Society of American Gastrointestinal and Endoscopic Surgeons
APPLICATION COVER SHEET FOR ENDOSCOPIC/LAPAROSCOPIC RESEARCH AWARD

TITLE OF PROJECT: *Comparison of traditional anterior component separation versus posterior component separation and transversus abdominis release in a cadaveric model.*

PRINCIPAL INVESTIGATOR: **Yuri W Novitsky, MD**: University Hospitals Case Medical Center, Professor of Surgery, Director of Case Comprehensive Hernia Center, Director of Advanced GI/MIS Fellowship (SAGES Member)

AMOUNT REQUESTED: $28,270 **DUE DATE OF APPLICATION:** November 4, 2015

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START DATE OF PROJECT: Jan 2016 **END DATE OF PROJECT**: April-May 2016

CO-INVESTIGATORS:
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CHECK SHOULD BE MADE PAYABLE TO
Institution: University Hospitals, Case Medical Center, Case Western Reserve University
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STATEMENT OF FUNDS
Neither this, nor any related research projects are pending funds or have funding from at hand sources. Preliminary data were collected through division allocated research funds.

SUMMARY

Recent advances in both technology and technique in realm of ventral hernia repair / abdominal wall reconstruction have led to improvements in recurrence rates and patient outcomes across the field. With the advent of prosthetic mesh implants recurrence rates have decreased significantly compared to primary repair. Operative methods however, remain less standardized relying on expert opinion and retrospective review to guide clinical practice. There remains a lack of objective data in regards to innovations in surgical technique.

The retrorectus Rives-Stoppa repair has gained traction as the gold-standard for complex hernia repair. However, this approach can be combined with either traditional anterior component separation or more recently various posterior component separation techniques to obtain myofascial advancement for restoration of linea alba. Our clinical experience with novel transversus abdominis release (TAR) as a method of posterior component separation (PCS) has been quite favorable with low recurrence rates and low perioperative morbidity. Despite the improvements seen in our practice and the relatively widespread adoption of the technique, there is little objective data as to how our improvement in technique affects the abdominal wall from the surgical and dynamic perspective.

Our hypothesis is that compared to traditional anterior component separation (ACS) during retrorectus ventral hernia repair, posterior component separation via transversus abdominis release results in a significant improvement in the amount of fascial advancement obtained and a consequent decrease in tension required for medialization and restoration of linea alba. This dynamic benefit is coupled with creation of a large plane for sublay mesh placement while preserving the neurovascular perforators to the rectus along with avoidance of large subcutaneous flaps, all of which lead to a durable and effective repair. Based on our clinical results as well as preliminary data generated in the patient population, we believe that an objective and demonstrable improvement in terms of myofascial advancement can be evidenced in a cadaveric model. Using this data we hope to provide concrete evidence for a novel technique in massive / complex ventral hernia repair. Hopefully, continued standardization in operative technique will maintain the trend towards lower recurrence rates and improved patient outcomes mirroring those seen with advances in technology.

BACKGROUND

Incisional hernia following laparotomy occurs in 10-23% of cases[1–3]. Owing to this statistic and a growing population, ventral hernia repair represents an ever increasing number of annually performed surgical procedures, nearing 350,000 cases per year in the US[4]. Despite the ubiquity in practice, there is a lack of standardization in treatment methodology due to variability in patient presentation and hernia characteristics. Even with advances in technology and technique, recurrence rates following initial repair remain high with reported incidence of 25-

54% following primary tissue repair and up to 32% for open mesh repair in some series[5–8]. While use of mesh reinforcement has become standard practice for the vast majority of hernia repairs, with significant reductions in hernia recurrence compared to primary repair, the actual placement of mesh into the abdominal wall continues vary in location and technique utilized for deployment[9].

The Rives-Stoppa technique pioneered in the 1970s brought a paradigm shift to hernia repair with the novel placement of prosthetic mesh between the rectus abdominis muscle and the posterior rectus sheath. While the durability of this repair exceeded the standard at that time, dissection was nonetheless limited laterally by the border of the posterior rectus sheath (linea semilunaris) approximately 6-8cm from midline[10,11]. Consequently, the size of implantable mesh was limited by this plane rendering it essentially unsuitable for massive hernias with associated loss of domain. Additionally in cases with significant loss of domain, traditional Rives-Stoppa repair did not offer a large degree of myofascial advancement to allow complete restoration of the linea alba and visceral sac. Previously, techniques such as bridged or inlay repair were used to overcome these issues. More recently, advances such as component separation and preperitoneal repair were developed to address these shortcomings[12,13].

Landmark work in the 1990s by Ramirez with component separation in a cadaveric model pioneered myofascial advancement. This work has been pivotal in the modern field of hernia repair. With anterior component separation, benefits were seen with reduction in tension along the repair and myofascial advancement allowing for closure of large abdominal defects without need for prosthetic mesh[14]. Subsequent improvements seen in recurrence rates led to adoption of the Rives-Stoppa repair with component separation as the gold standard in patient care by the American Hernia Society in 2004[5,7,15].

More recently, our group developed a novel advancement to open posterior component separation (PCS) via the transversus abdominis release (TAR). After laparotomy and complete adhesiolysis, the posterior rectus sheath is incised approximately 1cm from the edge (Figure 1).

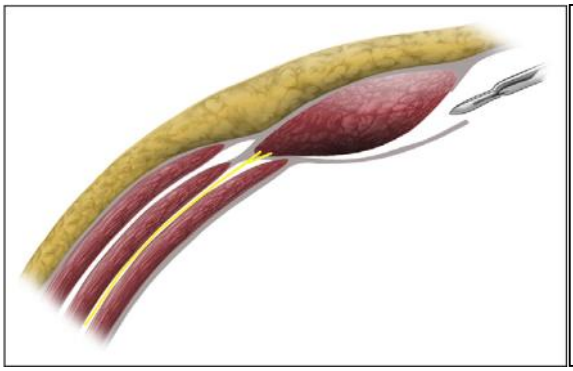


Figure 1: Incision of the posterior rectus fascia 0.5-1cm from edge.

From Novitsky et al., *Am J Surg.* 2012; 204: 709–716.

After development of the retrorectus plane as in the Rives-Stoppa repair, dissection is carried laterally past linea semilunaris. This is accomplished with incision of the posterior rectus

sheath, specifically the posterior lamina of the internal oblique fascia. The incision is made on the ventral aspect of the posterior rectus sheath, usually 0.5cm medial to the perforating neurovascular bundles to the rectus abdominis. This is also medial to the junction between anterior/posterior sheaths (linea semilunaris). This incision allows exposure of the underlying transversus abdominis muscle, which is then isolated from the underlying transversalis fascia and peritoneum with a right angle and divided along its length. The avascular plane beneath the transversus muscle is developed bluntly and carried laterally towards the psoas laterally, to the xiphoid process / diaphragm superiorly, and pubic symphysis inferiorly (Figure 2). This release allows for significant posterior sheath advancement, preservation of existing neurovascular bundles to the rectus abdominis, avoidance of subcutaneous tissue undermining and ultimately much larger area for prosthetic implantation[16].

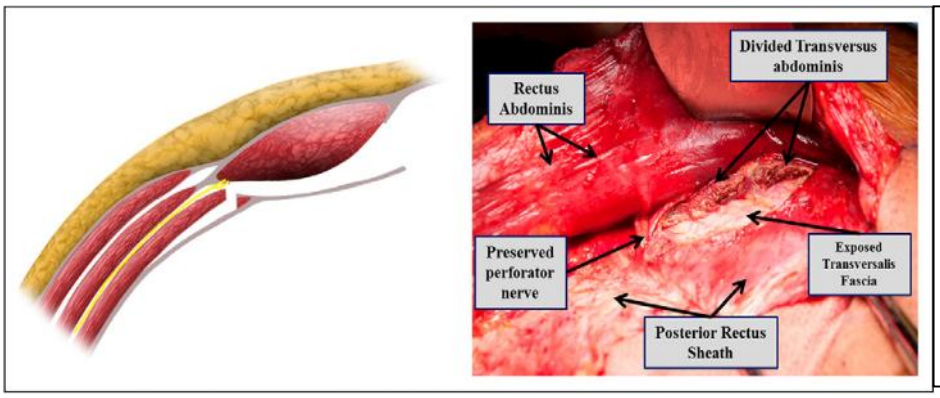


Figure 2: Division of the transversus abdominis and development of pre-transversalis/pre-peritoneal plane.

From Novitsky et al., *Am J Surg.* 2012; 204: 709–716.

