Plastic and Reconstructive Surgery

Simultaneous prosthetic mesh abdominal wall reconstruction with abdominoplasty for ventral hernia and severe rectus diastasis repairs

--Manuscript Draft--

Manuscript Number:	PRS-D-14-00737R2
Full Title:	Simultaneous prosthetic mesh abdominal wall reconstruction with abdominoplasty for ventral hernia and severe rectus diastasis repairs
Article Type:	Original Article
Corresponding Author:	Gregory A. Dumanian, MD Northwestern Memorial Hospital Chicago, IL UNITED STATES
Corresponding Author Secondary Information:	
Corresponding Author's Institution:	Northwestern Memorial Hospital
Corresponding Author's Secondary Institution:	
First Author:	Jennifer E Cheesborough, MD
First Author Secondary Information:	
Order of Authors:	Jennifer E Cheesborough, MD
	Gregory A. Dumanian, MD
Order of Authors Secondary Information:	
Abstract:	Introduction: Standard abdominoplasty rectus plication techniques may not suffice for severe cases of rectus diastasis. In our experience, prosthetic mesh facilitates the repair of severe rectus diastasis with or without concomitant ventral hernias. Methods: A retrospective review of all abdominal wall surgery patients treated in the last eight years by the senior author was performed. Patients with abdominoplasty and either rectus diastasis repair with mesh or a combined ventral hernia repair were analyzed. Results: Thirty two patients, 29 female and 3 male, underwent mesh reinforced midline repair with horizontal or vertical abdominoplasty. Patient characteristics include: mean age 53 years, mean BMI 26, average width of diastasis or hernia 6.7 cm, and average surgery time 151 minutes. There were no SSI and two SSO - two seromas treated with drainage in the office. After an average of 471 days follow up, none of the patients had recurrence of a bulge or a hernia. Conclusions: For patients with significant rectus diastasis, with or without concomitant hernias, the described mesh repair is both safe and durable. Although this operation requires additional dissection and placement of prosthetic mesh in the retrorectus plane, it may be safely combined with standard horizontal or vertical abdominoplasty skin excision techniques to provide an aesthetically pleasing overall result.
Response to Reviewers:	Reviewer Comments: Click the link below to view any attachments that reviewers have added to the submission record for this paper (if no link appears, no attachments have been added): ******** Instructions for downloading attachments are available here: Reviewer #1: In the revised manuscript "Simultaneous prosthetic mesh abdominal wall reconstruction with abdominoplasty for ventral hernia and severe rectus diastasis repairs," the authors have made significant improvements to address the reviewer's comments. The manuscript would be reasonable for PRS-GO or for submission as an

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Ideas and Innovations for the following reasons:

1. The authors have clarified that this technique has not been previously reported in the literature and is therefore "new." For this reason, the manuscript may be reformatted as an Ideas and Innovations article despite the relatively small number of patients and short follow-up. Even though the mean length of follow-up was 537 days, the range is extremely broad with at least one patient follow-up being less than 2 months. This is extremely short to be able to make any definitive conclusions regarding rates of recurrence or even pain improvement. Has the senior author evaluated and treated similar patients prior to 2007 in the same manner? If so, inclusion of these patients would significantly strengthen this manuscript.

Response: Thank you for your comments. This manuscript combines two well described techniques, management of skin and subcutaneous tissue for abdominoplasty with retrorectus abdominal wall repair with mesh. The senior author did not combine these two procedures prior to 2007. As a critical issue is SSI, short follow-up of patients still would provide meaningful information to the use of mesh at the time of abdominoplasty. Therefore, 5 additional more recent patients were added. To our knowledge, this is the largest series of these patients to be reported.

2. The use of the PROMIS scale is still confusing in the manuscript. Are the mean postoperative pain behavior and interference scores collected from the senior author's other 57 patients? Has this data been previously published? Were the 11 patients who completed the PROMIS survey also included within these other 57 patients?

Response: We have removed the PROMIS data, and will write a dedicated paper describing the decrease of pain seen in these abdominal wall patients over time using these mesh techniques.

3. The authors state the one outlier patient who required a larger mesh was removed. If so, does that change the data in terms of pain improvement, length of follow-up, etc? The total number of patients would now be 27 instead of 28 as well.

Response: The one patient to receive a wide mesh was removed.

Reviewer #2: The authors have made the appropriate revisions, and some of the limitations are not able to be addressed based on the recommendations. For example, the small number of patients who underwent their procedure is a limitation that is not easily corrected and their cohort is not uniform as not all 28 patients were presenting with rectus diastasis (n=4) and most had a hernia along with the diastasis. However, as the authors state, the precise number for describing a novel technique is fairly arbitrary. Again, this is a well-written study from a well-respected surgeon with very nice results in their follow-up period.

I would still like to see longer follow-up both in the likelihood of developing recurrent diastasis and pain scores. Undoubtedly, the senior author is very experienced in abdominal wall reconstruction with excellent results and I would expect his results for diastasis repair would mirror his abdominal wall reconstruction; however, for publication, data is necessary and we cannot simply extrapolate the senior surgeon's skills and expertise to his novel technique.

Response: Extra follow-up would be helpful, and we are currently collecting the much larger series of retrorectus hernia repairs that did not have abdominoplasties. So far, to my knowledge, I have not had a single hernia recurrence for a pure midline defect with this technique. Intraabdominal, 5-6%. Parastomals, 50+%. As I wrote to reviewer #1, a focus of this manuscript is SSI, and hence it does not seem unreasonable to include the patients with short follow-up. With this technique, we are not seeing the high complication rates typically associated with mesh use.

Since one argument for their technique is the high recurrence rates with plication alone and they are presenting a new, improved means of treating diastasis, longer follow-up is warranted in this reviewer's opinion to truly demonstrate that his novel technique is indeed superior long-term.

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Response: Thank you for your kind comments. We have made an effort to contact these patients, especially those with shorter follow up times. We have been able to extend the follow up times and, happily, have no additional complications to report as a result of this inquiry. Additionally, we have added the five most recent patients who have undergone this same procedure to further bolster our study numbers.

