Surgical Repair Using Biologic Tissue Matrix To Facilitate Tissue Healing: A Case-Based Report

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Introduction

Surgeons have many prosthetic mesh options available for the reinforcement and repair of soft tissue. For ventral hernia repair, a common type of abdominal wall surgery, the addition of prosthetic mesh has significantly reduced recurrence rates.1 Despite some favorable performance characteristics, synthetic mesh has been associated with complications, particularly in complex repairs.2,3 Biologic grafts have a clinical rationale: Each type is designed to serve as an extracellular matrix (ECM) scaffolding for neovascularization and eventual remodeling of tissue to resemble the native type.4 However, clinical outcomes may be greatly affected by unique characteristics and manufacturing processes that differentiate the available biologic grafts.5

XCM Biologic Tissue Matrix—a sterile, non-crosslinked 3-dimensional matrix derived from porcine dermis—offers preservation of natural fibrous architecture that provides a scaffold for cell ingrowth and proliferation. A proprietary manufacturing process removes cells and DNA for host acceptance, minimizing damage to native tissue architecture.6 XCM has characteristics that make it advantageous for trauma surgery: It’s available in multiple sizes—2 cm × 4 cm to 20 cm × 30 cm—and comes hydrated and immediately ready for use, which eliminates the risk for contamination during soaking.6

Clinical Considerations in Mesh Selection

The mesh material and tissue repair technique ideally are determined after assessing patient factors, such as wound characteristics, past medical history and comorbidities, anatomy, and vascularity.7

Mesh-related infection—which has been reported at rates as high as 25%—is a risk factor for hernia recurrence.7,8 Because mesh-related infection is associated with substantial morbidities like enterocutaneous fistulae and reoperation to remove infected mesh,7 strategies to minimize the risk for infection are important in determining surgical approach, technique, and the choice of mesh material.

In the experience of Hesham Ahmed, MD, assistant professor of surgery at UMDNJ–Robert Wood Johnson Medical School in New Brunswick, New Jersey, the strength of a mesh material is a major clinical concern because the repair must be durable. Mesh strength can affect clinical performance, and a primary goal in soft tissue repair is to avoid splitting and tearing—especially in the early postoperative period.

"In abdominal wall reconstruction, you need to depend on the mesh for a few days or weeks—maybe 2 weeks in this kind of patient. The mesh is very important,” said Dr. Ahmed, who describes his patient population as a mixture of acute and semi-elective cases including high-risk patients. In preclinical studies, XCM porcine hydrated dermis mesh has been shown to sustain strengths greater than native tissue during the healing process.6,8 Preclinical studies and clinical experience have shown XCM to have high tensile strength, which, as noted by Dr. Ahmed, is an important mesh attribute in abdominal wall repair—one of several soft tissue repair applications for XCM.6,8

In Dr. Ahmed’s practice, having a dependable mesh is paramount. “In trauma, patient selection is not an option, so the features of the mesh that is used are very important,” he said. In such a time-constrained setting, XCM’s “out-of-the-package” availability for use is a clinical advantage. “With XCM, there’s no hydration time, no orientation, and it’s very thick,” said Dr. Ahmed.

Tissue regeneration and neovascularization are sought-after performance criteria. Dr. Ahmed described a patient who, after undergoing abdominal wall reconstruction with XCM, “had significant granulation tissue covering the mesh at almost 2 weeks. It’s an advantage when granulation can happen that fast. The mesh is doing what it’s supposed to do, assimilating itself into the natural tissue of the patient.”9 In another case that was particularly complex, in which he placed XCM over exposed bowel, “granulation tissue formed very quickly. The patient did very well and fistulae were avoided.”9

Finally, elastic properties of mesh can vary significantly. Human acellular dermal matrix, for example, has shown significant differences in the amount of stretching it offers when used in the hydrated state.10,11 Surgeons have described elasticity as a consideration when selecting a mesh graft, with excessive stretching posing a potential detriment to clinical performance and outcome. In a small prospective study of

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* Results from case studies are not predictive of results in other cases. Results in other cases may vary.
integration. In addition to good tensile and suture pullout strength, preclinical studies performed in animals have shown that XCM exhibits cellular infiltration and is well integrated while retaining many proteins and cytokines present in native tissue.

