



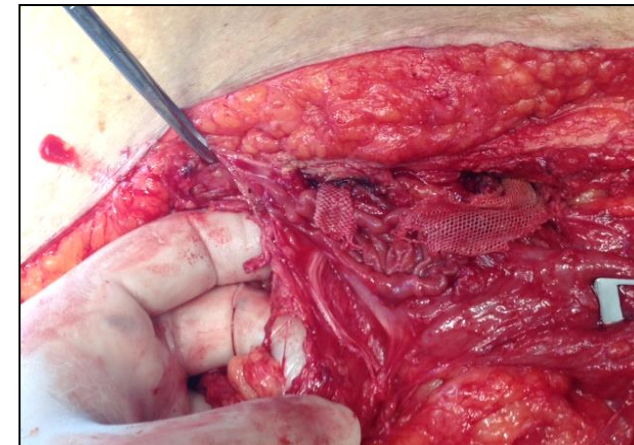
MESHES IN CONTAMINATED FIELDS

OVERVIEW

JP Palot , Y Renard (Reims)



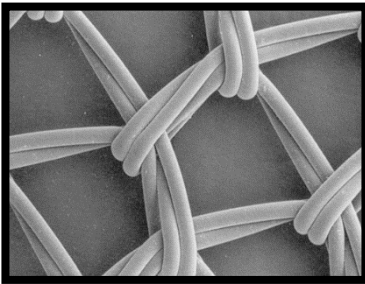
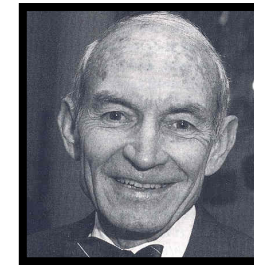
WHICH TYPE OF MESH? A HEAVILY DEBATED TOPIC ! NO CONSENSUS



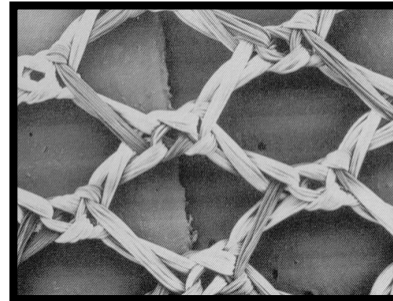
Wound	Class definition
I (clean)	An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract are not entered.
II (clean-contaminated)	An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination
III (contaminated)	Open, fresh, accidental wounds. Operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation are encountered.
IV (dirty-infected)	Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera.

ONCE UPON A TIME IN THE SIXTIES

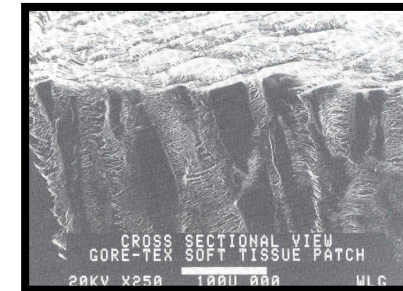
- Very few surgeons were using meshes
- Very few meshes



polypropylene



polyester

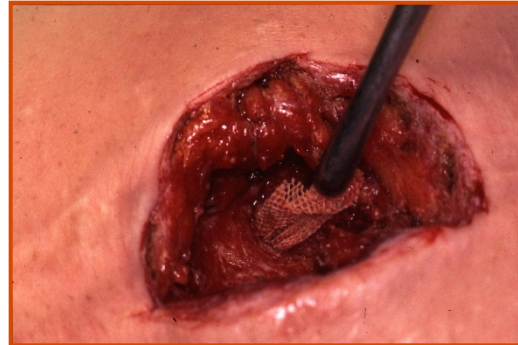


ePTFE

One dogma : no synthetic non absorbable mesh in septic or potentially septic conditions ...NEVER

- Few solutions : repair without mesh or with an absorbable mesh
- One consequence : a very high recurrence rate → two step procedure

Our experience of Vicryl mesh: SSI=45.6% (superficial 26.3% deep=19.3%) 24 month recurrences: 68.5%



OFTEN A CATASTROPHIC SITUATION

Length of hospital stay, pain, re-admissions, re-interventions and sometimes death

RATHER A RECURRENCE THAN A MESH INFECTION

WHAT HAS CHANGED?

