

Laparoscopic pouch surgery in ulcerative colitis

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Abstract

Laparoscopic restorative proctocolectomy is a complex procedure with a steep learning curve. It has been proven to be safe and feasible with outcomes comparable to those of open surgery if performed in experienced centers. Published evidence in favor of laparoscopic approach is mainly from small case series and data from randomized controlled trials are currently awaited. This article reviews and analyzes the existing literature on laparoscopic ileoanal pouch surgery in light of the available evidence, demonstrating safety and efficacy of the laparoscopic approach and potential short-term benefits. Technical aspects and future directions in the minimally invasive approach to restorative proctocolectomy are also discussed.

Keywords laparoscopic restorative proctocolectomy, ileo-anal pouch anastomosis, ulcerative colitis

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Introduction

Restorative proctocolectomy with an ileoanal pouch for ulcerative colitis was initially described in 1978 by Parks and Nicholls [1]. Several pouch designs have been described since that time, such as the J, S, W pouches of which the J pouch has become the most popular and easily reproducible method of pouch construction. Improved case selection and refinements in the technique of open proctectomy and pouch construction have resulted in diminishing pouch failure rates and excellent functional outcomes with high levels of patient satisfaction and quality of life [2-5]. Whether these results are replicated or improved with the application of laparoscopy is the question of this review.

Methods

Literature search strategy

Pubmed and Embase databases were searched electronically from 1990 until March 2012. Search terms included: ulcerative colitis, polyposis, laparoscopic, minimally invasive, restorative proctocolectomy, ileoanal pouch. Terms were searched both in isolation and in combination to identify all relevant published

evidence. Search limits were applied to include articles published in English language, those with abstracts, and human studies only. Articles published in abstracts form only, relating to animal work, case reports, or reporting less than five cases were excluded. All full articles that were retrieved were also hand searched for further studies identifiable from the reference list. Articles describing hand-assisted techniques were included so long as part or all of the procedure was completed laparoscopically. Review articles and studies where panproctocolectomy was performed without reconstruction were excluded. Where possible, short-term outcomes from each study were assessed: number of cases, age, blood loss, operating time, hospital stay, conversion rate, major and minor complications, re-operations, 30-day re-admission rates and mortality (Table 1).

A limitation of this review is the lack of large randomized controlled trials with most of the evidence currently reliant on data from prospective or retrospective case series. It may however be reasonable to concede that blood loss, morbidity, re-operative rate, re-admission rate, length of hospital stay compare favorably with the published literature in open surgery. This may be because laparoscopic approaches have better visualization and low estimated blood loss is fundamental for a minimally invasive technique to be undertaken. Additionally, use of energy devices such as the Harmonic scalpel may confer improved hemostasis during dissection. However, robust evidence in the form of properly conducted randomized trials is needed to conclusively establish the case for laparoscopy in ileo-anal pouch surgery.

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What is the role of laparoscopy in colorectal surgery?

In general, laparoscopy has decreased the trauma associated with open surgery, producing a more prompt recovery, reduced

Table 1 Studies reporting on early outcomes after laparoscopic IPAA

Author & Year	n	BMI	Conversion (%)	Median Blood loss (mL)	Median Op time (min)	Major morbidity (%)	Re-operation (%)	Mortality	Minor morbidity (%)	Median LOS	Re-admission (%)
Randomized studies (Hand assisted laparoscopic)											
Maartense 2004	30	23	0	263	214	15	10	0	0.05	10	NA
Non-randomized studies											
Schmitt 1994	22	NA	0	NA	240	NA	4	0	NA	9	NA
Marcello 2000	20	24	0	NA	330	5	NA	0	15	7	NA
Ky 2002	32	NA	0	NA	NA	9	9	0	27	NA	NA
Kienle 2005	50	23	8	200	320	18	18	0	22	12	NA
Larson 2006	100	22	6	NA	333	3	3	0	12	4	21
Lopez-Rosalez 2007	10	NA	0	46	187	10	10	0	10	3	
Zhang 2007	21	22	0	115	325	1	0	0	7	9	NA
Rotholtz 2008	32	NA	13	NA	292	25	6	0	NA	5	NA
El-Gazzazo 2009	119	24	8	250	272	10	NA	0	6	5	NA
Lefevre 2009	82	23	11	NA	314	15	6	0	17	11	22
Berdah 2010	75	22	0	NA	386	5	3	0	NA	22	NA
Fajardo 2010	55	25	2	294	268	33	16	0	33	8	15
Duff 2011	75	NA	0	NA	NA	11	3	0	17	7	24
Fleming 2011	339	NA	NA	NA	298	17	7	0	9	7	NA
Goede 2011	72	24	7	NA	210	NA	NA	0	NA	7	10
Gu 2011	47	25	2	150	227	19	NA	0	NA	5	NA
Pandey 2011	118	24	0	164	316	40	NA	0	NA	9	NA
Ozawa 2012	20	19	0	50	385	15	15	0	20	21	NA
Hor 2012	71	23	13	NA	399	14	13	0	9	12	NA

