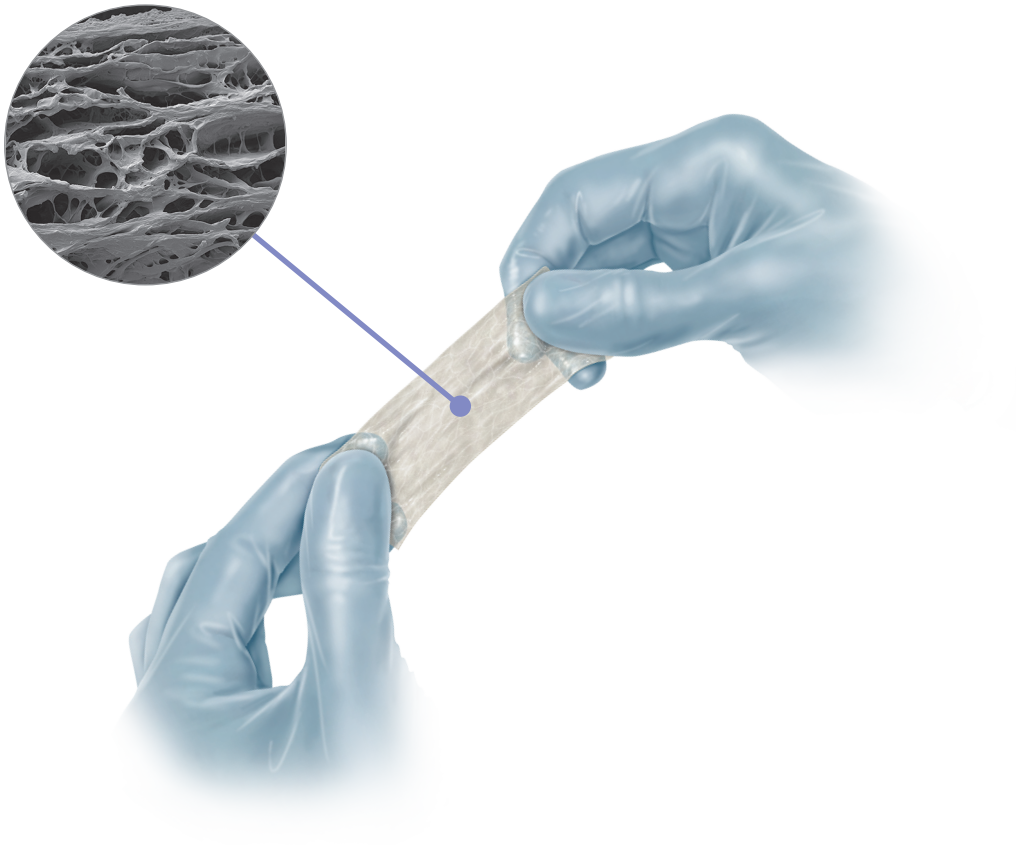
Biodesign® overview
and product catalog



Biodesign®
BIOLOGIC GRAFT PORTFOLIO

COOK BIOTECH
cookbiotech.com

Our history

More than 30 years ago, a Purdue University biomedical engineering team discovered the regenerative properties of porcine small intestinal submucosa (SIS).

In 1995, based on research supporting the versatility and effectiveness of SIS, Cook Biotech Incorporated was founded to develop and manufacture the promising new material.

Since then, Cook Biotech has globally distributed more than 6 million SIS products.[1]

Cook Biotech was founded in 1995 to develop and commercialize advanced tissue-repair products derived from SIS.

Cook Biotech, Purdue Research Park, West Lafayette, Indiana.

A foundation of continuous improvement

1988 - 1998 — **SIS discovered, developed**

SIS discovered as promising regenerative technology, developed into medical-grade material

1998 — **Surgisis® released**

First SIS hernia-specific device gains FDA clearance

2004 — **Application-specific processing introduced**

Processing tuned to match clinical application

2008 — **Biodesign Hernia Graft released**

PGA stitching and perforations added. Lipids and DNA fragments removed.

2010 — **Fistula plug improved**

First SIS fistula plug with resorbable button

2013 — **Head & neck grafts released**

Skull-base reconstruction, sinonasal repair products receive FDA clearances

2017 — **Regulatory clearances/ approvals expanded**

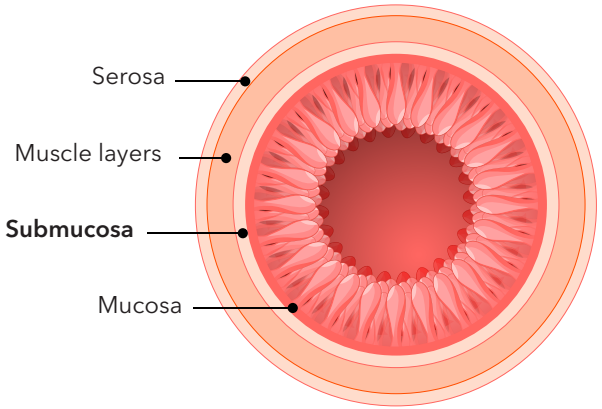
A total of over 150 cleared/ approved indications worldwide[2]

2020 — **New SIS formats launched**

Powder and liquid SIS compositions developed

SIS technology

SIS is derived from porcine small intestinal submucosa, a naturally occurring extracellular matrix (ECM) located between the mucosal and muscular layers of the small intestine.

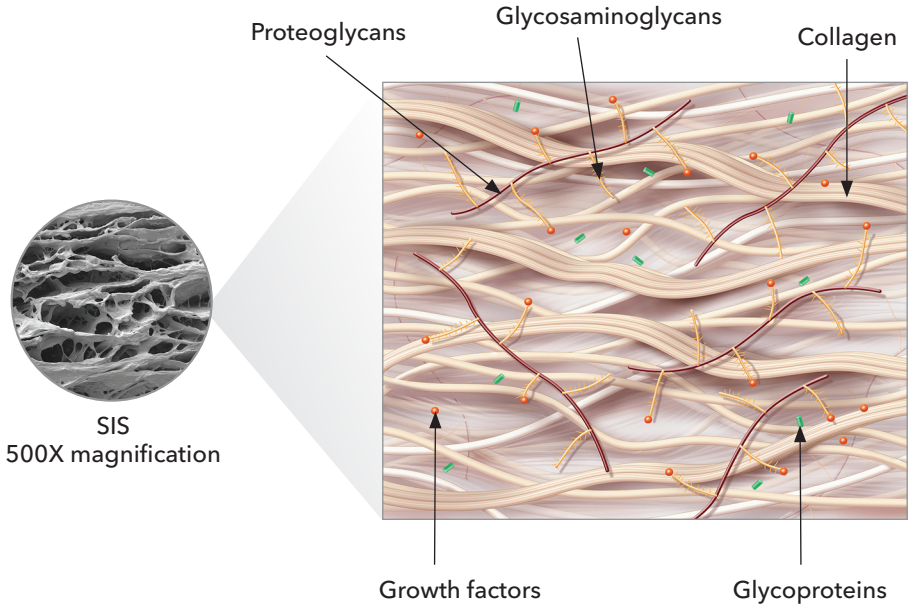


ECM is the structural and functional material that supports cells in nearly all body tissue. It serves as the structure upon which cells orient and move in response to other cells and signals and provides a healthy environment necessary for tissue maintenance and repair.[3]

