CME MODULE ON
LAPAROSCOPIC REPAIR OF ABDOMINAL HERNIAS

Department of Medical Health and Family Welfare
Government of Uttar Pradesh

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MESSAGE

SHRI BRIJESH PATHAK

Hon'ble Deputy Chief Minister
Minister of Medical Health and Family Welfare Department
Government of Uttar Pradesh

Continuing Medical Education (CME) enables medical professionals to enhance their knowledge base and provides an opportunity for knowledge creators to share their expertise with the broader medical community. CMEs facilitate collaboration among medical professionals, fostering valuable networking opportunities.

To address the sustainable development goals and alleviate the global burden of non-communicable diseases, the Government of Uttar Pradesh is committed to enhancing its Healthcare Ecosystem through CME, incorporating technological advancements and medical breakthroughs.

Primary Health Centers (PHCs) and Community Health Centers (CHCs) serve as the initial point of contact with qualified doctors in the public health sector. By implementing systematic CME programs, these initiatives aim to update the proficiency of medical officers by imparting current knowledge and skills. This will significantly enhance patient care, instill patient confidence, and improve patient satisfaction.

In line with this objective, the State Institute of Health & Family Welfare, Uttar Pradesh (SIHFW), is actively developing CME modules that are crucial for our healthcare personnel. I anticipate that the Laparoscopic Repair of Abdominal Hernia module, focusing on modern management techniques for the repair of inguinal and ventral hernia, will greatly contribute to the knowledge enhancement of medical officers in the Provincial Health & Medical Services in Uttar Pradesh. The advantages of laparoscopic hernia surgery result in an early return to work and minimum morbidity. This will ultimately benefit both the medical officers and their patients.

I extend my best wishes to the SIHFW team in their continued development of CME modules, which will undoubtedly benefit the medical officers in the Provincial Health & Medical Services in Uttar Pradesh, and subsequently improve the well-being of their patients.

(Brijesh Pathak)

MESSAGE

Shri Mayankeshwar Sharan Singh

Hon'ble State Minister
Medical Health and Family Welfare Department
Government of Uttar Pradesh

I am proud of the fact that the State Institute of Health & Family Welfare, Uttar Pradesh (SIHFW) through this module on Continuing Medical Education (CME) on Laparoscopic Repair of Abdominal Hernias for Medical Officers in Provincial Health & Medical Services in Uttar Pradesh.

Since advancements in medical science and research compel doctors to stay up to date on current practices and trends. It is widely felt that CME programs are earnestly needed to impart recent knowledge and skills in a systematic manner to update the existing proficiency of doctors.

By collating the relevant information in the field of abdominal hernia, covering all domains such as medical anatomy, detection, and treatment approaches, with a main focus on laparoscopic repair techniques, the module seeks to be a working document which can also be reviewed and updated periodically based on the experience of the implementation of the public health services.

In lieu of the above the State Institute of Health & Family Welfare (SIHFW), has developed module on Continuing Medical Education (CME) on laparoscopic repair techniques for Medical Officers in Provincial Health & Medical Services in Uttar Pradesh. I hope that this module on CME is the first of many to come, that will aid our Medical Officers in knowledge up gradation on concurrent intervention practices.

I wish the director and the team at the State Institute of Health and Family Welfare (SIHFW), Uttar Pradesh (Lucknow) success in their endeavors of aiding an improved health service delivery system through such Continuing Medical Education on various prevalent repair techniques of abdominal hernias.

(Mayankeshwar Sharan Singh)

FOREWARD

Shri Partha Sarthi Sen Sharma

Principal Secretary
Department of Medical, Health and Family Welfare
Government of Uttar Pradesh

Continuing Medical Education (CME) module serves as a mechanism through which medical professionals can remain updated on the rapidly evolving practices in the field of medicine and surgery. Given the current COVID era, it has become increasingly important for medical officers to keep pace with the emerging modes of treatment and management, which are developed in response to feedback from the medical community.

Medical officers at the primary level encounter numerous challenges in managing common surgical conditions such as inguinal hernia and its complications. Continuous knowledge and skill enhancement are required to effectively address these challenges. However, due to their responsibilities in managing healthcare centers and implementing government policies, medical officers have limited time to dedicate to learning.

To address and rectify this situation, the State Institute of Health & Family Welfare (SIHFW) in Uttar Pradesh has developed a CME module specifically focused on Laparoscopic Repair of Abdominal Hernia modulefor Medical Officers in the Provincial Health & Medical Services. This module has been created in collaboration with subject matter experts.

The module provides a comprehensive overview of recent developments in the modern treatment of various abdominal hernias including inguinal, incision, ventral and special types of hernia. Its primary goal is to enhance the skills and knowledge of Medical Officers, ultimately leading to improved healthcare services for the general population.

I would like to extend my congratulations to SIHFW and the other subject matter experts involved in the development of this comprehensive module. I hope that this CME module will shed light on the laparoscopic repair techniques of various abdominal hernias contribute to better healthcare outcomes.

(Partha Sarthi Sen Sharma)

MESSAGE

Dr. Renu Varma Srivastava
Director General
Medical and Health Services
Uttar Pradesh

Abdominal wall hernias are one of the most common surgically treated medical conditions worldwide. Laparoscopic repair is becoming an increasingly popular alternative in the treatment of abdominal wall hernias.

To address the needs of Medical Officers in the Provincial Health & Medical Services of Uttar Pradesh, the State Institute of Health & Family Welfare (SIHFW) has developed a comprehensive Continuing Medical Education (CME) program focused on laparoscopic repair techniques. This program incorporates the latest advancements in the field and provides detailed guidance on essential treatment strategies for these conditions at the primary level. The aim is to educate the Medical Officers about the standards for hernia repair that have changed greatly over the last few decades to facilitate optimal treatment of such patients.

It is expected that Medical Officers in Uttar Pradesh, after completing this CME program, will be able to enhance their service delivery by effectively managing such patients and also treating emergencies timely. As a result, communities will benefit from improved access to healthcare services, increased patient satisfaction, and enhanced population health. This CME program not only enhances clinical and technical expertise but also strengthens the provision of healthcare services and bridges the gap between theory and practice in healthcare management.

We extend our best wishes to the SIHFW team and hope to see the publication of many more tailored CME modules in the future.

(Dr. Renu Varma Srivastava)

MESSAGE

Dr. Anita Joshi

Director General Family Welfare,
Directorate of Family Welfare
Uttar Pradesh

Continuing Medical Education (CME) modules serve as a means for healthcare professionals to stay updated on the rapidly evolving practices in the field of medicine. In the context of evolving hernia management, it has become increasingly crucial for medical officers to keep pace with the treatment methods and management approaches.

Medical officers at the primary healthcare level face several difficulties in effectively managing conditions such as obstructed or incarcerated hernias. Continuous acquisition of knowledge and skills is necessary to address these challenges. However, due to their responsibilities in running healthcare places and implementing government policies, medical officers have limited time available for pursuing additional education and skill development.

To address and resolve this issue, the State Institute of Health & Family Welfare (SIHFW), Uttar Pradesh, has developed a CME module focused on the laparoscopic repair of abdominal hernia for Medical Officers in the Provincial Health & Medical Services in Uttar Pradesh. This module integrates the latest laparoscopic techniques of abdominal hernias. Its primary goal is to enhance the skills and knowledge of Medical Officers, leading to improved healthcare services for the population.

I would like to extend my congratulations to SIHFW and the subject matter experts involved in the development of this comprehensive module. I am optimistic that this CME module will shed light on the effectivelaparoscopic repairtechniques of abdominal hernias.

(Dr. Anita Joshi)

MESSAGE

Dr. Deepa Tyagi
Director General (Training)
Medical Health and Family Welfare
Uttar Pradesh

Abdominal Hernia surgicalmanagement is very important in saving lives and serious health conditions. The reaching of an effected person to a center which has facilities for management of health-related emergencies helps in saving lives and physical impairment.

This module on Continuing Medical Education (CME) on Laparoscopicmanagement of Abdominal hernia for Medical Officers in Provincial Health & Medical Services in Uttar Pradesh provides a coherent and research-based insight to laparoscopic repair techniques of abdominal hernias. It has been designed and written for Medical Officers and healthcare professionals and takes government perspective in consideration, drawing upon and comparing ideas and developments from national and international healthcare practices.

I hope that after this CME, Medical Officers in Uttar Pradesh will be able to scale up the services delivery in provide optimal treatment in their health facilities, thus benefitting communities. In addition to improving clinical and technical area of expertise, this CME will lead to providing improved access to health services and enhancing patient satisfaction and population health.

The director and team at State Institute of Health & Family Welfare, Uttar Pradesh and the team of experts of the field has done a commendable job by publishing this module on CME on laparoscopic repair on abdominal hernias for Medical Officers in Provincial Health & Medical Services in Uttar Pradesh. I hope the participants coming to attend their upcoming CME will take advantage of this initiative and make the most in their field with this handy module.