- SURGERY
- BETTER KNOWLEDGE OF MESH BIOLOGICAL BEHAVIOR
- **NEW MESHERS :**
 - lightweight synthetic
 - biologic
 - biosynthetic absorbable



- **NEW TOOLS** for the treatment of SSI

Incisional ventral hernias: Review of the literature and recommendations regarding the grading and technique of repair

Surgery 2010

The Ventral Hernia Working Group

The Ventral Hernia Working Group: Karl Breuing, MD,^a Charles E. Butler, MD, FACS,^b Stephen Ferzoco, MD, FACS,^a Michael Franz, MD,^c Charles S. Hultman, MD, MBA, FACS,^d Joshua F. Kilbridge,^e Michael Rosen, MD,^f Ronald P. Silverman, MD, FACS,^g and Daniel Vargo, MD, FACS,^h *Boston, MA, Houston, TX, Ann Arbor, MI, Chapel Hill, NC, San Francisco, CA, Cleveland, OH, Baltimore, MD, and Salt Lake City, UT*

Grade 1

Low Risk

- Low risk of complications
- No history of wound infection

SYNTHETIC MESH

Grade 2

Co-Morbid

- Smoker
- Obese
- Diabetic
- Immunosuppressed
- COPD

SYNTHETIC MESH?

Grade 3

Potentially Contaminated

- Previous wound infection
- Stoma present
- Violation of the gastrointestinal tract

NO SYNTHETIC MESH

Grade 4

Infected

- Infected mesh
- Septic dehiscence

Surg Infect (Larchmt). 2011 Jun;12(3):205-10. Epub 2011 Jul 18.

Mesh infection in ventral incisional hernia repair: incidence, contributing factors, and treatment.

Sanchez VM, Abi-Haidar YE, Itani KM.

Department of Surgery, Veterans Affairs Boston Healthcare System and Boston University , Boston, Massachusetts.

- review of literature

- risk factors :

- obesity
- COPD
- Aortic aneurysm
- microporous mesh or ePTFE
- length of operation

- concomitant procedure
- violation of gastro-intestinal tract
- entero cutaneous fistula

Use of Mesh During Ventral Hernia Repair in Clean-Contaminated and Contaminated Cases: Outcomes of 33,832 Cases.

Choi JJ, Palaniappa NC, Dallas KB, Rudich TB, Colon MJ, Divino CM.

Source

Ann Surg 2011

From Division of General **Surgery**, Department of **Surgery**, Mount Sinai School of Medicine, New York.

National Surgical Quality Improvement Program

Significant increase :

- SSI (superficial and deep infection)
- burst abdomen
- pneumonia



Clean contaminated

- septic shock
- ICU



Clean contaminated +
contaminated

CONCLUSION:

There is a significant increase in risk of postoperative occurrences following VHRs using mesh in **clean-contaminated** and contaminated cases relative to **clean** cases. We recommend avoiding the use of mesh in any level of contamination.

BIOLOGIC ACELLULAR XENOGRAFTS

Holl-Allen RT (1984) Porcine dermal collagen repair of inguinal hernias. J R Coll Surg Edinb 29(3):154–157

Sarmah BD (1984) Porcine dermal collagen repair of incisional herniae. Br J Surg 71(7):524–525

LATE 90'S : ABDOMINAL WALL REPAIR IN POTENTIALLY CONTAMINATED / CONTAMINATED FIELDS

- very very (too much) expensive
- no (not yet) strong evidence
- published studies generally very heterogeneous : several types of meshes, lot of different techniques of repair, different indications

Different biologic meshes :

