Single-Port Onlay Mesh Repair of Recurrent Inguinal Hernias after Failed Anterior and Laparoscopic Repairs

Hanh Tran, MD, Kim Tran, Marta Zajkowska, RN, Vincent Lam, MD, Wayne J. Hawthorne, MD

ABSTRACT

Background and Objectives: Despite the exponential increase in the use of laparoscopic inguinal herniorrhaphy, overall recurrence rates have remained unchanged. Therefore, a growing number of patients are presenting with recurrent hernias after conventional anterior and laparoscopic repairs have failed. This study reports our experience with single-incision laparoscopic (SIL) intraperitoneal onlay mesh (IPOM) repair of these hernias.

Methods: Patients referred with two or more recurrences of inguinal hernia underwent SIL-IPOM from November 1, 2009, to June 24, 2014. A 2.5-cm infraumbilical incision was made, and an SIL port was placed intraperitoneally. Modified dissection techniques were used: chopstick and inline dissection, 5.5-mm/52-cm/30° angled laparoscope, and conventional straight dissecting instruments. The peritoneum was incised above the pubic symphysis, and dissection was continued laterally and proximally, raising the inferior flap below the previous extraperitoneal mesh while reducing any direct, indirect, femoral, or cord lipoma before placement of antiadhesive mesh, which was fixed to the pubic ramus, as well as superiorly, with nonabsorbable tacks before the inferior border was fixed with fibrin sealant. The inferior peritoneal flap was then tacked back onto the mesh.

Results: Nine male patients underwent SIL-IPOM. Their mean age was 53 years and mean body mass index was 26.8 kg/m^2. Mean mesh size was 275 cm^2. Mean operation time was 125 minutes, with a hospital stay of 1 day. The umbilical scar length was 23 mm at the 6-week follow-up. There were no intra-/postoperative complications, port-site hernias, chronic groin pain, or recurrence of the hernia during a mean follow-up of 24 months.

Conclusion: Inguinal hernias recurring after two or more failed conventional anterior and laparoscopic repairs can be safely and efficiently treated with SIL-IPOM.

Key Words: Intraperitoneal onlay mesh repair, Recurrent inguinal hernia, Single-incision laparoscopic repair.

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INTRODUCTION

Laparoscopic inguinal herniorrhaphy has become widely accepted as an effective alternative to the treatment of inguinal hernias with the anterior approach, because it is minimally invasive, has success rates identical to those of the conventional method, and quickens recovery by decreasing time until return to work or physical activities.[1] In Australia, the rate of laparoscopic inguinal herniorrhaphy in 2012 was 48% of the total number of inguinal hernia repairs.[2] In 2010–2011, 46 651 separations were performed in hospitals for inguinal hernias, and at least 3711 (7.9%) were for those specified as recurrent, although the statistics do not differentiate between the rates of recurrence of each type of repair.[3,4] It is generally accepted that the best procedure for an inguinal hernia that recurs after laparoscopic repair is anterior repair and vice versa.[5–8] However, there is currently no consensus as to the best technique for hernias that recur after both anterior and laparoscopic repairs have failed, partly because not all surgeons who perform laparoscopic inguinal hernia repair also perform laparoscopic ventral hernia repair (LVHR). Consequently, there are experts in laparoscopic inguinal hernia repair who have successfully attempted a second laparoscopic repair, but this practice is confined to very few surgeons in specialized hernia centers.[9,10] On the other hand, surgeons who are confident in performing LVHR and total extraperitoneal (TEP) or transabdominal preperitoneal (TAPP) inguinal hernia repair may regard intraperitoneal onlay mesh (IPOM) repair as merely an extension of LVHR, although detailed knowledge of laparoscopic extraperitoneal inguinal anatomy would be essential.[11]
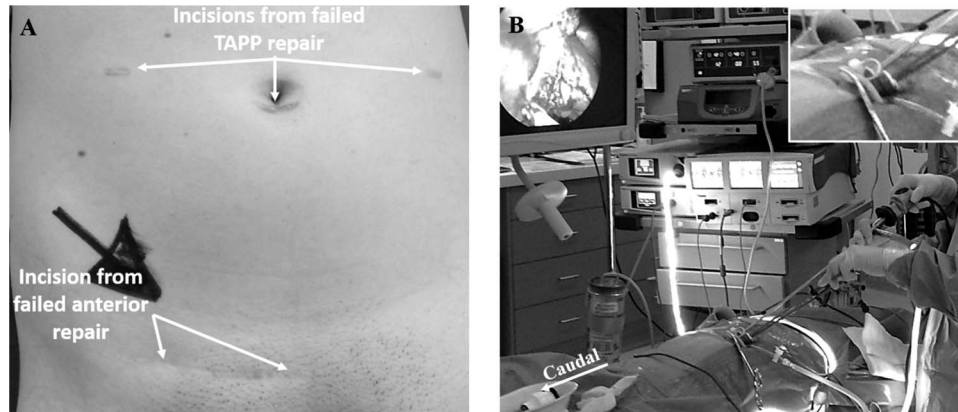
Figure 1. A single-incision laparoscopic intraperitoneal onlay mesh repair of a right inguinal hernia with multiple recurrences. A, Patient with incisions from previous anterior and laparoscopic repair; B, The setup (an extra-long laparoscope was used to prevent clashing of the handles of the conventional straight dissecting instruments with the side arm of the scope) and inset showing close up view of the single-port device.

