27. Open Component Separation for Abdominal Wall Reconstruction

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The occurrence of ventral hernia as a sequence of abdominal section is so common that it should command our thoughtful consideration. B. Brindley Eads, M.D. 1901

Reconstructive surgery has been defined as trying to make something abnormal normal. This is in contrast to cosmetic surgery, the goal of which is to make something normal, better—at least in the eyes of the beholder. It is important to note that there is no consensus on a single definition of abdominal wall reconstruction, although many use this term to refer to complex abdominal wall hernia repairs that involve some sort of component separation technique as part of the procedure. Complex ventral hernia repair has been an underestimated disease by surgeons and patients alike for years, unless you happen to be the patient or surgeon facing such a daunting task. This sentiment was specifically noted in the closing remarks of the discussion of an article about incisional hernia repair in 1978 by Dr. Harold Harrower from Providence, Rhode Island, who stated, "Junior house officers tend to underestimate the complexity of incisional hernia repairs. Supervision by senior surgeons improves their understanding of the problem and the results" [1]. Local abdominal wall musculoaponeurotic flaps have been utilized as far back as 1894 when Gerseny of Vienna described splitting the rectus fascia [2]. Charles Gibson suggested that these local flaps are only intended for difficult cases that "would have been denied operative relief or subjected to some procedure of doubtful value, such as the implantation of a filigree" [3]. Ramirez described "separation of components" in 1990 as a potential solution to repairing large ventral hernias [4]. His primary goal was to be able to mobilize flaps of the musculoaponeurotic abdominal wall such that they could possibly be reapproximated, or reconstructed. What he did not take in to account in his manuscript were the short and long term

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physiologic issues associated with this. The anterior fibers of the external oblique muscles, acting bilaterally, are responsible for trunk flexion. This action pulls the midline from both sides, in essence pulling the linea alba "apart." After an external oblique "release," at least in the short term, the absence of the force of the external oblique muscles creating tension on the midline closure may serve as one mechanism for successful healing of the midline repair.

In addition, there is no mutually agreed upon definition of "component separation" save for the fact that some of the aponeuroses, muscles, or overlying sheathes of the abdominal wall are in some way divided and/or mobilized to enable closure of the defect. All muscles and aponeurosis have been mobilized in some way, and many series do not even have a single method of reconstruction, variably utilizing a variety of prosthetics in a variety of locations within the abdominal wall, making comparisons of outcomes nearly impossible [5, 6].

Additionally, it appears that the external oblique is the least important of the flank muscles in terms of respiratory assistance based on electromyography studies [7, 8] and lumbar spine support [9], making this a logical choice for division and separation as part of an abdominal wall reconstruction.

This chapter will focus on separation of the external oblique muscle with detachment of its medial insertion just lateral to the rectus muscle, combined with posterior rectus sheath mobilization. This is currently the most widely practiced method for component separation utilized for the purpose of a midline abdominal wall reconstruction. For the remaining part of this chapter, the term component separation (CS) will refer to release of the external oblique and posterior rectus sheath as described above. Additionally, prosthetic-related issues such as type and placement are beyond the scope of this chapter and are discussed elsewhere in this book.

Indications and Relative Contraindications

It is important to note that a component separation technique is only one technical part of an abdominal wall reconstruction. Other technical components of an abdominal wall reconstruction include suturing technique, prosthetic use and placement, management of the excess skin and subcutaneous tissue, and management of concomitant procedures such as gastrointestinal and gynecological procedures to name a few. In general, the indications for utilizing a component separation technique should be based on the aligned goals of the patient and surgeon, anatomic details of the