Reviewer #6: Title: Simultaneous prosthetic mesh abdominal wall reconstruction with abdominoplasty for ventral hernia and severe rectus diastasis repairs

Manuscript Number: PRS-D-14-00737

This article is a case series of abdominal wall reconstructions for ventral hernia and severe rectus diastasis.
This paper is well written and clear. Some of the pictures could be eliminated. The ability to carry out successful abdominal reconstruction with mesh and encounter no infections or recurrence is important. But is it significant?

This paper is a case series and therefore has the weakness that there is no control. In the absence of a control we need to trust the authors to point to historical controls in the literature. They do so with appropriate references that mostly argue against rectus repair or show poor results not comparable to those of Drs. Cheesborough and Dumanian. (1) (2)

The results of Drs. Cheesborough and Dumanian are superior to many of the papers reported in the literature. (3) However, there are articles that claim results similar to these authors without the use of mesh, and in most cases no recurrence. Often the follow up is longer than the manuscript under consideration. (4-9) For example there is one publication with controls that used absorbable sutures to repair rectus diastasis and used ultrasound to evaluate the outcome. These authors claim outcomes the same as Drs. Cheesborough and Dumanian with longer average follow-up (10). Drs. Cheesborough and Dumanian should consider addressing these other papers that claim similar results without the use of mesh.

The patients in the submitted article could also possibly be evaluated using the VHWG classification system. Admittedly the patients in the manuscript are different from Dr. Dumanian's previous report on ventral hernia, where he demonstrates that the VHWG classification. But there is a group of 24 patients with ventral hernias and rectus diastasis in the manuscript under consideration. These 24 patients could be evaluated by the VHWG and/or compared to the previous publication by Dr. Dumanian. This could be of value.

Admittedly it is not an "apples to apples" comparison. If a number of the patients in the manuscript do not get infected yet fall into a class where the VHWG anticipated sepsis, than the VHWG classification system of when to use synthetic mesh is challenged. If on the other hand the majority of patients fall in the groups where mesh is expected not to cause infection, then they confirm the VHWG classification system. Either way information is gained regarding a cohort of patients (ventral hernia plus rectus diastasis) not previously reported using the VHWG.

This is a good paper, with an impressive series of results, that possible could still add more information to the area of abdominal wall reconstruction.

Response: Thank you for your comments.

The senior author regards this as an important contribution, as many women suffer from back and abdominal wall pain from rectus diastasis. The ability to repressurize the abdomen reliably would aid many patients. We will work for longer follow-up as written to Reviewer 2--in a larger series on retrorectus repairs without abdominoplasty for the general surgery literature.
The manuscript has been rewritten from many angles to address these comments. We have added the concept that simple suture approximation is insufficient to repair most hernias, and that mesh repairs are the standard. We have added VHWG classifications, but due to low SSI numbers did not push us to correlate our few

	seromas to VHWG levels.

Dumanian
Enkwell Corresponding Author Last Name (Please Print)

PRS-D- __ __ - __ __ __ __ __ __
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TITLE PAGE (ALL IDENTIFYING INFORMATION: AUTHORS, CORRESPONDING AUTHOR, AFFILIATION, FINANCIAL DISCLOSURE

Simultaneous prosthetic mesh abdominal wall reconstruction with abdominoplasty for ventral hernia and severe rectus diastasis repairs

Jennifer E. Cheesborough

Gregory A. Dumanian

Northwestern University, Feinberg School of Medicine

Corresponding Author:

Dr. Gregory Dumanian

Division of Plastic Surgery

675 N. St. Clair, Suite 19-250

Chicago, IL 60610

312-695-6022

gdumania@nmh.org

Fax 312-695-5672

Financial disclosures: none

Abstract

Introduction: Standard abdominoplasty rectus plication techniques may not suffice for severe cases of rectus diastasis. In our experience, prosthetic mesh facilitates the repair of severe rectus diastasis with or without concomitant ventral hernias.

Methods: A retrospective review of all abdominal wall surgery patients treated in the last eight years by the senior author was performed. Patients with abdominoplasty and either rectus diastasis repair with mesh or a combined ventral hernia repair were analyzed.

Results: Thirty two patients, 29 female and 3 male, underwent mesh reinforced midline repair with horizontal or vertical abdominoplasty. Patient characteristics include: mean age 53 years, mean BMI 26, average width of diastasis or hernia 6.7 cm, and average surgery time 151 minutes. There were no SSI and two SSO – two seromas treated with drainage in the office. After an average of 471 days follow up, none of the patients had recurrence of a bulge or a hernia.

Conclusions: For patients with significant rectus diastasis, with or without concomitant hernias, the described mesh repair is both safe and durable. Although this operation requires additional dissection and placement of prosthetic mesh in the retrorectus plane, it may be safely combined with standard horizontal or vertical abdominoplasty skin excision techniques to provide an aesthetically pleasing overall result.

Introduction

The overwhelming majority of abdominoplasties involve suture manipulation of the abdominal wall and resection of skin as described by Pitanguy in 1967 (1). For the abdominal wall, correction of mild to moderate rectus diastasis via suture approximation of the anterior rectus sheath gives excellent results. Small umbilical hernias and epigastric defects are often repaired at the time of abdominoplasty through suture plication.

While there is consensus that hernias are best repaired using mesh as opposed to simple suturing, no such agreement exists for the repair of severe cases of rectus diastasis. The return of muscle laxity in certain patient populations has been reported as high as 100% using the plication technique. (2) Previous authors have recommended mesh overlay to support the midline plication in patients with marked musculoaponeurotic laxity. (3,4) Some surgeons have recommended posterior rectus sheath plication, rectus advancement, and anterior rectus aponeurosis fixation to the posterior rectus sheath (5). General surgeons have recommended a laparoscopic mesh reinforced technique and consider rectus diastasis a "hernia without a defect" and worthy of hernia repair techniques (6). Still others do not believe that rectus diastasis repair will last in the setting of large intra-abdominal fat volume or male pattern rectus diastasis and therefore recommend against repair (7). In Schwartz's Principles of Surgery, the authors express concern that rectus plication could actually introduce the risk of ventral

hernia development (8). These concerns have prevented many surgeons from attempting repair of significant diastasis, particularly in men. Regarding the use of mesh, an entire industry of bioprosthetic meshes has developed in order to avoid feared prosthetic mesh complications of abdominal wall reconstruction (AWR). Surgical site occurrences (SSO) are quoted in the 14-43% range for clean or clean-contaminated AWR--a number not compatible with aesthetic procedures (9).

