R ADAMS COWLEY
SHOCK TRAUMA CENTER
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AAST MOC Session 2015

Abdominal Wall Reconstruction in Acute Care Surgery

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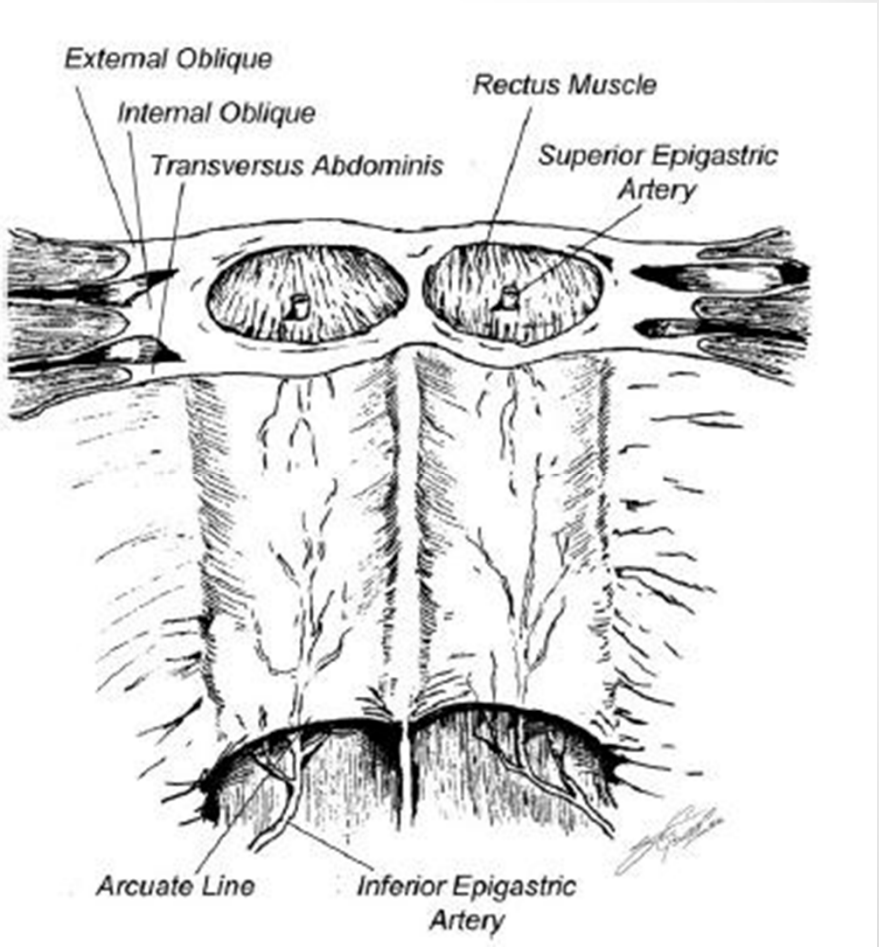
Outline

- 1. Review options for challenging abdominal wall reconstruction, including SBO, Hernias, NecFasc, etc.
- 2. Discuss pro/con of biologic vs. synthetic meshes in clean vs. contaminated abdomen
- 3. Review optimal decision-making regarding laparoscopic vs. open approaches to reconstruction



History

Annals of the Royal College of Surgeons of England (1986) *vol.* 68

The results of incisional hernia repair: a twelve year review

C D GEORGE FRCS*
Surgical Registrar
H ELLIS MCh FRCS
Professor of Surgery
Westminster Hospital, London

Incisional hernia complicated 5-11% of abdominal wound closures
Br J Surg 1985; 72:70-1

Results of incisional hernia repair: a twelve year review

TABLE I Incidence of recurrent herniation related to possible causal factors (numbers of patients or median and range)

Factor	*Patients without recurrence (n=44)*	*Patients with recurrence (n=37)*	
Patient			
Age	58.5 (31–76)	60.0 (37–80)	M–W U * NS
Sex M	28	19	χ^2 † NS
Sex F	16	18	
Weight (Kg)	74.5 (54–120)	74.0 (50–105)	M-W U NS
Smoker	25	19	χ^2 NS
Original incision			
Midline	22	24	
Paramedian	16	7	χ^2 NS
Others	6	6	
Hernia			
Time noted after laparotomy (months)	7 (1–120)	6 (1–240)	M-W U NS
Maximum diameter (cms)	8 (1–20)	10 (2–30)	M-W U NS
Hernia Repair			
'Keel'	24	19	
Mass nylon	19	16	χ^2 NS
Others	1	2	
Postoperative wound complications	4	17	P=0·0004
Follow-up			
Duration (months)	13.5 (1–156)	—	
Time to recurrence (months)	—	6 (1–120)	
Maximum diameter (cms)	—	5 (2–15)	

* Mann-Whitney U test
† Chi-square test

TABLE II Recurrence rates after incisional hernia repair

Author/year	*Centre*	*Technique*	*Number of patients*	*Recurrence rate (%)*
1 Suture Techniques				
Obney *(13)* 1957	Shouldice Clinic Canada	Layered steel wire	192	12.5
Young *(10)* 1961	Warrington UK	Rectus relieving incision	15	6.6
Akman *(12)* 1962	Shouldice Clinic Canada	Layered steel wire	500	1·6
Horton *(5)* 1969	Bristol UK	Various	36	44.0
Fischer *(7)* 1974	Edmonton Canada	Various	151	17·2
Maguire *(8)* 1976	Warrington UK	Rectus relieving incision	32	18.8
Jenkins *(9)* 1980	Guildford UK	Mass nylon	50	8.0
Present Authors	Westminster UK	Keel or mass nylon	81	46.0
2 Graft techniques				
Usher *(15)* 1962	Houston USA	Marlex	156	10.2
Hamilton *(14)* 1968	Louisville USA	Fascia lata	43	7.0
Usher *(17)* 1970	Houston USA	Marlex	48	0.0
Fischer *(7)* 1974	Edmonton Canada	Synthetic mesh	18	5.6
Larson *(6)* 1978	Providence USA	Marlex	53	11.3
Lewis *(16)* 1984	McGill University Canada	Marlex	50	6.0

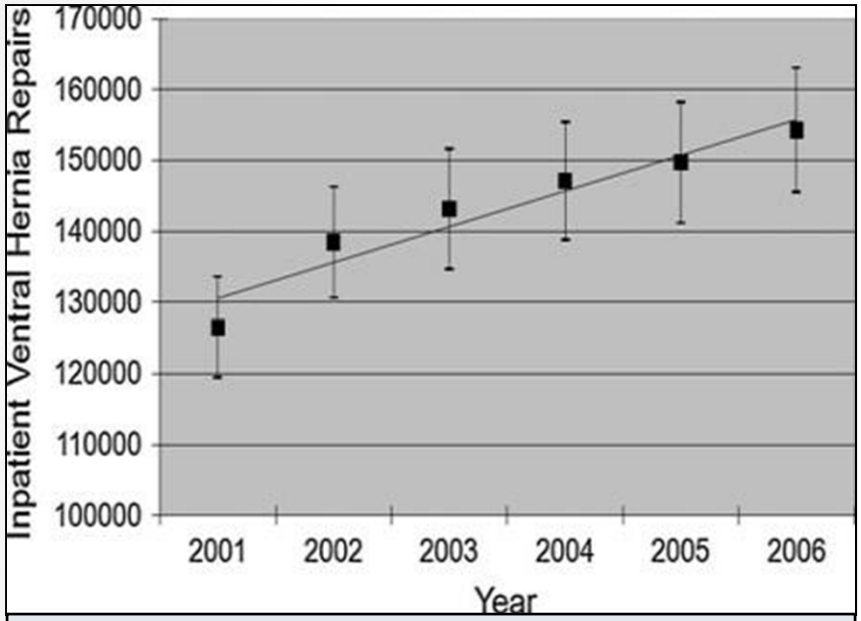
George, Ann R Coll Surg Engl. 1986 Jul;68(4):185-7.

Epidemiology and cost of ventral hernia repair: making the case for hernia research

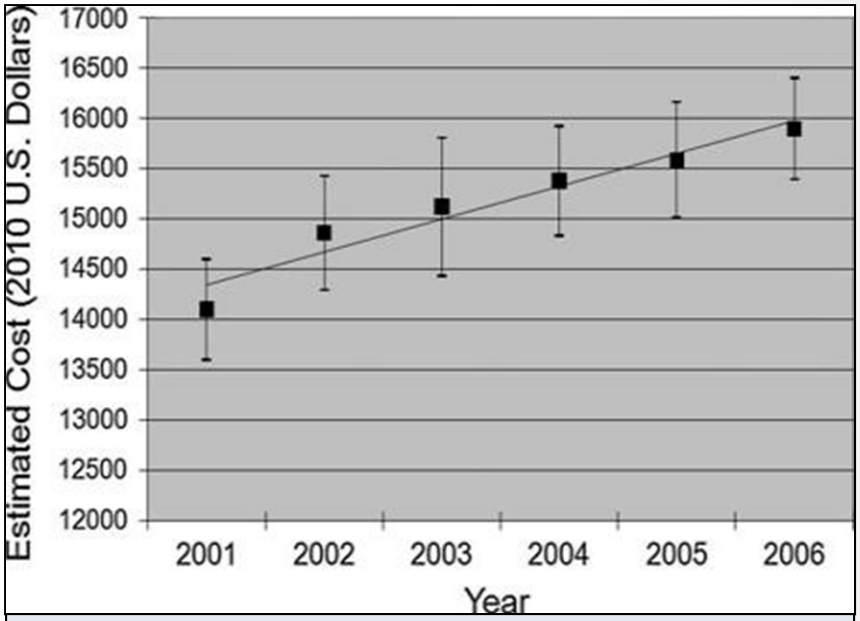
- # inpatient VHRs - 126,548 2001 - 154,278 2006.
- 193,543 outpatient operations, ets. 348,000 VHR 2006.
- Inpatient costs consistently rose with 2006 costs estimated at US $15,899/operation.
- Est. cost for outpatient VHR US $3,873
- Total cost of VHR - 2006 US $3.2 billion.

- Poulose et al, Hernia. 2012 Apr;16(2):179-83.

Epidemiology and cost of ventral hernia repair: making the case for hernia research



Cumulative incidence of inpatient ventral hernia repairs performed between 2001 and 2006 (nonfederal US hospitals); point estimates for each year are shown with 95% confidence intervals (95% CI). Source: (NIS)



Estimated periprocedural costs for inpatient ventral hernia repairs performed between 2001 and 2006 (non-federal US hospitals); point estimates for each year are shown with 95% confidence intervals (95% CI). Source: NIS

- Poulose et al, Hernia. 2012 Apr;16(2):179-83.

Classification Systems

- World Society of the Abdominal Compartment Syndrome (7).
- The grading is as follows:
  - grade 1A, clean open abdomen (OA) without adherence between bowel and abdominal wall or fixity of the abdominal wall (lateralization);
  - grade 1B, contamination OA without developing adherence/fixity;
  - grade 2A, clean OA developing adherence/fixity;
  - grade 2B, contaminated OA developing adherence/fixity;
  - grade 3, OA complicated by fistula formation;
  - grade 4, frozen OA with adherent/fixed bowel, unable to close surgically with or without fistula

Classification Systems

- Ventral Hernia Working Group, (8).
- The grading system has four grades which are as follows:
  - grade1 – low risk (low risk of complications, no history of wound infections),
  - grade 2 – co-morbidities (smoker, obese, diabetic, immunosuppression, COPD),
  - grade 3 – potentially contaminated (previous wound infection, stoma, violation of the gastrointestinal tract),
  - grade 4 – infected (infected mesh, septic dehiscence).

Classification Systems

- complex ventral hernias as follows:
  - normal wound, healing (type I),
  - impaired wound healing (type II),
  - contaminated wound (type III),
  - massive weight loss (type IV),
  - loss of domain (type V). (9).

Risk Factors

- Patient Risk Factors (Co-morbidities)
  - Inherent (Genetic) and modifiable
- Perioperative Risk Factors
  - Pre- op
  - Operative
  - Post-Operative

Perioperative Risk Factors

Pre-operative

- Pre-operative
- Operative
- Post-Operative

- Pre-operative ABX
- Skin Prep
- Room Temperature

Surgeon

- Surgical Techniques

- Surgeon Experience

RISK FACTORS FOR THE DEVELOPMENT OF SURGICAL SITE INFECTION

Patient factors

- Ascites
- Chronic inflammation
- Corticosteroid therapy
- Obesity
- Diabetes Mellitus
- Extremes of age
- Hypercholesterolemia
- Hypoxemia
- Peripheral vascular disease (especially for lower extremity surgery)
- Postoperative anemia
- Prior site irradiation
- Recent operation
- Remote infection

Peri-Operative Risk Factors

- Skin carriage of staphylococci
- Skin disease in the area of infection (e.g., psoriasis)
- Malnutrition
- Environmental factors
- Contaminated medications
- Inadequate disinfection/sterilization
- Inadequate skin antisepsis
- Inadequate ventilation
- Treatment factors
- Drains
- Emergency procedure
- Hypothermia (<34°)
- Inadequate antibiotic prophylaxis
- Oxygenation (hypoxia)
- Prolonged preoperative hospitalization
- Prolonged operative time >4 hrs.

Patient Risk Factors (Co-morbidities)

Inherent & Genetic

- Age
- Errors of Metabolism
  - Type III collagen gene expression and protein synthesis
- Size of Hernia
- Number of previous repairs
- Size of hernia
- Wound Infection / Dehiscence
- Aneurysm Surgery

Modifiable

- Obesity
- Diabetes Mellitus
- OSA
- Wound Infection
- COPD
- Steroids
- Difficulty Voiding
- Constipation
- Chronic Cough

Surg Gynecol Obstet. 1993 Mar;176(3):228-34.
Am Surg. 2004 Apr;70(4):281-6.

Errors of Collagen Metabolism

- Lathyrism – acquired disorder of connective tissue
  - diet high in chick peas inhibits collagen cross-linking leading to a laxity in fascial planes
- Ehlers-Danlos syndrome - collection of collagen isoform disorders
  - predisposing to hernia formation
- Type III collagen gene expression and protein synthesis

Pre-operative Considerations

- History of tobacco abuse must be counseled to stop smoking as they have the highest risk of wound complications, intestinal leak rates, and pulmonary complications (11, 12, 13, 14, 15).
- Other risk factors associated with pre-operative morbidity after ventral hernia repair failure
  - Steroids (16),
  - COPD,
  - diabetes mellitus,
  - BMI> 30,
  - Previous wound infection
  - Infected mesh (17)

Timing of Reconstruction

- While most abdominal reconstructive surgeons will recommend waiting a minimum of six months prior to a planned abdominal wall reconstruction only one study has demonstrated this time period as a safe approach without significantly affecting the morbidity rates (18).

