Component Separations

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Abstract

Component separation is a technique used to provide adequate coverage for midline abdominal wall defects such as a large ventral hernia. This surgical technique is based on subcutaneous lateral dissection, fasciotomy lateral to the rectus abdominis muscle, and dissection on the plane between external and internal oblique muscles with medial advancement of the block that includes the rectus muscle and its fascia. This release allows for medial advancement of the fascia and closure of up to 20-cm wide defects in the midline area. Since its original description, components separation technique underwent multiple modifications with the ultimate goal to decrease the morbidity associated with the traditional procedure. The extensive subcutaneous lateral dissection had been associated with ischemia of the midline skin edges, wound dehiscence, infection, and seroma. Although the current trend is to proceed with minimally invasive component separation and to reinforce the fascia with mesh, the basic principles of the techniques as described by Ramirez et al in 1990 have not changed over the years. Surgeons who deal with the management of abdominal wall defects are highly encouraged to include this technique in their collection of treatment options.

Keywords

- component separation
- abdominoplasty
- abdominal wall hernia
- abdominal wall defects
- abdominal wall closure

Published in 1990 by Ramirez¹ and colleagues, the component separation technique was originally developed to allow closure of a wide midline abdominal wall defect without the use of prosthetic material. This technique is based on lateral fasciotomies that allow sliding of the muscular/fascia layers toward the midline and subsequently enlargement of the abdominal fascia surface. The initial report was derived from anatomic findings following the dissection of 10 fresh cadavers, and it revolutionized the field of abdominal wall reconstruction because it allowed for the repair of large abdominal wall defects without the use of prosthetic materials such as mesh. These findings were implemented in the surgical management of 11 patients with anterior abdominal wall defects stemming from various sources, including recurrent hernia defects and deficits following muscle harvest for transverse rectus abdominis myocutaneous (TRAM) flap breast reconstruction.

Technical Approach

The basic principles of the technique include bilateral midline to lateral dissection in a subcutaneous plane adjacent to the

fascia up to a line lateral to the rectus muscles and longitudinal transection of the aponeurosis of the external oblique muscle. The incision is done ~2 cm laterally from the rectus sheath (► **Fig. 1**), extending from the inguinal ligament to the level of the costal margin. Occasionally, the incision is elongated cranially over the costal margins to allow for closure of defects in the area of the xiphoid. The external oblique muscle is separated from the internal oblique muscle (► **Fig. 1**) as far laterally as possible while meticulous attention is given to avoid any injury to the internal oblique fascia or muscle as well as the segmental innervations of the rectus abdominis muscle. Caution should also be given to avoid injury to the Spigelian fascia. The dissection between the external and internal oblique muscles is done in a relatively avascular plane and is continued in a lateral direction beyond the area of skin while undermining and dissecting toward the level of the midaxillary line.

Once released from the external oblique muscle and its fascia, the compound flap of rectus muscle and the attached internal oblique/transversus abdominis muscle complex is subsequently advanced medially (► **Fig. 2**). In the rare

Figure 1 A demonstration of a ventral wall hernia. Components separation achieved dissection between the external and internal oblique muscles with closure of the midline defect by advancement of the rectus muscles and the fascia.

instance that additional advancement is needed, the rectus muscle can be elevated off of the posterior rectus sheath in its entirety. However, in many cases due to previous surgical procedures, the posterior rectus sheath is fibrotic, and the dissection between the rectus muscle and the posterior rectus sheath is associated with damage to the rectus muscle.

After the advancement of the rectus complex toward the midline, the closure is done with interrupted nondissolvable stitches. The skin flaps are closed in a layered closure after two drains are left in the subcutaneous plane. Based on the surgeon's preference, the catheters of a pain pump may be left on the same plane. During the closure of the fascia, meticulous attention is given to any increase in the peak airway pressure, and efforts should be made to avoid an increase higher than 5 mm H₂O. An increase greater than 5 mm H₂O can be associated with respiratory restriction, prolonged

ventilation, and increased chances for abdominal compartment syndrome. In such a situation, release of the fascial closure is necessary to restore hemodynamic stability, and fascia or mesh should be used to bridge any remaining defect.

