Lateral abdominal wall hernia repair

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INTRODUCTION

The first description of a lateral abdominal hernia can be traced back to a case reported in 1906 [1]. While these defects occur less frequently than ventral abdominal hernias, they can progress to a very large size and cause significant morbidity.

Lateral abdominal wall hernias are a distinct entity from ventral abdominal wall hernias with respect to their anatomy, clinical behavior, and surgical management. The etiology of the defect, presence of substantial static anatomic supporting structures, and extent of reinforcement have a significant impact on long-term recurrence rates.

The anatomy, physiology, pathogenesis, diagnosis, and surgical management of lateral abdominal wall hernias are discussed here. Ventral abdominal wall hernia is discussed in multiple other topics:

- (See "Overview of abdominal wall hernias in adults".)
- (See "Clinical features, diagnosis, and prevention of incisional hernias".)
- (See "Management of ventral hernias".)
- (See "Spigelian hernias".)
- (See "Open posterior component separation techniques" and "Robotic component separation techniques".)

ANATOMY

The lateral abdominal wall encompasses a much larger surface area than the ventral abdominal wall and is comprised of the external oblique, internal oblique, and transversus abdominis muscles, as well as the transversalis fascia. Its boundaries include the costal margin superiorly, iliac crest inferiorly, linea semilunaris anteriorly, and paraspinous muscle and fascia posteriorly. The muscles comprising the lateral abdominal wall are innervated by the thoracoabdominal intercostal nerve bundles arising from T7 through T12. The blood supply to the lateral abdominal wall musculature is provided by the intercostal, lumbar, and deep circumflex iliac vessels [2]. (See "Anatomy of the abdominal wall".)

A clear understanding of the distinct anatomy and behavior of lateral abdominal wall hernias is necessary for appropriate management of patients.

PHYSIOLOGY

Most of the studies of abdominal wall physics and physiology pertaining to hernia formation have been carried out on the ventral abdominal wall. The literature lacks a detailed study of the interaction of the various forces and stresses associated with the lateral abdominal wall. Our understanding of the mechanics of lateral abdominal wall defects is therefore derived from our knowledge of ventral abdominal wall physiology [2-5]. However, there are important differences between ventral and lateral abdominal wall hernias that stem from the differences in the anatomic composition of these structures.

The lateral abdominal wall has a higher proportion of muscle fibers than aponeurotic tissue. Since muscle fibers have a lower tensile strength than aponeurosis, the lateral abdominal wall may be more prone to larger and more broad-based defects than the ventral abdominal wall.

The defects in the lateral abdominal wall are also asymmetrically located and subject to the combined pull of the rectus complex and contralateral lateral abdominal wall on one side and the attenuated pull of the ipsilateral lateral abdominal wall on the other. The asymmetric distribution of forces may contribute to defect instability and enlargement.

Finally, lateral abdominal wall hernia and bulge are usually caused by denervation injury with or without direct muscle injury. Denervation leads to a much larger area of weakness surrounding the actual defect. The true region of weakness surrounding the hernia or bulge may be much larger than is the anatomic defect.

PATHOGENESIS AND RISK FACTORS

Pathogenesis — Lateral abdominal defects (hernia or bulge) are generally a result of incisional hernia, denervation injury caused by prior surgical incisions, direct excision of myofascial tissue during tumor extirpative surgery, or trauma.

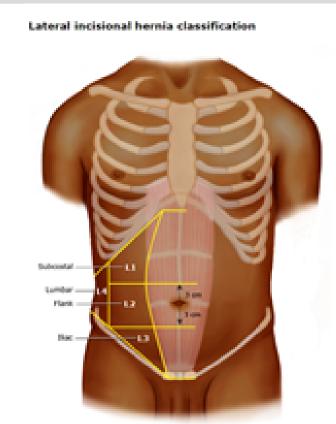
Subcostal incisions such as Kocher and Chevron incisions in hepatobiliary surgery, retroperitoneal access incisions in vascular procedures, or flank incisions in urological procedures can result in hernia or denervation injury that leads to a flank bulge in 8 to 57 percent of patients [6-9]. In a meta-analysis of 26 studies, the incidence of flank hernia recurrence following nephrectomies and abdominal aortic aneurysm (AAA) repairs was noted to be 17 percent. The incidence was slightly lower for nephrectomies (14 percent) than for AAA repairs (20 percent) [10].

Risk factors — Patient-related risk factors that increase the risk of recurrence or complications are similar to those seen with ventral abdominal wall reconstruction. These include obesity, uncontrolled diabetes, hypertension, chronic obstructive pulmonary disease, coronary artery disease, and chronic kidney disease [7,11,12]. The use of immunosuppression in transplant patients and incision lengths longer than 15 cm have also been shown to increase the risk of hernia formation [9]. (See "Clinical features, diagnosis, and prevention of incisional hernias", section on 'Risk factors'.)

While most of these risk factors cannot be eliminated, those specific to incision placement and length can be significantly optimized by placing incisions in line with the dermatomal distribution of nerves (figure 1), minimizing the number of dermatomes crossed by reducing the vertical component of the incisions, and reducing denervation injury by avoidance of posterolateral placement of incisions. Placement of incisions below the 12th rib is recommended to avoid injury to the 11th intercostal and 12th subcostal nerves. Dermatomal incisions that are intended to reduce intercostal nerve injury also contribute to some weakness because they result in direct muscle transection due to the crossing orientation of muscle fibers [7,8,10,11,13-15].

CLASSIFICATION

Anatomical classification — The European Hernia Society developed a classification system for both ventral and lateral abdominal wall hernias in 2007. Based on this classification system, lateral abdominal wall hernias are defined to lie lateral to the rectus sheath and were classified into subcostal, flank, iliac, and lumbar hernias. Subcostal hernias extend from the costal margin to a horizontal line 3 cm superior to the umbilicus. Flank hernias extend from 3 cm superior to the umbilicus to a line 3 cm inferior to the umbilicus. Iliac hernias extend inferiorly from 3 cm below the umbilicus to the iliac crest and inguinal region. Lumbar hernias lie posterior to flank



Lateral incisional hernia classification hernias and are located lateral and dorsal to the anterior axillary line (figure 2) [16].

Figure 2 - larger image below

Other informal classification schemes have since then been published. Based on these schemes, "true" lateral abdominal wall hernias are those that lie between the anatomic boundaries of the lateral abdominal wall: costal margin, linea semilunaris, iliac crest, and paraspinous muscles. In many cases, however, defects can extend beyond these boundaries and are categorized based on the boundaries they cross. (See 'Cross-boundary defects' below.)

Etiological classification — Lateral abdominal defects can also be classified based on their etiology as "excisional" or "hernia" or "bulge."

- "Excisional" defects occur following tumor resection that involves resection of lateral abdominal wall muscle, fascia, or skin.
- "Hernia" defects, on the other hand, are incisional hernias or can be associated with the progressive weakening of a portion of the abdominal wall distal to an area of denervation caused by prior surgical incisions [3].
  - In true hernia defects, all the myofascial layers are involved [3,7,11,12,17].
  - An interparietal hernia is caused by a defect in a subset of the muscle layers. In most of these cases, there is a defect in the internal oblique, transversus abdominis, and transversalis layers, but the external oblique muscle remains intact [18].
- A "bulge" is caused by attenuation of the myofascial layers without a defect in any of the layers. A "bulge" has no true musculofascial opening and is commonly caused by denervation injury.

DIAGNOSIS

Lateral abdominal wall defects tend to be fairly broad based and are less likely than ventral defects to be obstructive or lead to incarceration of peritoneal contents. Patients note a progressive bulging of the lateral abdominal wall with occasional back pain near the origins of the oblique musculature. Computed tomography (CT) imaging is used to confirm the diagnosis, which can vary between bulge, interparietal hernia, and a true lateral abdominal wall hernia. (See 'Classification' above.)

