



# Site of extraction for laparoscopic colectomy: review and technique

Haris Chaudhry, Alessio Pigazzi

Department of Surgery, University of California Irvine, School of Medicine, Irvine, CA, USA

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*Correspondence to:* Alessio Pigazzi, MD, PhD, FACS. Professor of Surgery, University of California Irvine, 333 City Blvd. West, Suite 850, Orange, CA 92868, USA. Email: apigazzi@uci.edu

**Abstract:** Laparoscopic colon resection has shown many beneficial outcomes including reduced pain, earlier recovery and shorter length of stay at hospital. A minilaparotomy after colon resection is necessary for the creation of intestinal anastomosis and specimen extraction. This incision can cause complications including incisional hernia (IH) and wound infection. To retain maximum advantage of minimally invasive surgery, different incisions and specimen retrieval techniques have been practiced. In this review article, we include and discuss alternative incision and specimen extraction techniques including periumbilical incision, transverse incision, Pfannenstiel incision, natural orifice specimen extraction (NOSE) and stoma site extraction (SSE) after colectomy and recommends the use of the Pfannenstiel incision as the ideal extraction site after laparoscopic colectomy due to significantly reduced incidence of IH.

**Keywords:** Laparoscopic colon surgery; site of extraction; specimen retrieval

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## Introduction

After the introduction of laparoscopic cholecystectomy three decades ago, laparoscopic techniques have been extensively implemented in many arenas of surgery, including colon surgery. Numerous clinical trials and meta-analyses have shown the beneficial outcomes of laparoscopic colon surgery, which includes reduced pain, earlier recovery and shorter length of stay at the hospital (1).

After laparoscopic colon resection, an incision—also known as a minilaparotomy—is usually necessary for two major reasons: creation of the intestinal anastomosis, and specimen extraction. The size and location of the minilaparotomy have a profound impact on short and long-term recovery after laparoscopic colorectal surgery (2).

Incisional hernia (IH) has an impressive economic burden on the healthcare system, and profound physiological and psychological effects on patients (3,4). IH is a common

long-term complication after open colon surgery, found in about 20% of the patients who undergo the procedure. Trocar-site and specimen extraction site both can also cause IH after laparoscopic colorectal surgery but the latter contributes more to the incidence of IH and is the most important modifiable factor to influence IH in laparoscopic colectomy (5-8).

It was proposed that the implementation of laparoscopic technique would diminish the risk of IH (9,10), however, some studies with long-term follow up have demonstrated conflicting results that laparoscopic colon surgery has similar risk of IH when compared to open colon surgery (11).

Wound infection is another dreaded postoperative complication that can result in an increased hospital length of stay, recovery time and burden of cost on healthcare system (12,13). Wound infection rates between 5% and 30% have been reported in patients who undergo colon surgery (14-18). Due to the fundamental difference between

the technique of laparoscopic and open colon surgery, it was expected that the wound infection rate would be lower with a laparoscopic technique as it was in other surgical specialties (19,20). However, it has been observed that the extraction site behaves in a similar manner as a traditional midline incision in terms of wound-related complications (11).

Due to the above-mentioned concerns, there is a growing desire among surgeons to optimize the size and location of the specimen extraction incision in order to retain the maximum advantages of a minimally invasive procedure. This has led surgeons to investigate different approaches to specimen retrieval: from an incision at or away from the port sites to methods for extracting the specimen without a need for an incision altogether. Here, we discuss different approaches to specimen extraction after laparoscopic colectomy.

### Periumbilical incision

In this technique, the umbilical trocar (if present) is removed for the extraction of the specimen, an endobag is inserted and the specimen is placed in it while the abdominal cavity is inflated. An incision is made along the circumference of the umbilicus around the umbilical ring. For extraction, the umbilical incision is extended 3 to 5 cm in a cranial to caudal direction at the fascia and skin and slight traction is exerted on the bag which results in the removal of the specimen without any risk of neoplastic seeding. Alternatively, the wound can be covered with a wound protector and the specimen is extracted without an endobag (21).

The advantage of this technique is its rapidity and that an entirely separate incision is not needed for the extraction of the specimen. In addition, the circumference of the cutaneous scar can be hidden by the umbilical scar. Naturally the cosmetic advantage of this approach is limited by the size of the specimen being extracted as it may not be an appropriate approach for the extraction of a specimen greater than 6 or 7 cm (8). In addition, there is a high rate of subsequent umbilical IHs (4).

