

# Three steps and a join: a simple guide to right- and left-sided medial to lateral laparoscopic colorectal surgery

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## Abstract

**Background** To provide a standardised ‘medial to lateral’ approach to laparoscopic colorectal surgery.

**Methods** Both right- and left- sided laparoscopic colorectal procedures were simplified into three well-defined steps and a join. An instructional video and procedural guide provides the important pearls and pitfalls in performing laparoscopic colorectal surgery.

**Results** During a 10-year period (2006–2016) at a single institution, 20 senior colorectal trainee surgeons and 20 general surgery registrars were trained in the ‘three steps and a join’ technique. Five hundred and sixty-eight laparoscopic anterior resections using this technique were performed. There were 5 (0.9%) leaks. Five hundred and forty-three laparoscopic right-sided resections were performed. There were 3 (0.6%) anastomotic leaks requiring reoperation and loop ileostomy.

**Conclusions** This step-by-step instructional video and procedural guide provides a simple and standardised approach which may be incorporated into a training pathway for laparoscopic right- and left-sided colorectal surgery.

**Keywords** Laparoscopic colectomy · Colorectal surgery · Laparoscopic anterior resection · Laparoscopic right hemicolectomy · Laparoscopic ileocolic resection · Medial to lateral

## Introduction

The rate of laparoscopic colorectal surgery has been increasing over the past decade, with trials reporting short-term benefits and good oncological outcomes. Large multicentre trials have shown both a good safety profile and low complication rates [1–4]. However, there are a wide range of options and variations in technique in laparoscopic colorectal surgery including ‘medial to lateral’, ‘lateral to medial’ approaches, hand-assisted techniques, hybrid surgery, single-incision laparoscopic surgery and robotically assisted laparoscopic surgery.

In this video, we provide a simple, standardised ‘three step and a join’ ‘medial to lateral’ technique for both left- and right- sided conventional laparoscopic colorectal surgery.

## Indications

This technique may be used in laparoscopic resections for cancer, inflammatory bowel disease, complicated diverticular disease and other indications for laparoscopic colorectal surgery, and may be used in the emergency and elective setting.

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## Materials and methods

### Laparoscopic right hemicolectomy

After the patient has been adequately consented, anaesthetised and prepared for surgery, a standard Hasson port is placed at the umbilicus, with an suprapubic midline port, a 5-mm left infraumbilical port and a 5-mm left supraumbilical port. We perform our laparoscopic dissection with the harmonic scalpel. The harmonic scalpel is an effective energy device for haemostasis and is a useful dissection tool. Although it takes longer to cut and coagulate tissues, it creates less smoke, causes less lateral thermal damage and offers greater precision than diathermy.

#### Step 1 Medial–lateral dissection under ileocolic vessels and division of the ileocolic artery

The patient is rolled (left side down) and the ileocolic junction is grasped and extended anteriorly. This tents up the ileocolic artery. Dissection is begun by opening the peritoneum just under and parallel to the ileocolic artery, close to its origin from the superior mesenteric artery.

This opens a plane just anterior to the duodenum. The duodenum should be encountered immediately. The colonic mesentery is dissected off the duodenum and the head of the pancreas. Dissection then extends cranially and to the right until the colon at the hepatic flexure is visualised.

The ileocolic artery is then divided with a vascular stapler (placed through the umbilical 10/12 port, using a 5-mm camera placed in one of the 5-mm ports). We recognise that there are many techniques for dealing with the vascular pedicles including skeletonisation and use of Hem-o-lok. We have found that stapling the vascular pedicle is safe, effective for haemostasis and does not require complete skeletonisation of the vascular pedicle.

A Ray-Tec is placed at the supero-lateral margin of the dissection, and this Ray-Tec will be encountered in Step 2.

#### Step 2 Mobilisation of the hepatic flexure

The patient is placed head up (with left side down maintained). The omentum is placed medially. The proximal transverse colon is retracted caudally and triangulated. Dissection is begun at the peritoneum over the proximal transverse colon mesentery. This dissection should quickly meet the Ray-Tec placed in Step 1. Dissection then continues around the hepatic flexure. Lateral dissection continues to the lower margin of the caecum.

