# Single Incision Laparoscopic Inguinal Hernia Repair

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## Introduction

Since the first laparoscopic inguinal hernia repair in 1988 [1], the technique was refined and standardized over the next two decades such that the laparoscopic technique increasingly became acceptable as a safe, quicker, and more cost-effective alternative to the open repair. Indeed, in Australia, where Medicare Australia keeps accurate data, the laparoscopic inguinal hernia repair increased from 9.7% in 2000 to 54% in 2016 which coincided with the fact that some 50% of surgeons were performing laparoscopic inguinal hernia repair as part of their practice [2].

Parallel with the increasingly standardized technique of endoscopic repair is the development of mesh prosthetics resulting in the development of a plethora of meshes varying from "mosquito net" [3, 4] to biological mesh [5]. Apart from making general surgeons increasingly confused as to what they should use in a particular patient, laparoscopic skill development also became stunted. This changed with the advent of natural orifice transluminal endoscopic surgery (NOTES) [6–8] and its offshoot, single incision laparoscopic surgery (SILS). It was suddenly possible to perform scarless or virtually scarless surgery from a single incision whether it was from a natural orifice, such as the vagina, or a carefully crafted incision of a natural "scar" such as from within the umbilicus. Opponents of the new technique point to loss of triangulation as the main reason for not learning the newer skills, while proponents reassert the relative ease of adapting the new procedure by simple modifications of the dissection techniques such as "chopsticks" and "in-line" dissection [9, 10].

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Like all new techniques, SILS is needed to be carefully investigated, and unfortunately most studies, mainly in SIL cholecystectomy, lacked scientific rigor and uniformity and included the learning curve through eagerness of the "young guns" to publish [11]. This resulted in suboptimal results of the new procedure. Lessons learned from such failures allowed some leading hernia centers to perform well-conducted randomized controlled trials (RCTs) comparing single- and multiport TEP repair well past the learning curve. Currently, three RCTs with 100 or more patients [12–14] have been published, and all have confirmed the safety of the single incision laparoscopic repair, and two have confirmed its efficacy [13, 14] meaning that the procedure could be performed in the same time period as conventional multiport repair. In fact, one study [15] showed that SIL TEP repair was highly cost-effective compared to multiport repair once balloon dissection of the extraperitoneal space was replaced with telescopic extraperitoneal dissection which negated the cost of the balloon dissector and hence minimized the total cost of disposables.

Having adopted SILS for virtually all cases of inguinal and ventral/incisional (including parastomal) hernia repair since 2009, the principal author has performed some 2000 cases and has amassed unparalleled experience with SILS so that the readers may enjoy and, hopefully, be inspired to adopt the new technique knowing that SIL TEP repair is a proven acceptable alternative to multiport repair with no adverse side effects and with the potential to improve patient care with potential cost savings [16, 17].

## Preoperative Considerations

For hernia repair, the eligibility for TEP repair applies equally to SIL and multiport surgery. During the learning curve of the surgeon for SIL TEP, it is advisable to start with simple cases such as ventral hernias and not perform complicated cases such as inguino-scrotal hernias. Equally important is the delicate but necessary question of informed consent. If the surgeon is technically competent (i.e., having performed more



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than 250 cases of multiport repair) [18], then it becomes a simple matter of informing the patient of the safety and efficacy of SIL TEP repair and reassuring them of willingness to convert to multiport repair, without any adverse side effects, should SILS become difficult for any reason. It is reasonable to expect the first few cases to take significantly longer than normal, and hence care is taken to adjust the operating list to accommodate for increased operating time.

The surgeon needs to be familiarized with the new devices, instruments, and modified techniques so that he/she can confidently project knowledge to his/her scrub staff who too will need to be trained. More often than not, companies promoting single-port devices will have well-trained staff to assist with the transition to SILS. Such companies may even run SILS courses and assist surgeons with proctorship with an experienced SIL practitioner.

There are bare minimum number of instruments and equipment that are necessary to successfully undertake SIL TEP repair; these are detailed below:

1. An operating table which can be tilted sideways as well as being able to be positioned in Trendelenburg and reverse Trendelenburg position
2. Two monitors for clear angle of observation for the principal surgeon, assistant and scrub nurse
3. Two S-shaped retractors (Fig. 17.1)
4. A 30° angled, 52 cm, and 5 mm laparoscope (Fig. 17.3)
5. A pair of "Dolphin" and "Merryland's" forceps with diathermy pin below the handle (Precision Endoscopic Instruments, Baulkham Hills, NSW, Australia) (Figs. 17.3 and 17.4)
6. Single-port device (Figs. 17.3, 17.4, 17.5)

## Patient Positioning and Theater Setup

Prior to entering the operating theater, the patient should be asked to empty their urinary bladder. Urinary catheterization should be used in selective cases, especially those with history of prostatic symptoms or in complicated cases such as inguino-scrotal hernias, where it is anticipated that the operation may take much longer than an uncomplicated case. Additionally, judicious fluid administration, by the anesthetist, during the operation may also limit urinary production so as not to overfill the bladder. After the patient is anesthetized, their arms are tucked into their sides of their body by using pillowcase wraps, and the use of an extension intravenous line may assist the anesthetist with ease of access to administer medications. Patients must always have calf compressors in place during the procedure, and the use of lower body warmer and upper body blankets (the author avoids the upper body warmer due to its bulkiness which may interfere with ease of maneuvering instruments) will assist in keeping the patient warm during the operation. The patient is shaved from 5 cm above the umbilicus to mid-thighs and prepped with aqueous iodine solution (or chlorhexidine if there is an iodine allergy). In particular, care is taken to clean out the umbilicus with a small iodine-soaked gauze to ensure sterility of the incision site. The patient is then draped so that only 2–3 cm of the skin is exposed from 2 cm above the umbilicus to pubic symphysis so that there is minimal skin exposure (Fig. 17.1). In cases where SIL TEP is combined with open groin exploration, e.g., tri-neurectomy with or without removal of the mesh, an iodine-impregnated adhesive drape is also used to cover the side of the abdomen to be operated on.