INDICATIONS FOR REPAIR

Indications for surgical repair vary by the etiologies of the lateral abdominal wall defects. (See 'Etiological classification' above.)

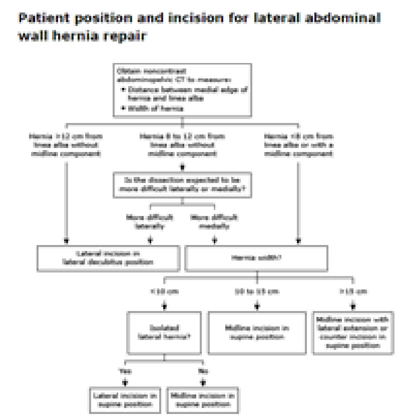
Excisional defect — These defects are caused by tumor resection and are repaired in the same operative setting.

Incisional hernia — These defects generally occur months to years following prior flank incisions as a result of denervation, progressive weakening, and eventually herniation through one or more layers of the lateral abdominal wall. We generally recommend surgical repair with mesh; however, if the patient is not a surgical candidate or does not want surgery, they may be managed with an abdominal binder. In this case, it is important to educate the patient about signs and symptoms of incarceration and worsening of the hernia.

Bulge — These defects are generally managed conservatively with the use of an abdominal binder. Bulges may continue to progress over time if managed conservatively. Surgical repair is considered for symptomatic and large bulges.

SURGICAL MANAGEMENT

Patient position and incisions — In most instances, lateral abdominal wall hernias are incisional hernias from prior nephrectomy or aortic abdominal aneurysm access incisions. The most direct approach to the hernia sac is by opening the prior flank incision and dissecting down to the defect. However, a midline laparotomy may be required if the lateral hernia defect extends medially to involve the semilunar line or if there is a concomitant midline ventral hernia [19]. The following algorithm based on the distance from the medial edge of the hernia defect to the linea alba and the width of the hernia has been proposed to aid the selection of an incision (midline versus lateral) and patient position (supine versus lateral decubitus) (algorithm 1) [20]:



Patient position and incision for lateral abdominal wall hernia repair

Algorithm 1 - larger image below

- If the medial edge of the hernia is >12 cm from the linea alba, the repair can be performed through a lateral incision with the patient in the lateral decubitus position.

- If the medial edge of the hernia is <8 cm from the linea alba, or when the hernia has a midline component, adequate midline mesh coverage cannot be obtained due to limitations by the linea alba. In such cases, the repair should generally be performed in the supine position with a midline incision. However, there are two exceptions:

  - Isolated lateral hernias that are small (width <10 cm) can be repaired through a lateral incision with the patient supine.
  - Very large hernias (width >15 cm) may require a lateral extension or counterincision in addition to the midline incision to expose the lateral aspect of the hernia defect and facilitate posterior and lateral dissection.
- If the medial edge of the hernia is between 8 and 12 cm from the linea alba, the repair can be performed through either a lateral incision or a midline incision, depending on whether the lateral or medial aspect of the dissection is judged to be more difficult by the surgeon.

A midline laparotomy incision is usually followed by lateral dissection in the preperitoneal plane or transversus abdominis release (TAR) plane toward the hernia defect. This is identical to the TAR approach that has been described to address ventral hernias [14,21-25]. In cases where the TAR plane cannot be accessed due to scarring or prior resection, an underlay or intraperitoneal plane can be used. In this case, a biologic mesh is preferred to a synthetic mesh. (See 'Mesh plane' below and "Open posterior component separation techniques", section on 'Open transversus abdominis release'.)

The use of remote incisions avoids reopening the old incision and dissecting in an area with preexisting weakness [7,11,12,17,21,22,26]. In addition to midline incisions, others have proposed the use of an abdominoplasty technique to repair flank bulges. In this case, a transverse abdominoplasty incision is used to elevate the soft tissues superficial to the myofascial layer to expose the boundaries of the lateral abdominal wall. The weakened lateral abdominal muscle layers are imbricated and then reinforced with an overlay piece of synthetic mesh [15].

Mesh reinforcement — The majority of lateral abdominal wall hernia defects and all excisional defects require surgical repair with mesh reinforcement. Given the heterogeneity of defects and the lack of a clear mechanistic description of forces incident on the lateral abdominal wall, multiple types of surgical solutions have been described. These procedures vary based on incision location, plane of mesh placement, type of mesh used, and extent of mesh fixation.

Mesh plane — As is the case with ventral hernias, different planes for mesh placement have been described [27]. A clear comparison between outcomes with respect to plane of mesh placement can be difficult due to the multiple synonymous terms used by various groups in reporting. (See "Hernia mesh", section on 'Mesh location'.)

Among the various possible planes of mesh placement, we prefer to place the mesh in the preperitoneal plane whenever possible (figure 3). If the preperitoneal plane is not accessible (due to scarring or prior resection), we place the mesh intraperitoneally [4].

- The overlay (onlay) plane lies superficial to the myofascial layers (the external oblique muscle and aponeurosis laterally and the anterior rectus sheath medially). Due to concern for higher risk of recurrence, this plane is seldom used for reinforcement of lateral defects except for extreme posterolateral defects to avoid injury to important retroperitoneal structures, such as the posterior insertion of the diaphragm, spine, aorta, and vena cava [2,15].

- The next plane is referred to as the intramural, interparietal, or interoblique plane. This plane is entered by separating the composite layers of the internal oblique, transversus abdominis, and transversalis fascia from the external oblique layer. The deeper muscles are repaired using either imbrication or "vest over pants" techniques. The mesh is then placed between the internal and external oblique muscles, followed by repair of the external oblique layer [12,26,28].

- The TAR or retromuscular plane is accessed by dissecting between the transversalis fascia and the transversus abdominis muscle or between the transversalis fascia and peritoneum [12,21-25]. The plane can be extended cranially to the central tendon of the diaphragm or caudally to Cooper's ligaments. The plane can also be extended laterally and posteriorly between the peritoneum and the investing fascia of the quadratus lumborum and psoas muscles. If the hernia defect extends medially up to or beyond the linea semilunaris, then the plane can be extended into the retrorectus plane. The mesh is placed superficial to the transversalis fascia or peritoneum laterally and the posterior rectus sheath medially [14,19,21-23,29,30].

- The preperitoneal or intraperitoneal planes have been referred to as the underlay plane. The preperitoneal plane is created by dissecting the peritoneal lining off the transversalis fascia. This might not be possible if there is significant scarring or inflammation that obscures these layers. In such cases, the mesh is placed deep to the peritoneal lining in the intraperitoneal plane [3,11,12]. In certain scenarios, the mesh can be placed in the preperitoneal plane in the lateral abdominal wall and extended into the retrorectus plane if the defect crosses over into the ventral abdominal wall [7].

There are certain groups that advocate for two layers of mesh reinforcement to sandwich the intervening weakened myofascial layers [14,31]. The deeper piece of mesh in the underlay plane is anchored to osseous structures such as the iliac crest and pubic symphysis, and a second piece of mesh is placed as an overlay [31].

Mesh material — Lateral abdominal wall repairs have been described with both synthetic and biologic mesh. If mesh can be placed in a plane without risk of bowel contact, and the case is otherwise deemed a clean or clean-contaminated case, an uncoated, macroporous, medium-weight synthetic mesh can be used. If there is risk for bowel contact, then a coated (antiadhesive) synthetic mesh or biologic mesh is preferred. If there is significant wound contamination, then a biologic mesh is preferred.

