Autologous Tissue Reconstruction of Ventral Hernias in Morbidly Obese Patients

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Hypothesis: Separation of components is a safe and effective technique for abdominal wall reconstruction in morbidly obese patients.

Design: Review of a prospectively accumulated database.

Setting: University tertiary care medical center.

Patients: Thirty morbidly obese patients who underwent ventral hernia repair using the separation of components technique between August 1, 2001, and August 31, 2005.

Intervention: Ventral hernia repair using the separation of components technique.

Main Outcome Measures: Postoperative complications and hernia recurrence.

Results: Thirty morbidly obese patients (mean body mass index [calculated as weight in kilograms divided by height in meters squared], 61; range, 35-93) underwent ventral hernia repair by the separation of components technique (mean width of defect, 12.8 cm; mean length, 17.6 cm). Twenty-five patients (83%) had comorbidities. Twelve (40%) had undergone previous repairs (9 had undergone multiple repairs; mean, 2.4 repairs per patient; range, 2-4 repairs) and 6 (20%) had infected mesh. Sixteen patients (53%) underwent simultaneous pancreatectomies and 6 (20%) underwent simultaneous bariatric procedures (Roux-en-Y gastric bypass). Postoperatively, cellulitis developed in 2 patients (7%), which was treated with antibiotics; wound infections occurred in 2 patients (7%), which were managed with local wound care; and a seroma developed in 1 patient (3%), which resolved spontaneously. The lone recurrent hernia (3%) was repaired with mesh. The mean length of follow-up was 44 months.

Conclusions: These results show that (1) separation of components is a safe and effective technique for repairing primary and recurrent ventral hernias in morbidly obese patients; (2) performance of a simultaneous pancreatectomy or bariatric procedure does not affect the outcome; and (3) comorbidities do not compromise the results.

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Ventral hernias are especially common following laparotomies in morbidly obese patients (occurring in 40% of cases).7 As a group, obese patients are even more prone to postoperative hernia formation than are patients taking corticosteroids.8 Intra-abdominal pressure is greater by a factor of 2 or 3 in morbidly obese individuals,9 and wound infections are also more frequent.7 Achieving a satisfactory repair in such patients is challenging because of their size and propensity for comorbid conditions. A popular strategy is to delay hernia surgery until the obese patient loses weight, but this is a slow process. Laparoscopic repairs are difficult, particularly when previous surgical

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procedures have produced severe adhesions. An overlooked enterotomy can be catastrophic. Furthermore, the presence of infection or concomitant bowel surgery precludes the use of mesh.

In 1990, Ramirez and colleagues developed a novel operation for reconstructing abdominal wall defects, which they called the separation of components technique. In effect, the separation of components technique expands the muscular abdominal wall surface by medial advancement of an innervated composite of muscle and fascia, which allows the rectus abdominis muscles to be reapproximated in the midline without tension. The technique does not use mesh and is associated with a low recurrence rate (approximately 10%).

Our aims were to determine in morbidly obese patients: (1) the technique of ventral hernia repair using separation of components only; (2) whether it is reasonable to use this approach in association with panniculectomy and a Roux-en-Y gastric bypass; and (3) the long-term outcome of the repair.

METHODS

We analyzed the data from all morbidly obese patients (having a body mass index [BMI] calculated as weight in kilograms divided by height in meters squared ≥35) who underwent ventral hernia repairs by the separation of components technique at the University of California, San Francisco, a university tertiary care medical center, between August 1, 2001, and August 31, 2005. After institutional review board approval, information regarding initial presentation, comorbidities, and previous surgical procedures was extracted from the database and studied. The number and type of previous incisional hernia procedures were obtained from operative reports. Patients were excluded from the study for the following reasons: (1) if synthetic or biodegradable mesh was used during the repair; (2) if they required emergent closure of the abdominal wall; (3) if they had sustained significant abdominal tissue loss, such as from trauma or tumor resection; and (4) if the follow-up was shorter than 12 months.

Thirty patients met the inclusion criteria (25 women [83%] and 5 men [17%]; mean age, 47 years; range, 28-77 years). Comorbid conditions, which were present in 25 patients (83%), included hypertension in 11 patients (37%), diabetes mellitus in 9 (30%), sleep apnea in 6 (20%), gastroesophageal reflux disease in 6 (20%), asthma in 6 (20%), hypothyroidism in 4 (13%), atrial fibrillation in 3 (10%), congestive heart failure in 2 (7%), hypercholesterolemia in 2 (7%), endometrial cancer in 1 (3%), and Hodgkin lymphoma in 1 (3%). The mean BMI was 61 (range, 35-93). Twelve patients (40%) had undergone a previous ventral hernia repair (including 9 patients who had undergone multiple repairs; mean, 2.4 repairs per patient; range, 1-5 repairs). Mesh was present in 8 patients and it was infected in 6 of them. Five of these 8 patients (62%) had an enterocutaneous fistula. Preoperatively, 20 patients (67%) had undergone abdominal computed tomography to better characterize the hernia.