We believe that this technique is superior to traditional ACS both in regards to amount of myofascial advancement obtained and reduction in tension across the repair. The improvement in myofascial advancement occurs two-fold both in anterior and posterior components as the incision of the posterior lamina of the internal oblique frees the anterior components from the posterior and allows independent advancement of both layers. In addressing massive hernias with loss of domain, added myofascial advancement may often be the difference in the ability to close an abdomen with restoration of the midline versus failure to do so. Additionally, the reduction of tension across the repair adheres to established principles of tension-free hernia repair that are common to all hernias. Finally, the location of the mesh is critical for not only excellent overlap but also in terms of avoiding intra-abdominal adhesions and infection (Figure 3). The sublay repair allows placement of mesh away from both bowel by avoiding the underlay position and infections from superficial sources that affect the onlay position[9]. Additionally the plane developed during dissection is far larger than those limited by linea semilunaris allowing placement of large prosthetic mesh for visceral sac reinforcement.

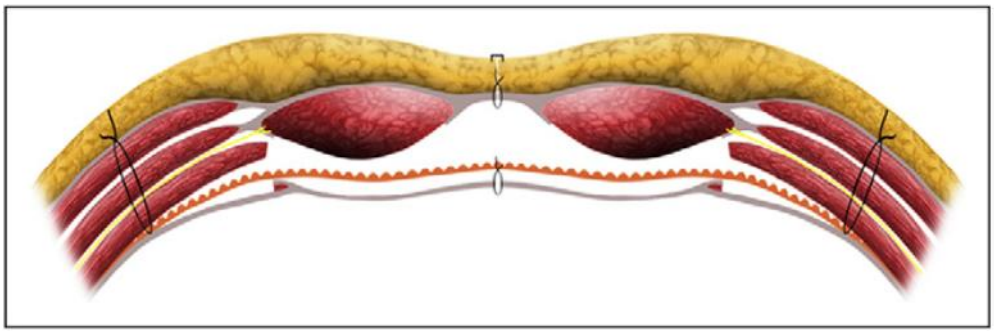


Figure 3: Deployment of mesh and re-creation of midline with closure of the anterior sheath. From Novitsky et al., *Am J Surg.* 2012; 204: 709–716.

While our published clinical results have been favorable, few objective measures exist to document the improved medialization and reduction in tension seen with PCS via TAR compared to traditional component separation. While this technique has gained traction amongst collaborating surgeons and across the hernia world, its penetrance as a standard of care has not been achieved despite its stated benefits. Ultimately practice patterns for surgeons continue to vary widely informed often by tradition or expert opinion.

We believe strongly that this method of hernia repair allows us the optimal space for deployment of mesh along with the largest amount of myofascial advancement possible. For massive and/or complex hernia repair, this may be the next step in reducing recurrence rates and mesh complications. To that end, we aim to objectively demonstrate the improvements in myofascial advancement and reduction in tension using a cadaveric model, mirroring some of the work pioneered by Ramirez in the 1990s. Hopefully our findings will add to the evolution of complex hernia repair and provide surgeons across the field objective and concrete data to determine which technique to employ when repairing complex ventral hernias. Our hope is that a broad exposure to this data will continue to improve patient outcomes with quality repair techniques being utilized across the spectrum.

PRELIMINARY WORK

In recent years there has been a shift at our institution from anterior and/or endoscopic component separation to PCS via TAR which has become standard practice during repair of massive ventral hernias. Due to the aforementioned limitations of the Rives-Stoppa repair, our modification to PCS with dissection and eventual division of the transversus abdominal muscle allows a far larger area for prosthetic mesh reinforcement of the visceral sac with excellent mesh overlap. In our recent publication we have shown a 4.7% recurrence rate at 26 months with low perioperative morbidity in the setting of a robust hernia repair[16]. Since that time we have shown the efficacy of the TAR procedure in a variety of complex patient populations including patients who previously had undergone anterior component separation[17–19].

To expand on these findings, in collaboration with Dr. William Hope, an intraoperative model was constructed to obtain tension data in patients undergoing laparotomies and open ventral hernia repairs at New Hanover Regional Medical Center (Wilmington, NC). This model

was used to obtain measurements of tension needed to bring the fascial edges to midline following laparotomy and adhesiolysis. The apparatus used consisted of two Kocher clamps placed onto the mid-portion of the fascia and tension measured with fishing scales attached to the clamps. A total of nineteen patients had abdominal wall tension measurements taken during surgery. Ventral hernia repair was performed in thirteen of the patients, eight of which had some form of component separation. Average length of the fascial incision was 21cm. Average overall tension needed to bring the fascial edge to midline was 6.7 pounds. Median tension for patients without abdominal wall hernias was less than in patients with hernias, but not significantly so (3.0 lbs vs. 5.8 lbs, p=0.3499). In those patients with abdominal wall hernias undergoing some form of component separation there was a significant difference in median abdominal wall tension prior to component separation compared to after (7.9 lbs vs. 2.5 lbs, p=0.0078).

This model showed a straightforward and replicable method by which to objectively measure improvements in fascial advancement and tension across a surgical wound during hernia repair or simply abdominal surgery. Further expansion of this data was completed with another fifteen observations, 12 (80.0%) were Caucasian and 8 (53.3%) were male, with a median age of 58.0 years (Table 1). Ten patients had at least one previous laparotomy (64.3%), and 3 (20.0%) were diabetic. No patients were taking steroids. The median incision length was 21.0 cm. The median wound length was 13.0 cm.

Table 1. Patient Characteristics

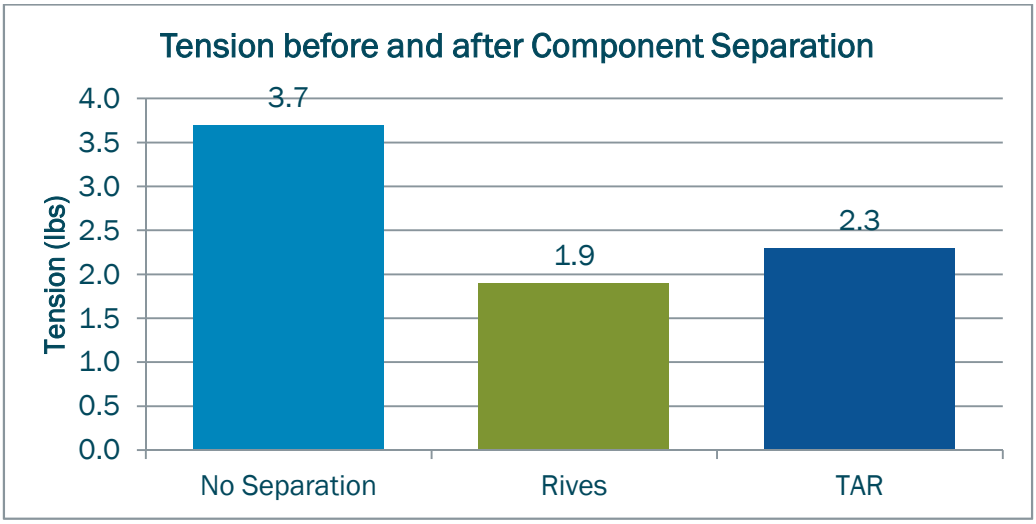
Characteristic		**N(%) or Median[Q1-Q3]**
Age		58.0 [50.0-65.0]
Gender	*Male*	8 (53.3)
	Female	7 (46.7)
Race	*Caucasian*	12 (80.0)
	African American	3 (20.0)
Previous Laparotomy (N = 14)		8 (64.3)
Diabetes		3 (20.0)
Steroids		0 (0)
Smoking Status	*Current*	3 (20.0)
	Former	5 (33.3)
	Never	7 (46.7)
Wound Length (cm)		13.0 [0.2-25.0]
Incision Length (cm)		21.0 [18.0-25.0]

There was a significant reduction in tension before component separation and after performing the Rives separation ($p = 0.0185$, Figure 4). There is a trend for reduced tension using the TAR method, but this trend was not significant ($p = 0.0918$), and there were no significant differences between the Rives and TAR methods ($p = 0.5955$). Data were analyzed with a repeated measures ANOVA, and differences between individual groups were analyzed by least square differences.

Given the small sample size and the relatively variability in patient presentation we believe that while the model is effective at reliably measuring tension, further standardization is needed to

elucidate any difference between the methods. To this end, our proposal of a cadaveric study will allow for a replicable and valid method by which to do so. We believe that this data will spur further discussion on the current standards of complex hernia repair and possibly have an impact on which surgical method is superior.

Figure 4. Tension before and after Component Separation



Given the variability in hernia presentation among patients and small sample size above, we also obtained data from a single cadaver to test our apparatus and proof of concept. Our apparatus consisted of a pulley-system with clamps attached to the fascia and both 2.5lb/5.0lb weights needed for myofascial advancement. Once laparotomy was made we attached three towel clamps to the fascia at upper, middle, and lower positions (Figure 5a). Neutral position was established on the wire of the apparatus and marked with a hemostat at the edge of the pulley (Figure 5b). Once weight is applied the new position marked again with a hemostat on the wire, the distance between hemostats is measured to obtain measurements for myofascial advancement (Figure 5c). We believe this dynamic wire measuring system allows for the most accurate and reproducible distance measurement compared to a stationary grid applied to the abdomen.

