

Open Incisional Hernia Repair at an Academic Tertiary Care Medical Center

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Objective: To describe the postoperative complication rates of a large consecutive series of patients who underwent open incisional ventral hernia repair.

Design: Retrospective medical record review of an accumulated database.

Setting: University tertiary care medical center.

Patients: All patients who underwent open incisional ventral hernia repair from March 1, 2003, through February 28, 2008.

Intervention: Open incisional ventral hernia repair.

Main Outcome Measures: Postoperative complications, including hernia recurrences.

Results: A total of 507 cases (465 patients; female to male ratio, 1.1:1) met our criteria; median follow-up was 40 months. In 23.5% of the cases, repair had been attempted previously, and 16.4% had previously undergone organ

transplant. The postoperative complication rate was 38.1%. Hernias recurred in 18.9% of cases. Perioperative mortality was 1.0%. Patients undergoing transplant were more likely than those not undergoing transplant to have a hernia recurrence (16.3% vs 32.5%; $P < .001$) and were equally likely to have a postoperative complication (36.9% vs 44.6%; $P = .19$). Patients who underwent repair of a recurrent incisional hernia were as likely to have a hernia recurrence as those who underwent initial repair (21.0% vs 18.3%; $P = .52$) but more likely to have an overall complication (47.9% vs 35.1%; $P = .01$).

Conclusions: In this series of incisional hernia repairs at a tertiary care center, the overall recurrence rate of 18.9% is comparable to that of other published series. Ours is the largest published series of recurrent hernias that shows a recurrence rate comparable to that for initial repairs. This outcome may be the result of greater use of more complex repair techniques.

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AN INCISIONAL HERNIA IS A relatively common complication after abdominal surgery, with a reported incidence of 11% to 23%.¹⁻³

It is a major source of morbidity for patients and includes pain and hospitalization in about 6% to 15% of cases.⁴ A tremendous cost is associated with hernia repair when factoring in lost wages, the additional hospitalization cost, and lifestyle changes.⁴

Many techniques have been introduced to help reduce recurrences and complications of incisional hernias, including simple suture repair, prosthetic mesh repair, component separation, laparoscopic repair, and recently, biological dermal substitutes for hernia repair.^{5,6} Simple primary repair of fascia has been associated with recurrence rates as high as 49%.⁷⁻⁹ When permanent mesh gained

widespread use after 1963,¹⁰ recurrence rates of incisional hernias decreased, with some series reporting recurrence rates closer to 10% for open mesh repair of ventral hernias.¹¹⁻¹⁶ Other methods for more complex hernias and recurrences have included component separation¹⁷ and combinations of mesh repair plus component separation.¹⁸ Recently, various biological mesh products such as collagen matrix (Alloderm; LifeCell Corporation, Branchburg, New Jersey) have added to the numerous ways incisional ventral hernias are repaired.¹⁹ However, no clear consensus has been reached about which procedure yields the best results. Even within a single institution, individual surgeons repair incisional hernias differently. Our institution is no exception. The University of California, San Francisco (UCSF), is a high-volume tertiary medical center for the repair of large incisional ventral hernias.

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We sought to describe our institutional practice, surgical techniques, recurrence rate, and total complication rate for open repair of incisional ventral hernia, focusing specifically on recurrent open incisional repairs.

METHODS

During the 5-year period from March 1, 2003, through February 28, 2008, 542 ventral hernia repairs were performed at UCSF Medical Center. We excluded 35 patients who had a laparoscopic repair of their hernia, were younger than 18 years, or had a nonincisional ventral hernia. After receiving approval from our institutional review board, we reviewed medical records to obtain the following information: surgeon, date of surgery, etiology of the incisional hernia, procedure type, patient age, sex, smoking history, body mass index, presence of diabetes mellitus or chronic obstructive pulmonary disease, and any immunosuppressive therapy, including long-term corticosteroid use. Outcomes consisted of any complication related to the hernia surgery and hospitalization, including minor wound complications, bowel injury, postoperative fistula formation, and hospital-acquired pneumonia or urinary tract infection. Hernia recurrence was determined by reviewing outpatient medical records and was considered a complication. Patients with a hernia recurrence consisted of those requiring additional surgery for repair, those with an incidental hernia found during unrelated additional abdominal surgery, and those whose hernias were detected on the physical or radiological examinations. We compared subgroups using the χ^2 and Mann-Whitney tests. Two-sided $P < .05$ was considered statistically significant.