In an attempt to further reduce parietal trauma, SIL repair has been touted as the most important innovation in laparoscopic surgical procedures since its inception with the first laparoscopic cholecystectomy in 1988.[12] Indeed, since the first commercial availability of the SIL port in 2007, several different single ports have been made available. Prospective randomized controlled trials (RCTs), mainly for cholecystectomy[13,14] and appendectomy[15] and mostly with small samples of patients, but more significantly, comparisons during of the learning curve of single-port and multiport surgery, have shown the single-port approach to be consistently safe and effective, as has single-port laparoscopic inguinal herniorrhaphy.[16–18] However, data regarding the superiority of single-port over conventional multiport procedures, other than cosmesis,[19] are still lacking, although it is hoped that with increasing experience with SIL, more high-powered RCTs will provide us with a clearer picture of the place of SIL in surgical approaches.

Our unit has been offering routine laparoscopic herniorrhaphy for inguinal hernias since 1991 and for ventral hernias since 2003. Since December 2009, we have routinely treated virtually all ventral (including parastomal) and inguinal hernias with the single-port approach.[11,20] After conventional anterior and laparoscopic approaches have failed, the treatment of a recurrent inguinal hernia with laparoscopic IPOM repair represents an obvious choice. In addition, parietal trauma can be reduced with single-port compared to multiport surgery.[11] To our knowledge, this is the first case series of SIL-IPOM repair for the treatment of recurrent inguinal hernias for which conventional anterior and laparoscopic repairs with mesh

have both failed. The independent review boards of St Luke's and Holroyd Private Hospitals approved this study.

MATERIALS AND METHODS

All patients referred with inguinal or femoral hernias from November 1, 2009, through June, 30, 2014, underwent SIL inguinal herniorrhaphy. For this study, the enrollment criterion was the recurrence of an inguinal hernia after failure of both anterior and laparoscopic repairs with mesh. The exclusion criteria were being unfit for general anesthesia or having chronic postherniorrhaphy groin pain. The participants were informed of our practice of performing laparoscopic IPOM repair, but that this procedure could now be performed with the SIL technique.

After induction of general anesthesia, the patients were prepped and draped with iodine from epigastrium to mid thigh and then draped with an iodine-impregnated adhesive cover (Ioband; 3M, St Paul, Minnesota), to expose the entire abdomen and both groins (**Figure 1**). A preoperative intravenous dose of cephalosporin was given, and a urinary catheter was routinely placed. After infiltration with bupivacaine 0.5% with 1:200 000 ephedrine in the umbilical area, a 2- to 2.5-cm (depending on the laxity of the skin) crescentic infraumbilical incision was made, the anterior rectus sheath was incised transversely, and the rectus sheath was retracted laterally. The site of entry was on the side contralateral to the previous laparoscopic entry (if a TEP approach was used), to avoid scar tissue. The posterior rectus sheath and the peritoneum were then entered for placement of an SIL port (Covidien, Norwalk, Connecticut). Insufflation with CO_2 was maintained at 12
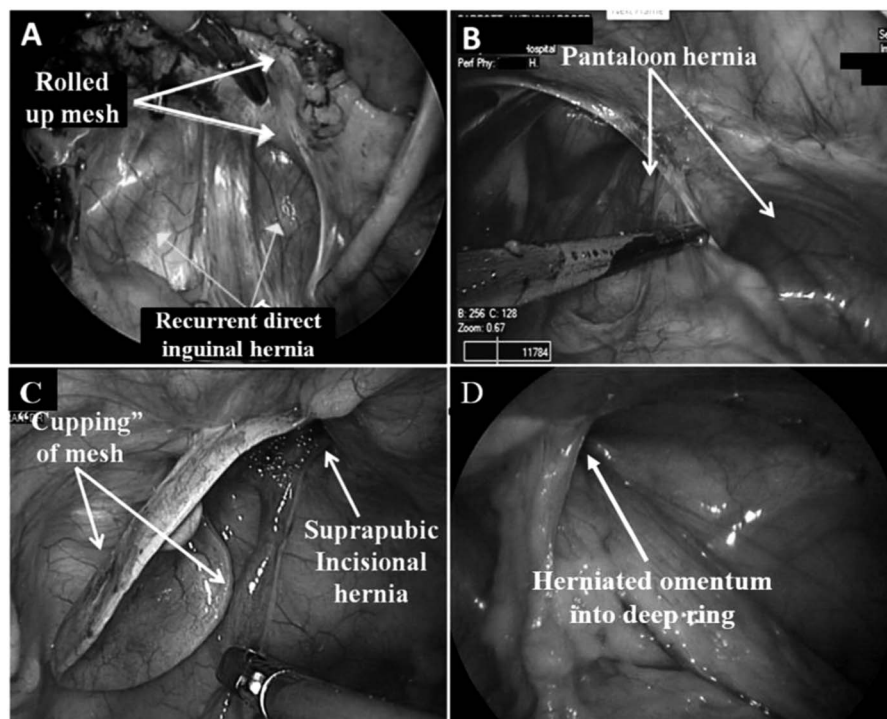
Figure 2. Laparoscopic findings in patients with recurrent inguinal hernias after TEP or TAPP and a mean of 2 anterior repairs. A, Rolled up mesh after TEP repair exposing a left direct inguinal defect. B, A pantaloon hernia after a left TAPP repair. C, A cupped, intraperitoneally placed mesh exposing a suprapubic defect. D, A right indirect defect after TAPP repair, with the inferolateral aspect of mesh being well above the deep inguinal ring.

