



Audit

Open mesh repair of incisional hernias with significant loss of domain

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Background: Incisional hernias develop in up to 13% of laparotomy incisions: the most difficult to repair are complex, multiply recurrent hernias with significant loss of domain (> 15–20% of the abdominal contents).

Methods: Retrospective analysis by standard proforma of a series of 52 patients operated on at a single institution between 1996 and 2002. All patients received pre-operative CT and anaesthetic assessment. Patients with significant tissue loss were assessed by a plastic surgeon. Cardio-respiratory status was optimised and trophic skin ulcers treated before operation.

Results: Sublay repair was applied in 33 patients, onlay in 16 patients, one patient received inlay repair and two patients the Ramirez abdominoplasty. Additional procedures of stoma closure, muscle flap or abdominoplasty were carried out in 7 patients. Complications occurred in 18 (34.6%) patients, 5 of whom required further surgery for haematoma, infection or fistulisation. One patient died from pulmonary embolism after postoperative complications. Three recurrences were apparent after follow-up of 6 months to 6 years.

Conclusions: Complex incisional hernias are a challenging surgical problem. Careful patient selection and surgical technique with a team involving anaesthetists and plastic surgeons is required. Post-operative management may require facilities in HDU and ITU. Clinical trials are required to identify techniques and materials which give the best results.

Key words: Incisional hernia – Recurrence – Abdominoplasty – Components separation

Currently, it is believed that up to 13% of laparotomy incisions will eventually develop hernias.¹ Recurrence after surgical treatment varies between 0% and 46% and is at least twice as frequent following open suture repair than after mesh repair.² Although laparoscopic repair is a promising approach, it is not applicable to complex hernias with significant (> 15–20% of the abdominal contents) loss of domain.³ This loss of domain (residence) implies that a proportion of the abdominal contents reside permanently (in a hernia sac =

the second abdominal cavity) outside their natural compartment, and returning these contents will require significant physiological adaptation (mainly respiratory) if the volume exceeds > 15–20% of this compartment. Which technique should be used for open mesh repair (sublay, onlay or inlay technique – see Fig. 1) has not been defined because there are no comparative trials to indicate under which circumstances the different techniques give best results, nor comparative studies to indicate which gives the lowest recurrence rate.

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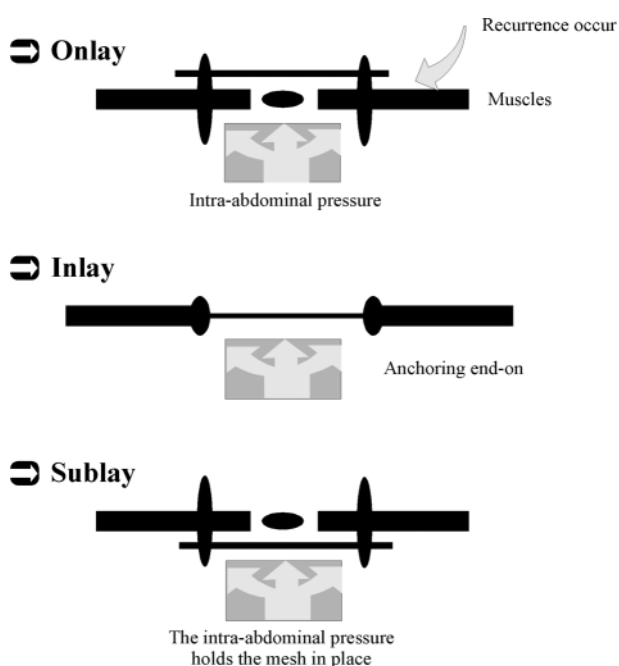


Figure 1 Techniques for open mesh repair.

A recent Experts Meeting on the surgical treatment of incisional hernia analysed 7 reports of the onlay technique (prefascial prosthetic repair or the Chevrel technique), and 11 reports of the sublay technique (subfascial prosthetic repair or the Rives technique).⁴ The onlay repair gives results ranging from 4–26% wound complications, 2.5–13% recurrence rate and mortality up to 2.7%. The sublay technique gives results ranging from 1–49% wound complications, 2–23% recurrence rate and mortality up to 4.5%. The Experts concluded that both onlay and sublay techniques give excellent results but the sublay technique is more complicated.

The present study in a single institution, to which many complex incisional hernias are referred from other centres, is a retrospective analysis of 52 incisional hernia repairs in patients with significant loss of domain.

Patients and Methods

This series consisted of a total of 52 patients, operated on between April 1996 and June 2002. They consisted of 22 males and 30 females, mean age was 57.8 years (range, 33–79 years). Length of follow-up was between 6 months and 6 years.