(Dr. Deepa Tyagi)

ACKNOWLEDGEMENT

Dr. Rajaganapathy. R
Director
State Institute of Health and Family Welfare
Uttar Pradesh

The primary objective of Continuing Medical Education (CME) is to ensure the perpetual learning and advancement of Medical Officers in order to deliver optimal medical care to their patients. The purpose of CME is to aid Medical Officers in augmenting their performance in terms of patient care and satisfaction.

Within the healthcare domain, there has been a noteworthy endeavor to emphasize the significance of effectively managing abdominal hernia among Medical Officers in Provincial Health & Medical Services. It has been observed that laparoscopic techniquesof hernia treatment demonstrated superiority in short-term results. Hence, there is a requirement for a tailored CME program aimed at equipping Medical Officers in Uttar Pradesh with exposure to the latest advancements in the field of abdominal herniastreatment.

In order to accomplish this objective and enhance knowledge, the faculties and research team of the State Institute of Health and Family Welfare (SIHFW), Uttar Pradesh, in collaboration with the help of Head of Surgery (General) Prof. Abhinav Arun Sonkar and his team, King George's Medical University (KGMU), Lucknow have helped in the formulationof this CME module. It is anticipated that this module will be widely disseminated, and feedback on its efficacy will be received in the upcoming months.

(Dr. Rajaganapathy. R)

CONTENTS

1

INTRODUCTION TO HERNIA AND ANATOMY OF OPEN HERNIA

Authors - Dr Mohd Danish, Dr Akshay Anand, Prof Abhinav Arun Sonkar

1.1 Introduction

An **abdominal wall hernia** consists of a protrusion of intra-abdominal tissue through a fascial defect in the abdominal wall.

Inguinal hernias are very common (approximately 75% of abdominal wall hernias) with other types of hernias occurring at weak areas of abdominal wall fascia. Typically a hernia consists of visceral contents, a peritoneal sac, and overlying tissue (e.g., skin, subcutaneous tissue).

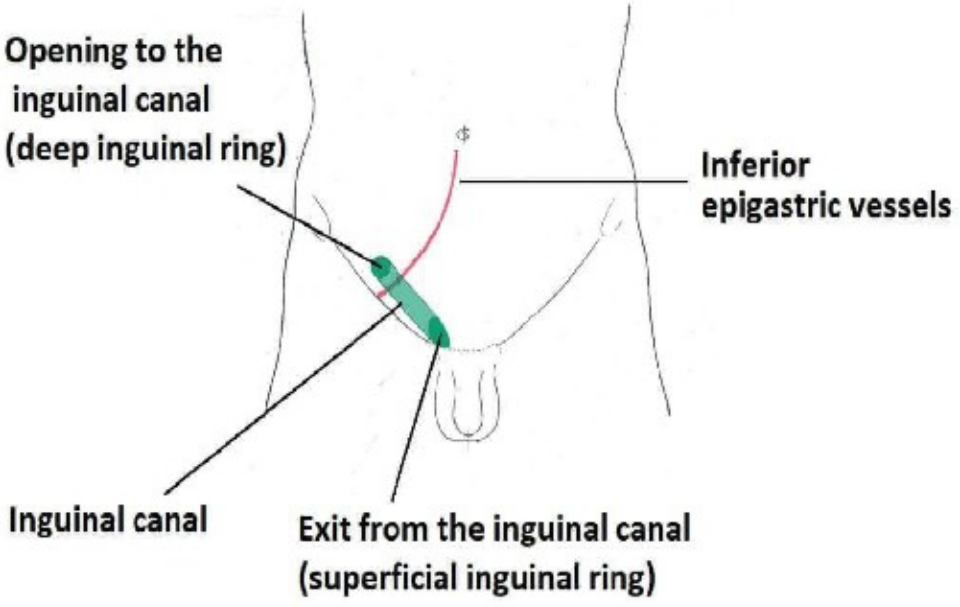


Figure 1.1.1: Inguinal Hernias

Hernias may be **reducible** where the protruding contents can be replaced into the abdominal cavity either spontaneously or with manual pressure.

Hernias may also be **irreducible** where the protruding contents are unable to be reduced. There are two classifications of irreducible hernias, incarcerated and strangulated.

An incarcerated hernia is irreducible protruding content that is usually due to a small hernia neck. The tissue or contents protruding remain viable and are not causing an obstruction or inflammation.

A strangulated hernia is an irreducible hernia in which the blood supply has been compromised. Ischemia, often progressing to necrosis of the protruding tissue or contents, is considered a surgical emergency.

1.2 Anatomy of Inguinal Canal

Inguinal anatomy is essential knowledge for the general surgeon. The canal exists between two openings within the abdominal wall known as the **internal (deep) inguinal ring** and the **external (superficial) inguinal ring.**

The **internal inguinal ring** is a lateral hiatus within the transversalis fascia, whereas the **external inguinal ring** is a medial hiatus within the external oblique fascia. The canal can range from 4 cm to 6 cm in length and is typically cone-shaped in adults. The inguinal canal is bordered anteriorly by the skin, superficial fascia, and external oblique aponeurosis to its entire extent. Additionally, the fibres of the internal oblique muscle are present on the lateral one- third of the canal.

The **posterior wall is bounded** by the fascia transversalis, extraperitoneal tissue, and parietal peritoneum to its entire extent. Additionally, **the conjoint tendon** is located on the medial two- thirds of the posterior wall.

The **roof is formed by** the arching fibres of the internal oblique and transversus abdominis, while the floor is formed by the grooved surface of the inguinal ligament and lacunar ligament. The spermatic cord (males) and round ligament (females) pass through the inguinal canal.

The spermatic cord consists of the vas deferens, three arteries/veins, the genital branch of the genitofemoral nerve, lymph vessels, and the pampiniform plexus.

The ilioinguinal nerve, which is a content of the inguinal canal, enters the inguinal between the external and internal oblique muscles distal to the deep ring but comes out of the superficial ring along with other structures.

Figure 1.2.1: Inguinal Canal

The iliopubic tract is an aponeurotic band that begins at the anterior superior iliac spine and courses medially before inserting on the superior aspect of Cooper's ligament.

The shelving edge of the inguinal ligament is the superior attachment of the inguinal ligament to the iliopubic tract. The iliopubic tract forms the inferior border of the internal inguinal ring as it courses medially before becoming part of the femoral canal.

Additionally, the **lacunar ligament** is in the medial aspect of the inguinal ligament as it fans out and inserts on the pubic tubercle.

Lastly, the conjoined tendon inserts on the pubic tubercle as the culmination of the internal oblique and transversus abdominis fibres.