We then performed anterior component separation on the left side beginning with subcutaneous flap creation. Again advancement in measured at this point using the same method of clamps and weights. Anterior component separation is performed with release of the external oblique fascia and then release of the muscle (Figure 6a). Repeat measurements were obtained of the anterior fascia. We then moved the apparatus to the contralateral side and performed a simple retrorectus (Rives-Stoppa) dissection. Measurements were obtained for anterior and posterior layers and then posterior component separation was performed via release of the transversus abdominis. Finally measurements were obtained for both anterior and posterior components for all locations (Figure 6b).

Figure 5a: Test apparatus in place following midline laparotomy

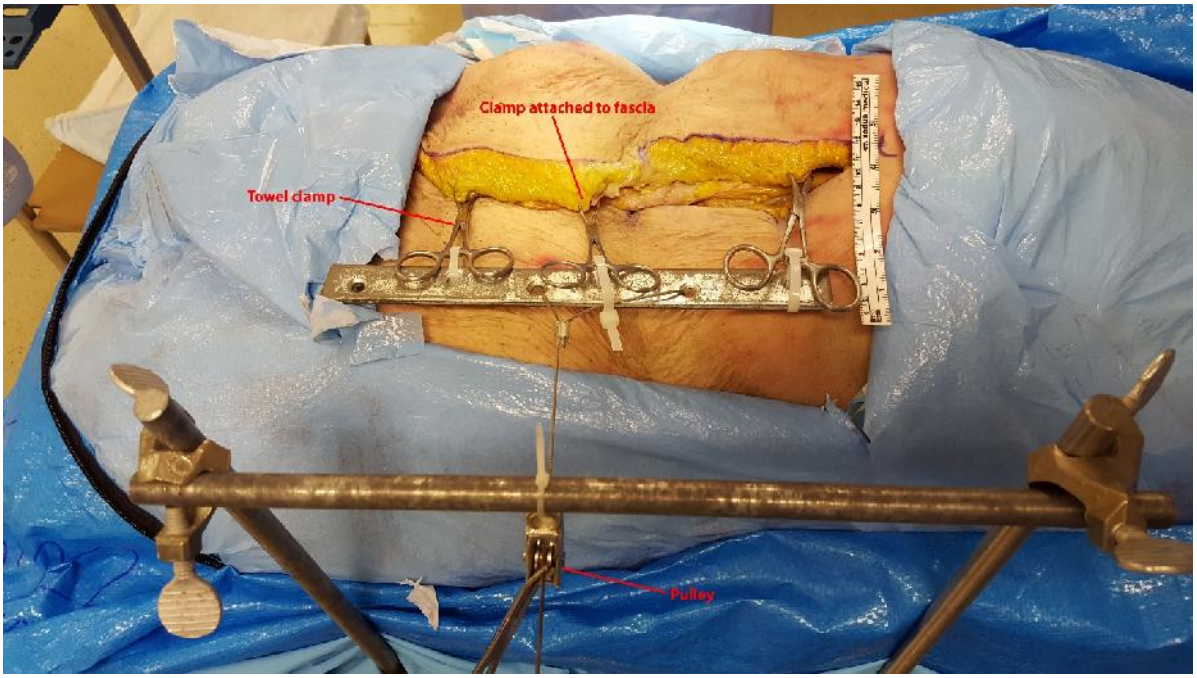


Figure 5b: Test apparatus with weight on pulley

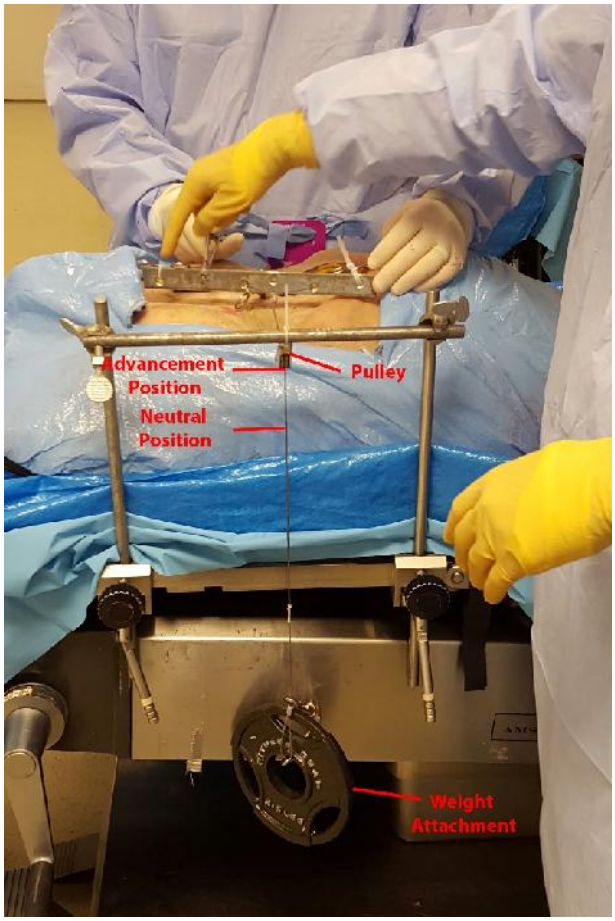
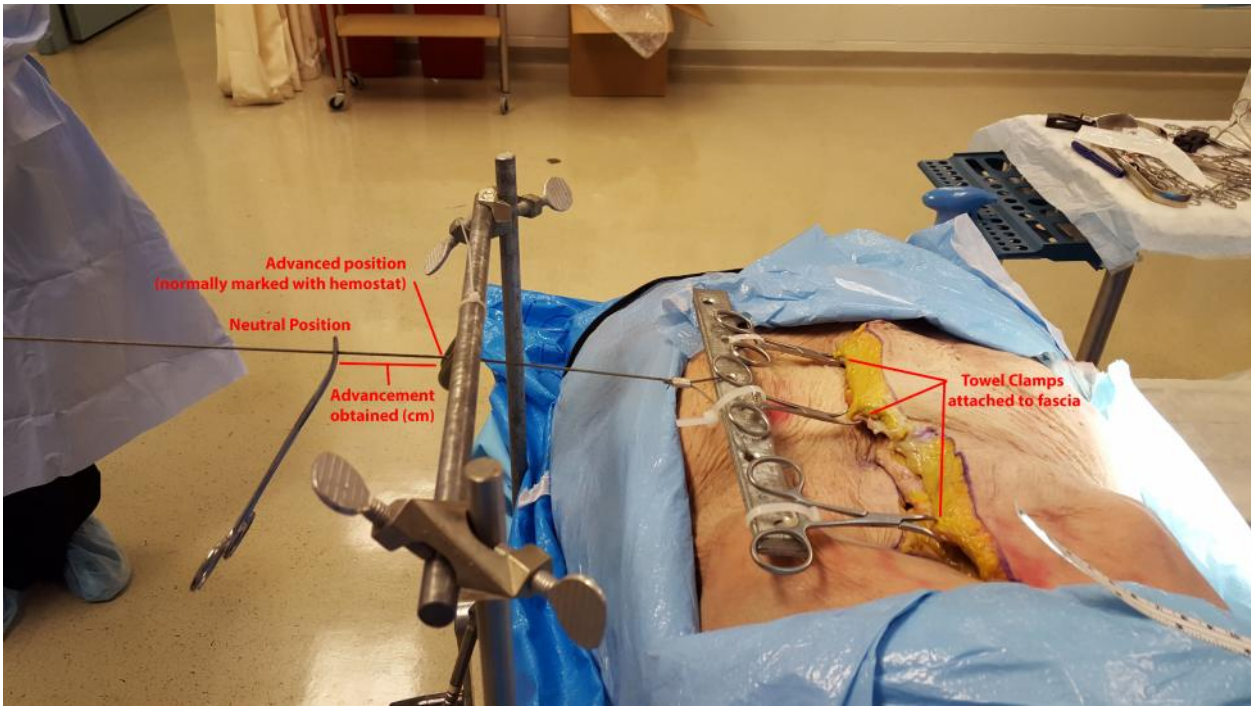


Figure 5c: Test apparatus with measurement methodology



Our test subject was a 61 year-old female with no prior abdominal surgeries. We performed a midline laparotomy and assessed advancement with 2.5 and 5.0lbs along with maximal advancement, defined as myofascial advancement at which point further tension applied does not result in further gains or fascial disruption (tearing). We obtained anterior and posterior component measurements following both anterior and posterior component separation combined with retrorectus plane development.

