16 Robotic Transabdominal Preperitoneal Inguinal Hernia Repair

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Introduction

Despite the well-established benefits in minimally invasive (MIS) inguinal hernia repairs, it is only offered by a minority of surgeons in the United States with adoption rates ranging between 14 and 19% [1, 2]. Many attribute low penetration rates to the difficulty of comprehending the anatomy of the retroinguinal space. This approach not only requires a thorough understanding of the anatomy, of the myopectineal orifice (MPO), but also requires the operative skill set to safely navigate within this space.

There has been a rapid adoption of robotic inguinal hernia repair in the armamentarium of general surgeons across the United States (Fig. 16.1). Surgeons boast the enabling quality of the robotic instrument in terms of visualization, tremorless precision, instrumentation articulation, and improved ergonomics [3]. We contend no distinction between conventional laparoscopic and robotic approaches all converging with a singular goal of a durable repair conferring low recurrence rates and a low incidence of postoperative chronic pain.

This chapter will introduce the concept of the critical view of the myopectineal orifice. Daes et al. recently published the importance of the critical view MPO in hopes of standardizing a technique inherent with surgeon variability [4, 5]. Common questions including but not limited to extent of preperitoneal dissection, rules of fixation, and minimum mesh size are addressed by this mandate and cover all approaches including laparoscopic TEP/TAPP or rTAPP. We conclude that mesh should not be placed prior to confirming the critical view of the MPO has been established.

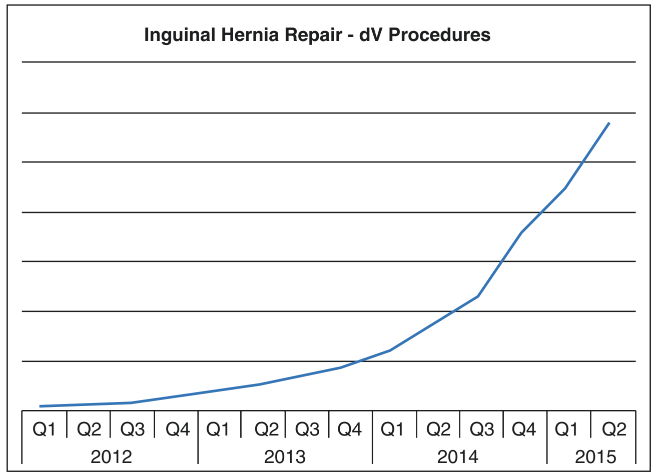

Fig. 16.1 Adoption of robotic inguinal hernia repair (courtesy of intuitive surgical)

This chapter utilizes the well-established principles of conventional laparoscopy to describe the robotic transabdominal preperitoneal (rTAPP) inguinal hernia repair technique.

Preoperative Conditions

Intolerance to general anesthesia represents the only true contraindication for rTAPP inguinal hernia repair. A history of multiple intra-abdominal surgeries, history of prostatectomy, previously failed MIS inguinal repair, large inguinoscrotal hernias, and coagulopathy are all important considerations that must be taken into account [6].

Imaging is generally not performed for primary inguinal hernias. Imaging is performed in the setting of incarcerated or strangulated inguino-femoral hernias, multiple recurrent hernias, concomitant ventral hernias, and large inguinoscrotal hernias in order to establish an effective operative strategy.

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Patient Positioning, Trocar Setup, Docking, and Instrumentation