Outcomes of complex abdominal herniorrhaphy

- 106 patients -(75%) had preoperative comorbid conditions.
- 63% postoperative complication
- Skin necrosis - most common complication 19.8%
- Other complications: seroma, cellulitis, abscess, pulmonary embolus/deep vein thrombosis, SBO, and fistula
- Factors that significantly contributed to postoperative complications: obesity, diabetes, hypertension, fistula at the time of the operation, a history of >2 prior hernia repairs, a history of >3 prior abdominal operations, hospital stay for >14 days, defect size > 300 square cm, and the use of human-derived mesh allograft.
- History of multiple abdominal operations is a major predictor of complications and recurrences

Ann Plast Surg. 2012 Apr;68(4):382-8.

Impact of SSI on the development of incisional hernia and small bowel obstruction

- SSI was independently associated with incisional hernia after adjusting for clinical covariates
- Patients - incisional hernia were 1.9 times more likely to have had an SSI
- Small bowel obstruction was significantly associated with operations involving the rectum
- SSI was not an independent predictor of small bowel obstruction
- Patients with an SSI were 1.9 times more likely to have an incisional hernia than those without an SSI.

Am J Surg. 2011 Nov;202(5):558-60.

Delayed repair of obstructing ventral hernias is associated with higher M&M.

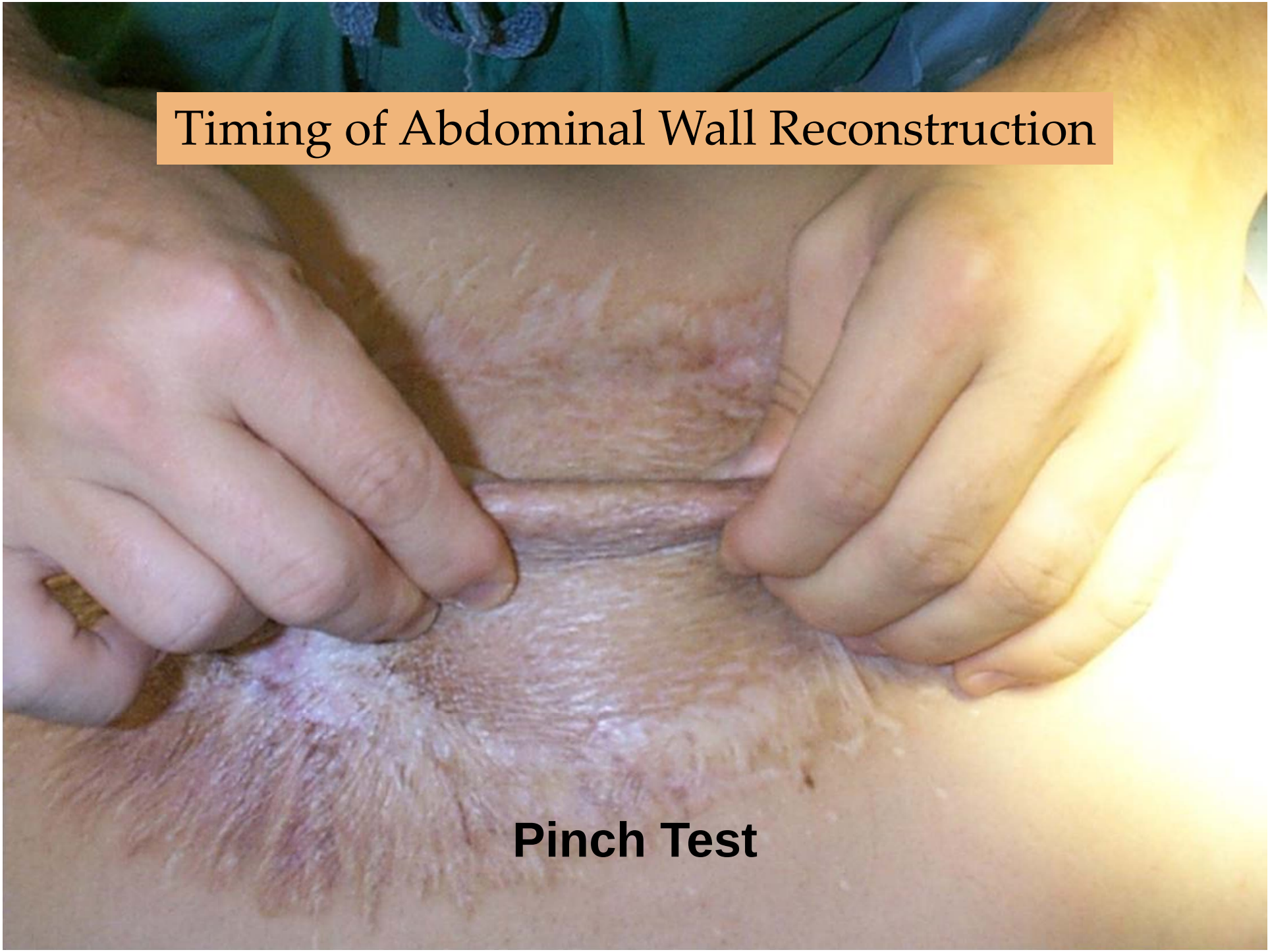
- NISQIP database from 2005 to 2011
- 16,881 patients - age of 58 and BMI 36 ± 10.
- Delayed repair occurred in 27.7% of the patients
- Controlling for comorbidities and ASA score, delayed VHR was independently associated with mortality, morbidity, SSI, and concurrent bowel resection VHR for obstructed patients is frequently performed over 24 hours after admission.
- Prompt repair after appropriate resuscitation should be the management of choice.

Am J Surg. 2015 May 14

Necrotizing Abdominal Wall Infections

Infected/Dirty Surgical Field
Loss of abdominal wall tissue / Loss of Domain
Consideration for ostomy placement and feeding access

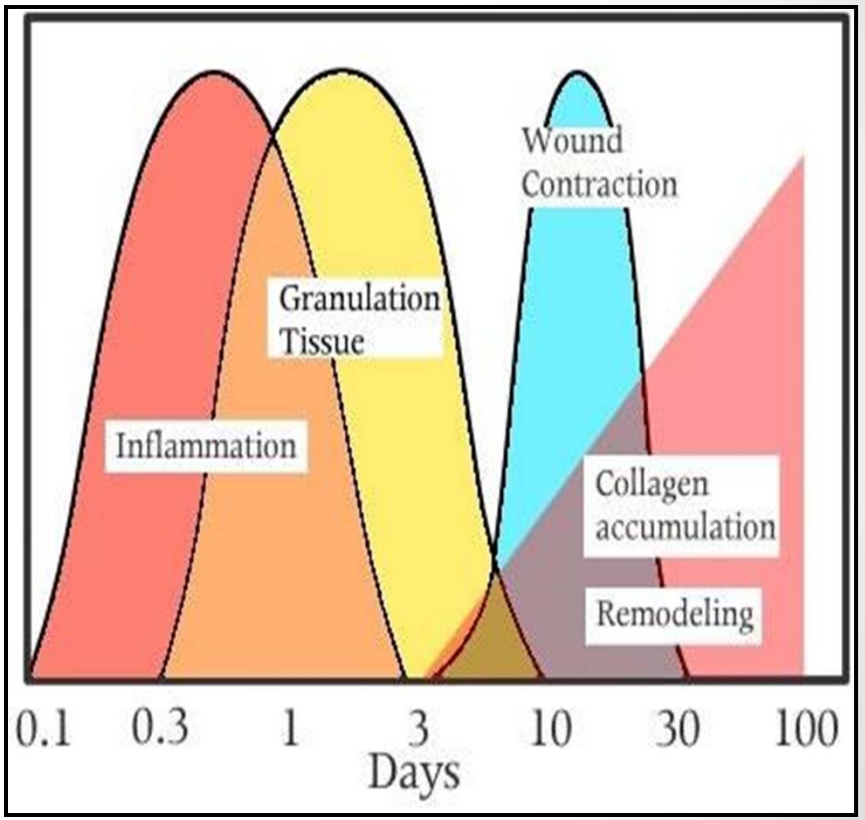
Timing of Abdominal Wall Reconstruction



Inflammatory Phase

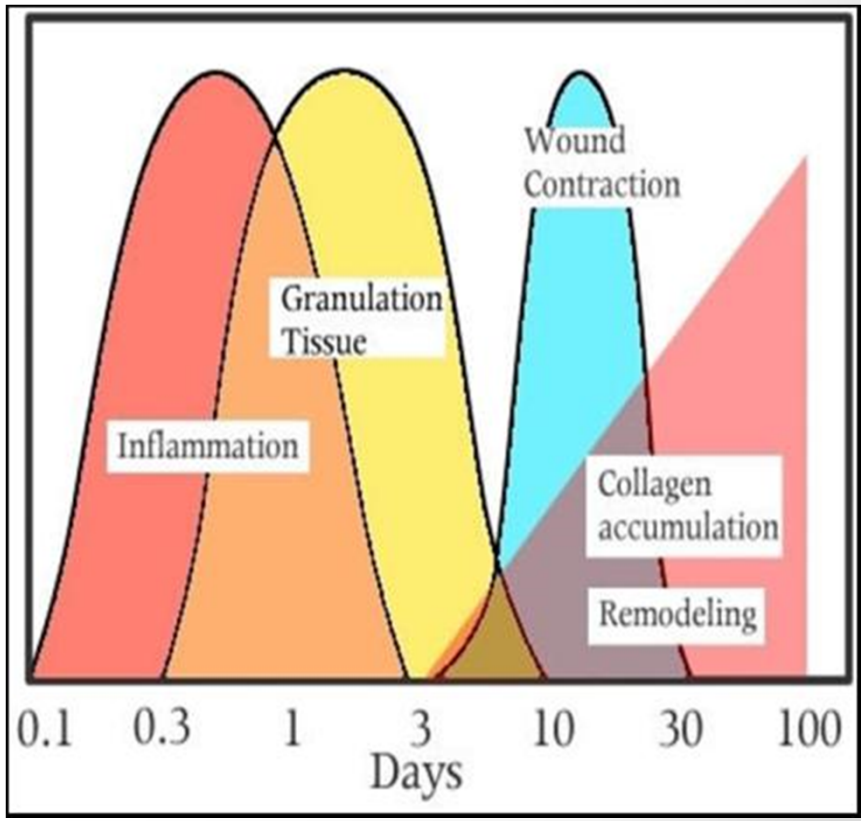
Initial response to injury

- Day 1-4 post injury
- Characterized: rubor, tumor, dolor, calor
- Platelet aggregation and activation
- Leukocyte (PMNs, macrophages) migration, phagocytosis and mediator release
- Venule dilation
- Lymphatic blockade
- Exudative
- Wounds closed by 1' intention, lasts 4 days
- Wounds closed by 2nd or 3rd intention, continues until epithelialization is complete



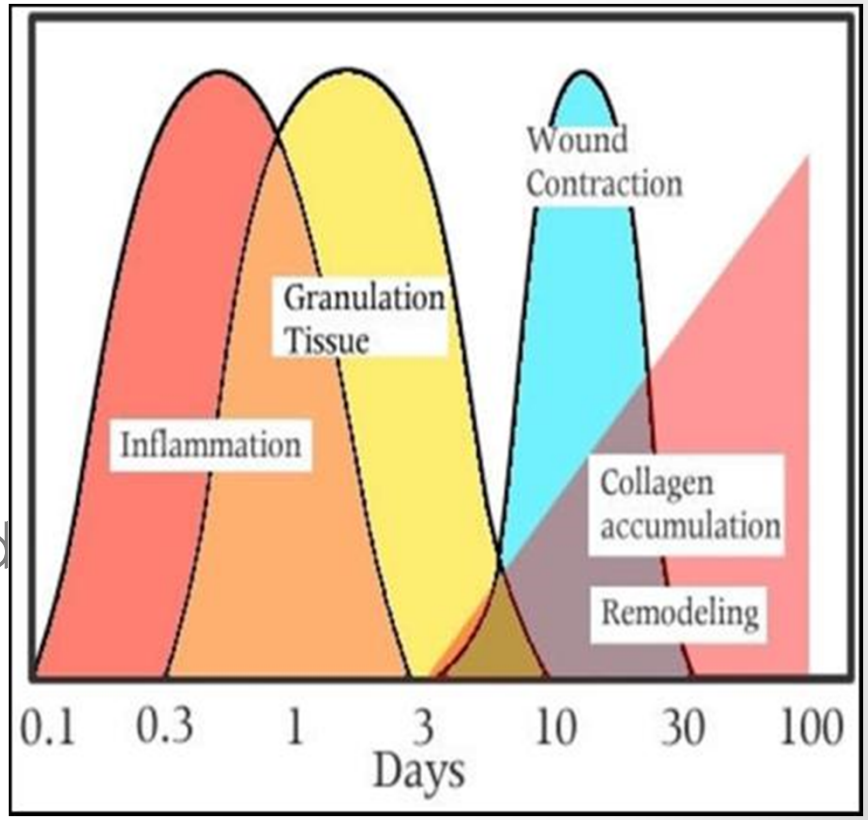
Proliferative Phase

- Day 4-42
- Fibroblast proliferation stimulated by macrophage-released growth factors
- Increased rate of collagen synthesis by fibroblasts
- Granulation tissue and neovascularization
- Gain in tensile strength