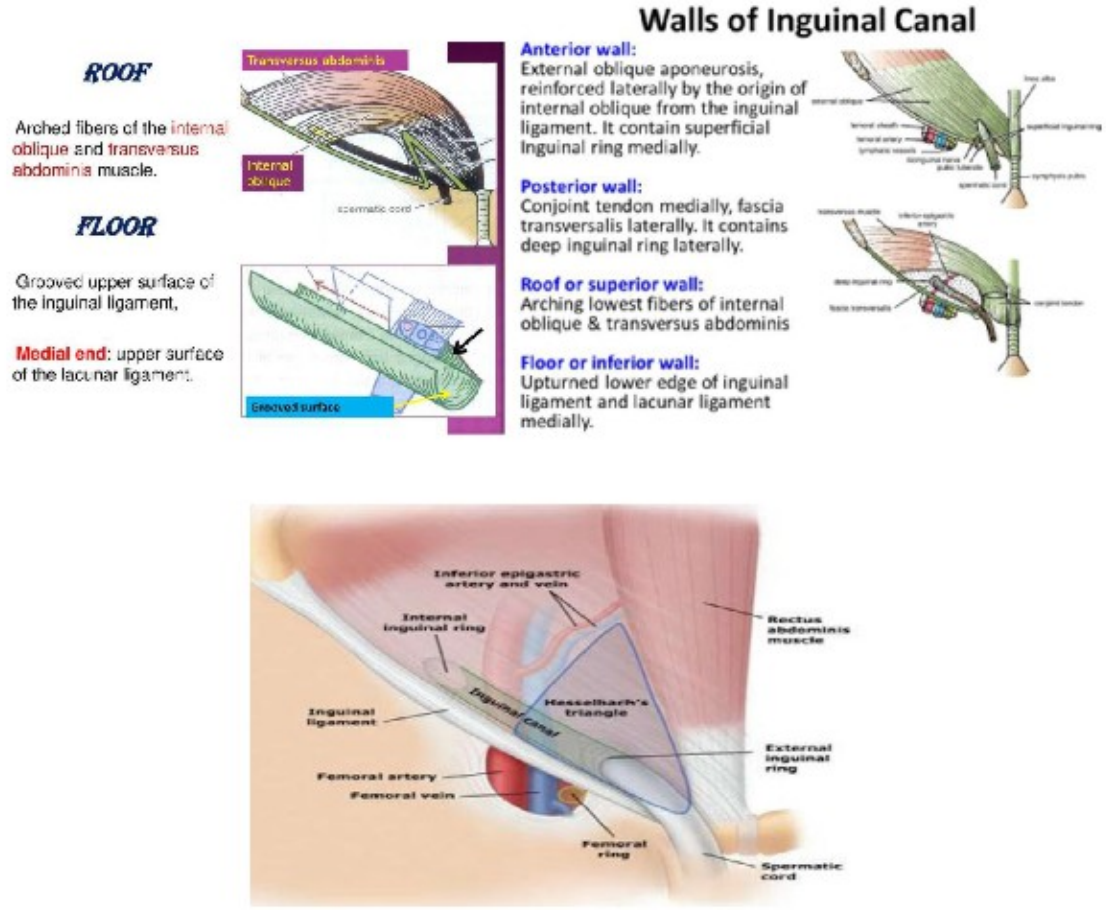


Figure 1.2.2: Boundaries Of Hasselbach's Triangle

An indirect hernia passes through the deep (internal) inguinal ring and is located lateral to the inferior epigastric vessels.

A direct hernia passes through a weakened area of transversalis fascia in Hesselbach's triangle (lateral edge of rectus abdominis, the inferior edge of the inguinal ligament, and medial to inferior epigastric vessels). A **Pantaloon hernia** is a combination of a direct and indirect hernia.

Alike the rest of the abdominal cavity, the inguinofemoral region is lined by the peritoneum. The preperitoneal space intervenes between the peritoneum and the transversalis fascia. The external iliac artery & vein pass under the iliopubic tract through the femoral canal where the arteries give rise to the inferior epigastric & deep circumflex arteries.

The external iliac vein, running posteromedial to the accompanying artery, receives venous blood from the inferior epigastric veins. Moving medial from the femoral canal the external iliac gives a pubic arterial branch that gives off the obturator artery crossing Cooper's ligament and entering the obturator foramen.

In the adult, the inguinal canal is approximately 4cm long, running superior to the inguinal ligament from the internal ring (deep ring) to the external ring (superficial ring).

In the male the canal contains the spermatic cord, in females, it contains the round ligament of the uterus. In both sexes, it contains blood and lymphatics along with the ilioinguinal nerve.

1.3 Preperitoneal Space

This space is mentioned due to the nerves, lateral femoral cutaneous nerve & genitofemoral, that course through it and is easily disturbed by hernia surgery. The lateral femoral cutaneous nerve, of L2/L3 origin, courses along the iliac muscle exiting at the anterior superior iliac spine (lateral attachment of the inguinal ligament).

The genitofemoral nerve, of L2 or L1/L2 origin, descends along the anterior belly of the psoas forming the genital branch that enters the inguinal canal via the deep ring and femoral branches that enters the femoral sheath.

Also coursing through the preperitoneal space are vessels; external iliac vessels, the inferior epigastric artery and veins, the obturator artery, and the arteria corona mortis. The ductus deferens courses from a superolateral location entering via the deep inguinal ring.

2

ANATOMY OF ENDOCOPIC REPAIR OF INGUINAL HERNIA

Authors - Dr Priyanshi Swaroop, Dr Akshay Anand, Prof Abhinav Arun Sonkar

2.1 Introduction

The laparoscopic view of the groin anatomy is very different from the open one. In laparoscopic hernia repair, we go through a posterior approach while we are used to the anterior approach in open hernia repairs. Changing to a laparoscopic approach requires proper knowledge of anatomy.

Certain structures like ilioinguinal nerve, inguinal ligament, pubic tubercle and lacunar ligament are clearly visible in open approach and not so in laparoscopy. Conversely, structures like Cooper's ligament and iliopubic tract that are not visible in the open approach are clearly visible with the laparoscopic approach.

2.2 Importance of the Kessler's triangle: The Kessler's triangle is the one between the inguinal ligament and the upper edge of the intersections of the internal oblique, the transversus abdominis muscle and its upper aponeurosis to the rectus sheath.

Thus, the triangle is medially bounded by the lateral border of the rectus sheath, inferiorly bounded by the inguinal ligament and laterally bounded by the internal oblique transverse section. It is said that when there is a larger Kessler's triangle due to higher intersections of internal oblique and transverses the muscle into the rectus sheath, there is a larger space available for the muscles to occlude the triangle when they contract. This incomplete occlusion is set to be an important anatomical factor in the etiology of inguinal hernia.

In the lower abdomen, there are five peritoneal folds or ligaments which are seen through the laparoscope in the umbilicus. These ligaments are generally overlooked at the time of open surgery.

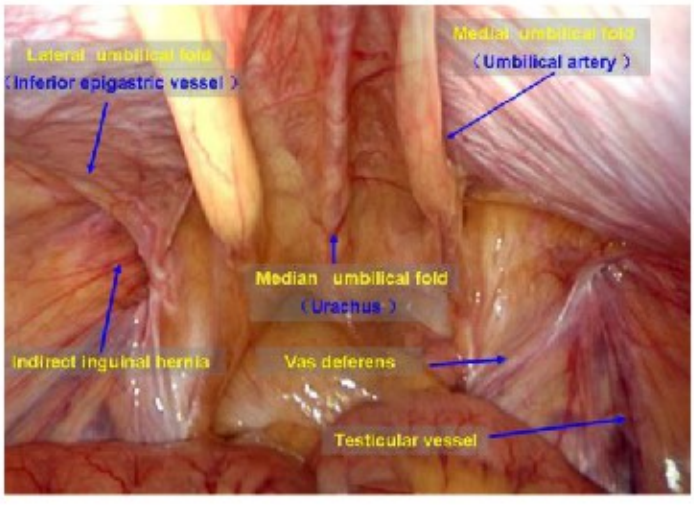


Figure 2.1.1: Kessler's Triangle

One Median Umbilical Ligament

In the midline, there is a median umbilical ligament extends from the mid of urinary bladder up to the umbilicus. The median umbilical ligament is obliterated urachus.

Two Medial Umbilical Ligament One on Either Side

The paired medial umbilical ligament is an obliterated umbilical artery except where the superior vesical arteries are found in the pelvic portion. The medial umbilical ligaments are the most prominent fold of the peritoneum. Sometimes, it hangs down and obscures the vision of the lateral pelvic wall. These ligaments are important landmarks for the lateral extent of the urinary bladder.

Two Lateral Umbilical Ligaments

Lateral to the medial umbilical ligament, the less prominent paired lateral umbilical fold contains the inferior epigastric vessels.

The inferior epigastric artery is a lateral border of Hesselbach's triangle and hence is a useful landmark for differentiating between direct and indirect hernia. Any defect lateral to the lateral umbilical ligament is an indirect hernia and medial to it is a direct inguinal hernia.

The femoral hernia is below and slightly medial to the lateral inguinal fossa, separated from it by the medial end of the iliopubic tract internally and the inguinal ligament externally.

Important landmarks for extraperitoneal hernia dissection include the musculoaponeurotic layers of the abdominal wall, the bladder, Cooper's ligament, and the iliopubic tract. The inferior epigastric artery and vein, the gonadal vessels and vas deferens should also be recognized. The space of Retzius lies between the vesicoumbilical fascia posteriorly and the posterior rectus sheath and pubic bone, anteriorly. This is the space first entered in the extraperitoneal repair of a hernia.

2.2 Indications of Laparoscopic Repair of Hernia

The indications for performing a laparoscopic hernia repair are essentially the same as repairing the hernia conventionally. There are, however, certain situations where laparoscopic hernia repair may offer definite benefits over conventional surgery to the patients. These include:

- Bilateral inguinal hernias
- Recurrent inguinal hernias.

In recurrent hernia, the surgery failure rate is as high as 25 to 30 percent, if again repaired by open surgery. The distorted anatomy after repeated surgery makes it more prone to recurrence and other complications like ischemic orchitis.

In recurrent hernia, the laparoscopic approach offers repair through the inner healthy tissues with clear anatomical planes and thus, a lower failure rate. In laparoscopic bilateral repair with three ports technique, there is simultaneous access to both sides without any additional trocar placement. Even in patients with clinically unilateral defects after entering inside the abdominal cavity, there is 20 to 50 percent incidence of a contralateral asymptomatic hernia being found which can be repaired, simultaneously, without any additional morbidity of the patient.