We found that the apparatus allowed for easy and reproducible measurement of myofascial advancement. The use of the wire for measurement removes any variability of grid or ruler placed over or under the abdominal wall as this often introduces error in establishing a neutral position and angles based on the height of the apparatus. Furthermore the use of towel clamps at three locations allows for even application of tension along the abdominal wall and allows us to note whether clamps are in the wrong position immediately as one or more may not apply any tension. We believe this model and apparatus will allow us to obtain a large amount of reproducible data and allow us to compare the various operative techniques available to surgeons. A summary of data generated from the first cadaver is listed in Table 2.

Figure 6a: Test apparatus measuring anterior component separation

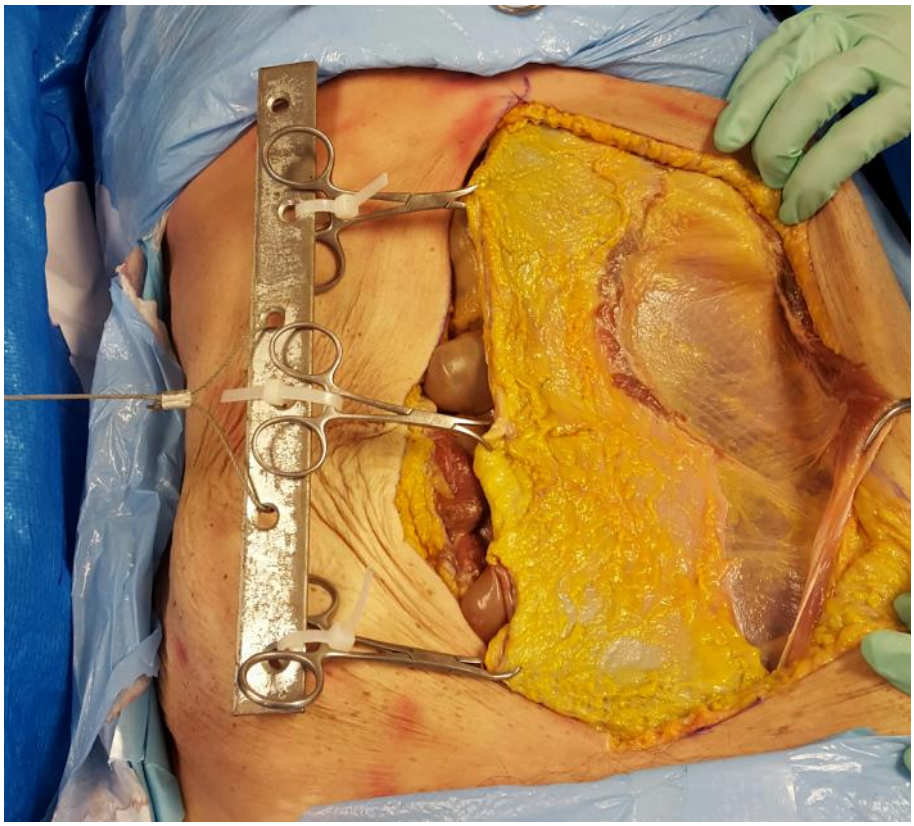


Figure 6b: Test apparatus measuring posterior component separation

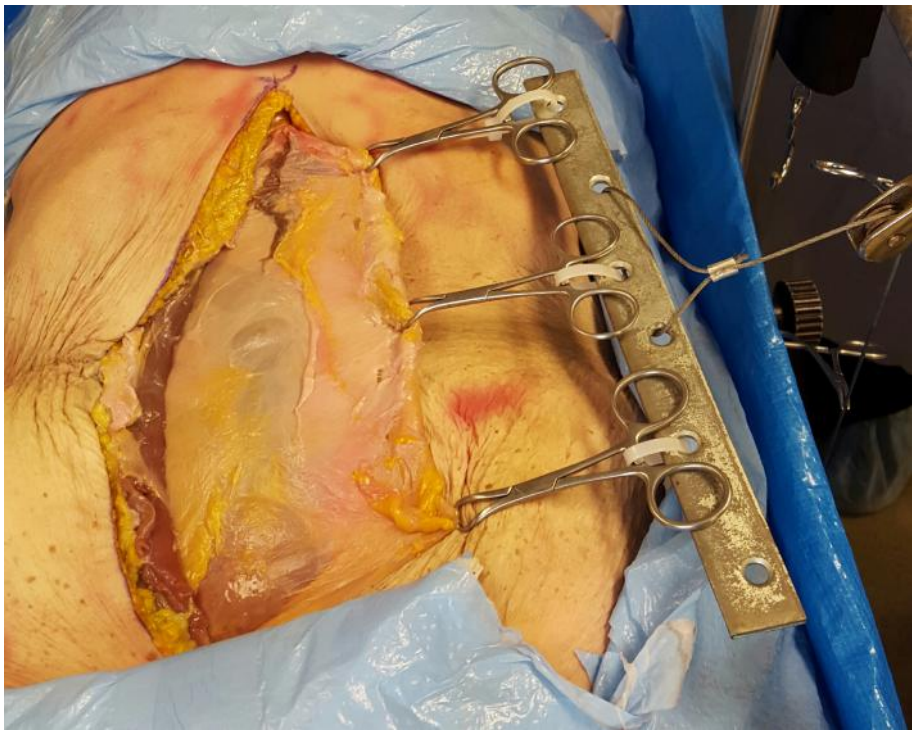


Table 2: Preliminary Data from First Cadaver (all data presented as advancement in centimeters)

	Midline Laparotomy			Anterior Component Separation					
	Whole Fascia			*Anterior Adv - SQ Flap*			*Anterior Adv - EO Release*		
	2.5lb	**5lb**	**Max**	**2.5lb**	**5lb**	**Max**	**2.5lb**	**5lb**	**Max**
Right	2.0	2.0	5.3						
Left	2.0	2.3	4.6	3.2	4.7	6.4	4.3	5.6	6.9

	Rives Stoppa (Retrorectus)					
	Anterior Advancement			*Posterior Advancement*		
	2.5lb	**5lb**	**Max**	**2.5lb**	**5lb**	**Max**
Right	2.2	3.0	6.0	4.8	6.2	8.0

	Posterior Component Separation (TAR)					
	Anterior Advancement			*Posterior Advancement*		
	2.5lb	**5lb**	**Max**	**2.5lb**	**5lb**	**Max**
Right	6.2	7.5	8.6	10.3	11.8	14.5

Our initial results reveal that in general only approximately 2cm of medialization can be obtained with nominal forces of 2.5/5lbs with a maximum of approximately 5cm following midline laparotomy. Anterior sheath advancement is extended another 2cm beyond that point following anterior component separation, less so with only subcutaneous flap creation prior to release of the external oblique. Contrastingly, limited retrorectus (Rives Stoppa) dissection does not allow for a significant amount of anterior sheath advancement and in fact anterior component separation offers better medialization. However the posterior sheath was advanced 8.0cm maximally with retrorectus plane development. Interestingly once posterior component separation via TAR was performed, the anterior sheath was able to be advanced 8.6cm compared to 6.9cm for ACS and importantly, more than 6cm was gained in posterior sheath advancement.

We believe these are promising preliminary data points worthy of further investigation. A larger sample size will allow us to determine if these isolated findings can be generalized. Furthermore we will be able to statistically compare the advancement offered along with isolation of upper, middle, and inferior portions of the abdominal wall to determine which techniques may be optimal for specific hernia locations. Additionally further testing including tensiometric analysis for force required for myofascial advancement will allow us to determine which technique offers the best reduction of tension across the closure.

HYPOTHESIS

We hypothesize that our modification of PCS with TAR during abdominal wall reconstruction allows for greater fascial advancement for both anterior and posterior components compared to traditional anterior component separation. Consequently we also believe this advancement allows for less tension needed to achieve medialization and restoration of linea alba. In concert, these two principles allow for closure of large defects with reduced tension across the repair.