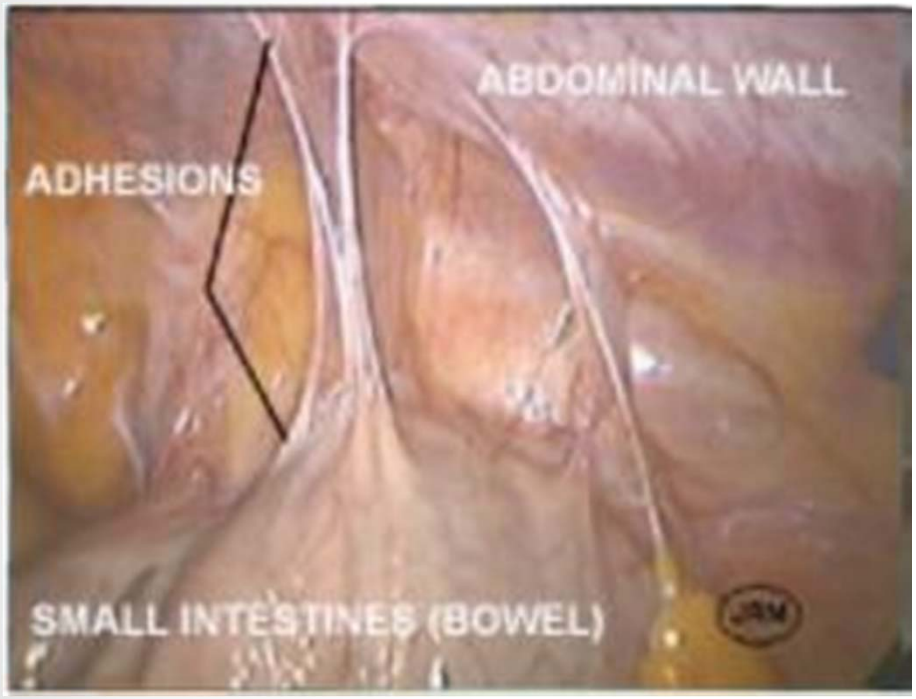


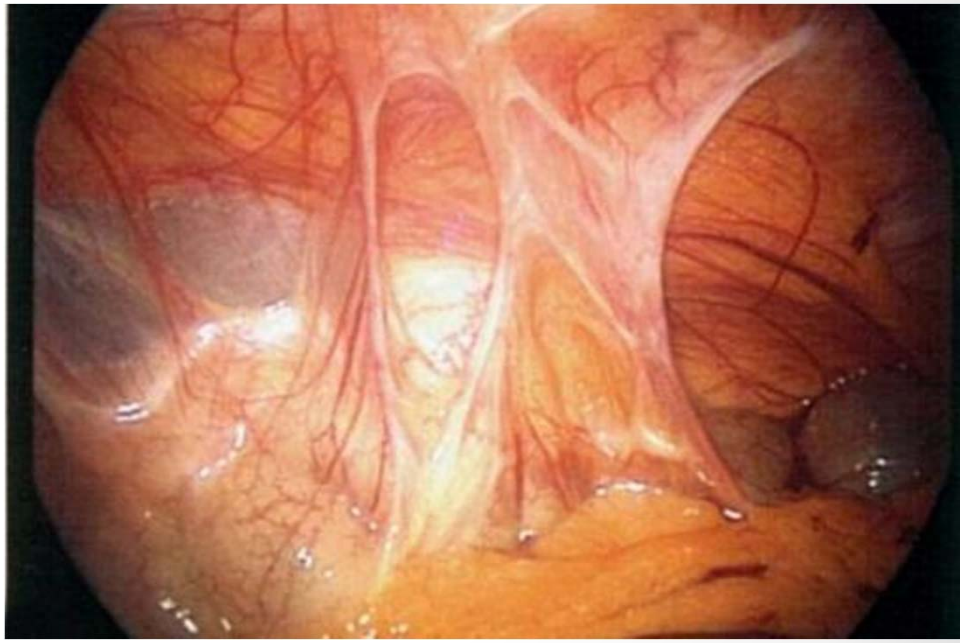
Remodeling Phase

- 6wks-1 year
- Intermolecular cross-linking of collagen via vitamin C-dependent hydroxylation
- Characterized by increase in tensile strength
- Type III collagen replaced with type I
- Scar flattens

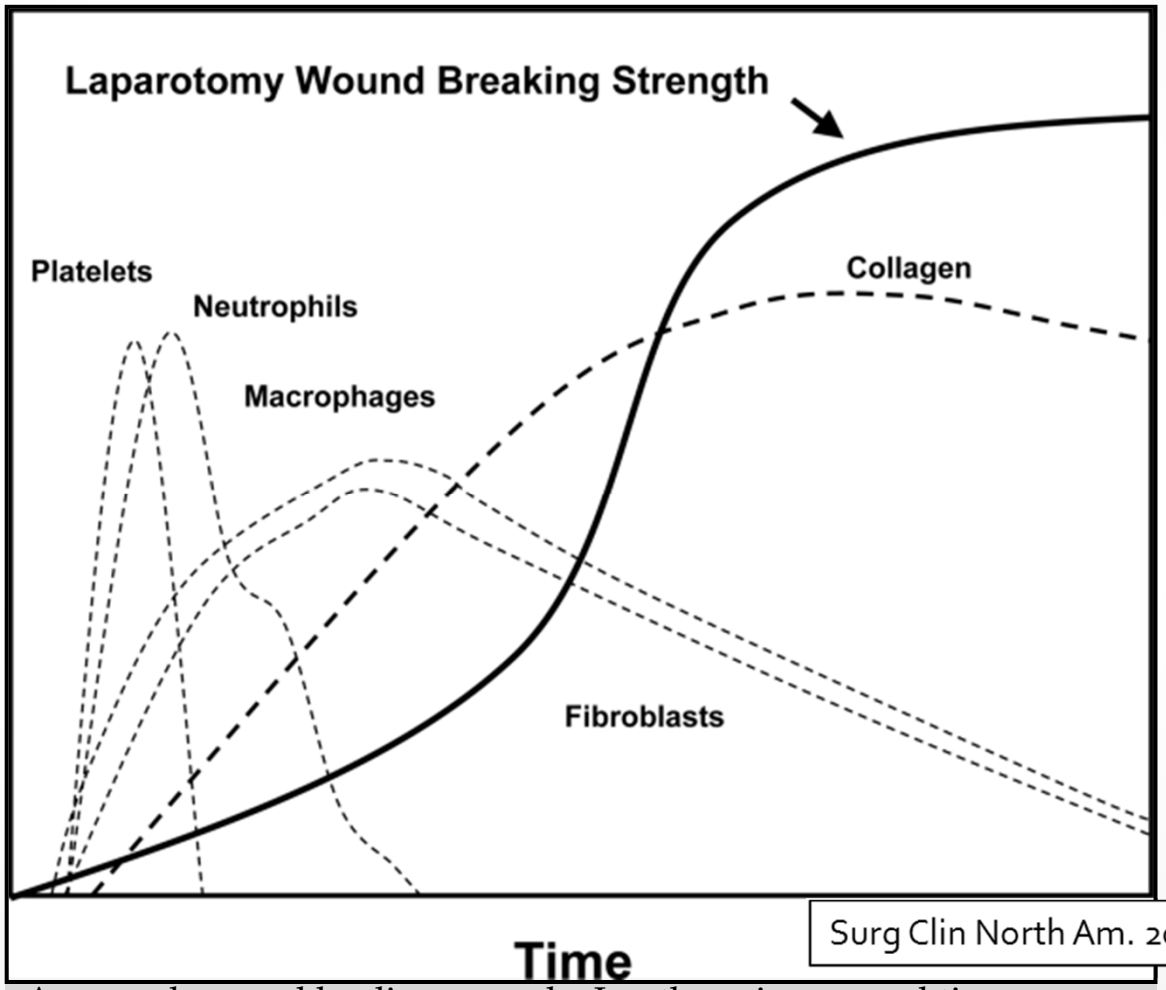


Mature Adhesions





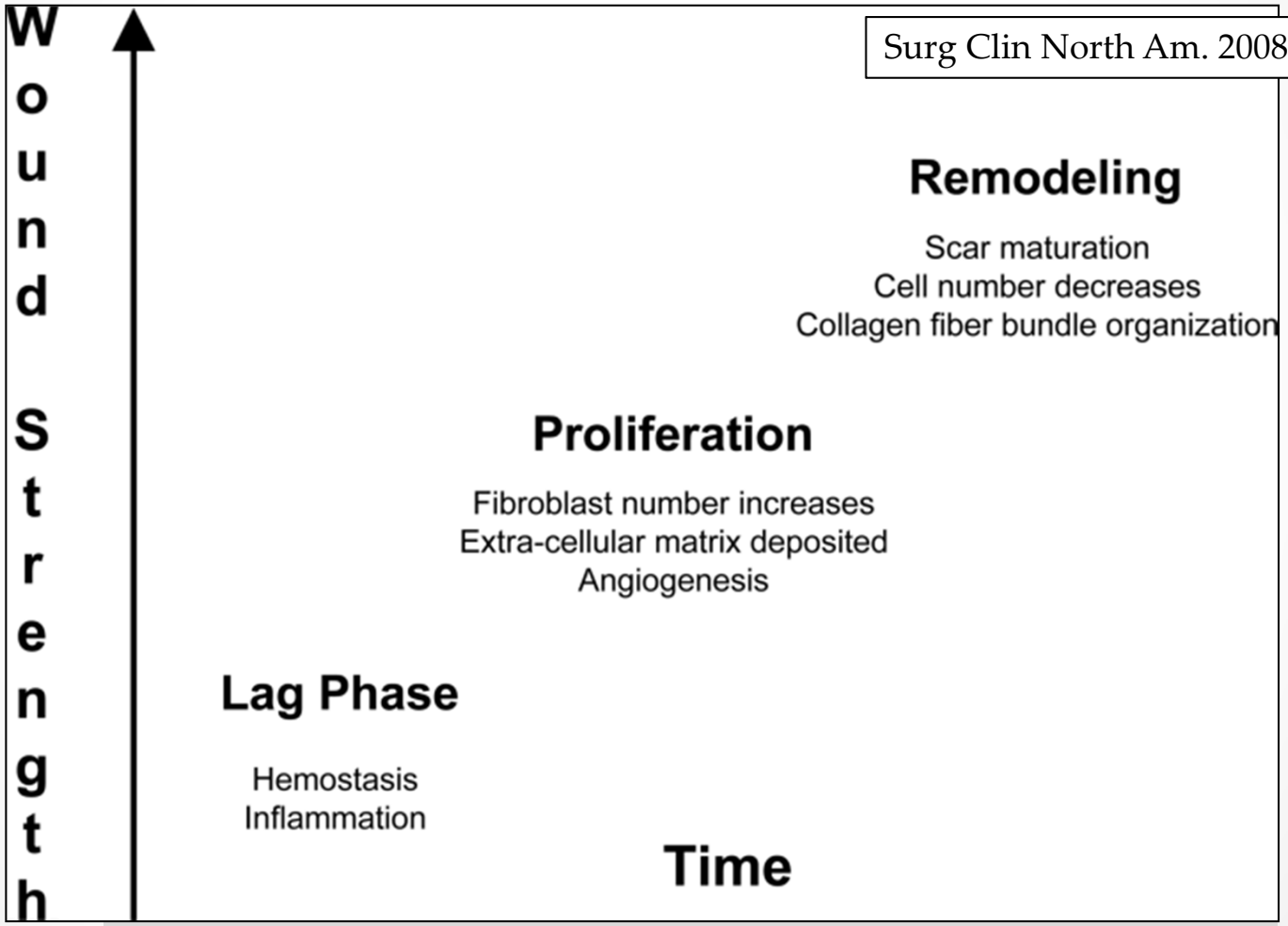
Biology of Hernia Formation



Surg Clin North Am. 2008 February ; 88(1):

A normal wound healing cascade. In otherwise normal tissue, without impediments to wound healing, sequential cellular and molecular elements of tissue repair are activated.

Biology of Hernia Formation



Surg Clin North Am. 2008 February ; 88(1)

During the initial "lag-phase" of healing, the laparotomy wound is mechanically weakest. As surgical patients recover, increasing abdominal wall loads can cause acute wound failure.

Special Considerations

- Enteroatmospheric fistula - organized approach to pre-operative preparations and planning for fistula takedown with an AWR.
- Skin coverage during the early stages of the open abdomen.
- Distal intestinal fistulas (especially colocutaneous fistulas), patients may be fed enterally to allow for the benefits of enteral nutrition.
- Rarely a very proximal enteroatmospheric intestinal fistula may be access with a feeding tube directly in order to feed the gut distally,
- TPN - often the only option to maintain the patient's nutritional status.
- Wound healing vitamins (vitamin C), and antioxidants (Zn, selenium) have been used in this severely malnourished patient population (19, 20).

Pre-operative Imaging

Preoperative CT measurements of hernia defects and AWT predict wound complications and the need for complex AWR techniques.

- Radiographic assessment of the abdominal wall anatomy prior to elective AWR
- Multi-detector computer tomography (MCT) can demonstrate the size of the ventral defect, and assess the degree of abdominal loss of domain.
- Demonstrate the amount of tissue loss after trauma or necrotizing wound infections as well as the presence of heterotopic ossification within the scar can be assessed .

J Surg Res. 2015 Jun 18.

ORIGINAL ARTICLE

Multi-institutional Experience Using Human Acellular Dermal Matrix for Ventral Hernia Repair in a Compromised Surgical Field

Jose J. Diaz Jr, MD; Anne M. Conquest, MD; Steven J. Ferzoco, MD; Daniel Vargo, MD; Preston Miller, MD; Yi-Chen Wu, BS; Rafe Donahue, PhD

Table 1. Details of 240 Study Operative Procedures

Repair Type	Total No.	Biliary	Gastric	SB	Colon	Appendectomy	ECF/Ostomy	LOA	Hepatic	GU-Bladder	None
Inlay	**91**	...	1	5	1	2	27	34	...	...	21
Onlay	**28**	...	...	1	4	...	9	9	...	...	7
Component	**31**	...	...	3	1	...	11	14	1	...	1
Interposition	**89**	1	...	7	...	...	34	25	1	2	17
Unknown	**1**	...	...	...	...	...	...	...	...	...	1

Abbreviations: ECF/ostomy, enterocutaneous fistula repair or ostomy takedown; GU, genitourinary; LOA, extensive lysis of adhesions requiring 50% or more of the operative time; SB, small-bowel resection.

Table 4. Risk Associated With 41 Hernia Recurrences

	No.	HR (%)	*P* Value
Wound classification			
Clean	50	9 (18.0)	.48
Clean-contaminated	113	22 (19.5)	
Contaminated	49	8 (16.3)	
Dirty	28	2 (7.1)	
Repair type			
Inlay	91	17 (18.7)	.46
Onlay	28	4 (14.3)	
Component separation	31	2 (6.5)	
Interposition	89	18 (20.2)	
Unknown	1	0	
Mesh removal	51	4 (7.8)	.048
Ostomy or fistula takedown	81	8 (9.9)	.03
Fistula formation	28	10 (35.7)	.005
Suture type[a]			
Absorbable	122	20 (16.4)	.81
Permanent	106	21 (19.8)	

[a] Two groups do not sum to 240 because not all the data were available.