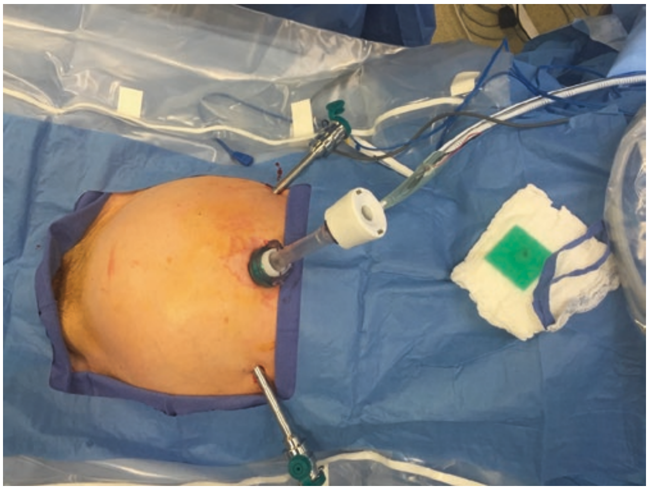

Fig. 16.2 Port position

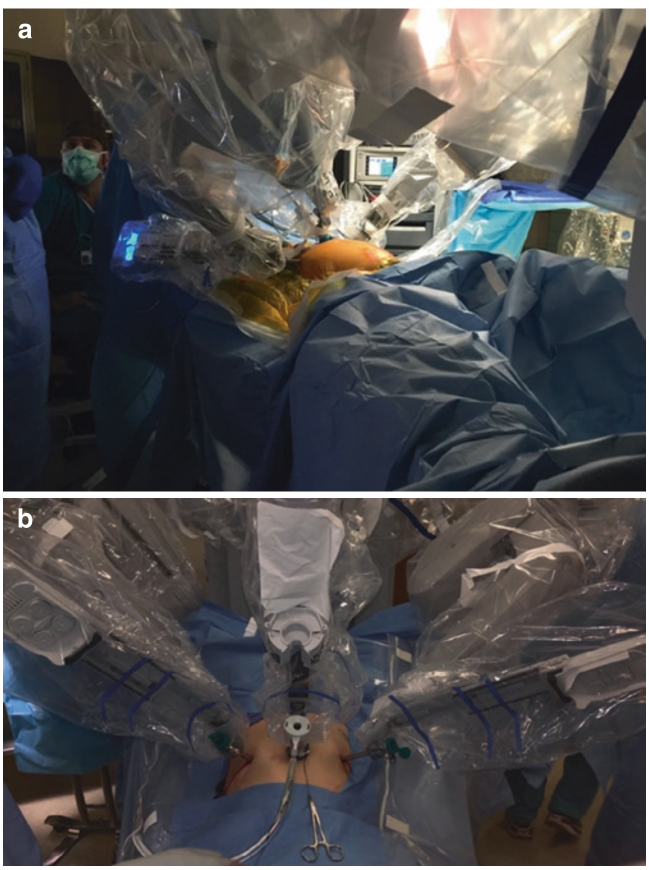

Fig. 16.3 (**a**, **b**) Docking in a supine lithotomy position

The patient can be placed in either a conventional supine or lithotomy position. Port placement and trocar setup are analogous to that of traditional laparoscopic repair (Fig. 16.2). We prefer an open supraumbilical entry with a 12 mm trocar, although an 8.5 mm da Vinci (dV) trocar for the 8 mm camera may also be utilized. Either 5 mm or 8 mm instrument trocars are then placed 10 cm lateral to the camera port. Users of the da Vinci Xi system (Intuitive Surgical) utilize an 8 mm camera and do not require 10 cm separation in between port sites. Patient positioning (Trendelenburg) must be complete prior to docking the robot.

While there are many ways to dock the robot (which also will vary depending on the type of system used), we prefer docking in between the legs with the patient in a supine lithotomy position (Fig. 16.3a, b). In the setting of bilateral hernias, adequate access to both right and left groins may be obtained by docking over either hip. After the robot is docked, the instruments are placed under direct vision. Although the choice of scope is at the surgeon's discretion, we prefer the 12 mm zero degree scope.

For most cases, we utilize two instruments including the dV prograsp and dV monopolar scissors (Fig. 16.4). A suture-cut needle driver can also be utilized for blunt preperitoneal dissection, sac reduction, and suture mesh fixation and re-approximation of the peritoneal defect. A dV Maryland bipolar grasper may be favored to facilitate reduction of hernia sac in those with large inguinoscrotal hernias.

Technical Steps

Reduction of the Hernia Content

As with any hernia repair, after gaining safe intraperitoneal access, the first step involves reduction of the hernia content. Bowel contents incarcerated through an inguino-femoral hernia must be handled safely and meticulously (Fig. 16.5). Should aggressive bowel handling be necessary, lower grip strength graspers are preferred.

Following successful reduction of any incarcerated hernia, the bowel contents must be examined for viability. We frequently utilize Firefly™ technology as an adjunctive measure to assess perfusion of the intestinal segment (Fig. 16.6a, b). This technique is similar to the use of fluorescein and a Wood's lamp to evaluate bowel viability. Five milliliters of indocyanine green (IcG) is administered intravenously, and within 1 min of infusion, intestinal perfusion can be assessed. If the bowel demonstrates a green tone under Firefly view, it is confirmed to be viable.

