# 2
# Incisions

## Introduction

With the advent of laparoscopy and other minimally invasive approaches, more and more operations can be performed through small incisions, thereby reducing the morbidity associated with large wounds. Nevertheless, there are instances where laparoscopy is either not feasible or would be unsafe, and an open incision is the best approach.

Several different types of incisions can be used to provide access to the body cavities. In the thorax, the most common incisions are a **sternotomy** and a **thoracotomy**. In the abdomen, the **vertical midline** incision is the most frequently used. Other options include a unilateral or bilateral **subcostal** (chevron) incision, a **paramedian** incision, or a **Pfannenstiel** incision. A **thoracoabdominal** incision is a single, large incision that spans both body cavities. Each incision has its own advantages and disadvantages; it is up to the surgeon to choose the route of entry that provides the best exposure for the intended operation while limiting morbidity to the patient.

Once the operation is complete, the phases of wound healing begin. Normal wound healing starts with an influx of neutrophils and macrophages that remove bacteria and devitalized tissue by phagocytosis. Next, fibroblasts migrate to the site and begin the work of collagen synthesis, angiogenesis, and re-epithelialization. With time, further remodeling and maturation of the wound occurs. Although the majority of the

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healing process is complete at 6 weeks, the full strength and final appearance of a wound can take up to 1 year to be fully established.

Many factors contribute to wound healing and must be considered by the surgeon when planning surgery. Severe malnutrition, immunosuppression, recent chemotherapy, chronic steroid use, smoking, and diabetes are all associated with poor wound healing and higher rates of complications. To the degree possible, any such factors should be addressed prior to surgery in order to maximize the chance of normal healing. For example, in certain cases it may be advantageous to delay surgery in order to allow for a period of aggressive nutritional supplementation. In the postoperative period, attention to tight glycemic control in diabetics has been proven to reduce infectious complications.

## Surgical Technique

The skin incision is made with a scalpel and carried down through the subcutaneous fat to the underlying fascia (Fig. 2.1). Once the fascia is reached, it is elevated and incised, taking care not to damage any underlying structures. Electrocautery should be used sparingly since necrotic fat promotes infection. When using a midline abdominal incision, it is important to accurately locate the **linea alba** where the fusion of the aponeuroses of the abdominal muscles occurs (Fig. 2.2). Making the incision through the **decussation of fibers** avoids the rectus muscles and allows for a stronger fascial closure. For incisions that traverse muscle groups, slow electrocautery should be used to divide the muscle fibers and achieve hemostasis.

Upon completion of the operation, different techniques can be used to re-approximate the fascial edges. Typically a single running suture is used from both ends of the incision and tied together at the midpoint. Alternatively, multiple interrupted sutures can be used depending on the setting and surgeon preference. It is not necessary to suture together muscle or subcutaneous fat since the strength of a closure

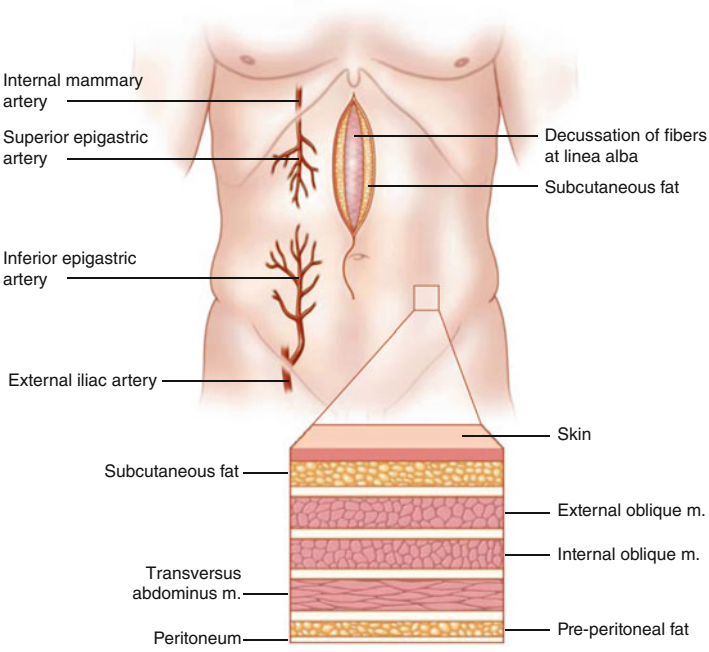


FIG. 2.1 Surgical anatomy for abdominal incisions: skin, subcutaneous fat, external oblique muscle, internal oblique muscle, transverses abdominus muscle, preperitoneal fat, peritoneum, decussation of fibers, linea alba, internal mammary artery, superior epigastric artery, external iliac artery, and inferior epigastric artery