- cross linking or not
- different industrial processes
- variable quality of meshes

Biologic mesh in ventral hernia repair: Outcomes, recurrence, and charge analysis **Surgery 2016**

Ciara R. Huntington, MD, Tiffany C. Cox, MD, Laurel J. Blair, MD, Samuel Schell, BS, David Randolph, BS, Tanushree Prasad, MA, Amy Lincourt, PhD, MBA, B. Todd Heniford, MD, FACS, and Vedra A. Augenstein, MD, FACS, Charlotte, NC

	<i>Alloderm</i> n = 40	<i>AlloMax</i> n = 23	<i>FlexHD</i> n = 70	<i>Strattice</i> n = 68	<i>Xenmatrix</i> n = 22	P value
	% or means \pm SD	% or means \pm SD	% or means \pm SD	% or means \pm SD	% or means \pm SD	
Hematoma	3.45	0	0	1.5	0	.58
Intraabdominal abscess	6.9	9.1	4.6	7.6	14.3	.61
Prolonged incisional pain	0	0	2.9	4.4	18.2	.02
Acute kidney injury	7.5	4.4	10.0	7.4	13.6	.81
Sepsis	10.0	8.7	4.3	4.4	13.6	.35
Seroma	37.9	13.6	34.9	15.2	31.8	.02
Wound dehiscence	3.5	13.6	21.2	10.6	9.5	.17
Postoperative SBO	0	4.6	4.8	3.1	0	.84
Postoperative wound vac	20.0	13.6	33.3	20.9	23.8	.29
Wound requires intervention	37.9	13.6	33.9	19.7	23.8	.12
Wound infection	44.8	27.2	43.9	29.9	33.3	.33
Mesh infection	0	0	1.4	1.5	0	1
Readmission within 30 d	20	13	24.3	20.6	22.7	.84
Reoperation within 30 d	15	8.7	12.9	16.2	13.6	.92
Inpatient mortality	2.6	0	1.4	1.5	0	1
Hernia recurrence	35.0	34.8	37.1	14.7	59.1	.001
Duration of stay (d)	9.3 \pm 8.9	12.4 \pm 11.4	13.1 \pm 18.2	10.3 \pm 8.6	16.1 \pm 21.8	.47
Average follow-up (mo)	26.5 \pm 37.0	17.0 \pm 19.8	18.4 \pm 22.1	17.6 \pm 15.7	11.0 \pm 13.1	.74
Mean hospital charges (US dollars \pm SD)						
Mesh charge	25,825 \pm 23,535	13,311 \pm 11,438	22,981 \pm 30,709	31,875 \pm 17,960	48,955 \pm 28,580	<.0001
Operating room charge*	5,407 \pm 6,395	10,672 \pm 6,115	9,929 \pm 6,140	19,939 \pm 13,934	24,520 \pm 26,971	<.001
Total hospital charge	100,797 \pm 94,330	111,775 \pm 103,547	113,819 \pm 154,947	140,394 \pm 80,709	221,966 \pm 263,494	.02

*Operating room charge does not include mesh charge. Numbers represent % unless otherwise specified.

ASA, American Society of Anesthesiology; COPD, chronic obstructive pulmonary disease; GERD, gastroesophageal reflux disease; SBO, small bowel obstruction; SD, standard deviation; wound vac, wound vacuum negative pressure device.

A 5-Year Clinical Experience With Single-Staged Repairs of Infected and Contaminated Abdominal Wall Defects Utilizing Biologic Mesh

Michael J. Rosen, MD, David M. Krpata, MD, Bridget Ermlich, RN, and Jeffrey A. Blatnik, MD **2013**

- 128 patients
- non cross-linked porcine matrix (Strattice)
- **SSI : 47% no explantation**
- follow up :26 months
- **recurrences : 31,3%**

Long-term outcomes (>5-year follow-up) with porcine acellular dermal matrix (PermacolTM) in incisional hernias at risk for infection