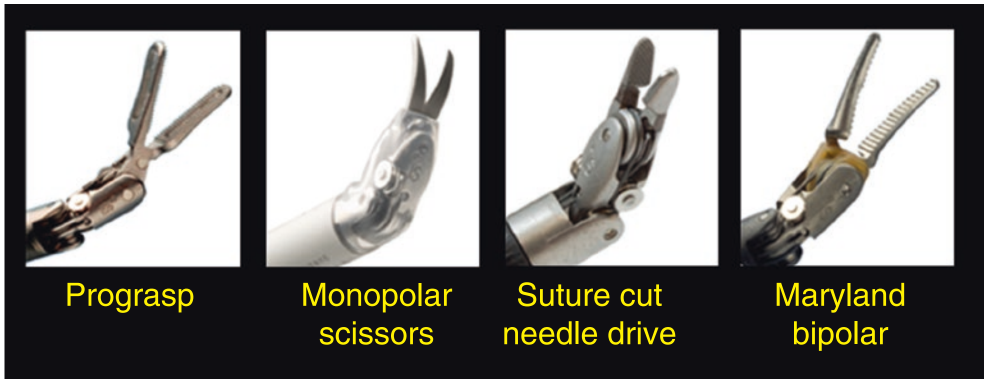

Fig. 16.4 dV instrumentation

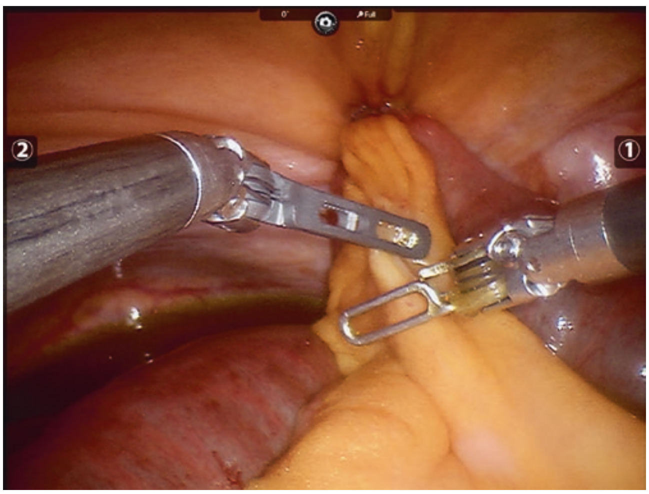

Fig. 16.5 Incarcerated femoral hernia

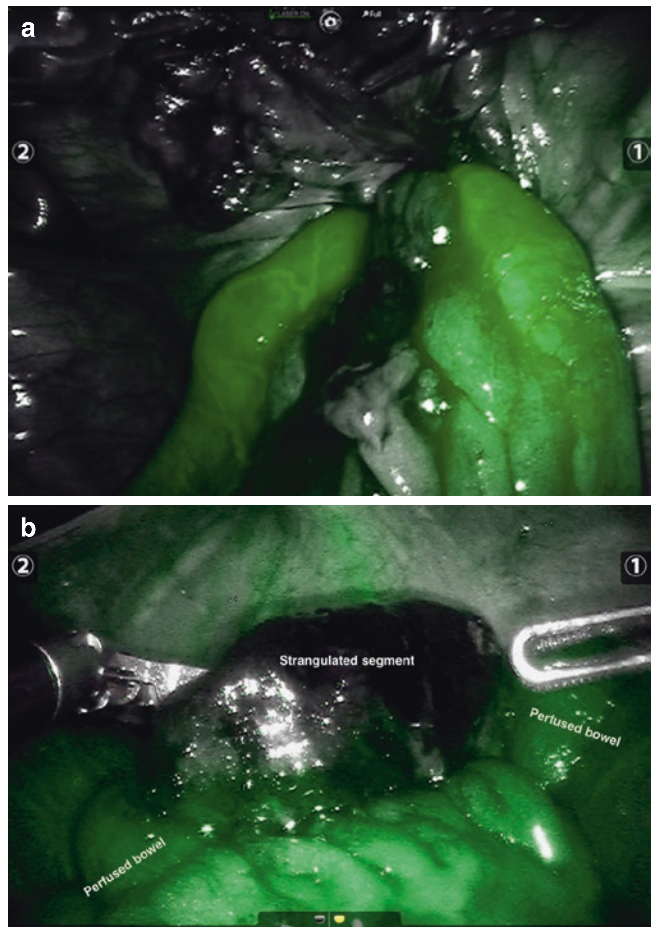

Fig. 16.6 (**a**, **b**) Firefly assessment of bowel viability

Evaluation of the Surface Anatomy

Following the successful reduction of the hernia content, key anatomical landmarks are identified (Fig. 16.7a, b). This will delineate the type of hernia present, as well as provide a guide to peritoneal incision and subsequent dissection.

Peritoneal Incision and True Preperitoneal Dissection

A transverse incision is made at a minimum of 5 cm over the level of the hernia defect, above ASIS, and extending medially to the level of the median umbilical ligament. This permits sufficient cephalad overlap of the mesh, as well as development of a redundant peritoneal flap to facilitate mesh re-peritonealization. While it is not uncommon to include the transversalis fascia in the initial peritoneal flap dissection, it is important to maintain dissection in the true preperitoneal space (Fig. 16.8). True preperitoneal dissection orients the operator within the correct avascular plane for hernia sac reduction and final flap development. Utilization of this space allows avoidance of perforating vessels to the overlying rectus muscle (pretransversalis plane), thereby minimizing unnecessary bleeding which can obscure effective dissection.

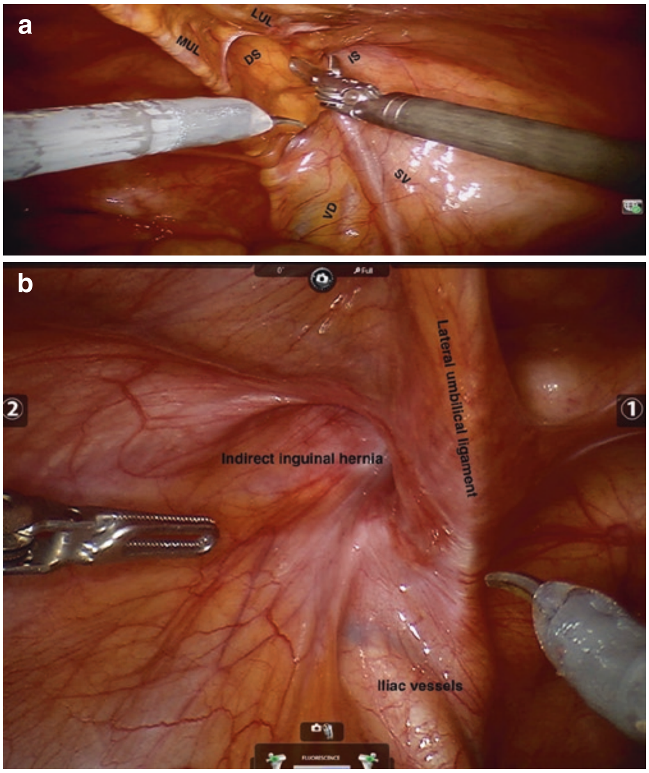

Fig. 16.7 (**a**) Surface anatomy. (**b**) View of left inguinal hernia. *MUL* medial umbilical ligament, *LUL* lateral umbilical ligament, *VD* vas deferens, *SV* spermatic vessels, *DS* direct space, *IS* indirect space