comes from the fascia. In cases where the fascia is of too poor quality to hold sutures reliably, **retention sutures** can be used. These sutures are placed en masse through the skin and abdominal wall, and provide greater strength to maintain abdominal closure.

In certain situations, the fascia even can be temporarily left open. For example, if the patient is too unstable to remain in the OR, or if there is too much bowel edema present for the fascial edges to reach, then a **vacuum dressing** can be used. A sterile sponge is placed into the incision and covered

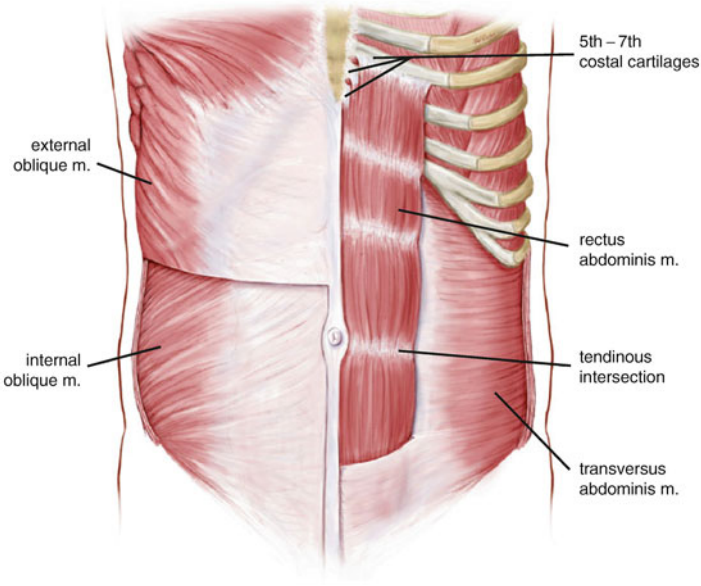


Fig. 2.2 Muscles of the anterior abdominal wall. [Reprinted from Prendergast PM. Anatomy of the Anterior Abdominal Wall. In: Shiffman M, Di Giuseppe A. Cosmetic Surgery: Art and Techniques. Heidelberg, Germany: Springer Verlag; 2013: 57-68. With permission from Springer Verlag.]

with a plastic sheet and is connected to a negative pressure machine. This dressing can be changed every 24–48 h, as needed and the fascial closure can be performed once patient has been stabilized or the bowel edema has resolved.

The skin itself can be closed primarily with sutures, surgical staples, or medical glue. In certain settings where there is not enough skin present to close a wound, alternative techniques can be used for coverage. Local **skin flaps** can be used to rotate or advance tissue into the surgical site and allow closure. A split or full-thickness **skin graft** can be taken from a separate body site and used to cover the wound. In order to survive, the skin graft must establish revascularization from

the surgical bed. Therefore, skin grafts can only be used on clean wounds that have well-vascularized tissue present. Lastly, the skin may also be left open, in which case it will heal by **secondary intention**, a slow process where the wound contracts over a period of weeks. This approach is best for heavily soiled wounds.

An incision that is created and closed under sterile conditions is typically kept dressed until the second postoperative day. By that time, epithelialization across the wound is complete, effectively sealing it off from the outside world. After this time, the wound may be left uncovered, unless dressings are needed to absorb drainage, for patient comfort, or per surgeon preference.

The timing of removal of skin sutures or staples depends upon on the location of the incision. The face and neck heal very quickly, allowing for suture removal in as little as 3 days, whereas sutures in the abdomen and trunk are typically left in for at least 10 days. Sutures may need to be removed sooner to allow drainage if a wound infection is suspected.