Table 5. Risk Associated With 96 Surgical Site Infections (SSIs)

	No.	SSI (%)	*P* Value
Wound classification			
Clean	50	14 (28.0)	.01
Clean-contaminated	113	44 (38.9)	
Contaminated	49	22 (44.9)	
Dirty	28	16 (57.1)	
Repair type			
Inlay	91	31 (34.1)	.003
Onlay	28	8 (28.6)	
Component separation	31	13 (41.9)	
Interposition	89	33 (37.1)	
Unknown	1	0	
Other procedures[a]			
Bowel	190	75 (39.5)	.79
None	50	21 (42.0)	
Ostomy or fistula takedown	81	24 (29.6)	.14

[a] Some patients had more than 1 "other" procedure.

Table 6. Risk Associated With 28 Fistula Formations (FFs)

	No.	FF (%)	*P* Value
Wound classification			
Clean	50	1 (2.0)	.01
Clean-contaminated	113	14 (12.4)	
Contaminated	49	11 (22.4)	
Dirty	28	2 (7.1)	
Repair type			
Inlay	91	10 (10.9)	.56
Onlay	28	2 (7.1)	
Component separation	31	2 (6.5)	
Interposition	89	14 (15.7)	
Unknown	1	0	
Other procedures			
Bowel	190	22 (11.6)	.93
None	50	6 (12.0)	
Ostomy or fistula takedown	81	18 (22.2)	<.001
SSI	96	22 (22.9)	<.001
Removal of STSG	40	1 (2.5)	.048
Recurrent hernia	41	10 (24.4)	.005

Abbreviations: SSI, surgical site infection; STSG, split-thickness skin graft.

Table 7. Other Complications

Other Complications	No. (%) of 240 Complications[a]
Wound dehiscence	21 (8.8)
Ileus	34 (14.2)
Seroma	31 (12.9)
Infection	
IAA	23 (9.6)
VAP	37 (15.4)
BSI	31 (12.9)
UTI	31 (12.9)
Total	**208** (86.7)

Abbreviations: BSI, bloodstream infection; IAA, intra-abdominal abscess; UTI, urinary tract infection; VAP, ventilator-associated pneumonia.

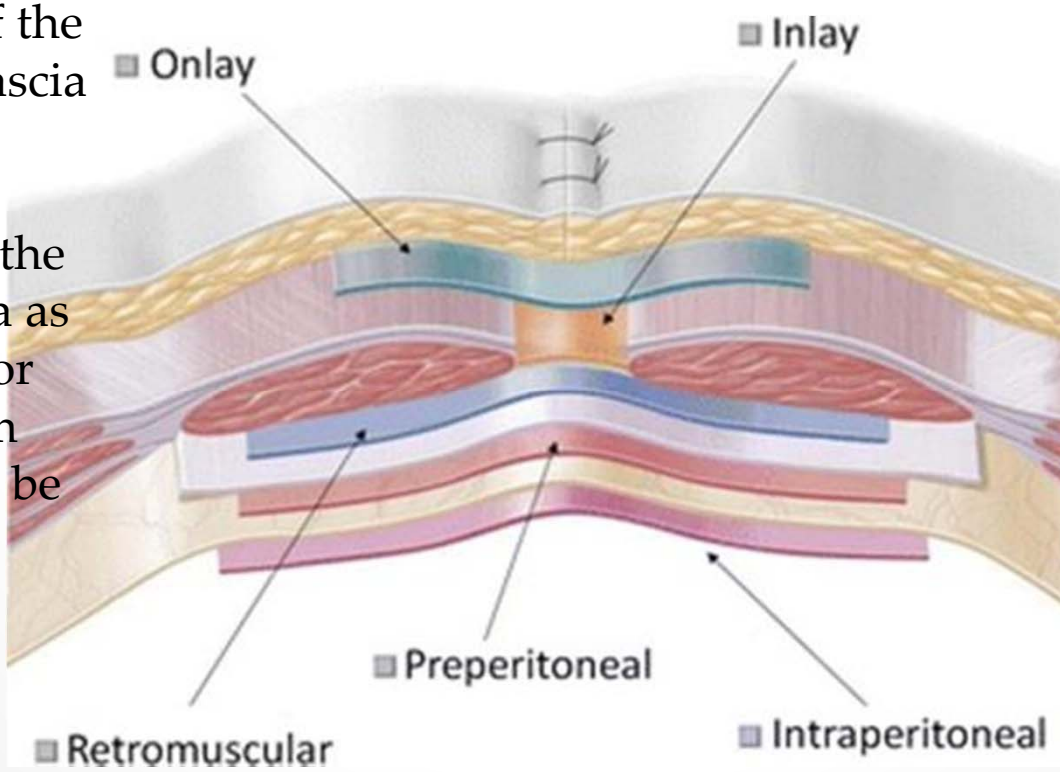
[a] Percentages may not total 100 owing to rounding.

Mesh Placement

- The mesh can be placed in the various positions and each has its benefits and risk:

Onlay –on top of the anterior rectus fascia

Inlay – "interposition" sewn directly to the edge of the fascia as a bridge repair for patients in whom the fascia cannot be directly re-approximated



Sublay –posterior to the rectus muscle between the muscle and the posterior rectus fascia, in the retro rectus space, just superficial to the peritoneum

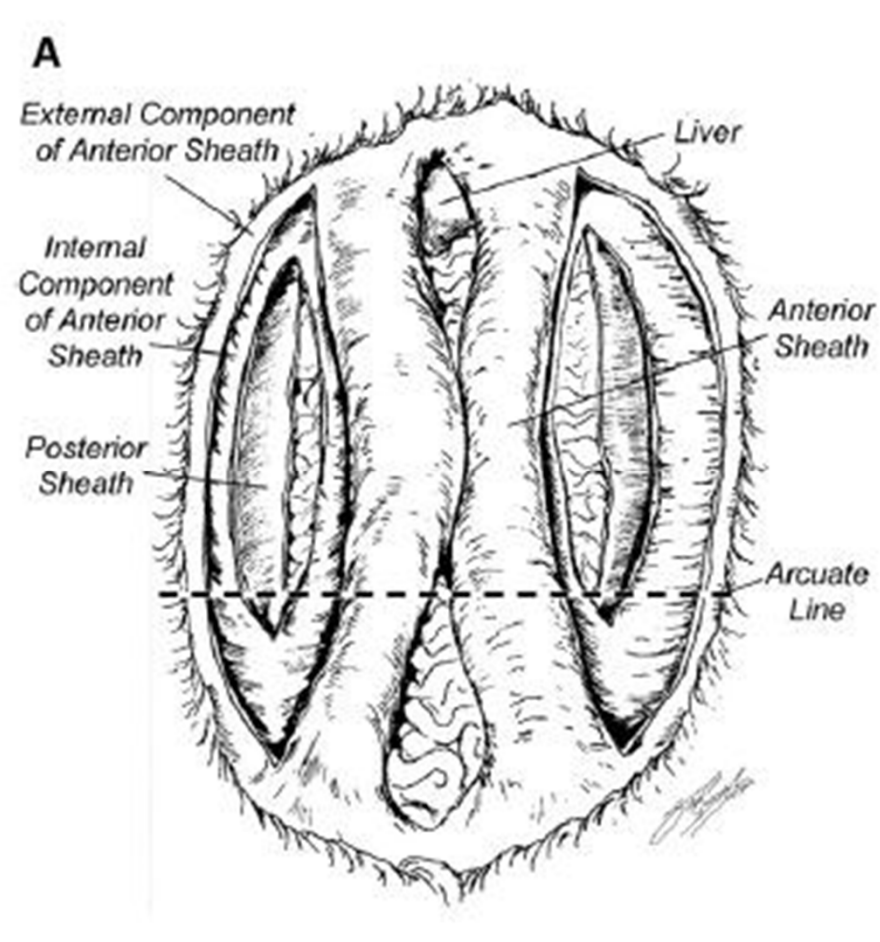
Underlay –intra-abdominally, posterior to the rectus fascia and directly on the peritoneum

Abdominal Wall Reconstruction with Component Separation

- Component separation was initially described by Ramirez as a tissue only repair.
  - Component separation involved the development of large skin flaps off the anterior rectus fascia.
  - Dissection exposed the aponeurosis of the external oblique fascia.
  - Aponeurosis is divided longitudinally starting at the anterior superior iliac spine and onto the costal margin.
- In the majority of cases the component separation technique will close an abdominal wall fascial defect of 15-20 cm in the mid-abdomen.

Plast Reconstr Surg. 1990 Sep;86(3):519-26.

"Separation of Parts"



- Fabian 1994 described the "separation of parts".
- Anterior rectus fascia and muscle are separated from the posterior rectus fascia.
- Anterior rectus fascia and muscle are mobilized medially allowing for the recreation of the linea alba.
- Lateral edge of the anterior rectus fascia is sewn to the medial edge of the posterior rectus fascia.
- This technique does result in three suture lines (5).

AWR: Component Separation Repairs

- Initial reports of component separation repairs had significant morbidity
  - 37-39% wound complications, and 32% hernia recurrence with follow-up period of 15 months (47, 48, 49, 50, 51).
  - Since component separation is a tissue only repair, the technique was commonly applied to wounds with bacterial colonization or contaminated surgical fields (52).
  - Large skin flaps used to expose the external oblique muscles and subsequent dead space allow for the development of seromas and wound infections.

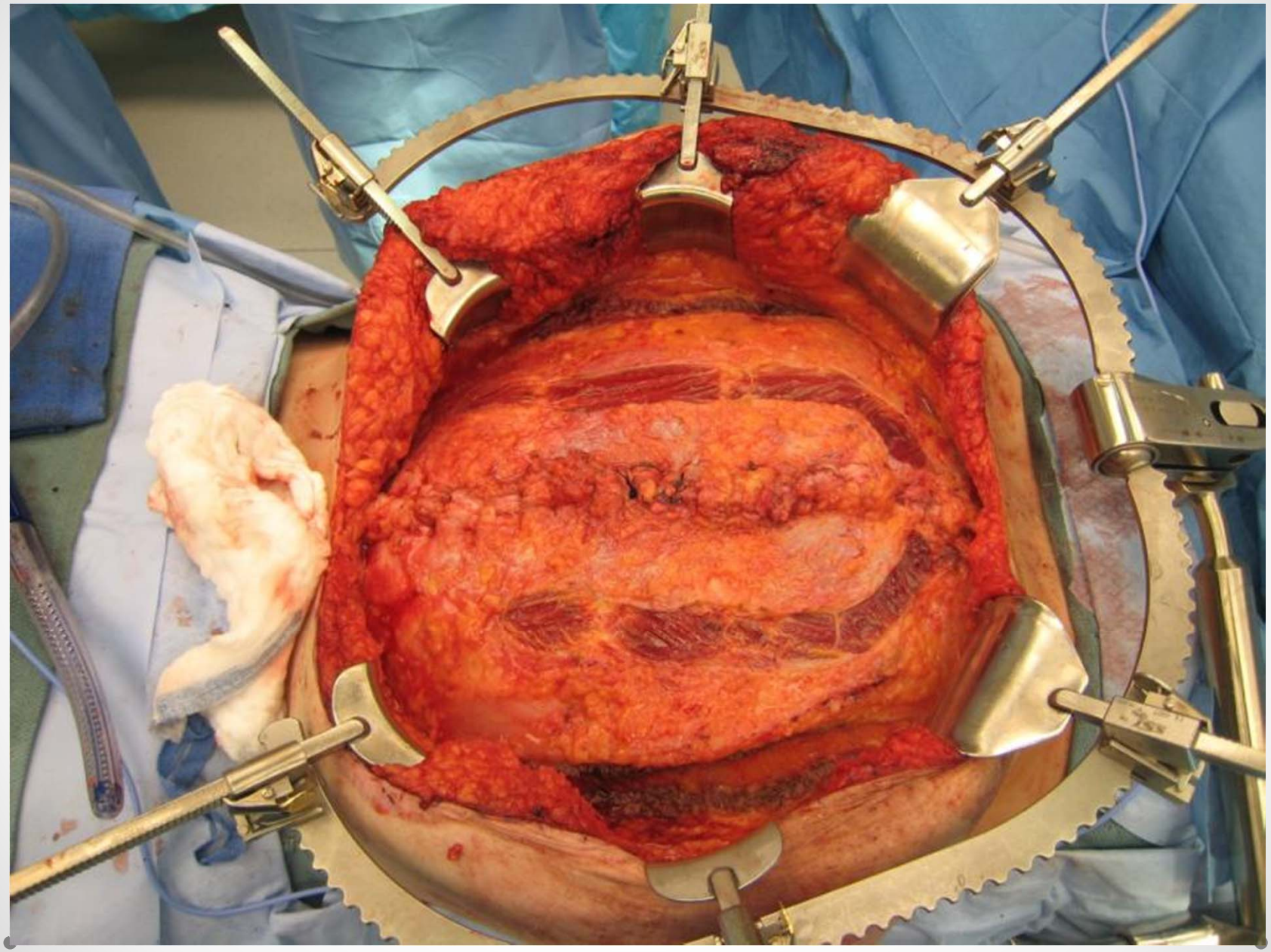
Component Separation with Synthetic Mesh