Over the years, we have developed familiarity with the use of prosthetic mesh for the repair of moderate to large ventral hernias. We hypothesized that prosthetic mesh support of severe female and male pattern rectus diastasis, as well as moderate to large ventral hernias could be safely and effectively combined with simultaneous abdominoplasty. While many would view the use of mesh for an aesthetic procedure to be unwarranted, low complications and reliability of the procedure in 32 patients has led us to document our indications and technique.

Pathophysiology

A. Rectus diastasis

The condition of rectus diastasis is familiar but without standard definition (10). Rectus diastasis, while not a true hernia, causes biomechanical alterations of the abdominal wall leading to patient discomfort and an aesthetically displeasing torso.

Increased intraabdominal pressure causes tissue expansion of the abdominal wall, particularly at the linea alba. While certain conditions such as genetic predisposition, aging, ascites, and COPD increase the risk of developing rectus diastasis, most women develop rectus diastasis after pregnancy, particularly those involving multiple gestations or sequential large infants. Female pattern rectus diastasis is centered at the level of the umbilicus, but can extend up to the xyphoid and down to the symphysis pubis. Male pattern rectus diastasis, on the other hand, more frequently develops as a sequelae of increased intra-abdominal fat volume, occurs primarily supraumbilically, and in the fifth to sixth decades of life (Figure 1) (7). Additionally, lateral insertion of the rectus muscles along the costal margin can contribute to both development of rectus diastasis and recurrence after plication repair. There is no risk of bowel incarceration with rectus diastasis, due to the smooth contour of the peritoneum (11).

Rectus diastasis is associated with epigastric and umbilical hernias. Some authors believe that the male abdominal wall is stiffer thus contributing to the coexistence of these hernias (12). Epigastric hernias represent true tears (rather than stretching) of the linea alba fibers, allowing preperitoneal fat and sometimes omentum to emerge. These epigastric hernias can be painful, but typically do not contain bowel and are not at risk for bowel strangulation. The physical stretching of the linea alba can be uncomfortable and even painful.

Significant rectus diastasis (as well as large hernias) causes a decrease in abdominal wall pressure and function. Abdominal wall pressure is necessary for the upper torso to "push-off" and to perform an effective Valsalva maneuver. There is increased muscle work from the isotonic contracture that occurs at the sarcomere level compared to the isometric contractions that occur with normal abdominal wall muscle activity when muscles tighten rather than shorten with contracture. With the increased abdominal circumference from the stretching of the linea alba, intra-abdominal pressure lowers, and a new steady state occurs. Some elastic recoil of the tissues is possible. Exercise and physical therapy may allow a patient to compensate, but the rectus muscles will not reapproximate spontaneously (10). Due to overuse of the back musculature to compensate for lost abdominal wall stability, low back pain is frequent in cases of significant rectus diastasis. There are few studies that evaluate pain as outcome, but those that do, note overall improvement in pain with rectus diastasis repair (13).

B. Ventral hernia

Lateral displacement of the rectus muscles, decreased intra-abdominal pressure, local discomfort, increased muscle work, and back pain all accompany large ventral hernias. A major difference between rectus diastasis and a true hernia is that for ventral hernias, scar tissue (rather than the linea alba) created at the time of a previous laparotomy incision has pulled apart in the midline. When the scar

stretches, the peritoneal surface is no longer smooth and assumes an omega shape, permitting bowel to enter the hernia sac. Therefore, there is a risk of incarceration and strangulation with ventral hernias. Large ventral hernias often coexist with rectus diastasis, occurring after a laparotomy or laparoscopy incision is made through the linea alba in a patient with a *prior* rectus muscle separation.

Methods

An IRB-approved, retrospective chart review of all patients undergoing abdominal wall surgery between 2007 and 2014 by the senior author revealed 32 patients who underwent abdominoplasty combined with either rectus diastasis repair with mesh or a prosthetic ventral hernia repair. As the majority of ventral hernia repairs will remove some element of skin and subcutaneous tissue, only those patients for whom there was an additional out-of-pocket payment for skin contouring were included. The rectus diastasis repairs were entirely out-of-pocket expenses. These patients were analyzed for patient characteristics, operative features, and postoperative course including surgical site infections and surgical site occurrences. Follow-up is defined as the last clinic visit or telephone contact. While these are aesthetic procedures, the lack of any validated aesthetic scoring scales left only the number of revisions as a proxy for patient satisfaction.

Surgery technique

A. Rectus diastasis

Skin is elevated to expose the linea alba and at least 4 centimeters of the anterior rectus fascia bilaterally. The retrorectus space is developed by incising the anterior rectus fascia along the medial muscle border The muscle is freed from the underlying posterior rectus sheath with blunt dissection, analogous to a pedicle TRAM flap. The anterior rectus sheath is left attached to the rectus muscle to maintain its vascularity. For the majority of patients, the plane of dissection, extends from the xiphoid to the symphysis pubis (Figure 2a-b). For men with isolated supraumbilical rectus diastasis, the rectus muscles are elevated to just below the umbilicus (Figure 3a-b).

Soft polypropylene uncoated mesh, 7 cm in transverse dimension, is anchored with up to 40 interrupted transrectus 0-polypropylene sutures with bites taken 4 cm from the incised edge of anterior rectus fascia. These sutures are each placed approximately 2-3 cm apart. The inferior epigastric artery is carefully avoided during suture placement, as are intercostal nerves. When these sutures are tied down, the mesh is flat and tight across the midline. This is a high-tension closure, but the force is distributed across many individual sutures thus avoiding suture pull-through. The rectus muscles and overlying anterior rectus fascia are then approximated in the midline with interrupted figure of eight 0-polypropylene sutures to achieve a direct supported repair (Figure 2b-d).