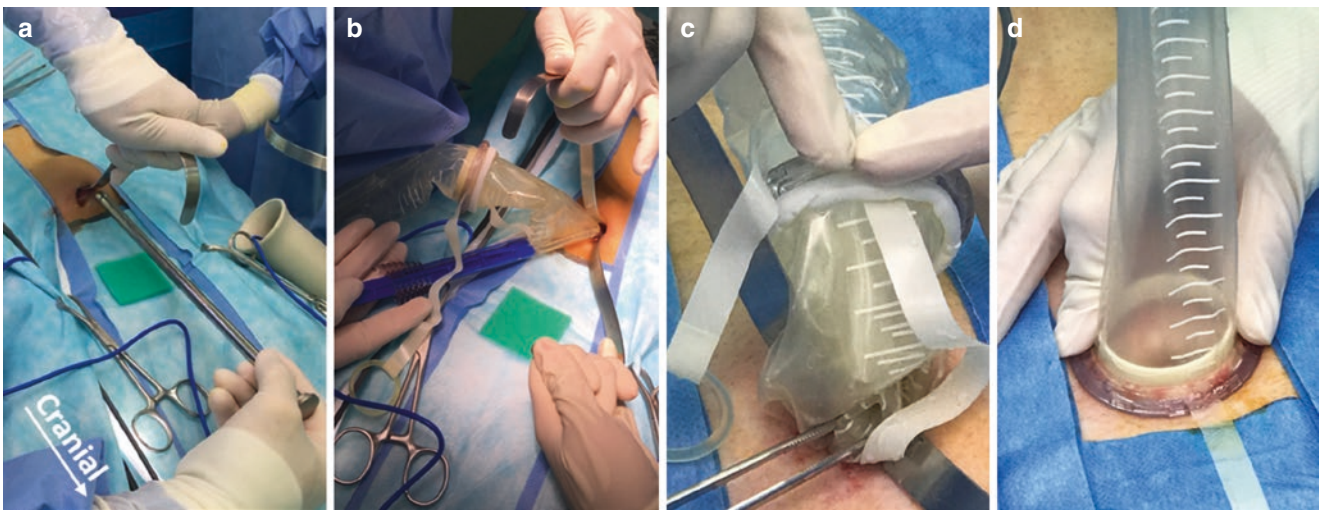


**Fig. 17.1** (**a**) shows insertion of a blunt metal probe into the extraperitoneal space toward the pubic symphysis; (**b**) shows the surgeon's left hand retracting the S-shaped retractor infero-laterally, while the assistant retracts superolaterally as the tip of the introducer is placed at the entrance of the anterior rectus sheath incision before the inner ring is deployed; (**c**) shows the remainder of inner ring being inserted into the extraperitoneal space with a pair of broad and blunt tissue forceps; and (**d**) shows the outer ring being snugged down

Irrespective of the side of the inguinal hernia to be repaired, the surgeon starts on the left side of the patient while the assistant on the right side. Monitors on each side of the operating table permit ease of the surgeon and assistant moving to the contralateral side to the hernia, especially for bilateral cases, without having to move the monitor while allowing the scrub nurse full view of the operative fields so that he/she can respond in a timely fashion to the needs of the surgeon. During laparoscopic dissection, the assistant stands cranial and medial to the surgeon holding the camera head with his/her hand corresponding to the side of the hernia to be operated on so that there is minimal interference with the surgeon's arms/hands (Fig. 17.3). The extra-long laparoscope further minimizes clashing of the surgeon and assistant's arms/hands.

## Incision and Port Placement

Following appropriate positioning of the patient, prepping and draping the incision site are infiltrated with local anesthetic; once ready, a crescentic 1.5 cm incision is made within the confines of the umbilicus. The incision is deepened using electrocautery until the anterior rectus sheath is reached. The muscle belly of the rectus is usually visible, and a transverse 1.5 cm incision is made into the anterior rectus sheath with care taken to avoid the intersection of the rectus, which would result in entry into the peritoneal cavity. If the latter is encountered, then the incision should then be moved 1 cm inferiorly or superiorly. The side of the rectus to be dissected should be the same side of the hernia so that only the extraperitoneal space of the side of the hernia is dissected to minimize disturbance of the contralateral space for a potential future contralateral extraperitoneal repair. The S-shaped retractors are effective in retracting the wound edges while permitting wider vision into the incision due to their shape. The inferior edge of the rectus sheath is then grabbed with a pair of broad blunt forceps, while a pair of Metzenbaum scissors is used to sweep the rectus muscle belly laterally, while the inferiorly placed S-shaped retractor (Fig. 17.1) is then repositioned to lie just deep to the rectus muscle belly, i.e., extraperitoneally. Then the other S-shaped retractor can then be inserted into the extraperitoneal space superiorly. The balloon dissector, if used, can then be inserted at this stage to create the extraperitoneal space. The superiorly placed retractor is now used to further dissect this space to allow the single-port device (see later) to sit evenly and snugly deep to the rectus muscle. The use of a particular commercially available single-port device depends on availability, cost considerations, individual patient characteristics, and personal preference. Three different devices will be discussed in detail:

### *The TriPort*⁺ (Olympus Winter & Ibe GmbH, Hamburg, Germany)

In the author's view, this port requires a little extra preparation and a few steps beyond the manufacturer's recommendations, but it offers unrivaled flexibility of instrumentation while minimizing the incision length and is the author's preferred device in most cases for SIL TEP repair. The TriPort⁺ has three 5 mm ports which are not all necessary for inguinal hernia repair, and the middle of the 5 mm ports is amputated, plugged with a bung (Safesite injection site, B. Braun Medical Inc., Bethlehem PA, USA), and taped to secure and maintain air seal (Fig. 17.2). The plastic sleeve is next pre-

