Original Article

An Overview Of Modalities In Surgical Management Of Inguinal Hernia

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Abstract

Background: The surgical repair for inguinal hernia has been similar to other technologies, subject to periods of stasis and explosive innovation.it is up to those applying the technology to judge the usefulness and merits of each change as it is brought along. Most practicing surgeons today have spanned a period of tissue repair in many forms, the introduction and championing of prosthetic mesh buttressing defects, to the minimally invasive era with its focus on rapid recovery, minimal incision size, and decreased infectious risk. The discussions still centre on the merits of each of these advancements and which repair is appropriate for which patient. Repairs can be divided initially into open repairs and laparoscopic repairs. There are different modalities of laparoscopic repair such as trans-abdominal pre-peritoneal repair (TAPP) and the totally extraperitoneal repair (TEP). The techniques of laparoscopic hernia repair have evolved in parallel with experience and technology. In the laparoscopic procedure, tension free repair is achieved by placement of a prosthetic mesh to cover the entire groin area including the sites of direct,indirect and femoral hernia. The laparoscopic approach is based on the principle of tension free repair, which has been well established by Nyhus and Stoppa. The dissection is done in the area of major vessels and also the possibility of injury of the nearby viscera. It is so required that the surgeon probable to undertake the repair must have experience of laparoscopic surgery. Laparoscopic anatomy of the inguinal area is completely not the same as what's seen throughout the open technique. The surgeon needs to learn this anatomy. Accommodation with this particular anatomy by the surgeon performing the laparoscopic hernia repair regularly is very helpful for proper orientation.

Keywords: Inguinal Hernia

INTRODUCTION

Introduction

The open inguinal hernia repair is the most important procedure of general surgery. Understanding the nature of the repair and the anatomy leading to a successful repair is vital to any general surgery trainee. It begins as early as a junior resident and continues throughout the surgical career. This is analogous to the history of inguinal hernia repair and the ongoing improvements of one of the oldest surgical procedures [1-10].

The history of hernia repair is the history of surgery, the treatment of groin hernia can be divided into several eras, including the ancient era, the era of start of herniology, the anatomic era, the era of repair under tension, the era of tensionless repair and the era of laparoscopic hernia repair [11-12]

Laparoscopic Anatomy Of The Inguinal Region The Anatomical Landmarks:

At first laparoscopic glance of the inguinal region, we can identify five peritoneal
folds which are (1) the median umbilical ligament (remnant of the urachus), (2) the two medial umbilical ligaments (remnants of the umbilical arteries) and (3) the two lateral umbilical ligaments (or the lateral umbilical folds) which contain the inferior epigastric vessels(IEV). The lateral fold may be difficult to visualise by laparoscope and in these cases the vessels are palpated externally to help visualize the lateral fold and avoide injury to the IEV. The groin region is divided by the medial umbilical fold into a medial space (of Retzius) and a lateral space (of Bogros) , [18].

Hasselbach's triangle is considered an important landmark. Its boundaries are the inferior epigastric vessels laterally, the lateral border of the rectus abdominis muscle medially and the inguinal ligament inferiorly **,Figure 1**[(19)]**.**

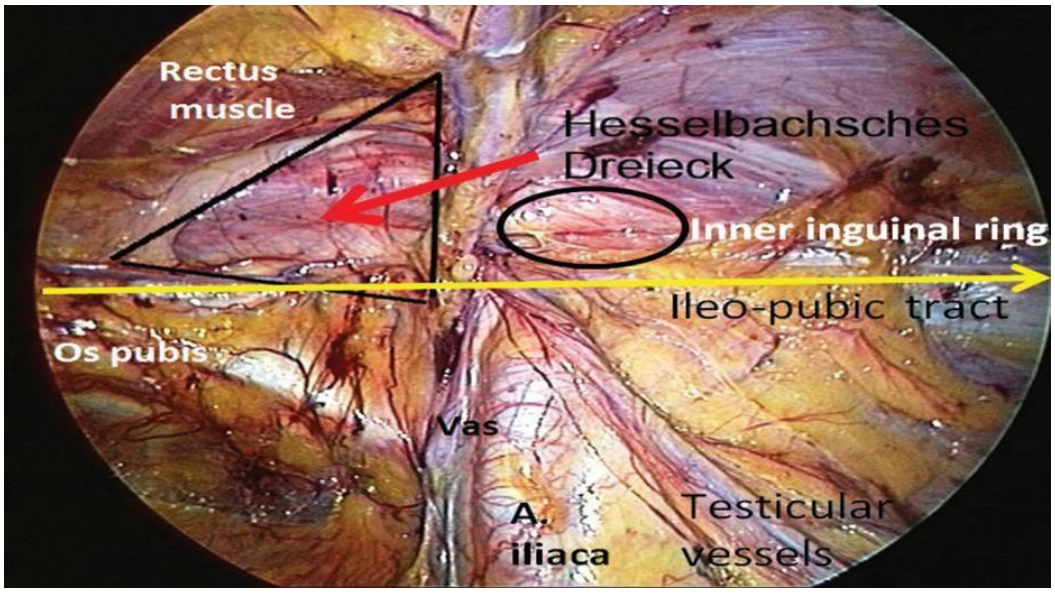


Figure 1: Anatomy of the right groin after dissection of the peritoneal flap and exposing all important landmarks [(18, 19)]