mm Hg. The patient was placed in a Trendelenburg position at 10° to 15° (**Figure 1**). The procedure was performed with a 52-cm/30° angled laparoscope, to assess the amount of adhesions (**Figure 2**), and those were meticulously divided by sharp dissection, to avoid electrocautery (**Figure 3**). Modified dissection techniques, namely, chopstick and inline, were used to overcome the relative loss of triangulation. The pubic symphysis was identified, the peritoneum was incised 2 cm superior to it, and the incision was extended laterally, or superior to a direct sac, if present (**Figure 4**). No attempt was made to incise (or remove any part of) the previously placed (extraperitoneal) mesh; rather, the dissection was performed from the inferior aspect of the mesh and continued proximally. Care was taken to stay below the inferior epigastric vessels as the dissection continued laterally. The peritoneum was then reflected inferiorly over the pubic symphysis and continued laterally over the spermatic cord and its structures, thus reducing any direct, femoral, and indirect hernia and lipoma of the cord, akin to the dissection during TAPP inguinal hernia repair. Extreme care was taken to prevent damage to the urinary bladder, external iliac vessels, vas deferens, testicular vessels, and femoral

nerve and to preserve other retroperitoneal nerves in the vicinity (**Figure 4**). No attempt was made to dissect the superior flap of peritoneum overlying the previous laparoscopically placed mesh. Often the previously placed extraperitoneal mesh had folded during placement or deflation, causing the recurrence of the hernia, and consequently the inferior peritoneal flap was usually surprisingly easy to lift (**Figures 3** and **4**). Even so, it had to be assumed that, although the previously placed extraperitoneal mesh had been poorly positioned, there would have been some attempt to dissect the peritoneal space below the pubic ramus; therefore, millimeter-by-millimeter meticulous sharp dissection, with avoidance of electrocautery, was used to minimize damage to the aforementioned retroperitoneal structures and to minimize tearing of the inferior peritoneal flap. After deflation to 8 mm Hg, measurements were taken externally for the size of the mesh (Gore-tex Dualmesh; WL Gore & Associates, Flagstaff, Arizona), which was at least 5 cm longer craniocaudally, extending inferior to the pubic symphysis. A polydioxanone (PDS) 0 suture (Ethicon, Somerville, New Jersey) was placed in the superior medial corner of the mesh to provide transfascial suture fixation, and the mesh was
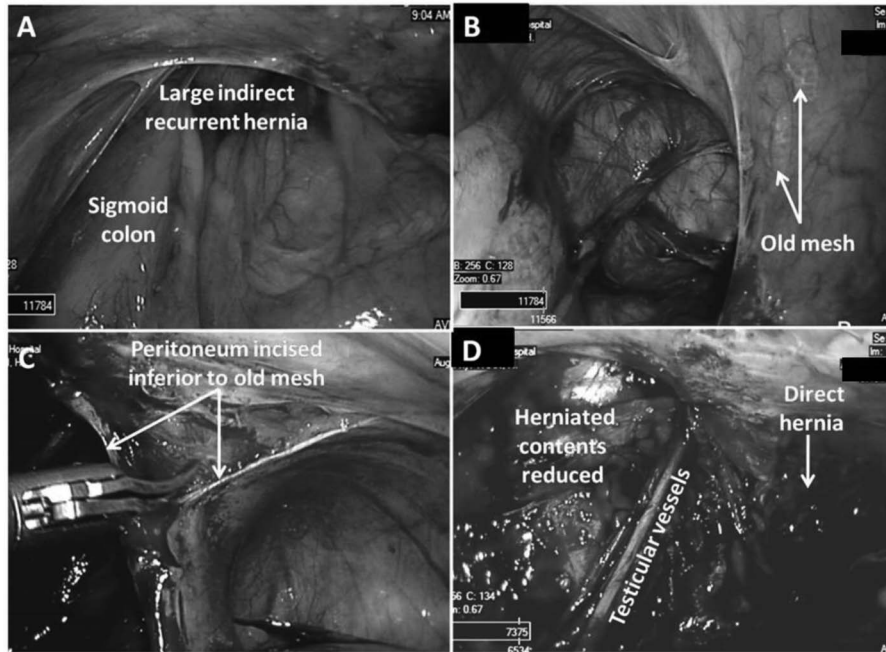
Figure 3. Intraoperative photographs of dissection of a left pantaloon hernia after previous TEP and 3 anterior repairs. A, Incarcerated loop of sigmoid colon. B, Previous extraperitoneal mesh that has been displaced upward, allowing indirect and direct recurrence. C, Incision of the peritoneum along the inferior edge of the mesh, which is then extended medially and laterally. D, Complete reduction of the direct and indirect defects, with preservation of cord structures.