Case Presentation

A 48-year-old male was involved in a car accident while wearing his seatbelt. Abdominal and pelvic computed tomography (CT) scans, as part of the trauma assessment, revealed hemoperitoneum. After the scan, the patient became hemodynamically unstable and was emergently taken to the operating room. Because of prior exploratory laparotomy, chevron incision was used to enter the abdomen. Two small bowel resections and a sigmoid colon resection were required. Due to the patient’s condition, a damage control approach was used and a temporary abdominal closure was performed with the intention of returning for a mature sigmoid colostomy and closure of the abdomen within 48 hours. This was performed as planned but post-closure, the patient continued to have a fever and elevated white blood cell count, which required a rescan. Necrotizing fasciitis of the abdominal wall—especially in the left side—was diagnosed and required multiple trips to the operating room for aggressive debridement of the fascia and rectus muscle on the left side of the abdominal wall. He recovered but had complications of enterocutaneous fistula (Figure 1) and wound dehiscence at the chevron incision site.

Mesh Matters in the Surgeon’s Hands

For abdominal wall reconstruction, Dr. Ahmed typically performs component separation (CS) and places mesh using the sandwich technique, which consists of an underlay and an overlay. He finds that the CS approach—which employs native tissue—is useful for avoiding the development of seroma between mesh and fascia.

One of the most important aspects of decellularized ECM mesh materials is the combination of strength and integration. In the event of an infection, synthetics often require removal; in contrast, dermis-based meshes that incorporate into the repair may not require removal, thus potentially preventing expensive and challenging recurrences.

Dr. Ahmed also has observed a low incidence of seroma formation with XCM in his cases. His observations are consistent with a study using other biologic meshes that evaluated functional outcomes and host responses to mesh materials that were manufactured with a variety of tissue processing techniques, some of which led to modified collagen matrices. Clinically, these processed meshes may be associated with scar tissue, inflammatory responses, graft pleating, and poor integration. In addition to good tensile and suture pullout strength, preclinical studies performed in animals have shown that XCM exhibits cellular infiltration and is well integrated while retaining many proteins and cytokines present in native tissue.

Figure 1. Open wound with enterocutaneous fistula and colostomy.

Image courtesy of Hesham Ahmed, MD.

Figure 2. Vacuum-assisted closure dressing applied to the XCM Biologic following repair.

Image courtesy of Hesham Ahmed, MD.
After prolonged wound care management and the use of a skin graft to cover his exposed bowel and to facilitate the management of his output from the enterocutaneous fistula, the patient was discharged home. He then developed a large hernia, mainly on the left side of the abdomen. Approximately 9 months after the initial injury, the decision was made to reverse the colostomy, take down the enterocutaneous fistula, and perform abdominal wall reconstruction to repair his large incisional hernia. The patient received preoperative bowel preparation and antibiotics. A midline surgical incision was followed by extensive lysis of adhesions, takedown of both the enterocutaneous fistula and sigmoid colostomy, and reanastomosis for large bowel continuity. Subsequently, a large portion of missing rectus muscle and rectus sheath was observed, especially on the left side.

Permanent monofilament sutures were used to approximate the sheath horizontally with some released incisions to be able to achieve approximation to reach the midline. On the right side, where most of the rectus muscle was preserved, CS was performed in the typical fashion. XCM mesh size 30 cm × 20 cm was secured in a transfascial approach on each side and on 6 points in underlay fashion. Midline fascia was closed with loop polydioxanone suture; figure-of-eight permanent monofilament suturing technique also was used. Another small piece of biologic mesh was placed in onlay fashion to reinforce the midline repair as part of a sandwich mesh placement technique. Excess skin was removed and vacuum-assisted closure dressing was applied over the mesh (Figure 2). Figure 3 shows CT scans of the pelvic region following abdominal wall reconstruction.

**Conclusion**

After 4 weeks, the abdominal wall repair was complete and the patient made good clinical progress. This clinical outcome was facilitated by the use of XCM Biologic Tissue Matrix, which is designed for repair and reinforcement of soft tissue where weakness exists. The structure of the material allows for cellular infiltration. Furthermore, XCM has been shown to sustain strength greater than native tissue during the healing process.²,³,⁴

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Footnotes:

¹ Bench/Animal Test results may not necessarily be indicative of clinical performance.

² Results from case studies are not predictive of results in other cases. Results in other cases may vary.
References


Disclosure

Dr. Ahmed received funding for his participation in this project.

For more information, go to www.synthes.com, or visit booth #311 and our lunch & learn symposium at the American Hernia Society meeting on March 15, 2013.