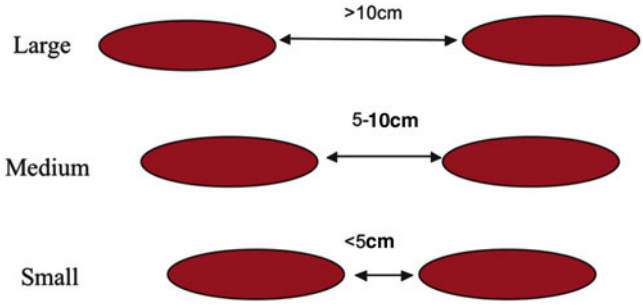

Fig. 27.1. Sizing the hernia defect. Midline hernia defects are measured as the gap between the medial borders of the rectus muscles as one defect, regardless of the size and number of hernia sacs seen on the physical examination. This may be accomplished with physical examination alone or with CT scanning depending on the clinical scenario. Small (<5 cm), medium (5–10 cm), and large (>10 cm) defects are based on the width between the rectus muscles, not the length of the defect. Component separation should usually be done for medium-sized defects where deformity is a significant problem, or avoidance of a permanent synthetic prosthesis is desired for infectious related concerns. Most large defects should be repaired with the assistance of a component separation technique, unless limited by obesity or active smoking.

hernia (size, shape, and location), and the clinical scenario (medical history, urgency of operation). While there are exceptions to every rule, this technique should be utilized when there is a significant deformity of the abdominal, and correction of that deformity is important to the patient. In general, it is appropriate to consider CS as part of an abdominal wall reconstruction when there is a medium to large size defect (Fig. 27.1), reduction of the viscera is feasible (not limited by obesity or loss of domain), and the patient is not actively smoking. A list of factors associated with the decision making about abdominal wall reconstruction utilizing CS is listed in Table 27.1.

Clinical examples of when you may not want to perform CS as part of the operation include morbid obesity with a large defect and no major deformity. This is particularly true if the fat distribution has a significant visceral component, making reduction of the viscera with complete closure of the midline tenuous or not possible. Currently, there is no way to determine this other than looking at the patient and/or a CT scan of the abdomen and estimating whether or not the viscera will fit inside a closed abdominal wall. Component separation generally requires the tissues to heal together, and active smoking is known to increase wound complications and reduce healing and would be considered a relative contraindication in a completely elective setting [6].

Table 27.1. Indications and relative contraindications for utilizing component separation techniques.

	Indications	Relative contraindications (precautions)
Defect size medium to large	X	
Deformity significant	X	
Patient desires correction of deformity	X	
Obesity—limiting reduction of viscera		X
Active smoking		X
Active infection		X

In general, most of the indications should be present, and as many as possible relative contraindications should be absent. Combined excision of excess skin and subcutaneous tissue may also be employed, and nicotine testing can confirm smoking cessation. Control of infection preoperatively is best when possible

Technique

The concept is straightforward, but there are clearly some technical pitfalls and pearls that are important to a successful outcome. The steps of this procedure are (in no particular order):

1. Division of the medial attachment of the external oblique muscle only (lateral to the rectus abdominis muscle).
2. Separation of the internal and external oblique muscles.
3. Mobilization of the posterior rectus sheath.
4. Midline closure (commonly performed with closure of the posterior rectus sheath, followed by closure of the linea alba/anterior rectus sheath to approximate the rectus muscles).

The order of the procedures will depend on the operative plan, which in turn depends somewhat on the goals of the operation. For example, if there is significant excess skin and subcutaneous tissue from a large hernia sac and/or significant weight loss, this is often excised as part of the operation to avoid problems with postoperative seroma, excessive tension on the closure due to the weight of the excess tissue, and persistent abdominal wall deformity. If this portion of the operation is being done first, then the incision for this will dictate exposure for the external oblique release. In the case where the incision for this will allow fairly easy access to the full length of the medial attachment of the external oblique, this portion of the CS can be performed through the existing incision. In the case where the incision is not enough to allow proper exposure, large skin

flaps from the midline incision or laterally based vertical flaps or "tunnels" can be utilized for proper exposure. If excess skin excision is not being performed, then large skin flaps from a midline incision or transverse laterally based incisions will be required for exposure of the external oblique medially. It is important to note that the blood supply to the skin of the abdominal wall comes from the laterally based intercostal, subcostal, and lumbar arteries, and medially based deep inferior and superior epigastric arteries, along with direct branches of cutaneous vessels from the circumflex iliac and superficial epigastric networks [10]. These perforator sparing have been utilized to reduce wound complication rates, primarily related to tissue ischemia and infection.