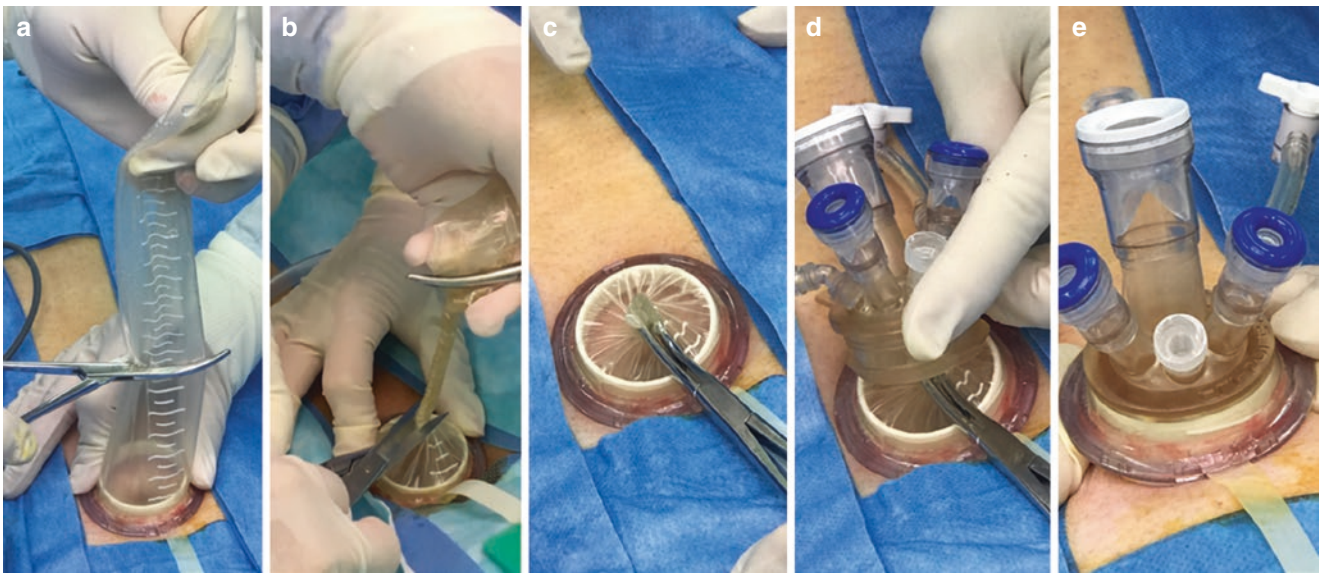


**Fig. 17.2** (**a**) shows application of a pair of Kocher's forceps in the lower part of the plastic sheath which is then twisted to allow the excess sheath to be removed (**b**), the plastic sheath stump is then inverted into the outer ring (**c**), and (**d**, **e**) show placement of the top platform of the TriPort⁺ into the outer ring

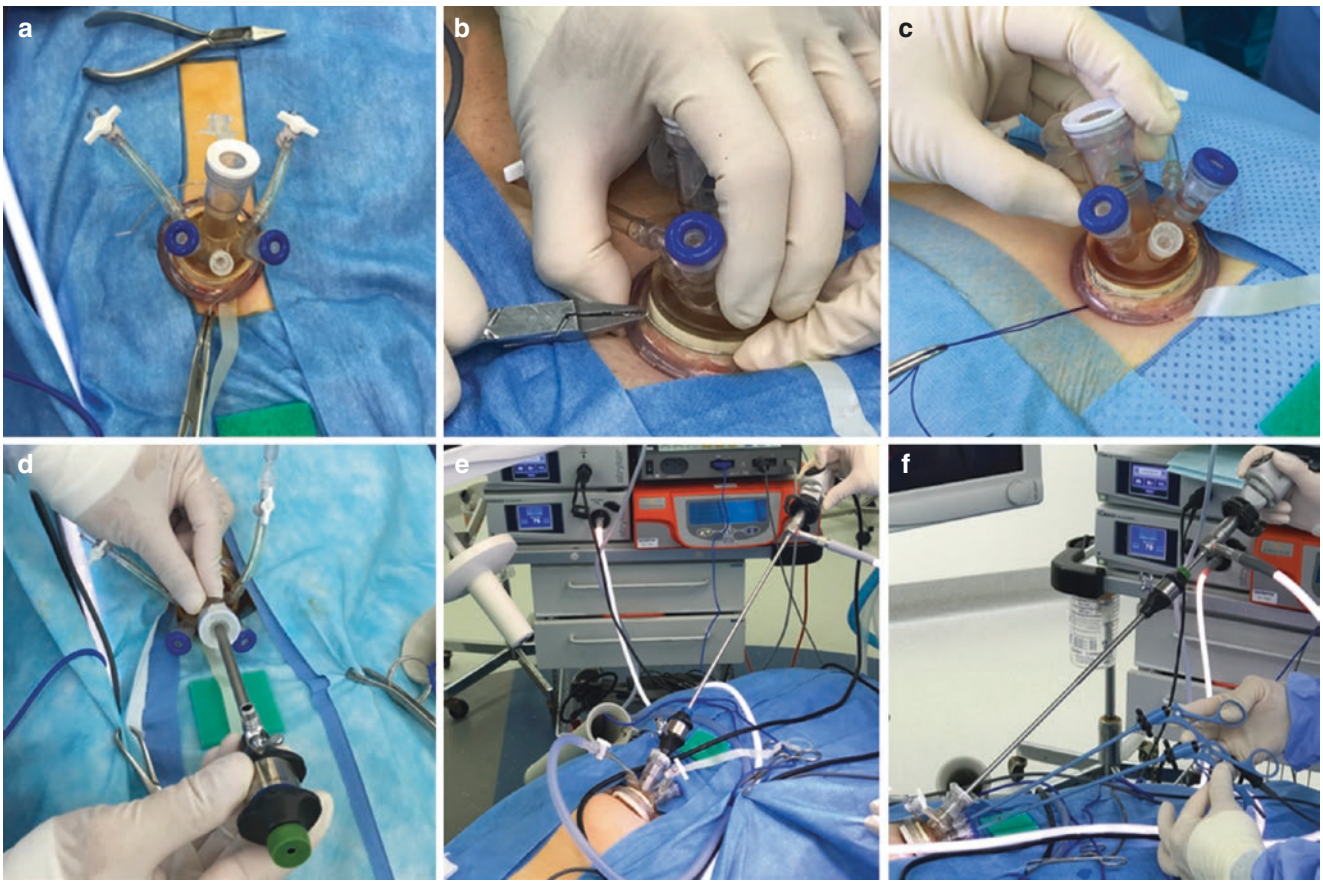


**Fig. 17.3** (**a**, **b**) demonstrate how a wire loop is applied around the outer ring and is tightened to prevent slipping, (**c**) shows a figure-of-8 suture placed in the attenuated anterior rectus sheath to prevent dislodgement of the inner ring, (**d**) demonstrates the placement of a 5 mm non-disposable port into the extraperitoneal space, (**e**) is of the 5 mm scope being inserted into the extraperitoneal space, and (**f**) the 5 mm port being pulled back along the 5 mm scope with insertion of the dissecting instruments below the scope (note the inferiorly placed diathermy pin)

pared by lubricating the sheath both from outside and inside with gel before the inner ring is placed inside the introducer (Fig. 17.1). These preparative steps can be performed by the assistant while the surgeon preps and drapes the patient without increasing operative time. The incision for the TriPort⁺ is kept to no more than 1.5 cm, and this requires discipline by the assistant not to over-retract with the S-shaped retractors which would lead to tearing of the anterior rectus sheath. Furthermore, the tip of the introducer is placed at the entrance to the rectus sheath opening, and the inner ring is deployed into the extraperitoneal space (Fig. 17.1), without placing the entire width of the introducer into the extraperitoneal space, as this will increase the risks of dislodgement of the inner ring. In some patients, the anterior rectus sheath is very attenuated in which case a figure-of-8 suture is placed at the lateral edge, without tying it, and once the inner ring is introduced, this can be tied to restrict the opening to assist with keeping the inner ring in place (Fig. 17.3). On rare occasions, placement of the same suture medially is also necessary. It must be borne in mind that placement of these sutures will decrease maneuverability of the instruments and hence are only placed if the inner ring becomes dislodged during placement. Once the inner ring is in place, the outer ring is then snugged down in one swift motion (Fig. 17.1). With the assistant holding the outer ring down, the surgeon applies a pair of Roberts forceps to the plastic sleeve and turns it in one direction, and then another pair is applied closest to the outer ring before the excess is removed (Fig. 17.2). The top platform is then placed inside the outer ring with the assistant slowly wriggling the pair of Roberts forceps out before the top platform is placed fully inside the outer ring (Fig. 17.2). As opposed to the original TriPort system [13], where there was a locking outer ring to minimize the risks of the plastic sleeve from sliding through, the author has experienced significant slippage of the plastic sleeve during surgery, especially if surgery is prolonged in more difficult cases, and so a wire is always applied and twisted outside of the outer ring until it indents the ring (Fig. 17.3). This has been found to significantly minimize slippage of the plastic sleeve. Furthermore, while other ports such as SILS and