- Synthetic mesh is preferred if it can be insulated from peritoneal or retroperitoneal structures. Exposure to intraperitoneal contents can be avoided if the preperitoneal plane or more superficial planes are available for mesh placement but not when the mesh has to be placed in the intraperitoneal plane. Synthetic mesh is considered by some to have a more robust strength profile; however, it is prone to stimulating scarring and adhesion formation, which increases the risk of bowel obstruction and complexity of future surgical intervention. Furthermore, a higher infection risk can lead to an increased risk of mesh explantation if the infection cannot be cleared by conservative measures [32,33].

- Biologic meshes are commonly used in contaminated cases or if the mesh needs to be placed in an underlay plane where it could come into contact with internal organs. The risk of adhesion formation and infection is generally lower, and wound complications can usually be conservatively managed with dressings and antibiotics [2,34,35].

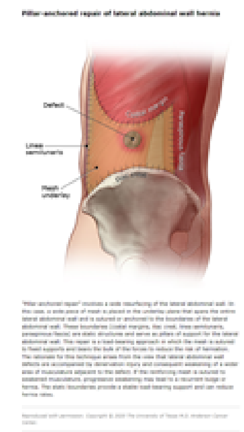
Extent of mesh reinforcement — In addition to the plane of mesh placement, the extent of mesh overlap and reinforcement can also have an important impact on outcomes. There are two major viewpoints with regard to how these defects are reinforced. We prefer the pillar-anchored repair whenever anatomically feasible.

- "Direct mesh repair" or "direct supported repair" involves the use of an underlay sheet of mesh that extends 3 to 5 cm beyond the edges of the defect and is sutured to robust-appearing muscle tissue surrounding the hernia [26]. "Direct mesh repair" is a load-sharing approach in which both the mesh and the adjacent abdominal wall share stresses to avoid recurrence. The rationale behind the "direct mesh repair" technique is that coaptation of the mesh to the dynamic adjacent musculature maintains the abdominal wall compliance such that the forces at the mesh-muscle interfaces are lower.

- "Pillar-anchored repair," on the other hand, involves a much wider resurfacing of the lateral abdominal wall [3]. In this case, a wide piece of mesh is placed in the underlay plane that spans the entire lateral abdominal wall and is sutured or anchored to the boundaries of the lateral abdominal wall. These boundaries (costal margins, iliac crest, linea semilunaris, paraspinous fascia) are static structures and serve as pillars of support for the lateral abdominal wall. The "pillar-anchored repair" is a load-bearing approach in which the mesh is sutured to fixed supports and bears the bulk of the forces to reduce the risk of herniation. The rationale for the "pillar-anchored repair" arises from the view that lateral abdominal wall defects are accompanied by denervation injury and consequent weakening of a wider area of musculature adjacent to the defect. If the reinforcing mesh is sutured to weakened musculature, progressive weakening may lead to a recurrent bulge or hernia. The static boundaries provide a stable load-bearing support and can reduce hernia rates.

These two major repair techniques were compared in a retrospective study of 106 patients undergoing lateral abdominal wall reconstruction [4]. After a median follow-up of 28 months, patients who underwent pillar-anchored repair had a 3.5-fold lower hernia recurrence rate compared with those who underwent "direct mesh repair." There were no significant differences between the two techniques with regard to other outcomes such as surgical site occurrences (hematomas, seromas, or wound dehiscence) or surgical site infections (cellulitis or abscess). Lateral "hernia" defects were associated with a higher likelihood of hernia recurrence than "excisional" defects. (See 'Etiological classification' above.)

Although these two viewpoints describe the two ends of the spectrum, in practice many groups will anchor the mesh to the static pillars if they are close enough to the defect. If the defect is far from the static boundary, then dissection will be carried out to at least 5 cm beyond the defect or until substantial soft tissue can be found to anchor the mesh (figure 4 and figure 5) [7,11,12,17,28]. Mesh reinforcement using the TAR techniques requires at least a 10 cm overlap of tissue beyond the defect [30].



Pillar-anchored repair of lateral abdominal wall hernia

Figure 5 - larger image below

Role for primary fascial closure — Contrary to the findings reported in the ventral abdominal wall hernia repair literature, primary fascial closure did not confer a significant advantage over bridged repairs of lateral abdominal wall defects.

In primary fascial closure, mesh is placed in an underlay (preperitoneal or intraperitoneal) plane and the overlying myofascial tissue is approximated over it, thereby providing a dual layer of closure and strength. On the other hand, in bridged repairs (ie, inlay mesh), mesh is sutured to substantial tissue or static supports, but the overlying fascia cannot be approximated.

Reconstruction of ventral abdominal wall defects with primary fascial closure and mesh underlay has significantly better outcomes than bridged repair with respect to surgical site occurrences, surgical site infections, and hernia recurrence. In a study of 535 patients with a follow-up of 30 months, bridged repair was shown to have a significantly higher hernia recurrence rate (33.3 versus 6.2 percent) and overall complication rate (59 versus 30 percent) than primary fascial closure [36]. (See "Laparoscopic ventral hernia repair", section on 'Fascial defect closure'.)

However, when outcomes of lateral abdominal wall hernias were reviewed, bridged repairs did not lead to significantly higher hernia recurrence rates or wound complication rates when compared with primary fascial closure [3]. The reason for this finding is the subject of further study. One possible cause could be the differences between the strength of the bonds formed at the mesh-muscle interface in the lateral abdominal versus mesh-aponeurotic interface in the ventral abdominal wall.

Soft tissue reconstruction — The main objectives of soft tissue reconstruction are to obliterate dead space and to provide robust, tension-free coverage over the mesh-reinforced myofascial closure. Stable soft tissue coverage reduces the risk of surgical site infection and surgical site occurrences (hematoma, seroma, wound dehiscence). Options for soft tissue reconstruction depend on the size of the soft tissue defect and the presence of adjacent well-vascularized tissue.

- Given the wide surface area and overlapping angiosomes of the lateral abdominal wall, extensive undermining followed by local advancement can be effective in most cases.

- When this is unachievable, pedicled myocutaneous or fasciocutaneous flaps can be transposed into the defect. The latissimus dorsi myocutaneous flap, superiorly based vertical rectus abdominis myocutaneous flap, or omentum flap can be used to cover defects that are located in the superolateral abdominal wall. (See "Overview of flaps for soft tissue reconstruction".)

  - The latissimus dorsi myocutaneous flap can be based on either the thoracodorsal or segmental lumbar and intercostal vessels depending on the arc of rotation needed to cover the defect.

  - The omentum flap is an intraperitoneal structure and therefore requires an obligate hernia to allow it to be externalized.

  - The vertical rectus abdominis myocutaneous flap can be superiorly based on the superior epigastric vessels or inferiorly based off the inferior epigastric vessels. When used as a superiorly based flap, extra venous outflow might need to be constructed if the superior epigastric vessels are diminutive.

  - Other options for coverage of the inferolateral abdominal wall include flaps based on the branches of the lateral circumflex femoral vessels (anterolateral thigh flap, vastus lateralis muscle flap, tensor fascia lata flaps). In certain cases, a bipedicled thoracoepigastric flap can be transposed to cover the defect.

- If pedicled flap options are unavailable, free tissue transfer is used. Free flaps are most commonly harvested from the thigh, which provides a versatile source of skin, fat, and muscle tissue combinations. Most commonly, an anterolateral thigh flap or vastus lateralis muscle flap can be harvested as a free flap. Recipient vessels include deep inferior epigastric vessels, internal mammary vessels, intercostal vessels, or lumbar vessels. When recipient vessels of adequate diameter cannot be located close to the defect, vein grafts such as the saphenous vein grafts can be harvested to construct an arteriovenous loop from the internal mammary system or the femoral-saphenous system. In less frequent scenarios that allow for a staged approach to reconstruction, tissue expanders can be used to increase the amount of adjacent local tissue that can be advanced into the defect [4,37]. (See "Overview of flaps for soft tissue reconstruction", section on 'Anterolateral thigh flap'.)

