Prevention of Hernia in Long Midline Abdominal Incisions: An Opinion Paper

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Abstract

Background: Laboratory and clinical data have shown that small (0.5-1.0 cm) bites of a running suture closely spaced (0.5 cm) and only through midline fascia results in the lowest incidence of incisional hernia.

Methods: Laboratory and clinical manuscripts were used to formulate a goal for optimal closure of a long midline abdominal incision. Using these conclusions as a starting point, surgical technology to achieve an optimal wound closure was formulated.

Results: A fixed retractor must be placed prior to performing an abdominal incision. Skin traction sutures elevate the skin and subcutaneous tissue to make a fascial incision directly through the linea alba. Peritoneum and preperitoneal fat beneath the posterior rectus sheath are resected. Separations of the anterior and posterior rectus sheath are repaired prior to fascial closure. A running suture of closely spaced small bites is used to bring the fascial edges together. Maintaining fascial exposure with the skin traction sutures facilitates accurate placement of fascial only sutures.

Conclusions: Revised surgical techniques for opening and closing a long midline abdominal incision will minimize the incidence of incisional hernia.

INTRODUCTION

Much has been written concerning the repair of a hernia that develops within a large midline abdominal incision [1]. Fewer publications concern the prevention of an incisional hernia especially an incision that must extend the entire length of the midline from near the pubic symphysis to (sometimes including) the xiphoid process. This manuscript describes a multistep process that can be associated with a reduced incisional hernia incidence. Attention to detailed surgical technology from start to finish of the procedure is necessary and will be described. Level I evidence constitutes the basis for this approach to hernia prevention. The many steps required to implement this data established in a randomized controlled trials constitute a personal opinion of this author. Most important is a revised and more meticulous surgical technology used for opening and closing the abdomen through a midline incision.

Theoretical basis for prevention of a midline incision

If the fascial edges of the two sides of the abdominal incision heal with a strong cord of scar tissue, a hernia will not occur. The goal of the abdominal closure is a reapproximation of these intact fascial edges with an absence of tension, an absence of infection, and an absence of other tissues or fluid between the fascial edges.
edges to more perfectly suture the edges together. The remainder of this manuscript focuses on the surgical technology that will facilitate this goal of precise apposition of fascial edges.

**Preoperative preparation**

Before initiating the abdominal incision, some measures are undertaken to optimize recovery and thereby minimize subsequent hernia formation. A nasogastric tube should be inserted by the anesthesiologist in order to prevent postoperative abdominal distension that will cause unnecessary tension on the fascial suture line.

Also, before the vertical abdominal incision is performed, approximately 3 lines cross wise to this incision are made. One midway between symphysis and umbilicus, one at the umbilicus, and one midway between umbilicus and xiphoid process. These lines will guide the surgeon to properly space the two sides of the abdominal closure (Figure 1).

**Improved exposure of fascia using skin traction sutures**

In a majority of open abdominal or pelvic surgical procedures, a self-retaining retractor should be used to facilitate exposure during the subsequent surgical procedure. A retractor that frames the abdominal incision is positioned after the skin preparation and abdominal drapes are applied but before the abdominal incision are made. Skin traction sutures secured to the frame of the self-retaining retractor will facilitate the clear identification of the abdominal wall fascia (Figure 2). These sutures are progressively tightened as the skin incision is deepened through the subcutaneous incision. The more obese the patient, the greater the utility of the skin traction sutures.

In a patient who has no prior midline incision, the skin traction sutures progressively elevated will facilitate identification of the linea alba [3]. In a majority of patients the fascial incision can occur precisely between the right and left external oblique aponeurosis and within the linea alba. In this ideal situation, no muscular tissue of the left or right rectus abdominis muscle is exposed and the midline fascia is a single layer of combined anterior and posterior rectus sheath. This fascial edge clearly defined is the ideal layer of tissue to reapproximate with a small bite running suture (Figure 3).

In patients who have a prior midline abdominal incision, skin traction is of increased importance. The strong elevation of the skin and subcutaneous tissues allow the surgeon to completely excise the scar within the subcutaneous tissue. Also, the scar tissue from the prior surgery can be dissected accurately down to the anterior rectus sheath. Hernia defects associated with the prior abdominal closure can be clearly identified and the dissection extended to expose the fascial edge. This prevents a mass suture technique from incorporating a prior hernia into the new abdominal closure.

