The American Journal of Surgery (2014) ■, ■–■

The American Journal of Surgery®

Repair of recurrent hernia after biologic mesh failure in abdominal wall reconstruction

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KEYWORDS:
Ventral hernia;
Biologic mesh;
Components separation;
Underlay mesh;
Recurrent hernia

Abstract

BACKGROUND: Biologic mesh is commonly used in abdominal wall reconstruction but may result in increased hernia recurrence. There are minimal data on repair of these recurrent hernias.

METHODS: We conducted a retrospective chart review of 24 patients presenting to a single surgeon with recurrent ventral hernia, previously repaired with biologic mesh.

RESULTS: Seventeen of 24 study patients underwent open repair, including 5 revisions of incomplete external oblique release. Mesh was polypropylene in 11 patients and fenestrated condensed polytetrafluoroethylene in 3 patients. In 1 patient, no mesh was used. In 2 patients, bridged biologic mesh was used because of risk of exposure. All biologic repairs have since recurred. Complications occurred in 3 of 15 prosthetic mesh patients and in all biologic mesh patients.

CONCLUSIONS: Prior components release can be repeated if computed tomography scan reveals incomplete release. Recurrence is common after bridged biologic mesh repair. Conventional mesh can be used safely in many recurrent abdominal hernias after biologic mesh failure.

Incisional hernia is a common occurrence, with an incidence of 11% to 20% after midline laparotomy.[1–6] Attempted repair of these hernias with synthetic mesh is associated with recurrence rates of up to 32% and numerous complications.[7–11] When biologic mesh was initially described for abdominal wall reconstruction in 2003, it represented an option for mesh reinforcement with the potential for vascular ingrowth and resistance to infection.[12] In 2010, the Ventral Hernia Working Group (VHWG) suggested a role for biologic mesh in all but the lowest risk patients.[11] Unfortunately, the experience with biologic mesh-assisted hernia repair has been mixed at best.[13–21] In a recent publication from Bochicchio et al,[22] 1-year hernia recurrence rates after hernia repair were 100% and 31% with AlloDerm and FlexHD. Increased use of biologic mesh has resulted in a new patient population presenting for abdominal wall reconstruction: those who have a recurrent hernia after a previous failed biologic mesh repair. The optimal treatment of these patients has not been determined. We hypothesize from our prior experience that the use of biologic mesh can be avoided in a large majority of these reoperative cases. In this retrospective study, we examine this patient population at our center.

This study was funded by the Division of Plastic Surgery and received no external funding. Dr Dumanian received research funding from Medline industries, maker of the fenestrated PTFE (MOTIF) mesh utilized in several patients in this study.

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Manuscript received January 28, 2014; revised manuscript April 14, 2014

0002-9610/$ - see front matter © 2014 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.amjsurg.2014.05.008

Patients and Methods

After approval from the Northwestern University Institutional Review Board, a retrospective chart review was carried out on all patients presenting to a single surgeon (G.A.D.) with a recurrent abdominal hernia after prior placement of biologic mesh. In a 3-year period from 2009 to 2012, 24 consecutive patients fit these inclusion criteria. This period of time was chosen to avoid previously reported patients.[19] Thirteen patients had a "bridged" biologic mesh placed by the senior author, with mesh spanning a defect where the rectus muscles could not be brought together in the midline. These patients had a bridged biologic repair because of contamination (6 patients) poor soft tissue coverage with a high risk of mesh exposure (5 patients) or both circumstances (2 patients). In all but 4 of these cases, a components separation was performed at the time of bridging mesh placement and the rectus complexes could still not be approximated in the midline. The 4 patients who did not have a release and instead had a bridged mesh only had this procedure chosen because of differing factors: 2 patients had loss of the rectus muscles so a release could not be performed. One patient had Child–Pugh B cirrhosis and so additional incisions and dissections were avoided, and 1 patient had significant abdominal wall induration and inflammation and it was thought best to delay a component separation. In all these cases, it was decided that the rectus muscles could not be moved to the midline without significant risk of compartment syndrome. The remaining patients had biologic mesh placement at other institutions. Patient characteristics, such as age, body mass index, comorbid medical conditions, and hernia size, were obtained. Twenty patients had a general surgery, urologic, or gynecologic procedure as the initial cause of their hernia, and 4 patients were traumatic in origin. Twenty-three of the patients had midline defects. One patient had a flank hernia from sarcoma resection. Fourteen patients had a previous component separation procedure. Fourteen patients previously had non–cross-linked porcine acellular dermal matrix placed, 8 had human acellular cadaveric dermis placed, 1 patient had bovine acellular dermis, and 1 patient had an unknown biologic mesh found at the time of his hernia repair. Of the 24 patients, all were offered a repeat ventral hernia repair. All patients were requested to have preoperative clearance from their internist and appropriate specialists, including anesthesiology. A frank discussion of the risks and benefits of reoperation was had with all patients. Of these 24 patients, 17 elected to undergo this procedure, and their outcomes will be reported.