Role for minimally invasive repair — While this topic is mainly focused on the open management of lateral abdominal wall defects, certain groups have described the use of laparoscopic as well as robotic techniques.

- Laparoscopic repairs are generally performed using intraperitoneal onlay mesh (IPOM) or transabdominal preperitoneal placement of mesh (TAPP) techniques. In both cases, a plane is dissected in order to create a 5 cm landing strip along the edges of the defect. The defect is then reinforced with mesh with at least 5 cm of overlap. Laparoscopic mesh repairs may require additional mobilization of colon to achieve a better field of view, which can increase the risks of visceral injury [18,38,39].

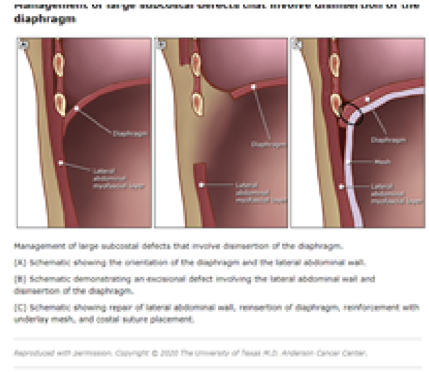
- Endoscopic techniques such as total endoscopic sublay repair have gained popularity due to the reduction in the inherent risk of intra-abdominal organ injury associated with transabdominal laparoscopic techniques. Proponents of the technique claim that the preperitoneal pocket is more effectively preserved compared with the traditional transabdominal technique, thereby reducing the likelihood of mesh exposure to intra-abdominal organs [29]. A study comparing robotic repair of lateral hernias using intraperitoneal onlay or preperitoneal or retromuscular mesh placement found no significant difference in outcomes [40]. Robotic-assisted extended total extraperitoneal repairs with TAR release repairs have also been performed. Extraperitoneal access is gained through the retrorectus space ipsilateral to the hernia. A TAR release is then performed to open the plane for large mesh placement with 10 cm of overlap [41]. (See "Robotic component separation techniques", section on 'eTEP approach'.)

- Others have also described a combined open and laparoscopic or robotic approach in which two pieces of mesh are applied to essentially sandwich the fascial repair. In these cases, the open approach is performed through an incision directly over the hernia defect followed by onlay mesh placement, and the laparoscopic or robotic approach is used to place the mesh in the preperitoneal plane [42,43].

CROSS-BOUNDARY DEFECTS

In many cases, lateral abdominal wall defects can extend beyond their defined boundaries into other areas such as the ventral abdominal wall, chest wall, and pelvis (see 'Anatomical classification' above). Special considerations must be taken into account when dealing with these surgical scenarios.

Subcostal defect — Certain subcostal lateral abdominal wall defects caused by direct excision can extend beyond the costal margin into the chest wall and diaphragm. Chest wall resection generally involves removal of the lower ribs and sometimes a portion of the diaphragm and its attachments. The entire mesh-diaphragm-abdominal wall muscle complex is affixed to the lowest unaffected rib, which is then reinforced with a wide piece of biologic mesh placed in the underlay plane. For smaller defects, the diaphragm can be sutured to the adjacent rib instead of the lateral abdominal wall musculature (figure 6) [2].



Management of large subcostal defects that involve disinsertion of the diaphragm

Figure 6 - larger image below

Paramedian defect — In certain cases, the defect extends medially beyond the linea semilunaris, into the ventral abdominal wall. These defects are again reconstructed with a wide underlay mesh that is sutured to the nearest pillars of strength and the boundaries of the lateral abdominal wall. Since the ipsilateral linea semilunaris has been compromised, the medial edge of the mesh is sutured to either the linea alba or the contralateral linea semilunaris. The underlay mesh is used to reinforce both the ventral and lateral abdominal wall (picture 1 and picture 2) [2,14,44]. "Paramedian" defects include Spigelian hernias, which form within the aponeurosis adjacent to the linea semilunaris [44]. (See "Spigelian hernias".)

Iliac crest defect — In a type 1 internal hemipelvectomy, the iliac crest is resected. These defects can be particularly destabilizing because the iliac crest serves as the major caudal support of the lateral abdominal wall. In this case, the mesh underlay is sutured to the most cranial aspect of the remaining iliac wing. Drill holes are made in the bone to allow for the mesh to be securely sutured to this osseous margin [2,45]. Alternatively, bone anchors can be used.

Parastomal defect — Lateral abdominal wall defects can also originate from parastomal hernias that can widen and extend into the lateral abdominal wall. Parastomal hernia repair is discussed in a separate topic. (See "Parastomal hernia".)

OUTCOMES

Due to the infrequent nature of lateral abdominal hernias, most of the outcomes data are derived from small uncontrolled case series or case reports.

- A study on lateral abdominal wall hernias reviewed outcomes from 11 studies that included a total of 345 patients followed on average for 36 months (range 4 to 60). The study reported a 7.4 percent risk of hernia recurrence, 11 percent risk of chronic pain, and 20 percent risk of overall complications [10]. The study included information from multiple smaller studies that were heterogenous with respect to the defect type, terminology, and repair techniques [6-8,10-12,17,26,28].

- In another report of 142 consecutive patients who underwent open repair of either flank or lumbar hernia at a high-volume center, wound infections occurred in 8.3 percent and hernia recurrence in 3.5 percent after 29.9±13.1 months follow-up. At six months postoperatively, 21.2 percent reported chronic pain, with two-thirds of these individuals having preoperative pain [46].

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or email these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "Patient education: Abdominal wall hernia repair (The Basics)" and "Patient education: Abdominal wall hernia repair – Discharge instructions (The Basics)")

SUMMARY AND RECOMMENDATIONS

- **Anatomy** – The lateral abdominal wall is made up of external oblique, internal oblique, and transversus abdominis muscles as well as the transversalis fascia. Its static borders include the costal margin, iliac crest, linea semilunaris, and paraspinous fascia. (See 'Anatomy' above.)

- **Physiology** – Lateral abdominal wall hernias occur less frequently than ventral abdominal wall hernias but can be larger and more progressive. The lateral abdominal wall has a higher proportion of muscle fibers than aponeurotic tissue. The asymmetric distribution of forces may contribute to lateral defect instability and enlargement. (See 'Physiology' above.)

- **Pathogenesis and risk factors** – Lateral abdominal wall defects usually result from trauma or prior surgical incisions; congenital defects are rare. They can be caused by denervation injury with or without direct muscle injury. Denervation leads to a much larger area of weakness surrounding the actual defect. (See 'Pathogenesis and risk factors' above.)

- **Diagnosis** – Lateral abdominal wall hernia should be suspected when patients note a progressive bulging of the lateral abdominal wall with occasional back pain near the origins of the oblique musculature. Computed tomography (CT) imaging is used to confirm the diagnosis, which can vary between bulge, interparietal hernia, and a true lateral abdominal wall hernia. (See 'Diagnosis' above.)

- **Surgical repair** – The majority of lateral abdominal wall hernia defects and all excisional defects require surgical repair with mesh reinforcement. For most patients, we suggest a pillar-anchored repair rather than a direct mesh repair (**Grade 2C**). (See 'Extent of mesh reinforcement' above.)

  We prefer to access the defect through the prior flank incision and place the mesh in an underlay (preperitoneal or intraperitoneal) plane. Hernias close to the midline or with a midline component require a midline incision for mesh repair in the transversus abdominis release (TAR) plane (algorithm 1). (See 'Patient position and incisions' above and 'Mesh reinforcement' above.)