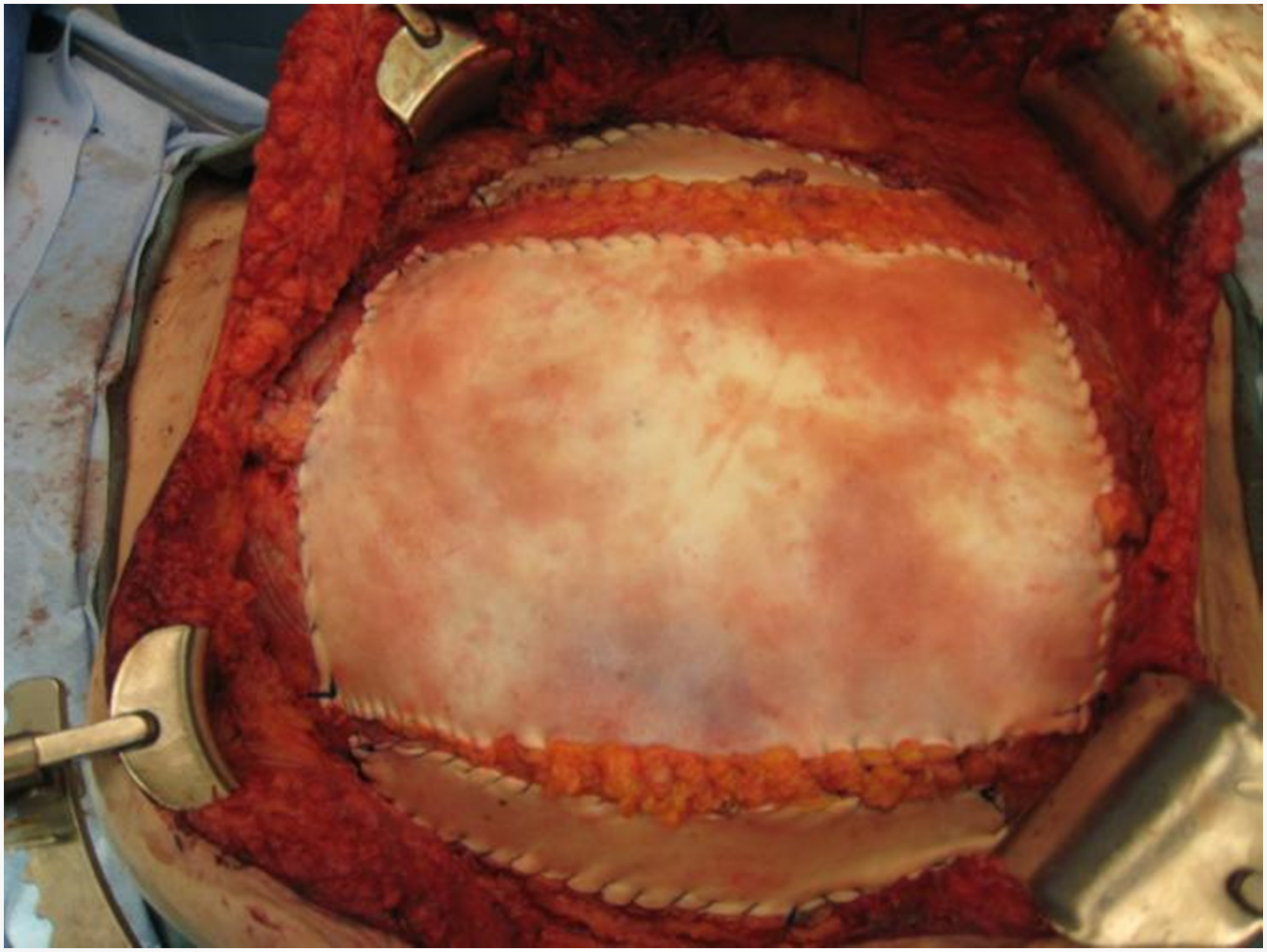
- Use of prosthetic mesh to support the component separation repair in either an onlay and/or underlay position with the goal to decrease the hernia recurrence rates.
- The procedure still has significant morbidity:
  - wound infection rates of 10-35% and with a recurrence rate of 5.5-15% over a 50 month follow up period (39, 34).

Bridge Repair with Biologic Mesh

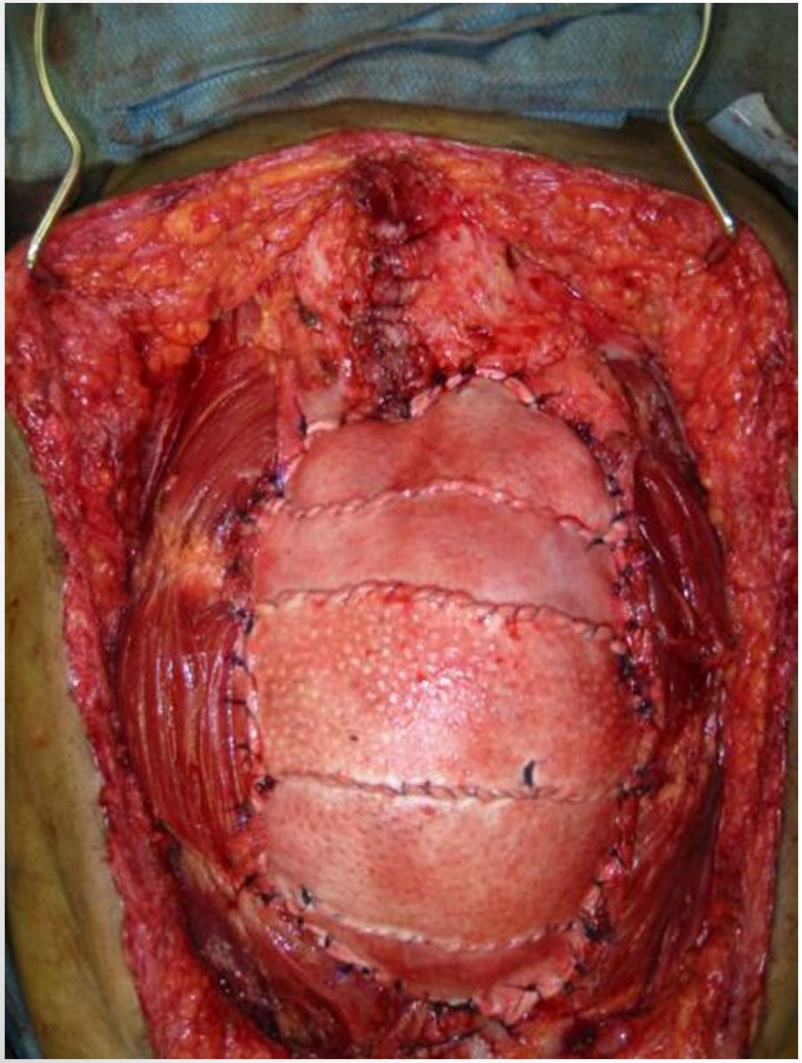
- Subsequent studies with longer follow-up times showed that most patients repaired with a biologic mesh positioned as a bridge repair developed an eventuation or attenuation of the repair described as hernia recurrence (33, 53, 54, 56, 57).

Planned Ventral Hernia





Component Separation with Implantation of HADM

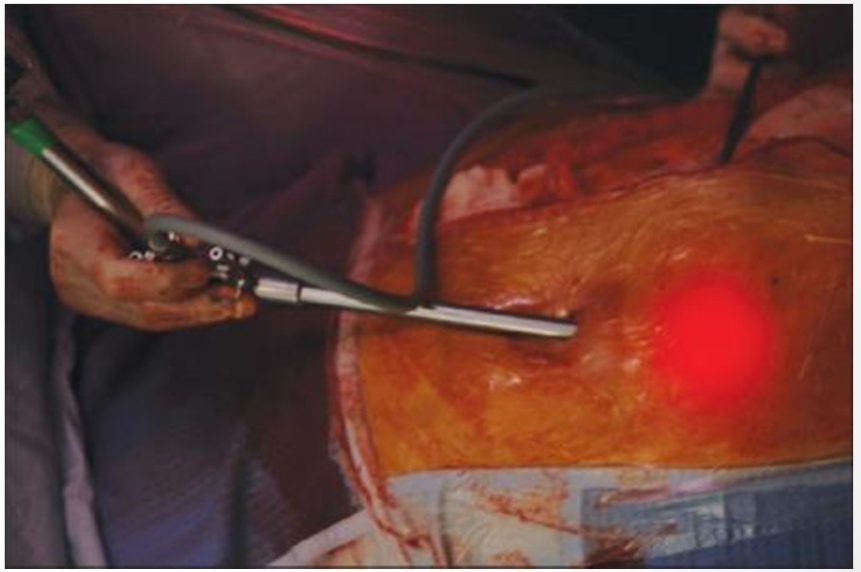


Minimally invasive / Endo-Laparoscopic Anterior

Component Separation/ Posterior Component Separation

- New surgical techniques - decrease the wound complications rates: 20% to 2%. (80)
- Laparoscopic and minimally invasive surgical techniques for component separation
  - Transverse incision is made medial to the anterior superior iliac spine and lateral to the rectus muscle which allows one to dissect down to the external oblique fascia.
  - Endo / laparoscopic technique utilize a hernia balloon to develop a plane in-between the external and internal oblique muscles.
  - The area is insufflated and the external oblique aponeurosis can be seen anteriorly and divided (85, 86, 87, 88).
- Minimally invasive technique, the external oblique aponeurosis is directly visualized and divided (89, 90) while using a narrow Deaver type retractor to elevate the tunnel.
- Both techniques allow the rectus muscle and fascial component to be mobilized medially, and avoid creation of large dead space.
- Preserve the rectus vascular perforators which decrease the risk of wound infection and potential flap loss

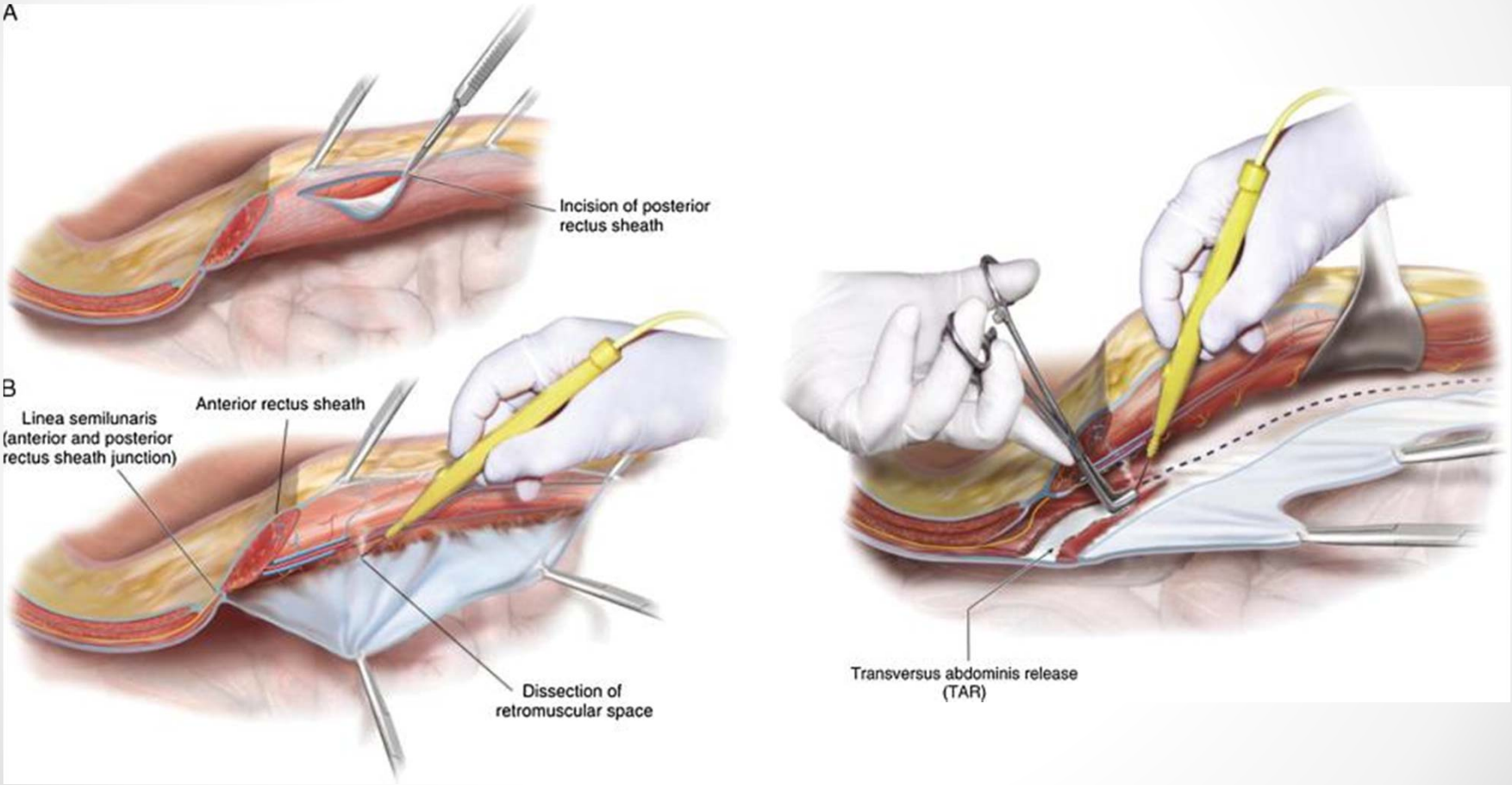
Minimally invasive / Endoscopic Component Separation