Fig. 16.8 Preperitoneal dissection

Hernia Sac Reduction

To ensure proper plane dissection during reduction of the hernia sac, all attempts should be made to "follow the peritoneum." Direct hernia sacs found medial to the epigastric vessels and above the iliopubic tract are often easily reducible. The peritoneal sac is dissected free from the transversalis fascia (pseudosac) (Fig. 16.9). With indirect hernia sacs, dissection is performed both medially and laterally to isolate the sac and associated cord structures or female equivalents (FEs). The peritoneum is parietalized from the cord structures or the FEs. Electrocautery must be judiciously used to minimize bleeding while also minimizing potential injury to the somatic and autonomic nerves intimately associated with the cord. The peritoneum is bluntly dissected off the vas deferens and spermatic vessels. The round ligament is typically divided in females to facilitate posterior peritoneal dissection.

Cord lipomas represent retroperitoneal fat that transit the deep inguinal ring and are positioned lateral to the cord structures (Fig. 16.10). Lipomas must be distinguished from the normal fat associated with cord vessels. Skeletonizing these elements may lead to unnecessary bleeding. Lipomas can be found in all potential sites of herniation including the femoral and obturator spaces. These lipomas are reduced for two reasons: to minimize the risk of postoperative bulging and to clear the MPO for flat approximation of mesh against the retroinguinal space.

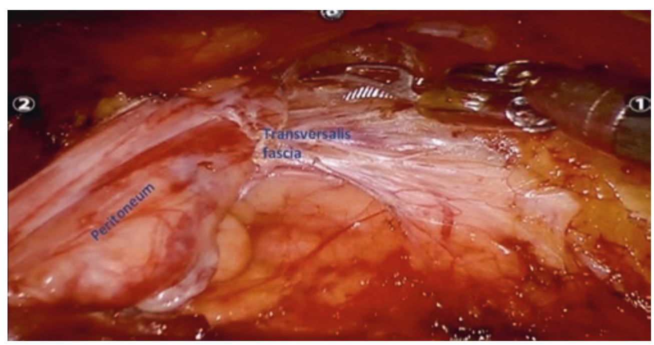

Fig. 16.9 Hernia sac reduction

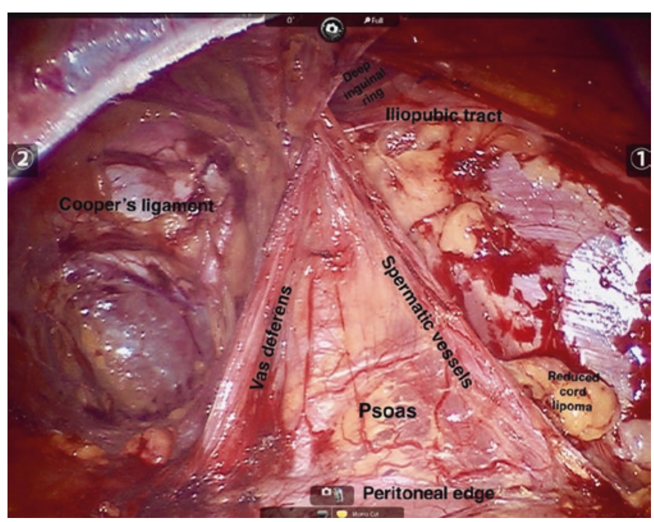

Fig. 16.10 Cord lipoma

Critical View of the Myopectineal Orifice

Similar to the rule in laparoscopic cholecystectomy where the critical view must be obtained prior to placing any clips, the authors believe that the critical view of the myopectineal orifice must be established prior to placing the mesh. Essential elements of the critical view include exposing all four potential sites of herniation (indirect and direct space, femoral and obturator foramina), adequate posterior peritoneal dissection exposing the peritoneal edge overlying the psoas muscle, and adequate lateral dissection that is confluent with the wide retroinguinal dissection plane. Conceptually, dissection of the retroinguinal space is divided into three zones: medial dissection, psoas dissection, and lateral dissection.

Zone of Medial Dissection

Exposure of the direct space, the femoral canal, and the obturator foramina should be exposed by dissecting medial to the inferior epigastric vessels (Fig. 16.11a–c). Cooper's ligament should be exposed with dissection extending across the midline, revealing the pubic symphysis. Just below the pubis, the bladder is bluntly dissected away from the bone, exposing the space of Retzius. Dissection should continue below the pubic bone exposing the obturator foramen and into the space of Retzius thereby creating a deep medial pocket for large medial and inferior mesh overlap.