### Step 3 Mobilisation of the terminal ileum

The patient is placed steep head down (with left side down maintained). The small bowel is delivered out of the pelvis and placed in the left upper quadrant. The caecum and terminal ileum are retracted cranially and anteriorly. Dissection is commenced under the mesentery of the terminal ileum, and this dissection should quickly meet the dissection in Steps 1 and 2 (i.e. ‘open up’), leaving only some lateral peritoneum right at the caecum that can be divided to complete the dissection. The dissection on the terminal ileal mesentery should continue medially to the third part of the duodenum (to allow full ileal mobility when the specimen is exteriorised).

#### The join

The periumbilical incision is extended cranially and caudally. The size of the incision is dictated by the pathology to be removed. (It should not be necessary to do any more dissection through this incision.) The caecum is delivered first. The mesentery is divided and the resection performed. Type of anastomosis is based on surgeon preference (hand sewn or stapled).

It is important to note that patients with ileocaecal Crohn’s disease often have an ileocaecal phlegmon. In these cases, the surgeon should attempt as much dissection in normal tissue as possible before approaching the phlegmon. Usually most of Steps 1 and 2 as well as the medial component of Step 3 can be performed before approaching the phlegmon. As with all inflammatory and malignant conditions, it is often best to ‘sneak up’ on the pathology and identify normal planes and anatomical structures around the difficult area before dealing with the diseased region. The surgeon should orientate the initial dissection by appreciating where the edge of the small bowel mesentery is, as, in some cases, the more proximal small bowel may be adherent to the phlegmon. For left-sided resections (as described below), ‘sneaking up’ on the pathology is a useful tip in surgery associated with diverticulitis. In obese patients, the weight of the specimen can be significant, but the steps should still be able to be performed sequentially as described.

### Laparoscopic anterior resection

After the patient has been adequately consented, anaesthetised and prepared for surgery, a standard Hasson port is placed at the umbilicus, with a suprapubic 10-mm midline port, a 5-mm right infraumbilical port and a 5-mm right supraumbilical port. We perform our laparoscopic dissection with the harmonic scalpel.

### **Step 1 Medial–lateral dissection under inferior mesenteric vein (IMV), inferior mesenteric artery (IMA) and division of IMA and IMV**

The patient is rolled (right side down). The omentum and transverse colon are retracted cranially. The small bowel is retracted to the right, and the duodeno–jejunal (DJ) junction is exposed. Sometimes it is necessary to divide some adhesions (congenital or acquired) over the duodenum. The IMV is always placed just lateral to the DJ junction. The IMV and its overlying peritoneum are retracted anteriorly, and dissection is begun posterior to the IMV.

This should open a plane just anterior to Gerota’s fascia. This dissection is continued in this plane anterior to Gerota’s fascia laterally until the proximal descending colon is encountered.

The IMV is then divided at the lower border of the pancreas with clips or a vascular stapler. There is usually a small tributary (coming from the left colon) just caudal to this point of division, and dividing this now ensures proper mobilisation and exteriorisation later. Care is taken not to extend the dissection too far underneath the pancreas.

The patient is then placed head down (with right side down maintained). The left colon is retracted anteriorly, and the peritoneum over the IMA origin is divided. Dissection is continued under the IMA, and the left ureter and gonadal vessels are encountered. Dissection is continued cranially and lateral to the IMA to meet the previous dissection.

After re-identification of the ureter and confirmation that it has been ‘dropped’ laterally, the IMA is divided with a vascular stapler (placed through the suprapubic 10/12 port). Once the IMA and IMV are divided, it is possible to further extend the medial–lateral dissection out to the white line of Toldt laterally and to the upper rectal mesentery caudally. A Ray-Tec is placed at the lateral margin of the dissection.

### **Step 2 Lateral mobilisation of the left colon and splenic flexure**

The left colon is then retracted medially, and dissection begun at the apex of the sigmoid colon mesentery (the traditional starting point for open and lateral–medial laparoscopic surgery). The medial dissection will be quickly met and the Ray-Tec encountered.

The dissection is extended cranially. Care must be taken not to inadvertently dissect lateral to the kidney.