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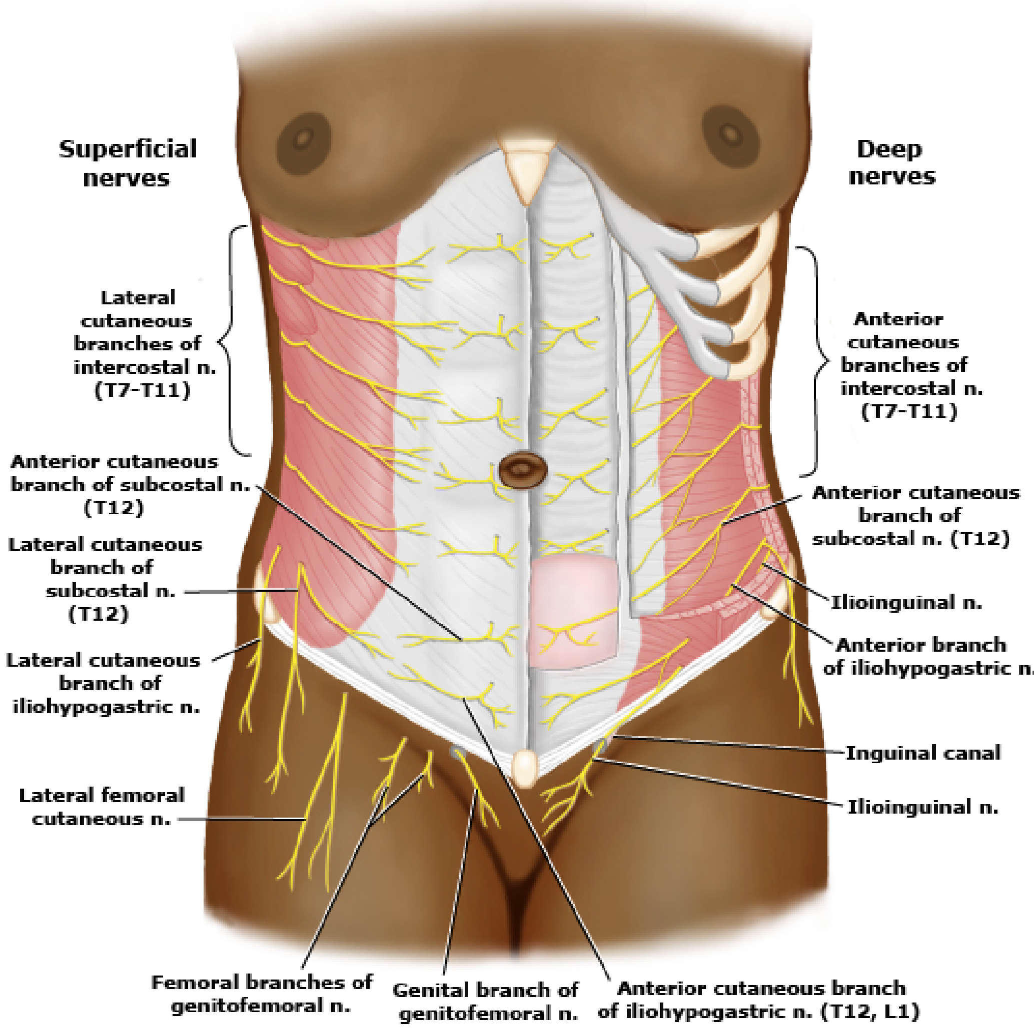
Topic 126998 Version 11.0

