions include the following: When is surgery recommended? Should the rectum be removed or is it safe to leave it behind? Should a mucosectomy be performed? What type of anastomosis is better? Although colorectal adenomas dominate the clinical phenotype, FAP is a multisystem disease and extracolonic manifestations such as desmoid and duodenal disease cause significant morbidity and mortality. This article focuses only on some of the treatment challenges in FAP with a focus on surgery for colorectal neoplasia. Both surgical decision-making and surgical technique are addressed.

## Timing of Surgery

As colorectal cancer incidence approaches 100% in FAP, colectomy is the cornerstone of treatment. The optimal time in one's life to have that surgery is an individual decision.

Cancer is rare before the age of 20 years<sup>3</sup> and deferring surgery to the late teen years until after physical, emotional, and social maturation, is a reasonable option for the asymptomatic patient. Many patients will choose a time of transition in education or employment as the time for surgery. For example, patients often choose to have surgery before starting college, or after completing college but before starting a new job. Patients who develop symptoms such as bleeding or obstruction have a higher incidence of colorectal cancer,<sup>4</sup> and surgical management is recommended at the time of presentation. Certain patient circumstances may favor delaying surgical intervention. For example, given the decrease in fecundity following pelvic surgery,<sup>5</sup> young females who would require a proctocolectomy may consider deferring surgery until after their family is complete. Morbid obesity presents another situation in which surgery may be postponed if it is possible for the patient to lose weight and thus make ileal pouch-anal formation more feasible. The presence or risk of abdominal desmoids may also be considered in determining the timing of surgery. As desmoids formation typically follows surgery in those prone to developing desmoids, it may be prudent to delay surgery as long as possible in these patients. None of these conditions are absolute and patient safety remains the most important issue. Deferral of surgery should only be done in patients who are asymptomatic, motivated, and adherent to surveillance protocols.

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## Extent of Surgical Resection: Proctocolectomy vs. Colectomy and Ileorectal Anastomosis

The primary goals of colorectal surgery in FAP are cancer prevention and treatment, and maximizing quality of life. As colorectal surgery is preemptive and often in young patients, there are increasing patient expectations for technical perfection.<sup>6</sup> The extent of resection relies on a balance of reducing future cancer risk while preserving bowel function and quality of life. Surgical options include total proctocolectomy (TPC; with restoration of gastrointestinal tract or with end ileostomy) or colectomy with ileorectal anastomosis (IRA). Each option has both oncologic and functional implications. Although colectomy and IRA maintains better bowel function, there is cancer risk associated with the remaining rectum. Conversely, restorative TPC with ileal pouch anal anastomosis (IPAA) nearly eliminates colorectal cancer risk, but results in worse function compared to an IRA. The data behind each of these arguments is presented below.

### Future Neoplasia Risk

Attempts to quantify rectal cancer risk following an IRA can be divided between the prepouch (1983) and the pouch eras. Essentially, before IPAA became a viable option for treatment of FAP, surgical choices included TPC and end ileostomy or colectomy and IRA. Given the alternative, patients and surgeons would often opt for IRA without much consideration of rectal adenoma burden and future cancer risk. Given the lack of appropriate patient selection, rectal cancer incidence following IRA in the prepouch era was unacceptably high. This is supported by a study from Cleveland Clinic that compared rates of proctectomy before and after the introduction of IPAA. The completion proctectomy rate following 62 IRA operations in the prepouch era was nearly 33% at a median time of 212 months.<sup>7,8</sup> Of 135 IRAs in the pouch era (median follow-up 60 months), only 2% required subsequent proctectomy. This trend was also demonstrated in European studies that mirror other historical data.<sup>9</sup> The group from St. Mark's Hospital in London reports similar rates of rectal cancer.<sup>10</sup> Of 89 patients undergoing IRA for FAP, only two developed subsequent rectal cancer. Surgical practices have changed with the introduction of IPAA as an option and more appropriate patients can be selected for an IRA. In fact, a lower percentage of patients are being treated by IRA, but they are selected more carefully to represent a group that is at a lower risk for rectal cancer.<sup>8</sup>