GelPorts can be removed and placed as many times as necessary (see later), once the excess plastic sleeve of the TriPort+ is cut, any reapplication of the inner ring into the extraperitoneal space is usually impossible necessitating the use of another new device which unnecessarily increases the cost of the disposables and hence the operation.

While the 5 mm port of the SILS port allows for placement of the 5 mm laparoscope directly into the extraperitoneal space (see later), the inverted plastic sleeve provides an obstacle to the introduction of the laparoscope which often becomes smudged. This can be overcome by placing a non-disposable 5 mm port, which is long enough to go past the plastic sleeve, into the extraperitoneal space (Fig. 17.3). Once the scope is inside, the non-disposable port can then be pulled back along the long scope toward the head so that it does not interfere with the dissecting instruments (Fig. 17.3). Should the scope need to be cleaned, then the non-disposable port can be inserted into the extraperitoneal space again, while the scope is withdrawn.

### *The SILS Port* (Covidien, Norwalk, Connecticut, USA)

To allow for appropriate insertion, the foamy SILS port is grasped with a pair of Roberts forceps so that the tips of the Roberts forceps lie close to the insufflation hose (Fig. 17.4). While the surgeon retracts the inferiorly placed S-shaped retractor, the assistant retracts superiorly and laterally, and the well-lubricated SILS port with gel is then placed firmly into the extraperitoneal space (17.4). If the device is in the correct space, then the device will appear "sucked" down (Fig. 17.4). Failure to be able to insert it into the correct space usually means the skin incision and/or the rectus sheath incision is too small. For the SILS port, the incisions need to be approximately 2–2.5 cm which will still result in excellent cosmetic result for a moderately large and deep-seated umbilicus. For small and shallow umbilici, the relatively larger incision would offer a poorer cosmetic result, and an alternative single-port device should be used (see later).

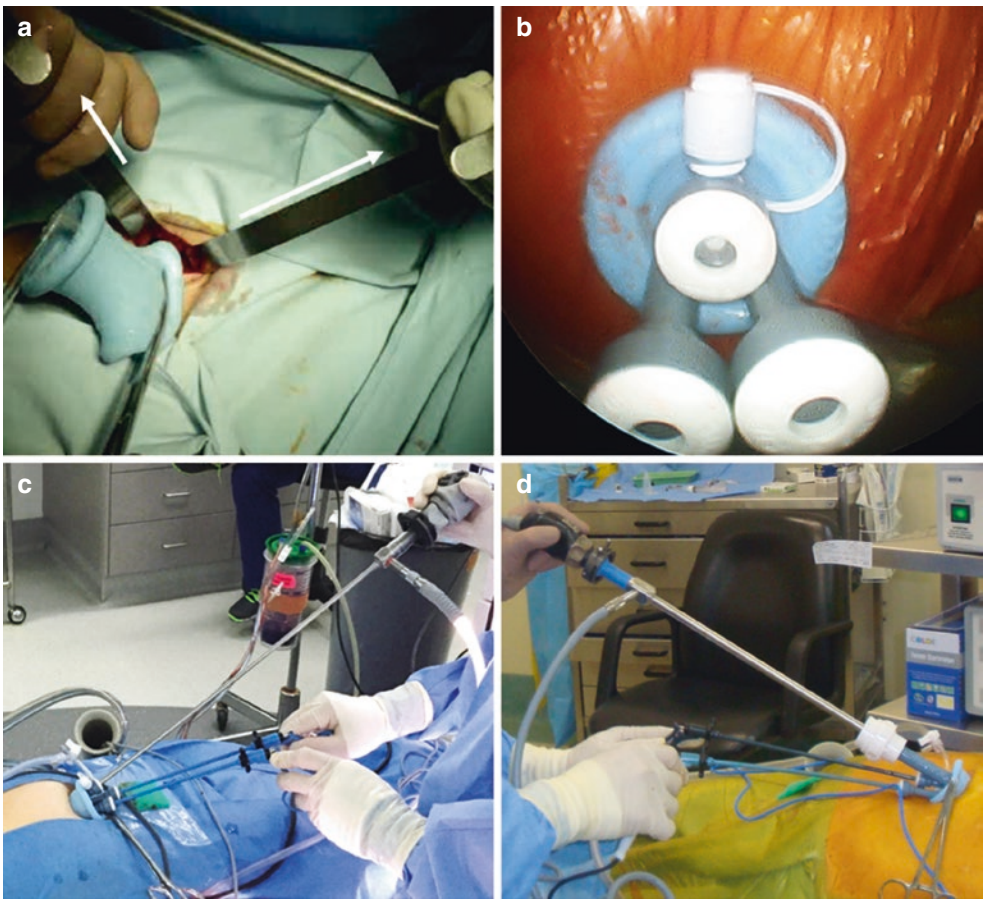


**Fig. 17.4** (**a**) Insertion of the SILS port with the surgeon retracting the inferiorly placed S-shaped retractor (*short arrow*) infero-laterally, while the assistant retracts superolaterally (*long arrow*); (**b**) the foamy part of SILS port appears "sucked" down, when correctly placed, with 3 × 5 mm ports inserted; (**c**) the long scope with conventional straight dissecting instruments; and (**d**) dissection can also be accomplished by a 10 mm/30°/52 cm scope inserted into a 12 mm port; the latter allows for placement of the mesh into the extraperitoneal space

Once the SILS port is in the correct position, it is then grasped with two pairs of Roberts and rotated 180° so that the insufflation hose is posterior to the three 5 mm holes so that 5 mm ports can then be inserted. Initially only the anterior 5 mm port is placed into the extraperitoneal space so that the 5 mm laparoscope can be inserted directly into it before insufflation with $CO_2$ to ensure one is in the correct space. Once more space is created with gas, the other two posteriorly placed ports can be fully inserted into the extraperitoneal space. Once dissection has been completed, the laparoscope can be moved into one of the posteriorly placed 5 mm ports, while the anteriorly placed 5 mm port is removed, and the well-lubricated 12 mm port can then be inserted so that the mesh can be introduced into the extraperitoneal space (Fig. 17.4). Insertion of the 12 mm port can be assisted by partially pulling the "free" 5 mm port out beyond the rectus sheath to increase the space within the foam and the rectus sheath opening.