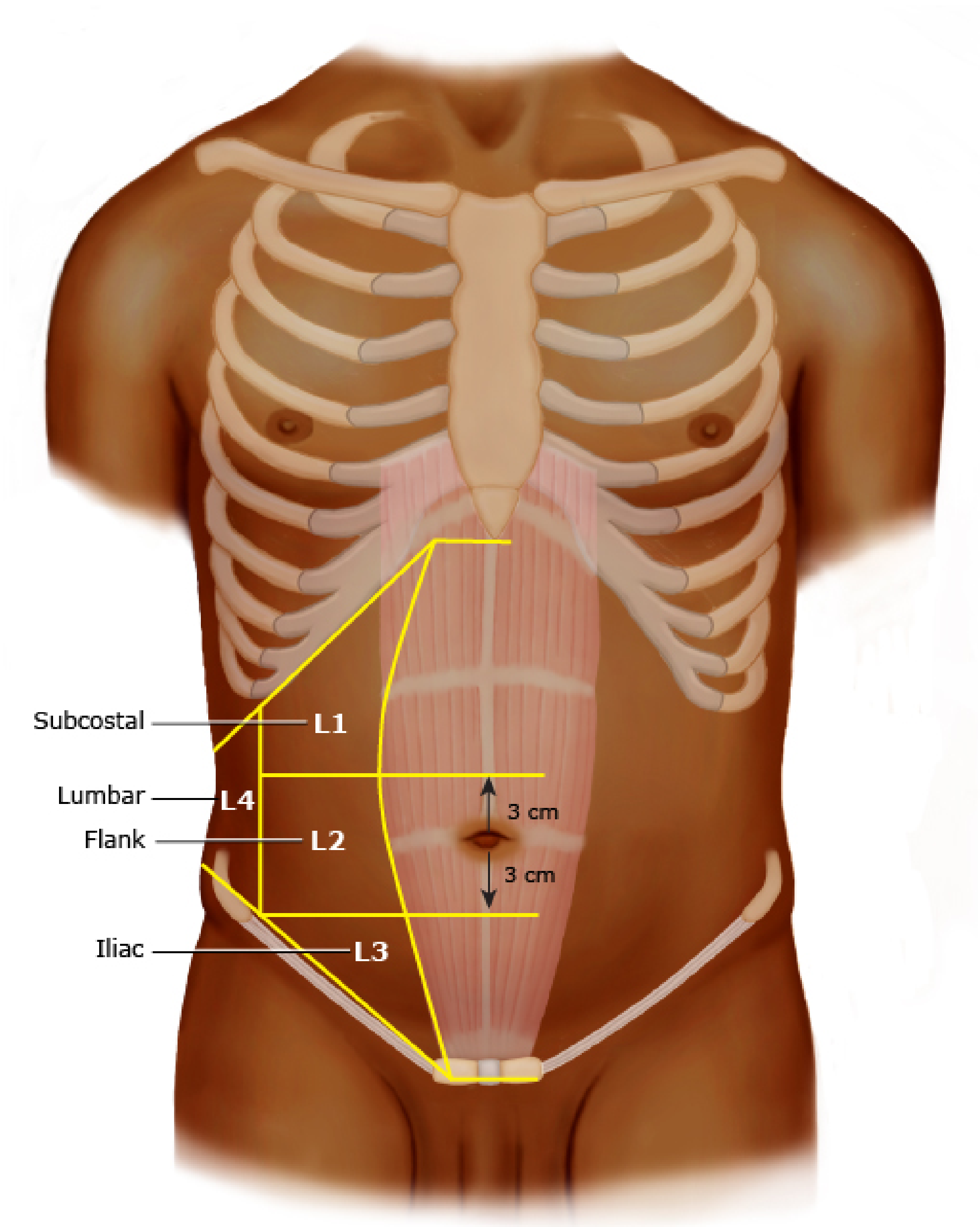
GRAPHICS

Figure 1: **Nerves of the abdominal wall**



Graphic 71423 Version 4.0

Figure 2: **Lateral incisional hernia classification**



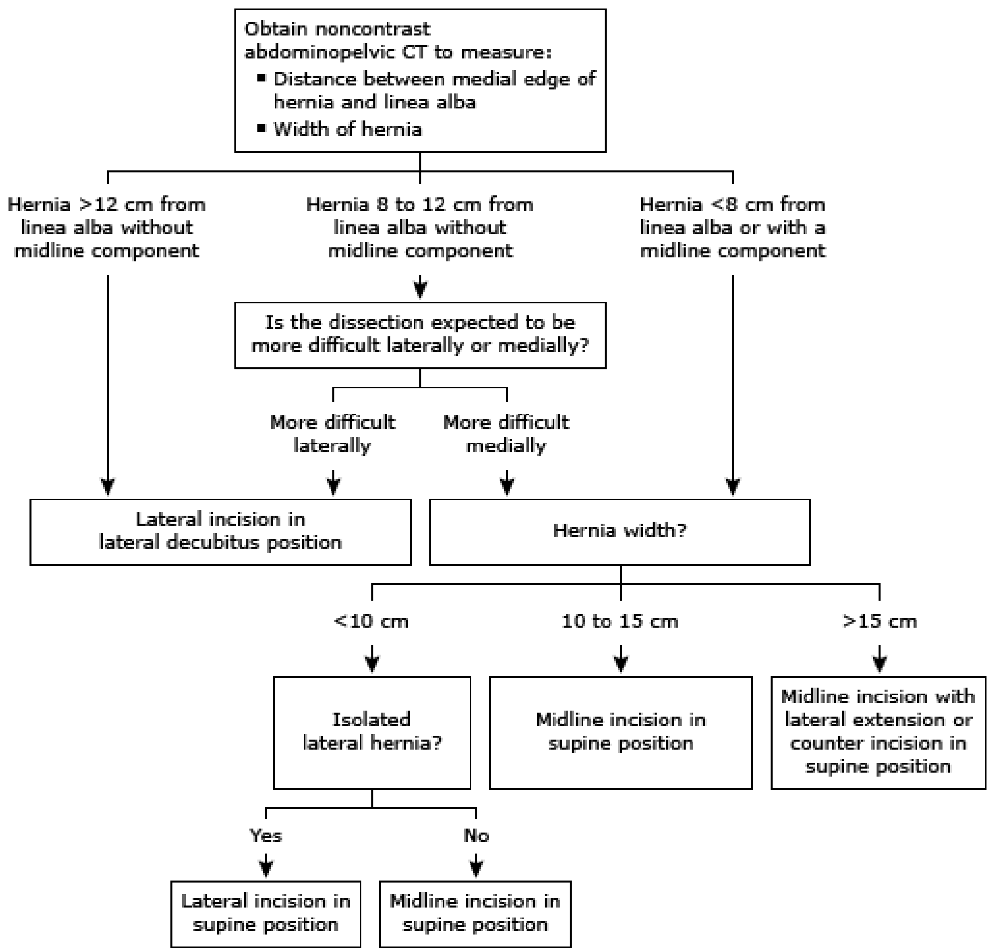
European Hernia Society classification of lateral abdominal wall hernias.

- L1: Subcostal (between the costal margin and a horizontal line 3 cm above the umbilicus)
- L2: Flank (lateral to the rectal sheath in the area 3 cm above and below the umbilicus)
- L3: Iliac (between a horizontal line 3 cm below the umbilicus and the inguinal region)
- L4: Lumbar (laterodorsal of the anterior axillary line)

Modified from: Muysoms FE, Miserez M, Berrevoet F, et al. Classification of primary and incisional abdominal wall hernias. Hernia 2009; 13:407.

Graphic 127927 Version 2.0

Algorithm 1: **Patient position and incision for lateral abdominal wall hernia repair**



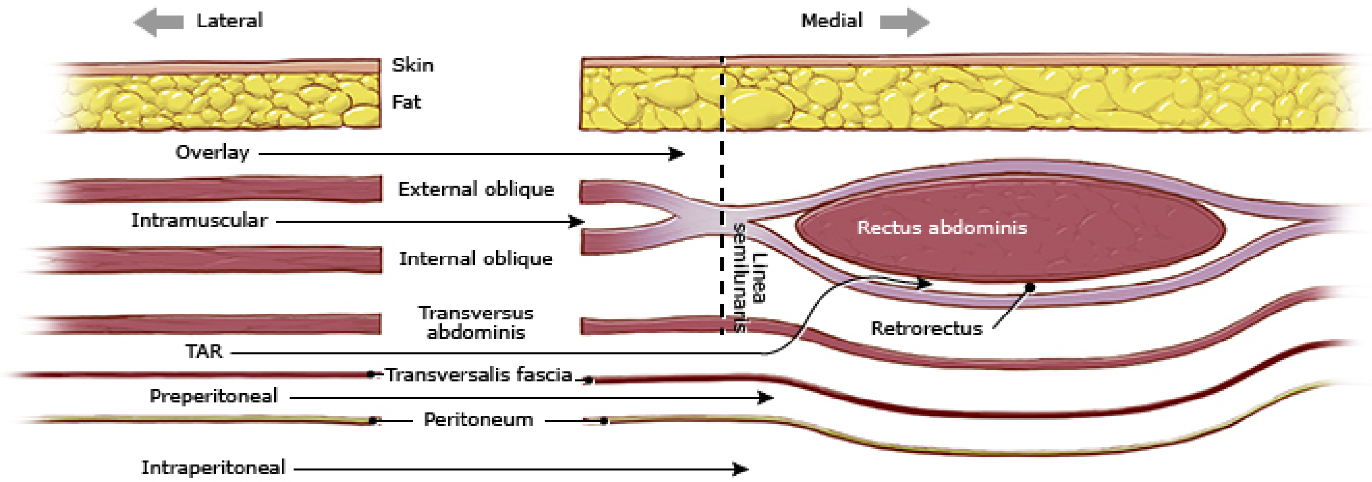
CT: computed tomography.

Reference:

1. *Montelione KC, Petro CC, Krpata DM, et al. Open retromuscular lateral abdominal wall hernia repair: Algorithmic approach and long-term outcomes at a single center. J Am Coll Surg 2023; 236:220.*