If a patient has a prior abdominal incision that is being reopened, the scar tissue associated with the old incision may be opened so that the linea alba is removed. The medial edges of both anterior and posterior rectus sheath are separated with exposure of the rectus muscle (Figure 4, top). This approach may be required in a patient with prior resection of an abdominal or pelvic cancer in whom recurrent disease within the old incision is suspect. If the anterior and posterior rectus sheaths are separated, their repair to reconstitute the linea alba is required prior to abdominal closure using a small bite running suture (see below).
My preferred approach with opening the fascia through an old abdominal incision is scar preservation only as necessary to maintain anterior and posterior rectus sheath together at the midline. Excessive scar should be excised and removed as a specimen. The fascia and old scar provide an edge which can be reapproximated with the small bite running suture.

**Excision of preperitoneal fat including the epigastric fat pad**

An important aspect of direct fascia reapproximation is precise identification of the fascial edge for accurate small bite sutures. This requires that other tissues such as fat and peritoneum are prevented from being included in the fascial closure. To keep the fascial suture exclusively for fascia, the peritoneum and fat adherent to the posterior rectus sheath are generously dissected away from the midline fascia. This means that the epigastric fat pad and peritoneum beneath are resected as a specimen taking care not to injure the posterior rectus sheath in the process. Also, a portion of the preperitoneal fat below the semi lunar line and anterior to the bladder should be resected. Care should be taken not to injure the deep epigastric vessels.

**Excision of the umbilicus**

An anatomic site at high risk for incisional hernia is the mid-abdomen at the umbilicus. There is beneath the umbilicus a natural fascial defect which may manifest itself as an umbilical hernia. To close the midline abdominal incision with optimal fascial repair the tissue that constitutes the umbilical fascia defect must be resected and removed as a specimen. To optimize fascial exposure on both sides of the umbilicus, partial resection of the umbilicus is recommended (Figure 1).

**Elliptical abdominal incision around a prior abdominal scar**

Usually, the scar tissue of the skin and scarred subcutaneous tissue are resected when entering the abdomen or pelvis through a prior midline abdominal incision. To facilitate primary skin closure and allow serous drainage from the wound postoperatively the incision through the skin at the edge of the scar is not made perpendicular to the surface of the skin. The skin incision is made at an oblique angle to the skin. The dissection into the subcutaneous tissue for 2 to 3 cm is required before placement of the skin traction sutures. After uniform elevation and exposure of the abdominal wall tissues has been obtained, the subcutaneous tissue can be dissected away from the midline scar from skin to fascia. If this occurs the distance from fascia to skin edge will be the same on both sides of the abdomen. An even and cosmetically acceptable skin closure over an abdominal closed suction drain can occur. This well closed skin and subcutaneous tissue will maximally protect the fascial closure against infection and build up of serous fluid. A scarred, irregularly closed skin and subsequent tissue is suboptimal for fascial healing.

**Repair of defects between anterior and posterior rectus sheath**

If the laparotomy involves the reopening of an old abdominal incision, dense scar tissue in the prior abdominal closure is not an optimal site for placement of the small bite running closure suture. Ideally, a one cm layer of scar tissue that joins anterior and posterior rectus sheath is preserved as the optimal site for placement of the small bite closing suture. However, often the anterior and posterior rectus sheaths are separated as a result of scar tissue excision or deviation of the abdominal incision from the midline. If this occurs a running absorbable suture is used to recreate a new linea alba prior to abdominal closure (Figure 4, bottom). Oftentimes only a portion of the linea alba has been resected. However, with skin traction sutures in place to clearly expose anterior and posterior rectus sheath and the intervening rectus muscle, these structures are returned to their anatomic condition. The edges of anterior and posterior rectus sheath are used to incorporate a small bite running suture prior to closure of the fascial edges. The reapproximation of anterior and posterior rectus sheath can begin from approximately 5 cm below the xiphoid process. Superior to this fascial level, the posterior rectus sheath is so thin it does not hold stitches. The reapproximation of the anterior and posterior rectus sheath can be continued to the semi lunar line and sometimes to the pubic symphysis if the posterior rectus sheath is firm enough to hold the running suture.

**Tension on the small bite running suture**

In the past strong tension on the mass closure running suture was advised. Using a small bite fascial closure technique only moderate tension that will bring the fascial edges together but not cause ischemic necrosis [4]. Apposition of well vascularized fascial edges is advised [5].
Use of closed suction drains

Anything that can separate the fascial edges between the small bite running sutures can produce an incisional hernia. This includes not only fat, peritoneum or greater omentum but also serous fluid. Especially after a large oncologic procedure with multiple peritonectomies, serous drainage from within the abdomen or pelvis may be as much as a liter per day. In the absence of closed suction drains within the abdomen or pelvis, extensive ascites may accumulate within the abdominal and pelvic space. As it accumulates under increasing pressure, it will be forced through the fascial closure. Also, accumulation of ascites increases intraabdominal pressure and places stress on the fascial closure. In order to minimize serous fluid buildup within the abdomen and pelvis, a minimum of 3 abdominal and pelvic drains are recommended in patients who required extensive soft tissue resection, especially peritonectomy [6]. A closed suction drain is also recommended for a short time within the subcutaneous space.