Simple endoscopic evaluation of the rectum can help stratify future rectal cancer risk. Colectomy and ileorectal anastomosis for FAP is the preferred operation if the rectum is relatively spared. Less than five rectal adenomas at initial presentation nearly always correlates with mild disease and an ileorectal anastomosis is appropriate.<sup>11</sup> Conversely, 20 or more rectal adenomas implies severe disease and proctectomy is recommended. The colonic adenoma burden also has clinical implications for future rectal cancer risk. In a single institution study, 95 patients with less than 20 rectal adenomas and less than 1000 colon polyps were followed for a

median of 12 years after IRA and none required proctectomy. On the other hand, 33 patients who had what was considered a significant colon and rectal polyp burden (>1000, >20 polyps, respectively) underwent an IRA and 56% subsequently required proctectomy.<sup>11</sup>

In addition to polyp phenotype, genotype provides important information regarding risk of future rectal cancer development.<sup>12</sup> There is a genotype-phenotype correlation in FAP with the location of the mutation predicting severity of disease. Wu and colleagues showed that *APC* mutations at codon 1309 and 1328 predicted severe polyposis and were independent risk factors for secondary proctectomy following TAC for FAP.<sup>13</sup> Other studies have reported similar findings.<sup>7,14</sup> In a small Italian study, the natural history of patients following colectomy and IRA were reviewed. All patients were selected for IRA based on well-defined endoscopic criteria. Importantly, three patients with a small rectal polyp burden required proctectomy. All had mutations at 1309. Two of these patients had less than 10 rectal polyps and one had less than 30 rectal polyps at the time of colectomy, but all subsequently developed carpeting rectal polyposis requiring proctectomy.<sup>15</sup> Mutations at the 5' and 3' ends of the *APC* gene are associated with attenuated polyposis.<sup>14</sup> As the polyp burden is less and cancer onset later in life, patients with attenuated FAP are usually best treated by IRA.

Proponents of proctocolectomy for FAP argue that future CRC risk can be eliminated by removing the rectum at surgery.<sup>16</sup> Theoretically, every single colorectal epithelial cell carries the *APC* mutation and potentially can transform to adenocarcinoma and thus should be removed.<sup>17</sup> Importantly, however, adenomas and carcinomas can develop in patients who have undergone proctocolectomy for FAP.<sup>18</sup> Neoplasia occurs within the ileal pouch, in the anal transition zone, and even in the ileum. The combination of fecal stasis and the *APC* gene germline mutation, can promote adenoma formation. This risk is time-dependent and at 7 years there is a 42% risk of pouch polyposis following proctectomy.<sup>19</sup> Adenomas have also been noted in the ileum following an IRA. Adenocarcinomas have also been found following IPAA and in end ileostomies. For this reason, annual endoscopic surveillance of the reservoir, terminal ileum, anastomosis, and ATZ is important.<sup>20,21</sup>

Importantly, two other phenomena should be mentioned. First, spontaneous rectal polyp regression following IRA occurs in up to 64% of patients with the majority occurring in the first decade following surgery.<sup>22,23</sup> This effect seems to be reversed after 10 years and annual surveillance is still required even in early follow-up as initial polyp regression does not prevent future development of rectal adenomas and cancer.<sup>23</sup> Second, IPAA is still possible with comparable outcomes when done as a completion proctectomy following an initial IRA.<sup>24,25</sup> Bjork and colleagues compared 120 patients who had undergone an initial IPAA with those who had undergone IPAA as a secondary procedure. Complications occurred in 40% of patients who underwent IPAA initially compared with 56% who underwent secondary IPAA. The functional outcomes were similar.<sup>26</sup>

### Surgical Morbidity and Functional Outcome

In addition to cancer risk, morbidity and quality of life should be considered. A meta-analysis of 12 observational studies comparing restorative proctocolectomy and colectomy and IRA showed similar rates of bowel obstruction, hemorrhage, intraabdominal sepsis, and anastomotic leak following either operation. However, IPAA was associated with an increased rate of 30-day reoperation<sup>27</sup> and worse functional outcome with regard to daily stool frequency and 24-hour incontinence.<sup>9</sup> No difference was observed in terms of nocturnal stool frequency and daytime incontinence. Pelvic surgery is associated with increased sexual and urinary dysfunction complications,<sup>28</sup> decreased fecundity in females,<sup>5</sup> risk of impotence in men, and reduced quality of life scores following IPAA compared with IRA.<sup>29</sup> The fact that many of these surgeries are in young patients, the potential complications can be even more devastating, and colectomy is favored if appropriate from an oncologic standpoint.