Tissue-repair processes occur through the coordinated activity of cells that reside within the ECM. Because the ECM is necessary for tissue maintenance, it also plays a major role in tissue repair.[3] Without a functional ECM, the body can no longer support normal cellular processes, and tissue repair fails to progress.[4]

Complex composition

SIS is a naturally occurring ECM that contains collagen, glycosaminoglycans, proteoglycans, growth factors, and glycoproteins.[5]



These components create an environment that allows cells in the body to secrete growth factors and replicate.[6,7]

Our process

Cook Biotech designs and continuously improves proprietary processing methods to adapt SIS for specific clinical applications.

The result is variations of SIS that are optimized for application-specific requirements, such as strength and biochemical specifications.

Cook Biotech obtains SIS material from the intestine in a manner that removes all viable cells but leaves the naturally fibrous and porous nature of the matrix behind.[5]

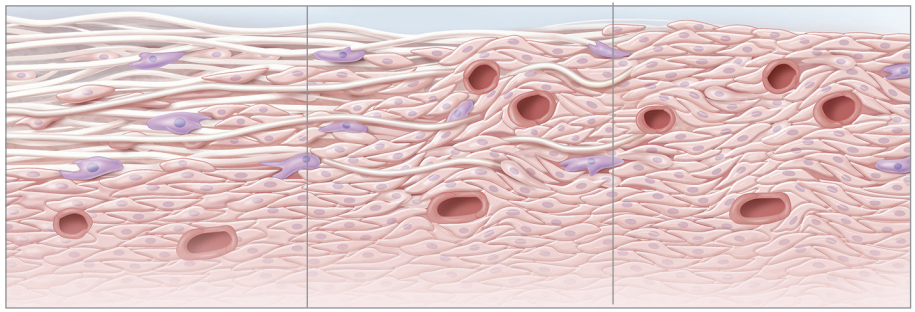
SIS is carefully processed and meticulously crafted into Biodesign biologic grafts designed for specific clinical applications.

The complex architecture and composition of the ECM are retained, providing not only the structural collagen framework but also the natural non-collagenous ECM components that are essential for cell interaction, function, and growth.[5,6]

Each product is then meticulously crafted to meet global quality standards with SIS material that was processed specifically for the product's clinical application.

Tissue remodeling

SIS provides a natural scaffold that allows the body to restore itself through the complex natural process of tissue remodeling. Tissue remodeling involves the **recruitment** of cells, the **renewal** of tissue composition, and the **reinforcement** of structural tissue architecture.[8] As the body heals, SIS is gradually remodeled and integrated into the body, leaving behind organized tissue that provides long-term strength.[9-11]



Recruit

Immediately after implantation, the remodeling process starts when the body's inflammatory and progenitor cells populate the matrix and release cytokines and growth factors that recruit collagen-secreting fibroblasts.[12,13] In this phase, SIS acts as a scaffold material to support the population of the ECM with patient-derived cells.

Renew

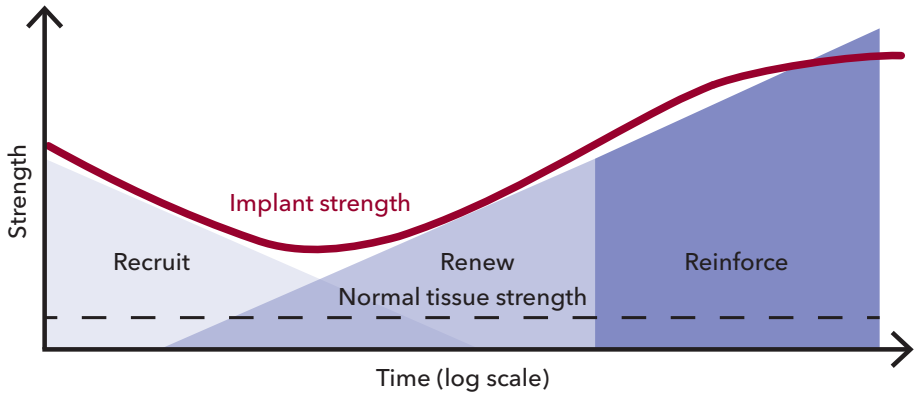
As remodeling progresses, host macrophages and fibroblasts in the newly populated matrix work together to renew the tissue through the complementary processes of phagocytosis, collagen deposition, and angiogenesis (blood vessel formation).[14] In this phase, SIS is gradually replaced by the patient's own tissue and cells.

Reinforce

Over time, the resident fibroblasts secrete cytokines and growth factors to signal reinforcement of the deposited tissue through the processes of additional collagen deposition and maturation, resulting in a strong, repaired tissue.[6,9-11] In this phase, SIS is no longer needed as the patient's own collagen has gradually matured into a stable structure that has long-term strength but is entirely the patient's own.[9-11]

Recruitment of cells, renewal of tissue composition, and reinforcement of structural tissue architecture result in mature, organized, strong tissue that can withstand the natural physiological forces it encounters.[15]