The postoperative regimen is usually decided by the general surgery team. Efforts are made to avoid increased intraabdominal pressure by keeping the patients NPO (nothing by mouth) with placement of an enterogastric (NG) tube and Foley catheter. In our practice, an abdominal binder is used as a routine postoperatively. The drains are removed when they achieve a drainage lower than 30 cc/24 hour.

Discussion

Since its initial description by Ramirez in 1990, the component separations technique has gained significant popularity. At the same time, it has evolved to become less invasive in an effort to reduce the morbidity associated with the surgery and to decrease the recovery period. However, the principles of the technique have remained the same throughout the years. Today, the technique is employed routinely for closing complicated or recalcitrant midline and para-median abdominal wound defects. The procedure can be done with or without the reinforcement of the fascia with mesh; however, the combined technique with the use of mesh is described elsewhere in this volume. The procedure is usually done by a team approach in conjunction with a general surgery team. Preoperative imaging assessment, such as an abdominal computed tomography (CT), can help evaluate the size of the defect and the location of the rectus muscle complex. This is particularly useful in cases of massive midline defects, where the rectus muscles can be situated at the lateral extremes of the abdomen. In our institution, the general surgery team proceeds first with the dissection of the hernia sack and lysis of the intraabdominal adhesions as well as any other intraabdominal procedures that are needed. Upon the

Figure 2 Components separation achieved with lateral dissection of two subcutaneous tunnels to proceed with release of the fascia with preservation of the perforators to the skin.

completion of their part, the plastic surgery team proceeds with the closure of the abdominal wall. A high level of cooperation and communication is required between the two teams with respect to preoperative planning (location of the incision) as well as during the procedure (level of contamination or enterotomies). Ultimately, medial translocation of the abdominal wall using the component separations technique allows for unilateral movement of 5 cm in the epigastrium, 10 cm at the waist, and 3 cm in the suprapubic area. Bilateral releases therefore could encompass defects of up to 20 cm in the midline at the waistline level.

Although the component separation technique is an efficient method for the reconstruction of abdominal wall defects, the technique as it is employed in its original description has several drawbacks. The technique requires significant skin and subcutaneous tissue mobilization over a large distance to reach the aponeurosis of the external oblique muscle, which is retracted far laterally into the flank. This creates a large wound surface area that covers the whole ventral abdominal wall from the costal margin to the pubic bone and predisposes this area to hematoma and seroma formation and infection. In addition to this, mobilization of the skin and subcutaneous tissue endangers its blood supply, which can lead to skin necrosis in the midline and dehiscence of the surgical incision series.²⁻⁶ If the musculocutaneous perforators of the epigastric artery are transected, then the blood supply of the skin depends solely on the intercostal arteries. Interference with the blood supply from the intercostal arteries by scars or enterostomies can result in skin necrosis, as was found in 20% of the patients in the study by Lowe and colleagues.³ Additionally, the technique destabilizes the outer layer of the abdominal wall allowing the skin to shift in relation to the underlying myoaponeurotic tissue. This makes application in patients with enterostomies difficult.

Since its original publication,¹ multiple authors have cited their own accounts with the component separations technique, and several of them advocate their own modifications to address potential shortcomings. In an effort to preserve the blood supply to the skin, Dumanian et al proceeded with a modified version of the components separation technique^{7,8} in which they used a limited and selected lateral dissection from the defect edges to expose the linea semilunaris and gain access to the external oblique. However, the periumbilical perforators of the epigastric system were preserved by means of subcutaneous dissection performed both superior and inferior to the umbilicus. Later, these two areas were connected by a tunnel coursing lateral to the perforators. This allowed for access to the external oblique for division from the inguinal ligament inferiorly to above the costal margin while still preserving good blood perfusion to the skin. This technique allowed a significant decrease in superficial wound complications (from 20% to 2%) when compared with the traditional technique.⁸ Current techniques allow for a more extensive preservation of the perforators to the skin in the periumbilical area while decreasing the dead space.