B. Ventral hernia

After exposure of the hernia sac and entry into the abdomen, adhesions of the viscera to the posterior aspect of the sac and the abdominal wall are taken down bluntly. The retrorectus space is entered bilaterally and extended both superiorly and inferiorly, For the majority of the patients, this dissection was from the symphysis pubis to the xyphoid. The posterior sheath is closed in the midline with an absorbable running 0 monofilament suture, recreating the identical appearance of the rectus diastasis patients. Midweight macroporous polypropylene uncoated mesh 7-cm in transverse dimension and running the length of the abdominal muscle dissection is placed in the retro-rectus plane. The abdominal muscles are closed over the mesh using up to 40 interrupted 0-polypropylene sutures to achieve a direct supported repair.

C. Skin handling

Male pattern rectus diastasis repair is most frequently performed through a vertical incision from xyphoid to umbilicus. Female pattern rectus diastasis repair is more often performed through a standard horizontal abdominoplasty incision. Skin elevation must be wide enough to reach the mid-portion of the anterior rectus fascia for suture placement, and may progress even farther to achieve proper skin redraping when completed (Figures 2c and 3c).

Simultaneous ventral hernia repair with abdominoplasty can be performed through either a vertical or horizontal incision. Many of the hernia patients already have a midline incision. The vertical incisions minimize skin undermining and improve the torso hourglass shape (Figure 4).

Preoperative markings are crucial for either pattern. Standard low transverse abdominoplasty markings are made for horizontal approaches. For the vertical approach, skin staples are placed equidistant from the midline in the epigastrium, at the level of the umbilicus to facilitate equal skin excision and a centered final closure (Figure 2a). The standard low horizontal incision is easier to camouflage, but comes at the cost of greater skin flap elevation.

D. Umbilicus creation

For vertical skin patterns, the umbilicus is excised and reconstructed. Initial marking of the umbilical position in the coronal plane is helpful in orienting these skin flaps. To create a neoumbilicus, "pumpkin teeth" flaps are designed along the medial aspect of the planned skin excision as shown in Figure 2e and tacked down to the abdominal wall (14). A circular dermal "scratch" is made with the #15 blade to create a circular scar. Umbilicus reconstruction may not be wise in hirsute men, as the hair-bearing skin may cause unacceptable hair growth within the umbilicus.

Results:

From 2007 through 2014, 32 patients underwent cosmetic abdominal contour procedures combined with either a ventral hernia repair with mesh or a rectus diastasis repair with mesh. Five patients had rectus diastasis alone. The mean age of the patients was 53 years with a range of 32 to 73 years of age. 29 (91%) of the patients were female. The mean BMI of the patients was 26 kg/m^2 (range 18-34). The most common comorbidity was hypertension (n=11), followed by smoking (n=4) and diabetes (n=3). For the patients with preoperative CT scans, the greatest separation of the rectus complexes was measured to be a mean of 6.7 cm (range 3.2 to 9.5).

The average time from entry into the operating room to leaving the room with dressings in place was 151 minutes with a range of 80-243 minutes. The more complex ventral hernia repairs had longer operative times. The three patients with operative times over 200 minutes had abdominal wall procedures combined with additional mastopexy, bowel resection, or excision of a chronic seroma cavity.

The Ventral Hernia Working Group Grade of the patients included in this study ranged from 1 to 3. The majority (17) of the patients were Grade 1 (low risk), 12 were classified as Grade 2 due to comorbidities, and 3 were Grade 3 due to potentially contaminated fields.

Early Outcomes

During the first 30 days of follow up, there were no superficial or deep surgical site infections (SSI). The Ventral Hernia Working Group defines surgical site occurrences (SSO) for abdominal wall surgery as an infection, wound dehiscence, seroma, or development of an enterocutaneous fistula (15). Two patients had an SSO – both prolonged seromas requiring office drainage. One patient had partial skin loss at the inferior aspect of her abdominal skin flap that was successfully treated with local wound care alone (does not meet American College of Surgeons criteria for wound disruption). One patient was readmitted to the hospital three days after discharge for a GI bleed thought to be related to NSAID use (not requiring transfusion) and another patient with a known patent foramen ovale had a transient ischemia attack during her postoperative course necessitating evaluation by neurology.

Late Outcomes

With a mean of 471 days of follow up (range 60-2292 days), there were no hernia or bulge recurrences. There were no reoperations for abdominal wall complications. Three patients requested touch-up liposuction performed in the office for refining of the abdominal contour. All other patients had uneventful postoperative courses. Results shown in Figures 1, 4 and 5.

Discussion:

There is a need for cosmetically sensitive and lasting abdominal wall reconstruction for patients with both hernias and significant rectus diastases. Even though it is well established that repair of ventral hernias with mesh is more durable than suture repair alone, prosthetic mesh is avoided by many due to concerns regarding risk of infection, extrusion, pain, and the need for removal of the mesh. High rates of surgical site occurrences (SSO) would not be compatible with cosmetic surgery procedures. Therefore, a surgical technique that reproducibly allows reestablishment of the linea alba with low SSO would be an important addition to the care and treatment of patients.

Al-Qattan noted a frustrating 100% return of musculoaponeurotic laxity one year after vertical midline plication and abdominoplasty in 20 multiparous women with severe abdominal wall laxity. The author questions the durability of plication alone and suggests that a reinforced mesh repair may be more suitable (2). In a systematic literature review, Hickey et al (16), noted varying evidence for recurrence after plication alone. This ranged from 0% in Nahas' computed tomography follow up of 12 women at an average of 81 months after surgery (17) to 40% in 63 women at an average of 64 months on ultrasound evaluation by van Uchelen et al (18).

The main reason that simple suture approximation of the rectus muscles may not provide a durable repair for both rectus diastasis and hernias is suture pull-through.