All patients were referred to a specialist hernia service and initially assessed in a consultant-led out-patient clinic. The history is often complex; some patients have been psychologically traumatised by major abdominal sepsis, multiple operations and long periods in intensive care. Hernias were examined and, if a clinical assessment of

significant loss of domain was made, a CT scan was requested. The CT scan can assess the volume of contents of the sac, nature of the contents, reducibility when lying flat, estimate of the percentage of the contents in the sac and size of the defect; all of which assist in planning the surgery. All patients were assessed in a separate clinic by a consultant anaesthetist with experience of the care of patients undergoing surgery for large incisional hernias. Pre-operative lung function tests were performed in selected patients and patients with cardiorespiratory co-morbidity were managed in HDU/ITU after operation, in order to pre-empt potential respiratory problems associated with splinting of the diaphragm and increase in intra-abdominal pressure after surgery.

The hernias were classified into primary or multiply recurrent hernias (one, two, three or greater than three recurrences), into groups according to the orientation of the incision, and at operation the maximum diameter of the abdominal wall defect was measured.

The following criteria were applied to selecting patients for onlay and sublay technique: (i) lower midline hernias with a suprapubic component received sublay mesh anchored to Cooper's ligament; (ii) upper midline hernias received sublay mesh unless the fascial layers had to be closed under tension in which circumstance an onlay mesh was sutured to the underlying fascia with several rows of continuous and interrupted sutures to maintain fascial wound closure; and (iii) lateral and transverse hernias received onlay mesh.

Selected patients were assessed by a plastic surgeon and subsequently received the following additional treatments: one received a supplementary tensor fascia lata flap, two received cosmetic abdominoplasty, and two received Ramirez abdominoplasty.

The meshes used to repair the hernias were sized to allow 6–8 cm of excess prosthesis in all directions from the abdominal defect and sutured to underlying fascial structures with a continuous peripheral suture and interrupted central sutures of non-absorbable material (1 Nylon) spaced not more than 1–2 cm apart. Polypropylene mesh was the preferred prosthetic material. Patients received a single intravenous dose of broad-spectrum antibiotics at induction. Epidural anaesthesia was routinely used in addition to a general anaesthetic to improve postoperative pain control and to optimise breathing, protecting against basal atelectasis and other respiratory complications. Two to four suction drains were placed between fascial layers, which were removed postoperatively when drainage was less than 50 ml in a 24-h period.

Patients were discharged when pain was at an acceptable level, when they were fully mobile and when the surgical team were satisfied that there were no immediate complications. Follow-up in an out-patient clinic was initially at 6–8 weeks and then 6-monthly, depending on clinical course.

Results

Surgery was undertaken in 52 patients for incisional hernia with significant loss of domain. The fascial defects at operation were classified⁴ as medium (5–10 cm; $n = 14$, 27%) or large (> 10 cm; $n = 38$, 73%). The largest fascial defect was measured at 40 x 20 cm and the loss of domain was 50%. Four patients had stomas which were closed simultaneously with the incisional hernia repair and three patients had had skin grafts applied to laparostomy wounds.

Hernias were repaired by onlay or sublay techniques (16 and 33, respectively) and three were repaired by other methods – one by the inlay technique (mesh is positioned between the un-approximated fascial edges in cases where fascial closure is not possible) and two by Ramirez (components separation) technique. Mean surgical time was 110 min (range, 90–500 min). Six patients (11.5%) required a postoperative transfusion of between 2 and 5 units of packed red cells. Length of in-patient stay in hospital was between 6 and 50 days (mean, 7.9 days).

Complications

Complications of incisional hernia surgery recorded for this study are those related to the wound; haematoma, wound infection (superficial or deep) and seroma and hernia recurrence. Sixteen patients experienced postoperative complications (34.6%). Some patients with a seroma or haematoma progressed to an infectious complication and, therefore, a number of patients had more than one complication. In the entire cohort of patients, there were 5 haematomas, 11 seromas, 8 infections and two patients developed fistulas, complicating deep infection.

The patients' complications seen in this study can also be considered by the type of repair they underwent. In the sublay group, there were 10 patients who suffered complications (30.3%) and in the onlay group 5 patients were affected (31.2%). One of the patients who developed a fistula received an inlay repair.

Of the 18 patients that suffered complications, five had to have further surgery to evacuate haematoma or to incise and drain infection or repair fistula. The remaining patients were managed non-operatively with antibiotics and 7 patients had drainage of their haematoma or seroma either by direct aspiration or ultrasound guidance. One patient who required surgery had persistent but minor chronic infection which was managed non-operatively for 2 years, but then required removal of part of the mesh and went on to a successful recovery with no further infection or recurrence of the hernia.