Any discussion with young female FAP patients about operative strategy must include discussions about fecundity. Fecundity is defined as the biological ability to conceive. In general, studies have been difficult to interpret due to inherent flaws and confounding factors in the published literature. A Scandinavian registry study reported a 50% reduction in fecundity following TPC compared with controls in patients with FAP.<sup>5</sup> This effect was not observed in patients who had undergone IRA.<sup>5</sup> The reduction in fecundity is attributed to the pelvic component of the surgery. It is conceivable that laparoscopy may reduce adhesions and thereby lessen the decreased fecundity in these patients, but this has not been proven.

### Patient Factors Determining Extent of Resection

Patient factors may also be considered in determining the extent of resection. For an example, one may be more inclined to offer an IRA to an obese male with a narrow pelvis where technically it is not possible to perform an IPAA, or in young female patients where fertility is desired. In the former case an IRA may be used as a bridge to lose weight prior to embarking on an IPAA, while in the latter patient a planned IPAA can be offered following cessation of reproduction. As discussed above, this should only be considered in patients without symptoms and who will be compliant with surveillance regimens.

### Impact of Desmoid Disease on Surgical Decision-Making

The utilization of appropriate endoscopic surveillance and prophylactic colectomy has prolonged FAP patient survival and thus the complications of extracolonic disease are becoming more prevalent.<sup>7</sup> Desmoid tumors and duodenal polyposis are major challenges facing these patients. Desmoids are a significant cause of morbidity and mortality in these patients arising from local effects such as bowel obstruction, perforation, and ureteric compression with subsequent renal failure.<sup>2</sup> Intraabdominal desmoid tumors in FAP can have varying presentations and while often a sequelae of surgery, have an incidental rate at primary surgery of 3%<sup>30</sup>

and an overall prevalence of 9 to 25%.<sup>31</sup> The presence or future risk of intraabdominal desmoids affects surgical decision making.

Susceptibility to desmoid formation can be suspected by family history and genotype and several factors have been collated into a desmoid risk factor score.<sup>32</sup> A 3' *APC* mutation, surgical intervention for FAP, age at surgery, and family history of desmoids have all been shown to be predictors of future desmoid occurrence.<sup>33</sup> Caspari et al reported that a genotype 3' to 1444 was associated with desmoids,<sup>34</sup> although this codon does not represent a functional component of the *APC* gene and others have suggested 3' *APC* to codon 1399 as a more appropriate cutoff.<sup>42</sup> Across several studies, family history has been shown to be an independent risk factor independent of genotype.<sup>35-37</sup> Some studies have also shown female gender to be an independent risk factor for desmoids in FAP.<sup>15,16,39,40</sup>

For patients that are prone to develop desmoids, it may be prudent to delay surgery as desmoid formation seems to follow surgical intervention; this approach is recommended by several authors.<sup>38-40</sup> Published guidelines suggest that the presence of intraabdominal desmoid tumors should prompt the surgeon to offer proctocolectomy and IPAA to alleviate concerns that a proctectomy and/or IPAA may not be able to be safely performed in the future.<sup>41</sup> A recent study from Cleveland Clinic challenges this dogma.<sup>42</sup> Although not easy, IPAA can still be performed after IRA in patients with desmoid disease. Church recently reported on 67 patients who needed proctectomy after IRA. All 67 patients were able to undergo successful proctectomy, even in the presence of intraabdominal tumors (unpublished data, presented at the meeting of the International Society of Gastrointestinal Hereditary Tumors; March 31–April 2, 2011; San Antonio, TX).

### Considerations for the Surgical Approach to Restorative Proctocolectomy

#### Mucosectomy and Handsewn Anastomosis vs. Stapled IPAA

For restorative proctocolectomy, how to manage the distal anorectal mucosa remains a debate. One of two basic approaches is followed. Mucosectomy was first described by Parks and Nichols who suggested removing the anorectal mucosa proximal to the dentate line and then perform a handsewn anastomosis.<sup>43</sup> The approach conceivably removes all at-risk mucosa; however, a potential pitfall described from this approach is incomplete mucosectomy where islands of rectal mucosa remain after the procedure. The alternative technique described by Heald et al in 1986, was to retain the anal mucosa and perform a stapled anastomosis.<sup>44</sup> This was championed as a method that was quicker to perform, with less manipulation of the anal sphincter mechanism, and therefore reduced the risk of postoperative continence problems. The relative benefits of each technique are the subject of debate.