Six ventral hernias, 8 umbilical hernias, and 16 incisional hernias were repaired in the 30 patients. Nine of the incisional hernias resulted from a previous open Roux-en-Y gastric bypass, 3 from open cholecystectomies, 2 from colectomies, 1 from an open splenectomy, and 1 from an exploratory laparotomy. The hernia size was assessed in the operating room immediately after the incision. The mean width of the defect was 12.8 cm (range, 3-55 cm) and the mean length was 17.6 cm (range, 3-50 cm). Six small-bowel resections were performed: 5 for enterocutaneous fistulas, and 1 for severe small-bowel damage that occurred during lysis of adhesions. Six patients underwent simultaneous Roux-en-Y gastric bypass procedures and 16 underwent simultaneous panniculectomies (mean weight of the pannus, 5.6 kg; range, 1.7-10.9 kg).

SURGICAL TECHNIQUE

Informed consent was obtained from the patients, and the risks and benefits of the procedures were explained in detail. The surgical procedures were performed with the patient under general endotracheal anesthesia, and epidural catheters were routinely placed at the T8 to T10 level. Sequential compression devices were applied to the lower extremities, and subcutaneous heparin sodium, 5000 U, was administered before making the incision. Postoperatively, the patients were admitted to the postanesthesia care unit or the intensive care unit depending on their clinical status, the complexity of the procedure, and their comorbid conditions.

The general surgeon (M.G.P.) performed the operative exposure, lysis of adhesions, bariatric procedure, takedown of enterocutaneous fistulas, bowel resection, and exposure of the anterior abdominal wall. Subsequently, a plastic surgeon (R.D.F.) performed the panniculectomy and repaired the hernia according to the separation of components and rectus advancement technique. The key technical aspects were as follows: after the overlying skin was elevated, the external oblique aponeurosis on either side of the abdomen was released from its insertion into the lateral border of the rectus sheath and separated from the internal oblique muscle. The rectus abdominis muscles were advanced and approximated in the midline using figure-of-8 sutures of No. 1 nylon. The skin was closed with 3-0 absorbable, interrupted dermal sutures, followed by a running subcuticular suture of a synthetic 4-0 suture material. Drains were routinely left in the subcutaneous space. First-generation cephalosporins were administered until the drains were removed.

FOLLOW-UP

The patients were seen in the general surgery and plastic surgery clinics every other week for the first 2 months and then at 3-month intervals. All patients were interviewed before submitting the data for this study. The mean follow-up time was 44 months (range, 13-66 months).

RESULTS

There were no intraoperative complications. The mean length of the operation was 348 minutes (range, 150-564 minutes) and the mean blood loss was 65 mL (range, 30-300 mL). Five patients with asthma and severe sleep apnea were placed in the intensive care unit (range, 1-3 days) following the operation. The mean hospital stay was 6.6 days (range, 4-11 days).

Postoperative complications occurred in 5 of the 30 patients (17%): cellulitis developed in 2 patients (7%) and was successfully treated with antibiotics, wound infections developed in 2 patients (7%) and were treated with local wound care, and a seroma developed in 1 patient (3%) and resolved spontaneously. A hernia recurred in 1 patient (3%) 14 months after the surgical procedure. This patient had severe comorbidities (gastroesophageal reflux disease, asthma, sleep apnea, diabetes mellitus, and hypertension), had undergone 4 previous ventral hernia...
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were all easily treated, and only 1 hernia (3%) recurred.

To our knowledge, this is the first report on the use of the separation of components technique for ventral her-
ia repair in a cohort of morbidly obese patients. The av-
average BMI of our patients was 61, which means that they
are among the most challenging patients with abdomi-
inal wall hernias surgeons will face. Forty percent of them
had undergone a previous repair (often with mesh), and
infection and an enterocutaneous fistula were fre-
quently present. Because of infection or the need for a
bariatric procedure, mesh could not have been used in
12 of the 30 patients (40%). A laparoscopic approach was
contraindicated in an additional 9 patients (30%) be-
cause of the presence of extensive adhesions. Thus, the
separation of components technique was applicable and
successful in situations where other methods often fail.

