Plastic surgery repair of abdominal wall and pelvic floor defects

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Abstract

Urologists often encounter large perineal and abdominal wall defects, the treatment of which may require close collaboration with the plastic surgeon. These complex defects can be successfully treated using a variety of techniques. Ventral hernias or freshly created abdominal wall defects can be treated with the basic principles of tension-free closure using abdominal wall components separation, synthetic mesh reconstruction, and, more recently, biosynthetic acellular dermis reconstruction. Pelvic floor defects often require flap reconstruction using gracilis flaps, vertical rectus abdominis myocutaneous flaps, or local fasciocutaneous flap. In this article, we seek to familiarize the urologists with the most common techniques used by plastic and reconstructive surgeons in the treatment of these complicated pelvic floor and abdominal wall defects. © 2007 Elsevier Inc. All rights reserved.

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Introduction

Abdominal wall defects result from multiple etiologies, including trauma, previous abdominal surgery, congenital abnormalities, and infection [1]. Ventral hernia after laparotomy occurs in almost 10% of patients [2]. Untreated, these complex defects may lead to significant physical, functional, and esthetic complaints. Although the techniques used in abdominal wall reconstructions are constantly changing, the goals of treatment remain the same: protection of abdominal contents and restoration of functional support.

In our practice today, we are often called to assist in the closure of large abdominal wall defects. Admittedly, there is a selection bias toward more complex defects because other surgical specialties typically handle smaller, simpler defects that may be amenable to primary closure. We resort to 3 techniques in the reconstruction of large abdominal wall defects: components separation, synthetic mesh reconstruction, and acellular dermis reconstruction. Selection of the appropriate technique is based on a variety of factors, including patient medical status, prior surgeries, defect size, and defect position, and the presence or absence of wound contamination [3].

Components separation technique

In 1990, Ramirez et al. [4] described the “components separation” technique for the closure of midline abdominal defects. This technique mobilizes local abdominal musculature and fascial components for defect closure, without the need for regional flaps or prosthetic materials. The components separation technique is an excellent option for the repair of large midline hernias.

Components separation involves the elevation of skin flaps off the abdominal wall musculature, followed by sequential incision and release of the external and internal oblique muscles and the posterior rectus sheath, allowing midline advancement of rectus fascia. Bilateral components separation can provide approximately 10, 20, and 6 cm of advancement in the upper, middle, and lower thirds of the abdomen, respectively [4] (Fig. 1).

Components separation restores function and integrity to the abdominal wall with innervated and vascularized muscle and fascia, provides stable skin and soft tissue coverage, and re-approximates tissues in a relatively tension-free manner [1]. Reported rates of recurrence after components separation range from 8% to 14% [4,5], markedly lower than the approximately 46% recurrence rate reported for primary closure of abdominal wall defects [6].

The major limitations associated with this technique include an increased risk of hematoma and seroma formation caused by the dead space created by elevation of the skin flaps. With wide elevation of skin flaps to expose the ab-
Abdominal wall musculature, skin ischemia and necrosis at the wound edge can lead to skin flap dehiscence [6]. This dehiscence can almost always be treated with bedside debridement and dressing changes.

### Synthetic mesh reconstruction

In abdominal wall defects too large for primary closure or component separation, synthetic mesh material has become a mainstay in treatment [7], especially in a noninfected wound with stable skin coverage. The most commonly used is polypropylene or Marlex mesh (Davol, Inc., Cranston, RI) [8]. It provides tension-free tensile strength and porous scaffolding, allowing the ingrowth of scar and incorporation into the abdominal wall. Mesh reconstruction is highly efficacious in reducing the risk of re-herniation, with recurrence rates less than 10% [8]. Polytetrafluoroethylene (Gore-Tex; W.L. Gore & Assoc., Inc., Newark, DE) can be used as an inlay to reconstruct abdominal wall defects because of its low risk of bowel adhesions and erosion into underlying viscera.