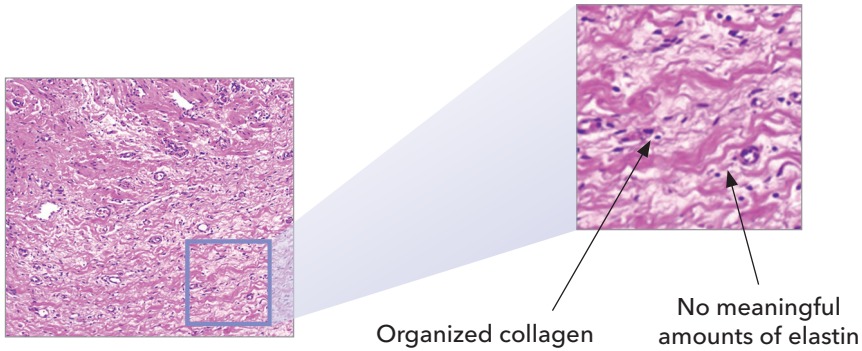
Biodesign graft remodeling



Non-dermis, non-cross-linked

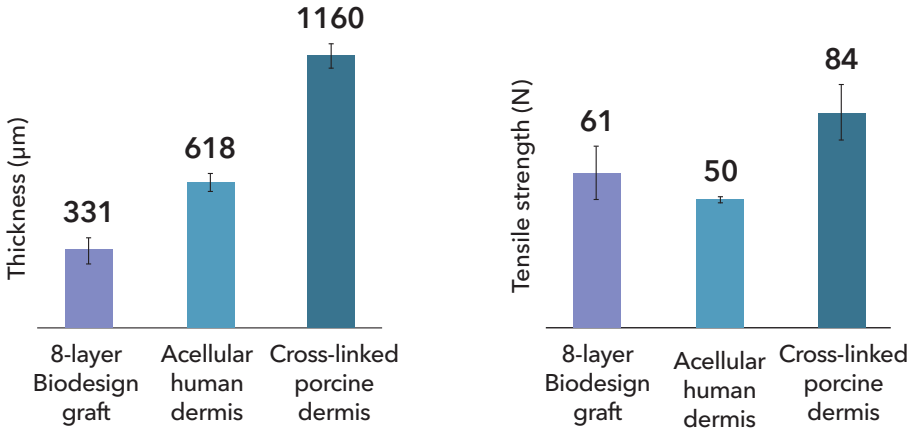
Because Biodesign products are not manufactured from dermis, they contain no meaningful amount of elastin.[16] Dermis-based biologic grafts contain high amounts of elastin. Studies attribute higher rates of failure to higher elastin levels.[17,18]

Biodesign grafts are designed to maintain strength throughout the remodeling process, so there is no need for chemical cross-linking.[11] Cross-linked grafts have been associated with chronic inflammation and encapsulation.[19]



Thin but strong

Even though Biodesign grafts are typically thinner than dermis-based grafts, the average tensile strength of a Biodesign graft is comparable to the average strength of either an acellular human dermal graft or a cross-linked porcine dermal graft.[20,21]



Because Biodesign grafts are thin yet strong, they offer significant advantages to grafts made from thicker materials.

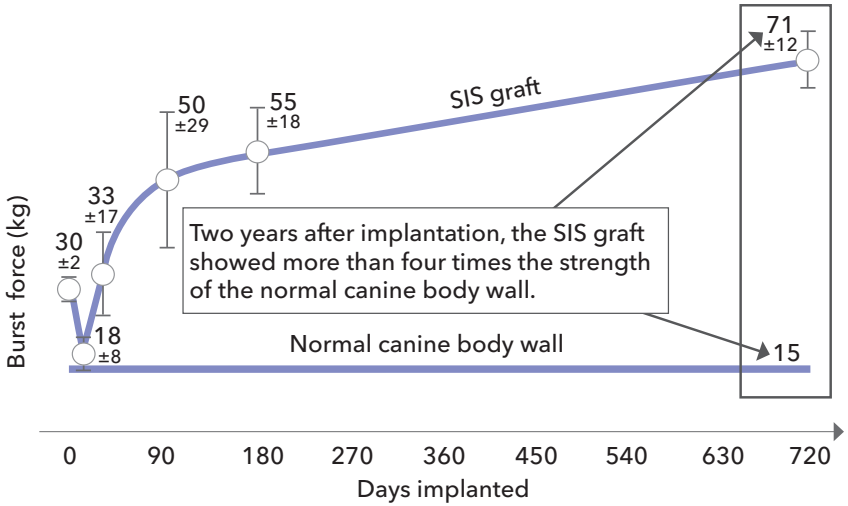
- They can be quickly hydrated, in a minute or less, using sterile saline or lactated Ringer's solution.
- They can easily be secured to the adjacent tissues using a suture, tack, or staple.
- They can easily be placed through a port during a laparoscopic operation.

Long-term strength

Preclinical data have shown long-term strength as SIS remodels.[11]

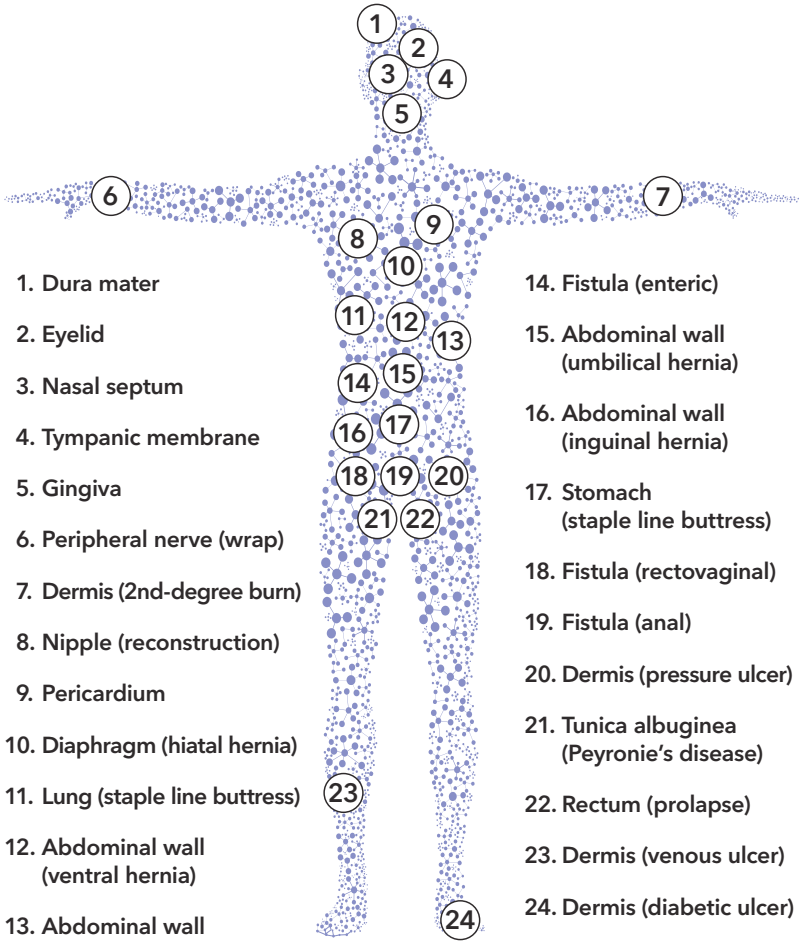
Not only is the material strong at the time of implant, it is designed to exceed the strength of the recipient's tissue during the time it is being remodeled into vascularized tissue.