The use of rectus abdominis muscle for abdominal wall
reconstruction was first described by Mathes and Bostwick19 in 1977 and was subsequently popularized by Ramírez and coworkers20 after their 1990 description of the separation of components technique. Many studies have shown that this operation is safe and effective for re-
constructing complex abdominal wall defects, with re-
currence rates of approximately 10%.

Among our pa-
tients, 5 (17%) had postoperative complications, which
were all easily treated, and only 1 hernia (3%) recurred.

These good results required a team approach whereby
each case was discussed preoperatively by a group that
included plastic surgeons, general surgeons, and anes-
thesiologists. An experienced general surgeon per-
served the exploratory laparotomy and lysis of adhe-
sions, which is the best way to avoid enterotomies.20
Switching the teams did not add time to the procedure.
The panniculectomy and the separation of components
aspects were performed by the plastic surgeon. Al-
though we recognize that a plastic surgeon, versatile in
both plastic and abdominal surgery, probably could per-
form the entire procedure safely, this is not the usual pro-
tocol at our institution. We took steps to prevent deep
vein thrombosis, epidural infusions were used to con-
trol postoperative pain, and high-risk patients were cared
for in the intensive care unit.

We learned several lessons from this experience. First,
the decision to repair a hernia and the technique used
should not be based solely on the patient’s BMI. Second,
the considerations in choosing a method of repair for large
hernias are the same for obese and nonobese patients.
Third, autologous tissue techniques are particularly use-
ful in patients with infected mesh, contaminated wounds,
or hernias larger than 15 cm in diameter. Hernias larger
than 15 cm may require mesh in addition to rectus re-
lease. Primary repairs without mesh are rarely appropri-
ate. Even in small defects, the tissue surrounding the de-
fect may be weak, requiring that sutures be placed too
far beyond the edges of the hernia. In such cases, a com-
ponents release is indicated for at least 1 side.

CONCOMITANT PROCEDURES

Six small-bowel resections, 6 Roux-en-Y gastric by-
passes, and 16 panniculectomies were performed along
with the ventral hernia repair. The results show that such
concomitant procedures can be done safely, which ob-
viates the need for an additional procedure. In 12 pa-
tients (40%), the ventral hernia repair would have been
delayed if these requisite intestinal procedures had been
done first. This approach decreased the risk for compli-
cations, such as small-bowel incarceration and stran-
gulation.21 For example, Eid and colleagues21 showed that,
when the treatment of a ventral hernia was deferred at
the time of a bariatric operation, small-bowel incarcer-
ation requiring emergent surgery occurred in approxi-
mately one-third of patients.

We found that a panniculectomy could be performed
safely in conjunction with the ventral hernia repair and other
procedures. Sixteen patients (53%) underwent extensive
panniculectomies (mean weight of the removed pannus,
5.6 kg), and they all did well. The complications were lim-
ited to 5 patients who had minor wound complications,
such as wound cellulitis or infection, which were man-
aged without readmitting the patient. Finally, comorbid con-
ditions did not impair the operative results.

ROLE OF THE SEPARATION OF COMPONENTS
TECHNIQUE IN VENTRAL HERNIA REPAIR

A recent large, population-based study22 on the surgical
treatment of ventral hernias between 1987 and 1999
showed that the use of mesh, which almost doubled (from
34%-65%) during the study period, decreased the recur-
rence rate by 24%. During the latter years of the study,
laparoscopic repairs, with their improved results, came
into widespread use. Nevertheless, of 10 822 patients who
underwent incisional hernia repairs between 1987 and
1999, the 5-year reoperation rate was 24% after the first
operation, 35% after the second, and 39% after the third,
and the results did not improve during the study pe-
period. The type of hospital where the surgical procedure
was performed (rural vs urban, profit vs nonprofit, and
教学 vs nonteaching) did not affect the outcome. The
authors were at a loss to explain the absence of progress,
but the major point was clear: ventral hernias are a source
of substantial morbidity and expenditures.

In summary, we believe that the overall surgical strat-
egy for treating ventral hernias should be as follows:

- Primary suture repairs should be abandoned in fa-
vor of those involving mesh.
When adequate expertise is available, the repair should be performed laparoscopically. Evidence shows that recurrences and overall morbidity are optimal with laparoscopic repairs.3,6,11,21

The separation of components technique is particularly appropriate when infection is present or when concomitant bowel surgery is indicated. It is also the technique of choice for abdominal wall hernias that have recurred several times.23 A team approach that includes a general and a plastic surgeon working together offers the best chance for success.