The symphysis pubis is the first landmark to be exposed medially and it's the medial reference when placing the mesh. The pectineal ligament (cooper's ligament) is identified as a shiny white tendinous band it runs on the pectineal line as a continuation of the lacunar ligament. It's an important landmark during pacing the mesh as it holds tacks and no tacking is allowed below it (trapezoid of Disaster)

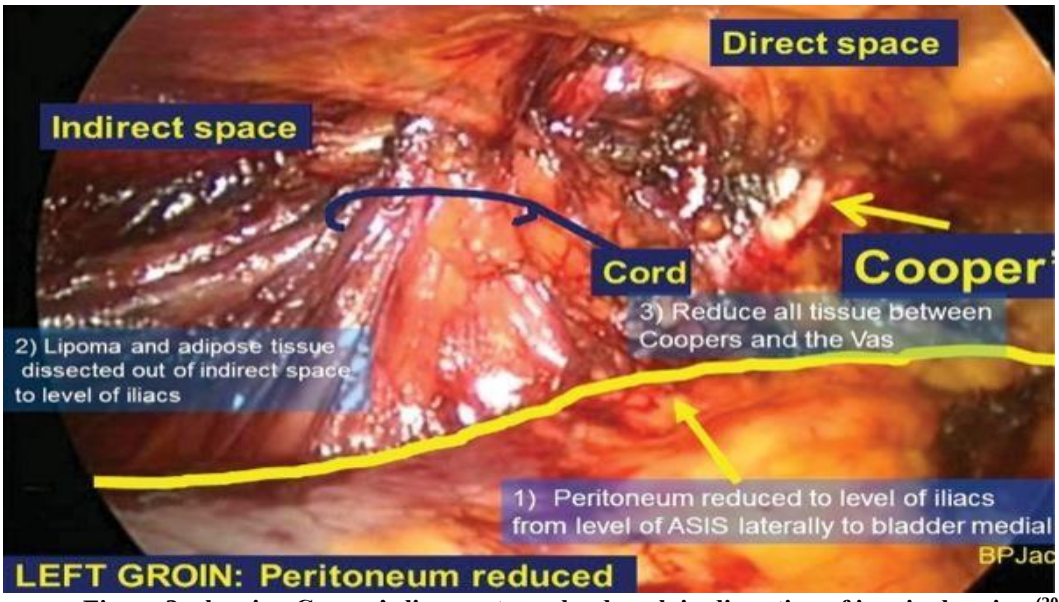


Figure 2: showing Cooper's ligament as a landmark in dissection of inguinal region [(20)]

During dissection laterally from cooper's ligaments, the external iliac vessels start to appear. The vein appears as a dark blue structure and the artery appears as a white elastic pulsating structure [(21)]**.**

The Inferior Epigastric Vessels:

They can be seen on top of the external iliac vessels. Usually the artery runs with two or more accompanying veins towards the rectus abdominis muscle and the upwards behind it to the umbilicus. They are located just medial to the internal inguinal ring. They may be difficult to locate during laparoscopic dissection especially in obese patients, so their site is determined by locating the internal inguinal ring at the junction of the vas and the testicular vessels [(21)].