M. M. Abdelfatah · N. Rostambeigi ·
E. Podgaetz · M. G. Sarr

2013

- 65 patients
- cross linked porcine matrix (Permacol)
- different procedures (bridging+++)
- 59 patients followed > 5 ans
- **explantation :25%**
- **recurrences : 46 à 80%**

Prospective study of single-stage repair of contaminated hernias using a biologic porcine tissue matrix: The RICH Study

Kamal M. F. Itani, MD, FACS,^a Michael Rosen, MD, FACS,^b Daniel Vargo, MD, FACS,^c Samir S. Awad, MD, FACS,^d George DeNoto III, MD, FACS,^e Charles E. Butler, MD, FACS,^f and the RICH Study Group, Boston, MA, Cleveland, OH, Salt Lake City, UT, Houston, TX, and Lake Success, NY

2012

- 80 patients
- Strattice
- **SSI : 30%**
- **no explantation**
- follow up: 2 years
- **Recurrences 28%**

Table V. Hernia recurrence

Type of repair	Incidence of recurrences, % (n/N)	
	12 months	24 months
Fascial closure with and without CST (defect area: $203 \pm 150 \text{ cm}^2$)	14 (9/64)	23 (15/64)
With CST (defect area: $220 \pm 150 \text{ cm}^2$)	17 (9/52)	27 (14/52)
Without CST (defect area: $126 \pm 121 \text{ cm}^2$)	0 (0/12)	8 (1/12)
No fascial closure with and without CST (defect area: $355 \pm 141 \text{ cm}^2$)	38 (6/16)	44 (7/16)
All intent-to-treat patients	19 (15/80)	28 (22/80)

Use of biological mesh versus standard wound care in infected incisional ventral hernias, the SIMBIOSE study: a study protocol for a randomized multicenter controlled trial

Christophe Mariette^{1,2,3,6*}, Nicolas Briez^{1,2}, Fanette Denies⁴, Benoît Dervaux^{2,5}, Alain Duhamel^{2,5}, Marie Guilbert¹, Emilie Bruyère¹, William B Robb¹, Guillaume Piessen^{1,2,3} and on behalf of FRENCH

inclusions closed on 7/01/2016

Outcomes of Synthetic Mesh in Contaminated Ventral Hernia Repairs

J Am Coll Surg 2013

Alfredo M Carbonell, DO, FACS, Cory N Criss, MD, William S Cobb, MD, FACS, Yuri W Novitsky, MD, Michael J Rosen, MD, FACS