BMI, body mass index; LOS, length of stay; IPAA, ileal pouch-anal anastomosis; NA, not available

blood loss, reduced narcotic use and lower rates of wound complications [6-8]. As a result of continued improvements in laparoscopic techniques and the refinement of instruments, laparoscopic surgery has emulated practically every open abdominal surgical procedure. How the application of laparoscopy to more complex colorectal procedures should be interpreted has been confusing owing to marked heterogeneity in what has been reported as “laparoscopy”.

Several randomized clinical trials in colorectal cancer surgery have demonstrated that the minimally invasive approach is associated with superior short-term outcomes as compared to the open approach with no detrimental effects upon oncological outcome and with or without Enhanced Recovery [9-13]. With such evidence-based endorsements of laparoscopy, increasing numbers of surgeons are now offering laparoscopic resection for both malignant and benign disease and interest is building in developing skills in more advanced laparoscopic colorectal surgery such as those that might be

required in restorative proctocolectomy; although there is currently a dearth of high-level evidence on this topic.

The laparoscopic approach in restorative proctocolectomy

The application of laparoscopy to ileoanal pouch surgery is not new and was first described by Peters in 1992 [14]. The feasibility and safety of laparoscopic ileoanal pouch surgery has been reported in several subsequent small series from specialist centers [15,16]. However, the more widespread adoption of laparoscopic pouch surgery has not been feasible owing to the technical demands inherent in the surgery and a steep learning curve. Whether or not laparoscopic pouch surgery should be offered only in specialist centers is also contentious and beyond the scope of this review; although evidence indicates that a volume effect exists in relation to long-term pouch outcomes [17]. Nevertheless, the laparoscopic approach should only be

recommended when an experienced team is available.

Often there are marked variations in the reported “laparoscopic” surgical approach. For example, some use a Pfannenstiel incision to permit completion of rectal dissection and/or transection of the rectum and to some laparoscopic purists, this modification may reduce the benefit of a truly minimally invasive procedure. Study heterogeneity in the existing meta-analyses assessing these procedures underlines the fact that restorative proctocolectomy is a demanding procedure unsuitable for surgeons early in their experience of laparoscopic colorectal surgery. Our own view is that when experienced laparoscopic teams are available, patients are likely to derive as much, if not more, benefit from applying this technique as patients undergoing other, less complex, laparoscopic colorectal segmental resections.

Initial reports comparing laparoscopic to open proctocolectomy and ileoanal anastomosis identified no difference in the reported short-term outcomes but found significantly longer operating times in the laparoscopic group [18-20]. These conclusions were based on small numbers of patients, early in the learning curve of the reporting surgeons and, in truth, the majority of published studies to date [21-25] including a randomized controlled trial [26] exclusively employed laparoscopically-assisted techniques with a Pfannenstiel incision which effectively mitigated the potential advantage of a minimally invasive approach compared to a hybrid “laparoscopic” approach.

Secondly, the technical skills of the surgeons undertaking complex laparoscopic procedures and the instrumentation have vastly improved over the past decade. Consequently, the more recently published series have demonstrated clearer benefits in terms of reduced post operative pain, earlier recovery, shorter hospital stay, reduced ileus, reduced blood loss, lower incidence of hernia and wound infections along with greater patient satisfaction and cosmesis [27-30]. A randomized controlled trial comparing the open technique to a well-established laparoscopic technique with experienced laparoscopic surgeons is currently underway and is expected to support the building evidence in favor of laparoscopy [31].