### Transverse incision through the right or left iliac fossa

Iliac incisions are made parallel to the inguinal ligament. The incision starts medially to the anterior superior iliac spine and terminates at the lateral border of the rectus muscle. The external oblique, internal oblique, transverse

muscle and transverse fascia are dissected exposing the peritoneum which is then dissected with fingers (22).

This technique is useful for removal of a large specimen. The right iliac fossa is used for the retrieval of the specimen if right hemicolectomy is done whereas the left iliac fossa is used if the left hemicolectomy or sigmoidectomy is done. The size of the incision is dependent on the diameter of the tumor to be delivered but in most cases the size is between 4 and 8 cm (23).

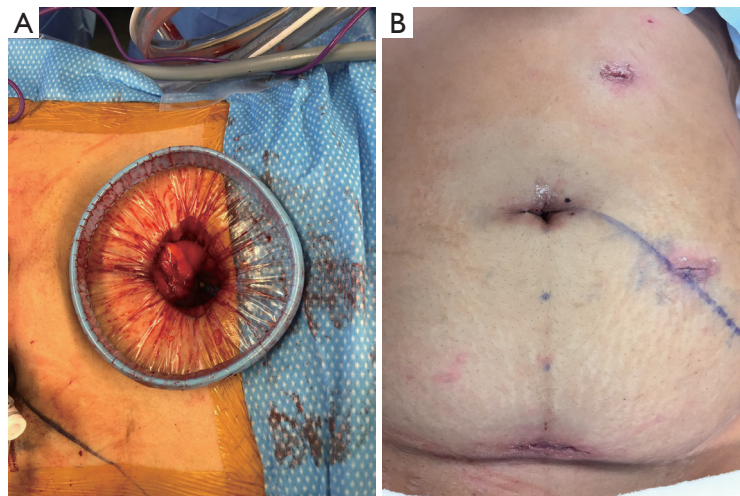
A study done by Kam *et al.* (24) included a retrospective review of 280 randomly selected patients who underwent open colon resections for colorectal cancer. 140 procedures were done with a midline incision whereas the other 140 were performed with an incision in the left iliac fossa. They concluded that the patients with incision in left iliac fossa had earlier ambulation, less narcotic use and length of stay at the hospital.

### Pfannenstiel incision

It is a lower abdominal transverse incision which was described by Pfannenstiel in 1900 (*Figure 1*) (25). This incision preserves the anterior fibrous sheath (including the aponeurosis formed by the fibers of external oblique, internal oblique and transversus muscle). In this technique, a low transverse skin crease is used as a surface marking for the Pfannenstiel incision. One common technique is incising the subcutaneous fat and the anterior rectus sheath along the same line of the skin incision. Flaps are raised between the anterior rectus sheath and the rectus muscle inferiorly up to the pubic symphysis. The rectus muscle is then split and the peritoneum is incised (26).

This technique has been associated with a significantly lower incidence of IH 0% to 2% (27,28). In gynecological procedures, Pfannenstiel incision is used for the majority of pelvic procedures and has shown favorable outcomes including ileus, length of hospital stay and wound infections (27,29). A retrospective cohort study of 2,148 patients undergoing laparoscopic colorectal resection was done by Benlice *et al.* (5) to assess the relationship between extraction site location and IH. They concluded that the preferential extraction site to minimize IH rate should be Pfannenstiel or incision off the midline whereas midline incisions should be avoided when possible.

DeSouza *et al.* (30) suggested two major mechanisms that protect against hernia formation after Pfannenstiel incision. They postulated that the incisions are at right angle between the anterior rectus sheath and the rectus



**Figure 1** Pfannenstiel incision and specimen extraction site. (A) Pfannenstiel extraction site covered with wound protector; (B) closed port and extraction sites after laparoscopic right colectomy with intracorporeal anastomosis.

muscle which offers a shutter valve-like action when intra-abdominal pressure is increased. Secondly, the tension lines on the anterior rectus fascia run parallel to the long axis of the incision which opposes the fascial ends.