## Complications

Regardless of the size and location, all incisions carry the risk of **wound infection**. The topical application of sterilizing preps to the skin prior to incision destroys any bacteria present at the surface, however new bacteria migrate up from the intradermal glands within hours. Systemic antibiotics decrease the risk of wound infection and are given pre-incision in operations that involve contaminated areas such as the gastrointestinal or genitourinary tracts. It is important to re-dose antibiotics every few hours, as indicated, during a long operation.

Subcutaneous fat is poorly vascularized and provides ideal conditions for bacterial growth and abscess formation. Therefore, any postoperative erythema of the incision should be investigated for purulent collections by partially opening the skin and probing the subcutaneous fat. When operating in a grossly infected field (e.g., perforated appendicitis) the risk

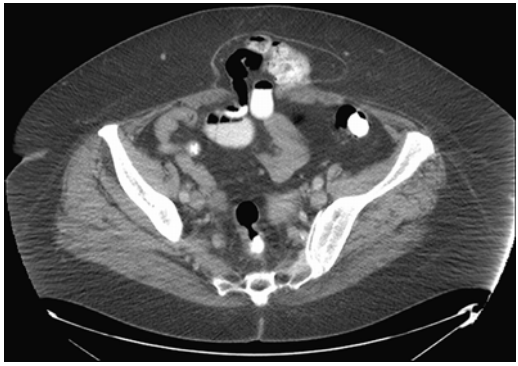

FIG. 2.3 CT scan image of a patient with an incisional hernia through a prior midline incision

of wound infection is so high, that the skin should be left open to allow for free drainage.

**Dehiscence** of the wound describes postoperative disruption of the fascia. This most often occurs secondary to a wound infection that has eroded away the underlying fascia allowing the sutures to pull through the tissue. The classic presentation of dehiscence is the new onset of copious salmon-colored fluid from the incision in the postoperative period. This fluid is normal peritoneal fluid that suddenly begins to drain through the wound once the fascial edges separate. Dehiscence can be accompanied by **evisceration** if the skin also opens and the abdominal viscera extrude through the wound. Patients may describe an incident of increased intra-abdominal pressure such as coughing or a bowel movement that resulted in a sudden opening of the incision with visible bowel. If evisceration occurs, immediate operative repair should be performed.

Longer-term issues with fascial healing can result in the patient developing an **incisional hernia** (Fig. 2.3). Most incisional hernias occur due to poor tissue strength, a technical error in closure, too much tension on the closure, or a postoperative wound infection. In addition, early resumption of

physical activity can result in a hernia, and thus patients are advised to avoid heavy lifting for one month following surgery. Depending on the clinical scenario, most incisional hernias should be repaired due to the risk of incarceration and strangulation.

In the setting of trauma or sepsis, massive fluid resuscitation is sometimes required and can lead to extreme bowel edema. Forcibly closing the abdominal fascia over such edematous bowel causes elevated intra-abdominal pressures, known as **compartment syndrome**. These high pressures decrease perfusion to the kidneys, leading to oliguria and rising creatinine. In addition, intubated patients will demonstrate high peak airway pressures caused by the intra-abdominal organs compressing the diaphragms and limiting pulmonary capacity. The intra-abdominal pressure can be measured using a foley catheter equipped with a pressure transducer. If compartment syndrome is diagnosed, the abdominal fascia should be immediately opened to relieve the pressure.

## Classic Case

A surgical consultation is requested on a 76-year-old diabetic, obese woman who presents with peritonitis. Evaluation with an upright chest X-ray reveals that she has free air under the diaphragm. Immediate operative exploration is performed through a vertical midline incision and reveals perforated diverticulitis with gross fecal contamination of the abdomen. A Hartmann's procedure is performed, where the proximal colon is exteriorized with a colostomy and a rectal stump is left in the pelvis. Antibiotics were administered prior to incision and are re-dosed appropriately throughout the operation. Upon completion of the operation, the fascia is closed with a running suture from either direction and the skin is only loosely approximated with staples.

The patient initially does well, but on the third postoperative day she develops a fever to 38.8 °C. Examination of the wound reveals blanching erythema of the skin with extension

laterally across the abdominal wall. The staples at the site of greatest erythema are removed and probing of the wound is performed. The fascia is intact but some necrotic debris is present. Systemic antibiotics are initiated with some recession of the erythema and local wound care with twice-daily wet to dry dressing changes are initiated.

