Journal of Pediatric Surgery 51 (2016) 461–464

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jpedsurg

Non-cross-linked porcine acellular dermal matrix (Strattice Tissue Matrix) in pediatric reconstructive surgery☆,☆☆

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ARTICLE INFO

Article history:
Received 20 April 2015
Received in revised form 30 September 2015
Accepted 30 October 2015

Key words:
Reconstruction
Abdominal wall
Chest wall
Biological membrane

ABSTRACT

Background: A variety of prosthetic materials are used in the pediatric population for abdominal and chest wall reconstruction. Pediatric experience of non-cross-linked porcine acellular dermal matrix is limited to patients following liver transplantation. We review our outcomes in patients in whom this matrix was used.
Methods: A retrospective analysis of patients who underwent abdominal and chest wall reconstruction with a non-cross-linked porcine acellular dermal matrix (Strattice TM) was performed to assess clinical outcomes.
Results: The tissue matrix was used in thirteen patients over a three-year period. Eleven had abdominal wall reconstruction and two underwent chest wall reconstruction. Seven procedures were contaminated at the time of surgery. Median age at insertion was 8.1 years (5 days–18 years) with a median weight of 20.6 kg (1.9 kg–99 kg). The tissue matrix failed in one patient with no unanticipated adverse events.
Conclusion: Future growth and need for reoperation requires special consideration in pediatric patients undergoing abdominal or thoracic wall reconstruction. Non-cross-linked porcine acellular dermal matrix can be safely used for abdominal and chest wall reconstruction in the pediatric population with a number of advantages over previously utilized materials. In our study, children have a favorable risk profile as compared to published adult series.

There are a wide range of congenital and acquired conditions that require abdominal wall reconstruction in children. For many years synthetic materials have been an essential tool in providing structural support, but their use is limited in infected surgical wounds. Synthetic materials can result in poor healing, rejection and a significant inflammatory response resulting in dense adhesion formation. The latter is an especially important consideration in pediatric patients who may require further surgical intervention during their lifetime.

Bioprosthetic materials derived from xenogenic sources are being increasingly used in adult practice. Biologic materials initially act as tissue reinforcement and then undergo remodeling, resorption and replacement. They act as a scaffold that is ultimately replaced with native tissue through the natural healing process [1]. This is dependent on the inflammatory reaction mediated by monocytes, macrophages and carefully balanced cytokine activity that influences cell mitosis, migration and recruitment of nearby tissues which promote tissue regeneration [2].

Strattice Reconstructive Tissue Matrix (LifeCell Corporation, One Millenium Way, Branchburg, NJ) is a non-cross-linked acellular porcine dermal matrix. It undergoes a proprietary processing that removes the main antigentic component that is responsible for xenogenic rejection reactions [3]. In Strattice TM there is cellular infiltration and revascularization as early as two weeks and provides mechanical strength that is equivalent to that of synthetic materials. Rapid revascularization, white cell migration and cell repopulation allow the matrix to transition into the host tissue for a natural repair process making it a suitable alternative to synthetic materials when repairing abdominal wall defects [4].

It has been used in various surgical procedures in adults, but experience in the pediatric population is limited to only six liver transplant patients [5]. We present thirteen cases of children, eleven who had abdominal wall reconstruction and two requiring chest wall reconstruction using a non-cross-linked porcine acellular dermal matrix.

1. Methods

A retrospective case note analysis of all pediatric patients who underwent abdominal and chest wall reconstruction using non-cross-linked porcine acellular dermal matrix, at the Royal Manchester Children's Hospital (RMCH) was performed. Patients' demographics, indication for repair, previous surgical repairs, and any complications were documented.

2. Results

Between May 2012 and April 2015, non-cross-linked acellular porcine dermal matrix was used in thirteen children (seven male, six female). Indications for use were: abdominal wall reconstruction for congenital abdominal wall defects in six patients (four gastroschisis

☆ Sources of Funding: None.
☆☆ Not previously presented or published.
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http://dx.doi.org/10.1016/j.jpedsurg.2015.10.083
0022-3468/

Table 1
Patient demographics and indications for use of matrix.

Indication for surgery	Underlying diagnosis	Age at insertion	Weight at insertion (kg)	Contaminated	Position of mesh	Primary or delayed primary closure
Congenital abdominal wall hernia	Exomphalos	4.25 years	16	No	Sublay	Primary
Congenital abdominal wall hernia	Exomphalos	5.8 years	16.6	No	Sublay	Primary
Congenital abdominal wall hernia	Gastroschisis	1 year	8.7	No	Sublay	Primary
Congenital abdominal wall hernia	Gastroschisis	5 days	1.9	Yes	Bridging	Secondary
Congenital abdominal wall hernia	Gastroschisis	33 days	2.5	Yes	Bridging	Secondary
Congenital abdominal wall hernia	Gastroschisis	15 days	2.8	Yes	Initially bridging but subsequent underlay	Secondary
Reinforce closure following gastrostomy breakdown	Neurodevelopmental delay	15.5 years	20.6	Yes	Sublay	Primary
Reinforce closure during bowel lengthening procedure	Short gut secondary to gastroschisis	8.1 years	24.4	Yes	Sublay	Primary
Incisional hernia	Severe neurodevelopment delay Previous esophagogastric dissociation	11.3 years	23	Yes Gastrostomy in situ close to wound	Sublay	Primary
Incisional hernia	Previous splenectomy and bone marrow transplant for X linked inhibition of apoptosis protein	18 years	99	No	Sublay	Primary
Parastomal hernia	Colostomy for severe idiopathic constipation	12 years	64.5	Yes	Sublay	Primary
Chest wall reconstruction	Right 4th and 5th rib metastasis from femoral osteosarcoma (2 ribs excised)	16 years	40	No	Bridging	Primary
Chest wall reconstruction	Primary Ewing's sarcoma left 9th rib (4 ribs excised)	16 years	64	No	Bridging	Primary