2.4 Contraindications of Laparoscopic Repair of Hernia

- Nonreducible incarcerated inguinal hernia
- Prior laparoscopic herniorrhaphy
- Massive scrotal hernia
- Prior pelvic lymph node resection
- Prior groin irradiation.

2.5 Advantages of Laparoscopic Approach

- Tension-free repair that reinforces the entire myo-pectineal orifice
- Less tissue dissection and disruption of tissue planes
- Three ports are adequate for all type of hernias
- Less pain postoperatively
- Low intraoperatively and postoperative complications
- Early return to work.

2.6 Disadvantages of Open Method

- Requires 4 to 6 inches of incision at the groin
- Generally very painful, because of muscle spasm
- Considerable postoperative swelling of tissues in the groin, around the wound.
- Requires cutting through the skin, fat, and good muscles in order to gain access for repair, which in itself causes damage.
- Frequent complications of wound hematomas, wound infection, scrotal hematomas, and neuroma.
- Usually takes 6 to 8 weeks for recovery.
- Sometimes long-term disability may follow, e.g. neuralgia, neuroma, and testicular ischemia.
- Whether a flat mesh or a plug is used from the front, they do not hold themselves in place; what holds them in place are stitched, so the strength of the repair still depends on the stitches, not so much on the mesh or plug.
- Bilateral inguinal hernias require 2 incisions, doubling the pain; or 2 operations.
- Recurrent inguinal hernias are very difficult to operate open and more liable to complications.
- The size of the mesh used in open methods is limited by the natural fusion of muscles.
- All meshes and plugs shrink with time, and this works against all open method.

Any method of repair must achieve 2 fundamental goals, removal of the sac from the defect and durable closure of the defect. In addition, the ideal method should achieve these with the least invasion, pain, or disturbance of normal anatomy. Laparoscopic repair in expert hands is now quite safe and effective and is an excellent alternative for patients with an inguinal hernia. It is the confusion that laparoscopic repair is more complex and is not widely available. The public needs to be educated as to its advantages. All surgeons agree that for bilateral or recurrent inguinal hernias, laparoscopic repair is unquestionably the method of choice. The argument against its use for unilateral or primary inguinal hernias is unfounded if it is the best for bilateral or recurrent hernias.

2.7 Types of Laparoscopic Hernia Repair

Many techniques were used to repair hernia like:

- Simple closure of the internal rings
- Plug and patch repair
- Intraperitoneal Onlay mesh repair
- Transabdominal preperitoneal mesh repair (TAPP)
- Total extraperitoneal repair (TEP).

The technique of transabdominal preperitoneal repair was first described by Arregui in 1991. In the transabdominal preperitoneal (TAPP) repair, the peritoneal cavity is entered, the peritoneum is dissected from the myopectineal orifice, mesh prosthesis is secured, and the peritoneal defect is closed. This technique has been criticized for exposing intraabdominal organs to potential complications, including small bowel injury and obstruction.

The totally extraperitoneal (TEP) repair maintains peritoneal integrity, theoretically eliminating these risks while allowing direct visualization of the groin anatomy, which is critical for a successful repair. The TEP hernioplasty follows the basic principles of the open preperitoneal giant mesh repair, as first described by Stoppa in 1975 for the repair of bilateral hernias.

Laparoscopic/Endoscopic procedures are especially suitable for recurrent and bilateral inguinal hernia.

The major procedures done nowadays include

- transabdominal preperitoneal (TAPP) repair
- total extraperitoneal (TEP) repair

2.8 Myopectineal Orifice

This anatomic region was originally coined by Dr. Fruchaud, a French researcher, in 1956. All direct inguinal hernias, indirect inguinal hernias and femoral hernias are caused by weakness of transverse fascia in the myopectineal orifice.

The inguinal ligament divides the myopectineal orifice into two regions:

The suprainguinal region and

The subinguinal region.

The spermatic cord or the round ligament of the uterus runs through the suprainguinal region, while the femoral nerve, the femoral artery, the femoral vein and the femoral canal run through the subinguinal region.

A single-side repair of the myopectineal orifice can simultaneously and completely repair the site of anatomical weakness for inguinal, direct and femoral hernias. This approach is also the principle of adult laparoscopic inguinal hernia repair.

Proper exposure of this orifice is essential to do a proper inguinal hernia repair. The whole orifice is divided by the iliopubic tract into superior and inferior compartments, with the inferior epigastric artery bisecting the superior compartment. Thus, direct and indirect hernias are visualized in the superior compartment and femoral hernias in the inferior compartment. The superomedial compartment of the myopectineal orifice corresponds to the original Hesselbach's triangle. Covering the complete myopectineal orifice is the anatomical fundamental of laparoscopic hernioplasty. From the large posterior myopectineal orifice, the inguinal canal funnels forward into a narrow anterior wall, explaining the need for a larger mesh for posterior cover and a much smaller mesh for anterior cover. (15 × 12 cm in laparoscopic repair as it is posterior repair against 6 × 10 cm in open repair of hernia as it is anterior repair).

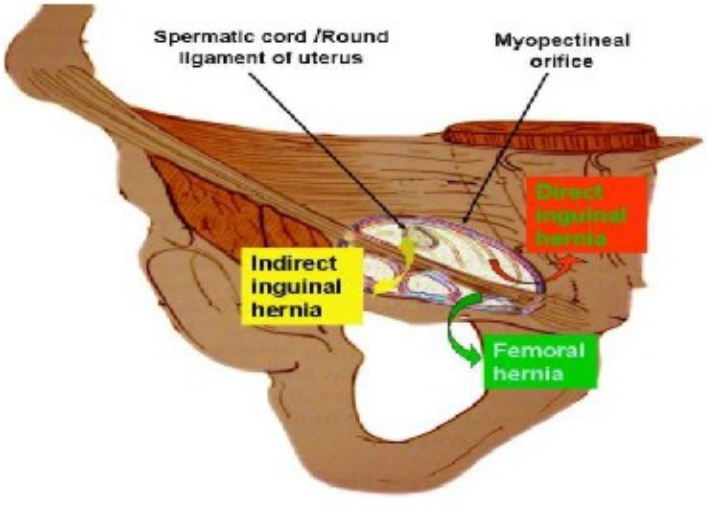


Figure 2.8.1: Myopectineal Orifice

2.9 Transverse Fascia

It is a thin aponeurotic membrane that lies between the rectus abdominis, the deep layer of the transverse abdominal muscle, and the peritoneum. The transverse fascia in the lower anterior abdominal wall is divided into two layers.

The superficial transverse fascia is thin and has no clinical value in a hernia repair. The deep transverse fascia covers the parietal peritoneum and is relatively thick.

The space between the superficial and deep transverse fascia is the parietal space.

The superficial and deep transverse fasciae extend to the inguinal region and blend at the site lateral to the inferior epigastric blood vessels. It forms the internal spermatic fascia and covers the spermatic cord structures entering the inguinal canal. Thus, the internal spermatic fascia must be incised during the separation of the indirect inguinal hernia sac to expose the cord structures and the hernia sac.

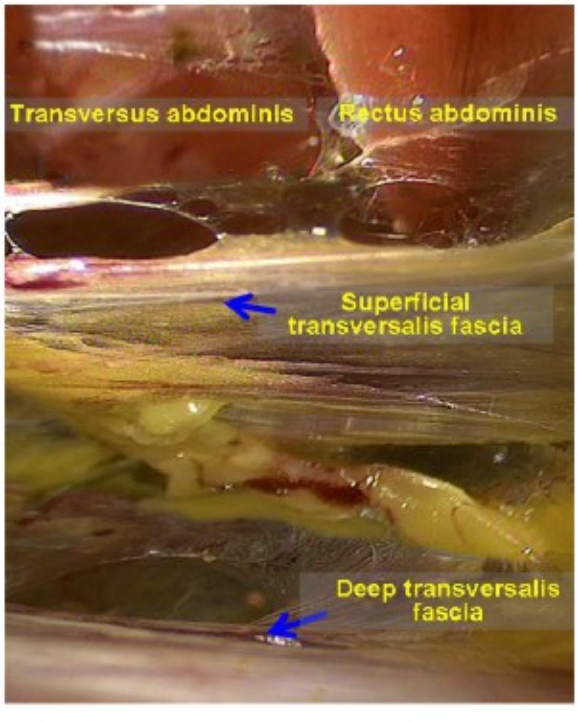


Figure 2.9.1: Preperitoneal retropubic space and extraperitonealspace posterior to the transverse fascia (Space of Bogros)

These two spaces are potential non-natural cavities under the lower anterior abdominal wall, and lie between the superficial transverse fascia and the peritoneum.

The preperitoneal retropubic space is located in the midline with the superficial transverse fascia and the pubic bone anteriorly, the bladder posteriorly, the umbilicus level superiorly, the pelvic floor muscles inferiorly, and the inferior epigastric arteries laterally. It is filled with loose connective tissue and fat. Usually, the preperitoneal retropubic space is considered to be equivalent to the space of Retzius.