marked 5 cm above its inferior medial corner to correspond to the superior edge of the pubic symphysis (**Figure 5**). The mesh was rolled inward along its horizontal axis, like a scroll, and placed intraperitoneally via a 12-mm trocar, which temporarily replaced the 5-mm camera trocar. One of the 5-mm trocars was temporarily withdrawn until it was outside the fascial defect, to facilitate insertion of the 12-mm trocar. The mesh was then unrolled and positioned to cover the defect(s). A stab incision was then made in the midline and inferior to the umbilicus, to retrieve the PDS suture in the superior medial corner of the mesh with a suture passer. This method allowed the mesh to be more easily maneuvered into the correct position before nonabsorbable tacks (Protack; Covidien) were placed onto the pubic bone and along the pubic ramus, taking care to avoid the external iliac vein (**Figures 2** and **5**). The mesh was then tacked medially and superiorly and, cautiously, laterally, to avoid the nerves in the vicinity. The process was aided by the mesh's craniocaudal dimension being of sufficient size that its superior edge was well above the previously placed extraperitoneal mesh and within 2 cm of the umbilical SIL port, so that the tacks were unlikely to pierce the iliohypogastric nerve, ilioinguinal nerve, genital branch of the genitofemoral nerve, or the lateral cutaneous nerve of the thigh.

Fibrin sealant (2 ml) (Tisseel Duo; Baxter AG, Vienna, Austria) was sprayed along the inferior edge of the mesh (**Figure 5**). The inferior peritoneal flap was then reflected up and tacked lightly onto the mesh, with care taken not to leave any significant gaps that would allow herniation of the bowel loops. Fibrin sealant (2 ml) was also sprayed along the mesh–peritoneum interface, on the periphery of the mesh, and over the tacks, to minimize the risk of adhesions (**Figure 5**). The fascial defect in the umbilical wound was closed in layers, subcutaneously and subcuticularly, with interrupted No. 0 PDS sutures and absorbable sutures. The urinary catheter was left in place overnight and removed before the patient was discharged home. All patients were seen at 1 week and 4 weeks, with plans to see them annually for 5 years.

