

# Recalcitrant Abdominal Wall Hernias: Long-Term Superiority of Autologous Tissue Repair

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Secondary repair of recurrent ventral hernia is difficult, and success depends on re-establishing the functional integrity of the abdominal wall. Current techniques used for closure of these defects have documented recurrence rates as high as 54 percent. The authors' 8-year experience utilizing variations of the components separation technique for autologous tissue repair of recalcitrant hernias emphasizes that recurrent or recalcitrant hernias benefit from the creation of a dynamic abdominal wall. A total of 389 patients were retrospectively identified as having abdominal wall defects, and 284 of these patients met the selection criteria. Study patients were grouped according to the type of surgical repair used. The recurrence rate was 20.7 percent over all study groups and was directly related to the extent of repair required. Group 1 patients (wide tissue undermining) had a recurrence rate of only 15 percent, while in group 2 (complete components separation), the recurrence rate was 22 percent. Group 3 patients (interpositional fascia lata graft) had a 29 percent recurrence rate. Time to recurrence was also significantly different across treatment groups, with study group 3 experiencing earlier hernia recurrence. The most frequent postoperative complication was wound infection, which was directly related to the repair performed. The relative odds of recurrence versus the risk factors of age, sex, perioperative steroid use, wound infection, defect size, and the presence of enterocutaneous fistula were studied with a logistic regression analysis. These factors did not possess statistical significance for predicting hernia recurrence. The preoperative presence of mesh was independently significant for hernia recurrence, increasing the relative odds 2.2 times ( $p = 0.01$ ). Similarly, when other risk factors were controlled for, increasing the complexity of the treatment group, from study group 1 (wide tissue undermining) to study group 3 (interpositional fascia lata graft), also increased the odds of hernia recurrence 1.5-fold per group ( $p = 0.04$ ). Average inpatient cost was \$24,488. The length of inpatient stay ranged from 2 to 172 days (average, 12.8 days). The length of inpatient stay and costs were directly related to the extent of repair required. Using the analysis of variance test for multiple factors, the

presence of an enterocutaneous fistula ( $p = 0.0014$ ) or a postoperative wound infection ( $p = 0.008$ ) independently increased the length of inpatient stay and hospital costs. A total of 108 successfully repaired patients were contacted by telephone and agreed to participate in a self-reported satisfaction survey. The patients noticed improvements in the appearance of their abdomen, in their postoperative emotional state, and in their ability to lift objects, arise from a chair or a bed, and exercise. These results suggest that recalcitrant hernia defects should be solved, when possible, by reconstructing a dynamic abdominal wall. (*Plast. Reconstr. Surg.* 112: 106, 2003.)

Ventral hernia complicates nearly 11 percent of abdominal surgery procedures. Repair of recalcitrant hernias is often difficult and depends on re-establishing the functional integrity of the abdominal wall. Current techniques for closure of these defects have documented recurrence rates as high as 54 percent.<sup>1-3</sup> For the past 8 years, we have utilized variations of the components separation technique for autologous tissue repair of recalcitrant hernias. It is our hypothesis that recalcitrant hernias—hernias that have failed at least one prior attempt at repair—benefit from the recreation of a dynamic abdominal wall by muscle approximation. Our long-term outcomes document lower recurrence rates in these difficult patients than do other published techniques. Recalcitrant hernia defects represent a difficult surgical problem requiring extensive hospital time and resources.

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## PATIENTS AND METHODS

A cohort of patients was identified retrospectively. The following inclusion criteria were established: the presence of a ventral wall abdominal defect and a history of at least one prior attempt at repair. These study patients were defined as possessing recalcitrant abdominal wall defects. Patients were specifically excluded from the study if they met one of the three following criteria: (1) if they required emergent closure of their abdominal wall; (2) if they sustained significant abdominal tissue loss, such as from trauma or tumor extirpation; or (3) if their follow-up was less than 6 months.