When tissue repair and remodeling are complete, the resulting tissue is stronger than that which was implanted. No permanent material is left in the patient's body.[9,11]



Versatile platform

SIS has been used globally in more than 6 million tissue repairs throughout the body.[1]

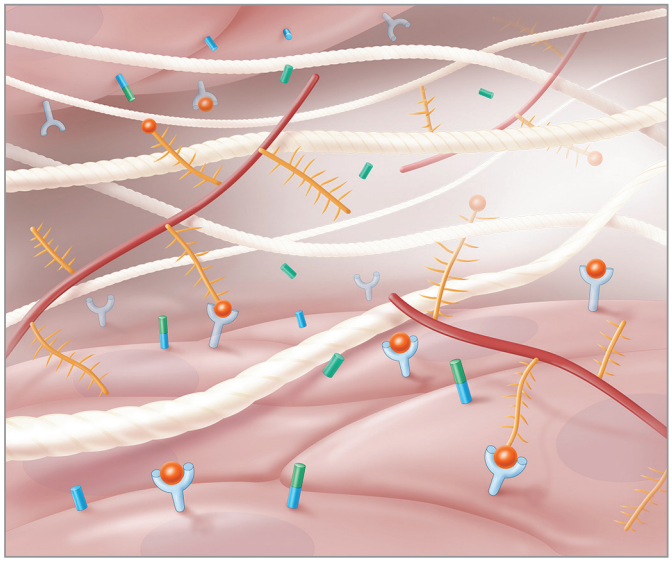


1. Dura mater
2. Eyelid
3. Nasal septum
4. Tympanic membrane
5. Gingiva
6. Peripheral nerve (wrap)
7. Dermis (2nd-degree burn)
8. Nipple (reconstruction)
9. Pericardium
10. Diaphragm (hiatal hernia)
11. Lung (staple line buttress)
12. Abdominal wall (ventral hernia)
13. Abdominal wall (parastomal hernia)
14. Fistula (enteric)
15. Abdominal wall (umbilical hernia)
16. Abdominal wall (inguinal hernia)
17. Stomach (staple line buttress)
18. Fistula (rectovaginal)
19. Fistula (anal)
20. Dermis (pressure ulcer)
21. Tunica albuginea (Peyronie's disease)
22. Rectum (prolapse)
23. Dermis (venous ulcer)
24. Dermis (diabetic ulcer)

This is a summary of historic global uses for Cook Biotech products. Not all products or indications are approved in all regulatory jurisdictions. Products should be used for on-label, approved indications only.

Site-specific remodeling

Biologic grafts made from natural tissues, when processed correctly for clinical use, have unique properties that are not found in synthetic materials, bioabsorbable materials, or highly processed and cross-linked graft materials.



The natural ECM, when retained in its complex arrangement of matrix proteins and associated factors, can provide the key components needed to restore damaged tissues to their natural state.[7,22]

These unique properties allow the naturally occurring biologic graft to completely integrate with the recipient's tissues and cells to ultimately form a vascularized, highly organized tissue structure that resembles the native tissue structure and architecture.[9,11]

As a result of this site-specific remodeling process, **no permanent material is left behind.**[9,11]

A key concern when implanting any material into the body is how it will react and what may go wrong. Because no Biodesign material is left behind after site-specific remodeling is complete, complications that may be common when synthetic materials are implanted, such as **erosion, encapsulation, and prolonged inflammation, are minimized**.[13]

Immune response

SIS-derived biologic grafts have been shown to be accepted by the body's immune system and do not lead to a rejection response.[23] They do not cause the activation of the complement cascade, nor are they acutely rejected following implant.[23] They are associated with a Th2-dominant lymphocyte response (a response associated with transplant acceptance[24]) that does not adversely affect the patient's ability to overcome viral or bacterial infections,[25,26] and have also been associated with an M2 macrophage phenotype response[27] – a macrophage phenotype that promotes immunoregulation, tissue repair, and constructive tissue remodeling.[28]

Pain or discomfort

Two clinical studies have shown that SIS-derived biologic grafts are associated with **lower incidence of pain or discomfort** when compared to polypropylene mesh in inguinal hernia repair.[29,30]

Erosion, encapsulation, inflammation

Additionally, because Biodesign grafts are designed to fully integrate with the patient's surrounding tissues, numerous studies in a variety of clinical applications have shown a reduced risk of erosion, encapsulation, and prolonged inflammation as compared to synthetic materials.[9, 31-33]

Studied and proven

The technology behind Biodesign grafts is supported by more than 1,950 total publications. More than 750 publications describe clinical use. Eight publications have more than five years of follow-up data.

36
Clinical RCTs

>1,950
Published articles

>790
Clinical publications

8
Articles with more than five years of follow-up

Publications focused on SIS and its applications continue to grow. These numbers are accurate as of April 2024.

Key clinical evidence

Porcine small intestinal submucosa mesh to treat inguinal hernia in young adults using laparoscopic inguinal hernia repair: a retrospective controlled study

Liu Y, Cao Z, Yang H, Shen Y, Chen J. Porcine small intestinal submucosa mesh to treat inguinal hernia in young adults using laparoscopic inguinal hernia repair: A retrospective controlled study. *Surg Laparosc Endosc Percutan Tech*. 2020;30(4):367-370.

The use of porcine small intestinal submucosa as a prosthetic material for laparoscopic hernia repair in infected and potentially contaminated fields: Long-term follow-up.

Franklin ME Jr, Treviño JM, Portillo G, Vela I, Glass JL, González JJ. The use of porcine small intestinal submucosa as a prosthetic material for laparoscopic hernia repair in infected and potentially contaminated fields: Long-term follow-up. *Surg Endosc*. 2008;22(9):1941-1946.

Biologic prosthesis to prevent recurrence after laparoscopic paraesophageal hernia repair: long-term follow-up from a multicenter, prospective, randomized trial

Oelschlager BK, Pellegrini CA, Hunter JG, et al. Biologic prosthesis to prevent recurrence after laparoscopic paraesophageal hernia repair: long-term follow-up from a multicenter, prospective, randomized trial. *J Am Coll Surg*. 2011;213(4):461-468.

Porcine small intestinal submucosa (SIS) myringoplasty in children: a randomized controlled study

D'Eredita RD. Porcine small intestinal submucosa (SIS) myringoplasty in children: a randomized controlled study. *Int J Pediatr Otorhinolaryngol*. 2015;79(7):1085-1089.