RESULTS

Between November 1, 2009, and June 24, 2014, there were 12 patients with recurrent inguinal hernias after previous failed anterior and laparoscopic repairs; 3 patients with chronic neuropathic pain were excluded from the study. The patients were part of a cohort of 505, over the same period, who had undergone SIL inguinal herniorrhaphy. Each of the 9 patients enrolled in the study had had one
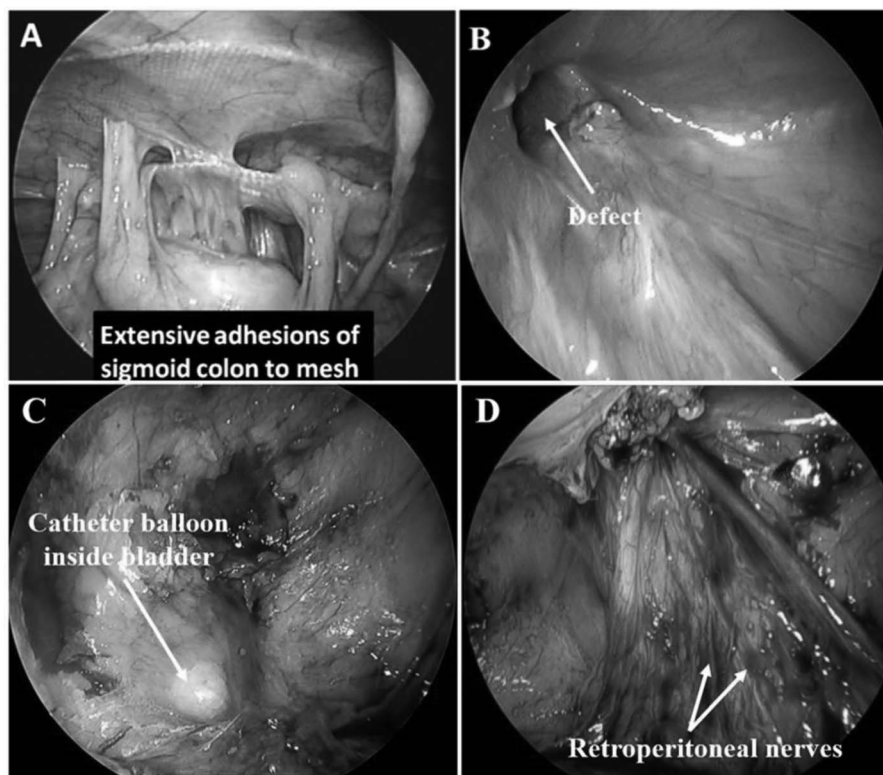
Figure 4. Intraoperative findings in patients with multiple recurrences of inguinal hernia. A, Extensive adhesions of the sigmoid colon to the rolled up mesh medially of a left recurrent inguinal hernia. B, A right indirect defect below mesh placed during an earlier TAPP procedure. C, D, Meticulous dissection below the pubic symphysis and along the cords, exposing the bladder and retroperitoneal nerves, which can be at risk of damage during dissection; hence, there is no fixation of mesh with tacks in these areas.

laparoscopic repair (5 TAPPs and 4 TEPs) and a mean of 2 anterior repairs (range, 1–4). The mean age was 53 years (range, 24–74 years); all were men. The mean BMI was 26.5 kg/m² (range, 24.5–28.4 kg/m²) (**Table 1**). All but 1 patient were found to have direct hernias with 4 having incarcerated hernias containing small bowel/colon/omentum that had to be reduced. Furthermore, there were always omental adhesions in the inguinal region that had to be divided (even in the 5 patients who had undergone the TEP approach). In all but 1 patient, the mesh was deficient medially, either found within the direct defect or folded, exposing the direct defect. In 4 patients the mesh was also found to be rolled up laterally. One patient also had a contralateral primary hernia, which was treated by IPOM repair during the same operation. The mean mesh size was 275 mm² (range, 255–285 mm²). The mean operation time was 125 minutes (range, 95–165 minutes). There were no deaths, morbidities, port-site hernias, or recurrences during a mean follow-up of 24 moths (range, 2–48 months). Mean scar length was 23 mm (range, 15–37 mm) at the 6-week follow-up.

DISCUSSION

Since the first laparoscopic extraperitoneal inguinal hernia repair by Ger et al[21] in 1989, there has been an exponential increase worldwide in the use of laparoscopic repair for inguinal hernias. Data from Medicare Australia show that, of all hernia repairs, the rates of laparoscopic anterior repair were 9.4% in 1994, 20.5% in 2000, and 48% in 2012.[4] The latter statistic (for 2012) is reflected in the same percentage of surgeons performing laparoscopic repair (as defined by any surgeon who entered a claim to Medicare Australia with the code 30609, which corresponds to laparoscopic inguinal hernia repair). This exponential increase in the use of laparoscopic inguinal herniorrhaphy is remarkable, given that most laparoscopic repairs are performed in private hospitals, where surgical trainees are not usually trained, and that the surgery is normally performed only by the consultants. It is possible that many surgeons go overseas to attend hands-on animal workshops in TEP/TAPP repair, possibly because of the lack of such courses in Australia, owing to the country's stringent
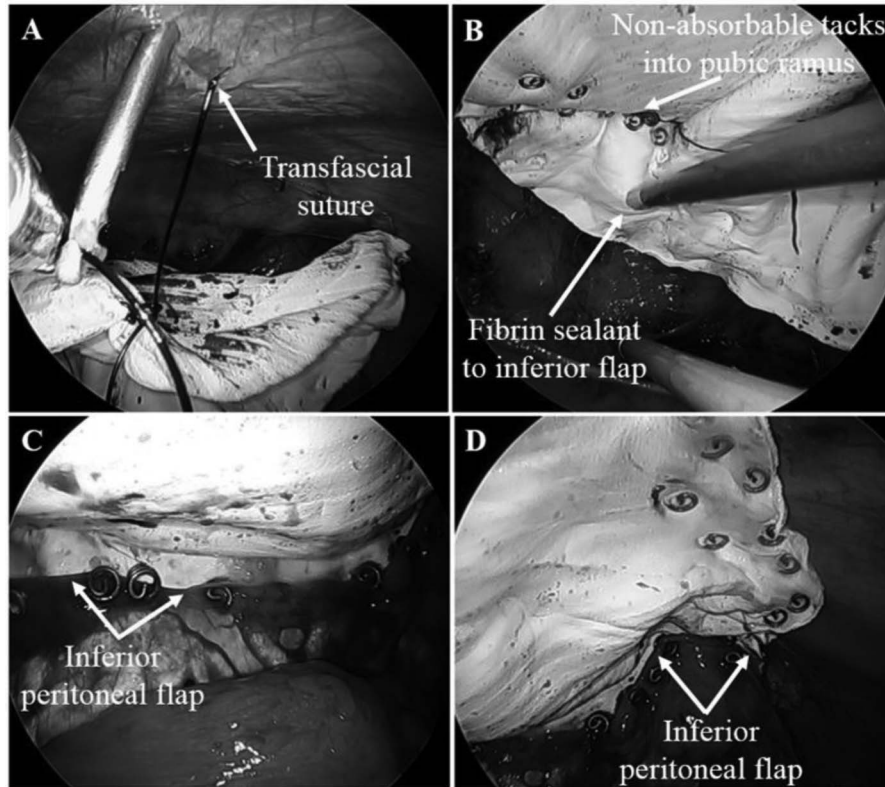
Figure 5. A, Single-incision laparoscopic intraperitoneal onlay mesh repair for a right inguinal hernia with multiple recurrences. A, Transfascial suture. B, Mesh fixation into pubic ramus and inferior edge of mesh glued with fibrin sealant. C, D, The inferior peritoneal fold tacked back onto the mesh with fibrin sealant sprayed along the mesh–peritoneum interface.