The literature suggests that Pfannenstiel incisions result in a lower rate of IH when compared to other extraction sites. However, in order to use this extraction site for right colectomy an intracorporeal anastomosis is necessary (30,31). Intracorporeal anastomosis allows great flexibility in the extraction site which is not available when extracorporeal anastomosis is carried out as the specimen should be extracted in the vicinity of the anastomosis being performed (32,33). Moreover, unlike extracorporeal anastomosis, intracorporeal anastomosis enables resection of the right colon with minimal mobilization and mesenteric traction which decreases the rates of mesenteric tears, bleeding and tissue torsion. This may result in a faster recovery, reduced complications and adhesion formation (34).

Shapiro *et al.* (33) conducted a comparative study of two anastomotic techniques for right hemicolectomy in patients with malignancy. Out of 191 patients, 91 underwent intracorporeal anastomosis whereas 100 patients underwent extracorporeal anastomosis. In the group which had intracorporeal anastomosis, lower rates of IH (2.2% *vs.* 17.0%,  $P=0.001$ ) were found which they attributed to the fact that vast majority of the patients undergoing intracorporeal anastomosis had specimen extraction performed through a Pfannenstiel incision.

### Natural orifice specimen extraction (NOSE)

NOSE is a technique in which the specimen is retrieved via a visceral opening that is communicating with an outside world. The most common extractions are either transanal or transvaginal. NOSE significantly reduces the surgical trauma and post-operative pain as it eliminates the need of a separate incision for the specimen extraction. A meta-analysis published by Ma *et al.* (35) has shown that this technique of specimen extraction has many advantages which include shorter length of hospital stay, faster return of bowel function and lower post-operative pain scores.

A randomized clinical trial done by Wolthuis *et al.* (36) compared postoperative analgesic use between NOSE and conventional specimen extraction group. The NOSE group used significantly less acetaminophen, patient-controlled epidural analgesia and the pain scores also remained significantly lower after one week.

NOSE is of significance when treating patients with body mass index (BMI) greater than 30 as they are more prone to incision related complications and IH. However, a high BMI poses challenges to this procedure itself and an increase in BMI causes more visceral fat which may be associated with specimen bulk (37).

As a new technique for specimen extraction, this approach poses certain challenges which include disturbing an otherwise healthy organ, and the potential for seeding an unaffected organ during extraction of a neoplastic tissue (38).

Another technical problem faced by this technique is removal of proximal specimens, such as the right colon.

A suitable technique for removal of the right colon is the transvaginal approach. Transvaginal NOSE has shown to be effective for both right and left sided resections. Our experience suggests caution when using the technique for extraction of large specimen and in women who have undergone prior hysterectomy (2).

### Stoma site extraction (SSE)

This technique can be applied to patients who require either an ileostomy or a colostomy. In this procedure, the port is positioned at the future ileostomy site and the procedure can also be done through a single incision laparoscopy access system (SILS). This is done by using a stoma site as a port site as well as a site for specimen extraction, eliminating the need for another incision. The stoma site aperture is created by vertically dividing the anterior and posterior sheaths of the rectus muscle layers and splitting the muscle fibers (39).

A study conducted by Li *et al.* (40) analyzed the postoperative ileostomy complications in 738 patients. The patients who needed ileostomy were divided into two groups: SSE and non-stoma site extraction (NSSE) and were compared by BMI, age, comorbidities, etc. They concluded that SSE increases the incidence of stoma site complications including stoma prolapse, retraction, stenosis, strangulation, or abscess formation. Therefore, this technique should be used cautiously in patients requiring permanent ostomies or with an elevated BMI.

The increase in parastomal hernia rates in SSE might be due to the enlargement of the stoma site for extraction and resultant trauma on the fascia during the extraction process.

### Conclusions

Laparoscopic Colon surgery has many beneficial outcomes such as lower pain, earlier recovery and shorter length of hospital stay but there are still limitations due to the minilaparotomy used for specimen extraction. Complications such as IH and wound infections continue to cause great morbidity after laparoscopic colectomy. These limitations can be minimized by the use of a carefully selected extraction site. For the majority of cases, the literature supports the use of the Pfannenstiel incision as an ideal extraction site after laparoscopic colectomy. NOSE technique is an enticing new technique that can be used in selected cases provided that the operators have the adequate

skill set to perform advanced intracorporeal maneuvers.

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