The patient presented in Figure 1 is typical of the study population. Loss of abdominal wall integrity is seen, and the abdomen is embarrassed by a skin graft from an earlier attempt at repair. Intraoperatively, the integrity of the fascia and muscle has been re-established with the components separation technique.

## RESULTS

## Patient Groups

A total of 389 patients were retrospectively identified, and 284 of these patients met the selection criteria. Patient data were prospectively studied without matched controls. The age of our study population ranged from 15 to 85 years (mean age, 49.7 years), and 55.4 percent were female and 44.6 percent were male. The average follow-up time was 26 months (range, 6 to 96 months). The average defect size was large, equaling 140 cm<sup>2</sup>.

Study patients were organized into groups according to the type of surgical repair used. There were significant differences among our groups with respect to sex, the presence of preoperative synthetic mesh, and the perioperative use of immunosuppressive medications. These differences were addressed by our regression analysis.

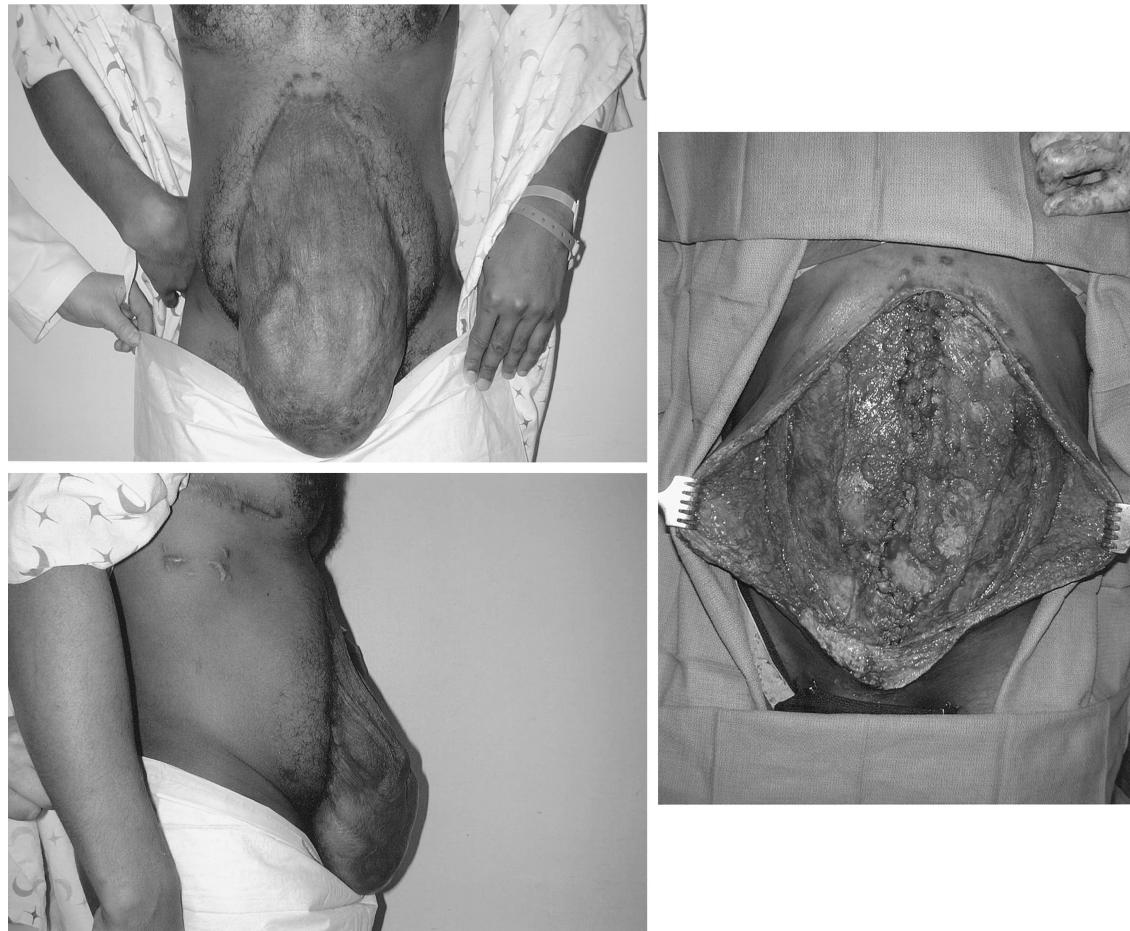


FIG. 1. This patient is typical of the study population. (Left) Loss of abdominal wall integrity is seen, and the abdomen is embarrassed by the presence of a skin graft from an earlier attempt at repair. (Right) Intraoperative closure of the abdomen with the "components separation" technique.

*Group 1: Primary muscle repair with mesh overlay (n = 110).* Patients with recalcitrant hernia defects were reconstructed by widely separating the subcutaneous tissues from the underlying fascia and muscle. This mobilization permitted primary repair of muscle and fascia without fascial incisions. Synthetic mesh was placed over the muscle when possible.

*Group 2: Component separation and primary muscle repair with mesh on lay reinforcement (n = 96).* Patients were similarly reconstructed by wide separation of the subcutaneous tissues from the underlying muscle and fascia. However, relaxing incisions in the aponeurosis of the external oblique muscles and/or elevation

of the rectus muscles from the posterior rectus sheath was also performed. Synthetic mesh was sutured over the repair when necessary.

*Group 3: Interpositional fascial reconstruction (n = 78).* In these patients, the use of synthetic mesh was thought to be contraindicated. Wide separation of the subcutaneous tissues from the underlying muscle and fascia was followed by a fascia lata graft used as an interposition between the muscles of the abdominal wall. Components separation relaxing incisions were used as necessary to minimize tension. Figure 2 demonstrates this technique.