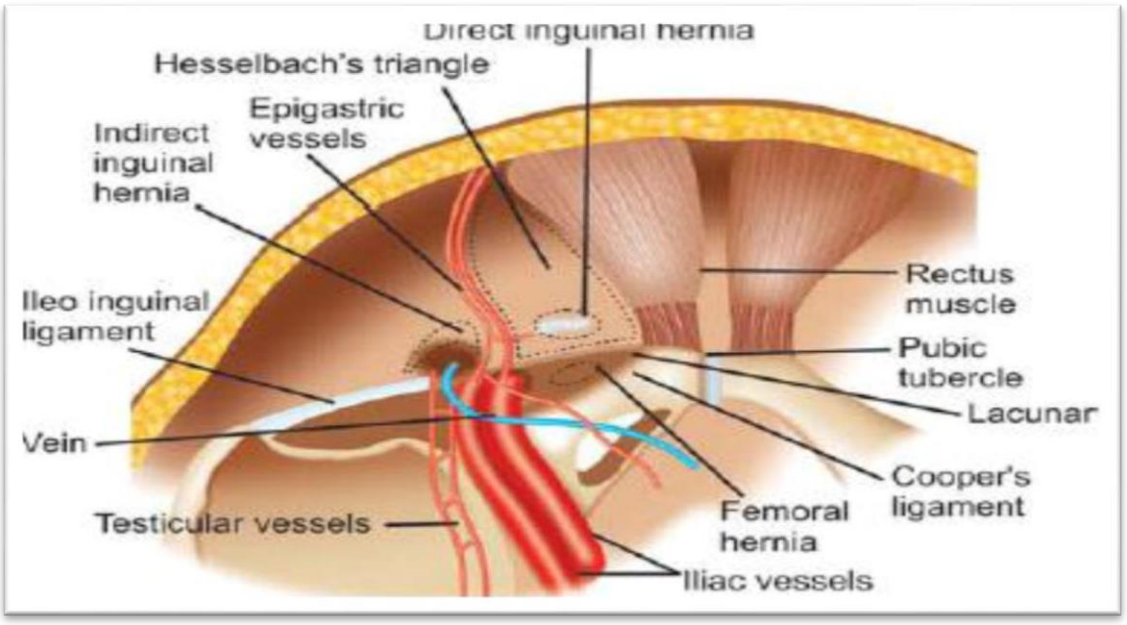


Figure 3: the location of the inferior epigastric vessels in relation to the internal rin [21]

The space of Retzius:

It is the space between the urinary bladder posteriorly and the pubic symphesis, the medial part of the pubic rami and the lamina of the rectus sheath anteriorly. It extends from the pelvic floor inferiorly to the umbilicus superiorl. The space of Retzius is bounded lateraly by the inferior epigastric vessels. This space contains fatty tissue and loose connective tissue and some vascular elements that should be dissected carefully to avoid bleeding [18].

Techniques Of Hernia Repair

The surgical repair for inguinal hernia has been similar to other technologies,

subject to periods of stasis and explosive innovation.it is up to those applying the technology to judge the usefulness and merits of each change as it is brought along. Most practicing surgeons today have spanned a period of tissue repair in many forms, the introduction and championing of prosthetic mesh buttressing defects, to the minimally invasive era with its focus on rapid recovery, minimal incision size, and decreased infectious risk. The discussions still centre on the merits of each of these advancements and which repair is appropriate for which patient [30,31].

Laparoscopic Inguinal Hernioplasty:

Repairs can be divided initially into open repairs and laparoscopic repairs. There are different modalities of laparoscopic repair such as trans-abdominal pre-peritoneal repair (TAPP) and the totally extraperitoneal repair (TEP). The techniques of laparoscopic hernia repair have evolved in parallel with experience and technology. In the laparoscopic procedure, tension free repair is achieved by placement of a prosthetic mesh to cover the entire groin area including the sites of direct,indirect and femoral hernia. The laparoscopic approach is based on the principle of tension free repair, which has been well established by **Nyhus** and **Stoppa** [32]**.**

Ger in 1982 was the first to attempt minimal access groin hernia repair by closing the opening of an indirect hernia sac by Michel clips, **Bogojavlensky in 1989** modified the technique, by intra-corporeal suture of the deep ring after plugging a polypropylene mesh into the sac. **Toy and Smoot in 1991** described a technique of intraperitoneal onlay mesh (IPOM) placement, where intra-abdominal piece of polypropylene or Polytetrafluroethylene (e-PTFE) was stapled over myopectineal orifice without dissection of the peritoneum. The IPOM had major flaws like the possibility of bowel adhesion and mesh migration.

The initial attempt of laparoscopic repair didn't meet with encouraging results. Ever since early attempts by **Ger**, refinements of the technique and innovations have changed the concept of hernia surgery forever and in spite of the longer learning curve and being more challenging than laparoscopic cholecystectomy or open hernioplasty, it became an increasingly popular procedure though controversies around. The present-day techniques of

laparoscopic hernia repair evolved from stoppa's concept of pre-peritoneal reinforcement of fascia transversalis over the myopectineal orifice with its multiple openings by a prosthetic mesh [33].

In the early 1990's, **Arregui** and his colleagues described the transabdominal pre- peritoneal repair (TAPP) and around the same time **McKernan** described the totally extra- peritoneal (TEP) technique of laparoscopic hernioplasty. In both of these repairs, the mesh is in direct contact with the fascia transversalis in the pre-peritoneal space, allowing tissue ingrowth leading to fixation of the mesh (as opposed to being in contact with the peritoneum as in IPOM repair where it is prone to migrate) [33].

Indications Of Laparoscopic Inguinal Hernioplasty

1. Recurrent hernia after previous anterior repair attempts. In such cases, a laparoscopic approach allows the surgeon to avoid the scar tissue and distorted anatomy present in the anterior abdominal wall by performing the repair through unviolated tissue, thereby potentially reducing the risk of damage to the vas deferens or the testicular vessels. This is especially true when mesh had previously been placed anteriorly [34].
2. Bilateral hernias or a unilateral hernia when the presence of contralateral hernia is strongly suspected. In such cases, a laparoscopic approach allows the surgeon to repair the two hernias at the same time (and perhaps more rapidly) without having to make additional incisions [35].
3. Repair of an inguinal hernia concurrent with another laparoscopic procedure, provided that there is no contamination of the peritoneal cavity [36].