As the splenic flexure is approached, the patient is placed head up (with right side down maintained). Dissection continues under and around the splenic flexure. Usually the lesser sac is entered as this dissection continues around the splenic flexure. Often the omentum needs to be ‘sorted out’ as it is sometimes draped over the transverse

and attached to the transverse colon mesentery anteriorly and/or the descending colon.

Once the lesser sac is entered, it is helpful to retract the colon caudally and laterally to dissect between the lower border of the pancreas and the transverse mesocolon. This dissection should continue until the clip (or staple line) on the IMV is encountered.

### **Step 3 Mobilisation of the upper rectum, division of the rectal mesentery and stapling of upper rectum**

The patient is placed steep head down (with left side down maintained). The small bowel is delivered out of the pelvis and placed in the right upper quadrant. The posterior rectal mesentery is dissected in the total mesorectal excision (TME) plane down to the mid-rectum (or lower if dictated by the pathology). This dissection is continued to the right of the rectum/rectal mesentery. The dissection on the left (at the apex of the sigmoid mesocolon) is continued into the pelvis on the left of the rectum/rectal mesentery.

A decision (based on the pathology) is made where to divide the rectum. The rectal mesentery at this point is divided with the Harmonic scalpel to leave a bare rectal tube at the point where it will be stapled. Care is taken to make sure that the rectal mesentery is divided at the same level all the way around. The rectum is then stapled intracorporeally.

### **The join**

The 10/12 suprapubic port is extended (size is dictated by the size of the pathology).

The rectus fascia is divided, and the 10/12 port site is stretched digitally to allow the passage of a small Alexis wound retractor.

The left colon is exteriorised and the pathology removed after appropriate division of the mesocolon. The anvil of an end-to-end anastomosis (EEA) stapler is placed and the proximal colon replaced into the peritoneal cavity. A glove is placed over the Alexis retractor to maintain pneumoperitoneum. The colorectal join is performed intracorporeally with a standard EEA stapling gun.

### **Results**

The technique described above has been used for 10 years (2006–2016) at Concord Repatriation General Hospital. During this period, 20 senior colorectal trainee surgeons and 20 general surgery registrars have been trained in this technique. Five hundred and sixty-eight laparoscopic anterior resections using the ‘three steps and a join’ technique were performed. There were 5 (0.9%) leaks, and 4

(0.7%) required reoperation. In one case, the patient was managed successfully non-operatively. Five hundred and forty-three laparoscopic right hemicolectomies or ileocolic resections using the ‘three steps and a join’ technique were performed. There were 3 (0.6%) leaks. In all 3 cases, patients required reoperation and formation of a temporary loop ileostomy.

We have previously reported on outcomes from our laparoscopic colorectal cohort and showed that our technique was performed well by surgical trainees in a closely supervised environment [5]. In that series, there was no statistically significant difference in complication rate between surgical trainees and surgeons performing laparoscopic colectomies, nor was there any difference in conversion rate between consultant and fellows (7.6 vs. 8.8%).

The average number of laparoscopic colectomies performed in our institution prior to standardisation of this technique was approximately 20 laparoscopic colorectal resections, with most procedures performed by a lateral to medial laparoscopic approach or by an open technique. Uptake of laparoscopic colorectal surgery at our institution increased rapidly with the adoption of this technique. In total, senior colorectal trainee surgeons perform approximately 60–80 laparoscopic resections using the medial to lateral technique during their fellowship. The majority of cases have been performed under supervision by consultants. However, consultants performed the entire operation in less than 10% of cases.

## Discussion

Laparoscopic colon and rectal surgery has a significant learning curve for both right- and left- sided resections [6]. Cases performed in the early stage of the learning curve may be associated with higher complication rates and readmission rates [7]. The learning curve of laparoscopic colorectal surgery is also associated with increased operative time [8].

There have been reports on various standardised techniques in multiport colectomy in textbooks, international guidelines, case series and technical notes. In order to understand which procedural steps are the most important, Dijkstra et al. [9] recently reviewed the existing literature, and after a panel of 22 experts was invited to rate the importance of each step described in the literature on a Likert scale, the expert consensus identified 25 key steps for right hemicolectomy and 24 key steps for sigmoid colectomy. This study formed the basis of a curriculum.