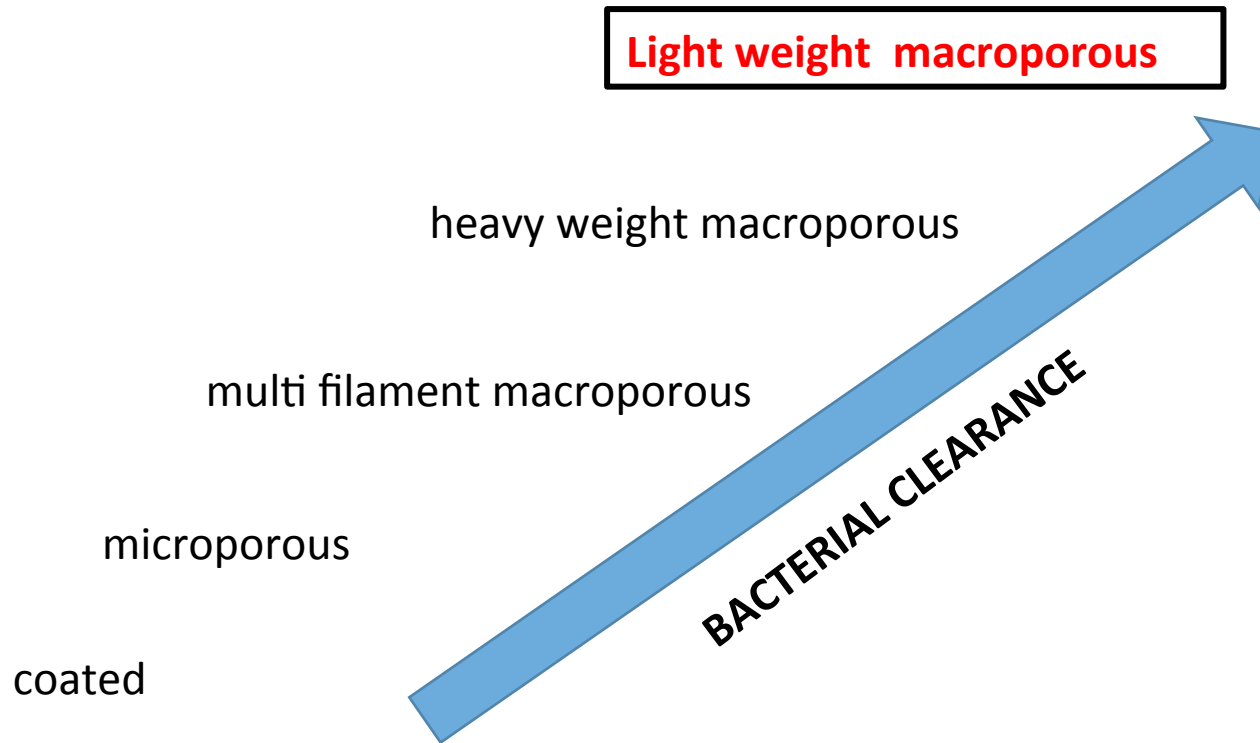
- Retrospective study on prospective databases
- Clean-contaminated/contaminated cases
- Bioburden-reduction
- **Lightweight polypropylene mesh**
- **Sublay technique 100%**
- Complete fascial closure 91%

Table 4. Surgical Site Occurrence, Surgical Site Infection, and Hernia Recurrence Rates of Patients Undergoing Clean-Contaminated and Contaminated Hernia Repairs

CDC wound classification	SSO		Frequency, %	30-Day SSI		Frequency, %	Recurrence		Frequency, %
	n	%		n	%		n	%	
Clean contaminated (n = 42)	11	26.2	11.0	3	7.1	3.0	3	7.1	3.0
Contaminated (n = 58)	20	34	20.0	11	19.0	7.0	4	6.8	4.0

SSI, surgical site infection; SSO, surgical site occurrence.

WHAT ABOUT LIGHT-WEIGHT SYNTHETIC MESHES ?



Central rupture and bulging of low-weight polypropylene mesh following recurrent incisional sublay hernioplasty.

Zuvela M¹, Galun D., Djurić-Stefanović A., Palibrk I., Petrović M., Milićević M. **Hernia 2014**

Central failures of lightweight monofilament polyester mesh causing hernia recurrence: a cautionary note

C. C. Petro • E. H. Nahabet • C. N. Criss •
S. B. Orenstein • H. A. von Recum •
Y. W. Novitsky • M. J. Rosen

Hernia 2015

Active *Staphylococcus aureus* infection: Is it a contra-indication to the repair of complex hernias with synthetic mesh? A prospective observational study on the outcomes of synthetic mesh replacement, in patients with chronic mesh infection caused by *Staphylococcus aureus*

Claudio Birolini*, Jocielle Santos de Miranda, Edivaldo Massazo Utiyama, Samir Rasslan, Dario Birolini

General and Trauma Surgery, Department of Surgery, University of São Paulo, School of Medicine, São Paulo, Brazil **Int J Surg 2016**

- Prospective observational study (2006-2014)
- 22 patients with chronic mesh infection
- Positive culture for *Staphylococcus aureus*
- Mesh removal
- Restoration of the midline
- Heavy-weight large pore polypropylene mesh
- Onlay

- SSO : 8 = 36.7%
- SSI : 6 = 27.3%
- Deaths : 2 = 9%

- Recurrence : 1 = 5%
- Chronic sinus: 1 = 5%

5. Conclusion

Synthetic mesh replacement in patients suffering from CMI caused by SA has an acceptable incidence of postoperative wound infection and prevents hernia recurrence. Large-pore monofilament polypropylene mesh is a suitable material to be used in the infected surgical field as an onlay graft.