Contraindications To Laparoscopic Inguinal Hernia Repair

There are no absolute contraindications to laparoscopic inguinal hernioplasty other than the inability to tolerate general anaesthesia. Patients may have relative contraindications which include:

1. Paediatric patients
2. Incarcerated hernias may be difficult to reduce via laparoscopic dissection **.**
3. History of recurrent peritonitis or multiple abdominal operations [37].

Equipment

Because inguinal hernias occur in the anterior abdominal wall, visualization through the umbilicus requires that the laparoscope be angled close the the horizontal plane. The view is paralleled anteriorly by the surface of the lower abdominal wall, which may make visualization with a 0° laparoscope difficult. In addition, an indirect hernia is a threedimensional tubular defect that can be well visualized in its entirety only with an angled lens. For these reasons, routine use of an oblique, forward viewing 30° or 45° laparoscope is recommended. Excellent laparoscopes are currently available in 10 mm and 5 mm sizes. For the TAPP repair, one 10mm and two 5 mm trocars are used. The dissection is performed with a dissector and scissors, to which and electrocautery may be attached. For mesh fixation a spiral tacker (e.g., TACKER; U.S. Surgical Inc., Norwalk, Connecticut) is used [36].

Figure 14: Laparoscopic inguinal hernia repair. Shown in one of several possible OR setups.

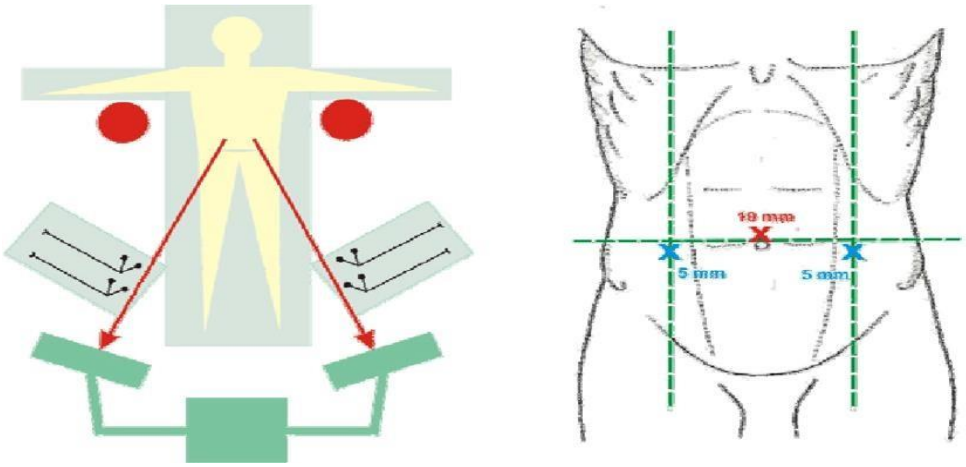


Figure 5:Operating room set up and trocars placement A operating room; note the surgeon and assistant position as well as the two monitors laparoscopic equipment; B trocars placement [36, 38]

Patient Selection

Patient selection is vital for the learning curve. Indirect hernial sacs are closely related to the cord and more often complete, making dissection hard, left sided hernias tend to be more challenging to dissect than right sided ones. Bilateral hernia repair though the learning curve may considerably increase the operating time. Recurrent hernias and irreducible hernias should be fixed only after knowledge is gained in repair of simple hernias [39].

Direct or small indirect primary hernias in slim and thin patients are the simplest. Indirect, left sided hernias, large, irreducible or complex hernias in obese patients would be best avoided during the learning curve. Laparoscopic inguinal hernia repair is a superior laparoscopic procedure.

Operative Technique For TAPP:

The dissection is done in the area of major vessels and also the possibility of injury of the nearby viscera. It is so required that the surgeon probable to undertake the repair must have experience of laparoscopic surgery. Laparoscopic anatomy of the inguinal area is completely not the same as what's seen throughout the open technique. The surgeon needs to learn this anatomy. Accommodation with this particular anatomy by the surgeon performing the laparoscopic hernia repair regularly is very helpful for proper orientation
(36).

Anaesthesia And Positioning Of The Patient

Laparoscopic TAPP hernioplasty is always done under general anaesthesia. In elderly patients, an in-depth cardiorespiratory assessment is done preoperatively for safe general anaesthesia and pneumoperitoneum. The patient is requested to pass urine just before transfer to the operating theatre. If the patient is much more than sixty years of age, or has the signs of prostatic growth or post void residual volume is much more than 50 ml, it is logical to catheterize the patient preoperatively. This may be removed 24 hours following the surgery. Perioperative prophylactic antibiotics are administered [39].