Both running and interrupted sutures, when placed under tension, can cut through the anterior rectus fascia like a cheese wire cutter leading to hernia recurrence and "stretching" of rectus diastasis procedures. However, the best aesthetic abdominoplasty procedure is probably the technique that achieves the highest tension. A high tension tightening of the stomach muscles is achieved with mesh with this technique, rather than sutures alone as is done for the standard abdominoplasty. The mesh is quilted into place by numerous sutures placed in three vertically oriented lines. Increased number of sutures lowers the force at each suture-tissue interface, thereby decreasing suture pull-through despite the high overall tension of the repair (19). We attribute the low SSO to a central tenet of maxillofacial surgery--that a well-fixed implant in a vascularized soft tissue bed does not become infected. Macroporous mesh (pore size greater than 1000 microns) incorporates well, improving the distribution of forces across the repair site as scar incorporates the mesh polypropylene fibers. A study of 185 patients by Zemlyak et al demonstrates the safety of combining abdominal wall mesh repair and skin surgery as there was no statistically significant differences between panniculectomy alone versus ventral hernia repair with mesh and panniculectomy (20).

A review by Montgomery supports the idea that placement of mesh in the retromuscular plane is the safest position and provides the most durable repairs (21). Iqbal et al reported long-term outcomes for the modified Rives-Stoppa technique for hernia repair with a relatively low 3% prosthetic infection in complex

incisional hernias (22). While the procedure described in our study places the mesh in the same retrorectus plane, current iterations of the retromuscular Rives-Stoppa hernia repair often involve posterior components releases, employ large meshes and develop the retrorectus space from psoas muscle to psoas muscle (23). The meshes are typically held in place with several anchoring sutures placed far from the midline. In order to avoid nerve irritation, some hernia surgeons completely avoid suture fixation of the mesh entirely. The extended Rives-Stoppa technique with extremely large meshes introduces more foreign material, creates more scar, and likely stiffens the abdominal wall more than the limited mesh technique described in this study. The procedure described above uses a narrow mesh as a suture line pledget—distributing the forces to decrease suture pull-through to provide a durable repair. So close to the midline, the transmuscular sutures are unlikely to entrap a sizeable nerve ending, and therefore long-term postsurgical nerve pain has been extremely uncommon in patients treated with this technique.

The concept of combining abdominoplasty and mesh reinforcement is not new; Marquez et al first described use of a 20 x 30cm polypropylene (Marlex) mesh overlay to support three lines of vertical plication of rectus diastasis in 1995. (3) They followed 18 women for 6 or more months and showed no infection, dehiscence or extrusion related to the mesh. They encouraged use of the mesh overlay in patients with marked musculoaponeurotic weakness “as though an extensive hernia was being managed.” A decade later, Prado, et al described their experience with three different patterns of polypropylene mesh strip overlay reinforcement of the

abdominal wall in 20 women with rectus diastasis with or without midline hernias. (4) At an average of 36 months follow up, none of the patients had infectious complications or notable recurrence of abdominal bulge.

In a Letter to the Editor, Horndeski and Gonzalez describe a technique of midline hernia repair utilizing the horizontal abdominoplasty skin incision for exposure (24) He then uses a large mesh overlay to cover the entire lower half of the anterior abdominal wall to prevent shearing at the midline and prevent further "biomechanical failure." None of his 14 patients developed a new hernia or infection. All of these three aforementioned studies include use of a mesh overlay, the placement of which, as noted by Marquez at al, can obscure normal abdominal muscle contour. The technique described in this study, uses a mesh underlay, which allows for the normal muscular contour to be appreciated through the redraped skin flap. Additionally, limited undermining preserves both the subtle aesthetics of the semilunar lines as well as blood flow to the skin flaps.

The cosmetic result is the patient's greatest concern, and this technique allows for both abdominal wall functional repair and safe skin contouring. The ability of this technique to tighten the abdomen with confidence is far greater than for suture alone. For the 11 patients who already had a vertical scar, the midline incision was utilized for the procedure. The vertical abdominoplasty allows for excellent narrowing of the waistline and the creation of a new umbilicus as described. The minimal mesh technique preserves the attachments of the semilunar line, improving

the final aesthetic contours. For patients without a preexisting vertical scar, the standard horizontal abdominoplasty incision allows for complete access to the hernia or rectus diastasis and excellent postoperative contour.

This study, the largest case series to date of abdominoplasty combined with prosthetic mesh, demonstrates the safety and feasibility of aesthetically sensitive repair of significant rectus diastasis and ventral hernias. This procedure employs familiar techniques combined in a straightforward manner that allows for a durable repair achieved within operative times acceptable to most surgeons. The concept that aesthetics and prosthetic mesh are incompatible is no longer valid, thereby giving additional options to men and women with separation of their rectus muscles for repair.

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Figures

1A: The best physical examination for rectus diastasis is a reversed sit-up maneuver.

1B: This male rectus diastasis patient with umbilical hernia underwent a retrorectus mesh repair and skin tailoring through the vertical incision.

2A-F: Female patient with a large rectus diastasis undergoing retrorectus diastasis repair, preservation of skin perforators, and excision of excess skin with vertical abdominoplasty and neoumbilicus formation.

3A-D: Male patient undergoing epigastric rectus diastasis repair with retrorectus mesh placement

4A-D: Female patient with significant rectus diastasis undergoing retrorectus diastasis repair and vertical abdominoplasty with neoumbilicus formation

5A-D: Female patient with severe rectus diastasis undergoing retrorectus diastasis repair and a standard abdominoplasty incision