A different approach was described by Maas who proceeded with lateral skin incisions that have been made to coincide directly with the area of underlying oblique muscle

release.⁹ The advantage of this approach is that it eliminates the extensive subcutaneous dissection seen in the original procedure while sparing the major blood supply to the medial skin edges by means of the cutaneous perforators of the epigastric arcade. The lateral incisions approach did not gain popularity due to endoscopic technologies becoming more common in the patients who undergo component separations.

Several authors have evaluated a variety of endoscopically assisted approaches to limit the wound morbidity associated with open component separation techniques.^{3,10} Lowe et al³ reported seven cases of endoscopically assisted component separation utilizing an endoscopically inserted balloon dissector, which was placed in the subcutaneous space above the external oblique. After insufflation, the fascia at the medial border of the external oblique muscle is incised. Although this space is not entirely avascular and some perforating vessels are divided, the endoscopic technique was not associated with increased wound complications, and the authors were able to close defects up to 15 × 25 cm along with a 50% reduction in the postoperative length of stay. As these authors point out, this reduction in hospital stay and postoperative wound care certainly justifies the initial expense of the laparoscopic instrumentation. Maas et al¹⁰ reported another series of endoscopically assisted component separation for the repair of complicated ventral hernias. Only 60% of their patients had active contamination during the procedure. This group performed a technique in which the balloon dissector is placed underneath the external oblique fascia, whereby allowing separation from the internal oblique. However, the actual release was not performed using laparoscopic techniques. Instead, it was performed through several small counter incisions under laparoscopic visualization. Despite these counter incisions, they noted no postoperative wound complications and had only one recurrence in their series of five patients. Interestingly, this series had several patients with stomas, and these authors noted that an endoscopic approach provided distinct advantages in the setting of concomitant stomas. Because the dissection plane is lateral to the rectus muscle, the stomas are not interfered with during the release. Minimally invasive component separation provides direct access to the lateral compartment without large subcutaneous flap dissection, whereby avoiding extensive skin undermining, ensuring the preservation of perforator vessels, and minimizing the potential space. This technique accomplishes the same objectives of an open component separation by developing the avascular plane in between the internal and external oblique muscles and releasing the external oblique muscle from the rectus complex. As these small series have demonstrated, a significant reduction in postoperative wound complications seems logical. In the setting of contamination, the laparoscopic approach provides unique advantages by allowing the release in a clean space, not in continuity with the midline incision, and decreasing the complexity of postoperative wound infections. One potential limitation of the minimally invasive component separation technique might be the adequacy of myofascial advancement. When performed laparoscopically,

there is no undermining of the skin flaps as compared with the standard open approach, which might reduce the maximal advancement.

Timing of reconstruction in relation to the time of insult also plays a key factor in choosing whether to use the component separations technique. Inflammation of the abdominal wall can limit the release and advancement of the myofascial flaps. Several publications have outlined the use of the component separations technique in the context of staged reconstruction of the abdominal wall defect.^{6,7,11–14} The typical situation involves the trauma patient who, following damage-control laparotomy, has an abdomen that has either become resistant to closure secondary to bowel edema, or requires a delayed approach, because second-look operations are necessary. Regardless of the initial cause, the acute recovery period usually is managed by temporary abdominal wall closure with interposition mesh, followed by split-thickness skin grafting once granulation of the wound bed has occurred. Following stabilization of the patient and resolution of the inflammatory process, the skin graft can be removed from the wound bed, and definitive closure of the abdominal wall can be achieved using the component separations technique. Time to definitive closure of the abdominal wall has varied from as little as 6 months to well over 2 years from the time of initial injury.

Conclusions

As with many surgical techniques, it is not the particular operation that has failed or has been met with success, but instead it is the choice of procedures that is of utmost importance. No one procedure is ideal for all situations; it is therefore incumbent upon the surgeon to select the proper procedure to fit the particular needs of the situation. In addressing complicated defects of the abdominal wall, the component separations technique can be viewed as simply a part, albeit a very important one, of the armamentarium necessary to address these deficits based upon their location, depth of the defect, timing of presentation, and background milieu of the wound bed and the patient himself or herself. Today, the component separation technique has become a very common procedure, and it is an integral part of the armamentarium of any surgeon who is involved in the management of patients with ventral herniation.

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