After initiation of anaesthesia, irreducible hernia contents, if any, are reduced before painting and draping is started. The patient lies supine with both of his arms placed by his side to make room for the surgeon and his assistant to face at shoulder level. The head end of the table is kept 15^{O} low to facilitate creation of pneumoperitoneum and shift bowel

away from the operative field. The laparoscopic monitor placed at the foot end of the table. The operating surgeon stands on the opposite side of the defect. The assistant, who supports the camera, stands opposite the operator. The scrub nurse positions herself on the left of the patient, standing to the left from the surgeon [39].

It is essential to maintain complete asepsis. All instruments must be properly sterilized by gas sterilization or disinfected by soaking in activated gluteraldehyde (cidex) for a minimum of 40 minutes just before surgery. A 30° telescope provides better exposure of the operative field and something can change perspectives by rotating the telescope, therefore further improve the operative field, specifically in the region from the pubic symphysis and laterally towards the posterior abdominal Wall [32].

Pneumoperitoneum and placement of ports

The Veress needle may be used to produce pneumoperitoneum. Patency from the needle spring function should be checked before insertion. The preferred site of the needle insertion can be the supra umbilical fold. The spring mechanism gives a click sound immediately on penetrating the parietal peritoneum. Insufflation is started with a set pressure of 12 mmHg. A pressure reading through of less than 7 mmHg that the tip is inside the abdominal cavity [39].

A higher pressure indicates that the position of the tip is extraperitoneal or obstruction towards the flow by the omentum. All quadrants of the abdomen are inspected and percussed to check for uniform pneumoperitoneum. Insufflation is continued until a pressure of 12 mmHg is reached, which requires about 2.5 to 3 litres of gas. After 10mm port is positioned through the supra umbilical incision. During insertion, the abdominal wall is lifted up and stable with the left hand and also the trocar is directed for the hollow of the pelvis. A 30° telescope attached to the camera, is introduced and also the groin area is visualized [40].

Two 5mm ports are put as working ports for the right hand and the left hand of the operator, one on each side, at the level of the umbilicus within the midclavicular lines. These ports should be placed under vision to prevent injury to the inferior epigastric vessels (IEV) and the underlying bowel. The hernia defect is inspected and also the kind of hernia is confirmed by the position of the defect in relation to the inferior epigastric vessels and the cord structures. The spermatic vessels arise laterally and the vas deferens originates

from medially to meet in the internal ring. They form an inverted V. The inferior epigastric vessels can be seen coursing upwards from this point. A direct hernia is medial to the inferior epigastric vessels and therefore medial to the point where the vas and spermatic vessels join to create an inverted V. An indirect hernia is lateral to the IEV and it is at the tip of the inverted V Formed by the vas and spermatic vessels. The actual cord structures are noticed to enter the inguinal canal through the defect within an indirect hernia. The inferior and medial margins are indistinct. The type of hernia found during surgery doesn't change the steps of the procedure but guides the extent of medial and lateral dissection for any minimum overlap of 5 cms [41].

PROCEDURE OF TAPP

After access, diagnostic laparoscopy is performed to rule out any adhesion or other intra-abdominal lesion. All the important anatomical landmark of hernia surgery is identified with the help of telescope and one atraumatic grasper. The important landmarks of laparoscopic hernia repair are the pubic bone and inferior epigastric vessels.

The defect should be seen carefully and if any content is present inside the sac it should be reduced gently. A sliding hernia of

colon should be carefully reduced because chances of perforation of large bowel are more than other viscus so the assistant should reduce the hernia by pressing it from outside. Any adhesion between bowel and omentum should be divided carefully using bipolar and scissors.
The next step of transabdominal preperitoneal repair of hernia is creation of preperitoneal space. Many surgeons like to do hydro dissection to create this preperitoneal space just by injecting normal saline into preperitoneal space. Some surgeon think that it is easy to create preperitoneal space using sharp dissection as well.

The peritoneum is cut minimum 4 cm lateral to the outer margin of deep ring at 2 O'clock position if the hernia is right side and 10 O'clock position for the left side of hernia. Medial dissection of peritoneal incision should continue up to medial umbilical ligament. Going medial to medial umbilical ligament is risky because there is fear of injury of urinary bladder. The flap of peritoneum is separated from above downward as soon as it
will reach at the site of internal ring the hernia sac will be encountered (42).