Zone of Psoas Dissection

With the reduction of the peritoneal sac, the cord structures or the female equivalents are parietalized. There must be adequate posterior peritoneal dissection to minimize the potential of peritoneum invaginating under the inferior edge of the mesh which represents one of the most common causes of recurrence after MIS inguinal hernia repair. Meticulous dissection is crucial to avoid injury to the cord structures, iliac vessels, and sensory nerves, which could result in testicular ischemia and chronic pain (Fig. 16.12a–d). The triangle of doom will be well defined with adequate posterior peritoneal dissection (Fig. 16.13). Posterior peritoneal dissection is complete when the posterior peritoneal edge approximates the level of the umbilicus thereby exposing its association with the psoas muscle. Adequate posterior peritoneal dissection can be tested by manipulation and retraction of the peritoneum. If the cord structures move or lift during peritoneal manipulation, further posterior dissection is required. This test is based on the concept that if the cord structures lift, the subsequently placed mesh can also shift or clamshell during re-approximation of the peritoneal flap, resulting in a pathway to recurrence. The hernia sac is completely returned to the intraperitoneal cavity (Fig. 16.14).

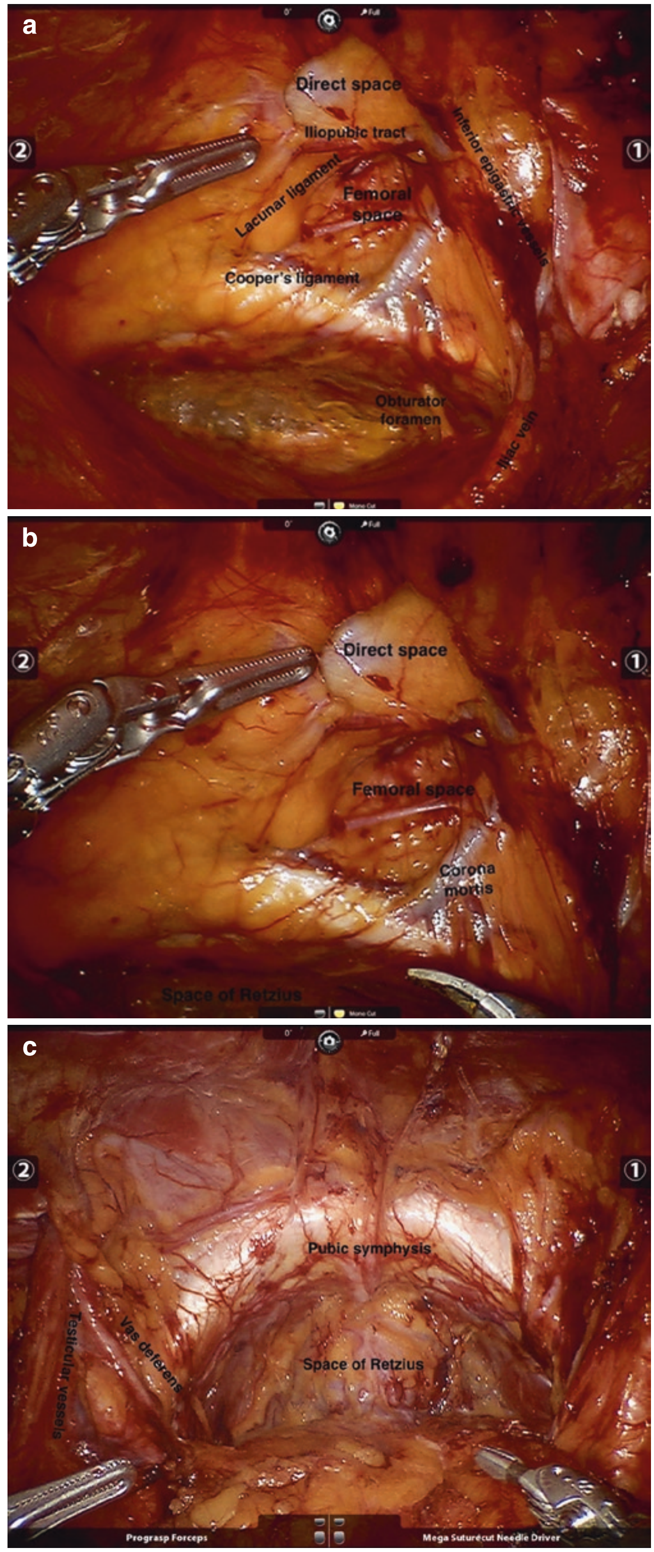

Fig. 16.11 (**a**–**c**) Zone of medial dissection

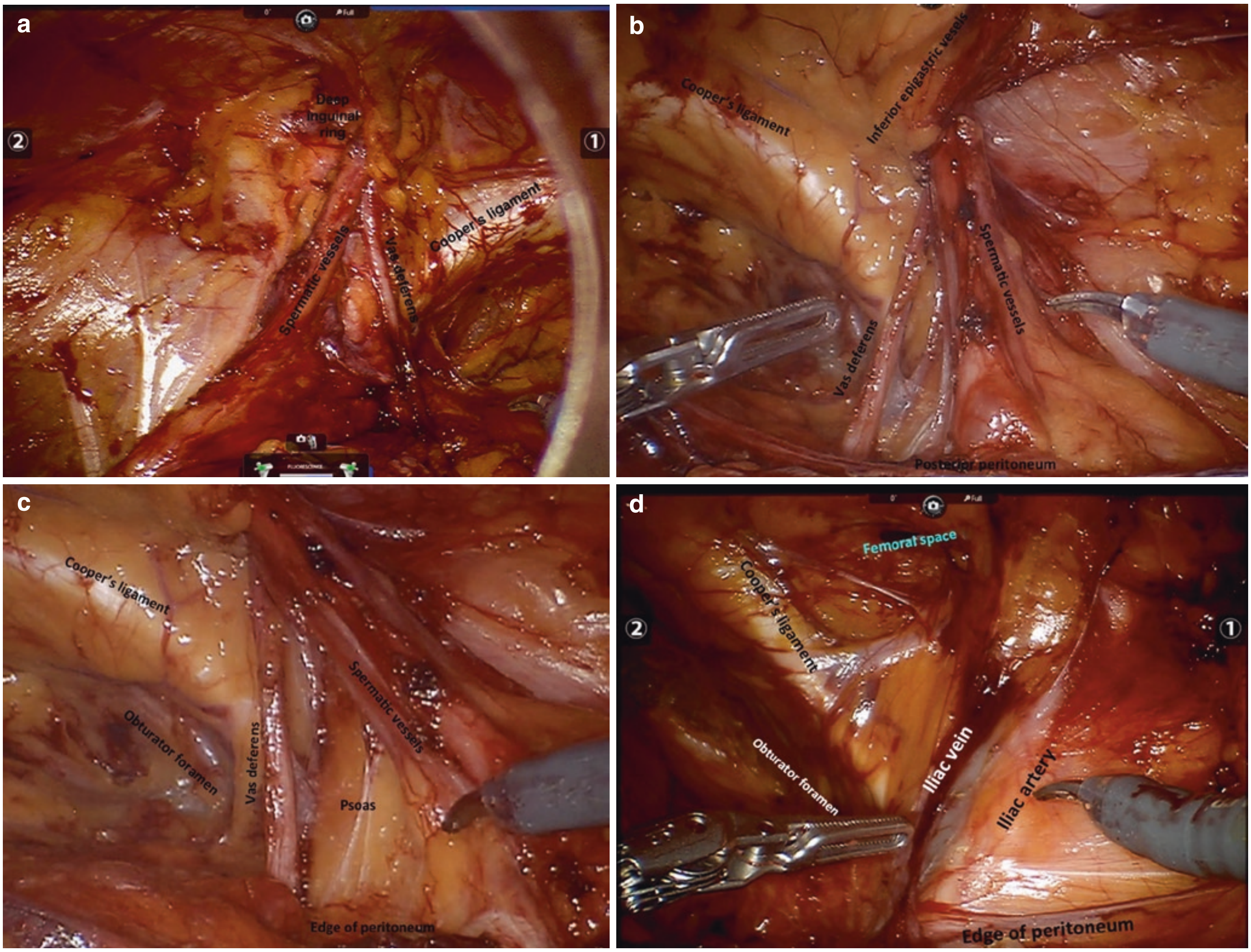

Fig. 16.12 (**a**, **b**) Zone of psoas dissection. (**c**, **d**) Female equivalent dissection after transection of round ligament

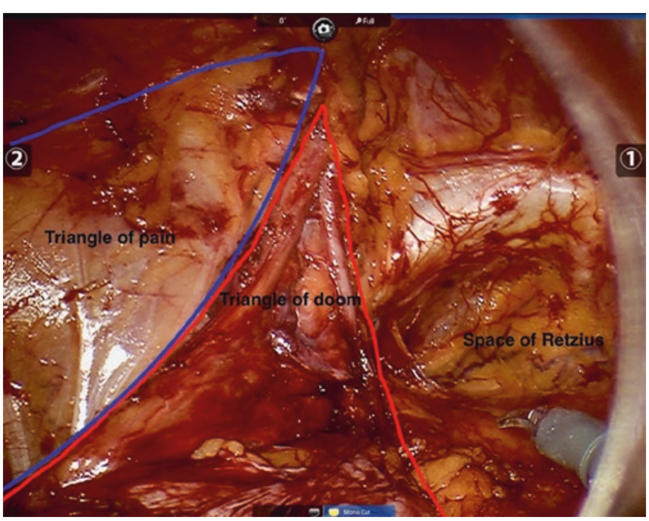

Fig. 16.13 Triangles of the MPO

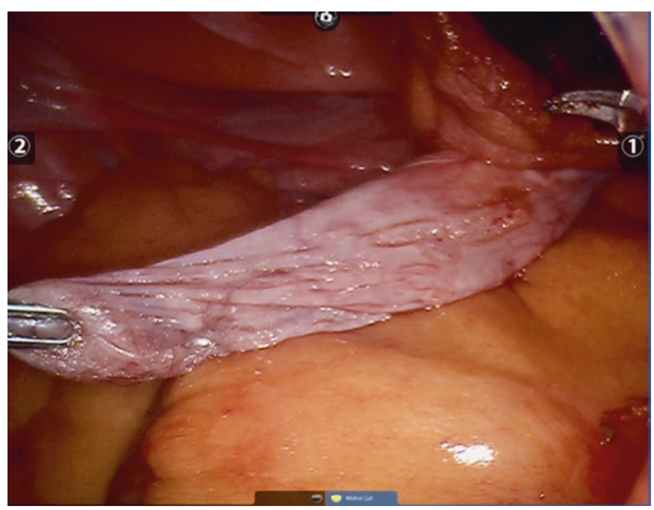

Fig. 16.14 Completed reduction of the hernia sac

Zone of Lateral Dissection

The myopectineal orifice must be adequately dissected laterally in order to place a large mesh with sufficient overlap of all four potential spaces. The posterior peritoneal dissection should be confluent from the space of Retzius, contouring over the psoas and extending to the level of the ASIS. The triangle of pain exists within the lateral MPO, requiring caution, to preserve the genitofemoral and lateral femoral cutaneous nerves, thereby minimizing the risk of postoperative chronic pain (Fig. 16.15).