RESULTS

PATIENT CHARACTERISTICS

A total of 507 cases were managed in 465 unique patients by 38 different surgeons from the fields of general surgery, plastic and reconstructive surgery, and transplant surgery. The median follow-up time was 40 months, and the mean time to recurrence was 15.4 (range, 0-58) months. Patient clinical and demographic data are summarized in **Table 1**. Overall, the average body mass index (calculated as weight in kilograms divided by height in meters squared) was greater than 30.0, which is considered obese by National Institutes of Health standards, and more than 25% of the case patients were severely or morbidly obese. Of the 507 case patients, 51.5% were women, 23.4% had diabetes mellitus, 4.2% had chronic obstructive pulmonary disease, and 36.7% were taking immunosuppressive medications. Most hernias (41.2%) were repaired by the placement of permanent mesh (eg, Prolene [Ethicon, Inc, Sommerville, New Jersey], Marlex [CR Bard, Inc, Murray Hill, New Jersey], GORE-TEX [WL Gore & Associates, Inc, Flagstaff, Arizona], and Dual Mesh [WL Gore & Associates, Inc]) (n=209) or the use of primary fascial sutures (n=109).

INITIAL VS RECURRENT HERNIAS

Nearly a fourth of the cases (119 [23.5%]) were repairs for recurrent ventral hernias, including attempted re-

Table 1. Patient Characteristics and Types of Hernia Repair

Variable	All Cases (N=507)
Follow-up, median (range), mo	40.0 (11.7-72.2)
BMI, mean (SD)	30.7 (7.2)
Smoking, mean (SD), pack-years	7.7 (16.0)
Active smoker, No. (%)	57/320 (17.8)
Sex, No. (%) ^a	
Female	261 (51.5)
Male	245 (48.3)
Obese, No. (%)	143/339 (42.2)
Diabetic, No. (%)	90/384 (23.4)
COPD, No. (%)	16/384 (4.2)
Immunosuppressive therapy, No. (%)	145/395 (36.7)
Hernia repair types, No. (%)	
Primary repair	109 (21.5)
Component separation	65 (12.8)
Permanent mesh repair	209 (41.2)
Component separation plus mesh	81 (16.0)
Biologicals	29 (5.7)
Others not classified	14 (2.8)
Complications, No. (%)	193 (38.1)
Recurrence, No. (%)	96 (18.9)
Mortality, No. (%)	5 (1.0)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); COPD, chronic obstructive pulmonary disease.

^aData were missing for 1 patient.

Table 2. First-Time vs Recurrent Hernia Repair

Variable	First Time (n=387) ^a	Recurrent (n=119)	P Value
Follow-up, mean (SD), mo	40.1 (17.9)	41.1 (18.1)	.65 ^b
BMI, mean (SD)	29.9 (6.4)	32.9 (8.7)	.03 ^b
Obesity, No. (%)	103/251 (41.0)	40/88 (45.5)	.47 ^b
Smoking, mean (SD), pack-years	5.7 (13.3)	13.2 (20.7)	.001 ^b
Sex, No. (%)			
Female	199 (51.4)	62 (52.1)	.88 ^c
Male	188 (48.6)	57 (47.9)	
Diabetes mellitus, No. (%)	69/290 (23.8)	21/94 (22.3)	.77 ^c
COPD, No. (%)	12/289 (4.2)	4/95 (4.2)	.98 ^c
Immunosuppressed, No. (%)	122/300 (40.7)	23/95 (24.2)	.004 ^c
Hernia repair types, No. (%)			
Primary repair	92 (23.8)	17 (14.3)	.01 ^c
Component separation	50 (12.9)	15 (12.6)	
Permanent mesh repair	165 (42.6)	43 (36.1)	
Component separation plus mesh	51 (13.2)	30 (25.2)	
Biologicals	20 (5.2)	9 (7.6)	
Others not classified	9 (2.3)	5 (4.2)	
Complications, No. (%)	136 (35.1)	57 (47.9)	.01 ^c
Recurrence, No. (%)	71 (18.3)	25 (21.0)	.52 ^c

Abbreviations: See Table 1.

^aData were missing for 1 patient.

^bMann-Whitney test.