### The GelPort Laparoscopic System (Applied Medical, Rancho Santa Margarita, CA, USA)

To provide easier insertion of the GelPort, an Alexis wound retractor is utilized being placed into the wound by grasping the lubricated inner ring of the Alexis wound protector/retractor with a pair of Roberts forceps, and this is then introduced directly into the extraperitoneal space (Fig. 17.5). Due to the relatively thicker, stiffer, and larger inner ring (compared to the TriPort+), the skin and rectus sheath incision is about 2 cm. However, the stiffer and larger inner ring also results in more secure inner ring placement so that dislodgement is rare during any procedure. The outer ring of the plastic sleeve is then turned inward, assisted by the assistant, turning it in with the surgeon until the outer ring is fully snugged down against the skin (Fig. 17.5). The GelSeal cap can be preprepared by the assistant by placing two 10 mm ports posteriorly and 12 mm port anteriorly through the gel with equal distances between them (Fig. 17.5). As the ports have inbuilt reducers, placement of 5 mm instruments or laparoscope will maintain the air seal. This is then clicked over the outer ring, and the outer lock is applied (Fig. 17.5). During insufflation, the gel membrane bellows out further separating the ports to minimize clashing.

## The Surgery and Specialized Techniques

The central tenet of laparoscopic surgery has, up until now, been about triangulation with instruments free of clashing with each other or with the laparoscope. Therefore, the relative lack of triangulation with SILS (and NOTES) must be overcome for safe and efficient operation. This is relatively easily overcome by firstly reducing the size of the laparoscope from 10 to 5 mm and increasing the length so that the side arm of the laparoscope moves away from the dissecting

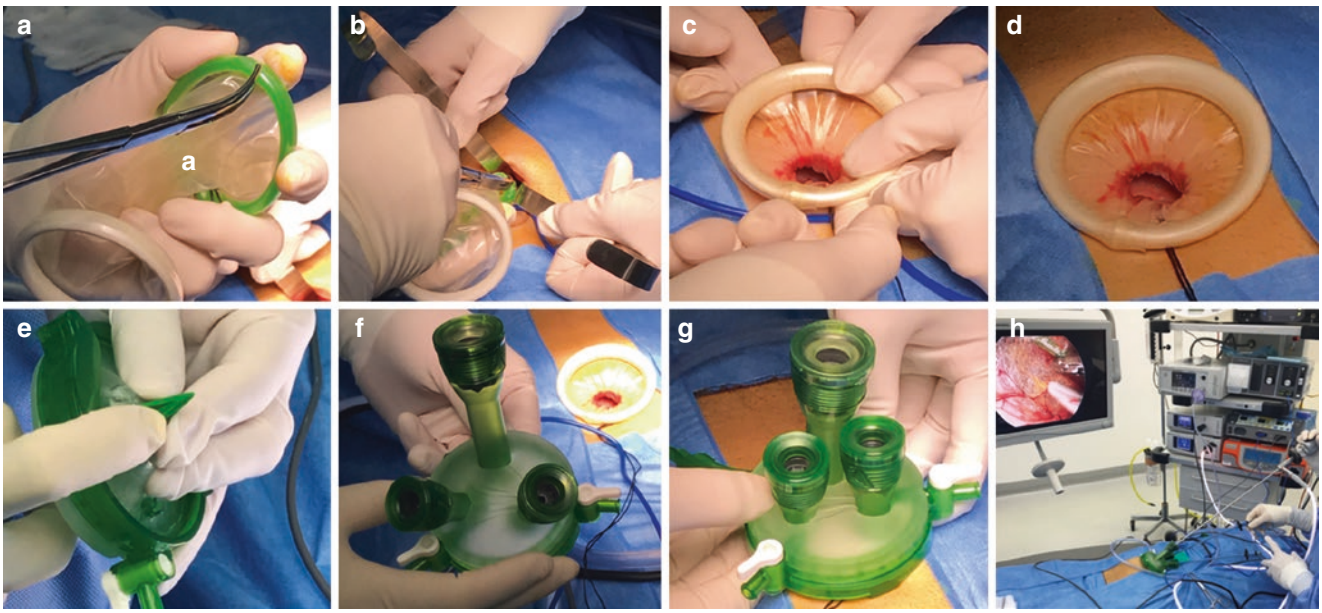


**Fig. 17.5** (**a**) The inner ring of the Alexis wound protector/retractor held by a pair of Kocher's forceps, (**b**) being inserted into the extraperitoneal space, with (**c**) showing how the surgeon and assistant simultaneously invert the outer ring, and (**d**) is of the outer ring snugged down against the skin. (**e**) placement of the ports into the GelSeal cap with (**f**) being the correct placement of the ports (2 × 10 and 1 × 12 mm) into the GelSeal cap. (**g**) demonstrates the placement of the GelSeal cap onto the outer ring of the Alexis wound protector/retractor and (**h**) the positioning of the dissecting instruments and scope during telescopic dissection of the extraperitoneal space

instruments (Fig. 17.3). The laparoscope is inserted in the direction of the area of dissection and by advancing it carefully, at least initially, until more extraperitoneal space is created. The dissecting instruments are then inserted parallel and inferior to the laparoscope (Fig. 17.3). If there is any resistance, the laparoscope is pulled back until the tips of the instruments are visualized before they are inserted any further as this prevents accidental puncture of the posterior rectus sheath and/or peritoneum. Secondly, modified dissection techniques, namely, "in-line" and "chopsticks," are used:

"*In-line*" *dissection:* the dissecting instruments are moved parallel "in-line" with each other but in the opposite direction (Fig. 17.6). This movement is useful for reducing an indirect sac. However, the range of movement with "in-line" dissection tends to be more limited.

"*Chopsticks*" *dissection*: where the fulcrum of the instruments is at the rectus sheath defect, the dissecting instruments are moved in the opposite direction on either side of the laparoscope, preventing clashing (Fig. 17.6). Significant range of movements can be achieved with this dissection in a singular movement, such as dissecting the peritoneum away from the anterior abdominal wall as dissection continues down to the symphysis pubis. Any blood vessels in the fibroareolar tissue in the extraperitoneal space can be cauterized safely with the assistant pulling the scope back until the metal parts of the dissecting instrument can be fully visualized to prevent inadvertent heat application to important structures including the peritoneum and underlying viscera (Fig. 17.7). In practice both techniques are employed at the same time in varying proportions to achieve efficient dissection.