Mesh Placement and Fixation

At minimum, a 10 × 15 cm mesh should be used in all MIS inguinal hernia repairs. Mesh sizes smaller than these are believed to be inadequate [4]. The authors prefer to use larger sheets of mesh to confirm adequate dissection and critical view. If the mesh doesn't fit flat on the floor of the retroinguinal space and contour over the cord structures and psoas muscle, preperitoneal clearance is deemed inadequate, and further dissection must ensue (Fig. 16.16a–c)

There are numerous options for both the introduction and fixation of the mesh to cover the MPO. The mesh and suture may be introduced prior to the preperitoneal dissection. We prefer to place our mesh once dissection is complete. Flat mesh can typically be introduced through the 8.5 mm trocars. The robotic arm ipsilateral to the hernia defect is undocked, and the mesh is placed by the bedside assistant, aiming toward the pubic symphysis. In order to lay the mesh flat with sufficient coverage of the potential spaces, there must be coordination between the operator and the bedside assistant. Alternatively, the trocar may also be re-docked, and using two grasping instruments, the operator can lay the mesh in its final position. Mesh placement is confirmed prior to fixation. This is done by manipulating the peritoneum to

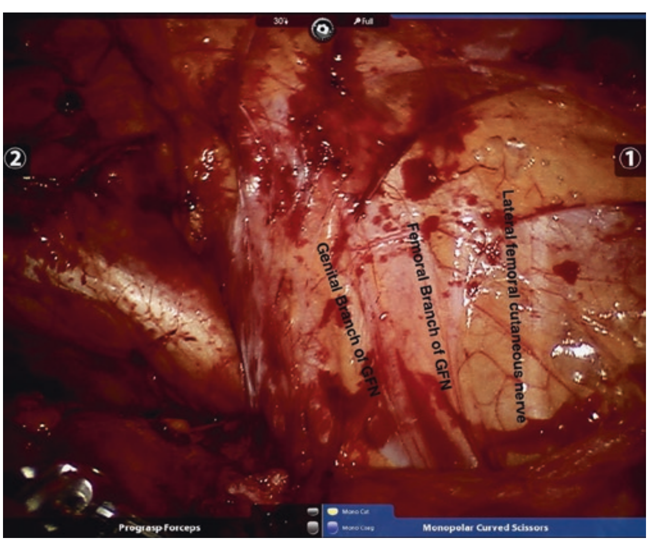

Fig. 16.15 Zone of lateral dissection

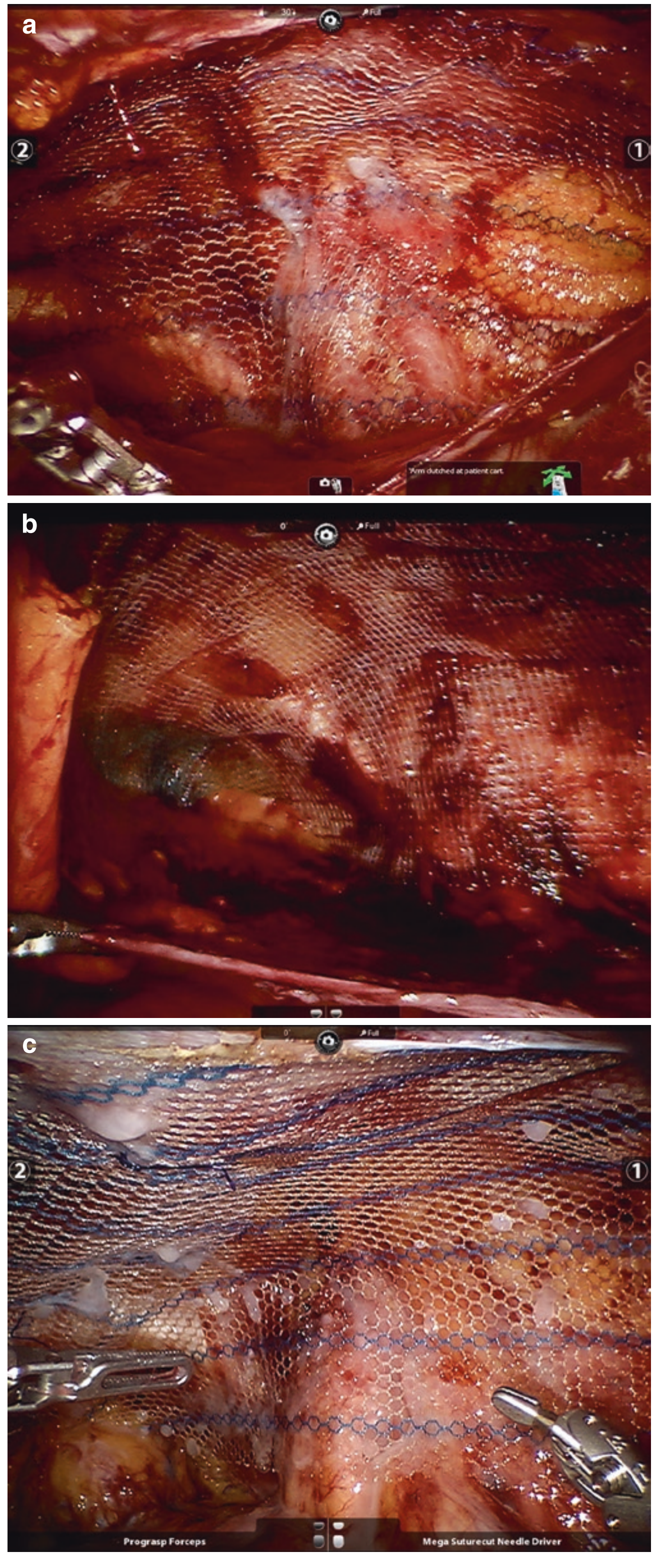

Fig. 16.16 (**a**–**c**) Mesh placement

assure the mesh does not fold or buckle, paying particular attention to the inferior edge of the mesh.

Depending on surgeon preference and choice of mesh, there are options for no fixation or fixation with glue, sutures, or tacks. All four options have been applied in our practice. We generally secure the mesh with three absorbable tacks: on Cooper's ligament, high superomedial, and high superolateral. In order to avoid major vascular injury and nerve entrapment, fixation is never employed below the iliopubic tract nor in the area of the triangles of doom or pain.