Operative technique

The goal of our operative technique is to achieve a directed supported prosthetic mesh repair of the rectus abdominis muscle.[19,23–26] With the patient under general anesthesia, the hernia is approached through a long midline incision. After freeing the hernia sac and the posterior aspect of the abdominal wall, 4 cm of the superficial surface of the rectus muscles is cleared. Tension is applied to the rectus muscles to ascertain if they can be reapproximated in the midline. If the rectus muscles under anesthetic relaxation cannot be manually reapproximated, then a components separation is performed, sparing the periumbilical perforators, via 6-cm subcostal transverse incisions.[27] If a patient in this series had a previous component separation by another surgeon, a preoperative computed tomography (CT) scan was performed. If the CT scan revealed an incomplete release of the external oblique component of the rectus sheath, a completion of the release was performed through lateral incisions as has been described by the senior author.[23,24] In all but the most challenging defects, this anterior component separation will enable transposition of the rectus muscles into a midline position. Posterior releases of the peritoneum or transversalis fascia are not performed. A 7.5-cm wide mesh is secured in an intra-abdominal underlay position. The mesh is sutured in place using interrupted 0 polypropylene sutures that travel from the lateral extent of the superficial rectus dissection (4 cm from the medial aspect of the rectus muscles) to the edge of the mesh. Sutures are spaced closely enough to prevent a bowel loop becoming interposed in between bites. Forty to 50 polypropylene sutures are typically required for a full midline repair. With the mesh being slightly narrower than the horizontal distance between sutures ($4\,cm \times 2 = 8\,cm$), the medial aspect of the rectus muscles fall together in the midline and are easily approximated with 0 polypropylene sutures as a third vertical suture line. The mesh thus serves as a pledget to prevent suture pull through and to better distribute the forces of the hernia repair over a broader area. The mesh is load sharing, as opposed to load bearing. Over time, the closure of the rectus muscles over the mesh, as well as mesh incorporation will add additional strength to the repair.

After closure of the rectus muscles over the mesh, all of the scarred hernia sac and much of the now-redundant midline skin are excised as a vertical panniculectomy, serving to remove the most ischemic skin and to limit the amount of subcutaneous dead space. Drains, quilting sutures, limited undermining via perforator-sparing techniques, and midline soft tissue excision all contribute to decreased wound complications.[24] Typically, 3 drains are placed superficial to the rectus fascia with one in the midline and one in each lateral components release tunnel. Drains are removed after output is less than 30 cc/day.

Choice of mesh

In clean or clean–contaminated surgeries, 11 of 17 patients were repaired with uncoated midweight polypropylene mesh (soft prolene; Ethicon, Somerville, NJ). This mesh was used even in VHWG grade 3 hernias. If a new bowel anastomosis was performed during the course of the operation, if there was an enterotomy during the operation, or it is felt for another reason it was felt there was a slighter

greater of infection or reoperation, fenestrated, cPTFE (MotifMesh; Medline Industries, Mundelein, IL) was utilized for 3 closures. It is our belief that this mesh may be a good compromise between the durability of a synthetic mesh repair and easier removal if infection occurs or reoperation is required. If there was gross spillage of enteric contents or it is felt that there was a high likelihood of mesh exposure because of unreliable soft tissue coverage (as can occur in a bridged repair), porcine acellular dermal matrix was chosen for 2 patients. In a single instance in this study, in a highly contaminated field where the rectus muscles could be approximated in the midline, no mesh reinforcement was used after components separation. In frankly infected cases (VHWG grade 4), it is our belief that a salvage procedure such as absorbable mesh placement with skin grafting or temporary abdominal closure should be used and a definitive closure should be performed at a later time. No cases of this type were included in this study. In 4 patients in this study, the rectus muscles could not be approximated in the midline and therefore mesh was placed in a bridged fashion. In 3 of these patients, mesh was bridged because of severe loss of domain. In the other patient, previous trauma had resulted in complete loss of one rectus abdominis muscle and rectus sheath. In all of these cases, a components separation was performed either previously by the senior author or during the repair of the recurrent hernia.