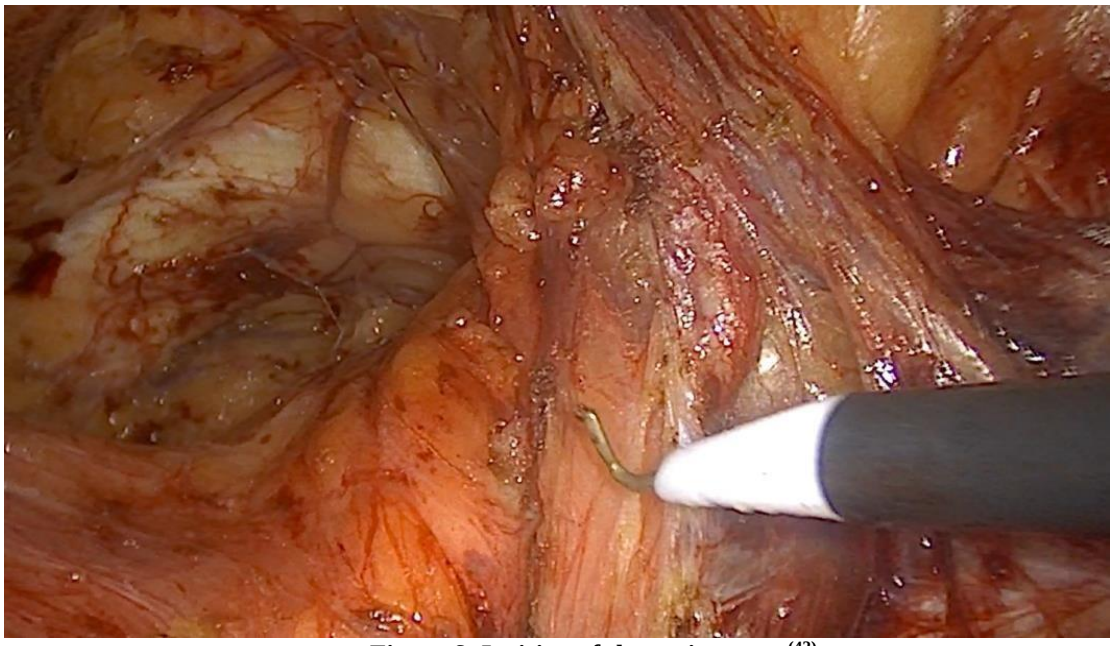
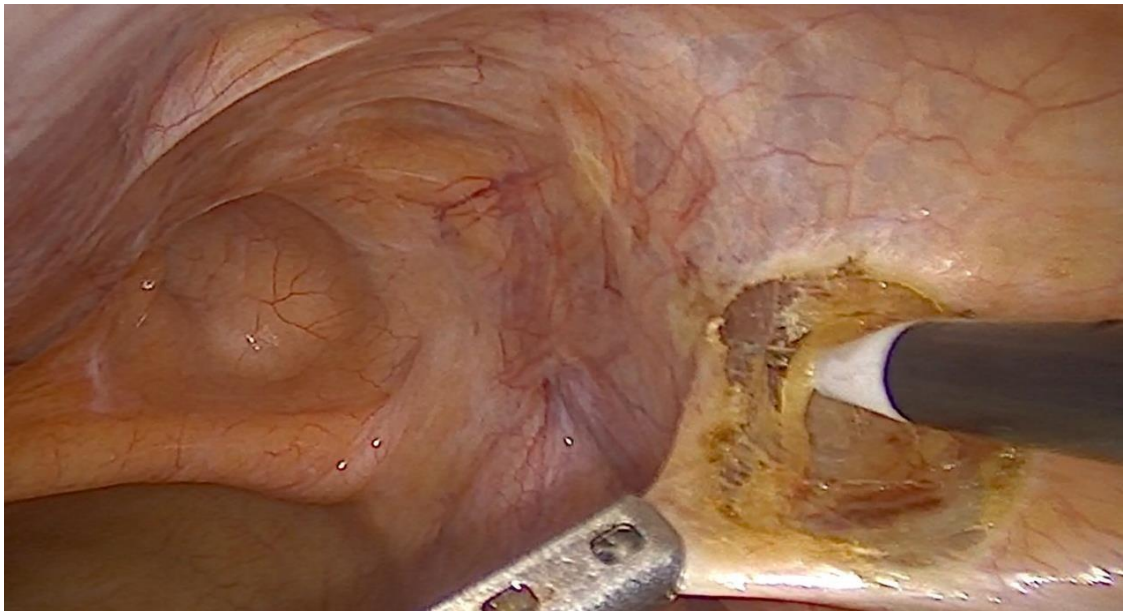


Figure 6: Incision of the peritoneum [(42)]



Dissection should be started with opening the peritoneum lateral to the medial umbilical fold in order to identify Cooper's ligament. Stoppa's parietalization technique should be used for dissection of the spermatic cord from the peritoneum by separating the elements of the spermatic cord from the peritoneum and peritoneal sac. In case of indirect defect, the hernial sac has to be either gently dissected free or inverted or if it is completely adhered with the transversalis fascia and cord structure it