In a series of 119 patients who were treated with an IPAA, 77 patients underwent a stapled anastomosis and 42 underwent a mucosectomy with handsewn IPAA. The mucosectomy

group experienced worse day and night seepage, incontinence rates, and increased pad usage compared with the stapled approach.<sup>45</sup> However, 28% of patients in the stapled group developed adenomas in the ATZ compared with a 14% neoplasia rate in the mucosectomy group. The authors concluded that functional outcome advantages outweighed the increased neoplasia risk. Those results are tempered by a follow-up study from the same institution where two cases of adenocarcinoma in the transitional zone developed at long-term follow-up.<sup>46</sup> However, one case occurred after a double-stapled anastomosis and one following mucosectomy; so neither technique is free from risk.

Recently published data from St. Mark's registry substantiate some of the earlier concerns of adenomas in the anorectal segment following stapled IPAA.<sup>47</sup> From 140 patients who underwent IPAA, 52 (37%) developed adenomas. Only 27% of the mucosectomy group developed adenomas compared with 54% in the stapled group. No difference was observed in patients who developed high-risk adenomas and a single patient developed a rectal cancer and subsequently died following mucosectomy and handsewn anastomosis. A meta-analysis by Lovegrove et al, including 21 studies and over 4000 patients, revealed worse nocturnal continence in the mucosectomy group compared with those in the stapled anastomosis group.<sup>48</sup> This correlated with anorectal physiology studies that showed a reduction in the resting and squeeze pressure in the handsewn group. No significant difference was observed in postoperative complications, the number of daily bowel movements, or the need for antimotility agents. The analysis did not seek to differentiate primary etiology and a subsequent meta-analysis by the same author showed worse functional outcomes following IPAA for ulcerative colitis compared with FAP. Since the conception of pouch surgery, only 30 years have lapsed.

There is no doubt that the debate will continue on which surgical technique should be offered as more long-term data emerges.

### Laparoscopy vs. Open Technique

Laparoscopic IPAA has been shown to be safe when compared with open surgery.<sup>49</sup> Larson et al presented a case-matched series of 300 patients with 100 laparoscopic cases demonstrating earlier return of bowel function, reduced requirements for narcotics, and equivocal complication rates.<sup>50</sup> The same author using a validated survey tool to address functional outcomes including sexual dysfunction, cosmesis, and quality of life found comparable outcomes in both groups.<sup>51</sup> A caution with that series is that there were a paucity of FAP cases in that study and the wider applicability of laparoscopy to FAP patients remains to be tested. A systematic review of laparoscopy compared to open IPAA including patients with FAP or ulcerative colitis revealed no difference in mortality or complications between the groups and reoperation and readmission rates were similar, although operative times were significantly longer with laparoscopy.<sup>52</sup> As expected, cosmesis scores in the review were considerably higher in the laparoscopic studies. Early case series have demonstrated that single incision laparoscopic IPAA can be performed safely

by well-trained laparoscopic surgeons.<sup>53</sup> Despite knowledge that laparoscopic colectomy and IRA is safe, cost effective, and cosmetically appealing for patients with FAP, there is limited data published on results specifically for patients with FAP. An initial series of 16 patients by Milsom et al demonstrated good short-term outcomes with FAP<sup>54</sup> and this has been substantiated by a recent comparative series from St. Mark's Hospital, where fewer complications were demonstrated in the laparoscopic group.<sup>55</sup>

### One-Stage vs. Two-Stage IPAA

A single institution study of 119 FAP patients revealed no significant difference in outcome between patients who underwent diverting loop ileostomy compared to those who had not. Interestingly, the study is biased in that it demonstrated an increased use of diverting ileostomy in handsewn rather than stapled IPAA. Every hand-sewn anastomosis was diverted, while only 47% of the stapled IPAA were diverted (37 of 77).<sup>23</sup> Creation of an ileostomy may have an adverse affect on the anastomosis by placing undo tension on the vascular pedicle. For example, with a shortened mesentery or a pouch that has difficulty with reach, pulling a loop ileostomy to the abdominal wall may be a challenge and create extra tension on the mesentery. This is particular relevant in obese patients and must be factored into any potential decision to defunction a pouch or not. Increased anastomotic separation rates are observed in obese patients following IPAA.<sup>56</sup> We favor the use of a diverting loop ileostomy to minimize the potential disastrous septic and functional consequences secondary to an anastomotic leak in a non-defunctioned pouch.