Systematic review and meta-analysis of the repair of potentially contaminated and contaminated abdominal wall defects

Jasper J. Atema, M.D., Ph.D.*, Fleur E. E. de Vries, M.D.,
Marja A. Boermeester, M.D., Ph.D.

Am J Surg 2016

Department of Surgery, Academic Medical Center, Amsterdam, The Netherlands

- 32 studies
- many different meshes (biologic and synthetic)
- many different procedures

- **potentially contaminated hernias :**
no benefit of biologic over synthetic (SSI and recurrence rate)
- **contaminated hernias :**
biologic : SSI = 38% recurrence rate = 30%
synthetic : only 1 study.....no comparison possible

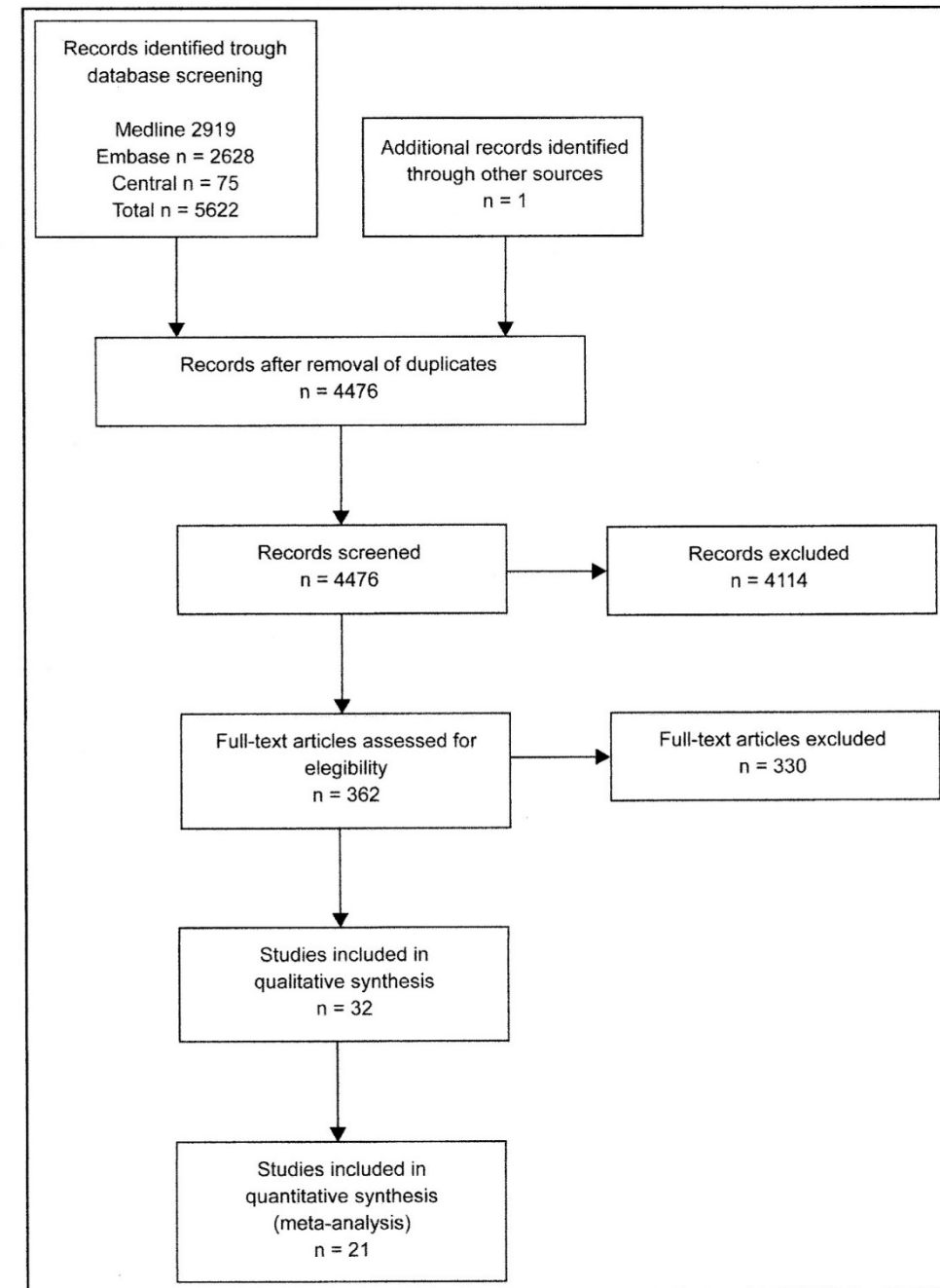


Figure 1 Flow diagram depicting search and study selection.

Comparative analysis of biologic versus synthetic mesh outcomes in contaminated hernia repairs **Surgery 2016**



Arnab Majumder, MD,^a Joshua S. Winder, MD,^b Yuxiang Wen, MD,^a Eric M. Pauli, MD,^b
Igor Belyansky, MD,^c and Yuri W. Novitsky, MD,^a Cleveland, OH, Hershey, PA, and Annapolis, MD

- multicentric retrospective study
- clean contaminated/contaminated
- sublay implantation in > 98%cases