For all repair techniques, the overall recurrence rate was 20.7 percent. Recurrence was



FIG. 2. This patient is typical of patients in study group 3 (interpositional fascia lata graft). (Above, left and center) Loss of abdominal wall integrity is seen, and the colostomy represents a relative contraindication to the use of synthetic mesh. (Above, right) The fascia lata interpositional graft is sewn into place. The components separation technique has also been used, with wide separation of the subcutaneous tissues from the underlying muscle and fascia and relaxing incisions in the aponeurosis of the external oblique muscle. (Below) Postoperative appearance after abdominal domain and intestinal continuity have been re-established.

directly related to the extent of repair required. Group 1 patients experienced a recurrence rate of 15 percent; in group 2, the recurrence rate was 22 percent. In group 3 patients, it was 29 percent. Time to recurrence was significantly different across treatment groups, with the earliest recurrence seen in group 3.

Postoperative complications varied but most frequently they involved wound infection. The frequency of wound infection was directly related to the extent of repair required. Postoperative infection in group 3 patients was related to either the abdominal repair or the tensor fasciae latae donor site. Infection frequency is depicted in Figure 3. Kaplan-Meier curves were calculated, and interestingly, postoperative wound infection did not affect the frequency of hernia recurrence.

A logistic regression analysis was undertaken to establish the relative risk of recurrence. Risk factors were age, sex, perioperative steroid use, wound infection, defect size, and the presence of an enterocutaneous fistula. Interestingly, these risk factors did not significantly increase the risk of hernia recurrence. A representative Kaplan-Meier curve for perioperative steroid use is illustrated in Figure 4.

The preoperative presence of mesh was independently significant for hernia recurrence and increased the relative risk of recurrence by a factor of 2.2 ( $p = 0.01$ ). Graphic depiction of this risk is seen in Figure 5. Similarly, when other risk factors were controlled for, increasing the complexity of the treatment group also

increased the risk of hernia recurrence by a factor of 1.5 per group ( $p = 0.04$ ).