Ventral herniorrhaphy: experience with two different biosynthetic mesh materials, Surgisis and Alloderm

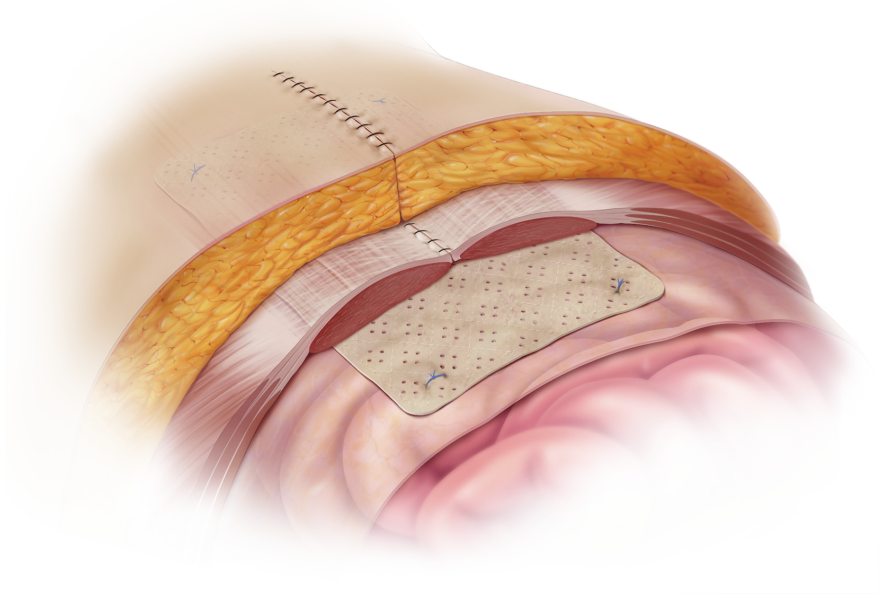
Gupta A, Zahriya K, Mullens PL, Salmassi S, Keshishian A. Ventral herniorrhaphy: experience with two different biosynthetic mesh materials, Surgisis and Alloderm. *Hernia*. 2006;10(5): 419-425.

Porcine small intestine submucosal graft for endoscopic skull base reconstruction

Illing E, Chaaban MR, Riley KO, Woodworth BA. Porcine small intestine submucosal graft for endoscopic skull base reconstruction. *Int Forum Allergy Rhinol*. 2013;3(11):928-932.

Biodesign Hernia Graft

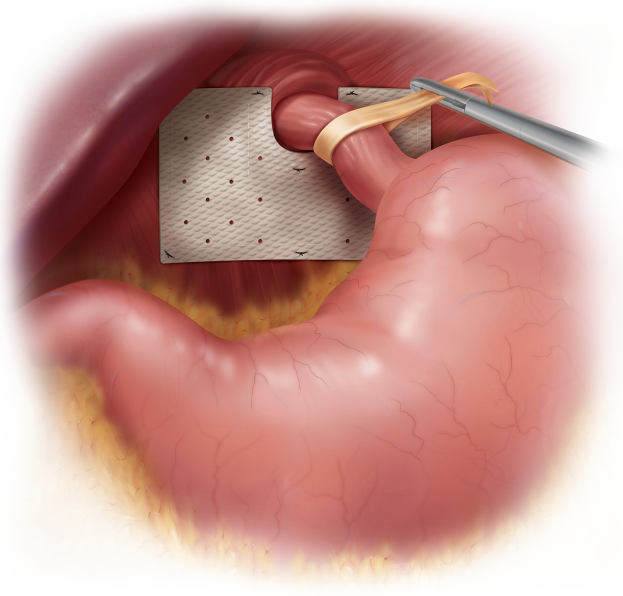
For implantation to reinforce soft tissues where weakness exists. Indications for use include the repair of a hernia or body wall defect.



Order Number	Reference Part Number	Size cm
G23764	C-SLH-8H-10X10	10 x 10
G36032	C-SLH-8H-13X15	13 x 15
G46600	C-SLH-8H-13X22	13 x 22
G36033	C-SLH-8H-20X20	20 x 20
G48216	C-SLH-8H-20X30	20 x 30
G55265	C-BIG-8X10	8 x 10
G55266	C-BIG-8X20	8 x 20
G55267	C-BIG-8X30	8 x 30

Biodesign Hiatal Hernia Graft

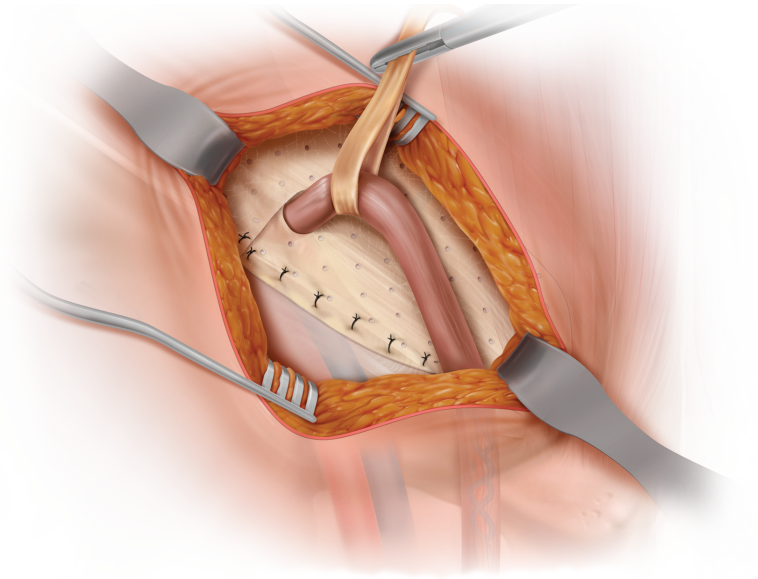
For implantation to reinforce soft tissue where weakness exists, including repair of hiatal hernias



Order Number	Reference Part Number	Size cm
Preshaped		
G31455	C-PHR-7X10-U	7 x 10
Standard		
G51578	C-PHR-7X10	7 x 10

Biodesign Inguinal Hernia Graft

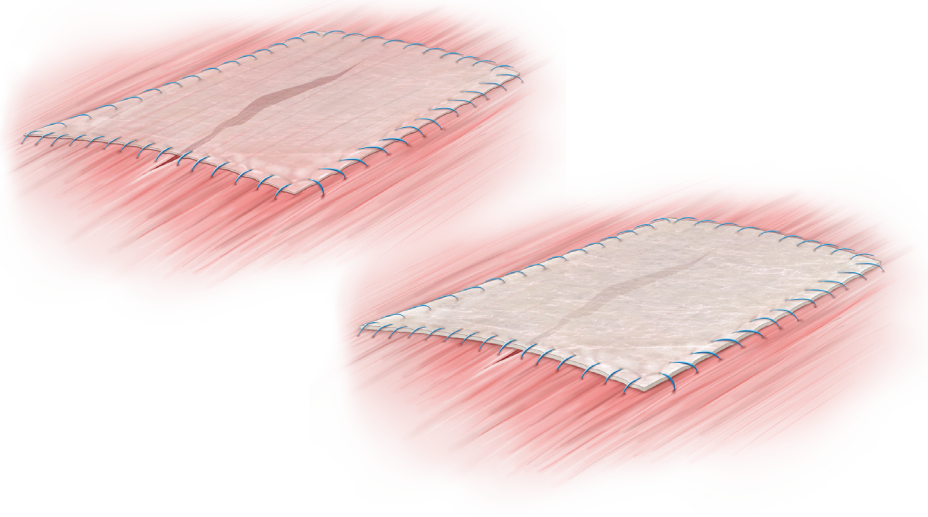
For reinforcing soft tissues where weakness exists, including the repair of inguinal hernias