Results

Table 1 summarizes the characteristics of patients who underwent repair of recurrent hernia. In 2 patients with no prior components separation, a components separation was performed. In 5 patients who had a previous components separation, it was determined with preoperative CT scan and confirmed intraoperatively that release of the external oblique component of the rectus sheath was incomplete (Fig. 1), and therefore a completion release was performed (Fig. 2). None of these patients had a prior components release by the senior author. In 5 further patients who had a prior complete external oblique release by the senior author, this plane was redissected to improve lateral abdominal wall compliance to permit medialization of the rectus complexes. VHWG grades ranged from 1 to 3, with 1 group 1 (low risk), 7 group 2 (comorbid), and 9 group 3 (potentially contaminated) patients. Complications stratified by VHWG grade and type of mesh used are reported in Table 2. No mesh required removal. Overall complication rates were 0% and 14% for VHWG grade 1 and 2 patients, respectively. In ventral hernia grade 3 patients, the complication rate was 44% (several patients had multiple complications). Both patients with a bridged porcine acellular dermis repair developed a recurrent hernia within 1 year. Recurrences by repair type are included in Fig. 3. No other recurrences were noted. All complications reported were during the complete period of follow-up, which was a mean of 11 months (range 4 to 40 months).

Table 1 Patient characteristics

Patient characteristics	Data (%)
Sex	
Male	8 (47)
Female	9 (53)
Age (years)	
Mean	47.4
Range	32–63
SD	8.9
Hernia transverse size (cm)	
Mean	14.5
Range	3–22
SD	6.4
Body mass index (kg/m^2)	
Mean	31.2
Range	18–46.1
SD	7.4
Previous abdominal surgeries	
Mean	6.1
Range	1–18
SD	4.3
Smoking	1 (6)
Diabetes	4 (24)
Simultaneous intra-abdominal procedure	3 (17)

Data are expressed as number (percentage).
SD = standard deviation.

Comments

It is helpful to conceptualize the outcomes of biologic mesh use into 2 categories—bridged (inlay) repairs, where no native rectus complex tissue exists to contain the

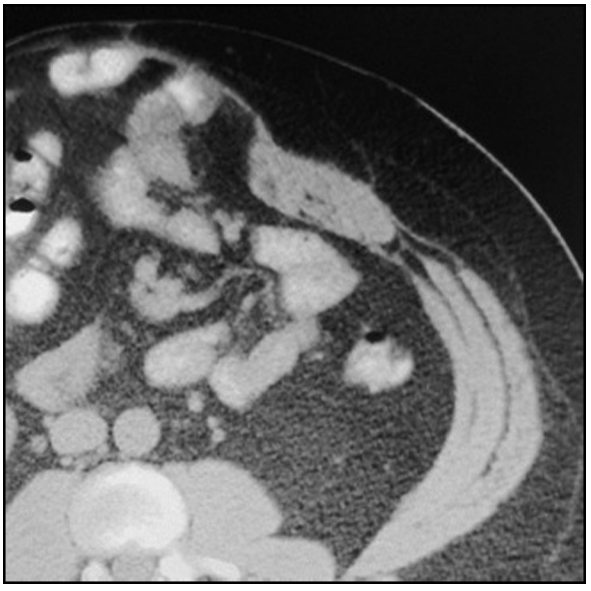

Figure 1 CT scan of a patient who had multiple previous abdominal component separations according to prior operative reports. All 3 components of the rectus sheath are intact and the patient benefited from a completion of release of the external oblique fascia.