Comprehensive billing data were available for 79.3 percent of our study patients from 1995. Average inpatient costs were \$24,488, and the length of inpatient stay ranged from 2 to 172 days (average, 12.8 days). The length of inpatient stay and costs were directly related to the study group. Specifically, group 3 patients required nearly 3 weeks in the hospital at a cost of more than \$40,000, whereas groups 1 and 2 stayed only 10 days in the hospital at a cost of approximately \$20,000. Using the analysis of variance test for the significance of multiple factors, the presence of an enterocutaneous fistula ( $p = 0.0014$ ) or a postoperative wound infection ( $p = 0.008$ ) independently increased both the length of inpatient stay and hospital costs (Fig. 6).

A total of 108 successfully repaired patients were contacted by telephone and agreed to participate in a self-reported satisfaction survey. They were asked a series of questions regarding their emotional health and well being, the appearance of their abdomen, and their ability to perform daily activities. Patients were asked to score their postoperative satisfaction in these areas on a 50-point scale, with 30 representing no improvement and 50 indicating "much better." The patients noticed improvements in the appearance of their abdomen, in their emotional state postoperatively, in abdominal strain, and in their ability to lift objects, arise from a chair and a bed, and exercise. Interestingly, they reported no change in their bowel function or in their back pain. Patient satisfaction results are graphically depicted in Figure 7.

## DISCUSSION

Incisional hernias frequently complicate abdominal surgery procedures.<sup>4-6</sup> Incisional hernias may cause serious morbidity from a variety of symptoms, including bowel or omental incarceration and strangulation. The abdominal wall is a uniquely dynamic structure. Its three-dimensional motion is essential to both respiratory and gastrointestinal function. Unlike the mobile thoracic cage, the abdominal wall is only supported at its periphery by bony anchors. The ideal abdominal wall reconstruction should fulfill the criteria of DiBello and Moore<sup>7</sup>: (1) prevent visceral eversion; (2) incorporate with the remaining abdominal wall; (3) provide dynamic muscle support; (4)

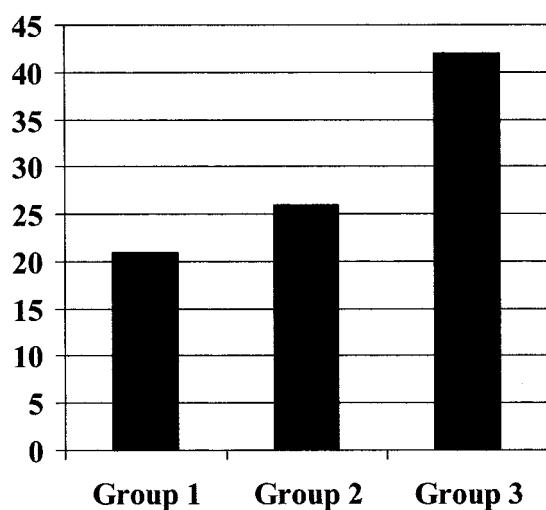


FIG. 3. Frequency of postoperative wound infection by study group: group 1, wide tissue undermining; group 2, complete components separation; group 3, interpositional fascia lata graft.