can be transected [43].
Surgeons should use both blunt and sharp dissection and the sac is dissected off the anterior abdominal wall. After being reduced partially it is ligated using an endoloop and then transected with scissors. In case of bilateral hernias, the procedure is repeated on the other side. The vas and spermatic vessels have been separated from sac. The next step is separation of sac from cord structures and dissection for creation of proper lateral space for placement of mesh. Lateral limit of dissection is the anterosuperior iliac spine while inferior limit laterally is the psoas muscle. Dissection should be avoided in the "triangle of doom" which is bounded medially by the vas deferens and laterally by the gonadal vessels. A large hernial sac creates multiple planes and it is easy for the beginners to get disoriented with sac vas and vessel [42].
The best way to avoid this confusion is that surgeon should keep himself as close as possible to the outer surface of peritoneum. If the spermatic vessels are injured accidentally it can be clipped. Even if the testicular vessel is injured, the testes will get the blood supply from collateral vessels developed through cremasteric. In direct hernias the creation of preperitoneal space is comparatively easy as there is no chance of injury of spermatic vessels and vas. The bulge in the transversalis fascia may be repaired by suturing or stapling. The tacker application and application of electrosurgery should be very careful at the triangle of doom, triangle of pain and trapezoid of disaster. In case of massive complete scrotal hernias, no attempt should be made to reduce the sac completely as it may increase the risk of testicular nerve injury and hematoma formation [43].

Placement Of The Mesh

Criteria for laparoscopic mesh:

1. Nonabsorbable
2. Adequate size
3. Adequate memory.

A Proline mesh of appropriate size, usually 15 × 15 cm should be taken, and one corner of mesh should be tailored. Mesh should be rolled and loaded backward in one of the ports. Mesh is placed inside the abdominal cavity through 12 mm port. If surgery is being performed by 10 mm port only the port should be removed and rolled mesh should be introduced though the port wound directly. After introduction of mesh it is unrolled when it reaches in peritoneal cavity. The mesh is fixed medially over the Cooper's ligament and pubic bone using a tacker or anchor or sutures [43].
The tailored corner of mesh should be positioned inferomedially. No lateral slit should be made in the mesh and it should not be fixed lateral to cord structures to prevent injury to lateral cutaneous nerve of thigh [44].
The mesh in this position covers the direct, indirect and femoral defects. It is essential that mesh should extend below the pubic tubercle so that it covers the femoral orifice. Mesh should also extend medially to cover all the possible orifices of hernia. Laterally mesh should project at least 2 to 3 cm beyond the margin of deep ring. If mesh is not of appropriate size, the chance of recurrence is high. Sometime, surgeon may be disoriented, and mesh is placed with its long axis vertical instead of transverse. If mesh is cut at one of the corners, chances of this disorientation is minimum [44].

Implant For Fixing Mesh
Many preloaded devices are available for fixing mesh in hernia surgery. Mesh is fixed medially over the Cooper's ligament and pubic bone using an implant. Currently three popular brands of implants to fix the mesh are available. These are Tacker, Protack or Anchor. After adjusting the mesh properly, it should be fixed by stapling first its middle part three finger above the superior limit of the internal ring. With mesh duly stapled pneumoperitoneum is reduced to 9 mm Hg. It is important to avoid pricking of the inferior epigastric artery or the testicular vessels. Intracorporeal suturing can also be used for fixation of mesh if surgeon has sufficient suturing skill. After fixing the mesh properly the peritoneum flap is replaced over the mesh and it is closed either by staples or suture or tacker, Figure 18 [45]
It is important that mesh should be completely covered by the peritoneum. Ideally peritoneum should be opposed by overlap fashion and peritoneum defect is closed either by staples or by continuous suturing and Aberdeen termination [45].

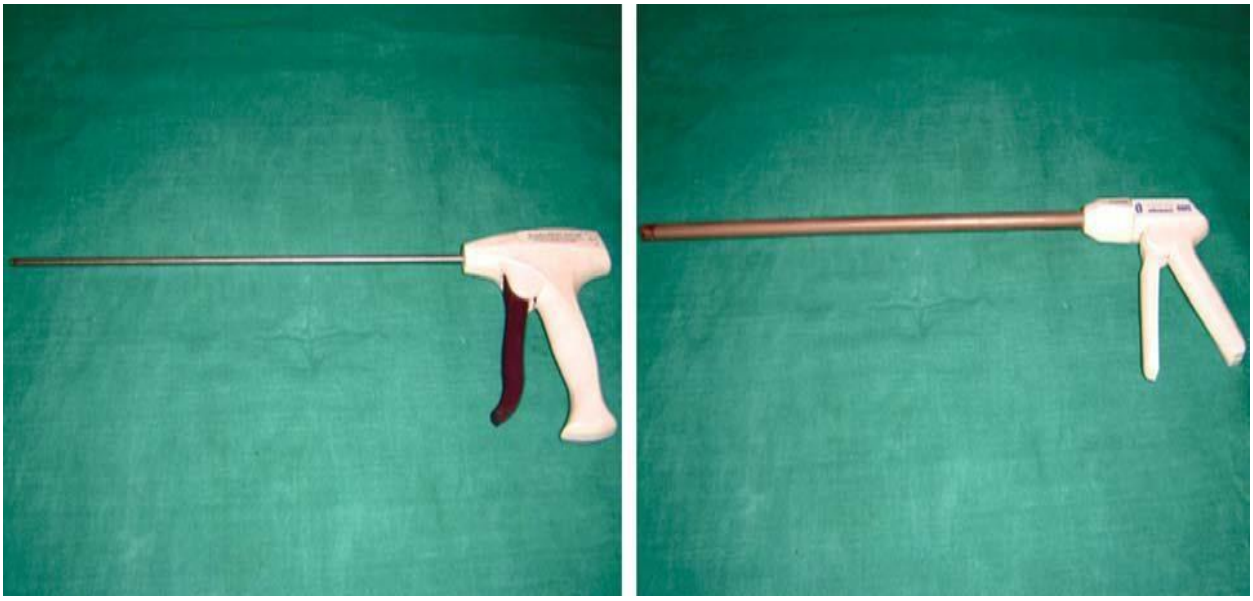


Figure 6:Hernia anchor (left) and hernia tacker (right) [45]