### Technical Tricks and Pitfalls in Colorectal Surgery for FAP

Colorectal surgery for FAP can be done using a laparoscopic or open approach. The principles are the same regardless of approach. As incidental adenocarcinoma is always possible in the setting of polyposis, we advocate a resection utilizing oncologic principles including minimal handling of the bowel and division of vessels close to the origin as a high ligation to maximize lymph node harvest. Upon entering the abdomen, it is critical to explore the peritoneal cavity for desmoid disease or potentially metastatic cancer. If the surgical choice is a colectomy and IRA, a simple colectomy is done using standard techniques and this is not discussed here. For a restorative proctocolectomy, several potential challenges and pitfalls exist during the rectal dissection and ileal pouch-anal anastomosis. After dividing the terminal ileum sharply, securing the colonic blood supply, and mobilizing the colon, the tubularized colon is retracted into the upper abdomen and attention is turned to the pelvic dissection. Observation and adherence to dissection along the plane of the fascia propria of the rectum is done in accordance with principles of total mesorectal excision. The hypogastric nerves are identified at the pelvic brim and are preserved as the dissection stays close to the fascia propria of the rectum following behind the plane of the divided superior rectal artery. The left ureter should

have been identified and preserved prior to division of the inferior mesenteric artery and its location is again confirmed before proceeding into the pelvis. Lighted pelvic retractors aid in the exposure and provide tension on the rectum to assist with the dissection in the proper planes. We approach the rectal dissection in the posterior midline first by entering the plane between the fascia propria of the rectum and the presacral fascia. Breaching the presacral fascia posteriorly can result in injury to the presacral veins and horrendous bleeding. Once down through the Waldeyer fascia posteriorly, attention is turned to the lateral dissection. The pelvic peritoneal attachments are opened bilaterally and the dissection moves anteriorly from each side. In the absence of a rectal cancer, the anterior dissection proceeds on the rectal side of the Denonvilliers fascia to avoid injury to the autonomic nerve plexus. As the dissection reaches the pelvic floor, the mesorectum naturally thins. If a doubled-stapled anastomosis is to be performed, the rectum is divided at this point. Our preference is to use an enclosed linear stapler with a restraining pin to prevent extrusion of the rectum during closure of the stapler. The stapler is placed perpendicular to the bowel wall and closed. After clamping the stapler across the anorectal junction, but before firing, a finger is placed in the anal canal to assess the level of division and to assure the absence of neoplasia in the remnant. During a digital rectal exam, resting the proximal interphalangeal joint at the anal verge usually corresponds to the finger tip located at the anorectal ring. Leaving too much of an anorectal remnant predisposes to pouch emptying difficulties and leaves more mucosa behind at risk for neoplasia. When properly using the double-stapled technique at the top of the anal canal, usually 1 to 2 cm of mucosa remains above the dentate line. Stapling too low into the anal canal risks incorporation of internal sphincter muscle during creation of the circular anastomosis.

Using a laparoscopic approach, placing a stapler at this level is often difficult, particularly in a narrow pelvis or in an obese patient. However, this cannot be compromised. One trick is to have an assistant apply perineal pressure to force the anorectal junction above the levator hiatus, which allows for the stapler to get into the anal canal. Ideally, the rectum should be divided with one firing of the stapler, but this is often not possible laparoscopically. To assist with this, the mesorectum should be completely thinned to the rectal wall. If it cannot be divided in a single fire, the second firing should be done at the same angle of approach so that the resected line is perpendicular to the bowel lumen. If this cannot be achieved laparoscopically, then a small Pfannenstiel or lower midline incision can be made and the stapler can be applied via a wound protector. It is essential not to compromise this part of the operation.

Due to improved functional outcomes and ease of surgery, we prefer to use the double-stapled technique. Potential complications can occur if the dissection is too low into the anal canal and the anastomosis actually divides a portion of internal sphincter muscle. During the end-to-end circular anastomosis, on closing the spike on the anvil, it must be assured that no other tissue is captured by the stapler.