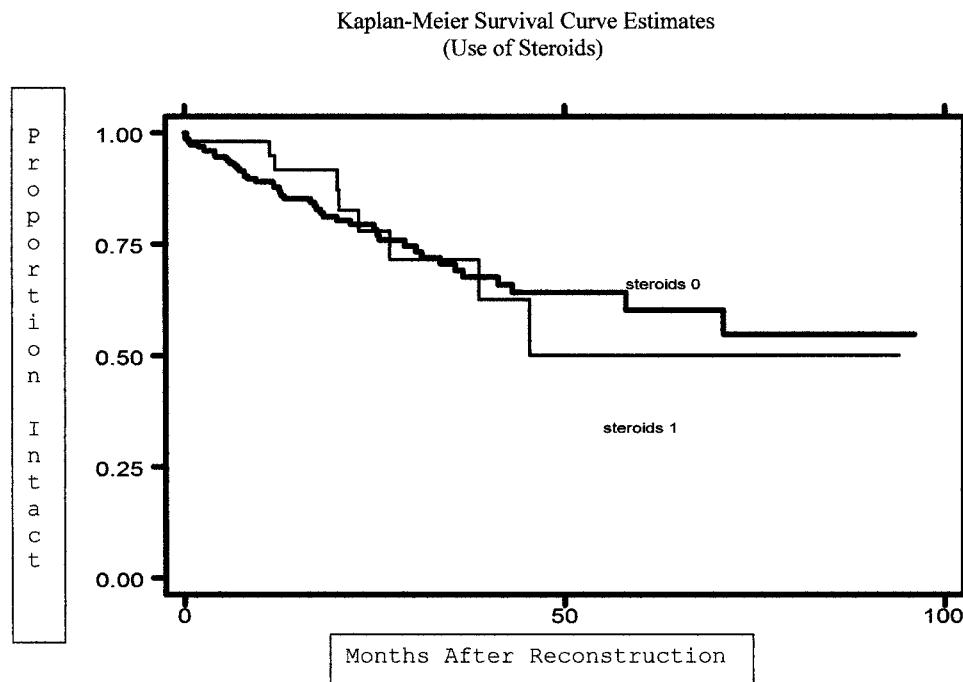


FIG. 4. Kaplan-Meier curves indicating that perioperative steroid administration does not significantly predict hernia recurrence.

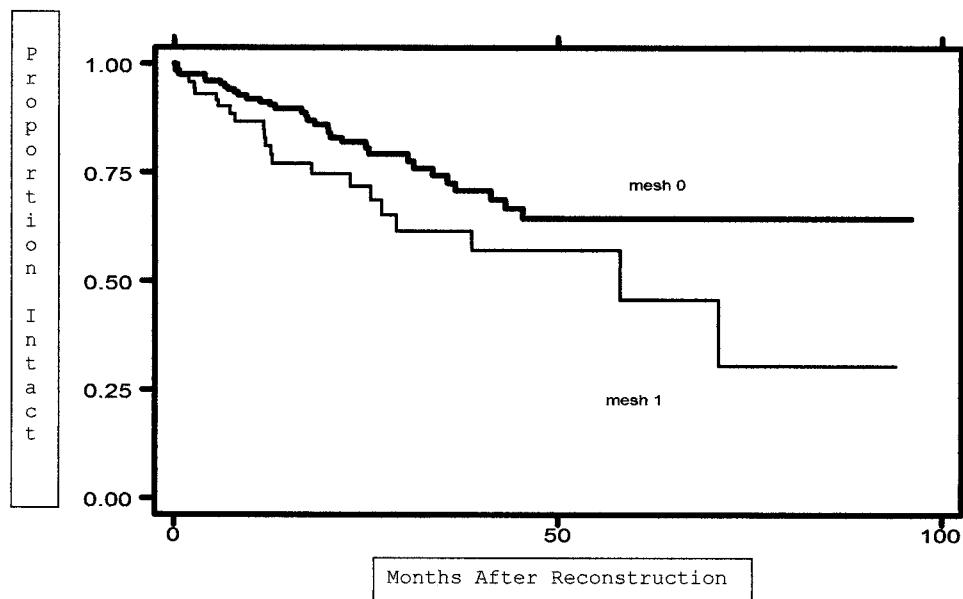


FIG. 5. Kaplan-Meier curves indicating that the preoperative presence of mesh was independently significant for hernia recurrence. The presence of preoperative mesh increased the relative odds of recurrence 2.2-fold ( $p = 0.01$ ).

provide a tension-free repair, and (5) endure over time.