animal ethics requirements for surgical training involving animals. It has been estimated that the recurrence rates for inguinal hernias range from 7% to 10% in Australia, which means that there are more and more patients with two or more recurrences of inguinal hernia after failed anterior and laparoscopic repairs.[4]

The International Endohernia Society Guidelines[8] suggest that the best repair for the treatment of an inguinal hernia recurrence after an anterior procedure is the laparoscopic approach, and vice versa. Yet, there are no specific recommendations for the treatment of hernias that recur after a patient has undergone both anterior and laparoscopic procedures. Anecdotal reports of a second laparoscopy, usually TAPP, have come from highly specialized centers, but the incidence of complications is much higher, even though the success rates are higher than other anterior approaches. van den Heuvel and Dwars [9] reported a series of 51 patients who underwent TAPP repair for recurrent inguinal hernia after previous posterior hernia repair. In two-thirds of the patients, the recurrence was located caudally or medially from the previously placed mesh. There was no recurrence during a mean follow-up of 70 months. However, there were 8 adverse postoperative events: 4 port-site hernias and 4 chronic postoperative pain that restricted daily activities.

The concept of IPOM in the management of inguinal hernia is not new. In 1998, Kingsley et al[22] demonstrated the feasibility of inguinal hernia repair by IPOM with expanded polytetrafluoroethylene (ePTFE) mesh (10–15 cm), but the recurrence rate was 43% at the 41-month follow-up. Sarli et al[23] compared TAPP to IPOM in a prospective, randomized study. A total of 76 patients underwent TAPP and 72 underwent IPOM; 10 × 7-cm ePTFE was used for IPOM and 15 × 12-cm polypropylene mesh was used for TAPP. There were no recurrences at 32 months after TAPP compared with an 11.1% recurrence rate for IPOM. Neuralgia was noted in 3 patients who underwent TAPP and in 11 who underwent IPOM ($P <$ .05). As a result of these and other studies, the IPOM technique has been considered to be inferior to TAPP and TEP repairs in the treatment of primary inguinal hernias.[8] Clearly, multiple factors have contributed to these poor

Table 1.
Patient Demographic and Sequence of Previous Hernia Operations

Patient	Age	BMI	Sequence of Previous Hernia Operations
1	54	26.4	Suture repair, anterior mesh repair, TAPP
2	62	28.4	Anterior mesh repair, TEP, anterior IPOM
3	64	24.5	Suture repair, 3 anterior mesh repairs, TAPP
4	74	26.8	Two anterior mesh repairs, TEP
5	56	26.6	Anterior mesh repair, TAPP
6	52	26.5	Anterior mesh repair, suture repair, TAPP
7	47	27.1	Anterior mesh repair, anterior mesh plug repair, TEP
8	44	26.0	Suture repair, anterior mesh repair, TEP
9	24	26.1	TAPP, anterior repair

All patients were men and age is given in years. BMI, body mass index (kg/m^2); IPOM, intraperitoneal onlay mesh repair; TAPP, transabdominal preperitoneal, TEP, totally extraperitoneal.

results, including no reduction of the hernia sacs, inadequate mesh size, lack of permanent bony fixation, and lack of tissue glue fixation of the inferior edge of the mesh.