Operative strategy

While a single stage restorative proctocolectomy without diverting ileostomy has been carried out in some centers with excellent results [32], in meta-analysis, the rate of anastomotic leakage and subsequent problems with pouch-related sepsis is doubled in patients without a diverting ileostomy [33]. Accordingly, in our practice, both in open and in laparoscopic pouch surgery, a 2-stage approach in the form of a restorative proctocolectomy with an ileal pouch-anal anastomosis (IPAA) and diverting loop ileostomy as the first stage and reversal of loop ileostomy as the second operation is regarded as the standard procedure. Ileostomy closure does carry a risk of morbidity and mortality, quantified as 11.4% and 0.06%, respectively by Wong *et al* [34-36] but we regard the overall impact of ileostomy morbidity as less devastating than the

potential consequences of pelvic sepsis.

A 3-stage approach is adopted in patients with acute severe colitis who are malnourished and immunocompromised and/or experiencing the side effects of corticosteroids or immunomodulators. This 3-stage approach involves an initial laparoscopic total abdominal colectomy and an end ileostomy as the first stage, followed by a restorative proctectomy approximately 3-6 months later with completion proctectomy, ileo-anal pouch formation and diverting loop ileostomy as the second stage, and reversal of the ileostomy as the final step in surgery. The safety of laparoscopic total colectomy in acute severe colitis has been confirmed in multiple case series [37-40]. A contrast enema confirming anastomotic and pouch integrity is a pre-requisite prior to the reversal of the diverting ileostomy.

Patient selection

Ileoanal pouch surgery is usually contemplated in patients who are relatively young, have adequate anal sphincter function and are free from any major comorbidities. Patients most likely have a diagnosis of ulcerative colitis, although a significant proportion will have a polyposis syndrome and be undergoing prophylactic surgery. The standard pre-operative evaluation does not vary from that which would be planned for any similar patient undergoing a complex open surgical procedure. A complete medical evaluation is mandatory. It is vitally important that patients are counseled extensively prior to their operation and encouraged to spend time with pouch care specialist nurses in order to maximize their understanding of the likely functional outcomes.

Relative contraindications to pouch surgery in general, and with the laparoscopic approach, would be a diagnosis of Crohn's disease, associated primary biliary cirrhosis with portal hypertension, a history of extensive previous abdominal surgery, and advancing age with a declining anal sphincter function.

How is it done?

Patient preparation and positioning

The patient is placed on the operating table in a modified Lloyd-Davies position, with the legs positioned in a 20° to 25° abducted position in padded stirrups, elevated only minimally above the abdomen. A higher elevation may cause the patient's thigh to impede movement of surgeon's hands and risks lower limb compartment syndrome if the limbs are elevated for a prolonged period of time. Displacement of the viscera with positional changes of the patient assists with exposure of the operating field. The operating table should permit position changes at any point intra-operatively to allow for gravity-aided retraction of the bowel as necessary.

It is important to ensure that the patient is positioned

securely on the operating table to prevent slippage in any direction when the table is rotated. The arms are wrapped and tucked to the sides of the body and padded supports are applied to the shoulders, in order to minimize traction injury to brachial plexus.

A nasogastric or orogastric tube and urethral catheter are inserted to decompress the stomach and bladder, and lower extremity pneumatic compression stockings are applied and activated prior to the start of procedure. The operative field is prepared and draped in the usual fashion as for any standard colorectal procedure. A single dose of intravenous antibiotics is administered before incision as prophylaxis.

Standard operative technique

The favored position of ports is as shown in Figure 1. The pneumoperitoneum is maintained preferably at insufflation pressures of 12-15 mmHg. With the patient in a very slight head-up position, the operating surgeon stands between the legs for mobilization of right colon and transverse colon and then on the patient's right for most of the remaining procedure with the patient moved into a steep Trendelenburg position with the right shoulder down. Proximal dissection and division of the vascular pedicles and full colonic mobilization is performed with a Harmonic scalpel.

Where an individual surgeon chooses to stand for the colonic mobilization and in what order the colon is mobilized,