Skin closure and abdominal dressing

The skin closure should occur over a closed suction drain that is positioned on the fascial sutures and exits through a stab incision at the superior aspect of the abdominal incision. Sutures should be used to bring together epithelial and dermal layers of the skin. A monofilament suture is preferred over staples. The skin sutures should be close enough to loosely bring the skin edges together but spaced far enough to allow serous drainage from the subcutaneous space. A bulky gauze dressing should be applied to absorb drainage from the surgical site. Occlusive dressings to seal the reapproximated skin edges may encourage seroma formation and subsequent surgical site infection.

Clear identification of the whole fascial edge prior to initiating the fascial closure

After the abdominal and/or pelvic dissection is completed the skin traction sutures should remain in place and strong traction resumed. Retractors to expose the abdominal and pelvic space can now be removed and the anatomy of the abdominal wall studied. A thorough irrigation of the edges of the abdominal incision should occur and any small bleeding points secured using electrosurgery. The edge of the fascia devoid of preperitoneal fat and clearly separated from the subcutaneous fat must be identified along the total extent of the abdominal incision. In some areas additional separation of fascia from subcutaneous fat may facilitate subsequent small bite fascial closure. Skin traction sutures are retained with reduced tension during small bite fascial closure in order to clearly visualize the midline fascial edge.

Suture material for fascial reapproximation

In the small bite versus large bite randomized controlled trial, a 2-0 PDS Plus II (Ethicon, Somerville, NJ, USA) with a 31 mm needle was used. The delayed resorption of PDS suture material may account for some late hernia recurrences. A permanent suture material with a small “Fisherman’s knot” at each end of the abdominal incision and the knot joining the superior and inferior suture buried so as not to point into the subcutaneous fat may be preferable. For very long midline incisions a non-absorbable suture is preferable.

Possible weakness of this approach to hernia prevention

The data that supports precise fascia to fascia reapproximation to reduce the incidence of hernia in midline abdominal incisions is reliable. Data from a randomized controlled study and a review of prior research is provided in reference 2. Nevertheless, there are weaknesses in this manuscript that should be addressed. First, there may be other techniques that facilitate small bite fascia reapproximation. This manuscript presents my own opinion regarding the use of skin traction sutures to expose the layers of the abdominal wall and identify the midline fascia that would allow precise fascia to fascia reapproximation. Second, randomized controlled studies were performed on primary midline abdominal incisions; data regarding the use of this suturing technique in patients with prior abdominal incisions is not, as yet, available. Our comments regarding the use of small bites in the closure of the abdomen with reoperative surgery are an extrapolation from data regarding primary midline abdominal incisions. Third, in this opinion paper, there is no comparison group by which to evaluate the technology described in the text and figures. Our goal was not to provide new data but to describe an optimal technique for small bite fascia to fascia closure. Finally, long-term follow-up on the large number of patients closed using this technology is not available. Patients should be studied for years and even decades in order to determine long-term the benefits from a small bite fascia to fascia closure of a midline incision.

Prophylactic use of mesh to supplement fascia closure

Certainly, the technology for repair of midline abdominal hernias has been improved by the selective use of a closure technique that involves mesh. However, routine use of mesh for closure of a primary midline abdominal incision cannot be recommended at this point in time. There may be indications for selective use [1]. It is possible that a group of “high risk patients...
for incisional hernia can be identified who would benefit from placement of a prophylactic mesh. Included in this group could be obese patients, patients with heavy cigarette smoking, patients on steroids, patients on cancer chemotherapy. Another group of patients would be those who may have a collagen defect. Most prominent in this group may be those having surgery for abdominal aortic aneurysm. The precise indications for prophylactic use of mesh in a midline abdominal incision have not, as yet, been reliably determined. In my practice, if the fascia is thin and small bite sutures are in danger of pulling through, an onlay mesh is indicated.

Summary statement regarding an optimal closure of a long midline abdominal incision

An important change in the small bite fascial closure data concerns the surgeons’ attitude towards abdominal wall surgery. The opening and closing of the abdominal incision is not only a quick abdominal incision followed by a mass closure after completion of the abdominal and/or pelvic dissection. It is an important part of an optimal surgical event with hernia prevention continuously of concern.

Table 1 lists nine concepts in surgical technology that deserve attention prior to making the abdominal incision and continuing through the procedure up until application of the wound gauze coverage. Although the meticulous small bite fascial closure is the focal point for change in the surgical approach to closure of long midline abdominal incisions, implementation of this surgical technology is greatly facilitated by changes that should occur at multiple times during the surgical procedure.

REFERENCES