Many techniques for hernia repair have been described. Recurrence frequently follows primary repair, and rates have been quoted as high as 54 percent.<sup>1-3</sup> It is this group of patients with recalcitrant defects who frequently re-

quire special closure techniques. For all patients studied here, at least one prior attempt at repair had failed. Our patients comprised a unique and challenging cohort that has received only peripheral attention in the literature. For the past 8 years, we have utilized variations of the components separation tech-

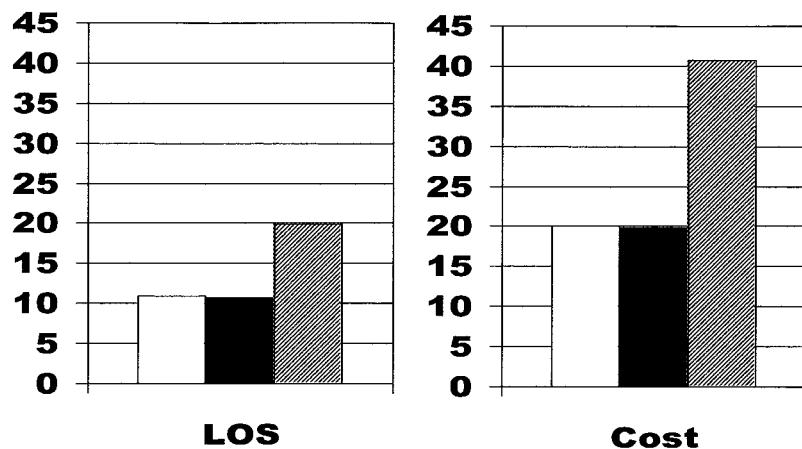


FIG. 6. (Left) Average length of inpatient stay (LOS, in days) by study group. (Right) Average hospital costs (in thousands of dollars) by study group. Group 1 (wide tissue undermining), □; group 2 (complete components separation), ■; group 3 (interpositional fascia lata graft), ▨.

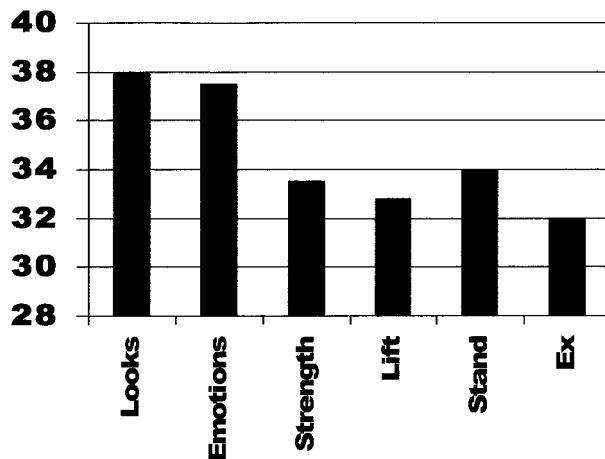


FIG. 7. Successfully repaired patients scored their post-operative satisfaction on a 50-point scale, with 30 representing no improvement and 50 indicating "much better." Improvements were noted in abdominal appearance (Looks), emotional state (Emotions), subjective abdominal strength (Strength), and ability to lift objects (Lift), arise from a chair and a bed (Stand), and exercise (Ex).

nique for autologous tissue repair of recalcitrant hernias. It is our hypothesis that recurring or recalcitrant hernias benefit from the creation of a dynamic abdominal wall and that wide exposure of the entire anterior abdominal wall permits identification of additional areas of weakness and simultaneous hernias. Fifty percent of patients had more than one hernia at the time of exploration.

The practice of direct suture repair of hernia defects by limited exposure is inadequate for two reasons. First, there is no relief of abdominal wall tension. Second, there is no opportunity to inspect the entire anterior abdominal

wall. Luijendijk et al.<sup>8</sup> reported on a cohort of patients prospectively randomized to either direct repair or repair with interpositional mesh. The long-term recurrence rate was significantly different between these two groups, with the suture repair failing 43 percent of the time and the mesh failing only 24 percent of the time. Among the patients in Luijendijk et al.'s study, only 27 could be classified as having recalcitrant hernias. Recurrences in patients with recalcitrant defects ranged from 20 to 58 percent.<sup>8</sup> The authors conclude that even for small defects, the use of interpositional mesh is superior to direct closure.