^c χ^2 Test.

pair of incisional hernias with a subsequent recurrence at UCSF or another hospital. As demonstrated in **Table 2**, these 2 groups were similar demographically, but significantly more patients with recurrent hernias had a history of smoking (mean [SD] pack-years, 13.2

Table 3. Nontransplant Hernia Repair vs Posttransplant Hernia Repair^a

Variable	Nontransplant Group (n=423) ^b	Transplant Group (n=83)	P Value
Follow-up, mean (SD), mo	40.5 (18.1)	39.8 (17.1)	.80 ^c
Obesity, No. (%)	127/282 (45.0)	16/57 (28.1)	.02 ^d
BMI, mean (SD)	31.2 (7.5)	28.0 (4.3)	.04 ^c
Smoking, mean (SD), pack-years	8.8 (17.0)	2.6 (7.7)	.003 ^c
Diabetes mellitus, No. (%)	61/313 (19.5)	29/71 (40.8)	<.001 ^d
COPD, No. (%)	15/313 (4.8)	1/71 (1.4)	.20 ^d
Sex, No. (%)			
Female	236 (55.8)	25 (30.1)	<.001 ^d
Male	187 (44.2)	58 (69.9)	
Hernia repair types, No. (%)			
Primary repair	88 (20.8)	21 (25.3)	<.001 ^d
Component separation	65 (15.4)	0	
Permanent mesh repair	151 (35.7)	57 (68.7)	
Component separation plus mesh	76 (18.0)	5 (6.0)	
Biologicals	29 (6.9)	0	
Others not classified	14 (3.3)	0	
Complications, No. (%)	156 (36.9)	37 (44.6)	.19 ^d
Recurrence, No. (%)	69 (16.3)	27 (32.5)	<.001 ^d

Abbreviations: See Table 1.

^aPercentages have been rounded and may not total 100.

^bData were missing for 1 patient.

^cMann-Whitney test.

^d χ^2 Test.

[20.7] vs 5.7 [13.3]; $P = .001$), a higher mean (SD) body mass index (32.9 [8.7] vs 29.9 [6.4]; $P = .03$), and more complications from the hernia repair (47.9% vs 35.1%; $P = .01$). In patients who underwent repair for a recurrent hernia, the recurrence rate was not significantly higher than that for patients who underwent initial repair (21.0% vs 18.3%; $P = .52$). The techniques used to repair recurrent hernias differed from those used for initial repair. Permanent mesh was the most common method in both groups (42.6% for initial repair and 36.1% for recurrent hernias). There were fewer attempts at primary fascial repair; instead, the more complex technique of component separation plus permanent mesh was used more often (13.2% for initial repair and 25.2% for recurrent hernias).

POSTTRANSPLANT HERNIAS

A total of 16.4% of the repairs were performed in patients whose incisional ventral hernia resulted from solid-organ transplant. These patients were all receiving immunosuppressive therapy. The transplant group had a higher male to female ratio and a higher rate of diabetes but a lower obesity rate than the nontransplant group (**Table 3**). The 2 main techniques used to repair posttransplant hernias included primary repair (25.3%) and simple mesh repair (68.7%). Only a small percentage of hernias (6.0%) were repaired using component separation plus mesh. The overall complication rates were similar for the 2 groups (44.6% for the transplant group vs 36.9% for the nontransplant group; $P = .19$), but the hernia recurrence rate was higher in the transplant group (32.5% vs 16.3%; $P < .001$).

Our review of a heterogeneous group of patients with hernias from a variety of causes shows that our outcomes are comparable to those of most large series of open incisional hernias. In our series, the overall complication rate was 38.1, which is relatively high compared with the reported range of 12% to 64%.^{7,8,20-22} We believe that this relatively high recurrence rate is related to our inclusion criteria of a complication. We defined a "complication" as any major or minor complication (ie, urinary tract infection or cellulitis treated with antibiotics) related to the hernia surgery or any hospitalization that occurred at any point after the procedure, including those for hernia recurrences. Most series that report lower complication rates do not consider hernia recurrence a complication. The overall recurrence rate was 18.9%, which is similar to the rates of other large institutional series.²³⁻²⁵

Not surprisingly, permanent mesh was the most commonly used method of hernia repair. A recent prospective study comparing mesh repair with primary repair for small ventral hernias showed that mesh repair had a lower incidence of recurrence (24% vs 43%).²⁰ In our series, 21.5% of hernias underwent primary repair alone. However, over time, the use of primary repair decreased in our institution from 34.8% in 2003 to 11.6% in 2008. This change in practice resulted in a decrease in recurrence rates from 29.2% to 10.0% during the same period. We found no significant difference in recurrence rates among the types of hernia repair. However, such a difference might not be expected in a study like ours, because selection of the repair technique was not randomized but was instead left to the clinical judgment of the surgeon, and we could not control for or measure the hernia defect size for each case.