While our technique incorporates many of the suggested steps and approaches, we have simplified our technique to

‘three steps and a join’ for right hemicolectomy and sigmoid colectomy, with a description of the pearls and pitfalls and important procedural steps in each of the four phases of the surgery, as well as a description of the order in which we perform each step. With both right- and left-sided dissection, we advocate a medial to lateral approach. The ease of our standardised technique is shown in both the video and description. We plan to use this instructional video to aid in the education of trainee surgeons in understanding the key steps involved in laparoscopic colectomies.

By simplifying the procedure into well-defined steps, it is possible to allow trainee surgeons to take part in the less difficult operative steps first, and allow them to progress to more difficult steps as their laparoscopic skills and experience improves. It is also possible to teach multiple trainee surgeons during each case and allow trainees at different levels of technical expertise to perform the steps appropriate to their level of training. A standardised approach to laparoscopic colorectal surgery with appropriate supervision is important in achieving excellent outcomes, efficiency and ensuring patient safety.

The principles of ‘three steps and a join’ require supervision from surgeons with advanced laparoscopic skills. This technique may be also utilised for subtotal colectomies and low and ultralow-anterior resection, but these require extra steps (such as dissection of middle colic vessels for subtotal colectomy and low rectal dissection for low anterior resection which has a considerable learning curve in its own).

We have reported excellent patient outcomes with leak rates of <1% for both right- and left-sided resections using this technique. However, we have not attempted to compare the outcomes of this standardised technique with other techniques, nor have we reported on complications based on the Clavien–Dindo classification and conversion to open rates.

## Conclusions

This step-by-step instructional video and procedural guide provides a simple and standardised approach which may be incorporated into a training pathway for laparoscopic right- and left-sided colorectal surgery.

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## Compliance with ethical standards

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

**Ethical approval** The present paper was written according to an appropriate ethical standard.

**Informed consent** No identifiable patient data has been included in this study.

## References

1. Fleshman JW, Nelson H, Peters WR, Kim HC, Larach S, Boorse RR et al (1996) Early results of laparoscopic surgery for colorectal cancer. *Dis Colon Rectum* 39(10 Suppl):S53–S58
2. Guillou PJ, Quirke P, Thorpe H, Walker J, Jayne DG, Smith AM et al (2005) Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC CLASICC trial): multicentre, randomised controlled trial. *Lancet* 365(9472):1718–1726
3. Hewett PJ, Allardyce RA, Bagshaw PF, Frampton CM, Frizelle FA, Rieger NA et al (2008) Short-term outcomes of the Australasian randomized clinical study comparing laparoscopic and conventional open surgical treatments for colon cancer: the ALCCaS trial. *Ann Surg* 248(5):728–738
4. Hazebroek EJ (2002) COLOR: a randomized clinical trial comparing laparoscopic and open resection for colon cancer. *Surg Endosc* 16(6):949–953
5. Krishna A, Russell M, Richardson GL, Rickard MJ, Keshava A (2013) Supervised surgical training and its effect on the short-term outcome in laparoscopic colorectal surgery. *Colorectal Dis* 15(8):e483–e487
6. Tekkis PP, Senagore AJ, Delaney CP, Fazio VW (2005) Evaluation of the learning curve in laparoscopic colorectal surgery: comparison of right-sided and left-sided resections. *Ann Surg* 242(1):83–91
7. Chen W, Sailhamer E, Berger DL, Rattner DW (2007) Operative time is a poor surrogate for the learning curve in laparoscopic colorectal surgery. *Surg Endosc* 21(2):238–243
8. Waters JA, Chihara R, Moreno J, Robb BW, Wiebke EA, George VV (2010) Laparoscopic colectomy: does the learning curve extend beyond colorectal surgery fellowship? *JLS* 14(3):325–331
9. Dijkstra FA, Bosker RJ, Veeger NJ, van Det MJ, Pierie JP (2015) Procedural key steps in laparoscopic colorectal surgery, consensus through Delphi methodology. *Surg Endosc* 29(9):2620–2627