Luijendijk et al.<sup>8</sup> reported few mesh-related complications. Traditionally, synthetic mesh in contact with the bowel carries the risk of erosion, infection, and fistula formation. Voyles et al.<sup>9</sup> reported long-term mesh extrusion or fistula formation to be 78 percent and 22 percent, respectively. Karakousis et al.<sup>10</sup> confirmed these data, documenting a fistula occurrence rate following abdominal wall repair with unprotected mesh of 23 percent.

Although new Marlex, Prolene, and Gore-Tex products are available for implantation, it remains desirable to interpose omentum and/or peritoneum between the mesh and the bowel. Such an interposition dramatically lowers the incidence of gastrointestinal complications.<sup>8,11</sup> Omentum, however, is often at a premium in the patient with a recalcitrant abdominal wall hernia. For that reason, we have advocated the use of vascularized, innervated tissue obtained with wide undermining and variations of the components separation

technique to release tension and re-establish the integrity of the abdominal wall. Wide undermining, as performed in group 1 study patients, accomplishes two important goals: (1) inspection of the entire abdominal wall to identify secondary hernia defects or weaknesses missed by physical examination and (2) release of the tension imposed by scar and skin contracture.

In our series of recalcitrant abdominal wall repairs, the recurrence rate was 20.7 percent. Recurrence was directly related to the extent of repair. When vascularized, innervated tissue is available and utilized via variations of the components separation technique, recurrence is lower. Specifically, group 1 patients had a recurrence rate of only 15 percent, whereas in group 2, the recurrence rate equaled 22 percent. Group 3 patients, repaired with the fascia lata graft, had a recurrence rate of 29 percent. The patients in study group 3 are a unique and difficult cohort. The degree of preoperative wound contamination in this group, either from fistulas or ostomy, theoretically prohibits the use of synthetic mesh. Clearly, the tensile strength of autologous fascia is less than that of synthetic mesh,<sup>12</sup> and this may ultimately contribute to the increased rate of recurrence observed.

Using the components separation technique in a limited group of patients ( $n = 35$ ) with recalcitrant hernias, DiBello and Moore<sup>7</sup> reported an overall recurrence rate of only 8.5 percent. Similarly, we have previously reported a group of recalcitrant hernia patients ( $n = 37$ ) with a recurrence rate of 5 percent overall.<sup>13</sup> Our average follow-up is now greater than 26 months (range, 6 to 96 months), compared with studies in which average follow-up times were less than 2 years. Time has proven to be a sterner judge of clinical outcomes.

The risks of recurrence were also evaluated by multivariate logistical regression. Most standard risk factors did not affect recurrence. Specifically, age, sex, perioperative immunosuppressive medications, size of defect, infection, and prior surgical treatment did not alter the relative risk of hernia recurrence. These results are different from the findings of Luijendijk et al.,<sup>18</sup> who reported a statistically significant link between infection and recurrence and between prior abdominal aneurysm surgery procedures and hernia recurrence. They also note that others have reported a similar increased frequency of inguinal and incisional hernias in

patients who have undergone prior abdominal aneurysm surgical treatment.<sup>14</sup> No clear mechanism of association is apparent.

The size of the defect has frequently been cited as a risk for hernia recurrence.<sup>15</sup> Excessive tension at the edges of the abdominal wall defect produces local tissue ischemia and has been widely implicated in the failure rates of some repair techniques,<sup>1</sup> especially primary repairs. Luijendijk et al.<sup>8</sup> have advocated the use of interpositional mesh to decrease wound closure tension. When mesh is contraindicated, as in the contaminated wound, the use of interpositional fascia lata grafting similarly reduces wound tension.

Advancing the individual components of the abdominal wall with the components separation technique, where fascia is incised, clearly reduces the tension of the closure, but it also weakens the abdominal wall in the areas of release. Nahas et al.<sup>16</sup> have presented cadaver data to document this statement. Documenting tension measurements from various positions along the rectus sheath during the stages of the components separation dissection, they demonstrated a statistically significant reduction in the traction index with increased dissection.