One way to compare repair techniques is to analyze the prevalence of their use for various types of hernias. Recurrent ventral incisional hernias compose a subcategory of hernias that tend to be more complex. After the repair of recurrent hernias, recurrence rates of up to 48% have been reported.²¹ In our series, 23.5% of repairs were for recurrent hernias, a group that includes patients in whom previous repair attempts had failed. These hernias are typically larger and have very challenging wound problems. These complex wounds, including multiple incisions, open wounds, and loss of abdominal wall soft tissue, can make definite repair more difficult. Moreover, many were previously repaired with mesh, which must be either removed or repaired. We showed that, although the overall complication rates were higher than those for initial repairs (47.9% vs 35.1%; $P = .01$), the long-term recurrence rate was similar (21.0% vs 18.3%; $P = .52$). Ours is, to our knowledge, the largest published series of recurrent hernias that shows a recurrence rate comparable to that for initial repairs. This outcome may be the result of a different technical approach to recurrent hernias. Primary repair was used in only 14.3% of recurrent cases and, although permanent mesh alone was still the most common repair technique (36.1%), component separation plus mesh was used in 25.2%. In contrast, component separation plus mesh was used in only

13.2% of initial repairs. Consequently, the change in repair technique may have had a key role in the success of repairing recurrent incisional hernias.

Like recurrent hernias, incisional hernias in patients who have undergone organ transplantation are very challenging. Our series had 83 such patients, all of whom were immunocompromised and had higher rates of comorbidities than the patients in the nontransplant group. In addition to receiving immunosuppressive therapy, many of these patients had diabetes mellitus, another important risk factor for poor wound healing. Given these factors, we were not surprised to find that they had a higher hernia recurrence rate than the nontransplant group (32.5% vs 16.3%; $P < .001$) (Table 3). Another challenging aspect of hernia repair in patients who have undergone transplant is the location of the posttransplant incisions. Most posttransplant incisional hernias occurred at nonmidline incisions. This presents a unique challenge for repair because it eliminates techniques such as component separation that are usually used for more difficult hernias. The fact that only 2 repair techniques were used in most of our patients in the transplant group—permanent mesh placement (68.7%) or primary fascial repair (25.3%)—is indicative of the limited options for repairing incisional hernias from nonmidline locations.

Our study has several limitations, mostly related to its retrospective design. Although we were specifically interested in the correlation between hernia size defects and outcomes and we expected that larger hernias would lead to higher recurrence rates, hernia size was not recorded in most of the operative reports, especially given the large number of surgeons and the different dictating styles. Also, given the retrospective design, we were unable to obtain each surgeon's rationale or decision making process for deciding which repair technique to use for each hernia. Because of this lack of randomization, we are unable to compare specific repair techniques and outcomes.

In conclusion, the overall hernia recurrence rate of 18.9% in our series is comparable to those of other published series. To our knowledge, ours is the largest published series of recurrent hernias that shows a recurrence rate comparable to that for initial repairs. This outcome may be the result of greater use of more complex repair techniques.

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DISCUSSION

Rodney Mason, MD, Los Angeles, California: This paper from UCSF looks at the recurrence rate and complications of 507 open incisional ventral hernia repairs over a 5-year period. The series contained 119 patients who had repair of a recurrent ventral hernia and is the largest series to date of recurrent ventral hernias.

For recurrence rates, the authors reviewed outpatient medical records and included symptomatic and asymptomatic patients found incidentally by clinical examination or on computed tomographic scan. Did the authors have a mandated routine postoperative follow-up schedule or policy for these patients, and did they look at records from other nonsurgical clinic visits? If there was no routine follow-up policy, there may be more asymptomatic recurrences in patients unaware of any problem.

The hernia repairs were performed by a very heterogeneous group of 38 surgeons in 3 categories: transplant, plastic, and general surgeons. Do the authors have any data for the recurrence rate per surgeon category? Did they look at the correlation in their outcome data between surgeons performing a high volume and a low volume of repairs?

The authors found a significant difference in the technique utilized for recurrent hernias, with significantly more patients undergoing separation of components with mesh repair compared to the patients undergoing initial repair. This group had significantly more complications. Was the high complication rate due to the high morbidity associated with the open component separation technique, which has tremendous postoperative wound issues due to the extensive nature of the dissection?