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William Schecter, MD, San Francisco, California: This remarkable series of 30 morbidly obese patients with an average BMI of 61 who were treated with the separation of parts technique for ventral herniorrhaphy, with a 3% hernia recurrence rate and only 9 relatively minor wound complications, speaks to the skill of Drs Patti and Foster and their team. These patients had all the usual comorbidities of the morbidly obese, yet only 5 required postoperative intensive care, none for more than 3 days, a testimony to the skill of the anesthesiologists. These were complex cases. Forty percent of the patients had recurrent hernias, 5 patients had enteroceleaneous fistulas associated with a previous mesh abdominoplasty, 6 had con-
comitant bowel resection, an additional 6 had Roux-en-Y gas-
tric bypass procedures, and 16 had concomitant panniculectomy, yet the average blood loss was only 65 mL, a truly remarkable accomplishment.

I have a number of questions for the authors regarding their technique to help all of us improve our results. First, your patients had a remarkably benign postoperative course, despite their high risk. One of them had a BMI of 93. Do you have any exclusion criteria for these patients? Dr Patti: We excluded from this study patients with loss of abdominal wall due to tumor or trauma, patients who had a follow-up of less than 12 months, and patients in whom closure of the abdominal wall was done in an emergency situation like a trauma case. Otherwise, these were consecutive patients.

Dr Schecter: Second question: 5 of the 8 patients with mesh abdominoplasty had enteroceleaneous fistulas, yet mesh abdominoplasty is now standard treatment for most ventral hernias. Did you learn anything about the placement of the mesh from these patients that might help us to avoid fistulas when repairing hernias with mesh in the future?

DISCUSSION
Dr Patti: A mesh repair should be the primary form of repair. However, when a hernia has recurred a couple of times, there is not enough omentum that can be interposed between the bowel and the mesh. This is one of the reasons some patients develop an enterocutaneous fistula. In these patients, the separation of components technique should be chosen.

Dr Schecter: Third question: there has been 1 report of a hernia occurring laterally at the point where the rectus sheath has been separated from the external and internal oblique fascia to allow medial advancement of the rectus myofascial unit. Do you think this is a real problem? Should we consider any prophylactic reinforcement of this potential abdominal wall weakness when employing this technique?

Dr Patti: It is a potential problem. However, the incidence is extremely low, so we don't prophylactically add mesh laterally. Do you have any tricks for handling the wound, preventing fat desiccation, or other maneuvers that can help the rest of us achieve these excellent results with these difficult patients?

Dr Patti: These results came from a lot of attention to details. As you mentioned, the anesthesiologist plays a very important role in these operations. Patients were monitored by using both an arterial line and a central line, and the urine output was kept at a pretty high level. The panniculectomy actually can help decrease the incidence of wound infection because the parts that are exposed to this risk are the flaps, which you have to elevate to get to the linea semilunaris. Removing the fat that has been desiccated and has poor blood supply helps decrease the incidence of wound infection. We always leave drains in the subcutaneous tissue, and antibiotics are routinely used.

Dr Schecter: My last question: I have had some experience using acellular dermal matrix in place of mesh rather than the separation of parts technique in repair of complex hernias with fistulas, infected wounds, or significant enteric contamination. There is also some literature to support this approach. It's hard to argue with your excellent results. Have you used acellular dermal matrix? If so, under what circumstances would you use this technique?

Dr Patti: We do not have any experience with the acellular dermal matrix.

Julie A. Freischlag, MD, Baltimore, Maryland: You probably are wondering what I am doing up here asking a question about this paper. I have my administrator's hat on now as I have a group that does these large hernias at Hopkins as well, and we are having a major problem getting paid for these procedures. We have a very funny state; we are a rate-controlled state. However, when we have tried to get these cases to be excluded we are having a major problem getting paid for these procedures. There is also some literature to support this approach. It's hard to argue with your excellent results. Have you used acellular dermal matrix? If so, under what circumstances would you use this technique?

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Dr Patti: The plastic surgeon and I have routinely billed as co-surgeons, and reimbursement has not been a problem.

Samuel Eric Wilson, MD, Orange, California: I certainly agree with you that this is the preferable technique for closure of the abdominal wall, especially after total removal of the infected mesh, but, given your excellent early and late results in the most difficult of hernias, why shouldn't this technique be used primarily instead of routine placement of mesh? After all, many of your patients suffered from complications of a failed mesh repair. My last question is with regard to a personal observation. One of my patients suffered a bothersome lateral abdominal wall neuralgia after such a repair. I thought it may have been due to trauma to a subcostal nerve in the area of the external oblique muscle. Have you seen that in any of your 30 patients?