Repair of Bilateral Inguinal Hernia

In laparoscopic surgery postoperative recovery of bilateral hernia is same as that of unilateral hernia. The technique of bilateral laparoscopic repair of hernia is same as that of unilateral hernia. Patients with bilateral hernia are good candidate of laparoscopy. The two sides may be repaired using two meshes but single long mesh also can be used and is pushed across from one side behind the bladder, and across the inguinal orifice on the opposite side. The size of the mesh for bilateral hernia should be 30 × 15 cm. Surgeon should avoid twisting of mesh. After placing the mesh in bilateral hernia surgery, it should look just like a bow tie , [46].

Figure 7: placement of mesh in bilateral hernia [46]

Repair of Recurrent Inguinal Hernia

Recurrent laparoscopic hernia after open surgery is better to repair laparoscopically, because external anatomy is disrupted, and open repair have more chance of recurrence. Laparoscopy is method of choice for recurrent hernia. The defect is usually direct and more than one in recurrent hernia. The result of laparoscopic repair is excellent even in case of multiple hernias [47].
At the end of surgery, the abdomen should be examined for any possible bowel injury or haemorrhage. The entire instrument should be removed and then all the port. ports should be removed under direct observation through telescope. Ports larger than 10 mm should be sutured. Telescope should be removed at last after releasing all the gas keeping in mind that last port should not be pulled without putting telescope or any blunt instrument in, to prevent entrapment of bowel or omentum and formation of adhesion or intestinal adhesion. Wound should be closed with suture, especially 10 mm wound, Figure 20 [43].

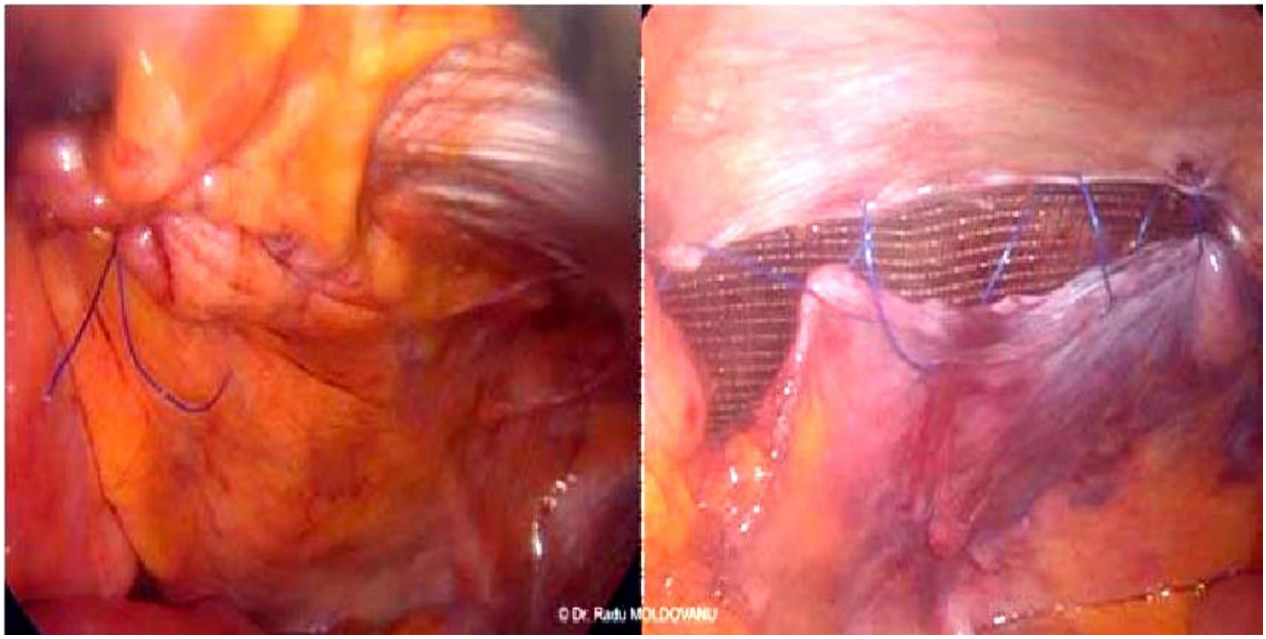


Figure 9:Closure of peritoneum [43]

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