SPECIFIC AIMS

- **Aim 1:** Determine maximal amount of myofascial advancement (medialization of linea alba) towards / past midline obtained for ACS versus PCS and TAR in the same specimen for whole fascia and subsequently in the sub-xiphoid, mid-abdominal, and suprapubic regions separately for both anterior and posterior components.
    - **Hypothesis:** The measured amount of advancement using PCS via TAR will exceed that of ACS combined with retrorectus repair overall.
- **Aim 2:** Compare amount of medialization obtained with standard tensile force of 2.5 and 5.0 pounds evenly applied to the fascia with each release overall and in each region (sub-xiphoid, mid-abdominal, and suprapubic).
    - **Hypothesis:** A greater amount advancement will be obtained at a standard tension of 2.5/5.0 lbs for PCS via TAR compared to ACS, implying less tension on a closed wound with PCS and TAR.
- **Aim 3:** Determine the amount of force (lbs or N) needed to advance anterior and posterior components 5cm / 10cm and beyond (if possible).
    - **Hypothesis:** A lesser amount of force will be required to advance 5/10cm for PCS via TAR compared to ACS.
- **Aim 4:** Determine any segmental advantages in advancement ACS versus PCS and TAR in sub-xiphoid, mid-abdominal, and suprapubic regions.
    - **Hypothesis:** Regardless of location in abdomen a greater amount of fascial advancement will be obtained with PCS and TAR making it the superior choice for both high and low occurring hernias.

RESEARCH METHODS

Subjects:

A total of ten fresh cadaver torsos will be obtained from UT Southwestern Willed Body Program (Dallas, TX). Exclusion criteria will be BMI>35, prior abdominal surgeries, prior abdominal trauma (penetrating or blunt requiring hospitalization), or rectus diastasis.

Procedure:

Each cadaver will have a midline laparotomy and examination of the abdomen. Any adhesions to

the abdominal wall will be taken down and recorded using the modified Diamond Adhesion Scale (0, 0%; 1, 1-25%; 2, 26-50%; and 3, > 50%). After evaluation of the abdominal contents, anterior component separation will be performed on one side of the abdomen determined randomly and posterior component separation with transversus abdominis release will be performed on the contralateral side. Additionally we will perform retrorectus plane development on both sides to allow for measurement of anterior and posterior components separately. Three Kocher or towel clamps will be placed along the fascia evenly at the quarter, midpoint, and three-quarter division. A straight metal plate with attachment points will be attached to each clamp, as seen in the test apparatus. A pulley with steel wire will connect the metal plate connected to the clamps to the weight which will hang off the side of the bed. Advancement from resting (neutral) position will be measured for the entire fascia for each side using hemostats clamped to the wire for 2.5lbs, 5.0lbs and then maximal (as defined above). Then using a Mecmesin BFG 200N Force Gauge (Slinfold, West Sussex, UK) the force needed to advance 5/10cm and beyond in 5cm increments will be measured for each side again. Finally the abdominal wall will be divided into three sections – sub-xiphoid, mid-abdominal, and supra-pubic with repeat measurements using a single clamp in each of these sections. All measurements will be performed three times to avoid discrepancies.

Statistical Analysis:

All data will be recorded and evaluated by the primary investigators along with the Biostatistics Department at Case Western Reserve University. Student's t-test and paired-sample t-test will be used to determine any significant differences. A Wilcoxon signed-rank test may be needed due to small sample size. Advancement will be compared between techniques for anterior and posterior components along with sub-sections.

Limitations and Alternatives:

One major limitation of this project will be due to the lack of live human tissue. Despite use of fresh cadavers, variances in tension will be generated compared to a live patient. While this is a limitation to the absolute numbers generated for advancement, the comparisons should be valid given the same tissue characteristics on each side of the abdomen in the cadavers. Additionally, the cadavers will not have had prior abdominal surgery or trauma to allow for some standardization of the sample, this is in departure from the many variances encountered in the clinical setting. Thus again while comparison of technique will be accomplished, the absolute tension measurements may not be clinically relevant.

Anticipated Problems:

1. Discrepancies in force data – multiple measurements will prevent single data point variability, however if further variation is encountered, this will be addressed with separate observers obtaining the data to ensure a simple difference in pulling/force applied is not the reason for variance.

2. Inability to perform complete TAR/ACS due to unforeseen cadaveric factors – we will only report data on fully operated specimens, ideally there should be no reason for inability to divide the transversus or external oblique aponeurosis, however if this is encountered, only segmental analysis will be performed on that particular sample.
3. Measurements with force will change the pliability of tissue as the experiment progresses – our preliminary model did not have much variance as the experiment progressed, but to ensure that elasticity changes have minimal effect on the measurements, we will obtain all numbers in a predetermined sequence for all specimens so any effect will be minimized.

BUDGET

SAGES RESEARCH GRANT APPLICATION
BUDGET SHEET

Cadaveric TAR - SAGES Budget

Detailed budget for 12 month period from Jan 2016 through April 2016.

Dollar amount requested (Omit cents) $29,970

Total for the grant request may not exceed $30,000.

* Salary funds should be used for staff required to execute the study, but should not be used for salary support for the primary investigator. If salary support exceeds 50% of the project budget, then specific justification is required.

**Funds requests for travel for the presentation of a SAGES funded study should be limited to $1,000.

NAME	POSITION TITLE	TIME/EFFORT		SALARY	FRINGE BENEFITS	SUB-TOTALS
		%	Hrs/ Week			
1. Yuri Novitsky, MD	Principal Investigator*	10	5			
2. Arnab Majumder, MD	Co-Investigator	60	15	n/a	n/a	-
3. Victor Sandoval, MD	Research Fellow	10	5	n/a	n/a	-
4. Ruel Neupane, BS	Medical Student	10	5	n/a	n/a	-
5. Mojtaba Fayezizadeh	Research Fellow	10	5	n/a	n/a	-
CONSULTANT COSTS	Biostatistics Department ($875), Lab Techs ($775)					$1,650.00
EQUIPMENT (List all Items&Total Equipment Cost)	Mecmesin BFG 200N Force Gauge ($820), Instruments ($125)					$945.00
SUPPLIES (List all Items&Total Supplies Cost)	Lab Space, Recording Equipment, Personal Protective Equipment, Consumables ($2625)					$2,625.00
TRAVEL**	SAGES Meeting Travel Cost ($1000)					$1,000.00
PATIENT CARE COSTS						-
CONSORTIUM/CONTRACTUAL COSTS						-
OTHER EXPENSES (List all Items & Total Cost)	Fresh Cadaver Torsos ($2375) x10					$23,750.00
TOTAL DIRECT COSTS						$29,970.00

REFERENCES

1. Itatsu, K. *et al.* Incidence of and risk factors for incisional hernia after abdominal surgery. *Br. J. Surg.* **101,** 1439–47 (2014).

2. Fink, C. *et al.* Incisional hernia rate 3 years after midline laparotomy. *Br. J. Surg.* **101,** 51–4 (2014).

3. Breuing, K. *et al.* Incisional ventral hernias: review of the literature and recommendations regarding the grading and technique of repair. *Surgery* **148,** 544–58 (2010).

4. Poulose, B. K. *et al.* Epidemiology and cost of ventral hernia repair: making the case for hernia research. *Hernia* **16,** 179–83 (2012).

5. Wheeler, a a, Matz, S. T., Bachman, S. L., Thaler, K. & Miedema, B. W. Retrorectus polyester mesh repair for midline ventral hernias. *Hernia* **13,** 597–603 (2009).

6. Burger, J. W. a. *et al.* Long-term Follow-up of a Randomized Controlled Trial of Suture Versus Mesh Repair of Incisional Hernia. *Trans. ... Meet. Am. Surg. Assoc.* **CXXII,** 176–183 (2004).

7. de Vries Reilingh, T. S. *et al.* Repair of giant midline abdominal wall hernias: 'components separation technique' versus prosthetic repair : interim analysis of a randomized controlled trial. *World J. Surg.* **31,** 756–63 (2007).

8. Awad, Z. T. *et al.* Mechanisms of ventral hernia recurrence after mesh repair and a new proposed classification. *J. Am. Coll. Surg.* **201,** 132–40 (2005).

9. Timmermans, L. *et al.* Meta-analysis of sublay versus onlay mesh repair in incisional hernia surgery. *Am. J. Surg.* **207,** 980–8 (2014).

10. Rives, J., Pire, J. C., Flament, J. B., Palot, J. P. & Body, C. [Treatment of large eventrations. New therapeutic indications apropos of 322 cases]. *Chirurgie* **111,** 215–25 (1985).

11. Stoppa, R. E. The treatment of complicated groin and incisional hernias. *World J. Surg.*

13, 545–54

12. Novitsky, Y. W. *et al.* Open preperitoneal retrofascial mesh repair for multiply recurrent ventral incisional hernias. *J. Am. Coll. Surg.* **203,** 283–9 (2006).

13. Ramirez, O. M., Ruas, E. & Dellon, A. L. 'Components separation' method for closure of abdominal-wall defects: an anatomic and clinical study. *Plast. Reconstr. Surg.* **86,** 519–26 (1990).

14. Heller, L., McNichols, C. H. & Ramirez, O. M. Component separations. *Semin. Plast. Surg.* **26,** 25–8 (2012).

15. Krpata, D. M., Blatnik, J. a, Novitsky, Y. W. & Rosen, M. J. Posterior and open anterior components separations: a comparative analysis. *Am. J. Surg.* **203,** 318–22; discussion 322 (2012).