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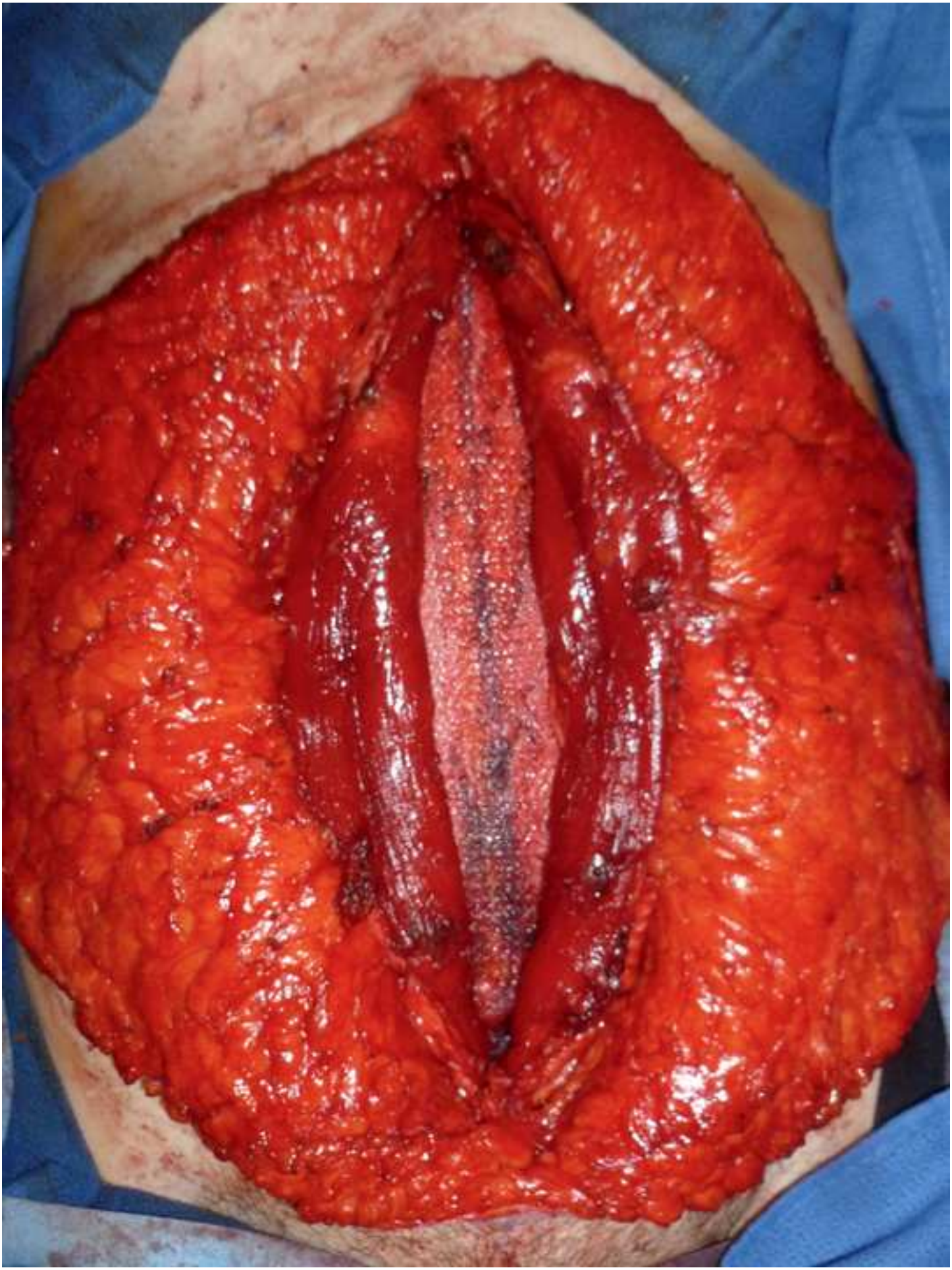

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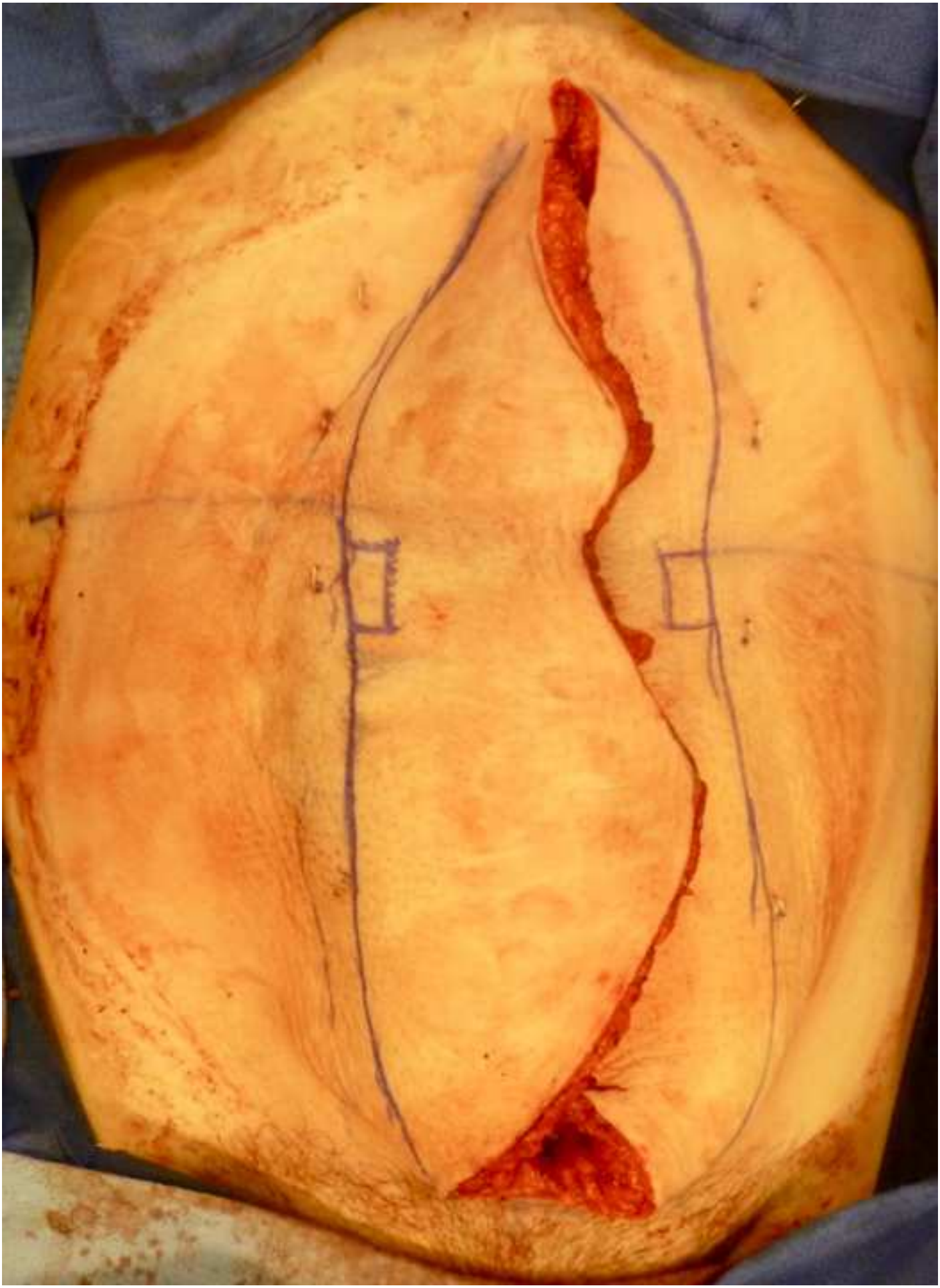