The steps of the dissection for a TEP repair are otherwise standardized: firstly, dissecting the extraperitoneal space toward and identifying the pubic symphysis to minimize the risks of accidental injury to the urinary bladder; secondly, identifying and dissecting high and lateral to the inferior epigastric vessels to create the lateral space sufficient for placement of the mesh; thirdly, identifying and reducing an indirect sac, often with its accompanying lipoma of the cord; fourthly, dissecting the peritoneum proximally so that the mesh can be comfortably placed without the inferior edge curling up; and finally, medially dissecting the peritoneum away from the vas deferens and external iliac vein. One point of difference with the multiport dissection is that the dissection of single-port totally extraperitoneal dissection with telescopic dissection starts superiorly into the inferomedial and lateral direction, whereas the multiport dissection begins inferiorly and continues laterally and superiorly. Telescopic dissection allows for cautery of all small blood vessels crossing the extraperitoneal space, thus potentially minimizing post-op bruising and pain [15] while specifically allowing for preservation of a thin layer of areolar tissue overlying the retroperitoneal nerves (Fig. 17.7), as achieved during a transabdominal preperitoneal (TAPP) repair, which may be protective against post-herniorrhaphy chronic groin pain.

For a unilateral inguinal hernia repair, the extraperitoneal space is dissected across to the contralateral side by approximately 2 cm especially for a direct hernia. Any significant direct hernia sac is reduced and plicated to the posterior pubic ramus with a couple of nonabsorbable tacks to minimize the risks of post-op seroma formation [13]. Reducing the sac by ligation is not necessary as this increases operative time, costs, and complexity.

For bilateral inguinal hernias, the surgeon and assistant must move to the contralateral side of the patient to resume dissection. In these cases, the dissection starts at the level of the symphysis pubis and continues laterally and superiorly. Depending on whether the median raphe is well developed or not, one may encounter some difficulties dissecting the lateral aspect of the second side in which case the inferior

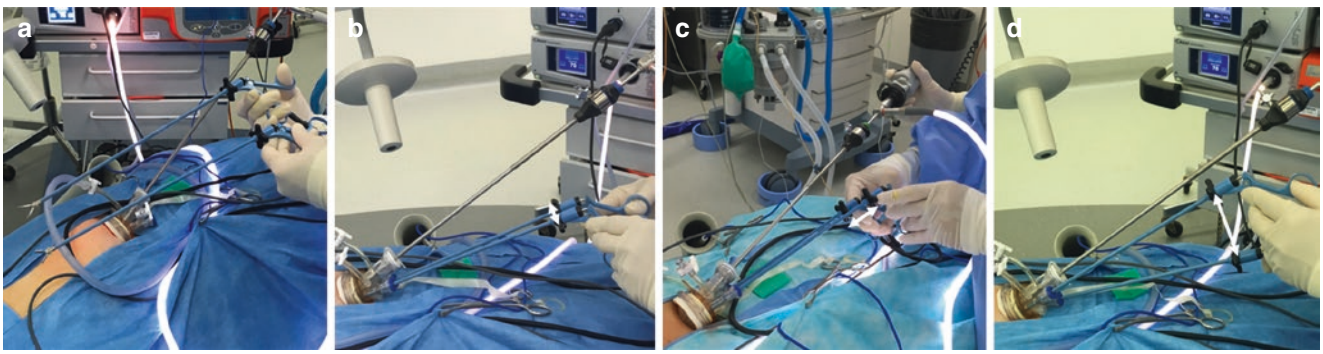


**Fig. 17.6** (**a**) demonstrates how to best set up the dissecting instruments with the Merryland's in the dominant (*right*) hand and the Dolphin forceps in the nondominant (*left*) hand, (**b**) shows neutral position of the dissecting instruments below the scope. (**c**) is of the "in-line" dissection technique with instruments moving in and out in opposite direction indicated by the increased separation of the rotating wheels of the dissecting instruments (*double arrow*). (**d**) demonstrates the "chopsticks" dissection technique where the instruments move in the opposite direction on either side of the scope as shown by increased length of the *double arrow*

portion of the raphe can be divided to ease dissection. It is usually possible to complete the repair of the contralateral side within 20 min of starting the dissection [13]. The anesthetist is warned (unless they are very familiar with SIL TEP repair) so that reversal of muscle relaxant can be instituted in good time to allow the patient to wake up without significant delay. This ensures that the procedure can be completed with the patient completely paralyzed to the end of the procedure, since the fascial and skin closure only takes a few minutes, the so-called fast finish.

## Mesh Insertion

*In order to best insert the mesh while using the TriPort*$^{+}$: the scope is placed into one of the 5 mm ports into the extraperitoneal space, and it is then withdrawn until its tip lies within the plastic sheath but beyond the rectus sheath. The 5 mm reducer is then removed, and the mesh is then rolled along the shortest dimension and folded half way and grasped with a pair of Dolphin forceps (Fig. 17.8). With the laparoscope pointing in the direction of the pubic symphysis, the mesh is introduced parallel and in the same direction, with a swift pass until the mesh is well past the rectus sheath opening when one would anticipate loss of "pneumoperitoneum" which is quickly regained once the Dolphin forceps are removed. With a pair of the latter then reintroduced into the other 5 mm port, the scope can now be reinserted into the 10 mm port via 5 mm reducer so that the mesh can now be positioned into the correct orientation.

*For insertion of the mesh while using the SILS port*: this is efficiently done by replacing the anterior 5 mm port with 12 mm port while introducing the mesh into the latter with the process being observed by the scope placed in one of the other 5 mm ports in the extraperitoneal space (Fig. 17.4). A 5 mm port then replaces the 12 mm port, and the operation continues as for before insertion of the mesh.

*By far the simplest mesh insertion is done while using the GelPort*: the mesh can simply be grasped with a pair of Dolphin forceps and inserted into the large 12 mm port directly through into the extraperitoneal space (Fig. 17.5).

With the medial and lateral ends of the rolled-up mesh correctly oriented into their appropriate space, the mesh can then be unrolled. Fixation of the mesh can be achieved using tacks (both absorbable and nonabsorbable) as well as with the addition of fibrin sealant (Fig. 17.8). The international guidelines for the management of adult groin hernias [18] recommend tack fixation for large direct inguinal hernias.