16. Novitsky, Y. W., Elliott, H. L., Orenstein, S. B. & Rosen, M. J. Transversus abdominis muscle release: a novel approach to posterior component separation during complex abdominal wall reconstruction. *Am. J. Surg.* **204,** 709–16 (2012).

17. Petro, C. C. *et al.* Transversus abdominis muscle release for repair of complex incisional hernias in kidney transplant recipients. *Am. J. Surg.* **210,** 334–9 (2015).

18. Petro, C. C. *et al.* Posterior component separation and transversus abdominis muscle release for complex incisional hernia repair in patients with a history of an open abdomen. *J. Trauma Acute Care Surg.* **78,** 422–9 (2015).

19. Pauli, E. M. *et al.* Posterior component separation with transversus abdominis release successfully addresses recurrent ventral hernias following anterior component separation. *Hernia* **19,** 285–91 (2015).

Local/Institutional Review Board

Approval has been obtained from our IRB to conduct a cadaveric study using the aforementioned model.

Available Resources

Laboratories

Department of Surgery Skills Laboratory at Case Animal Resource Center (ARC)

The Department of Surgery is assigned space in the Biomedical Research Building at Case Western Reserve University School of Medicine for large animal survival or non-survival procedures as well as cadaver studies with bench and office space. The Animate Skills Laboratory is an 1800 sq ft surgical area equipped with eight surgical stations used both for research and training courses. Each station includes a fully adjustable patient table, anesthesia, ventilator, monitor, suction and electrocautery. Each station can be used for open, laparoscopic or endoscopic procedures. Training courses have been conducted in laparoscopic colorectal surgery, laparoscopic hernia surgery, advanced endoscopic skills, Oncoplastic breast surgery, Natural Orifice (NOTES) surgery, ERCP techniques and others. The lab is also equipped with a cardiopulmonary bypass machine, cardiac output computer, ACT machine and blood gas analyzer. The Department has an additional 400 sq ft wet lab and office space. The labs are immediately adjacent to the Animal Resource Center which provides sterile survival operating suites, additional equipment and supplies and veterinary and husbandry support. In this project, we will use the facilities for dissection and work with cadavers.

Core Facilities

Computer

There is a complete computer network linking all involved facilities and hardware connections to the parent CWRU system is available to all personnel for scientific writing, editing, and data sharing. It is equipped with a complete set of word processing programs, and access to all experiment data and an in-house reference library is also provided. Access to the MEDLINE literature database is also available to every computer.

Equipment

The above core facilities and laboratories will provide all necessary equipment for our proposed study. The Mecmesin Force Gauge will be funded through the grant.

Project Role: Investigator

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME Novitsky, Yuri William	POSITION TITLE Professor of Surgery, Director, Case Comprehensive Hernia Center Director, Surgical Research, Department of Surgery
eRA COMMONS USER NAME YNOVIT	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
New York University, New York, NY	BA	1990-1993	Biology
Albany Medical College, Albany, NY	MD	1993-1997	Medicine
The Mount Sinai Medical Center, New York, NY		1997-1999	Surgery Resident
UMass Medical Center, Worcester, MA		1999-2004	Surgery Resident
Carolinas Medical Center, Charlotte, NC		2004-2006	Laparoscopic Fellow

A. A. Personal Statement

I am a Professor of Surgery, Director of Case Comprehensive Hernia Center and the Director of Surgical Research at the University Hospitals Case Medical Center. I am an experienced surgeon specializing in laparoscopic surgery and hernia repairs. I published over 60 relevant peer-reviewed publications and 11 book chapters, and has given more than 70 oral, poster and video presentations and invited lectures on surgical hernia repair. I have been a PI on an NIH-sponsored work investigating/developing a novel bioadhesive construct for a hernia mesh. I also received a SAGES grant in 2013 to investigate local genetic modulation of lower esophageal sphincter and diaphragm crura for the treatment of gastric esophageal reflux disease.

B. Positions and Honors.

PROFESSIONAL EXPERIENCE

2000-2002 University of Massachusetts Medical Center, Research Fellow, Minimally-invasive surgery
2004-2006 Carolinas Medical Center, Charlotte, NC, Research/Clinical Fellow, Minimally-invasive surgery
2006-2007 University of Connecticut Health Center, Farmington, CT, Chief of Laparoscopic Surgery
2007-2010 University of Connecticut Health Center, Farmington, CT, Director, CT Comprehensive Hernia Center
2011-present University Hospitals Case Medical Center, Cleveland, OH, Director, Surgical Research, Department of Surgery
2011-present University Hospitals Case Medical Center, Cleveland, OH, Co-Director, Case Comprehensive Hernia Center

SELECTED HONORS AND AWARDS

2010-2012 Marquis "Who's Who in Science and Engineering"
2008, 2009, 2010 Patients' Choice Award, Top 5% Surgery Physician in Connecticut, MDx Medical, Inc.
2008-2012 Marquis "Who's Who in America"
2008 Young Investigator Award, World Congress of Endoscopic Surgery
2006 Exhibit Advisory Council Award, SAGES
2004 Gold Medal Forum, Southeastern Surgical Congress
2004 Best Oral Presentation - Finalist, European Association of Endoscopic Surgery
2003, 2004, 2005 Poster of Distinction, Society of American Gastrointestinal Endoscopic Surgeons
2001 Resident Achievement Award, Society of Laparoendoscopic Surgeons

1993 Magna Cum Laude, New York University

1993 Phi Beta Kappa, New York Chapter

SOCIETIES

American Hernia Society	2007
Association for Academic Surgery	2005
American College of Surgeons	2003
Society of American Gastrointestinal Endoscopic Surgeons	2000
Society for Surgery of the Alimentary Tract	2001

C. Publications

Selected peer-reviewed publications (29 of 87).

1. Orenstein SB, Dumeer JL, Monteagudo J, Poi MJ, **Novitsky YW**. Outcomes of Laparoscopic ventral hernia repair with routine defect closure using "Shoelace" technique. Surgical Endoscopy. 2011;25:1452-1457
2. Blatnik JA, Krpata DM, **Novitsky YW**, Rosen MJ. Does a history of wound infection predict postoperative surgical site infection after ventral hernia repair? Am J Surg. 2012; 203(3):370-4
3. Krpata DM, Blatnik JA, **Novitsky YW**, Rosen MJ. Posterior and open anterior components separations: a comparative analysis. Am J Surg. 2012;203(3):318-22.
4. Orenstein SB, Saberski ER, Kreutzer DL, **Novitsky YW**. Comparative analysis of histopathologic effects of implanted synthetic meshes based on material type, weight and pore size. Journal of *Surgical Research*, 2011
5. Krpata DM, Schmotzer BJ, Flocke S, Jin J, Blatnik JA, Ermlich B, **Novitsky YW**, Rosen MJ. Design and Initial Implementation of HerQLes: A Hernia-Related Quality-of-Life Survey to Assess Abdominal Wall Function. J Am Coll Surg. 2012 Nov;215(5):635-42.
6. Hicks CW, Krpata DM, Blatnik JA, **Novitsky YW**, Rosen MJ. Long-term effect on donor sites after components separation: a radiographic analysis. Plast Reconstr Surg. 2012 Aug;130(2):354-9.
7. Blatnik JA, Krpata DM, Pesa NL, Will P, Harth KC, **Novitsky YW**, Rowbottom JR, Rosen MJ. Predicting Severe Postoperative Respiratory Complications following Abdominal Wall Reconstruction. Plast Reconstr Surg. 2012 Oct;130(4):836-41.
8. Krpata DM, Blatnik JA, Harth KC, Phillips MS, **Novitsky YW**, Rosen MJ. Evaluation of fibrin sealant for biologic mesh fixation at the hiatus in a porcine model. Surg Endosc. 2012 Nov;26(11):3120-6
9. **Novitsky YW**, Rosen MJ. The biology of biologics: basic science and clinical concepts. Plastics and Reconstructive Surgery 2012;130:9S-17S.
10. Orenstein SB, Saberski ER, Kreutzer DL, **Novitsky YW**. Comparative analysis of histopathologic effects of synthetic meshes based on material, weight, and pore size in mice. Journal of Surgical Research 2012;176:423-9.
11. **Novitsky YW**, Elliott HL, Orenstein SB, Rosen MJ. Transversus abdominis muscle release: a novel approach to posterior component separation during complex abdominal wall reconstruction. American Journal of Surgery 2012;204:709-16.
12. Krpata DM, Blatnik JA, **Novitsky YW**, Rosen MJ. Evaluation of high-risk, co-morbid patients undergoing open ventral hernia repair with synthetic mesh. Surgery 2013;153:120-5.
13. Krpata DM, Stein SL, Eston M, Ermlich B, Blatnik JA, **Novitsky YW**, Rosen MJ.. Outcomes of simultaneous large complex abdominal wall reconstruction and enterocutaneous fistula takedown. American Journal of Surgery. 2013;205:354-9.
14. Sadava EE, Krpata DM, Gao Y, **Novitsky YW**, Rosen MJ. Does presoaking synthetic mesh in antibiotic solution reduce mesh infections? An experimental study. J Gastrointestinal Surgery 2013;17:562-8.
15. Sadava EE, Krpata DM, Gao Y, Schomisch S, Rosen MJ, **Novitsky YW**. Laparoscopic mechanical fixation devices: does firing angle matter? Surg Endosc 2013;27(6):2076-81.
16. **Novitsky YW**. Biology of biological meshes used in hernia repair. Surgical Clinics of North America. 2013;93(5):1211-5.
17. **Novitsky YW**, Orenstein SB. Effects of patient and hospital characteristics on outcomes of elective ventral hernia repair in the United States. Hernia. 2013;17(5):639-645