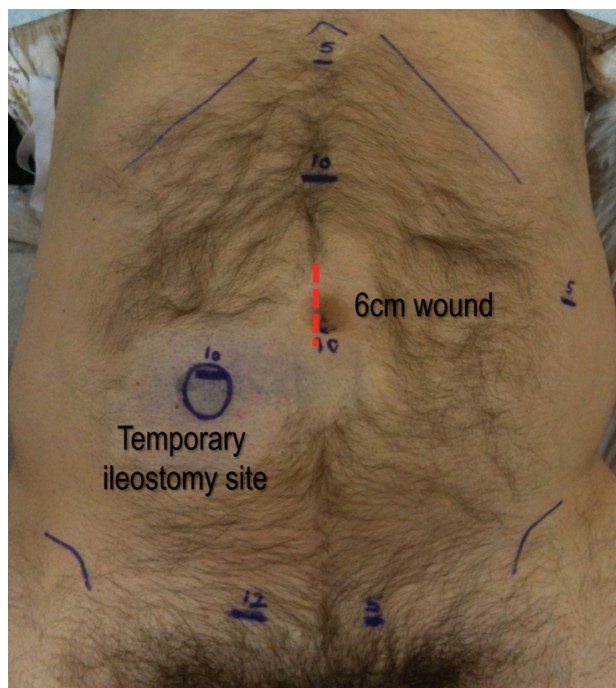


Figure 1 Laparoscopic port site positions. Pouch construction and retrieval through a 6 cm umbilical incision. 5 mm left lateral port to assist with anterior retraction in pelvis. 10 mm camera port at temporary ileostomy site

whether from right to left or left to right, is a matter of individual preference. The energy devices used to perform the dissection also tend to vary accordingly and there are no published data to provide evidence of superiority of one device over another.

We find it easier to commence full colonic mobilization by taking the middle colic vessels first. This allows safe entry into the lesser sac at an early stage in the operation and facilitates further dissection of the right colon with subsequent dissection of right colic and ileocolic vessels. All major vascular ligations are secure with titanium clips.

Left colonic mobilization commences in a standard medial to lateral fashion with the identification and preservation of important structures such as the hypogastric nerves, ureter and gonadals. The rectum is mobilized circumferentially in the intra-mesorectal plane thus ensuring that the risk of damage to hypogastric and pelvic nerves is minimized. Laterally, careful preservation of seminal vesicles and nervi erigentes is ensured and anteriorly, the dissection is kept behind Denonvilliers' fascia. The mobilization is continued down to the pelvic floor and into the intersphincteric plane between the internal and external sphincters.

One of the goals of pouch surgery is to ablate or minimize the amount of residual mucosa between the anal canal and the stapled or hand-sewn IPAA. This is particularly relevant in the presence of polyposis close to the dentate line or where cancer or dysplasia is present. The available laparoscopic staplers for laparoscopic use are not able to flex sufficiently to allow easy placement of a staple line across the rectum in a transverse direction as is favored in open surgery. As a result many surgeons struggle to achieve a low transection close to the dentate line risking leaving significant amounts of rectal stump below the anastomosis. Frequently, in this scenario, surgeons find it necessary to use a number of "firings" of the linear stapler to transect the low rectum and on occasion this produces a more oblique line than intended. This situation has been associated with an increased risk of anastomotic leakage for colorectal anastomoses [41,42]. To counteract this situation we deploy the linear stapler [ETS 45MM] through the 12 mm right suprapubic port that permits a near vertical transection of the rectum above the anal canal in a single firing even in the narrowest of male pelvises. We ensure that the intersphincteric plane has been partially mobilized and that we measure the distance between the staple line and dentate line digitally during surgery with the aim to leave approximately 1 cm between the dentate line and the anastomotic staple-line. In a series of laparoscopic-assisted pouch operations using a Pfannenstiel incision, the median length between dentate and anastomosis was 3 cm [49], perhaps demonstrating the difficulties incurred by using a Pfannenstiel incision to complete rectal transection.

After full mobilization and anorectal transection, the entire specimen is extracted through a wound protector through a 6 cm umbilical incision and sent for histopathological analysis after dividing the ileum at a suitable point close to the ileocecal valve with a linear stapler. It is ensured that the small bowel mesentery is free at its roots as proximally as possible and any necessary lengthening measures are undertaken to allow

a tension free pouch-anal anastomosis.

A J pouch is constructed from the terminal 30 to 40 cm of small intestine in a standard fashion. The blind loop of the J limb is reinforced by continuous sutures and supporting seromuscular stitches are inserted, anchoring the pre-pouch ileum to the blind end of J pouch. The pouch is returned to the abdomen and pneumo-peritoneum is re-established and the pouch orientation confirmed by assessing the cut edge of the ileal mesentery.