Despite its documented efficacy, mesh reconstruction is also associated with multiple complications. As with any foreign material, synthetic mesh has a propensity for harboring infection, thus, it should not be used in a grossly contaminated wound because alternatives exist. Mesh also induces inflammation and scarring of intraabdominal structures, leading to adhesion formation and the formation of enterocutaneous fistulae [8–10] when placed over bowel. It is for this reason that we use polytetrafluoroethylene or acellular dermis (AlloDerm; Lifecell Corp., Branchburg, N.J.) when reconstructing abdominal wall defects over bowel.

### Acellular dermis reconstruction

Because of the complications and limitations associated with synthetic abdominal wall reconstruction, the use of biosynthetic materials in abdominal wall reconstruction has gained popularity. These biosynthetic materials are derived from human or animal sources and, through a variety of processes, are rendered acellular, decreasing their antigenicity. They are natural extracellular matrices that promote revascularization, remodeling, and incorporation into the native abdominal tissue [10]. The most commonly used biosynthetic material is AlloDerm, derived from human cadaveric dermis. After implantation in the abdominal wall, AlloDerm induces rapid cellular infiltration and vascularization [11].

AlloDerm offers many advantages over polypropylene mesh, including minimal adhesions to underlying bowel, revascularization and reincorporation into the natural tissue, and relative resistance to bacterial infection [12]. Unlike mesh, biosynthetic materials can be implanted into contaminated wounds. AlloDerm has also proven efficacious in previously irradiated wounds [13]. For a stronger abdominal...
wall repair, AlloDerm can also be placed over the midline fascia closure to provide reinforcement [14]. The ultra-thick (1.8 mm and thicker) AlloDerm should be used for abdominal wall repair (Fig. 2).

The major disadvantages of AlloDerm include higher cost and limited size. Currently, AlloDerm comes in 6 × 12-cm sheets, thus, for large defects, multiple individual sheets of AlloDerm must be sutured or stapled together (Fig. 1), further increasing the cost [10], and introducing areas of potential weaknesses and recurrences at each seam. We have started using the GIA 228 stapler (80-mm length, 3.8-mm tissue thickness; U.S. Surgical, Norwalk, CT) with 2–0 Prolene (Ethicon, Inc., Johnson & Johnson, Somerville, NJ) running suture reinforcement of the staple line to increase the strength of the seams and decrease drainage of intraabdominal fluid, especially in patients with ascites.

Our approach

We find ourselves using a combination of the aforementioned 3 modalities. We begin our operation by elevating skin flaps off the abdominal wall fascia, to the level of the anterior axillary fold. When possible, we proceed with unilateral or bilateral component separation if to decrease the tension of the abdominal wall closure. The rectus muscles are re-approximated using interrupted No. 2 nylon suture. For recurrent complex hernia repairs, we often reinforce the entire abdominal wall with onlay mesh or AlloDerm. If primary re-approximation is not attained after component separation, the defect is closed up to the point of acceptable tension. The remaining defect is spanned using an inlay technique, most often with ultra-thick AlloDerm. The AlloDerm is sutured into position using interrupted 2–0 Prolene. Multiple 2–0 Prolene sutures are also placed as quilting sutures throughout the mesh to obliterate any dead space. This process allows rapid and complete ingrowth of tissue into the mesh. Quilting sutures are also used for the AlloDerm to increase its contact with the underlying vascularized abdominal wall tissue. Skin closure, especially after component separation, is rarely problematic. We have been able to treat successfully wound breakdown with exposure of mesh with dressing changes or placement of the vacuum assisted closure device. We use 2–4 Jackson Pratt drains to drain the dead space between the abdominal wall and skin flaps, and typically discharge the patient with the drains in place.