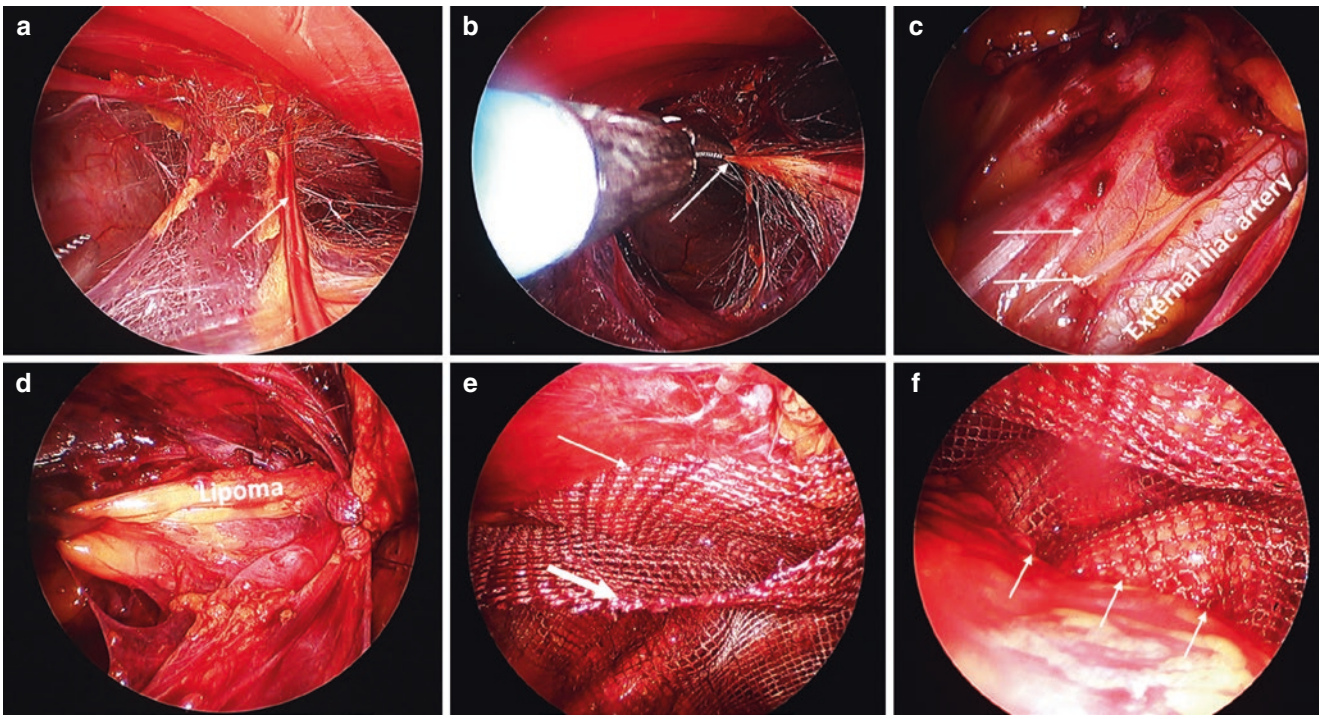


**Fig. 17.7** Intraoperative views of SIL TEP repair. (**a**) The *white arrow* indicates a small blood vessels crossing the extraperitoneal space, (**b**) is of telescopic dissection which allows for electrocautery of such vessels, (**c**) preservation of the fibro-alveolar (glistening) membrane overlying the retroperitoneal nerves is indicated here by the *white arrows*. (**d**) is an image of a reduction of a lipoma of the round ligament (in a female patient), whereas (**e**) is of a male patient with bilateral direct hernias where a mesh was placed centrally covering both direct defects (*thin white arrow*), while an additional mesh (*thick white arrow*) was placed on each side to cover the deep inguinal ring, and (**f**) the peritoneum (*thin white arrows*) descending onto the mesh during deflation

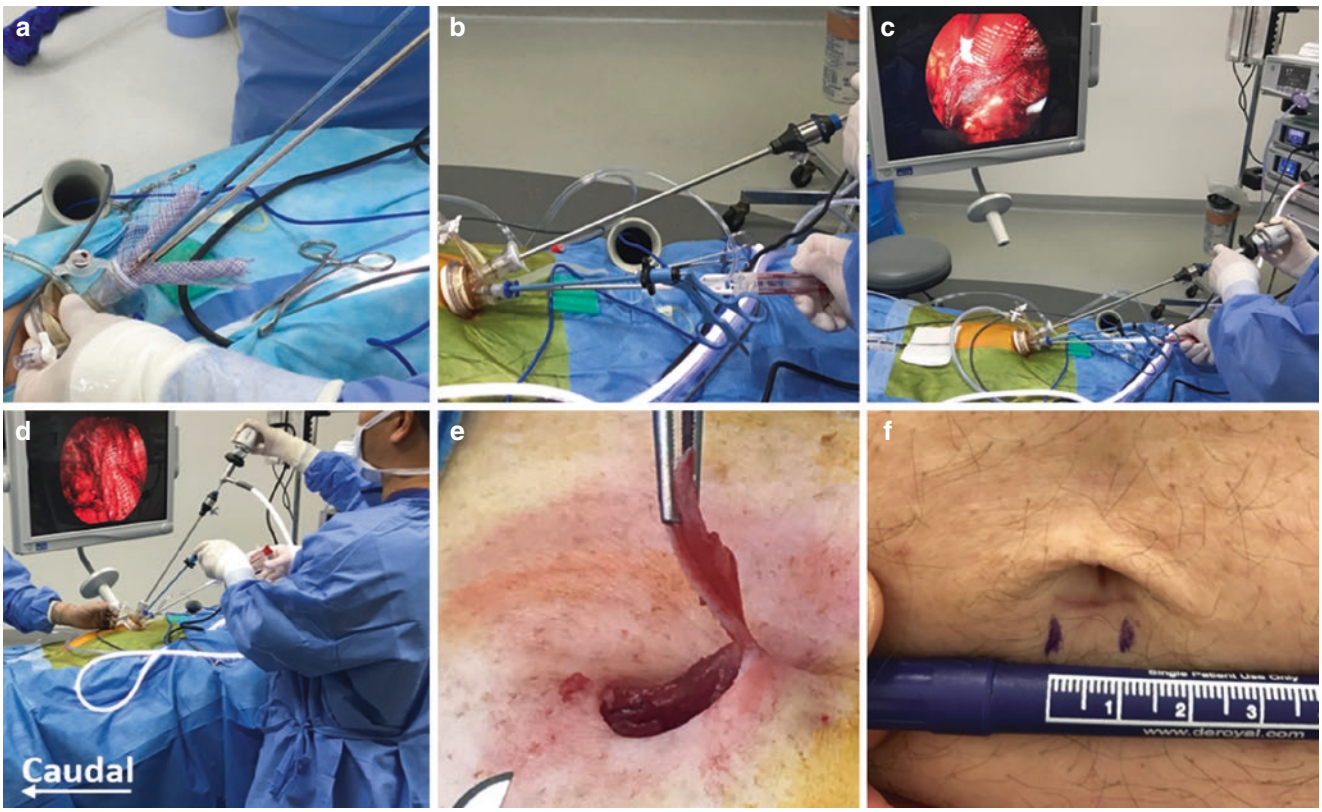


**Fig. 17.8** (**a**) demonstrates a scope in one of the 5 mm port to observe insertion of the mesh through the 10 mm port placed with a pair of Dolphin forceps, and (**b**, **c**) show application of fibrin sealant for mesh fixation. (**d**) The patient placed in the reversed Trendelenburg position during deflation with the scrub nurse releasing the gas in a controlled manner, (**e**) is excision of the traumatized inferior wound edge, and (**f**) the barely visible 1 cm scar 6 weeks post-op

