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Abstract

Synthetic meshes are associated with significant complications including infection, erosion, fistulization, pain and adhesion formation. This is in part due to the foreign material structure, polymer type and pore size, and may result in a chronic inflammatory response. Re-operations are more difficult with synthetic mesh in the abdominal wall. Peritoneal serosal surfaces adhere to mesh pores and points of fixation. The rationale for synthetic meshes is to provide mechanical integrity, at the expense of biological repair systems. The ideal soft tissue implant would stabilize abdominal wall repair while regenerating normal tissue planes.

The rationale for collagen-based (biological) meshes, therefore, is to provide a more normal repair signal for the injured abdominal wall. Current collagen meshes are a form of tissue extracellular matrix (ECM) capable of providing such wound healing signals (autograft, allograft or xenograft). Allografts and xenografts have donor cells removed in order to reduce the immune response, leading to rejection of the implant. The acellularized ECM may also be chemically modified to improve mechanical performance and to further reduce the expression of foreign transplant antigens. A leading candidate molecule for this is the alpha-galactose epitope important to cross-species xenograft immune surveillance. Table 1

Bio-Engineering	Matrix Types	Example	Mechanism of Actions
None	Autologous, preserved	TFL, dermis	Incorporation
Acellularize	Allo-, xenograft	Dermis	Re-cellularize, remodel
Cross-link ECM	Allo-, xenograft	Dermis	Mechanical stability, Encapsulate
Non-crosslinked ECM	Allo-, xenograft	Dermis	Regenerate
ECM immune modification	Xenograft	Dermis	Regenerate
ECM mechanical modification	Xenograft	Intestine	Inflammatory, resorption

Table 1

Human and animal model data demonstrate that collagen meshes acquire host cells and remodel over time. The ability to form vascular channels and improved oxygen delivery support improved wound healing and explantation is rare. To date, most series demonstrate the effectiveness of collagen matrix meshes in infected and contaminated fields. It appears that in terms of engineering the ideal collagen-based mesh, structural and biochemical integrity should be maintained. There remains a theoretical concern that biological meshes will be replaced with abnormal collagen in patients with wound healing defects. The problem of bulging or laxity has been reported, but may also be very dependent on surgical technique. Next generation collagen meshes may solve this problem through tissue engineering of cell-ECM hybrids embedded with immune privileged and pluripotent stem cells.

There are no level one clinical data showing that collagen meshes reduce adhesion formation when compared to synthetic meshes. Theoretically, a regenerative biological interface without large mesh pores should form fewer adhesions. Level two data suggests that collagen meshes form fewer adhesions and are less difficult to re-operate upon. One study found that a collagen mesh composite will reduce the incidence and severity of adhesion formation to a peritoneal synthetic polymer mesh. A biological matrix mesh surface should also support the earlier formation of a neo-mesothelium, also reducing adhesion formation (Fig. 1). Cytokeratin-19 staining (heavy arrow) was detected on the peritoneal surface 35 days following abdominal wall implantation of an allograft (★). This occurred directly to the collagen mesh, very early, and did not require the formation of the "scar plate" that forms around synthetic meshes.

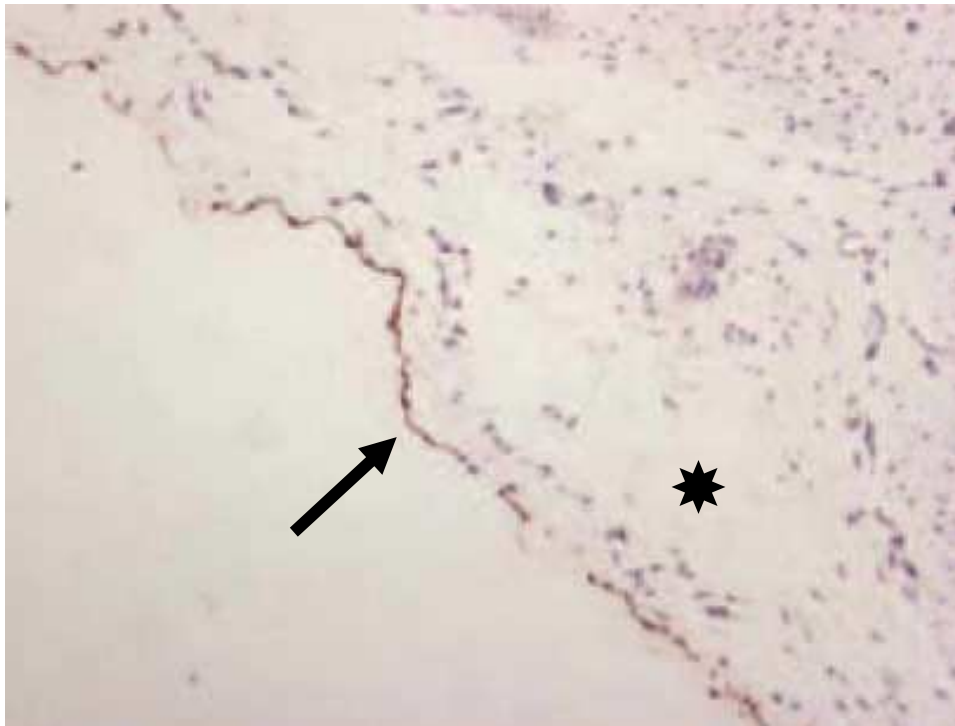


Figure 1.

Collagen matrix meshes are now established in clinical practice. They appear to be safe, and perform well. In this capacity, collagen meshes solve many of the problems introduced by synthetic meshes. Collagen matrix meshes may be more resistant to infection and adhesion formation, and support regenerative repair of the abdominal wall.