Order Number	Reference Part Number	Size cm
G44777	C-IHM-10X15-B	10 x 15
G44778	C-IHM-6X13-P-B	6 x 13
G44779	C-IHM-8X15-P-B	8 x 15

Biodesign 1-Layer and 4-Layer Tissue Grafts

For implantation to reinforce soft tissue

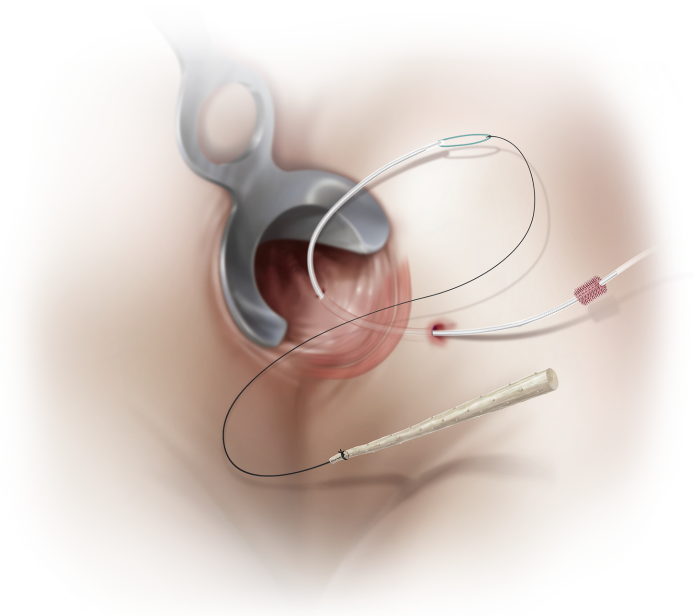


Order Number	Reference Part Number	Size cm
1-Layer Tissue Graft		
G13221	C-SLH-1S-2X3	2 x 3
G12581	C-SLH-1S-7X10	7 x 10

Order Number	Reference Part Number	Size cm
4-Layer Tissue Graft		
G13544	C-SLH-4S-1X10	1 x 10
G31320	C-SLH-4S-2X3	2 x 3
G13181	C-SLH-4S-4X7	4 x 7
G12580	C-SLH-4S-7X10	7 x 10
G12579	C-SLH-4S-7X20	7 x 20

Biodesign Anal Fistula Plug Set

For implantation to reinforce soft tissue where a rolled configuration is required, for repair of anorectal fistulas



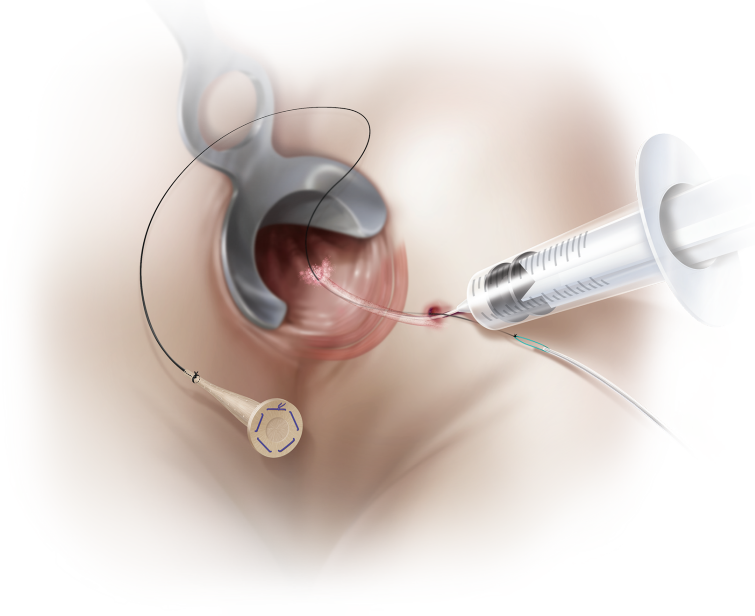
Order Number	Reference Part Number	Size cm
G53614	C-AFPS-0.6X9.5	0.6 x 9.5

Each plug set includes:

- Biodesign Anal Fistula Plug
- Cook® Fistula Brush
- Cook Irrigation Catheter
- 2-0 polyglycolic acid (PGA) absorbable suture with DUR-6 needle
- 0 silk nonabsorbable suture
- 10 ml Luer-lock syringe

Biodesign Fistula Plug Set

For implantation to reinforce soft tissue for repair of recto-vaginal or anorectal fistulas



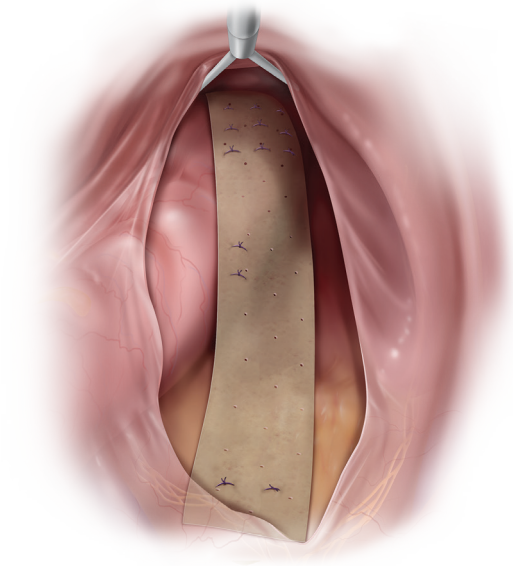
Order Number	Reference Part Number	Size cm
G54612	C-FPS-0.2	0.2
G54613	C-FPS-0.4	0.4
G54614	C-FPS-0.7	0.7

Each plug set includes:

- Biodesign Fistula Plug
- Cook Fistula Brush
- Cook Irrigation Catheter
- 2-0 polyglycolic acid (PGA) absorbable suture with DUR-6 needle
- 0 silk nonabsorbable suture
- 10 ml Luer-lock syringe