Graphic 140660 Version 1.0

Figure 3: **Lateral abdominal hernia mesh placement**

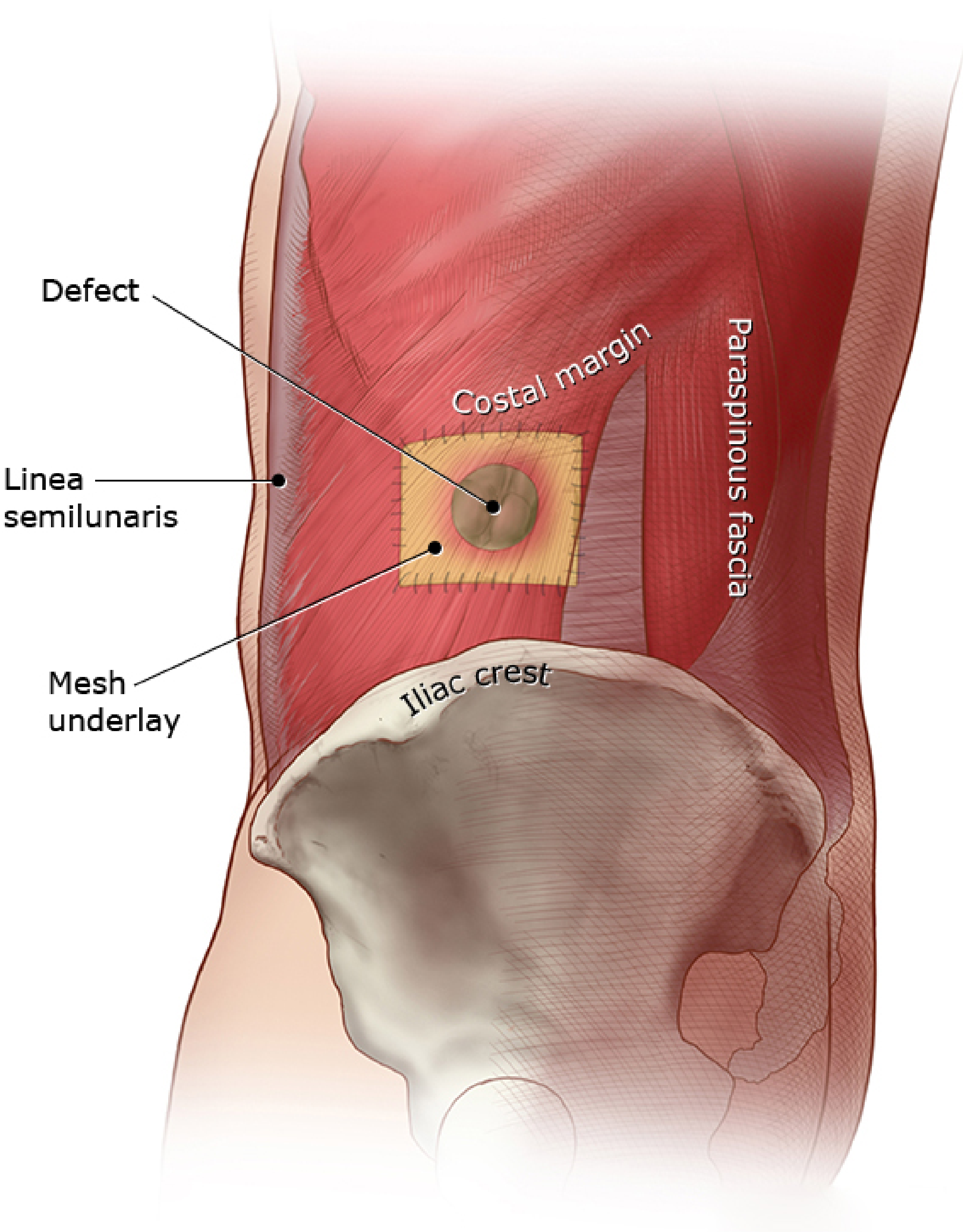


Mesh can be placed in many different planes of the abdominal wall during lateral abdominal wall hernia repair.

TAR: transversus abdominis release.

Graphic 128251 Version 1.0

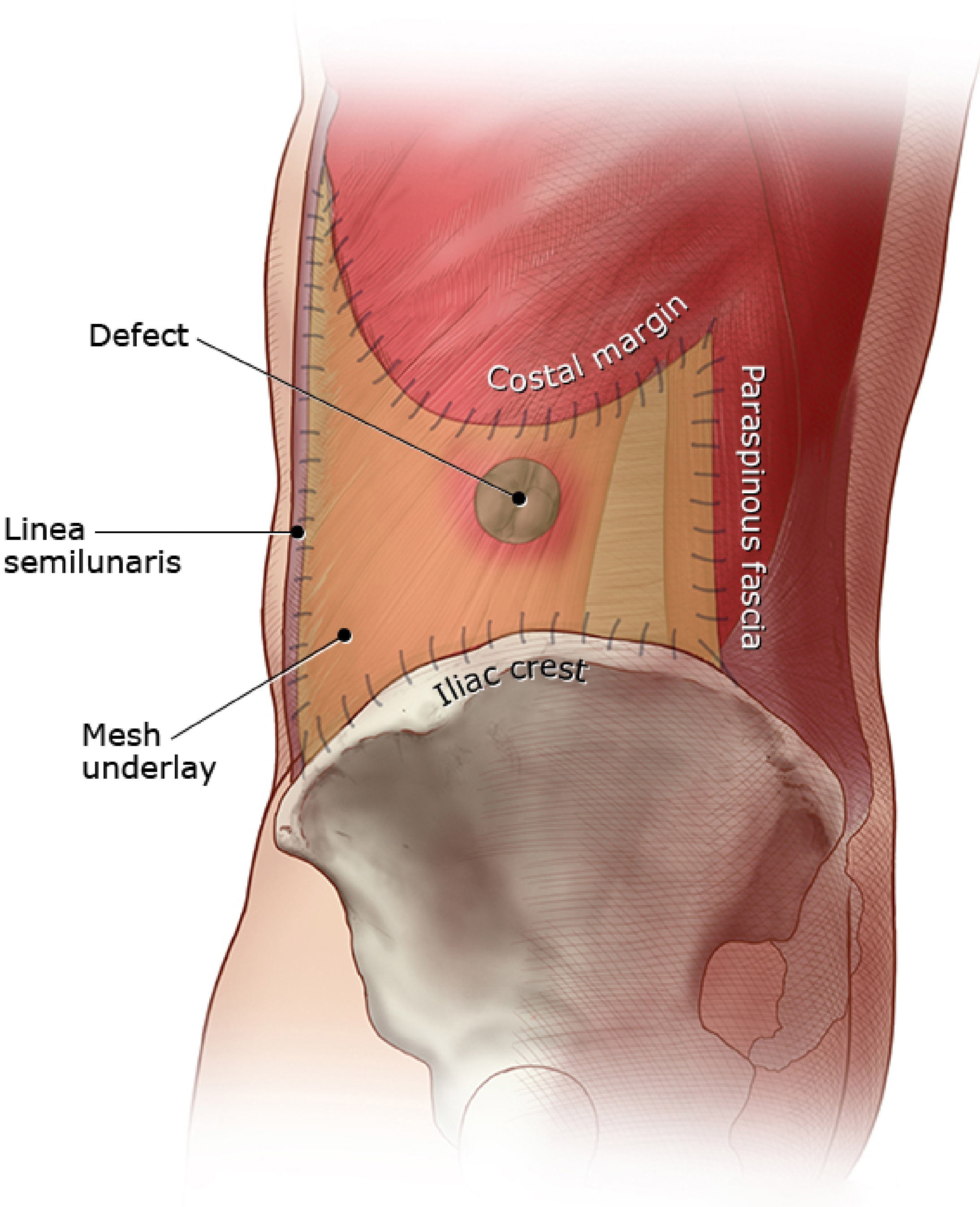
Figure 4: **Direct mesh repair of lateral abdominal wall hernia**



"Direct mesh repair" or "direct supported repair" involves the use of an underlay sheet of mesh that extends 3 to 5 cm beyond the edges of the defect and is sutured to robust-appearing muscle tissue surrounding the hernia. It is a load-sharing approach in which both the mesh and the adjacent abdominal wall share stresses to avoid recurrence. The rationale behind this technique is that coaptation of the mesh to the dynamic adjacent musculature maintains the abdominal wall compliance such that the forces at the mesh-muscle interfaces are lower.