Recurrence

There were 3 recurrences, which equates to a recurrence rate of 6%: in the onlay group, there were 2 recurrences and in the

sublay group there was 1 recurrence.

One patient who had an oblique hernia repaired using the onlay technique, had a recurrence lateral to the mesh, which occurred at 3 years. The second patient had a primary hernia repair and was obese with a body mass index (BMI) of 44. His recovery was complicated by postoperative deep infection and the recurrence occurred subsequent to this. The third patient had surgery for a first recurrence and the hernia recurred for a second time above the mesh. All of these three patients have had further surgery for the recurrences during the time span of this study and there has been no further documented recurrence.

Morbidity and mortality

From the series of 52 patients, there was no significant long-term morbidity. Eight patients required admission to the HDU and were monitored for 1–5 days after their surgery. They were subsequently discharged to the surgical ward without complication or need for significant intervention. One patient required admission to the ICU and was ventilated for several days after surgery for a massive hernia with 50% loss of domain. This patient was extubated successfully, returned to the surgical ward and went on to have an uneventful recovery.

There was one death in the series – mortality was therefore 1.9%. This was in a 65-year-old female patient who was referred to the hernia unit with a second recurrence of an incisional hernia and who developed a small bowel fistula after surgery. After several further interventions, this patient died due to a pulmonary embolus.

Discussion

Multidisciplinary teams of surgeons undertaking repair of complex abdominal incisional hernias should be conversant with the different methods of placement of prosthetic materials and be able to deploy the techniques of abdominal components separation, tissue expansion, local and distant muscle flaps, free tissue transfer and vacuum-assisted closure.⁶

Appropriate preparation for operation is mandatory in patients with large incisional hernias.^{7,8} When there is significant loss of domain (15–20% of the contents of the abdominal cavity permanently residing within a hernia sac outside the abdominal cavity), a CT scan should be performed to visualise the sac's contents.⁹ Skin erosions and trophic ulcers are often infected with *Staphylococcus aureus* and should be resolved prior to elective repair.¹⁰ Body weight and pulmonary function should be optimised and may include the use of progressive pneumoperitoneum.¹¹

The size of the prosthesis used to repair incisional hernias is important; it should cover any residual defect plus an additional 6–8 cm in all directions from the margins of the

hernial aperture and suture intervals should be no more than 2 cm to ensure adequate fixation.¹² In midline hernias below umbilicus and the arcuate line (where the posterior rectus sheath is deficient), repaired by the sublay technique, the mesh will lie in the preperitoneal space and here fixation to peritoneum is tenuous. If there is a suprapubic component with this type of hernia, with disruption of the musculotendinous elements that insert into the pubic bone, the mesh should be anchored laterally to the ligaments of Cooper and in between to the periosteum of the posterior aspect of the pubis.¹³ Hernias with such a suprapubic element must be repaired by the sublay method in order to achieve this fixation within the pelvis.

The inlay technique in which the fascial edges are not opposed should be required in no more than 5% of incisional hernia repairs. This need for inlay mesh can be reduced further by the use of tissue expanders placed laterally between the subcutaneous or submuscular layers for up to 90 days pre-operatively.¹⁴ The inlay technique leaves intra-abdominal contents exposed to the posterior aspect of the mesh with the risk of adhesion and fistulation. The components separation technique can also be used to lessen the indications for inlay mesh. With this technique, the external oblique is separated from the internal oblique in an avascular plane and a compound flap of rectus muscle/internal oblique/transversus is advanced into the midline.^{15,16} After midline fascial closure, mesh may be placed over this plastic procedure, where fixation is feasible with fibrin glue.¹⁷

Failure of incisional hernia repairs are more likely with large, multiply recurrent hernias in elderly patients who suffer postoperative complications.^{18,19} Recurrences can creep under the edges of the mesh if peripheral fixation is not adequate; this is particularly important around the umbilicus where an adequate overlap is necessary together with a slit to accommodate the linea alba.²⁰

A recent population-based analysis indicated that in spite of the wide application of prosthetic mesh in incisional hernia repair, results did not improve in the period 1987–1999.²¹ The present series indicates that with appropriate case selection both sublay and onlay mesh techniques give good results for repair of complex incisional hernias with significant loss of domain. Morbidity rates, however, are high but most can be managed conservatively without the need for further surgery. The sublay technique is mandatory where there is a suprapubic component to the hernia in order for (deep fixation to be applied within the pelvis. Because the onlay technique is technically more simple, its use is recommended in the upper abdomen where secure peripheral and central fixation is required to minimise seroma formation. We support the proposal for a multicentre randomised trial to compare the results of sublay and onlay techniques (excluding hernias with a suprapubic component) for treatment of large midline abdominal incisional hernias. Such hernias should be

managed by a skilled team of general surgeons, plastic surgeons, anaesthetists and intensivists.