The space of Bogros lies lateral to the space of Retzius and is bound anteriorly by the superficial transverse fascia, medially by the inferior epigastric blood vessels, laterally by the pelvic wall, and posteriorly by the psoas muscle, the external iliac vessels and the femoral nerve.

The space of Bogros is explored to access the iliac fossa as well as to make it easier to open the lateral mesh and lay it flat.

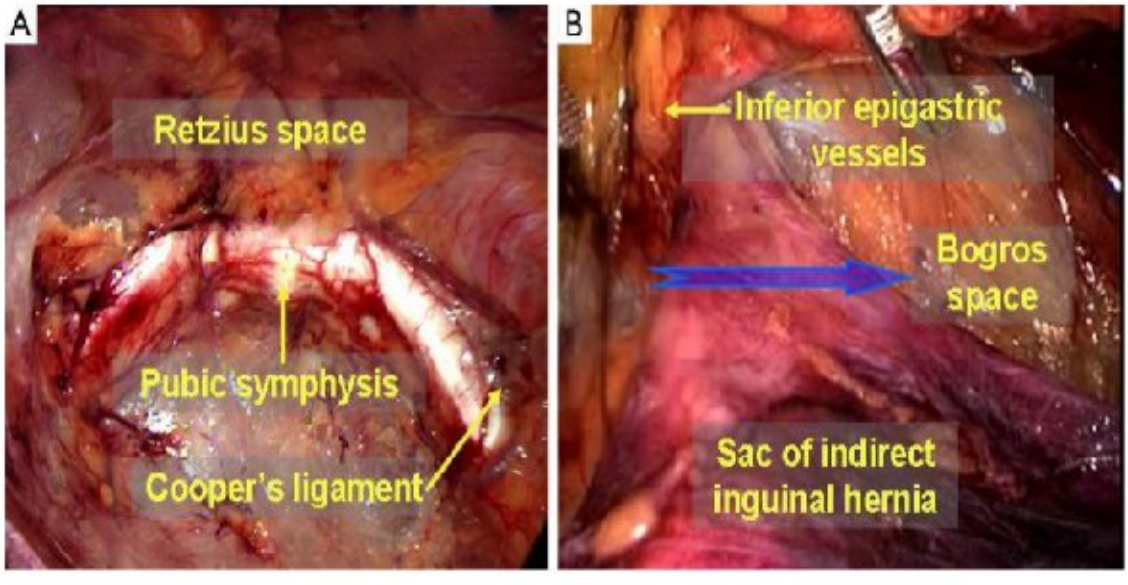


Figure 2.9.2: The space of Bogros lies lateral to the space of Retzius

Important anatomic structures and landmarks and their significance in hernia repair During laparoscopic inguinal hernia repair, it is important to recognize the following important structures in the abdominal cavity: the median umbilical fold, the medial umbilical fold, the lateral umbilical fold,

Hesselbach's triangle, the internal inguinal ring and the femoral ring. Other anatomical structures that must be recognized include the pubic symphysis, Cooper's ligament, the corona mortis, the inferior epigastric vessels, the vas deferens/the round ligament of the uterus, the testicular vessels, the iliopubic tract, the dangerous triangle (triangle of doom) and the triangle of pain.

The pubic symphysis is the first exposed anatomical landmark and is the medial reference line when placing mesh. One or several anastomotic vessels between the inferior epigastric or the external iliac vessels and the obturator arteries or veins, namely, the corona mortis, can be visualized at the site 5 cm away from the pubic symphysis, arching over Copper's ligament.

The corona mortis includes arteries and veins, most of which travel alone and leave the pelvic cavity via the obturator canal. During surgery, significant hemorrhage may occur, and hemostasis may be difficult to achieve if the corona mortis vessels are accidentally cut because they may retract into the obturator canal. Therefore, the corona mortis is known as the "crown of death" to remind surgeons to be alert during a procedure such as a separation and fixation on Copper's ligament.

The separation continues laterally along Cooper's ligament and the dark blue external iliac vein; the white, elastic, pulsating external iliac artery can be seen after passing the corona mortis. The slightly thin inferior epigastric arteries and veins can be seen at the top of the external iliac vessels. Most of the inferior epigastric arteries are branches of the external iliac arteries or veins. The inferior epigastric artery usually runs with two veins along the back of the rectus abdominis muscle toward the umbilicus.

The identification of the inferior epigastric vessels is very important before accessing the space of Bogros. Separating between the inferior epigastric vessels and the deep transverse abdominal fascia is the only approach to correctly gain access to the space of Bogros.

Otherwise, it is easy to accidentally damage the inferior epigastric vessels or pierce the peritoneum, which may cause difficulties while performing laparoscopic surgery or even require conversion to open surgery.

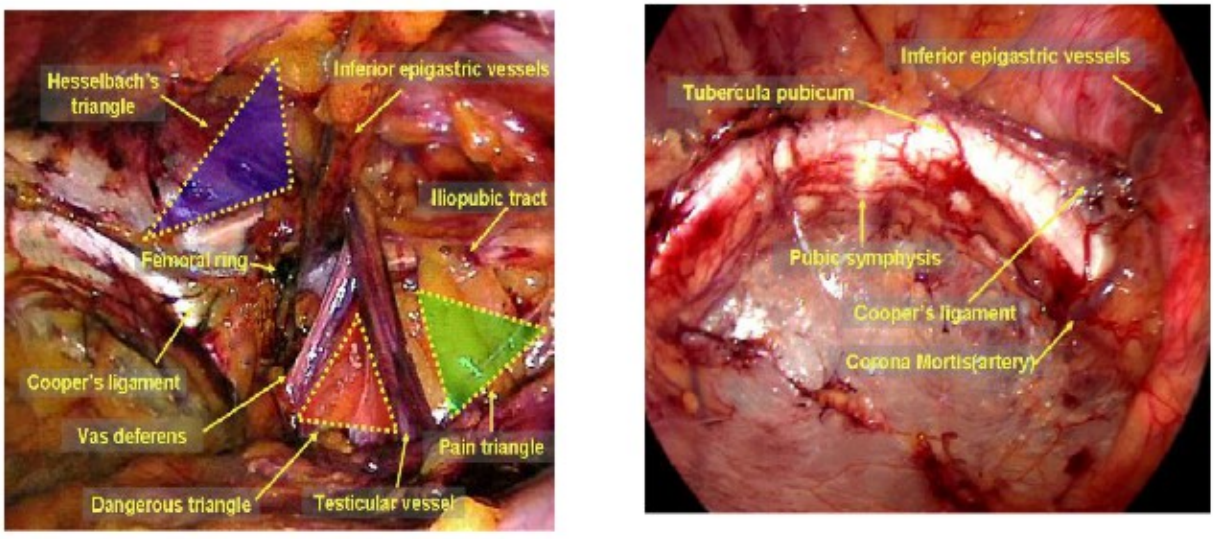


Figure 2.9.3: Anatomic Structures and Landmarks

During a laparoscopic inguinal hernia repair, the **dangerous triangle (the triangle of doom)** refers to a triangular area bound by the vas deferens, the testicular vessels and the peritoneal fold. Within the boundaries of this area, you can find the external iliac artery and vein.

The triangle of pain is a triangular area located lateral to the dangerous triangle and bound by the iliopubic tract, the testicular vessels and the peritoneal fold. This area from lateral to medial includes the lateral femoral cutaneous nerve, the femoral branch of the genitofemoral nerve and the femoral nerve, which runs on the surface of the psoas muscle and the iliac muscle.

Most of these nerves pass through the deep surface of the iliopubic tract to innervate the corresponding area of the perineum and thigh. The femoral nerve is 6 cm above the inguinal ligament and is not easily injured because it is covered by the psoas muscle.

The lateral femoral cutaneous nerve runs just below the iliac fascia and enters the thigh in the 1- to 4-cm-wide region infero–medial to the anterior superior iliac spine under the iliopubic tract. During separation of the space of Bogros, avoiding piercing the iliac fascia and exposing the nerves is one of the most effective methods to reduce the incidence of postoperative chronic neuropathic pain.

Clinical data have shown that the lateral femoral cutaneous nerve and the femoral branch of the genitofemoral nerve are more commonly damaged. Minor damage can result in abnormal sensation in the area innervated by these nerves. Such symptoms can resolve spontaneously in 2–4 weeks. However, these abovementioned nerves can suffer major damage or entrapment when performing separation or fixation or when controlling bleeding, which may cause abnormal sensation in the nerve-innervated area, especially chronic neuropathic pain, and may even cause motor disorders in the lower extremity. It is extremely difficult to manage or improve these symptoms.