Re-peritonealization of the Mesh

The peritoneal flap is re-approximated to completely cover the mesh, using either tacks or running suture (Fig. 16.17a, b). While the use of barbed suture facilitates closure of the peritoneal flap, we attempt to minimize barbed suture exposure to the intraperitoneal content. To minimize the risk of early postoperative small bowel obstruction, gaps in the closure should be avoided. Any peritoneal tears may be covered using the hernia sac or closed using sutures.

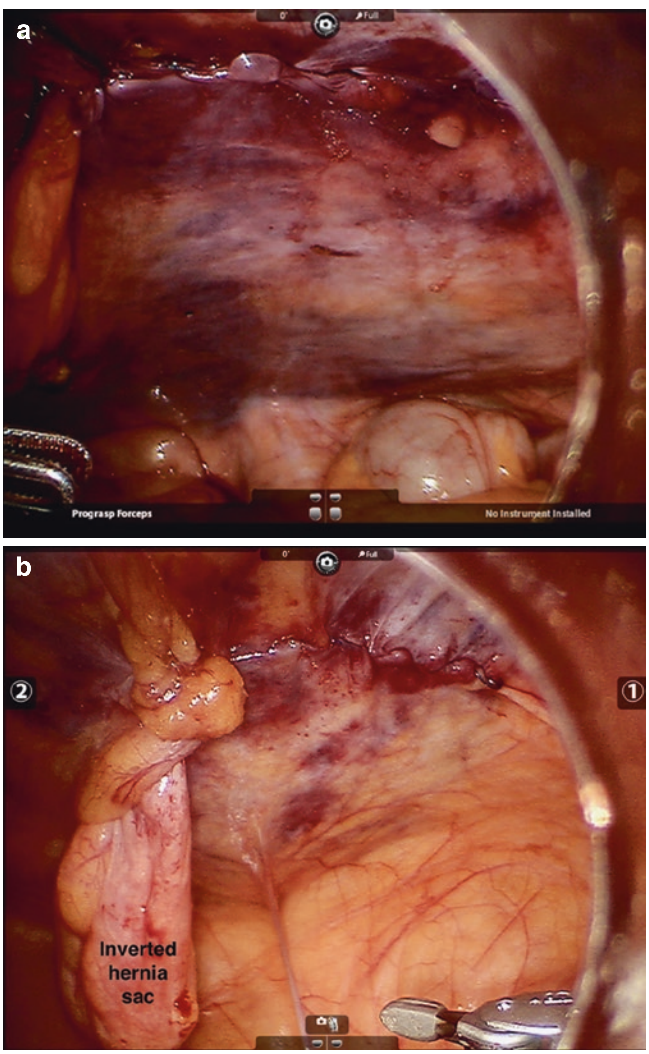

Fig. 16.17 (**a**, **b**) Re-peritonealization of mesh

Postoperative Management

Generally, all patients are treated as outpatients and discharged from the recovery room. Clinical indications to admit are based on the discretion of the physician. Patients are given a 20 lb. lifting restriction for 2 weeks after which time are allowed to resume unrestricted activity. Protocol for patient follow-up consists of a 2-week, 6-week, 6-month, and 1-year schedule.

Conclusion

The rapid adoption of rTAPP inguinal hernia repair emphasizes the importance that this technique be recognized as an operative equivalent to that of conventional laparoscopic TAPP repair, adhering to well-established principles of MIS repair. MIS inguinal hernia repairs demand a thorough appreciation of the anatomy of the MPO and a proper skill set to safely execute the approach. Strict adherence to the principles of the critical view of the myopectineal orifice can aid in achieving this goal of achieving a durable repair with a low incidence of postoperative chronic pain.

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