Dr Patti: Let me answer the easy question first. We have not seen that problem. I am grateful for your question because I don't want to leave you with the impression that we consider this the primary form of repair in every patient with a hernia. I think that the primary suture repair should be abandoned because it has a very high incidence of recurrence. I think that the best way to treat a patient is by the laparoscopic approach, which allows a shorter hospital stay, less discomfort, and a faster recovery. In most of our patients, however, a laparoscopic approach was not indicated. Some had infected mesh, some had enterocutaneous fistulas, and many of them had a concomitant procedure such as a Roux-en-Y gastric bypass or a bowel resection. In addition, a laparoscopic approach requires adequate expertise, as a missed enterotomy can have catastrophic sequelae and there are patients who have died after a laparoscopic ventral hernia repair. When the laparoscopic repair is not feasible, the separation of components technique is the best choice, and a team approach with a plastic surgeon and a general surgeon offers the best chance for success.

J. Craig Collins, MD, Los Angeles, California: Congratulations on these outstanding results. I have a couple of questions for you. The first concerns the choice of sutures. I believe that every surgeon in this room could attest that polypropylene, or in this case nylon, doesn't appear to be prophylactic for recurrence since we have taken out plenty of that stuff from incisional hernias. Have you considered using some of the newer strong, monofilament absorbable sutures, or do you think there is a fundamental difference in patients with morbid obesity that warrants a permanent suture?

Second, regarding the dosing and timing of antibiotics, data suggest that perioperative tissue levels are the most important factor and that there is no benefit to prophylaxis past 24 hours. Did you tailor the doses to the patient's weight? Did you redose intraoperatively, and have you considered shortening the course?

Dr Patti: Nylon was routinely used for the repair. Antibiotics were dosed on the basis of the patient's weight. We used intravenous antibiotics while the patient was in the hospital and oral antibiotics after discharge until the drains were removed.

Lawrence A. Danto, MD, Truckee, California: Your approach is excellent. I wanted you to comment a little more about the primary mesh repairs. Do you prefer the laparoscopic approach because you can dump the patients on Dr [Quan-Yang] Duh, do you prefer it because it is easy, or do you prefer it because the mesh is put in a subfascial plane rather than in continuity with the fascia or above the fascia?

Dr Patti: There is no question that the possibility of asking Dr Duh to help in the very large patient is very nice. The advantages of laparoscopic surgery in many studies have shown that the recurrence rate is around 5% to 10% only. The laparoscopic placement of the dual mesh is ideal because it can be placed a few centimeters lateral to the hernia defect without tension.

Jon M. Greif, DO, Oakland, California: I can attest to what happens when you have done a few of these procedures. You get a lot of referrals, and that is how a breast surgeon is up here talking to you about component separation. We did 1 or 2 of these...
every year when I was in San Diego and, in recent cases when we had finished, if there was a little bit of tension bringing together the rectus muscles, we put in one of the new biological meshes and it actually turned out very well. I wondered, just to take the tension off in the middle, if you have had any experience with that and if you would comment on that.

**Dr Patti:** That it is a great idea, but I do not have any personal experience [with that].

**David Hoyt, MD, San Diego, California:** I wanted to ask about your technique because you describe the lateral release of the external oblique longitudinally as far as you can get it. The traditional component separation describes subsequent steps, which actually involves incising the rectus sheath and then essentially rolling it up into the wound to get an additional 2 or 3 cm on either side. Of your 30 patients, in how many did you have to do all of the components of the component separation as opposed to simply lateral release?

**Dr Patti:** We only did the lateral release. However, it probably would have been better to do the additional release of the rectus fascia in the patient who had a recurrent hernia because the defect was huge.

**J. Augusto Bastidas, MD, Los Gatos, California:** Could you comment on the panniculectomy? How do you plan the panniculectomy? Do you decide how much skin and soft tissue to take preoperatively, or do you just assess it intraoperatively. In the patients who received panniculectomy, was it always planned? Quite often, once you have raised these big flaps, you have huge amounts of extra tissue, and there is always a debate about how much to take.

**Dr Patti:** The panniculectomy was always planned preoperatively, and patients were properly informed by the plastic surgeon and consented.

**Thomas R. Biehl, MD, Seattle, Washington:** Is there a maximal width of hernia that can be repaired with this technique? I noticed that one was up to 55 cm wide, I believe. Is that the one that failed? Does computed tomography help you figure out how big the hernias are and how much mobility you can get from release?

**Dr Patti:** The computed tomography helps very much. If you see that there is a huge defect, you know that you have to do the release on both sides and probably, as Dr Hoyt was suggesting, release also the rectus fascia. I believe that it is safe to repair a defect with a diameter of no more than 20 cm.

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