and two exomphalos), to reinforce wound closure in two patients, incisional hernia repair in two patients, parastomal hernia repair in one patient and two chest wall reconstructions following multiple rib excisions for tumors. Median age at insertion was 8.1 years (range 5 days to 18 years) with a median weight of 20.6 kg (range 1.9 kg to 99 kg) (Table 1). A single matrix was used in all patients. Median duration of follow up was 28.5 months (1–34).

The two patients with exomphalos and one patient with gastroschisis had large ventral hernias as a result of being unable to achieve abdominal wall muscle closure in the neonatal period. These patients underwent elective closure using non-cross-linked porcine acellular dermal matrix with no complications (Figs. 1–3).

The remaining three patients with gastroschisis had large defects requiring initial silo application. In one baby, the non-cross-linked porcine acellular dermal matrix was inserted at the time of silo removal and attempted closure of the defect. This was complicated by superficial skin dehiscence which was successfully treated by Vacuum Assisted Closure (VAC) dressing (KCI Medical, San Antonio, TX). Five weeks following initial membrane insertion the baby developed adhesive small bowel obstruction requiring laparotomy. The abdomen was accessed through an incision made in the non-cross-linked porcine acellular dermal matrix and it was noted that there were no adhesions between the bowel and the membrane. At the end of the procedure the incision in the biological membrane was directly sutured. Follow-up at one year demonstrates a good functional and cosmetic result. The second baby with gastroschisis initially required resection of ischaemic bowel followed by application of a silo for a significant abdominal wall defect. On removal of the silo, non-cross-linked porcine acellular dermal matrix was inserted to bridge the defect but skin closure was not achievable. A VAC dressing was applied but an enterocutaneous fistula developed lateral to the patch through native tissue (muscle). As the fistula was distant from the matrix it is unlikely to be directly attributable to the material. The baby developed sepsis and DIC secondary to a central line infection and died. Swabs from the matrix did not grow a pathogen. The third patient with gastroschisis required insertion of a bridging matrix at the muscle level with no skin closure owing to the size of the anterior abdominal wall defect. The patient returned to the theater twice over a six week period where the matrix was trimmed laterally and resecured to the muscle resulting in a staged closure of the abdomen. The final procedure resulted in the matrix being in a sublay position with direct muscle closure in the midline albeit under some tension. While exposed the matrix was kept moist with no infective complications (Table 2).

The only patient with a direct complication of the tissue matrix was an obese (BMI 36) child with chronic idiopathic constipation requiring formation of colostomy. Following two recurrent parastomal hernias initially closed by direct closure then Permacol patch, the non-cross-linked porcine acellular dermal matrix was inserted using a sutured underlay technique. Five months following insertion, the hernia recurred necessitating resiting of the stoma. No adhesions to the matrix were

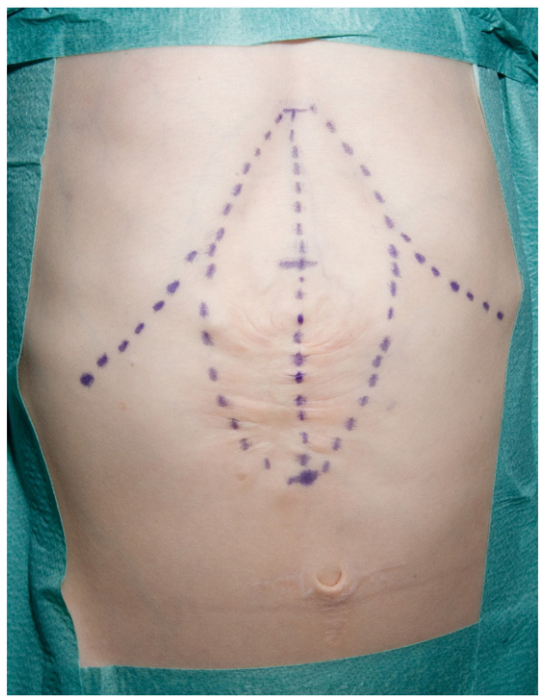

Fig. 1. A patient with large ventral hernia (6 × 12 cm) due to previous exomphalos.