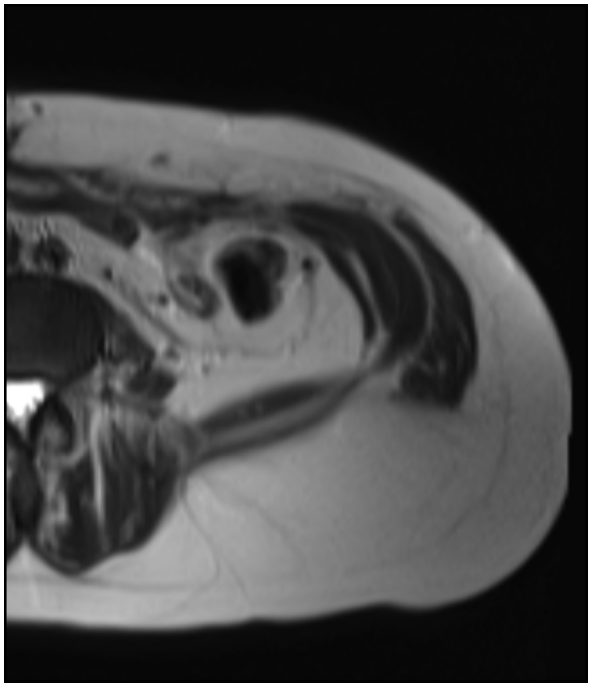

Figure 2 Magnetic resonance imaging of the abdomen showing evidence of a complete abdominal components separation. The external oblique is retracted laterally and its axis is oriented differently than the internal oblique and transversalis. The internal oblique shows significant hypertrophy.

abdominal viscera, and direct supported repairs (underlay), where mesh is used to reinforce a midline closure of the rectus complex. In the latter category, biologic mesh could act as a shield to offload the stresses and tension felt at the abdominal wall suture line. In both groups, the data to support the use of biologic mesh are underwhelming.

While direct supported repairs are ideal, bridging is the only option available if the rectus complex cannot be approximated in the midline after a components separation. Bridged prosthetic mesh repairs may be performed if the rectus complex cannot be reapproximated in the midline, but adequate soft tissue remains for coverage of the mesh. In the absence of dependable soft tissues or in the presence of many serosal injuries or persistent inflammation after debridement, prosthetics should be avoided. In this case, bridged biologic mesh is one of the few options for immediate closure. However, current data reveal that this is not a durable repair. For bridged repairs, using either human or porcine products, the recurrence rate is 44% to 100%.[16,22,28–31] Booth et al[26] recently published a comparison study of bridged and direct supported mesh repair, and found a 56% recurrence rate in bridged repairs versus 8% in direct supported repairs. Experience at our center corroborates these studies with a 100% failure rate of bridging biologic mesh.

For direct supported repairs, use of expensive biologic products would need to show low complication rates, and hernia recurrence rates less than unsupported primary repairs. The 2012 RICH study, supported by one of the manufacturers of biologic meshes, reported a 28% hernia rate at a 2-year follow-up.[28] This is similar to the recurrence rate of 23% at 15 months of the senior author of similarly complex patients who underwent unsupported repairs.[24] If the long-term recurrence rate is not dramatically improved with biologic mesh, then it is difficult to justify the increased cost ($18.17–$31.33/cm^2).[13]

Nevertheless, these long-term failures of biologic meshes require treatment and a plan for remedy. In the large majority of patients in this study, even with VHWG grade 3 hernias, prosthetic mesh was used for repair, with a 0% recurrence rate. While we view this data with caution, as the mean follow-up is only 11 months, this is in stark contrast to the 2 patients who had bridged biologic mesh repair. Both of these hernias recurred within 12 months.

We attribute successful closure in our patients to several factors. Each patient had a previously closed and pressurized abdomen. Constant movements of the diaphragm with breathing increases abdominal pressure, and push on the abdominal wall muscles to regain abdominal domain and to improve muscle compliance.[32] At the time of the repeat surgery, those muscles would be easier to mobilize and retain in position, resulting in less tension on the abdominal closure. We hypothesize that this decreased loss of domain contributes significantly to repair success. Second, in the setting of reduced inflammation soft tissues were more reliable. For example, there were no concurrent enterocutaneous fistulae takedowns

Table 2 Operative outcomes organized by Ventral Hernia Working Group grade and type of mesh used

Ventral Hernia Working Group grade	Mesh used	Number	Hematoma (%)	Cellulitis (%)	Seroma (%)	Delayed wound healing (%)	Adhesive bowel obstruction (%)	Hernia recurrence (%)	Mean hospital stay (days ± SD)
1 (low risk)	Polypropylene	1	0	0	0	0	0	0	7
2 (comorbid)	Polypropylene	7	0	1 (14)	0	0	0	0	5 ± 1.7
3 (potentially contaminated)	Polypropylene	3	0	0	0	1 (33)	0	0	5.3 ± 2
	cPTFE	3	0	1 (33)	1 (33)	0	1 (33)	0	6.7 ± 2
	Porcine	2	0	1 (50)	0	2 (100)	0	2 (100)	9.5
	None	1	1 (100)	0	0	1 (100)	0	0	30