The risk of recurrence is also directly related to the presence of preoperative mesh. Frequently, this mesh was exposed and contaminated. The recalcitrant abdominal wall defect that has already failed a mesh repair is a testament to the severity of that defect.

In today's environment of managed care, outcomes must also be examined within the framework of patient satisfaction and hospital costs. These interrelated measurements reflect the increase in the power of patient advocacy groups and of financial managers in medical care, including the government.

Comprehensive financial data were available for nearly 80 percent of our patients. The costs of recalcitrant hernia repair were striking, averaging more than \$24,000. Hospital costs were directly related to the extent of repair required. Patients in groups 1 and 2 spent fewer days in the hospital and had lower overall costs than patients in group 3. Analysis of variance testing for multiple factors revealed that only the presence of an enterocutaneous fistula ( $p = 0.0014$ ) or a postoperative wound infection ( $p = 0.008$ ) independently increased the length of inpatient stay and hospital costs. It should be noted that both of these risk factors

were found more frequently in group 3 patients.

Numerous studies have addressed the costs associated with inguinal hernia repair. Authors have attempted to justify open versus laparoscopic repair in terms of hospital costs, total costs, and time off work.<sup>17,18</sup> The results do not demonstrate a superior technique and bridge many different health care delivery systems. Few studies in the literature have examined the costs associated with ventral hernia repairs. Israelsson and Wimo<sup>19</sup> studied the operative costs as they related to different suture closure techniques. They found that the average cost of one hernia repair was \$42,643 Swedish Kronors (\$4028.48 in 2000 U.S. dollars). This cost is dramatically lower than the cost of the recalcitrant hernia defect. Patient selection, operative techniques, varying exchange rates, and differing national health care standards are, of course, difficult to equate.

Holzman et al.<sup>20</sup> compared the hospital costs and lengths of inpatient stay of patients with ventral hernias repaired laparoscopically and of patients repaired with a traditional open approach. Those patients repaired with a traditional open technique required a longer inpatient hospital stay (5 days versus 1.6 days) at a greater overall cost (\$7300 versus \$4400,  $p = 0.05$ ) compared with patients treated laparoscopically. Overall recurrence rates were similar (12 percent), with an average follow-up time of less than 2 years. Similarly, DeMaria et al.<sup>21</sup> studied laparoscopic ventral hernia repairs in comparison to traditional open techniques. This group documented a less painful recovery in the patients treated laparoscopically. There were also statistically significant differences between the groups with respect to length of inpatient stay and total cost. For our comparison, patients who required open repair experienced an average length of inpatient stay of 4.4 days at a total cost of \$12,500.

Most data are gathered on patients who present for their initial ventral hernia defect repair. For the 284 patients in this study, at least one prior attempt at repair had failed, and they had, by definition, recalcitrant defects. It is not surprising that this is a unique and challenging cohort of patients who experience longer hospital stays and incur greater overall costs than their counterparts; they also have more recurrences.

However, the satisfaction data suggest additional social and psychological benefits follow-

ing autologous tissue reconstruction. There are no similar data in the literature addressing abdominal wall repair.

## CONCLUSIONS

The incisional hernia frequently complicates abdominal surgery procedures. For the past 8 years, we have utilized variations of the components separation technique for autologous tissue repair of recalcitrant hernias. It is our hypothesis that recurring or recalcitrant hernias benefit from the recreation of a dynamic abdominal wall by components separation techniques. When surveyed, patients with successful autologous tissue repairs noticed improvements in the appearance of their abdomen, in their postoperative emotional state, in abdominal strength, and in their ability to lift objects, arise from a chair or a bed, and exercise. Our long-term outcomes document lower recurrence rates in these difficult patients than do other published surgical techniques. Recalcitrant hernia defects remain a challenging surgical problem, requiring extensive hospital stays and resources for successful repair.

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