TRAS Release

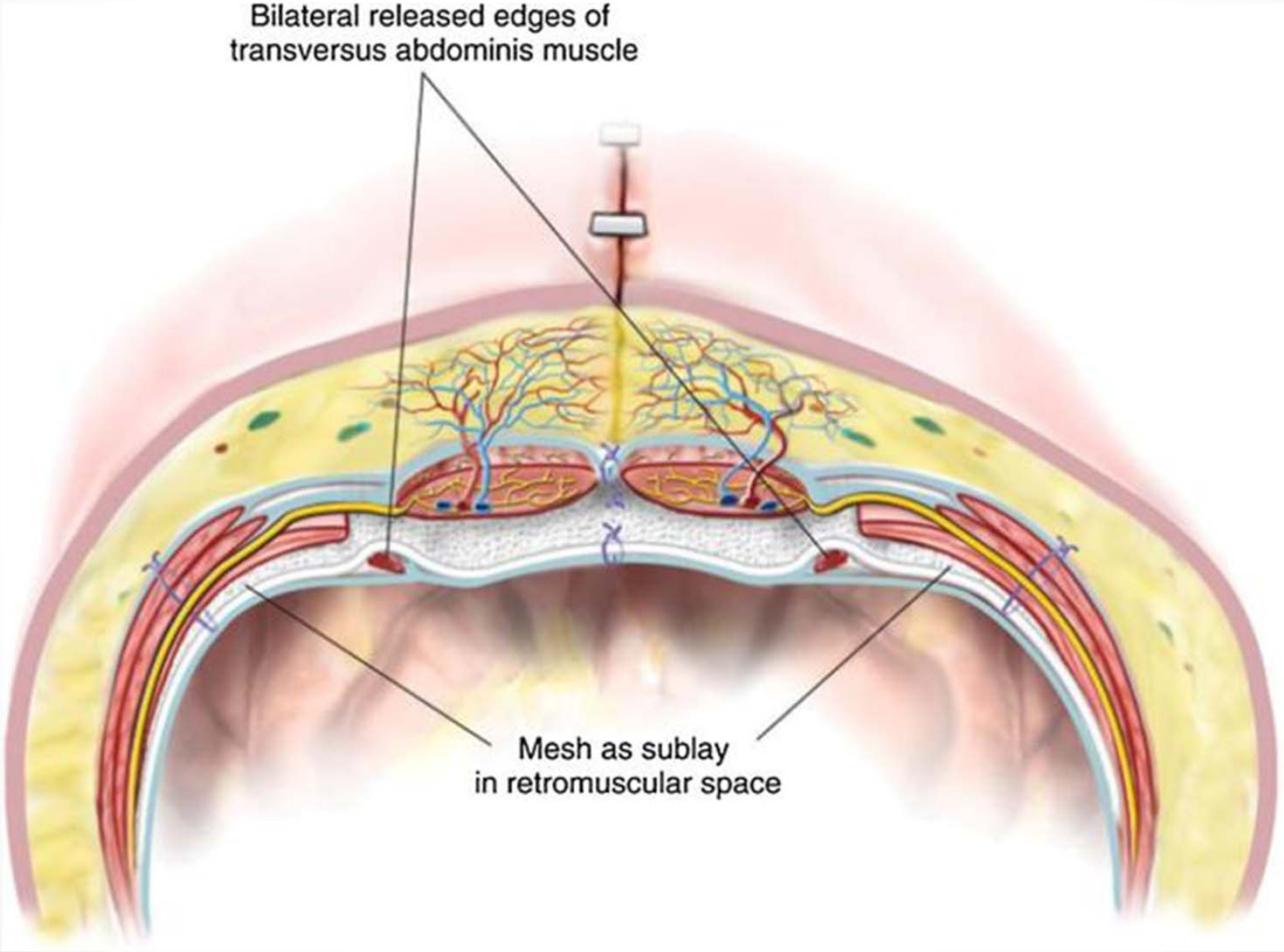
- Retrorectus approach to the transversalis muscle with division of the muscle (91, 92).
- 111 patients - demonstrated a lower wound complication rate (48.2% vs. 25.5%) as well as a lower hernia recurrence rate (14.3% vs. 3.6%) vs. the anterior component separation approach.
  - A retrorectus sublay mesh is placed to support the repair similar to a Rives-Stoppa type repair.
- This approach also eliminates creation of large skin flaps.

TRAS Release



J Trauma Acute Care Surg. 2015 Feb;78(2):422-9

Transversus Abdominis muscle release



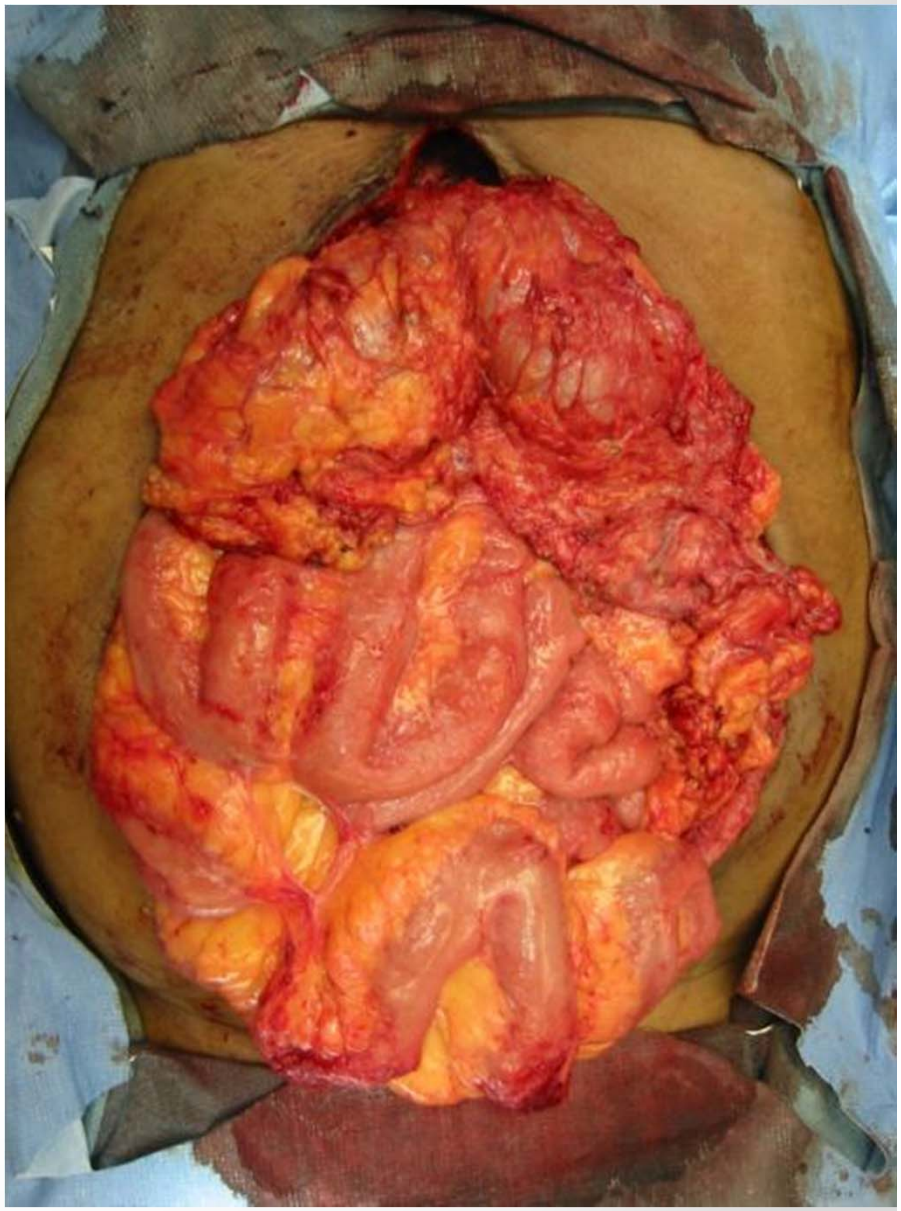
J Trauma Acute Care Surg. 2015 Feb;78(2):422-9

Outcomes for incisional hernia repair in patients undergoing concomitant surgical procedures.

- Veterans Affairs hospitals from 1998 to 2002.
- Concomitant procedure status, hernia characteristics, and operative details were determined using physician-abstracted operative notes.
- Outcomes of recurrence and mesh explantation were determined
- 1495 elective IHRs, 75 (4.8%) were same site and 56 (3.8%) different site concomitant procedures.
- Median follow-up of 69.3 months (range 19.1-98.3), 33.6% of patients had a recurrence, mesh explantation, or both.
- Permanent mesh placement was less likely among concomitant procedures as compared with nonconcomitant procedures
- Adjusted Cox proportional hazards models of hernia outcomes resulted in an increased hazard for recurrence among same site clean procedures and an increased hazard for mesh explantation among same site clean-contaminated procedures

Altom et al, Am Surg. 2012 Feb;78(2):243-9.

Planned Ventral Hernia



Hyper-trophic Calcified Scar

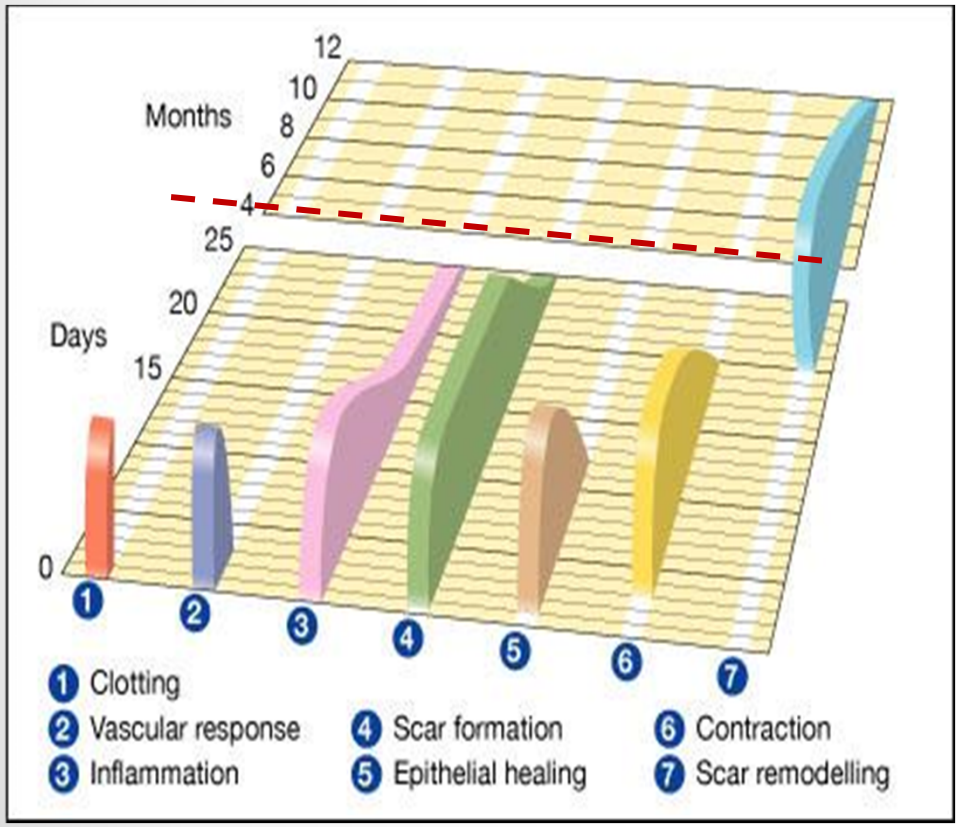
Functional abdominal wall reconstruction

improves core physiology and quality-of-life.

- Dynamometric analysis before and 6 months after an open posterior component separation (Rives-Stoppa technique complimented with a transversus abdominis muscle release) and mesh sublay.
- Quality-of-life was measured using our validated HerQles survey at the time of each dynamometric analysis.
- 13 patients (mean age, 54 ± 9 years; mean body mass index, 31 ± 7 kg/m(2)) underwent repair with restoration of the midline using the aforementioned technique.
- Mean hernia width was 12.5 cm (range, 5-19).
- Improvements in PT and PT/BW were significant in all 5 settings ($P < .05$).
- Improvement in power during isokinetic analyses at 45°/s and 60°/s was also significant ($P < .05$).
- All patients reported an improvement in quality-of-life, which was associated positively with each dynamometric parameter.

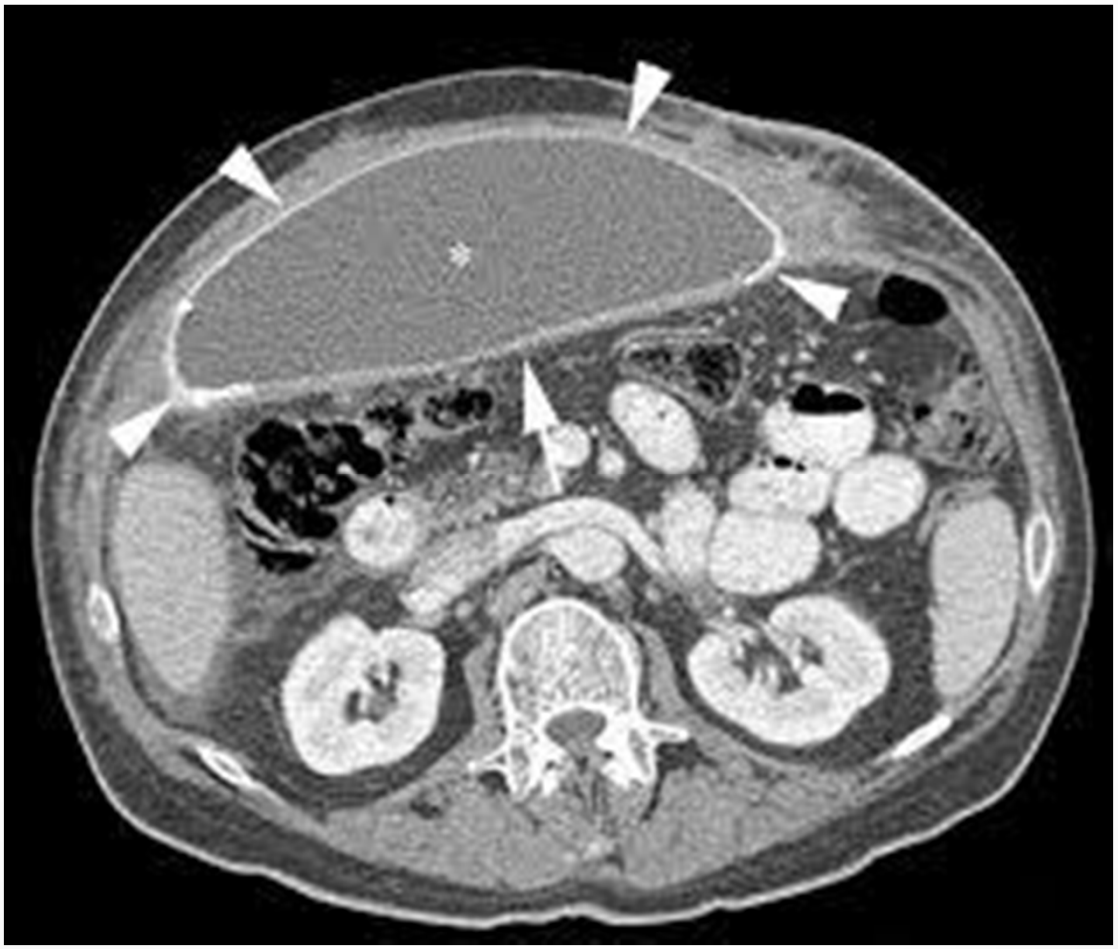
Criss et al Surgery. 2014 Jul;156(1):176-82

Post Operative / Discharge Instructions



- Physical Activity
- Weight lifting limitations
- Increase intra-abdominal pressures