References

1. Kingsnorth AN, LeBlanc KA. Incisional hernia – the open techniques. In: Kingsnorth AN, LeBlanc KA. (eds) *Management of Abdominal Hernias*, 3rd edn. London: Arnold, 2003; 262–79.
2. Cassar K, Muniro A. Surgical treatment of incisional hernia. *Br J Surg* 2002; **89**: 534–45.
3. Goodney PP, Birkmeyer CM, Berkmeier JD. Short-term outcomes of laparoscopic and open ventral hernia repair. *Arch Surg* 2002; **137**: 1161–5.
4. Korenkov M, Paul A, Sauerland S, Neugebauer E, Arndt M, Chevrel JP *et al.* Classification and surgical treatment of incisional hernia: results of an experts' meeting. *Langebeck's Arch Surg* 2001; **3986**: 65–73.
5. Ramirez OM, Ruas E, Dellon AL. 'Components separation' method for closure of abdominal wall defects: an anatomic and clinical study. *Plast Reconstruct Surg* 1990; **86**: 519–26.
6. Rohrich RJ, Lowe JB, Hackney FL, Bowman JL, Hobar PC. An algorithm for abdominal wall reconstruction. *Plast Reconstruct Surg* 2000; **105**: 202–16.
7. Santora TA, Roslyn JJ. Incisional hernia. *Surg Clin North Am* 1993; **73**: 557–70.
8. Wong S, Kingsnorth A. Abdominal wound dehiscence and incisional hernia. *Int J Surg Invest* 2001; **3**: 407–14.
9. Toms AP, Dixon AK, Murphy JMP, Jamieson NV. Illustrated review of new imaging techniques in the diagnosis of abdominal wall hernias. *Br J Surg* 1999; **86**: 1243–50.
10. Flament JB, Avisse C, Palot JP, Phiot M, Burde A, Rives J. Trophic ulcers in giant incisional hernias – pathogenesis and treatment: a report of 33 cases. *Hernia* 1997; **1**: 71–6.
11. Caldironi MW, Romano M, Bozza F, Pluchinotta AM, Pelizzo MR, Toniato A *et al.* Progressive pneumoperitoneum in the management of giant incisional hernias: a study of 41 patients. *Br J Surg* 1990; **77**: 306–8.
12. Condon RE. Prosthetic repair of abdominal hernia. In: Nyhus L, Condon RE. (eds) 3rd edn. London: Lippincott, 1989; 559–83.
13. Bendavid R. Incisional parapubic hernias. *Surgery* 1990; **108**: 898–901.
14. Tran NV, Petty PM, Bite U, Clay RP, Johnson CH, Arnold PG. Tissue expansion-assisted closure of massive ventral hernias. *J Am Coll Surg* 2003; **196**: 484–8.
15. Maas SM, van Engeland M, Leeksa NG, Bleichrodt RP. A modification of the 'components separation' technique for closure of abdominal wall defects in the presence of an enterostomy. *J Am Coll Surg* 1999; **189**: 138–40.
16. Shestak KC, Edington HJD, Johnson RR. The separation of anatomic components technique for the reconstruction of massive midline abdominal wall defects: anatomy, surgical technique, applications, and limitations revisited. *Plast Reconstruct Surg* 2000; **105**: 731–8.
17. Chevrel JP, Rath AM. Polyester mesh for incisional hernia repair. In: Schumpelick V, Kingsnorth A. (eds) *Incisional Hernia*. Berlin: Springer, 1999; 327–33.
18. Hesselink VJ, Luijendijk RW, de Wilt JHW, Heide R, Jeckel J. An evaluation of risk factors in incisional hernia recurrence. *Surg Gynecol Obstet* 1993; **176**: 228–34.
19. Rios A, Rodriguez JM, Munitiz V, Alcaraz P, Perez D, Parrilla P. Factors that affect recurrence after incisional herniorrhaphy with prosthetic material. *Eur J Surg* 2001; **167**: 855–9.
20. Wantz GE, Fischer E. Prosthetic incisional hernioplasty: indications and results. In: Schumpelick V, Kingsnorth A. (eds) *Incisional Hernia*. Berlin: Springer, 1999; 303–11.
21. Flum DR, Horvath K, Koepsell T. Have outcomes of incisional hernia repair improved with time? – a population-based analysis. *Ann Surg* 2003; **237**: 129–35.