Pelvic floor defects

The pelvic floor consists of several structures, each with important functions, including the pelvic diaphragm, lower urinary tract, reproductive organs, colorectal system, and anal sphincter [15]. Large pelvic floor defects related to tumor excision are a reconstructive challenge for the plastic surgeon. In addition to a large wound, the defect has often been irradiated, creating poorly vascularized local tissue.

The goal for pelvic floor reconstruction is to restore functional support and protection of internal organs. This process is achieved with the introduction of well-vascularized tissue into the defect to fill the defect and provide structural support [15]. Commonly used flaps for pelvic floor reconstruction include the gracilis muscle or myocutaneous flap, rectus muscle or myocutaneous flap, and medial thigh axial based cutaneous flaps, commonly termed Singapore flaps.

The gracilis flap

The gracilis is a muscle located in the medial thigh that functions as a thigh adductor and knee flexor but whose absence is inconsequential to the patient. It can be elevated reliably based on its dominant blood supply from a branch off the profunda femora artery. The arc of rotation of the muscle when elevated on its dominant arterial supply allows it to reach into the pelvis. It can be elevated as a myocutaneous flap, but the skin portion of the flap is not as reliable as the muscle alone. It can also be transferred as a functional muscle flap for anal sphincteric reconstruction after abdominoperineal resection (Fig. 3) [16].

Rectus abdominis myocutaneous flap

The vertical or transverse rectus abdominis myocutaneous flaps are commonly used to reconstruct pelvic defects. The rectus muscle is supplied by 2 vascular pedicles, the deep inferior epigastric artery and the superior epigastric artery, either one of which can support the muscle, and the overlying skin and fat. To reach pelvic defects, the flap,
consisting of muscle alone or muscle and the overlying skin and fat, is based on the inferior epigastric artery and rotated intra-abdominally to fill the pelvic defect. The skin paddle can be oriented vertically, obliquely, or transversely, depending on the needs of the defect (Fig. 4). The flap can provide a large amount of tissue to reconstruct the perineum or vagina. Compared to the gracilis muscle or local fasciocutaneous flaps, the rectus flap has slightly higher donor site morbidity, consisting mainly of abdominal bulges or hernias. Often in reconstructing the abdominal site donor defect, we prophylactically reinforce the site with mesh or AlloDerm to decrease the risk of bulge or hernia. Advantages of the rectus abdominis flap in pelvic defects are the reliability of the skin paddle and the bulk of well vascularized tissue provided, which decreases the overall complication rate by completely filling dead space associated with pelvic defects [17].

**Local fasciocutaneous flap**

Local fasciocutaneous flaps are often used for vaginal and scrotal reconstruction but can also be adapted for small pelvic defects. In 1989, Wee and Joseph [18] from Singapore described a technique using neurovascular pudendal-thigh flaps. The Singapore flap provides well-vascularized tissue that is thin and pliable, and can be rotated into the perineum to fill defects, create neovaginas, or seal rectovaginal fistulas [18,19]. In addition, the donor-site morbidity is low, and the scars are oriented along the groin crease. The main drawbacks of these flaps are the limited amounts of tissue and bulk provided for the repair. Nonetheless, in select circumstances, this is a very useful flap.

**Our approach**

For perineal defects in previously radiated or soon to be radiated fields, we prefer the bulk of a vertical or transverse rectus abdominis myocutaneous flap. In patients with stomas or low transverse abdominal incisions, an inferiorly based rectus flap may not be an option. If the rectus flap is not an option, we prefer to use the gracilis muscle with or without a skin paddle for reconstruction of perineal defects and the Singapore fasciocutaneous flap for vaginal or scrotal reconstruction. When using a gracilis or Singapore flap for reconstruction of total pelvic exenterations, we will often suture in an ultra-thick piece of AlloDerm circumferentially along the pelvic rim to prevent bowel from falling into the pelvis and resting against the reconstructed perineum. This procedure has the added advantage of keeping the bowel out of the pelvis when radiation therapy is to be performed after surgery.

**References**