The pouch-anal anastomosis is constructed using either a stapled or hand-sewn technique. We prefer a double-stapled technique over a hand-sewn IPAA because it is quicker and associated with better outcomes, except when there is associated dysplasia, when a mucosectomy and a hand-sewn ileoanal anastomosis is constructed. A 2-0 polypropylene purse string suture is applied to the apical enterotomy and anvil of an appropriate size circular stapler (usually CDH29) is secured. The circular stapler is advanced through the anorectal ring and the pin of the circular stapler is then mated with the anvil of the circular stapler. The small bowel should be correctly oriented to prevent twisting of the small bowel mesentery. Care must be taken to avoid including the posterior vaginal wall within the stapled IPAA in female patients. The ends are approximated and the stapler is fired to complete the anastomosis. The doughnuts are checked to ensure a uniform ring of muscle tissue is obtained. An air-leak test is not routinely performed although a pelvic suction is placed behind the pouch that is routinely removed on the day after surgery. Finally, a temporary diverting ileostomy using a loop of proximal ileum is brought out at the pre-marked site and is matured after closing the fascial and skin defects. Often for a 2-stage pouch the ileostomy is more easily placed on the left side of the abdomen compared the right owing to the orientation of the small bowel mesentery after anastomosis.

Outcomes from laparoscopic ileoanal pouch surgery

Feasibility & safety

The feasibility and safety of laparoscopic restorative proctocolectomy with ileoanal pouch reconstruction is now established as evidenced by outcome data from over 20 publications in approximately 1400 patients. In the review of the literature, we found a steady and significant improvement in short-term outcomes following laparoscopic ileoanal pouch surgery. A total of 1390 patients were identified in 20 articles. Five articles were purely on ulcerative colitis [24,25,29,43-44] and the rest included patients with ulcerative colitis and familial adenomatous polyposis. A totally laparoscopic technique was performed in 9 studies [27,29,32,43-48] and a laparoscopic-assisted technique in 11 studies [18,20-26,32,49,50]. The majority of studies were retrospective case series, though several groups collected data prospectively and there was

one randomized controlled trial that compared short-term outcomes of hand-assisted laparoscopic technique to the standard open technique. In the main, pouch procedures were performed in 2 or 3 stages.

Operation times

Average operating time is expected to be higher in the laparoscopic approach because this advanced procedure has a steeper learning curve than an open procedure. The median operating times reflected a mixture of procedures including proctocolectomy with pouch and proctectomy with pouch in those who had a previous colectomy. However, in published series of more than 20 cases, the average operating room decreased to <250 minutes [29,50], showing that experienced surgeons with minimally invasive expertise may be able to perform this procedure with similar operating times as open restorative procto-colectomy.

Morbidity

Initial studies failed to show the benefits of a laparoscopic approach [18-20]. While there were no significant differences with regard to morbidity and quality of life, the operating times were considerably longer in the minimally invasive arm perhaps accounting for the initial reluctance to embrace this technique.

In the selected studies, overall morbidity ranged from 1-49%. The incidence of major morbidity requiring re-operation was not consistently mentioned and was in the range of 0-18% where reported. Of the operations performed, 417 (30%) were straight laparoscopic and the rest were laparoscopic-assisted.

In the only randomized controlled trial, Maartense *et al* [26] compared hand-assisted laparoscopic surgery against open surgery (n=60). Short-term outcomes and measures of recovery in the form of quality of life were evaluated. They reported a low conversion rate, acceptable operating times, and little blood loss, and concluded that a hand-assisted laparoscopic approach was safe in terms of postoperative morbidity and comparable to open surgery. From the US, Ozturk *et al* reported early readmission was associated with the use of laparoscopy [OR 1.8] based upon the Cleveland Clinic Database [51]. Similarly, data based upon NSQIP (National Surgical Quality Improvement Program) from Fleming *et al* in the US confirmed that laparoscopy reduced length of stay, and both major and minor morbidity in 676 cases (with 339 laparoscopic operations) [30].

As suggested above, in contrast to the earlier studies, recent results from several case series are now able to report fewer complications and better short-term outcomes. There are 3 probable explanations for this. Firstly, the experience of surgeons undertaking these complex procedures has grown considerably over the years allowing them to negotiate the steep learning curve. Secondly, the advances in instrumentation such

as novel energy devices, stapling devices, camera systems have enabled various aspects of these procedures to be performed with greater efficiency. Finally, the number of procedures performed is rapidly rising worldwide with a greater uptake in recent years. Additionally, significant proportions of these are being performed with a totally laparoscopic technique as against a predominance of hand-assisted laparoscopic techniques employing a Pfannenstiel incision to complete the low rectal dissection and/or division in the earlier years and this may have produced the benefits, in part.