18. Pauli EM, Krpata DM, **Novitsky YW**, Rosen MJ. Negative Pressure Therapy for High-Risk Abdominal Wall Reconstruction Incisions. Surg Infect (Larchmt). 2013;14(3):270-4
19. Krpata DM, Criss CN, Gao Y, Sadava EE, Anderson JM, **Novitsky YW**, Rosen MJ. Effects of weight reduction surgery on the abdominal wall fascial wound healing process. Journal of Surgical Research. 2013;184(1):78-83.
20. De Silva GS, Krpata DM, Hicks CW, Criss CN, Gao Y, Rosen MJ, **Novitsky YW**. A comparative radiographic analysis of changes in the abdominal wall musculature morphology after open posterior component separation or laparoscopic ventral hernia repair. Accepted to Journal of the American College of Surgeons. 2014;218(3):353-7
21. **Novitsky YW**, Orenstein SB, Kreutzer DL. Comparative analysis of histopathologic responses to implanted porcine biologic meshes. Hernia. 2014 Oct;18(5):713-21
22. Petro C, Criss CN, **Novitsky YW**, Rosen MJ. Central failures of lightweight monofilament polyester mesh causing hernia recurrence: a cautionary note. Hernia. 2014 Mar 23.
23. Criss CN, Gao Y, De Silva G, Yang J, Anderson JM, **Novitsky YW**, Soltanian H, Rosen MJ. The effects of Losartan on abdominal wall fascial healing. Hernia. Apr 23.
24. De Silva GS, Krpata DM, Criss CN, Gao Y, Soltanian H, Anderson JA, Rosen MJ, **Novitsky YW**. Lack of identifiable biologic behavior in a series of porcine mesh explants. Surgery. 2014;156(1):183-9
25. Gao Y, Criss CN, Sadava EE, Krpata DM, De Silva GS, Anderson JA, **Novitsky YW**. Effects of mesenchymal stem cell and fibroblast coating on immunogenic potential of prosthetic meshes in vitro. Surgical Endoscopy. 2014;28(8):2357-67.
26. Fayezizadeh M, Petro CC, Rosen MJ, **Novitsky YW**. Enhanced recovery after surgery pathway for abdominal wall reconstruction: pilot study and preliminary outcomes. Plast Reconstr Surg. 2014 Oct;134(4 Suppl 2):151S-9S
27. Raigani S, De Silva GS, Criss CN, **Novitsky YW**, Rosen MJ. The impact of developing a comprehensive hernia center on the referral patterns and complexity of hernia care. Hernia. 2014 Oct;18(5):625-30.
28. Raigani S, Criss CN, Petro CC, Prabhu AS, **Novitsky YW**, Rosen MJ. Single-center experience with parastomal hernia repair using retromuscular mesh placement. J Gastrointest Surg. 2014 Sep;18(9):1673-7
29. Criss CN, Petro CC, Krpata DM, Seafler CM, Lai N, Fiutem J, **Novitsky YW**, Rosen MJ. Functional abdominal wall reconstruction improves core physiology and quality-of-life. Surgery. 2014 Jul;156(1):176-82.

BOOKS EDITED

1. Robert Kozol, **Yuri Novitsky** (editors). *Surgical Mentor*. Philadelphia: F.A. Davis Publishing Company, 2009.

BOOK CHAPTERS (10 of 22)

1. Harrell AG, **Novitsky YW**, Kercher KW, Heniford BT. Ventral Herniations in Adults. In: *Shackelford's Surgery of the Alimentary Tract*, 6th Edition. Yeo CJ, Dempsey DT, Klein, Pemberton JH, Peters JH, editors. Philadelphia: W. B. Saunders, 2006. Chapter 46, pages 401– 417.
2. **Novitsky YW,** Paton BL, Heniford BT. Laparoscopic ventral hernia repair. In: *Operative Techniques in General Surgery: Techniques of Laparoscopic Hernia Repair.* Koltun W, editor. New York: Elseiver, Inc, 2006. Chapter 3, pages 4-9.
3. **Novitsky YW**, Harrell AG, Hope WW, Kercher KW, Heniford BT. Meshes in hernia repair. In: *Surgical Technology International XVI.* Szabo Z, Coburg AJ, Savalgi RS, Reich H, editors. Universal Medical Press, Inc., 2007, pages 123-127.
4. **Novitsky YW.** Open Retromuscular Ventral Hernia Repair. In: *Atlas of Abdominal Wall Reconstruction*, Rosen MJ ed, Saunders 2011, Chapter 5, pages 74-95
5. Orenstein SB**, Novitsky YW.** Synthetic Mesh Choices for Hernia Repair. In: *Atlas of Abdominal Wall Reconstruction*, Rosen MJ ed, Saunders 2011, Chapter 19, pages 322-328.
6. Orenstein SB**, Novitsky YW.** Synthetic Mesh Choices for Hernia Repair. In: *Atlas of Abdominal Wall Reconstruction*, Rosen MJ ed, Saunders 2011, Chapter 19, pages 322-328.
7. **Novitsky YW**. Transversus Abdominis Release (TAR) for Posterior Component Separation and Retromuscular Repair. In: *Advances in Abdominal Wall Reconstruction*. Losken A, Janis JE eds, Quality Medial Publishing 2012. Chapter 11, pages 215-232

8. **Novitsky YW**. Bridging Versus Closing the Defect during Laparoscopic Ventrl Hernia Repair. In: *The SAGES Manual of Hernia Repair*, Jacob BP, Ramshaw B, eds. Springer 2012. Chapter 39, pages 439-444.
9. Fathi A**, Novitsky YW**. *Laparoscopic Repair of Recurrent Inguinal Hernias*. In: Current Surgical Therapies, 11th Edition, Cameron ed, 2013, in press
10. Elliot HL, **Novitsky YW**. *Laparoscopic Inguinal Hernia*. In: Netter's Surgical Anatomy and Approaches, Delaney C, ed, Philadelphia: Saunders, 2013, Chapter 29, pages 355-366

Selected national/international scientific presentations (18 of 91)