Biodesign Rectopexy Graft

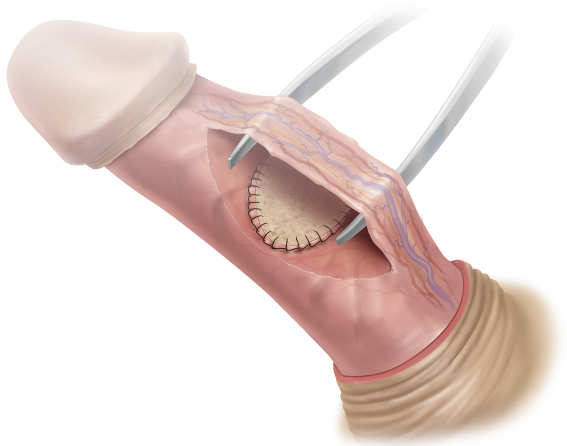
Used to reinforce soft tissue where weakness exists in the gastroenterological anatomy including transabdominal repair of colon and rectal prolapse



Order Number	Reference Part Number	Size cm
G35247	C-BRG-7X20-US	7 x 20

Biodesign Peyronie's Repair Graft

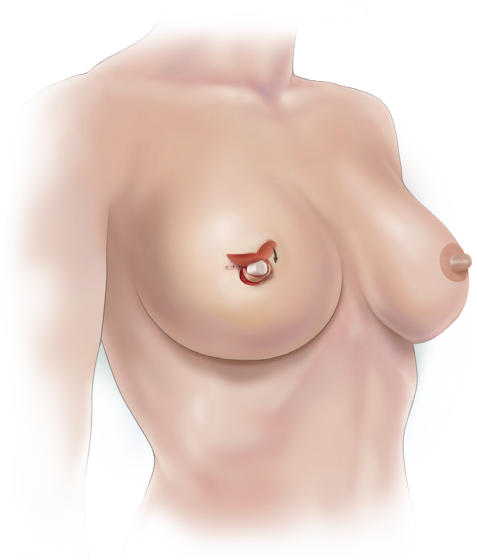
For implantation to reinforce soft tissue where weakness exists in the urological anatomy, including but not limited to repair of tunica albuginea defects and reinforcement in the repair of Peyronie's disease



Order Number	Reference Part Number	Size cm
G47654	SLH-4-PR1	4 x 10
G47655	SLH-4-PR2	7 x 10

Biodesign Nipple Reconstruction Cylinder

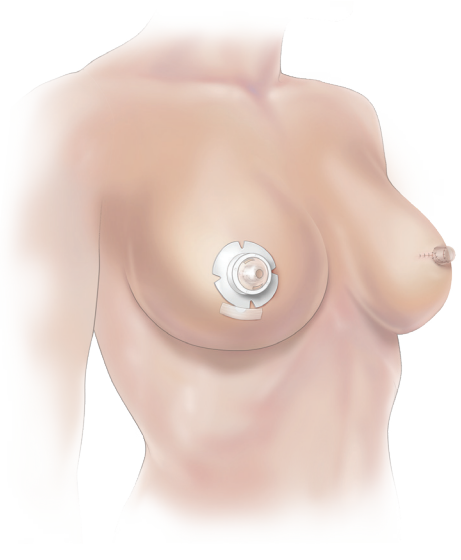
For implantation to reinforce soft tissue, where weakness exists, in plastic and reconstructive surgery of the nipple



Order Number	Reference Part Number	Size cm
G49127	C-NRC-0.7X1.0	0.7 x 1.0
G49126	C-NRC-1.0X1.0	1.0 x 1.0
G52549	C-NRC-1.0X1.5	1.0 x 1.5

HaloShield® Nipple Protector

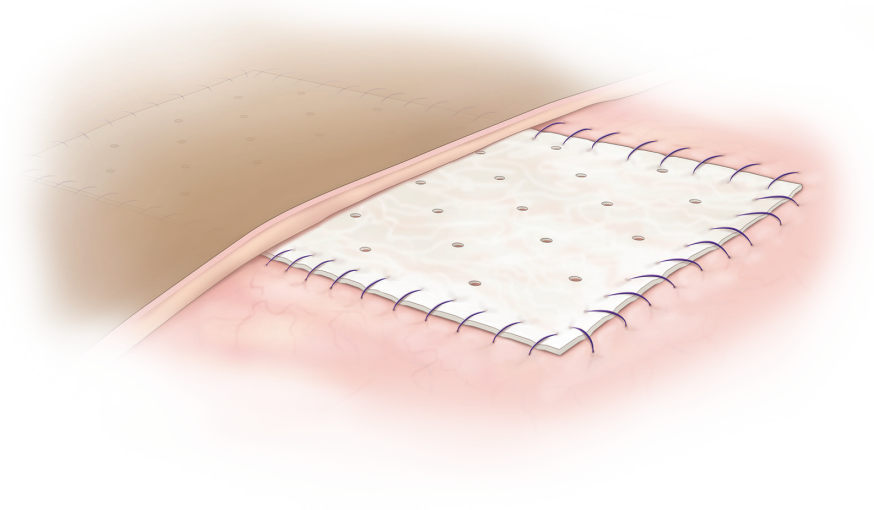
Used as a wound cover protector for the areola and nipple in breast reconstruction or surgery



Order Number	Reference Part Number	Projection clearance mm
G46289	C-SHIELD-1.0	10
G46290	C-SHIELD-2.0	20

Biodesign Plastic Surgery Matrix

For implantation to reinforce soft tissue where weakness exists in patients requiring soft tissue repair or reinforcement in plastic and reconstructive surgery



Order Number	Reference Part Number	Size cm
G52867	C-SLH-6H-4X7	4 x 7
G52865	C-SLH-6H-7X10	7 x 10
G52866	C-SLH-6H-7X20	7 x 20