Central to the conventional laparoscopic approach is the attempt to place the mesh in the extraperitoneal position, which means having to raise the peritoneal flaps sufficiently to cover the new mesh. By and large this is almost impossible, as often the peritoneum adheres so densely to the previous mesh that one ends up with multiple defects in the peritoneal flaps, exposing the normal mesh to bowel and causing adhesions with possible deleterious sequelae. Indeed, Lo Menzo et al[10] reported, in a series of 6 patients with 7 recurrent inguinal hernias after laparoscopic repair, that there were 2 patients in whom the peritoneal flap did not cover the mesh and a tissue-separating mesh with fibrin sealant had to be used to cover the myopectineal orifice. In addition, the TAPP repair involves placement of a 10-mm trocar through the linea alba in the umbilical region and of 2 × 5-mm trocars more inferiorly (although some surgeons prefer to place these latter trocars laterally on each side of the abdomen). All of these trocar sites are at risk of formation of a port-site hernia. An extraperitoneal approach, with the inferiorly placed 5-mm trocars, would be difficult, if not impossible, because the extraperitoneal space is likely to be obliterated from the previous laparoscopic repair. For this reason, most second laparoscopic repairs have been per-

formed as a TAPP procedure, in which the 5-mm trocars can be placed laterally on either side of the umbilical camera port. In our study, the umbilical (the only) port was placed via the previous infraumbilical scar, with transverse incisions in the anterior and posterior rectus sheaths with retraction of the rectus muscle laterally. Those incisions were closed with slowly absorbable monofilament sutures. These entry and closure techniques prevented port-site hernia formation in our series.

With the introduction of the first commercial single port device, SIL port (Covidien), in 2007, there has been an exponential increase in the number and variety of SIL procedures performed. It has been estimated that the learning curve for SIL for an experienced laparoscopic surgeon is between 25 and 50 cases,[24] which means that it should not take more than a year for a general surgeon in Australia, who would perform 26 inguinal hernias per annum,[2] on average, to be competent in performing SIL.

Although the conventional laparoscopic ventral hernia repair involves placement of a 10-mm camera port in the upper outer quadrant and 2 × 5-mm ports more inferiorly in the anterior axillary line, such a configuration of ports would be a considerable distance from the inguinal region, causing poor ergonomics for the dissecting instruments, necessitating the use of longer dissecting instruments, which would further compromise the ergonomics of the dissecting instruments. Although SIL suffers from a lack of triangulation, this drawback can be overcome by modifying dissection techniques, by using a smaller and longer laparoscope, and with increased experience.

Our recent prospective randomized controlled study comparing single-port with multiport laparoscopic TEP inguinal herniorrhaphy demonstrated safety and efficacy and additional cosmetic and noncosmetic benefits similar to those of the single-port technique beyond the learning curve.[20] To date the principal author has performed in excess of 800 SIL-TEP and 120 SIL-VHR repairs, with the latter including some of the most difficult abdominal wall (ie, parastomal) hernias. Therefore, it became a natural progression to treat inguinal hernias that recur after the patient has undergone both open and laparoscopic repairs with SIL, with the umbilicus used as the only point of access for placement of the single port. The SIL port allows for placement of a 12-mm trocar for ease of intraperitoneal placement of antiadhesive mesh. The SIL-IPOM repair follows closely the dissection of the inferior flap during the TAPP repair, as meticulous dissection of the inferior flap, below the inferior border of the previous extraperitoneally placed mesh, is important to reduce any

direct, indirect, and femoral hernias, as well as any lipoma of the cord, with preservation of the latter and its structures. Since virtually all of these hernias have a direct component, fixation of the mesh into the pubic ramus with nonabsorbable tacks is an important aspect of the repair that ensures permanent fixation and prevents further mesh displacement or eventration into the direct defect. Of course, this protection can only be effectively accomplished with permanent tacks that allow adequate fixation of the mesh to the bone. However, unlike a TAPP repair of a recurrent inguinal hernia, the SIL-IPOM does not interfere with the previously placed extraperitoneal mesh, but it aims to cover the defective inferior and medial borders of the previous mesh with an antiadhesive mesh that then extends well above the previous extraperitoneally placed mesh, in an attempt to prevent stapling of the relevant nerves in the groin causing severe chronic postherniorrhaphy pain. Furthermore, the fixation of the microporous mesh well above the previously placed extraperitoneal mesh allows for better tissue ingrowth into the rough side of the mesh, as the normal peritoneum above the peritonealized mesh would be healthy live tissue that allows for ingrowth into the mesh. That most hernias that recur two times or more seem to have a direct component suggests an intrinsic weakness of the myopectineal orifice. Indeed, Henriksen et al[25] found a consistent significant increase in immature type III collagen compared with the stronger type I collagen in patients with hernias, and the changes were most pronounced in patients with a direct inguinal hernia than in those with an indirect inguinal hernia. Furthermore, although the inferior edge of the mesh cannot be tacked to avoid damage to vital neurovascular structures, it can be fixed with fibrin sealant. In addition, reflection of the inferior peritoneal fold back onto the mesh and its fixation with tacks prevents any further folding of the mesh, which should minimize the risks of recurrence.