Patient selection

Of note is the experience of one group who studied the effect of infliximab on the postoperative course of patients after laparoscopic IPAA. They compared 13 patients who received infliximab with matched controls from their prospectively maintained database and found no difference in operating time, complication rates and hospital stay [52]. Similarly, other agents such as cyclosporine have been continued to the point of pouch surgery in some cases with no reported detriment to the patient although this has only been studied in open surgery groups.

Adhesions & fecundity

Intra-abdominal and pelvic adhesions following previous surgery are a well-known cause of female infertility. Cornish *et al* analyzed 22 studies with 1852 patients and found that the infertility rate was considerably higher at 26% after restorative proctocolectomy as against 12% before surgery [53]. In a recent prospective case-control study comparing the incidence of adhesions following laparoscopic and open restorative proctocolectomy, Hull *et al* reported significantly fewer adhesions in patients undergoing laparoscopic procedures [54]. Similarly, Bartels *et al* in their review of 100 patients, found that patients who underwent a previous laparoscopic colectomy had significantly fewer adhesions, incisional hernias and a shorter interval to completion proctectomy and pouch reconstruction [55]. It is argued that even though laparoscopic ileo-anal pouch anastomosis is a lengthy procedure, the prospect of fewer adhesions may justify persistence with the approach. Bemelman *et al* are currently seeking to investigate whether a laparoscopic approach to IPAA is associated with a superior outcome in terms of female fecundity. They are performing a large multicenter observational study in a cross-section of females of child-bearing age and who underwent laparoscopic or open IPAA surgery between 1993 and 2009 [56].

Function after laparoscopic restorative proctocolectomy

Several groups have reported functional outcome data following open restorative proctocolectomy. However, there is currently a paucity of data in the laparoscopic arm in this

respect for reasons discussed above. Berdah *et al* reported excellent functional outcomes at a median follow up of 38 months, in the only prospective series to date, of 40 patients who underwent 2-stage laparoscopic proctocolectomy with IPAA [48].

Newer developments

Robotic surgery

Pedraza *et al* have reported their experience of 5 cases performed with robotic assistance and satisfactory peri-operative outcomes [57]. Robotic-assisted surgery overcomes the technical difficulties in complex and difficult laparoscopic surgery by providing 3-dimensional imaging and instruments with seven degrees of freedom that mimic hand movements and dexterity. Despite its potential advantages, robotic total mesorectal excision surgery is not established as standard practice and issues, such as hybrid operations (laparoscopy with robotic surgery), second intervention, conversion, cost, standardization of technique and training will have to be addressed before its use can become widespread. However, its adoption may allow the development of intra-corporeal pouch formation that may further advance minimally invasive pouch surgery.

Single incision laparoscopic surgery

Enthusiasts of laparoscopic surgery have gone a step further in attempting to minimize the trauma of surgery and have introduced single incision laparoscopic surgery (SILSTM) total proctocolectomy with ileopouch anal anastomosis. The first reported SILSTM IPAA was from Cleveland Clinic in 2010 following which few other reports have been published [58-60]. Altogether less than 20 cases have been performed selectively with satisfactory short-term outcomes and essentially represent a cautious introduction of this new technique. While it has been shown to be feasible in the hands of a select few surgeons, this technique is still in early phases of development. Rigorous further evaluation in terms of safety and efficacy is still required before any comparative studies looking at its superiority over existing techniques can be performed. Training, credentialing, new instrumentation and national outcome registries are some of the other issues that also must be addressed prior to widespread introduction of this new technique.

Conclusions

Laparoscopic IPAA is feasible and safe with acceptable complication rates. The major drawback of available evidence is lack of randomized studies and limited follow up, which do not permit strong conclusions to be drawn. There is an urgent need

for large multicenter randomized trials in order to establish the efficacy or superiority of this approach over the existing techniques prior to its wider introduction. Currently, a single center RCT is being conducted in Germany, LapConPouch Trial [31]. This trial is designed to compare short-term outcomes (blood transfusion requirements) following a totally laparoscopic approach versus the standard open technique for restorative proctocolectomy and ileopouch anal anastomosis. If firm evidence can be provided in favor of laparoscopic approach, it will become the standard of care, especially in younger patients.

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