Mesh Infection

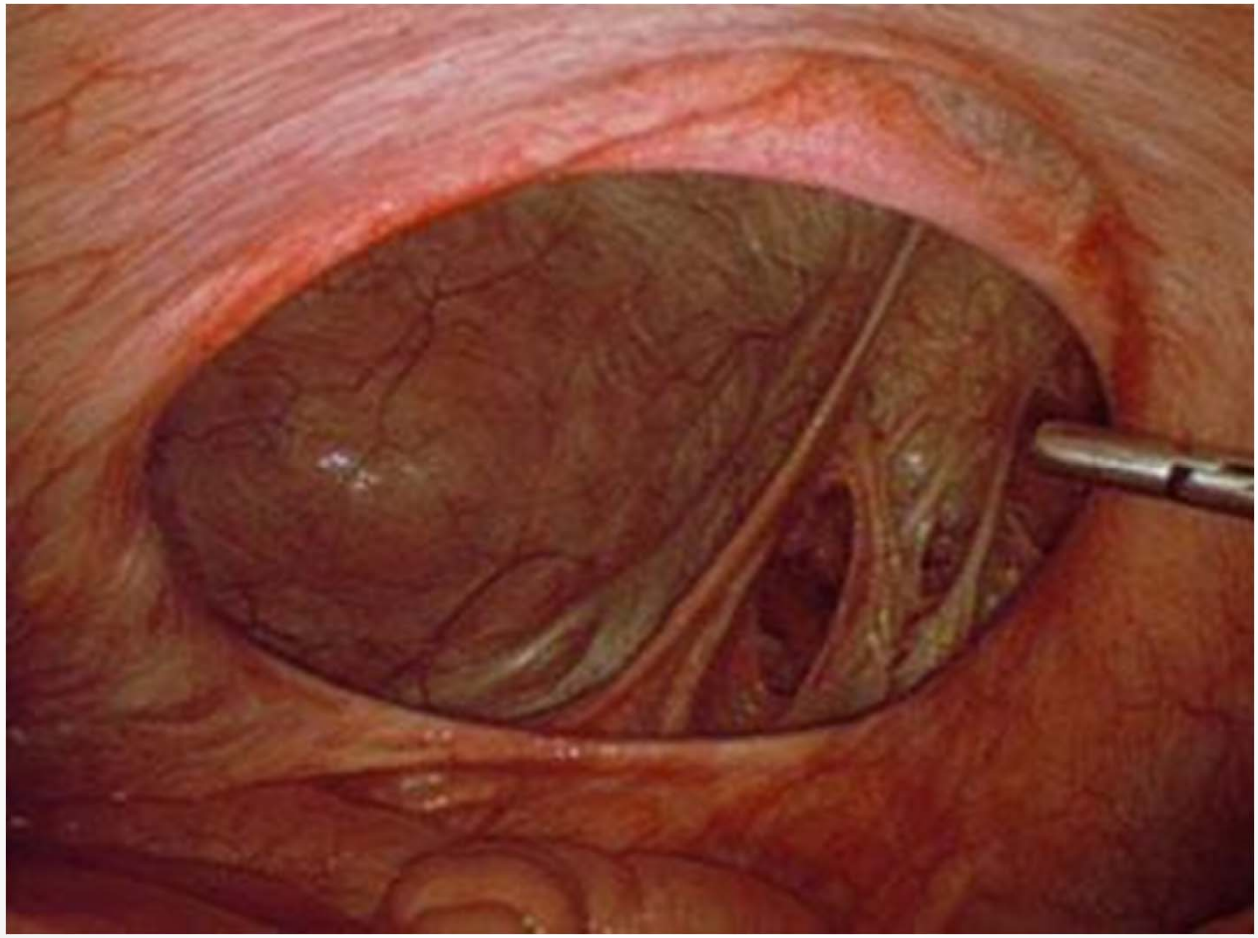


Mesh Infection

- Diagnosis depends on high clinical suspicion and relies on culture of the fluid surrounding the mesh or of the mesh itself.
- Risk factors may include a high body mass index (obesity)
  - chronic obstructive pulmonary disease
  - abdominal aortic aneurysm repair
  - prior surgical site infection
  - use of larger, microporous, or expanded polytetrafluoroethylene mesh
  - performance of other procedures via the same incision at the time of repair; longer operative time
  - lack of tissue coverage of the mesh
  - Enterotomy or enterocutaneous fistula
- Treatment of mesh infection is evolving on a case-by-case basis from explantation toward mesh salvage, to prevent complications such as hernia recurrence.

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

Laparoscopic ventral hernia repairs



Comparison of Laparoscopic and Open Repair With Mesh for the Treatment of Ventral Incisional Hernia

A Randomized Trial

Kamal M. F. Itani, MD; Kwan Hur, PhD; Lawrence T. Kim, MD; Thomas Anthony, MD; David H. Berger, MD, MHCM; Domenic Reda, PhD; Leigh Neumayer, MD; for the Veterans Affairs Ventral Incisional Hernia Investigators

- DESIGN: Prospective randomized trial conducted (2004–2007)
- SETTING: 4 Veterans Affairs medical centers.
- PARTICIPANTS: 162 patients with ventral incisional hernias.
- INTERVENTIONS: Standardized laparoscopic or open repair.
- MAIN OUTCOME MEASURES: Overall complication rates at 8 weeks and the odds of complications, adjusted for study site, body mass index, and hernia type.

Arch Surg. 2010 Apr;145(4):322-8;

Table 2. Postoperative Complications (Primary and Secondary Outcomes)

	Patients, No. (%)				
	Laparoscopic Repair (n=73)	Open Repair (n=73)	*P* Value[a]	Odds Ratio (95% Confidence Interval)	Attributable Risk per 100 Persons[b]
Primary outcome					
Overall complications through 8 wk	23 (31.5)	35 (47.9)	.03	0.5 (0.2-0.9)	−16.4
Intraoperative complications					
Injury to bowel	3 (4.1)	0			
Problems related to anesthesia	1 (1.4)	0			
Other	3 (4.1)	1 (1.4)			
Overall	7 (9.6)	1 (1.4)	.046	8.9 (1.0-76.9)	8.2
Short-term postoperative complications	(n=72)	(n=73)			
Hernia site infection	2 (2.8)	16 (21.9)			
Wound hematoma	2 (2.8)	2 (2.7)			
Bleeding	1 (1.4)	1 (1.4)			
Intra-abdominal abscess	2 (2.8)	2 (2.7)			
Ileus/bowel obstruction	3 (4.2)	2 (2.7)			
Seroma	6 (8.3)	18 (24.7)			
Skin necrosis	2 (2.8)	3 (4.1)			
Other	10 (13.9)	5 (6.8)			
Overall	15 (20.8)	33 (45.2)	.001	0.3 (0.1-0.6)	−24.4
Serious complications within 30 d	(n=68)	(n=72)			
Sepsis	2 (2.9)	0			
Urinary tract infection	1 (1.5)	0			
Other	1 (1.5)	1 (1.4)			
Overall	3 (4.4)	1 (1.4)	.25	4.1 (0.4-45.5)	3.0
Long-term (8 wk) postoperative complications	(n=69)	(n=70)			
Hernia site infection	1 (1.5)	1 (1.4)			
Wound hematoma	0	0			
Intra-abdominal abscess	1 (1.5)	0			
Ileus/bowel obstruction	1 (1.5)	0			
Seroma	0	0			
Skin necrosis	0	0			
Other	1 (1.5)	1 (1.4)			
Overall	3 (4.4)	2 (2.9)	.69	1.5 (0.2-9.4)	1.5

Arch Surg. 2010 Apr;145(4):322-8;

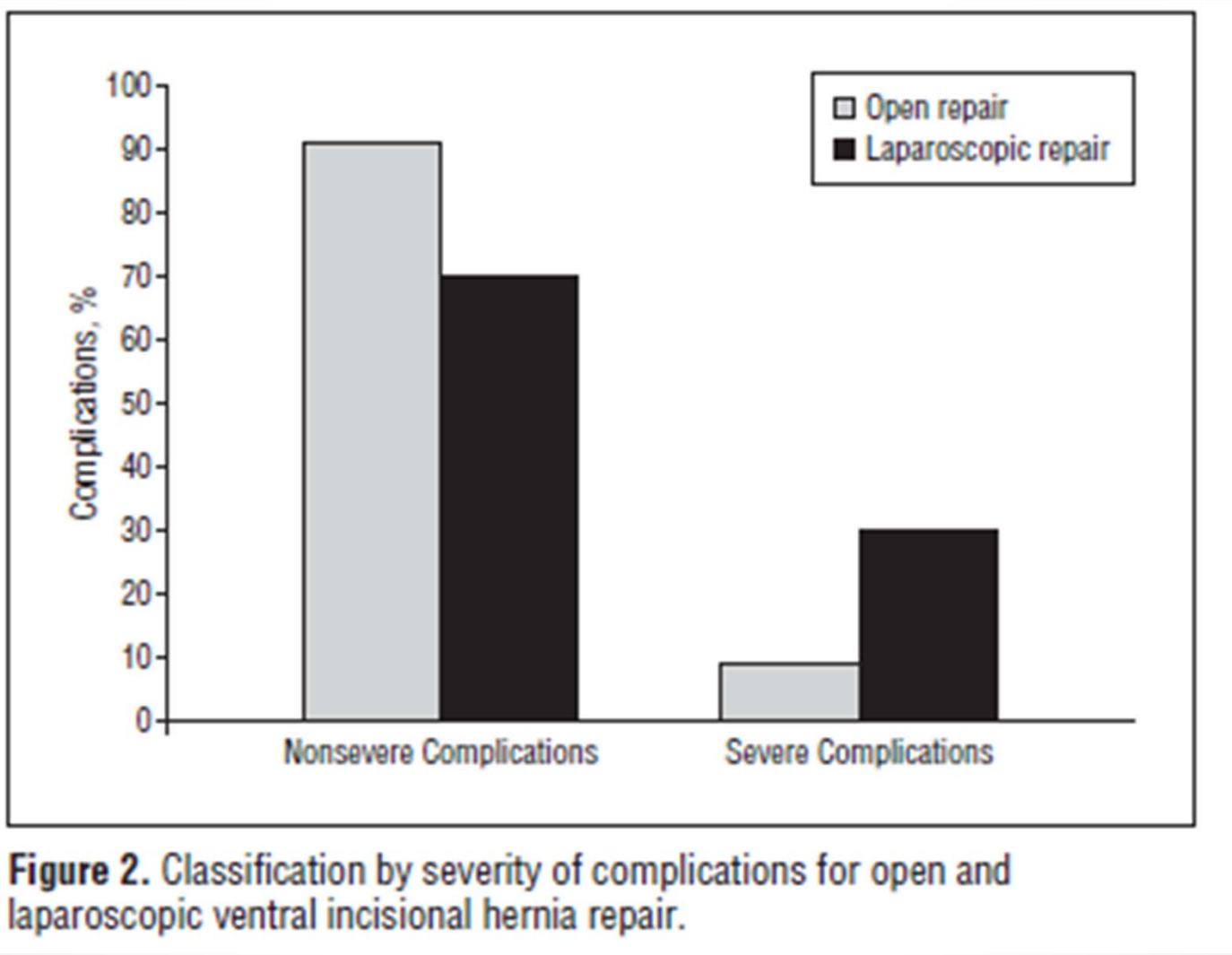


Figure 2. Classification by severity of complications for open and laparoscopic ventral incisional hernia repair.

Arch Surg. 2010 Apr;145(4):322-8;

Long-term follow-up of open and laparoscopic repair of large incisional hernias.

Table 4 Early and late morbidity

Parameter	Laparoscopy group ($n = 69$)	Open group ($n = 56$)	p*
SSI	4 (5.8%)	16 (26.8%)	0.006
Incisional, superficial	3 (4.3%)	14 (25%)	0.001
Incisional, deep organ space	1 (1.4%)	2 (3.6%)	NS
Intestinal fistula	0 (0)	1 (1.8%)	NS
Seroma	4 (5.8%)	8 (14.3%)	NS
Recurrence	11 (15.9%)	10 (17.9%)	NS
Mesh bulging	12 (17.4%)	4 (7.1%)	NS
Reoperation	17 (24.6%)	16 (28.6%)	NS.
Pain at follow-up (VAS)	0.6 (0–6)	0.5 (0–5)	NS**
Return to work (weeks)	3 (0–50)	6 (0–28)	NS**

Values are the median (range) unless otherwise indicated

SSI Surgical site infection; *VAS* visual analog scale

* Fisher's exact test unless otherwise indicated

** Student's *t*-test

Table 5 Multivariate analysis of risk factors for recurrence after large incisional hernia repair: logistic regression analysis

Factor	Odds ratio (95% CI)	p
BMI ≥30 kg/m^2	1.6 (1.1–2.5)	0.03
Surgical site infection	2.0 (1.3–3.2)	0.002
Width ≥10 cm	1.7 (1.1–2.7)	0.02
Multiple hernial orifice	0.7 (0.5–1.1)	0.14
Open technique	1.1 (0.7–1.8)	0.6

CI Confidence interval

- Abdominal bulging is a specific problem associated with laparoscopic repair of large incisional hernias.

World J Surg. 2011 Feb;35(2):297-301.

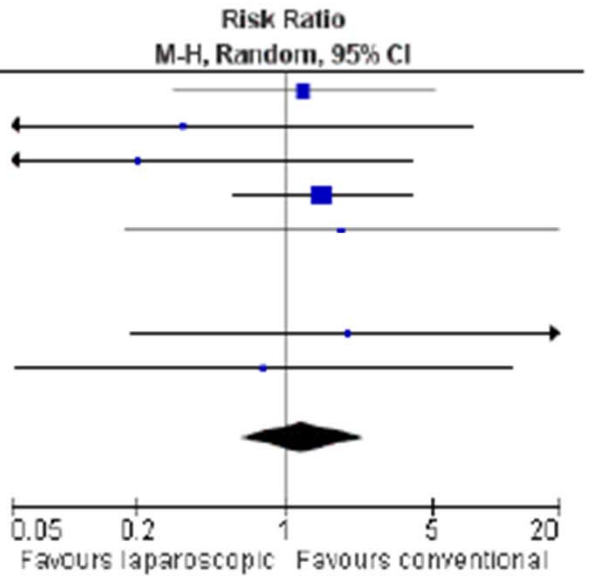
Laparoscopic versus open surgical techniques for ventral or incisional hernia repair.

Figure 3. Forest plot of comparison: 1 Laparoscopic versus open repair (overall analysis), outcome: 1.1 Hernia recurrence.