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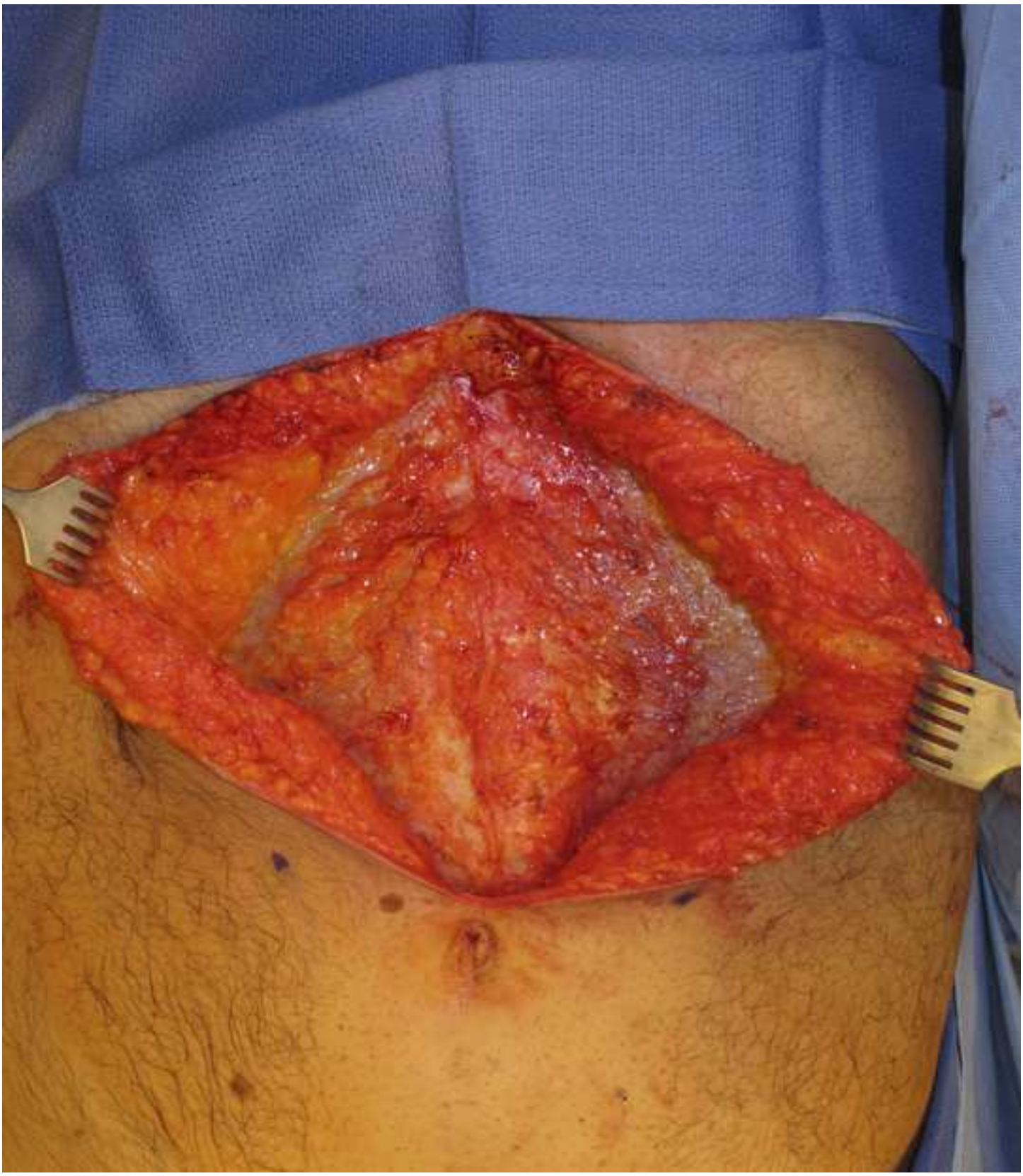