1. Internal Cook Biotech document: D00278582.
2. Internal Cook Biotech document: D00265723.
3. Clause KC, Barker TH. Extracellular matrix signaling in morphogenesis and repair. *Curr Opin Biotechnol.* 2013;24(5):830-833.
4. Daley WP, Peters SB, Larsen M. Extracellular matrix dynamics in development and regenerative medicine. *J Cell Sci.* 2008;121(Pt 3):255-264.
5. Hodde J, Janis A, Ernst D, Zopf D, Sherman D, Johnson C. Effects of sterilization on an extracellular matrix scaffold: Part I. Composition and matrix architecture. *J Mater Sci Mater Med.* 2007;18(4):537-543.
6. Nihsen ES, Johnson CE, Hiles MC. Bioactivity of small intestinal submucosa and oxidized regenerated cellulose/collagen. *Adv Skin Wound Care.* 2008;21(10):479-486.
7. Hodde J, Janis A, Hiles M. Effects of sterilization on an extracellular matrix scaffold: Part II. Bioactivity and matrix interaction. *J Mater Sci Mater Med.* 2007;18(4):545-550.
8. Turner NJ, Badylak SF. Biologic scaffolds for musculotendinous tissue repair. *Eur Cell Mater.* 2013;25:130-143.
9. Franklin ME Jr, Trevino JM, Portillo G, Vela I, Glass JL, Gonzalez JJ. The use of porcine small intestinal submucosa as a prosthetic material for laparoscopic hernia repair in infected and potentially contaminated field: Long-term follow-up. *Surg Endosc.* 2008;22(9):1941-1946.
10. Stelly M, Stelly TC. Histology of CorMatrix bioscaffold 5 years after pericardial closure. *Ann Thorac Surg.* 2013;96(5):e127-e129.
11. Badylak S, Kokini K, Tullius B, Whitson B. Strength over time of a resorbable bioscaffold for body wall repair in a dog model. *J Surg Res.* 2001;99(2):282-287.
12. Badylak SF, Park K, Peppas N, McCabe G, Yoder M. Marrow-derived cells populate scaffolds composed of xenogeneic extracellular matrix. *Exp Hematol.* 2001;29(11):1310-1318.
13. Hodde J. Extracellular matrix as a bioactive material for soft tissue reconstruction. *ANZ J Surg.* 2006;76(12):1096-1100.
14. Badylak SF. The extracellular matrix as a scaffold for tissue reconstruction. *Semin Cell Dev Biol.* 2002;13(5):377-383.
15. Frantz C, Stewart KM, Weaver VM. The extracellular matrix at a glance. *J Cell Sci.* 2010;123(24): 4195-4200.
16. Hiles M, Record Ritchie RD, Altizer AM. Are biologic grafts effective for hernia repair?: a systematic review of the literature. *Surg Innov.* 2009;16(1):26-37.
17. Gupta A, Zahriya K, Mullens PL, Salmassi S, Keshishian A. Ventral herniorrhaphy: experience with two different biosynthetic mesh materials, Surgisis and Alloderm. *Hernia.* 2006;10(5):419-425.
18. Kissane NA, Itani KMF. A decade of ventral incisional hernia repairs with biologic acellular dermal matrix: What have we learned? *Plast Reconstr Surg.* 2012;130(5 Suppl 2):194S-202S.
19. Novitsky YW, Rosen MJ. The biology of biologics: basic science and clinical concepts. *Plast Reconstr Surg.* 2012;130(5 Suppl 2):9S-17S.
20. Internal Cook Biotech document: 00-107.
21. Internal Cook Biotech document: 02-063.
22. Swinehart IT, Badylak SF. Extracellular matrix bioscaffolds in tissue remodeling and morphogenesis. *Dev Dyn.* 2016;245(3):351-360.
23. Raeder RH, Badylak SF, Sheehan C, Kallakury B, Metzger DW. Natural anti-galactose alpha1,3 galactose antibodies delay, but do not prevent the acceptance of extracellular matrix xenografts. *Transpl Immunol.* 2002;10(1):15–24.
24. Bach FH, Ferran C, Hechenleitner P, et al. Accommodation of vascularized xenografts: expression of "protective genes" by donor endothelial cells in a host Th2 cytokine environment. *Nat Med.* 1997;3(2):196–204.
25. Allman AJ, McPherson TB, Badylak SF, et al. Xenogeneic extracellular matrix grafts elicit a TH2-restricted immune response. *Transplantation.* 2001;71(11):1631–1640.
26. Allman AJ, McPherson TB, Merrill LC, Badylak SF, Metzger DW. The Th2-restricted immune response to xenogeneic small intestinal submucosa does not influence systemic protective immunity to viral and bacterial pathogens. *Tissue Eng.* 2002;8(1):53–62.

27. Badylak SF, Valentin JE, Ravindra AK, McCabe GP, Stewart-Akers AM. Macrophage phenotype as a determinant of biologic scaffold remodeling. *Tissue Eng Part A*. 2008;14(11):1835-1842.
28. Martinez FO, Sica A, Mantovani A, Locati M. Macrophage activation and polarization. *Front Biosci*. 2008;13:453-461.
29. Bochicchio GV, Jain A, McGonigal K, et al. Biologic vs. synthetic inguinal hernia repair: 1-year results of a randomized double-blinded trial. *J Am Coll Surg*. 2014;218(4):751-757.
30. Ansaloni L, Catena F, Coccolini F, Gazzotti F, D'Alessandro L, Pinna AD. Inguinal hernia repair with porcine small intestine submucosa: 3-year follow-up results of a randomized controlled trial of Lichtenstein's repair with polypropylene mesh vs. Surgisis Inguinal Hernia Matrix. *Am J Surg*. 2009;198(3):303-312.
31. Smart NJ, Pathak S, Boorman P, Daniels IR. Synthetic or biological mesh use in laparoscopic ventral mesh rectopexy – a systematic review. *Colorectal Dis*. 2013;15(6):650-654.
32. Albayati S, Morgan MJ, Turner CE. Laparoscopic ventral rectopexy for rectal prolapse and rectal intussusception using a biological mesh. *Colorectal Dis*. 2017;19(8):857-862.
33. Oelschlager BK, Pellegrini CA, Hunter JG, et al. Biologic prosthesis to prevent recurrence after laparoscopic paraesophageal hernia repair: long-term follow-up from a multicenter, prospective, randomized trial. *J Am Coll Surg*. 2011;213(4):461-468.

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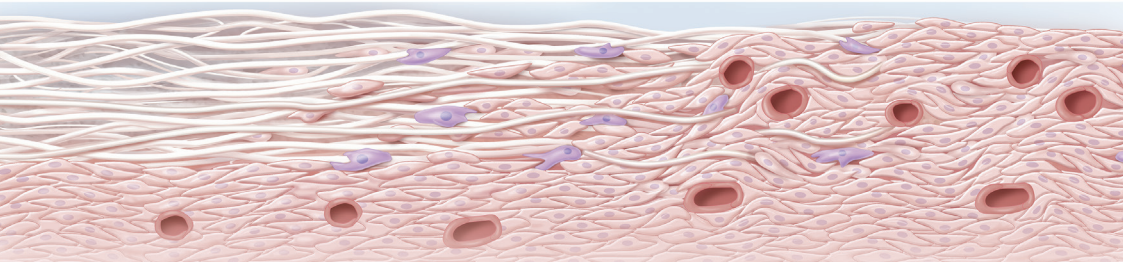

SIS scaffold → **Infiltration of host cells** → **Vascularized tissue**

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