«Finally, given a significant variability of patient and surgeon treatment goals in contaminated repairs as well variation of technique and mesh selection,our findings may not be applicable to all clinical situations

Table IV. Postoperative details for biologic versus synthetic mesh

	<i>Biologic (n = 69)</i>	<i>Synthetic (n = 57)</i>	<i>P value</i>
Wound morbidity			
SSE	29 (42.0%)	13 (22.8%)	.024
Seroma	3 (4.3%)	2 (3.5%)	1.000
Hematoma	1 (1.4%)	1 (1.8%)	1.000
Soft tissue breakdown	2 (2.9%)	1 (1.8%)	1.000
Cellulitis	1 (1.4%)	2 (3.5%)	1.000
SSI	22 (31.9%)	7 (12.3%)	.010
Superficial	4 (5.7%)	3 (5.3%)	1.000
Deep	15 (21.7%)	3 (5.3%)	.009
Organ space	3 (4.3%)	1 (1.8%)	.626
Postoperative outcomes			
Mesh explantation	2 (2.9%)	1 (1.8%)	1.000
Hernia recurrence	15 (26.3%)	4 (8.9%)	.039
Follow-up (mo)	21.5 ± 10.5	18.4 ± 9.6	.265
Follow-up duration > 12 mo	57 (82.6%)	45 (78.9%)	.602
Duration of stay (days)	10.8 ± 6.4	7.7 ± 3.1	.002
90-day readmission	15 (21.7%)	4 (7.0%)	.025
Wound morbidity	13 (87%)	3 (75%)	.530
Other	2 (13%)	1 (25%)	.530

Values are mean ± standard deviation (SD) or number (percentage).