Lau,[26] in a prospective randomized study of mesh fixation with either fibrin sealant or tacks in laparoscopic inguinal hernia repair, showed that fibrin sealant reduces the incidence of chronic postherniorrhaphy pain. In our study we used fibrin sealant to fix the inferior edge of the mesh; but in addition we used fibrin sealant for its antiadhesive property, on the basis of findings in our experimental and clinical research.[27] Indeed, since 2007, in all our patients undergoing LVHR we have sprayed fibrin sealant along the periphery of the mesh, where adhesions are likely to take place, as well as on the tacks, which are known to cause adhesions. Furthermore, the application of fibrin sealant along the mesh–peritoneum interface reduces the

risk that bowel loops will herniate through undetected gaps.

One important technical aspect in our study relates to the size of the mesh, which had to be long enough in the craniocaudal dimension that the superior edge of the mesh would be tacked well above the relevant nerves in the inguinal region to avoid nerve entrapment, even though, theoretically, only a 5-cm overlap of the defect is normally necessary for a sound repair. The single-port approach not only allowed the instruments to be inserted sufficiently far from the inguinal region, hence facilitating dissection, but it also permitted the mesh to be tacked more superiorly than would have been possible with the multiport approach. In addition, the inferior peritoneal flap had to be meticulously raised, without electrocautery, to prevent accidental damage to the retroperitoneal nerves that otherwise could have caused chronic postoperative pain. In our case series of 9 patients, during 4.5 years all were successfully treated with SIL-IPOM repair without any complication or recurrence during a mean follow-up of 24 months. Furthermore, none of the patients reported chronic pain after SIL-IPOM repair. These results compare favorably with those obtained with the alternative TAPP repair, which would not be suitable for surgeons trained only in TEP repair. In contrast, successful SIL-IPOM repair demands the highest level of competence in laparoscopic surgery. The surgeon must achieve safe adhesiolysis and avoid inadvertent nerve damage or entrapment through detailed knowledge of laparoscopic inguinal anatomy and the use of a sufficiently large piece of antiadhesive mesh, which must be judiciously fixed to achieve successful repair. In our series all of the patients had extensive adhesions of omentum, bowel, or both to the previously placed extraperitoneal mesh, and their meticulous division added significantly to the average operative time of 125 minutes, whereas a primary SIL TEP repair, in our experience, can be performed in 50 minutes, on average.[20] Furthermore, although the previously placed extraperitoneal flap was poorly positioned, it had to be assumed that there would have been some dissection of the peritoneum from the previous laparoscopic approach, either TEP or TAPP, and therefore, the dissection of the inferior flap was accomplished by meticulous and sharp dissection, millimeter by millimeter, to prevent damage to retroperitoneal structures, including the bladder, external iliac vessels, and the femoral and retroperitoneal nerves. This time-consuming process added to the relatively prolonged operative time compared to the time needed for a primary laparoscopic repair.

Finally, our hospital finance departments provided an accurate accounting of the costs of the disposables used as well as the hospital charges for LVHR procedures. The cost of an SIL port was US $480 compared with US $340 for the three disposable ports [consisting of a structural balloon trocar and inflation bulb (US $280; Tyco Healthcare, Norwalk, Connecticut) and two ribbed disposable 5-mm trocars (US $30 each; Kii Fios First Entry; Applied Medical, Rancho Santa Margarita, California)] that we would normally use for multiport hernia surgery. The total hospital charges for LVHRs were usually between US $8 000 and $10 000, depending on the size of the mesh and the number of tacks used, and therefore the small additional cost of the single-port device represents a very small percentage of the overall cost of the procedure, with the potential to reduce postoperative pain, analgesic requirements, and port-site hernia formation and to improve cosmesis, as demonstrated by our recent RCT comparing single-port with multiport inguinal herniorrhaphy.[20]

CONCLUSION

Multiple recurrences of inguinal hernias following failed conventional anterior and laparoscopic repairs can be safely and effectively treated with laparoscopic IPOM repair. When IPOM is combined with SIL, the umbilicus can be used as the only incision site, which, apart from having the potential to reduce port-site complications, also allows improved ergonomics of the dissecting instruments, albeit with modified dissection techniques, by being of optimal proximity to the inguinal regions, where bilateral repairs can be performed safely and effectively.

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