The complication rate for the whole series was high. The authors do not give specific details about the nature or type of complications, but I presume that a large number were wound related. Furthermore, only 5% of the patients were approached laparoscopically. Laparoscopic ventral hernia repair and now even laparoscopic component separation are associated with significantly fewer wound-related complications. What do the authors think about a laparoscopic approach for incisional hernias? Is this technique associated with fewer postoperative complications? Are they adopting this technique or do they not believe in it?

What do the authors think about a laparoscopic approach for the transplant patients? The majority had hernias off the midline and in difficult anatomical locations that may be repaired more easily with an intraperitoneal laparoscopic approach than an open procedure.

Hernia size is related to recurrence, and the authors were unable to get reliable data on hernia size. Can they give us some kind of breakdown as to the techniques of mesh placement (ie, the proportion with inlay, onlay, or sublay positioning of the mesh) and [tell us] whether there was any correlation with recurrence?

While there was a high prevalence of primary suture repair, the authors found no difference in recurrence rate based on repair type. This would seem to indicate that the recurrences are largely due to patient-related factors. The patients with recurrences were significantly more obese and had a greater proportion of smokers. Do the authors have any policies that may specifically improve the patient-related factors, for example, by performing any staged procedures such as a sleeve gastrectomy before hernia repair in the obese patients, or by not operating on current smokers? Or do they tailor the technique and type of repair based on the patient's preoperative comorbidities?

Finally, I would like to ask if the authors think that, in this day and age, there is ever any indication for a primary suture repair.

Dr Harris: We do not have a uniform follow-up policy. Most surgeons saw their patients between 2 and 4 weeks after sur-

gery and, of course, they followed patients who had complications for an extended period of time. But there was not a standardized mechanism for follow-up, which is one of the problems with retrospective reviews.

None of the hernias were picked up in a nonsurgical clinic. Regarding asymptomatic recurrences, we were only following patients who had a recurrence that required reoperation. Were we able to see a difference in recurrence rate by surgeon category? We certainly saw a difference with respect to the transplant patients, but not with an individual surgeon or across an entire broad category. One of the main problems with management of ventral hernias is that there is no standardized mechanism for classifying or grading hernias. When trying to determine how well one patient does in the hands of one type of surgeon vs another, it would be useful to have a means to ensure that you are actually comparing apples to apples.

In terms of volume outcome relationships, while there were 38 surgeons in the entire series, more than half of the patients were managed by 2 surgeons, and probably three-quarters by 6 of the surgeons. The vast majority of the surgeons had a small number of patients and made a very small contribution to the overall statistical observation.

Performing a component separation does increase the complication rate. However, recurrent hernias tend to be larger and more complex, but we don't have those data accurately recorded in this study. Skin problems, such as thinning of the skin, ulcerations, fungal cutaneous infections, and others contribute to the postoperative wound complications, and not simply the application of a component separation.

As you noted, the wound complication rate overall was about 11%, which frankly was surprisingly low to me, and we probably underestimate that number, since we are looking at only complications reported in the medical record.

Over the 5-year period, approximately 40 patients had a laparoscopic ventral hernia repair, and these were excluded from our study. My personal approach has been that many of these patients have a very complex surgical history and abdominal wall. We routinely get abdominal computed tomographic scans prior to developing an operative strategy. I have difficulty envisioning the repair of these complex cases using a laparoscopic approach. But I am certainly aware that, in properly selected patients, laparoscopic repairs can be done, as reflected in the literature.

Regarding techniques for mesh placement, not everyone dictates with the same clarity and detail as one would like. Most of the general and plastic surgeons place the mesh using what we refer to as *an inlay technique*, which you may be calling a *sublay*, where the mesh is placed intra-abdominally with at least 2 to 4 cm of circumferential overlap between the edges of the fascia and the mesh. That was not as true in the cohort of patients who had solid-organ transplants, where there was a higher frequency of primary repair. When mesh was used, our impression was that often it was simply sewn to the fascial borders, which you may be referring to as an inlay technique.

In terms of policies for improving patient factors, there are occasions when we have considered a gastric bypass prior to repair. Some patients underwent repair after weight reduction surgery. We do not have a uniform policy for addressing patient-related factors. Some of my colleagues are very hesitant to operate on patients who are actively smoking, whereas some of us are more lenient.

As we review these data and try to learn from our own experience, there is a diminishing enthusiasm for primary suture repair, even for very small primary hernias. Growing experience and data indicate that the recurrence rate is simply unacceptable and that mesh should be routinely employed.

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