1. **Novitsky YW**, Kercher KW, Romanelli JR, Kelly JJ, Callery MP, Litwin DEM. Is the use of a bougie necessary for a safe and effective laparoscopic Nissen fundoplication? New England Surgical Society. Providence, RI, 2001.
2. **Novitsky YW**, Czerniach DR, Kaban GK, Perugini RA, Kelly JJ, Litwin DEM. Decreased activation of peritoneal macrophages following hand-assisted versus open surgery in a porcine model. Society of American Gastrointestinal Endoscopic Surgeons. Denver, CO, April 2004.
3. **Novitsky YW**, Czerniach DR, Kaban GK, Wheeler S, Kelly JJ, Litwin DEM**.** Decreased activation of systemic immunity by hand-assisted surgery: comparison to open and laparoscopic approaches. European Association of Endoscopic Surgery. Barcelona, Spain, June 2004.
4. **Novitsky YW**, Sing RF, Kercher KW, Griffo ML, Matthews BD, Heniford BT. Prospective evaluation of accuracy of operative reports dictated by surgical residents. Southeastern Surgical Congress. New Orleans, LA, 2005.
5. **Novitsky YW**, Kercher KW, Harrell AG, Rosen MJ, Jyothinagaram S. Heniford BT. Clinical outcomes of laparoscopic adrenalectomy for lateralizing nodular adrenal hyperplasia. American Association of Endocrine Surgeons, Cancun, Mexico, April 2005.
6. **Novitsky YW**, Porter JR, Rucho ZC, Sing RF, Kercher KW, Heniford BT. Open preperitoneal repair of multiply recurrent ventral incisional hernias. Southeastern Surgical Congress, Boca Raton, FL, February 2006.
7. **Novitsky YW,** Wong J, Kercher KW, Litwin DEM, Swanstrom LL, Heniford BT. Severely disordered esophageal peristalsis is not a contraindication to laparoscopic Nissen fundoplication. Society of American Gastrointestinal Endoscopic Surgeons, Dallas, TX, April 2006.
8. **Novitsky YW,** Cristiano JA, Harrell AG, Norton JH, Kercher KW, Heniford BT. Immunohistochemical analysis of host reaction to heavy-weight, reduced-weight, and polytetrafluoroethylene-based meshes after short- and long-term implantations. Society of American Gastrointestinal Endoscopic Surgeons, Las Vegas, NV, April 2007.
9. **Novitsky YW**, Czerniach DR, Perugini RA, Yood SM, Kercher KW, Gallagher KA, Callery MP, Litwin DEM**,** Kelly JJ. Prospective randomized trial of mini-port versus conventional laparoscopic cholecystectomy. Poster at the Society for Surgery of the Alimentary Tract. San Francisco, CA, May 2002.
10. Orenstein SB, Qiao Y, Klueh U, Kreutzer DP, **Novitsky YW**. Role of mast cells in the biocompatibility of synthetic mesh. American/European Hernia Societies meeting, Berlin, Germany, September, 2009.
11. **Novitsky YW**, Stapleton RT, Scott JR. Antimicrobial efficacy of a minocycline/rifampin composite mesh coating in a rabbit model of open ventral hernia repair. World Congress of Endoscopic Surgery, San Antonio, TX, March 2011.
12. Criss CN, Krpata DM, Gao Y, Sadava E, **Novitsky YW**, Rosen MJ. The Effects Of Weight Reduction Surgery On The Abdominal Wall Wound Healing Process. Academic Surgical Congress, New Orleans, LA, February 2013.
13. Gao Y, Krpata DM, Anderson JM, Rosen MJ, **Novitsky YW,** Influence of Fibroblast and Mesenchymal Stem Cell Mesh Coating on Prosthetic's Biocompatibility and Ingrowth. Academic Surgical Congress, New Orleans, LA, February 2013.
14. Criss CN, Krpata DM, De Silva G, Fuitem J, **Novitsky YW,** Rosen MJ. Ventral hernia impedes abdominal wall musculature function. American Hernia Society, Orlando, FL, March 2013.
15. Gao Y, Criss CN, De Silva G, Rosen MJ, **Novitsky YW**. Cell-coating abolishes the difference in tissue integration between onlay and underlay mesh implantation. American Hernia Society, Orlando, FL, March 2013.
16. **Novitsky YW,** De Silva G, Krpata DM, Gao Y, Criss CN, Anderson JM, Rosen MJ. Lack of intended biologic behavior in a series of porcine mesh explants. American Hernia Society, Orlando, FL, March 2013.

17. Gao Y, Krpata DM, Blatnik JA, Criss CN, Anderson JM, Rosen MJ, **Novitsky YW.** Influence of fibroblast and mesenchymal stem cell mesh coating on prosthetic's long-Term ingrowth. American College of Surgeons, Washington, DC, October 2013.
18. Cavallo JA, Criss CN. Poulose BK, Matthews BD, Cobb WS, Carbonell AM, **Novitsky YW.** Rosen MJ. A Multicenter Prospective Observational Cohort Study of Permanent Synthetic Mesh Versus Biologic Mesh Reinforcement for Open Ventral Hernia Repair in Clean-Contaminated and Contaminated Surgical Sites. American College of Surgeons, Washington, DC, October 2013.

D. Research Support

Ongoing Research Support

SAGES Research Grant, 2013, $$27,781
Local Genetic Modulation of Lower Esophageal Sphincter and Diaphragm Crura for the Treatment of Gastric Esophageal Reflux Disease.
Project Role: Principal Investigator

Society of American Gastrointestinal Endoscopic Surgeons, 2013.$29,960 PI: Cavallo JA
A Multi-Institutional Randomized Controlled Trial to Evaluate the Comparative Effectiveness of Permanent Synthetic Mesh Versus Biologic Mesh in Clean-Contaminated and Contaminated Ventral Hernia Repair
Project Role: Co-Investigator

Completed Research Support

R44DK083199, 2009, $1,837,125, Novitsky/Lee (M-PI).
National Institutes of Health – NIDDK
"Bioadhesive Membrane Construct for Hernia Repair"
Role: Principal Investigator

Biomerix, Inc; 2009. $60,858
In-Vivo Evaluation of a Novel Composite Prosthetic Mesh in a Rabbit Ventral Abdominal Wall Model
Project Role: PI

Covidien Corporation, 2009. $82,000. PI: Rosen MJ.
Evaluation of postoperative pain following laparoscopic hernia repair.
Project Role: Site PI

Nerites Corporation, 2009, $102,000
Novel Adhesives for mesh fixation
Project Role: PI

National Institute of Health, SBIR Grant, 2008. $116,307. PI: Lee BP.
Bioadhesive membrane construct for hernia repair.
Project Role: Consultant

UConn Health Center Research Foundation, 2007. $200,000.
Minimally Invasive Surgery Innovations.
Project Role: PI

Society of American Gastrointestinal Endoscopic Surgeons, 2005. $9,600. PI: Heniford, BT. Prospective evaluation of intra-abdominal pressure in patients at high risk for failure of abdominal hernia repair.
Project Role: Co-Investigator

Project Role: Co-Investigator

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors in the order listed on Form Page 2. Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE
Arnab Majumder	Allen Research Scholar General Surgery Resident
eRA COMMONS USER NAME (credential, e.g., agency login)	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
Case Western University, Cleveland OH	BA	08/03-05/07	Biology, Psychology
The Ohio State University College of Medicine, Columbus OH	MD	08/07-06/11	Medicine
University Hospitals Case Medical Center, OH		07/11-present	General Surgery Residency

NOTE: The Biographical Sketch may not exceed four pages. Follow the formats and instructions below.

A. Personal Statement

I have completed three years of surgical residency and am currently an Allen Research Scholar in my second year at the UH Case Medical Center. I have worked with Dr. Novitsky since the beginning of residency and have pursued hernia research during my Allen Scholar years. I have completed basic science as well as clinical review projects since my start. We have multiple ongoing projects involving prospective databases, animal surgeries including mice/rats/pigs, along with testing of novel surgical techniques and biomaterials.

B. Positions and Honors.

PROFESSIONAL EXPERIENCE

2011-2014 University Hospitals Case Medical Center, Cleveland, OH, General Surgery Resident, Department of Surgery

2014-present University Hospitals Case Medical Center, Cleveland, OH, Allen Research Scholar, Case Comprehensive Hernia Center

SELECTED HONORS AND AWARDS

2006

2004 Cum Laude, Case Western Reserve University

SOCIETIES

American Hernia Society 2014

American College of Surgeons 2014

C. Publications

Peer-reviewed publications.

1. Ghoshal K, Motiwala T, Claus R, Yan P, Kutay H, Datta J, Majumder S, Bai S, **Majumder A**, Huang, T, Plass C, Jacob ST. HOXB13, a target of DNMT3B, is methylated at an upstream CpG island, and functions as a tumor suppressor in primary colorectal tumors. *PLoS One*. 2010 Apr; 5(4):e10338.
2. Posielski NM, Yee ST, **Majumder A**, Orenstein SB, Prabhu a. S, Novitsky YW. Repair of massive ventral hernias with "quilted" mesh. *Hernia*. 2015 Jun: 19(3) 465-472
3. **Majumder A**, Novitsky YW. Antibiotic coating of Hernia Meshes: The Next Step Toward Preventing Mesh Infection. *Surgical Technology International*. 2015 Oct: 7;XXVII

Invited Scientific Presentations

1. **Majumder A**, Fayezizadeh M, Fathi A, Petro C, Novitsky YW. Efficacy of Transversus Abdominis Plane Block with Liposomal Bupivacaine during Open Abdominal Wall Reconstructions. *Presented at the 1st World Conference on Abdominal Wall Hernia Surgery, April 2015, Milan, Italy*
2. **Majumder A**, Fayezizadeh F, Petro C, . Benefits of multimodal Enhanced Recovery Pathway (ERP) in patients undergoing major open abdominal wall reconstructions. *Presented at the 101st Annual American College of Surgeons Clinical Congress, October 2015, Chicago, IL*

Book Chapters

1. **Majumder A**. Anatomy and Physiology of the Abdominal Wall in Current Principles of Surgery of the Abdominal Wall. Novitsky YW & Heniford BT (Eds.), Springer, 2015.

D. Research Support

I am a funded Allen Scholar through UH Case Medical Center, no funding from this Grant will be used for salary support.