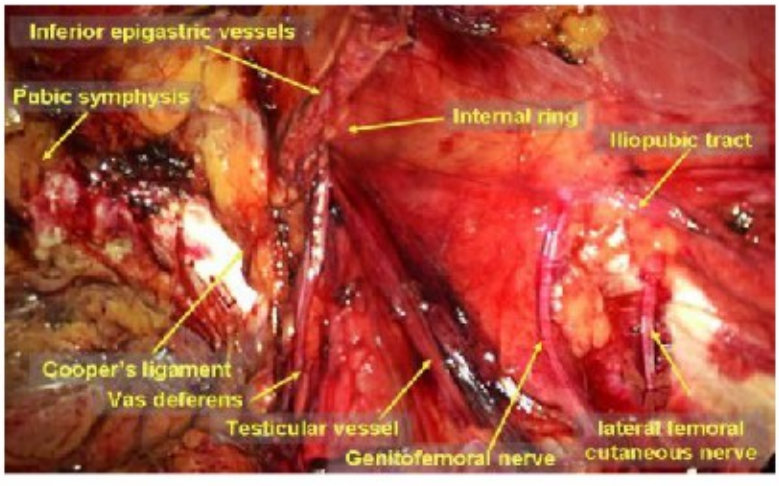


Figure 2.9.4: The Triangle of Pain

The iliopubic tract is a thickened tendinous structure of the transverse abdominal fascia that connects the anterior superior iliac spine and the pubic tubercle and parallels the inguinal ligament.

It arches medially across the front of the femoral vessels to insert via broad attachment onto the pubic tubercle and Cooper's ligament. The iliopubic tract is the outer boundary of the triangle of pain. The lateral part of a mesh should be fixated at a spot just above the level of the iliopubic tract. The white iliopubic tract can be seen at the lower edge of a direct hernia ring or below an internal inguinal ring.

However, the degree of development of the iliopubic tract may vary individually; the iliopubic tract in other areas may not be easy to recognize under the laparoscope. The simplest method to identify the iliopubic tract is to touch and press the projected spot of the stapler head on the body surface when using a stapler to staple the lateral part of a mesh; the feel of the stapler head indicates that the stapler head is located above the iliopubic tract. Otherwise, the stapler head is likely located below the iliopubic tract, and stapling may cause nerve damage.

The 4 nerves encountered and their common sites of injury

1. **Lateral femoral cutaneous nerve:** This nerve is the most commonly injured nerve during laparoscopic hernia repair.

Course of the nerve: As it arises from L2-3, it emerges at the lateral edges of the psoas, and courses along the iliac fossa lateral to the iliac vessels. It passes below (or sometimes even through the fibers of) the inguinal ligament lying in a fibrous tunnel 1 cm medial to the anterior superior iliac spine. Its area of supply is the upper lateral aspect of thigh.

Common site of injury in relation to the iliopubic tract is in the triangle of pain, resulting in the sequelae of pain and numbness in the upper lateral thigh called meralgia paresthetica or Bernhardt's syndrome.

2. **Genitofemoral nerve:** The femoral branch of the genital femoral nerve is at risk of damage during laparoscopic hernia repair. The genital branch of genitofemoral nerve is more often injured in an open inguinal repair. Sometimes if extensive maneuvers are performed to the sac and the perisac tissues at the internal ring, the genital branch of the genitofemoral nerve could be injured.

Course of the nerve: Nerve arises from L1-2, courses through the psoas major occupying the anteromedial aspect of the muscle, dividing into genital and femoral branches before reaching the internal inguinal ring.

The genital branch pierces the iliopubic tract lateral to the deep ring and then enters the ring (within 5 mm of the upper border of the ring, and courses through the inguinal canal). This is the reason why when the peritoneum is opened in a TAPP; it is always opened at the point atleast 1 cm superior to the upper edge of the ring to avoid injury to the genital branch of the genital femoral nerve. The femoral branch courses beneath the inguinal ligament to the thigh.

Area of supply of the genital branch is the cremaster, the spermatic fascia and tunica-vaginalis of the testes; it is also the efferent branch for the cremastric reflux, and in the female, it is sensory to the labium major. The femoral branch is the cutaneous branch to the skin over the femoral triangle and is the afferent branch for the cremasteric reflex.

Common site of the entrapment is on the posterior abdominal wall especially if tackers or staplers are used well below the iliopubic tract. Post injury, it causes pain in the groin, scrotum and upper thigh.

Tenderness is found along the internal ring and along the inguinal canal with hyperextension or external rotation of the hip, thus increasing the pain. The loss of cremasteric reflex indicates that either the genital, or the femoral branch or both have been injured during the operation.

3. Femoral nerve: Usually the intermediate cutaneous branch of the anterior division of the femoral nerve is at risk during laparoscopic meshplasty although injury to the main trunk of the femoral nerve has also been described.

Course of femoral nerve: Arising from L2–4, the femoral nerve emerges from the lateral aspect of the psoas muscle and travels, and courses below the inguinal ligament lateral to the femoral artery and outside the femoral sheath.

Common site of injury is the posterior abdominal wall, well posterior to the ilioinguinal tract and little lateral to the genitofemoral nerve (medial to lateral are the genitofemoral nerve, the femoral nerve and then the lateral cutaneous nerve of the thigh).

Post-injury pain could be the anteromedial aspect of the thigh with or without thigh paralgesia or paresthesia. Even a little hip extension causes pain. Later the quadriceps muscles weaken, and loss of patellar reflex could occur.

4. Ilioinguinal nerve: This nerve is rarely involved in laparoscopic hernia repair. It is frequently involved in open inguinal hernioplasty. It is only injured if excessive pressure is applied during laparoscopic mesh fixation, compressing the muscles sufficiently to allow the tacker or the stapler to reach the deeply situated nerve.

Course of ilioinguinal nerve: Arising from L1, travels retroperitoneally across the quadratus lumborum behind the kidney and then passes anterior to the iliac muscles, piercing the transversus abdominis near the anterior end of the iliac crest, and then piercing the internal oblique. It travels through the inguinal canal in an anterolateral position in the spermatic cord and exits through the superficial inguinal ring or the external oblique aponeurosis.

2.10 Area of supply:

- Skin at the root of the penis
- Anterior third of the scrotum
- Labium majora in female
- Small area of thigh inferomedial to the inguinal ligament
- Motor supply is the internal oblique before it reaches the inguinal canal.

Common site of entrapment is medial to the anterosuperior iliac spine (only if excessive pressure is applied on the anterior abdominal wall during the mesh fixation).

Post-injury paresthesia in the lower abdomen, scrotum and upper medial thigh. Extension of hip increases the pain.

3

ENDOCOPIC HERNIA REPAIR TECHNIQUES

Authors - Dr Sukesh KS, Dr Anirudh Gupta, Dr Akshay Anand, Prof Abhinav Arun Sonkar

3.1 Introduction

The definitive treatment of most hernias, regardless of their origin or type, is surgical repair. Laparoscopic groin hernia repair is increasingly popular because it offers the potential for less postoperative pain and a quick return to normal activities.

Common laparoscopic approaches for inguinal hernia repair in adults include three options: IPOM repair, TAPP repair and TEP repair. The basic principle for the hernia repair, i.e., repairing the weakness of the myopectineal orifice, is the same in all three approaches. The IPOM and TAPP techniques repair the hernia intraperitoneally, while the TEP approach requires the establishment of pneumopreperitoneum. Beginners can choose to perform the TAPP repair to reduce the surgical difficulty and to quickly master groin applied anatomy and surgical skills. With more experience, the surgeon can choose to perform TEP repair, which has many advantages, including not only the lower incidence of abdominal adhesions but also reduced expense.

3.2 Indications

Laparoscopic inguinal hernia repair is well suited for all types of adult inguinal hernia, especially bilateral hernias and recurrence after open hernia repair. However, the laparoscopic approach for inguinal hernia repair should be used with caution in patients with a history of lower abdominal surgery, abdominal radiotherapy, or bleeding tendency or in patients with giant irreducible hernia.

3.3 Contraindications

Relative contraindications to laparoscopic repair may mandate an open approach, including:

- Inability to tolerate general anaesthesia
- Prior abdominal surgery
- Strangulated or incarcerated inguinal hernia
- Large scrotal hernia
- Ascites
- Active infection
- severe benign prostatic hyperplasia

3.4 Preoperative Evaluation

Medical histories are collected to determine whether conditions that can induce increases in intra-abdominal pressure, such as chronic coughing, chronic constipation or difficulty urinating, are present, as increased intra-abdominal pressure is a common cause of postoperative hernia recurrence. In senior male patients, the history of nocturia should be obtained to evaluate if benign prostatic hypertrophy is present; if necessary, a post-void residual urine test may be performed. In male patients aged 50 and older, a selective α-1 receptor blocker, such as tamsulosin, should be prescribed orally (2 or 3 times daily) 2 or 3 days before surgery. This regimen can significantly reduce the incidence of postoperative acute urinary retention. Respiratory infection should be controlled before surgery, which can be scheduled after the coughing is relieved. For patients with recurrent hernia, the history of previous procedures (particularly of the use of synthetic mesh) and their postoperative diagnoses should be obtained to accurately assess the difficulty of the surgery and to select the appropriate surgical procedures.