Open Exposure of the External Oblique

When gaining exposure to the anterior abdominal wall for the external oblique release, preservation of as much of the blood supply as possible is important to avoid wound complications. Raising large flaps of skin from a midline incision was originally described and has been associated with significant wound morbidity. Sparing the periumbilical perforators (based on the deep epigastric network) is advantageous to reducing ischemia of the wound edges, which in turn reduces wound complications. This can be accomplished with transverse incisions in the lateral abdomen, through which laterally based vertical flaps (lateral to the periumbilical perforators) are raised to expose the medial border of the external oblique along its length. Lighted retractors or a laparoscope can be used to assist in lighting and retraction. Alternatively, if there is the need for a long, inferior transverse incision to excise excess skin, subcutaneous tissue, and hernia sac, laterally based vertical flaps can be made from below, also using lighted retractors or a laparoscope as needed for lighting and retraction. These techniques are collectively referred to as "perforator-sparing" CS techniques.

External Oblique Division and Separation

There are two steps in the external oblique release—(1) division of the medial attachment and (2) separation of the external and internal oblique muscles. With all open techniques, the first step is to divide the medial attachment of the external oblique.

Full division will extend from above the costal margin to near the inguinal ligament. For defects that are confined to the lower or upper abdomen, the division may be confined to the relevant portion only, particularly if the defect is not too large. Partial division of the medial attachment of the external oblique however may not yield the best benefit in terms of postoperative tension caused by lateral muscle contracture during a variety of Valsalva maneuvers. One of the major pitfalls of this is dividing the common attachment to the entire lateral muscle complex. To avoid this, it is usually easiest to start over the external oblique muscle fibers, rather than over the aponeurosis. This is best accomplished by scoring the overlying fascia with a monopolar instrument where you can visualize the muscle belly. Once the muscle fibers are exposed, separate the external oblique muscle fibers with a blunt-tipped clamp, spreading the fibers in a plane parallel to the direction they are positioned anatomically. Once the whitish color of the internal oblique fascia is identified, you do not want to continue any deeper. The clamp can then be placed in between the oblique muscles, parallel to the insertion of the external oblique, and the monopolar electrosurgical device utilized to divide the muscle longitudinally along its length. The laterally cut edge still can then be grasped with Allis clamps to lift the external oblique to allow the separation of the oblique muscles to occur.

Separating the oblique muscles is very straightforward, as they are only held together by a network of flimsy fibro-areolar connective tissue. Each strand of connective tissue is not strong, but collectively they act as resisters in series and are very strong. This separation is more important for medial mobilization and closure and does not contribute to the concept of postoperative tension during Valsalva maneuvers. With Allis clamps lifting the cut edge of the laterally attached external oblique, simple blunt dissection is then utilized to accomplish the separation of the two oblique muscles. At the lateral aspect of the separation will be neurovascular bundles, and identification of these should serve as the terminus of the separation. Knowledge of these, along with the expected position of the origins of the oblique muscles, should minimize the risk of injuring these neurovascular structures.

Posterior Rectus Sheath

It is important to identify the medial border of the rectus muscle prior to beginning. This can best be accomplished by lifting the edge of the laparotomy incision near the abdominal wall with Kocher clamps. Grasp

the hernia sac to avoid damaging the portion of the rectus sheath you will eventually be sewing together. Then, by visual inspection and manual palpation, you should be able to identify the medial border of the rectus muscle. Use the monopolar cautery to longitudinally make an incision at the medial border of the rectus, or slightly anteriorly. Once you identify the muscle fibers, enlarge the opening until you can insert an index finger which can be used to sweep the posterior rectus sheath away from the muscle and as a marker for where to continue the division of the posterior rectus sheath. This should be accomplished along the length of the incision, making sure to go both above and below the borders of the hernia defect. For a long midline incision, this typically extends from the xiphoid process to the pubic symphysis. Below the arcuate line, the mobilization consists of the bladder and extraperitoneal fat in the space of Retzius. Pitfalls of this include dividing the posterior rectus sheath too far posteriorly, as this will increase the difficulty in closing this layer if that technique is being utilized. Existing or previous ostomies placed through the rectus muscle can make this mobilization difficult at the location of the current or former ostomy. If the posterior sheath is to be closed, then this site can be closed transversely once the midline is closed. When closing the posterior rectus sheath, take care not to put sudden tension on the sutures while pulling them taut after placement. Also, pulling at a low angle (laterally) rather than a 90° angle (straight up) can avoid tearing the posterior sheath. It is also important to utilize the short suture technique described by Isrealsson and colleagues to distribute the tension over a wider surface area [11].