For bilateral indirect inguinal hernias, the author prefers to sequentially fix the mesh one side at a time after completion of dissection of one side. For bilateral direct inguinal hernias, the author prefers to complete the dissection of both sides and then place the meshes sequentially, with one placed centrally and high up to cover both direct defects (Fig. 17.7) and then one on each side being slightly more inferior to the centrally placed mesh as it more adequately covers potential or actual femoral and indirect defects (Fig. 17.7).

Once the mesh is in the correct position, for unilateral inguinal hernia, the patient can then be placed in the reversed Trendelenburg position before $CO_2$ insufflation is stopped. Then, with the tap open, deflation can be carefully observed to ensure that the inferior aspect of the mesh is not rolled up, which would then cause a recurrence of the defect due to incomplete mesh coverage. This process can take mere seconds, but cooperation of the assistant and scrub nurse is essential (Fig. 17.8). If there is any doubt as to the positioning of the mesh, then re-insufflate (and if necessary placing the patient back into the Trendelenburg position) to ensure the peritoneum has "fallen" onto the mesh (Fig. 17.7) rather than rolling the mesh up.

## Wound Closure

Once the port has been removed, and due to the repeated insertion of the instruments and constant uneven tension, the inferior wound edge nearly always becomes traumatized, and the author routinely excises a 1 mm sleeve of the wound edge to ensure a healthy skin edge (Fig. 17.8) to prevent proper healing which could also lead to wound infection. The anterior rectus sheath is then closed with a 0 suture of slowly absorbable monofilament, and the skin wound is closed with 4.0 absorbable monofilament. Meticulous fascial closure is necessary to achieve very low port-site incisional hernia rate, similar to multiport repair, as the incision does not involve entry into the peritoneum via the linea alba [19]. The wound is cleaned and dressed with adhesive tapes and a waterproof dressing.

Some 95% of patients undergoing SIL TEP repair can go home on the same day with adequate adult supervision [13], while most of the remaining are kept in for nonmedical reasons including patients who live more than 2–3 h from the hospital or those without adequate postoperative care. Patients are warned during the initial consultation of potential scrotal bruising and to wear firm and supportive underwear

to minimize discomfort should swelling occur. It is the author's practice to see his patients 1 week, 6 weeks, and annually for 5 years.

## Tips and Pitfalls

While most of the novel techniques have been described previously, some additional tips include the following:

- Due to the very limited extraperitoneal space available initially during telescopic extraperitoneal dissection, the patient must be fully paralyzed. It is paramount for the patient to be on an infusion of muscle relaxant during the procedure as this results in a smoother operation due to reliable muscle relaxation. On rare occasions, it has been noticed that the patient "appeared" to be not fully paralyzed as the rectus muscle could be seen to be moving in and out but not in synch with the respirator. This was found to be due to partial obstruction of the insufflation hose internally, since the extraperitoneal space is only minimally dissected initially for placement of the single-port device. This caused the apparent movements because the insufflation machine struggles to overcome the obstruction and consequently pumps gas in intermittently. Simple solutions include rotating the port slightly and/or changing the insufflation hose to the other side.
- During the dissection, the assistant may lift the head of the scope excessively which can result in the end of the scope moving between and below the tips of the dissecting instruments [13]. If this happens, the dissection becomes impossible. This situation can be remedied by lowering the head of the scope to neutral position and pulling the dissecting instruments back to the fulcrum and then reintroducing them below the scope. Note that pulling the scope back into the fulcrum and reintroducing it above the instruments can achieve the same result except this risks dislodging the scope out of the extraperitoneal space altogether and/or smudging of the scope.
- Even if there is an obvious direct hernia, the spermatic cord must always be pulled back some 5 cm, with or without external pressure in the groin to ensure that any cord lipoma is fully reduced. If this is missed, the patient can present later with pain due to a persistent lipoma of the cord. In fact, this is classified as a recurrence and may necessitate an open anterior operation to excise it.
- As the surgeon becomes more competent with SILS, he or she can undertake more difficult cases and even cases that are normally almost impossible, if not unsafe, with multiport TEP repair. For example, for irreducible inguinoscrotal hernias, it is possible to place the single-port device intraperitoneally on the contralateral side to the hernia, via the same mode of entry (i.e., avoiding entry into the peritoneal cavity via the linea alba) [19] except the posterior rectus sheath and peritoneum are entered. The incarcerated abdominal viscera can then be reduced with bowel graspers, with or without enlarging the defect to assist with the reduction. Once reduced, the single-port device can then be removed and the fascial incision closed in layers. The device can then be introduced on the opposite side, extraperitoneally, in the normal fashion for successful SIL TEP repair. The use of the SILS or GelPort in these cases allows repeated placements without additional costs.
- Always warn patients of scrotal bruising and reassure them that if it occurs, it will settle down after a week or so. This will minimize phone calls from potentially distressed patients, especially young ones, who are worried of damage to their manhood.
- Educate the patients during the consultation that they can and should return to normal activities as soon as the pain settles and to take adequate analgesia to allow them to mobilize immediately post-op.

For any surgeon contemplating SIL TEP repair, the author strongly advises careful studying of the procedure by reading this chapter and viewing videos of different surgeons performing this procedure, for example, via "YouTube" videos [20]. Ideally, proctorship from a qualified SIL practitioner will greatly speed up the learning process as well as provide confidence during the transition to SILS. In the author's experience, if the surgeon is competent with multiport repair, mastery of SIL TEP repair should not take more than 25 cases [21], i.e., an average of a year for a general surgeon performing the same number of TEP repairs. Furthermore, mastery of SIL TEP repair can then be simultaneously applied to other hernias including ventral/incisional hernias [22–25]. Just like surgeons who have accomplished the art of laparoscopic repair, one would never go back to open mesh repair. Similarly, once accomplished with SILS, the surgeon, such as the author, would never go back to multiport repair unless it is absolutely necessary.

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