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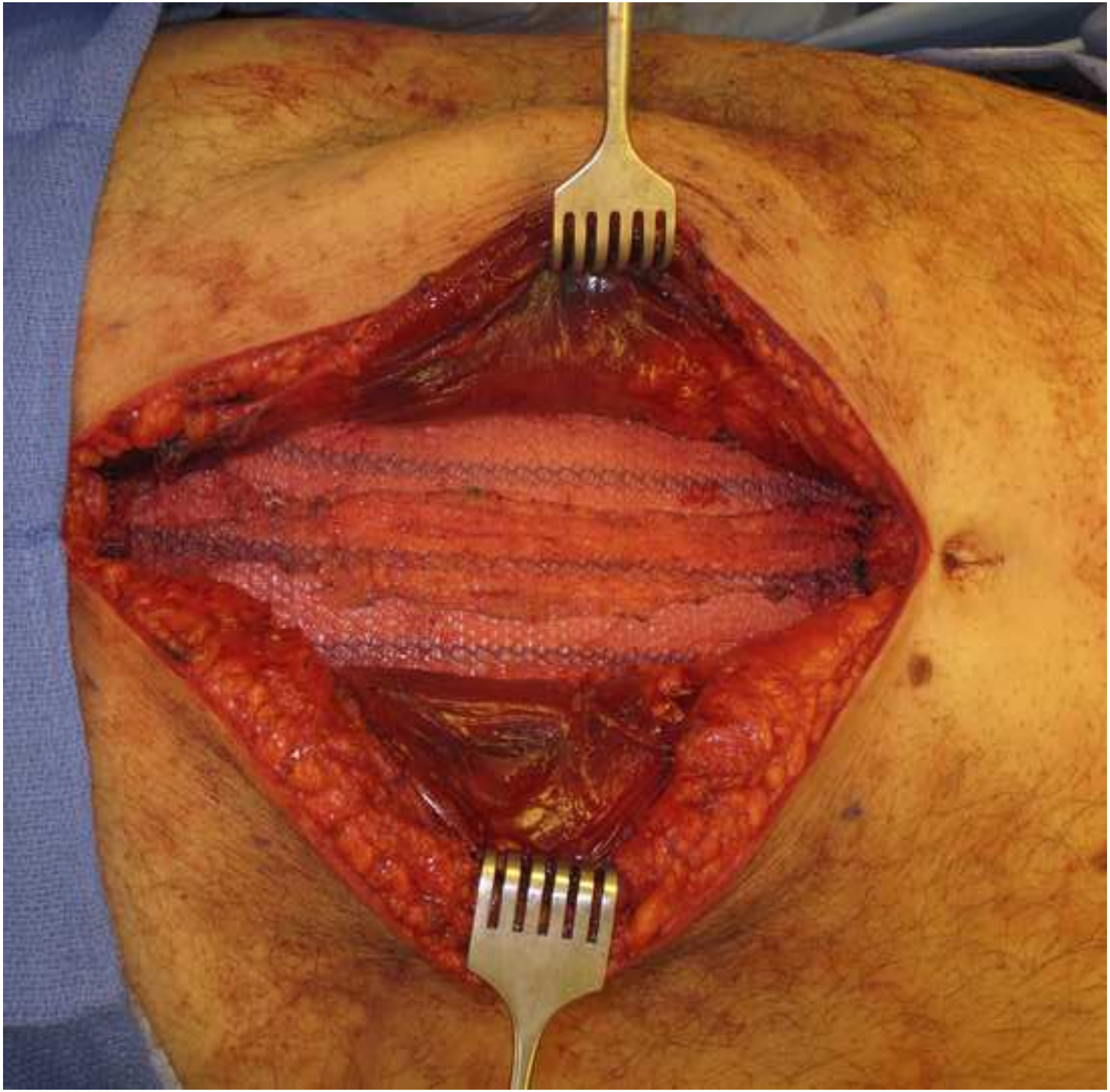

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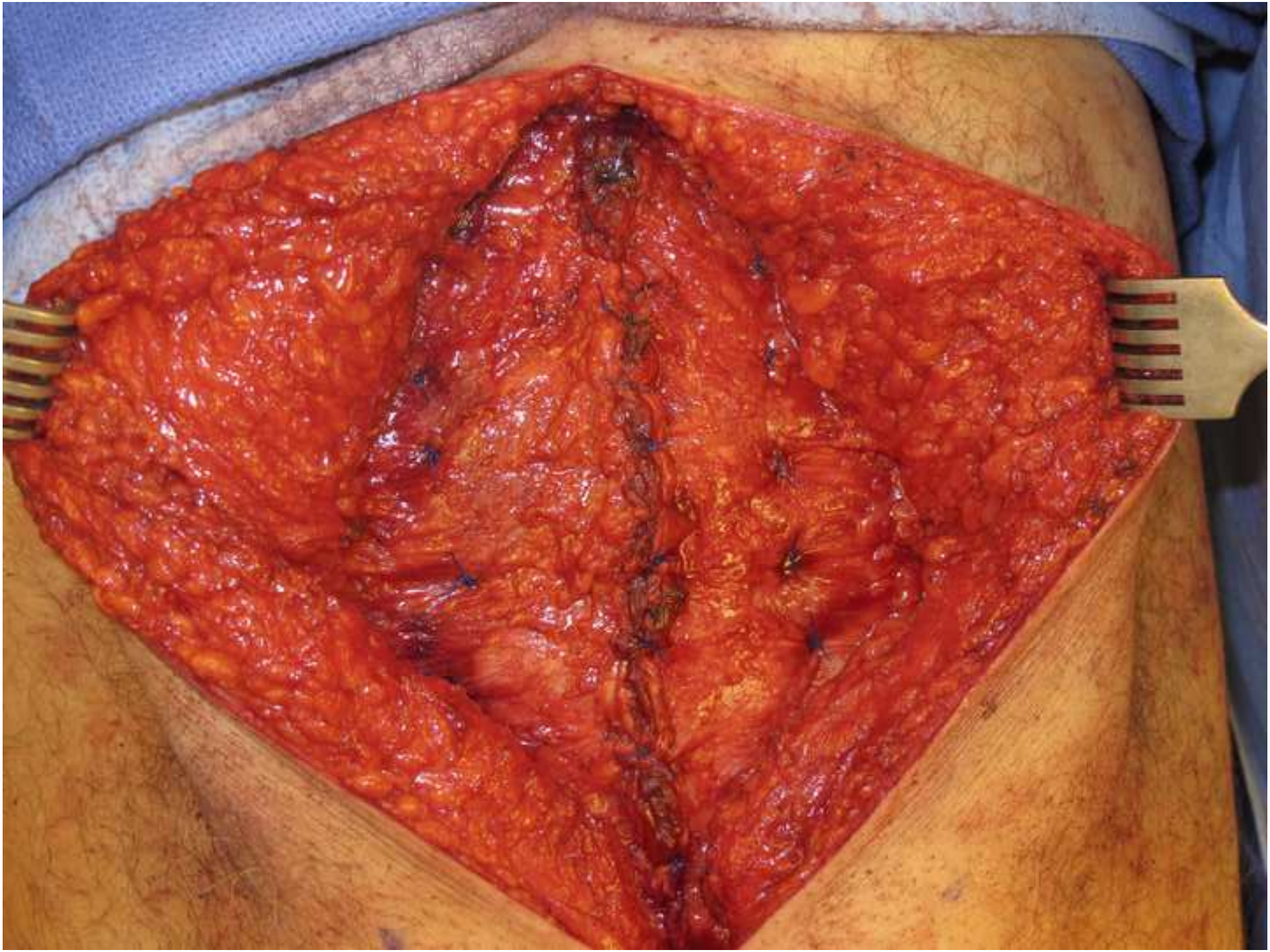

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