Graphic 128252 Version 1.0

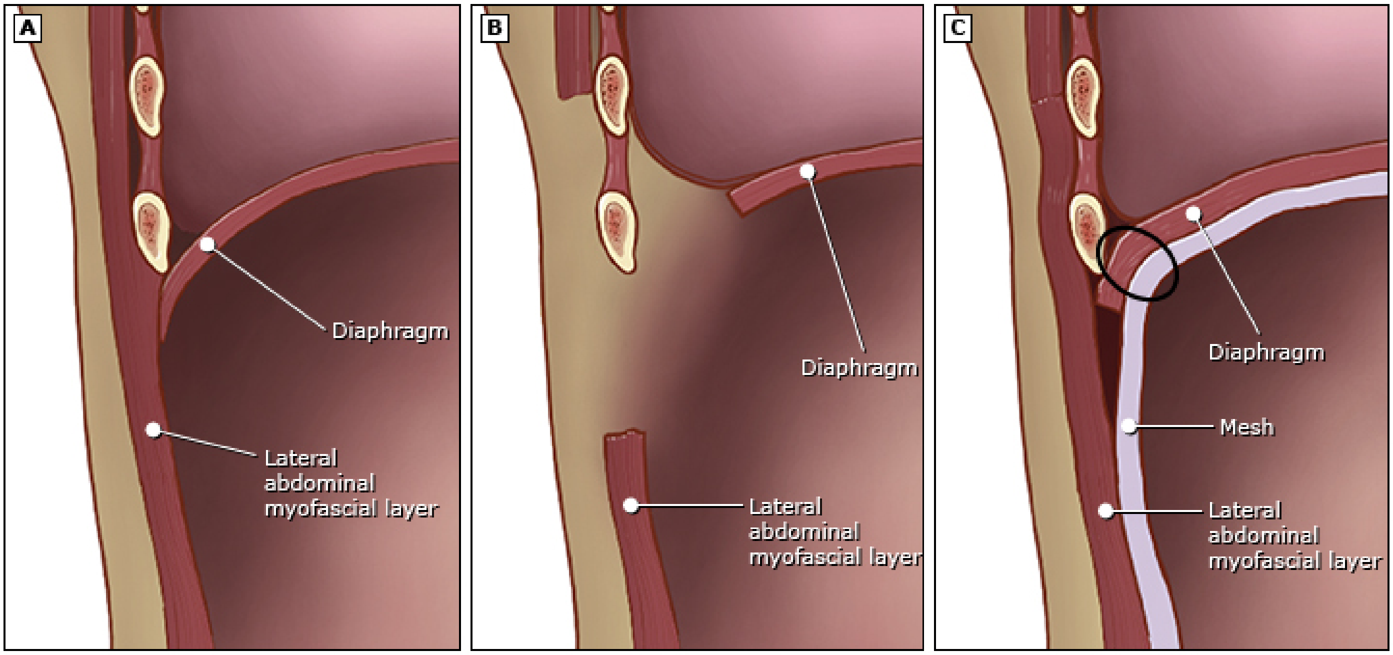
Figure 5: **Pillar-anchored repair of lateral abdominal wall hernia**



"Pillar-anchored repair" involves a wide resurfacing of the lateral abdominal wall. In this case, a wide piece of mesh is placed in the underlay plane that spans the entire lateral abdominal wall and is sutured or anchored to the boundaries of the lateral abdominal wall. These boundaries (costal margins, iliac crest, linea semilunaris, paraspinous fascia) are static structures and serve as pillars of support for the lateral abdominal wall. This repair is a load-bearing approach in which the mesh is sutured to fixed supports and bears the bulk of the forces to reduce the risk of herniation. The rationale for this technique arises from the view that lateral abdominal wall defects are accompanied by denervation injury and consequent weakening of a wider area of musculature adjacent to the defect. If the reinforcing mesh is sutured to weakened musculature, progressive weakening may lead to a recurrent bulge or hernia. The static boundaries provide a stable load-bearing support and can reduce hernia rates.

Graphic 128253 Version 1.0

Figure 6: **Management of large subcostal defects that involve disinsertion of the diaphragm**



Management of large subcostal defects that involve disinsertion of the diaphragm.
(A) Schematic showing the orientation of the diaphragm and the lateral abdominal wall.
(B) Schematic demonstrating an excisional defect involving the lateral abdominal wall and disinsertion of the diaphragm.
(C) Schematic showing repair of lateral abdominal wall, reinsertion of diaphragm, reinforcement with underlay mesh, and costal suture placement.

Graphic 128254 Version 1.0

Picture 1: **Extent of lateral abdominal wall reinforcement**

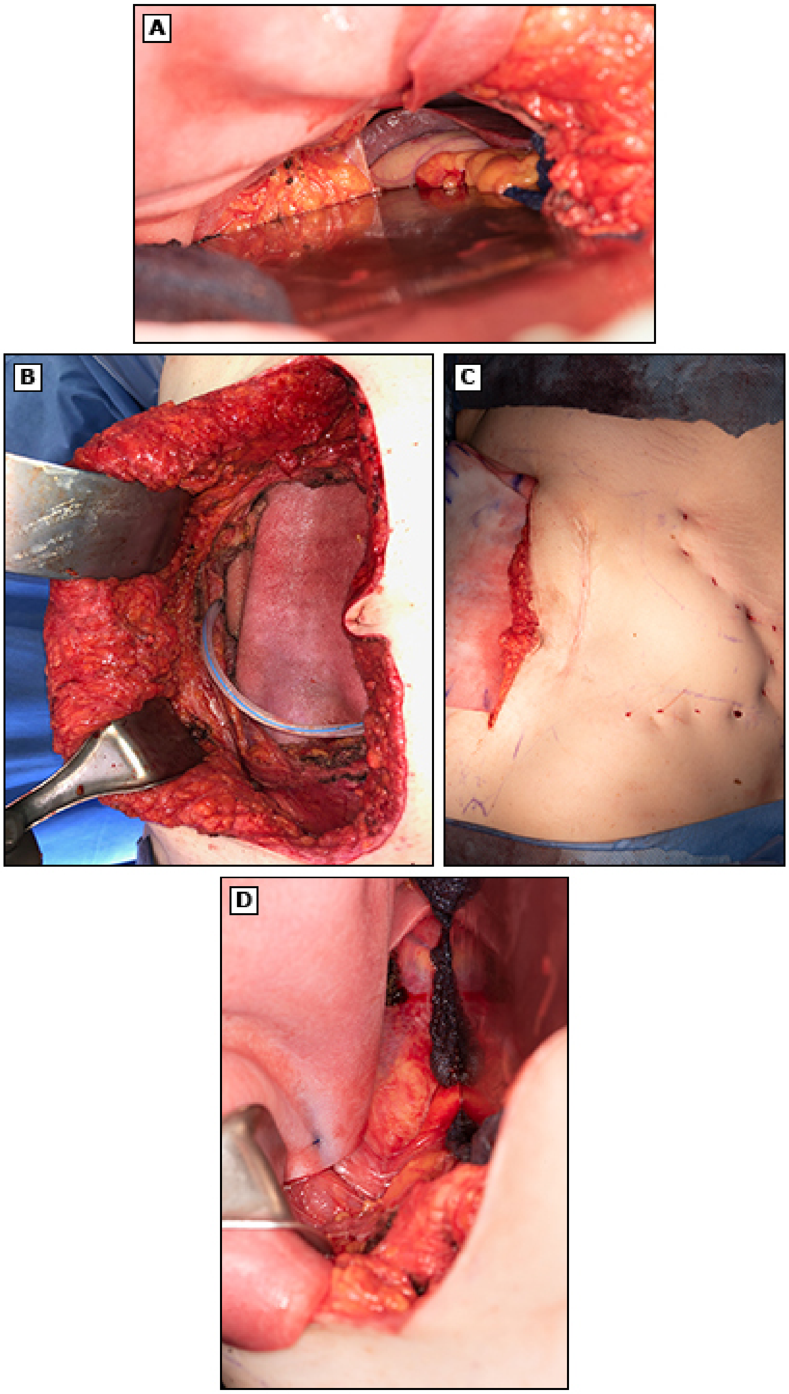
Preoperative markings showing planned extent of a right-sided lateral abdominal wall reinforcement.

Left: superior; right: inferior; top: medial; bottom: lateral.

Courtesy of Sahil K Kapur, MD, Donald Baumann, MD, FACS, and Charles E Butler, MD, FACS.

Graphic 128080 Version 1.0

Picture 2: **Intraoperative view of lateral abdominal wall hernia repair**



(A) Superior extent of mesh fixation (mesh sutured to the costal margin).
(B) Medial extent of mesh fixation (mesh sutured to the contralateral linea semilunaris).
(C) Lateral extent of mesh fixation.
(D) Inferior extent of mesh fixation (mesh sutured to the periosteum of the iliac crest).

Courtesy of Sahil K Kapur, MD, Donald Baumann, MD, FACS, and Charles E Butler, MD, FACS.

Graphic 128081 Version 1.0

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