Study or Subgroup	Laparoscopic Events	Laparoscopic Total	Conventional Events	Conventional Total	Weight	Risk Ratio M-H, Random, 95% CI
Asencio 2009	4	41	3	38	21.9%	1.24 [0.30, 5.17]
Barbaros 2006	0	23	1	23	4.5%	0.33 [0.01, 7.78]
Carbajo 1999	0	30	2	30	5.0%	0.20 [0.01, 4.00]
Itani 2010	9	73	6	73	46.5%	1.50 [0.56, 4.00]
Misra 2006	2	32	1	30	8.1%	1.88 [0.18, 19.63]
Moreno-Egea 2002	0	11	0	11		Not estimable
Navarra 2007	0	12	0	12		Not estimable
Olmi 2007	2	85	1	85	7.9%	2.00 [0.18, 21.64]
Pring 2008	1	30	1	24	6.1%	0.80 [0.05, 12.14]
Total (95% CI)		337		326	100.0%	**1.22 [0.62, 2.38]**
Total events	18		15			

Heterogeneity: Tau² = 0.00; Chi² = 2.64, df = 6 (P = 0.85); I² = 0%

Test for overall effect: Z = 0.58 (P = 0.56)



Cochrane Database Syst Rev. 2011 Mar 16;(3):CD007781

Figure 5. Forest plot of comparison: 1 Laparoscopic versus open repair (overall analysis), outcome: 1.3 Any complication.

Study or Subgroup	Laparoscopic Events	Total	Conventional Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Asencio 2009	15	45	2	39	8.3%	6.50 [1.58, 26.87]
Barbaros 2006	6	23	4	23	11.3%	2.00 [0.70, 5.73]
Carbajo 1999	2	30	20	30	9.7%	0.10 [0.03, 0.39]
Itani 2010	23	73	35	73	17.8%	0.66 [0.43, 0.99]
Misra 2006	7	33	14	33	14.2%	0.50 [0.23, 1.08]
Moreno-Egea 2002	0	11	4	11	3.0%	0.11 [0.01, 1.85]
Navarra 2007	2	12	1	12	4.3%	2.00 [0.21, 19.23]
Olmi 2007	14	85	25	85	16.2%	0.56 [0.31, 1.00]
Pring 2008	11	30	13	24	16.0%	0.68 [0.37, 1.23]
Total (95% CI)		342		330	100.0%	**0.72 [0.42, 1.22]**
Total events	82		118			

Heterogeneity: Tau² = 0.37; Chi² = 24.99, df = 8 (P = 0.002); I² = 68%
Test for overall effect: Z = 1.22 (P = 0.22)

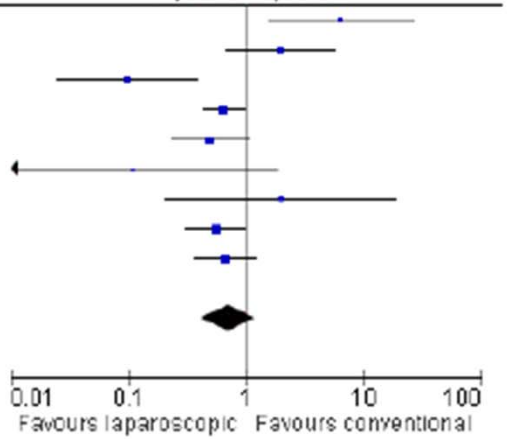
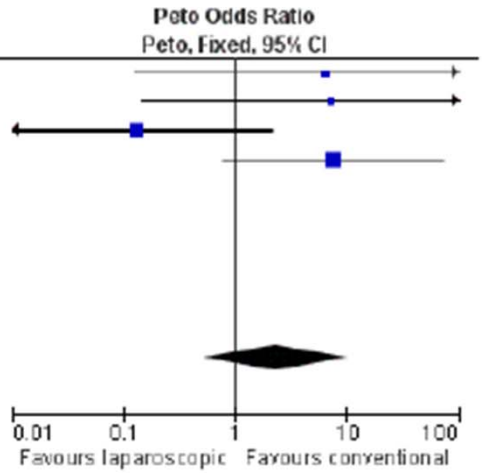


Figure 6. Forest plot of comparison: 1 Laparoscopic versus open repair (overall analysis), outcome: 1.4 Enterotomy.

Study or Subgroup	Favours laparoscopic Events	Total	Conventional Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Asencio 2009	1	45	0	39	14.4%	6.47 [0.13, 329.19]
Barbaros 2006	1	23	0	23	14.5%	7.39 [0.15, 372.38]
Carbajo 1999	0	30	2	30	28.4%	0.13 [0.01, 2.14]
Itani 2010	3	73	0	73	42.8%	7.60 [0.78, 74.21]
Misra 2006	0	33	0	33		Not estimable
Moreno-Egea 2002	0	11	0	11		Not estimable
Navarra 2007	0	12	0	12		Not estimable
Olmi 2007	0	85	0	85		Not estimable
Pring 2008	0	11	0	13		Not estimable
Total (95% CI)		323		319	100.0%	**2.33 [0.53, 10.35]**
Total events	5		2			

Heterogeneity: Chi² = 5.70, df = 3 (P = 0.13); I² = 47%
Test for overall effect: Z = 1.11 (P = 0.27)



Cochrane Database Syst Rev. 2011 Mar 16;(3):CD007781

Closure versus non-closure of fascial defects in laparoscopic ventral and incisional hernia repairs: a review of the literature

Katsuhito Suwa[1] · Tomoyoshi Okamoto[1] · Katsuhiko Yanaga[2]

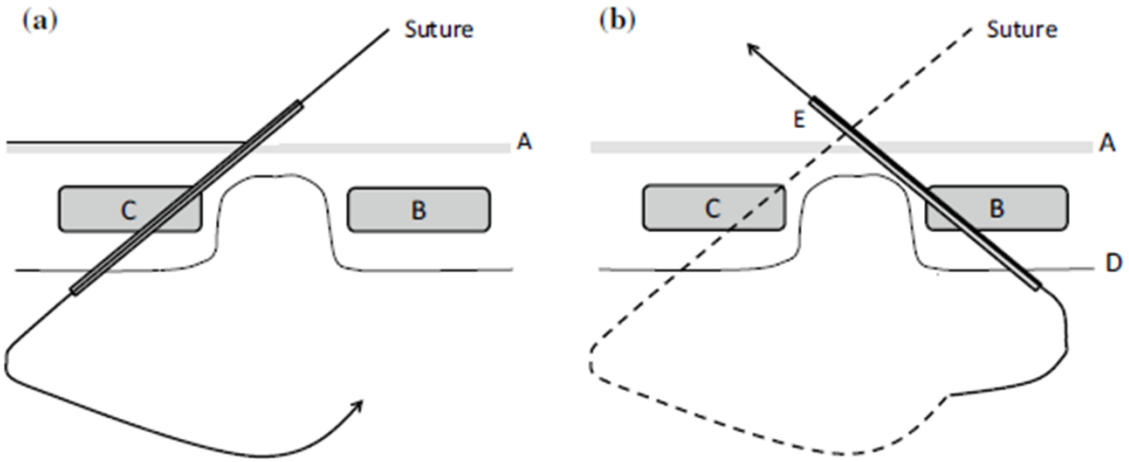


Fig. 1 The extracorporeal interrupted suture technique. A thick monofilament suture is passed through a midline skin incision through the right rectus muscle and fascia (**a**). Then, the suture is retrieved across the left rectus muscle by an EndoClose™ through the same skin incision (**b**)

Surg Today. 2015 Jul 22.

Long-term outcomes of 1326 laparoscopic incisional and ventral hernia repair with the routine suturing concept: a single institution experience.

Table 6 LIVH late complications

Total = 10.74 %	*N*	%
Chronic pain	34	2.56
Skin bulging/seroma	20	1.5
Trocar's site hernia	11	0.82
Recurrence controlled (/1101) overall recurrence (/1326) = 3.92 %	52	4.72
Chronic infection	3	0.22
Entero-cutaneous fistula	0	0
Small bowel obstruction	9	0.67
Bladder bleeding	1	0.07
Parietal lipoma/granulomas	13	0.98

Table 7 Rate of overall recurrence after LIVHR according to Chevrel and Rath's classification in 1101 controlled patients [23]

Chevrel and Rath's classification	1326 patients		1101 controlled patients		Recurrence	
	NB	%	NB	%	NB	% Out of 1101 patients
0–5 cm (W1)	329	24.81	269	24.43	11	4.09
5–10 cm (W2)	721	54.37	598	54.31	21	3.51
10–15 cm (W3)	142	10.71	121	10.99	12	9.92
>15 cm (W4)	134	10.11	113	10.26	8	7.08
Overall	1326	100	1101	100	52	4.72
Recurrent and incisional ventral hernia					38	3.45
Primary ventral hernia					14	1.27

Hernia. 2015 Jun 21.

Laparoscopic versus open ventral hernia repair in obese patients: a long-term follow-up.

Table 2 Comparison of perioperative data between laparoscopic and open ventral hernia repair

	Laparoscopic (35)	Open (151)	*p* value
Primary	8 (22.8 %)	31 (20.8 %)	0.91
Hernia size (cm^2)			
S	5 (14.2 %)	46 (30.0 %)	0.03
M	14 (40.0 %)	60 (39.7 %)	0.07
L	18 (51.0 %)	43 (28.4 %)	0.02
Operation time (min)	102 ± 42.3	67 ± 36.4	0.0001
Length of stay (days)	3.2 ± 1.75	3.8 ± 2.73	0.234
Postoperative complications	6 (17.1 %)	31 (20.5 %)	0.53
Wound infection	2 (5.7 %)	24 (15.8 %)	0.09
Follow-up achieved	33 (94.2 %)	126 (83.4 %)	0.09
Length of follow-up (months)	50.7 ± 32	62.3 ± 31	0.42
Recurrences (%)	7 (20.0 %)	41 (27.1 %)	0.28

s/m/l small-/medium-/large-sized hernias

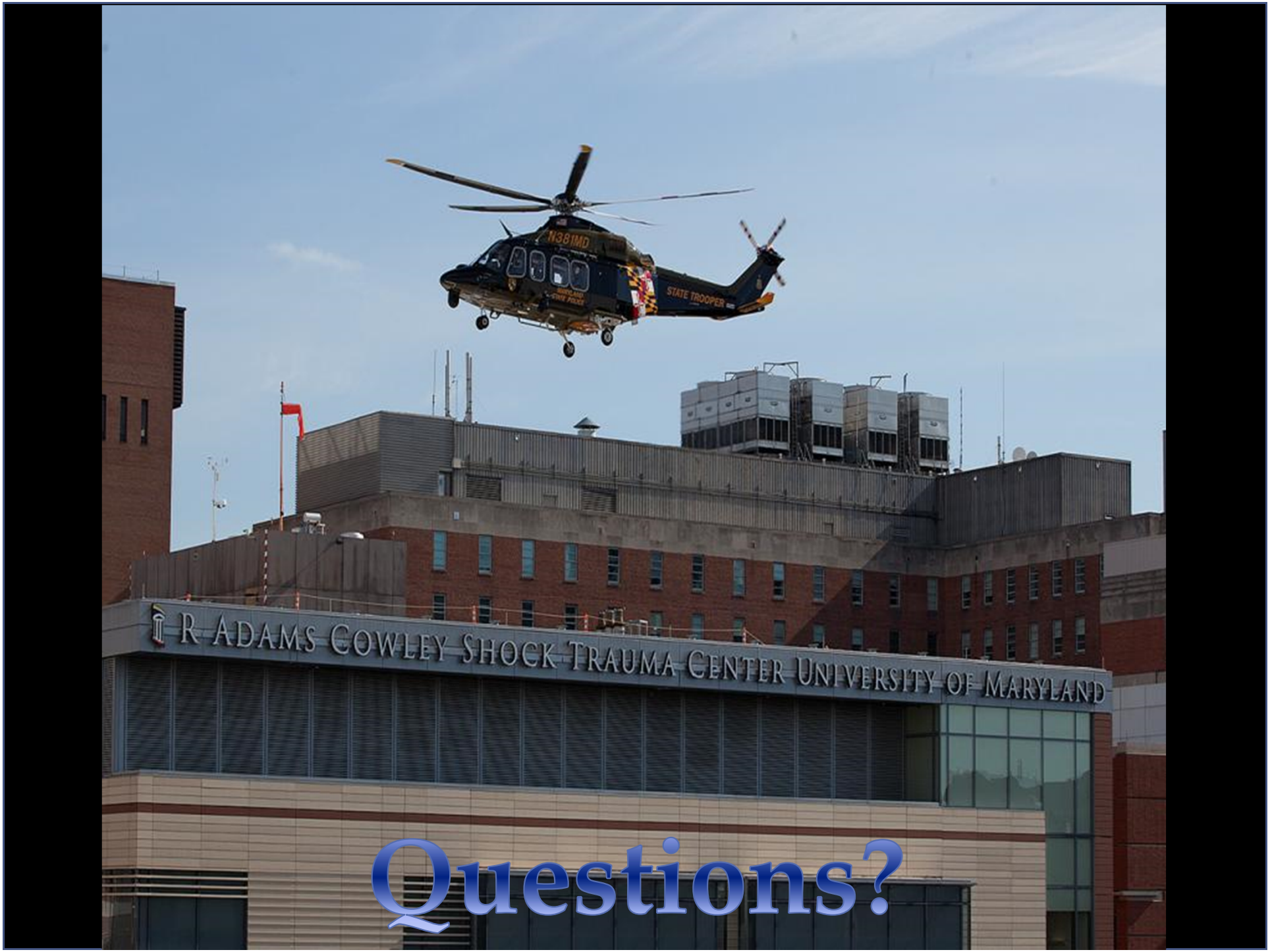
Table 3 Multivariate conditional regression analysis evaluating the correlation between recurrence and clinical parameters

Risk factor	Odds ratio	(95 % CI)	*p* value
Open repair	2.70	0.88–8.24	0.07
Sex (female)	0.92	0.39–2.15	0.85
Age (older)	0.96	0.93–0.99	0.01
BMI (kg/m^2)	1.08	0.98–1.20	0.10
Incisional hernia	−0.14	−0.29 to 2.5	0.79
ASA score (2 and 3)	3.8 and 6.3	0.63–22.97 and 0.87–45.93	0.14 and 0.06
Defect size (large)	1.03	0.34–3.09	0.94
Complications	1.35	0.53–3.43	0.51

ASA American Society of Anesthesiology, *BMI* body mass index

Conclusion

- Patient selection and Timing are key
- Pre-operative preparation starts months before
- Operative Planning
- Mesh: yes / no; what kind? Synthetic v biologic
- Surgical technique
  - Open – Rives Stoppa / Component Separation / TRAS Release
    - Minimal invasive / Endoscopic
  - Laparoscopic Ventral Hernia Repair
  - Post-operative management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Questions?