BIO-SYNTHETIC ABSORBABLE MESHES

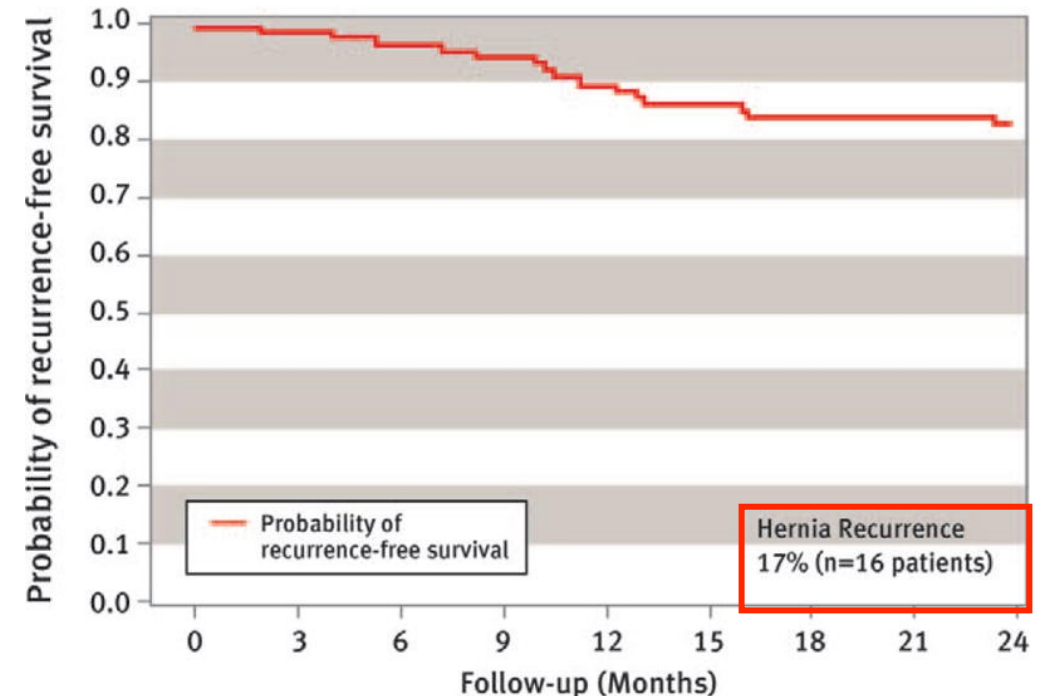
Multicenter, Prospective, Longitudinal Study of the Recurrence, Surgical Site Infection, and Quality of Life After Contaminated Ventral Hernia Repair Using Biosynthetic Absorbable Mesh: The COBRA Study

Rosen, Michael J. MD; Bauer, Joel J. MD; Harmaty, Marco MD; Carbonell, Alfredo M. DO; Cobb, William S. MD; Matthews, Brent MD; Goldblatt, Matthew I. MD; Selzer, Don J. MD, MS; Poulouse, Benjamin K. MD, MPH; Hansson, Bibi M. E. MD, PhD; Rosman, Camiel MD; Chao, James J. MD; Jacobsen, Garth R. MD

Ann Surg 2017

- 104 patients with ventral hernia repair
- clean contaminated : 23%
- contaminated : 77%
- clean and dirty excluded
- **GORE BIO A**
- sublay or underlay
- midline closure
- Follow up : 24 months

Variables	n = 104
Wound events*, n (%)	33 (28)
Surgical site infection†	21 (18)
Seroma	6 (6)
Fistula	2 (2)
Bowel obstruction	2 (2)
Wound dehiscence	1 (1)
Hematoma	1 (1)
Postoperative infections†, n (%)	21 (18)
Superficial incisional infections	9 (9)
Deep incisional infections	10 (10)
Organ space infections	2 (2)



CONCLUSIONS ?

Centers for Disease Control (CDC) wound classification

Wound	Class definition
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III (contaminated)	Open, fresh, accidental wounds. Operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation are encountered.
IV (dirty-infected)	Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera.

- **CLEAN CONTAMINATED** : macroporous synthetic meshes **may probably be used** preferably in sublay position
- **CONTAMINATED / DIRTY** **NO CONSENSUS**
 - two-step procedure : no mesh or absorbable mesh.....
 - biological mesh expecting a 20 – 30% recurrence rate
 - synthetic (lightweight?) mesh
 - biosynthetic absorbable mesh.....the future?