Inadvertently incorporating the vaginal septum will lead to an early pouch vaginal fistula.

If there is diffuse polyposis low in the rectum or if there is a rectal cancer, we prefer to remove all of the rectal mucosa via a mucosectomy and perform a handsewn anastomosis at the dentate line. Mucosectomy is a technically challenging procedure and meticulous dissection must be employed to avoid leaving islands of mucosa behind. It is often easier to perform the mucosectomy as the initial part of the operation with the patient in the prone jackknife position. This provides excellent exposure and is particularly helpful in obese patients. A 1:100,000 epinephrine solution is injected in the submucosal plane circumferentially to help elevate the mucosa from the muscle. Using electrocautery, an incision is made at the dentate line and the mucosa and submucosa are dissected away from the internal sphincter muscle. It is helpful to start in one quadrant and work circumferentially around the lumen to the level of the anorectal ring. We prefer to dissect 270 degrees around the lumen, leaving one quadrant undisturbed so that the specimen does not retract. Once all other areas are done, the mobilized area can be grasped with a Babcock clamp to keep retraction and attention is turned to the final quadrant. The circumferentially completed dissection stops at the level of the anorectal ring and gauze is packed into the anal canal. The patient is then turned and placed into lithotomy position for the proctocolectomy. The rectum is divided sharply beyond the extent of the mucosectomy. This is facilitated by applying perineal pressure to push the anorectal junction above the levators. This leaves a specimen whose distal extent is the mucosa only. With the specimen removed, the completeness of the mucosectomy is verified via the perineum before creating the pouch and handsewn anastomosis.

Some surgeons prefer to do the mucosectomy as the final step to the resection in the lithotomy position. Anal everting sutures or a retraction device are placed and the same techniques described above are followed via a perineal approach. The difference is that the proctocolectomy dissection is performed from an abdominal approach to the level of the anorectal ring, then the mucosa is dissected using a perianal approach. At the top of the anal canal, the dissection transitions perpendicularly to the full thickness through the rectal wall, resulting in complete detachment of the specimen. Surgeons must be aware that excessive or aggressive retraction during the mucosectomy or anastomosis can result in stretching of the anal canal and result in incontinence.

Our normal practice is to construct an S-pouch after performing a mucosectomy and doing a handsewn anastomosis at the dentate line. The 2-cm outlet of the S pouch lies nicely within the anal canal and the body of the pouch rests nicely at the top of the anorectal ring. In our opinion, this configuration makes more mechanical sense and may empty easier.

#### **Obtaining Reach and Reducing Pouch Tension**

It is often difficult to obtain adequate reach of the pouch into the pelvis without tension, particularly after mucosectomy. The pouch should reach to the anal canal without tension so

that blood flow is not compromised. Adequate reach can be assessed by grasping the proposed apex of the pouch with a Babcock clamp and gently coaxing the bowel into the anal canal using the other hand as a guide. The pouch apex should reach to the proposed level of the anastomosis. Another surrogate method that has been described is to determine if the pouch apex will reach beyond the pubic symphysis. Although we have not found this to be as accurate, if the pouch clearly goes beyond this point, there should not be a problem with tension in the anastomosis.

There are several helpful tricks to provide increased mobility of the small bowel mesentery. Mobilization of the small bowel mesentery to the level of the third part of the duodenum is a simple first maneuver. We also routinely ligate the ileocolic artery and vein close to the takeoff from the superior mesenteric artery (SMA). Peritoneal tissue to the right of the SMA can be excised as a veil of tissue to provide greater laxity.<sup>57</sup> Transillumination of the terminal arcades helps reduce risk of injury to these important vessels for pouch blood supply. If additional reach is still needed, 1- to 2-cm long transverse fenestrating incisions can be made along the anterior and posterior peritoneum overlying the SMA. It is important to note that if the ileocolic artery has been ligated high, the terminal branches of the SMA must be preserved as they are the main blood supply to the pouch.

## Summary

Careful thought and meticulous techniques are paramount to the surgical treatment of FAP. Appropriate consideration must be given to the patient and the disease when deciding when to operate and what type of surgery to perform. The surgeon must be aware of expected oncologic and functional consequences of his or her decisions and weigh the risk and benefits of each approach individualized for each patient.

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