Preoperative examination in male patients should include careful examination of the testicles, such as size, texture and location. Ultrasonography should be routinely performed in the bilateral inguinal region to exclude cryptorchidism, spermatic cord hydrocele and tumors.

3.5 Equipment

Appropriate instrumentation and supplies should be readily available and the proper functioning of laparoscopic imaging equipment verified prior to initiating anaesthesia. An angled laparoscope, usually a 30° or a 45° scope, is used for these procedures, which allows for better visualization than a nonangled laparoscope.

- 10 or 5 mm 30° laparoscope
- Trocars – (2) 5 mm, (1) 10 to 12 mm
- Preperitoneal balloon dissector totally extraperitoneal (TEP) hernia repair only
- Polypropylene mesh, flat or preformed
- Laparoscopic tack or strap applier
- Laparoscopic clip applier

Mesh for laparoscopic repair — Mesh is a necessary element of laparoscopic inguinal and femoral hernia repair to provide tension-free hernia repair, which is the recommended method. Polypropylene woven mesh is the preferred prosthetic material used in essentially all studies describing laparoscopic hernia repair.

Polypropylene mesh is commercially available in light, medium, or heavy weight. In a systematic review of patients who had a laparoscopic inguinal hernia repair, the use of a lightweight mesh, as opposed to a heavyweight mesh, was associated with a lower incidence of chronic groin pain, groin stiffness, and foreign body sensation without any increased risk for hernia recurrence.

Preformed mesh that conforms to the preperitoneal space is available and is preferred by some surgeons over a flat piece of mesh that needs to be trimmed to accommodate the patient's anatomy. The particular product or the method used for placement is a matter of surgeon preference.

3.6 Operating Room Layout

A video monitor is placed at the patient's feet. The surgical assistant stands on the patient's affected side, and the surgeon stands on the side opposite to the assistant. In terms of surgeries for patients with bilateral inguinal hernia, the surgeon may stand on either side based on their preference. The surgeon may change location with the surgical assistant at any time when appropriate. The anesthetist stands at the patient's head. The instrument nurses stand in line with the surgeon.

Patient positioning

The patient is usually placed in 15° to 20° Trendelenburg position to improve exposure of the working area, which is particularly important with TAPP hernia repair to move the small bowel away from the area of dissection.

3.7 Totally Extra-Peritoneal (TEP) Repair

Extraperitoneal exposure and dissection — The totally extraperitoneal (TEP) hernia repair avoids the peritoneal cavity by developing a plane of dissection in the preperitoneal space.

The anatomy of the preperitoneal space and the location of the hernia defects are illustrated in the figure.

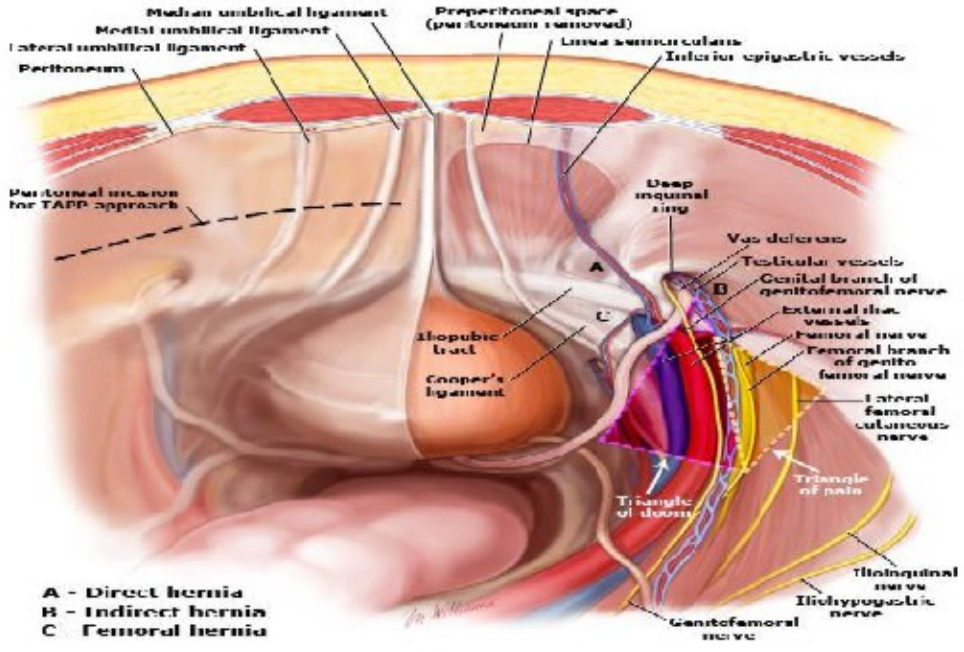


Figure 3.7.1: Extraperitoneal exposure and dissection

The TEP approach allows access to both groin regions and provides exposure of the inferior epigastric vessels, femoral vessels, pubic tubercle, Cooper's ligament, and spermatic cord.

Direct entry into the rectus sheath is via an incision just off the midline with blunt dissection to the linea semicircularis.

The anatomic landmarks for entry into the preperitoneal space are the median umbilical ligament and the hernia defect. The preperitoneal tissue is entered by establishing a plane between the posterior surface of the rectus muscle and the posterior rectus sheath and peritoneum.

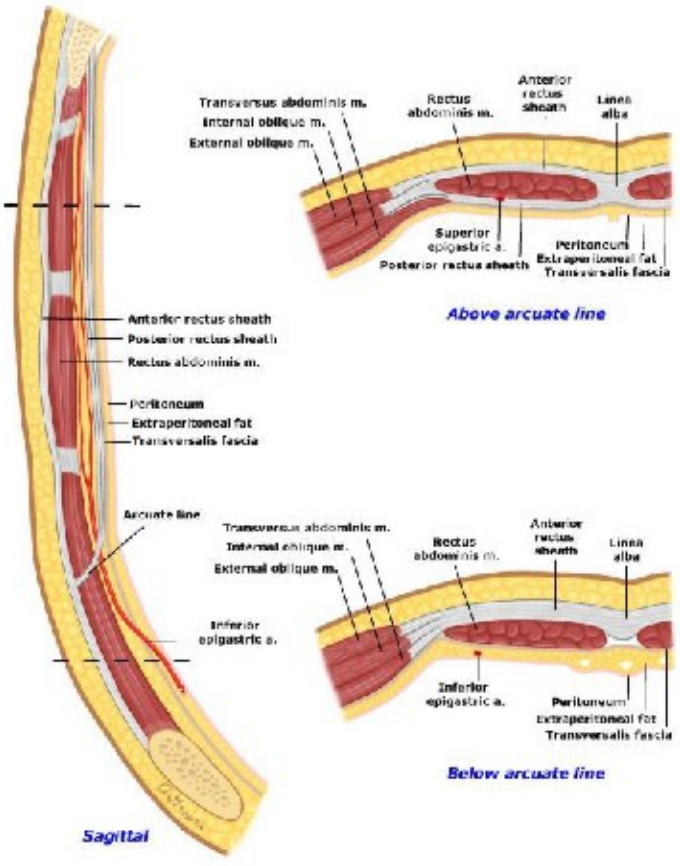


Figure 3.7.2: Anatomic Landmarks

To dissect the preperitoneal space and obtain exposure:

- Make an infraumbilical incision contralateral to the hernia, which increases the distance between the incision and the hernia, and incise the anterior rectus sheath transversely. Retract the rectus muscle laterally to allow a 10 mm blunt trocar to be placed through which a dissector can be used to develop the preperitoneal space under direct vision using an angled laparoscope.