Despite an initial tension on the closure, once the posterior sheath is completely closed, the tension often seems negligible. The closure should generally be accomplished vertically until the arcuate line is reached, at which point the peritoneum overlying the bladder mobilization can be brought up and closed to the arcuate line transversely. Long-acting absorbable suture is probably the best, and the use of barbed suture material may distribute the tension over an even greater surface area and reduce the chance of dehiscence and make this often difficult closure more easily accomplished by the surgeon.

The Anterior Rectus Sheath and Linea Alba

Once the posterior rectus sheath has been mobilized (and closed in many cases), the rectus muscles are then reapproximated by suturing together the anterior sheath, scar tissue, and remains of the linea alba. It

is important to note that the sutures should again be placed with the short suture technique, taking care to avoid incorporating muscle tissue and/or attenuated scar/anterior sheath. This will minimize tissue ischemia and allow the rectus muscles to be reapproximated [12]. While the short suture technique was proven to reduce hernia formation and infection rates for closure of primary and midline laparotomies, its use in abdominal wall reconstruction is logical, as the technique is based on the physics of broadening the surface area over which the tension will be distributed and reducing the amount of tissue within the suture line, thus reducing tissue ischemia within the suture line. These facts are no different for hernia repair than for primary laparotomy closure.

Outcomes

Recurrence rates of primary closure of incisional hernia vary widely but are generally considered to be high and are reported to be 63% in a long-term follow-up study of primary vs. prosthetic repair [13].

Primary closure with the addition of a component separation (without the use of mesh and without the short suture technique) reduces recurrence rates to between 0 and 20% [5]. When utilizing large skin flaps from a midline incision to expose the external oblique muscles, wound complication rates related to ischemia (20%), infection (40%), and dehiscence (43%) are often serious and require reoperation in as much as 20% of the cases [10]. Utilizing a perforator-sparing or endoscopic technique, the rate of serious wound complications decreases dramatically [14–17].

It is important to note, however, that the suturing technique is also likely to influence the recurrence rates. As mentioned above, the principles of the short suture technique should be no different for hernia repair than for primary laparotomy closure. Furthermore, if a suture fails after utilizing the short suture technique, the resulting gap in the tissue is small and more likely to be filled in with scar tissue rather than develop into another hernia defect [12]. It is therefore logical that application of the short suture technique for midline closure of hernia defect after a component separation would serve to further reduce the recurrence rates. Use of a prosthesis is also a factor that will undoubtedly affect recurrence rates but is beyond the scope of this chapter. It is also worth mentioning that a recurrence is not the sole metric of success or failure. For example, consider a patient with a 15-cm-wide midline defect and overlying skin

graft that is completely disabled from the abdominal wall defect. Repair of this hernia utilizing a component separation technique without a permanent prosthesis might result in a small recurrence at the superior aspect of the midline closure. Despite the fact that there is a recurrent hernia, the patient is typically still fully functional without symptoms and has many options for repair, or observation. From the typical patient's perspective, despite the existence of a recurrent hernia, the operation was a complete success.

Conclusion

In summary, open component separation can be described by a variety of techniques. The most commonly utilized technique involves detaching the insertion of the external oblique along its length lateral to the rectus abdominis muscles and separating the external oblique muscle from the internal oblique. This may be accomplished with or without the mobilization of the posterior rectus sheath and with or without the use of a prosthetic. Primary closure of the midline (posterior and anterior rectus sheaths) should be performed using a short suture technique in which 5–8-mm bites of tissue are taken with each bite in terms of both depth and travel, taking care to avoid incorporating muscle and attenuated fascia within the suture line. This technique should be used selectively for patients with medium to large defects as described in Table 27.1. The benefits of component separation performed in this manner are twofold: (1) medial mobilization of the rectus muscles and (2) reduced postoperative tension on the midline closure. Recurrence rates in the 5–20% range should be expected, and recurrences are typically smaller and easier to deal with compared to the hernia at the time of reconstruction with CS. A perforator-sparing technique is best when possible and should yield wound complication rates that should be less than 10% and generally minor in severity.

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