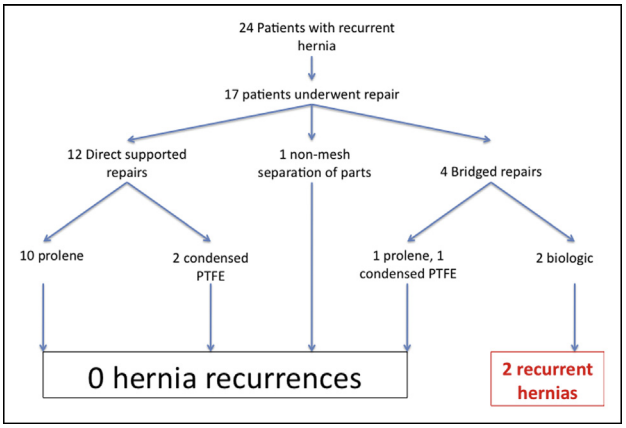

Figure 3 Number of recurrent abdominal hernias in the study population, grouped by repair type.

performed concurrently with hernia repair in any of these cases. However, in several of our previous bridged biologic mesh repairs that failed, there were takedowns of fistulae at the same time. With healed soft tissues over a hernia, and decreased inflammation overall, repair is likely more consistent. Similarly, in this patient series, there were only 3 concurrent intra-abdominal procedures performed and only 7 of 17 patients had significant lysis of adhesions. This keeps operative times low, decreases the potential for bowel edema and increased intra-abdominal pressure, and likely decreases hemodynamic instability and perfusion problems that all could contribute to a risk of recurrence. The net effect of all these factors is a less hostile field for prosthetic mesh closure.

Even with the distinct advantages of prosthetic mesh, 2 patients in our series did have a bridged biologic mesh repair, with 100% hernia recurrence rate. To give an example of the type of patient we select biologic repair for, one of these patients had a complete loss of the left rectus muscle and abdominal skin from trauma. The defect was initially repaired with bridged cadaveric dermis-based mesh. He had 2 large tissue expanders placed before his hernia repair to achieve skin closure. We used a non–cross-linked porcine acellular dermis to close his abdominal wall, with a significant bridged portion, and mobilization of the tissue-expanded skin for soft tissue coverage. There was a small area of skin breakdown, with exposure of the acellular dermis, and this went on to granulate and re-epithelialize with dressing changes. The hernia then recurred 8 months later. The complexity of this patient's case highlights both the utility and weaknesses of biologic mesh. Biologic mesh was able to withstand exposure without infection, but eventually failed as a long-term hernia repair.

Another significant finding of this review is the need to assess the completeness of the prior component separation release by CT scan. In fact, of 12 patients who had a prior component separation, we found an incomplete release of the external oblique in 5, with the release tending to end at the anterior superior iliac spine or not extending onto the rib cage. For a bipedicled flap to be effective, the length of the relaxing incision must be *longer* than the defect that is being closed. This has not been reported by Hultman et al where 16 patients underwent a rerepair of recurrent hernia after components release. All these patients had additional mesh placed, but none had a completion release or a remobilization of the rectus complex.[30] Even in patients with a complete prior release, we remobilized the plane between the external and internal oblique if the rectus complex could not easily be reapproximated in the midline. The idea behind remobilization is to improve lateral wall compliance by temporarily removing the lateral pull of the external obliques from the internal obliques. This case series highlights the variability of components releases that are being performed, and the necessity of preoperative CT scan in planning repair of recurrent hernia. Hicks et al performed a study of CT scan appearance of the abdominal wall, an average of 17.4 months after component separation. The consistent finding was an atrophy of the external oblique and hypertrophy of the internal oblique and transversus abdominis muscles.[33] There was no description of re-establishment of the external oblique portion of the sheath. Therefore, we must conclude that our findings are because of inadequate release of the external oblique during the original component separation.

In conclusion, patients presenting with a recurrent hernia after biologic mesh placement are a growing population. In the vast majority of these cases, we were able to successfully repair these recurrent hernias with prosthetic mesh, even in a minimally or potentially contaminated field. Bridged biologic mesh repairs, while perhaps an inevitable choice given the occasional patient with poor soft tissue coverage of the abdomen, are fraught with a high rate of recurrence in our series. Patients who have had a prior components separation should have a preoperative CT scan to determine if a completion of release should be performed.

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