Two days later the surgical team is paged STAT by the nurse. While coughing, the patient suddenly felt a gush of fluid from her wound. On examination, the skin is open and small bowel is visible in the wound. The patient is urgently taken to the operating room. Inspection of the wound reveals poor healing and frankly necrotic fascia with loose sutures. The wound is closed with retention sutures. The patient ultimately has an uneventful recovery and is discharged home.

## OR Questions

1. What patient factors are associated with poor wound healing?
   *Obesity*, *advanced age*, *chronic steroid use*, *smoking*, *poor nutrition*, *diabetes*, *history of prior radiation*, *and early excessive physical activity.*
2. What surgeon factors are associated with poor wound healing?
   *Poor closure technique*, *excessive tension on the fascia inadequate administration of perioperative antibiotics*, *and inappropriate closure of a contaminated wound.*
3. When closing an incision, is it advisable to suture together the layers of muscle and fat?
   *No*, *sutures placed in muscle and fat add no strength to the wound. Only fascia provides the necessary integrity for wound closure.*
4. Where are the majority of surgical site infections located?
   *In the subcutaneous fat*, *between the skin and the fascia.*
5. Can a wound infection be treated with antibiotics alone?
   *No amount of antibiotics will cure a wound infection in the presence of an undrained purulent collection beneath the skin*; *opening the wound is the necessary treatment.*

6. A patient with a well-healed scar from a previous paramedian incision now requires open surgery again. Is it advisable to make the incision through the previous scar, or to make a midline incision?
   *In general, the surgeon should choose the incision that best serves the needs of the current operation. However, it would be ideal to reuse the paramedian site, since a parallel incision may severely limit the blood supply to the area in between, risking tissue necrosis.*

## Incisions

**Vertical midline**
- Most often used
- Minimal blood loss
- No division of muscle fibers
- No nerve injury
- Easy to open and close
- Good exposure to most abdominal and pelvic structures

**Pfannenstiel**
- Low transverse incision just above the pubis
- Excellent cosmetic results
- Exposure is limited to the pelvis

**Subcostal**
- Rectus muscle is divided, which can be more painful
- Provides exposure to gallbladder on the right, and spleen on the left
- A bilateral subcostal (chevron) incision offers excellent exposure to entire upper abdomen

**Thoracic incisions**
- Sternotomy: excellent exposure to the entire thoracic cavity, can be complicated by sternal wound infection
- Thoracotomy: provides access to each lung and the esophagus, can be used to clamp the aorta in trauma situations
- Thoracoabdominal: only used when necessary due to the morbidity associated with such a large incision

**Paramedian**
- Better exposure to lateral structures
- Lower incidence of incisional hernia because the abdomen is closed with multiple layers of fascia
- Costal margin limits vertical extension

**Peri-op orders**

- Pre-incision antibiotics for clean-contaminated or contaminated cases
- First dressing change for clean incisions is usually POD#2
- Infected incisions may need dressing changes bid, as indicated

**Complications**

- Infection: most wound infections are superficial to the facial closure: opening of the skin allows drainage and resolution
- Dehiscence: separation of the fascia, most often secondary to wound infection or excessive tension, may be heralded by the sudden new discharge of fluid from the wound
- Evisceration: protrusion of the abdominal viscera through the wound, due to a dehiscence, requires immediate operative repair
- Incisional hernia: essentially a late fascial dehiscence
- Compartment syndrome: elevated intra-abdominal pressure caused by closing the fascia in the setting of edematous bowel. May present with elevated creatinine or decreased urine output. A bladder pressure >25mmHg is diagnostic. Abdominal fascia must be opened for relief.

## Suggested Readings

Roses RE, Morris JB. Incisions, closures, and management of the abdominal wound. In: Zinner MJ, Ashley SW, editors. Maingot's abdominal operations. 12th ed. New York: McGraw-Hill Professional Publishing; 2013.

Buck DW, Galiano RD. Wound care. In: Thorne CH, Chung KC, Gosain AK, Gurtner GC, Mehrara BJ, Rubin PJ, Spear SL, editors. Grabb and Smith's plastic surgery. 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2014.

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