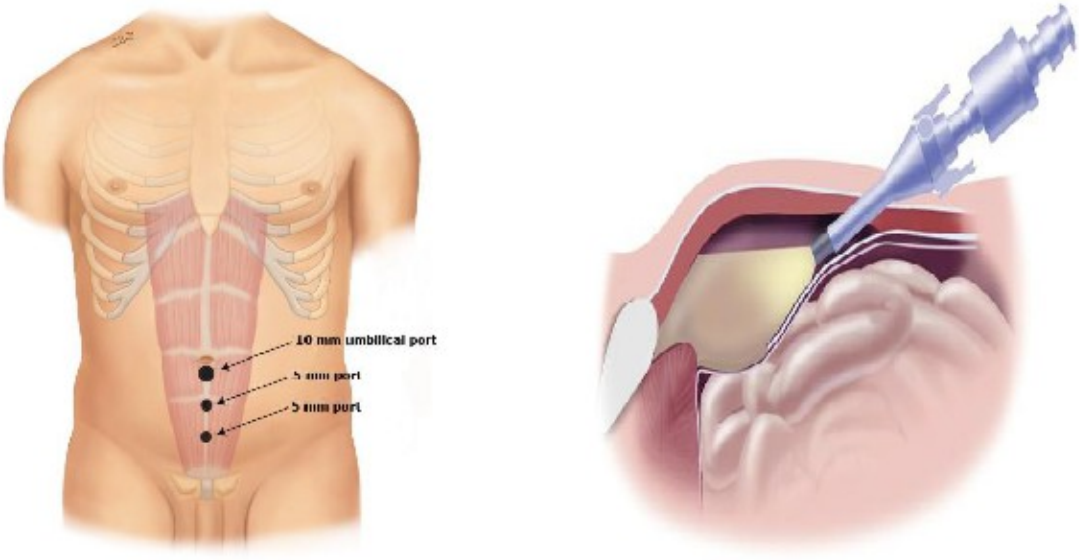


Figure 3.7.3 : Preperitoneal under direct vision using & angled Laproscape

Alternatively, a balloon dissector can be used to expand this potential space.

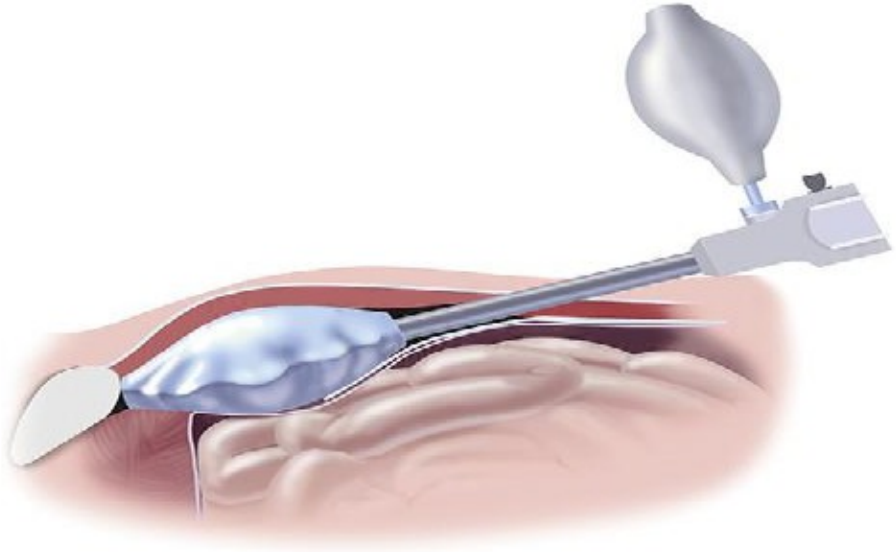


Figure 3.7.4 : Balloon disssector

- Bluntly dissect the preperitoneal space in the avascular plane between the peritoneum and the transversalis fascia. Avoid the use of electrocautery during the dissection as this can lead to nerve injury.

- Identify the course of the epigastric artery and vein, and try to maintain their position anteriorly against the abdominal wall. Occasionally, the balloon dissector may develop the wrong plane and will dissect the epigastric vessels or rectus muscle fibres from the abdominal wall, which can make the remainder of the procedure more challenging.
- Once the preperitoneal space is dissected below the arcuate line, place two additional 5 mm trocars in the midline under direct vision.
- Position one of these approximately 5 cm superior to the pubic symphysis. Place the other cannula midway between the umbilicus and the pubic symphysis. Some surgeons prefer to place these working cannulas lateral to the 10 mm umbilical trocar, contralateral to the hernia. Once the preperitoneal space is developed, insufflate the space through the 10 mm camera port.
- The iliopubic tract (inguinal ligament) is not as well seen with a TEP approach but can be felt at the lower border of the internal inguinal ring. Direct hernia sacs often reduce spontaneously during the course of dissection. Indirect sacs are more difficult to manage and can be quite adherent to the cord structures. To identify an indirect sac, trace the epigastric vessels toward their origin to identify the spermatic cord as it enters the internal ring.

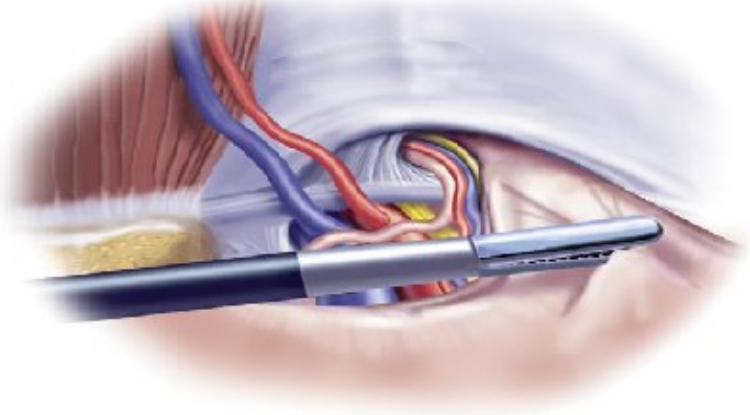


Figure 3.7.5 : Inguinal Ligament

- Minimize dissection in the area of Cooper's ligament to avoid disrupting the venous circle of Bendavid, a venous network fixed to the abdominal wall in the subinguinal space, which can produce troublesome bleeding. Avoid excessive dissection in the region of the femoral canal, which can be identified by tracing Cooper's ligament laterally. Lymph nodes in the femoral canal can produce bleeding, and excessive dissection can lead to the development of a femoral hernia.
- Take care in dissecting an indirect hernia sac to ensure the vas deferens and the testicular blood vessels are not injured. Often, a cord lipoma will also be removed during this process. Once a small (<1.5 cm) sac is mobilized, it should be returned back to the peritoneal cavity.

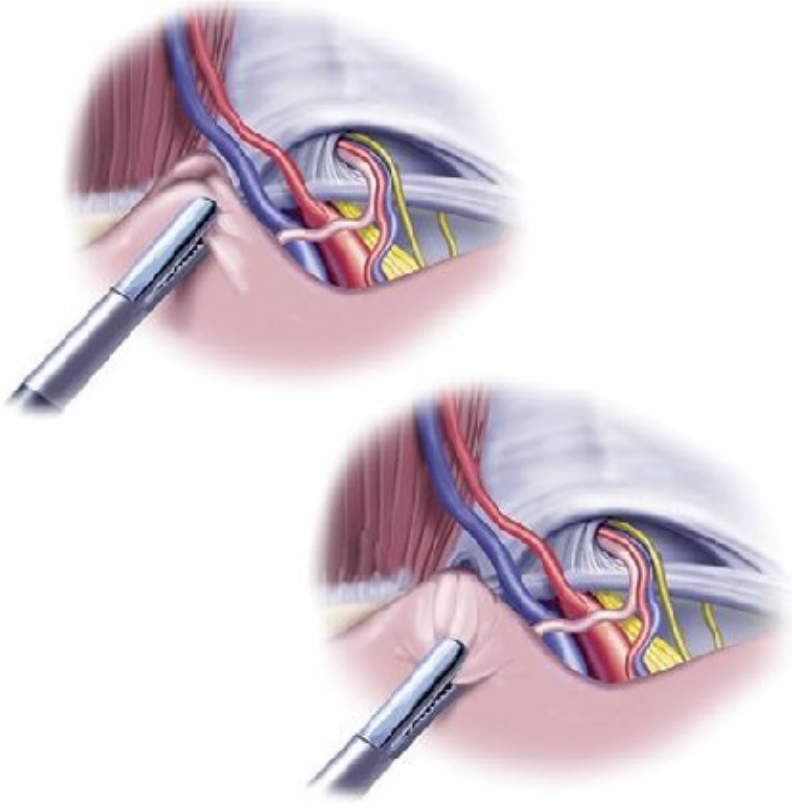


Figure 3.7.6 : Dissecting & Indirect Hernia

- Larger indirect (>3 cm) sacs that are difficult to dissect and reduce may need to be carefully divided just distal to the internal ring, leaving the distal sac in situ within the inguinal canal.
- Some surgeons prefer to lower the insufflation pressure during a TEP procedure to reduce the chance of peritoneal CO2 leakage. It is our preference to set the insufflation pressure to 12 mmHg and to maintain a low-to-medium flow rate (3 to 20 L/minute) rather than a high flow rate (40 L/minute). This will allow the surgeon to create and maintain an appropriate preperitoneal space to dissect and place the mesh safely.

3.8 Trans Abdominal Pre-Peritoneal (TAPP) Repair

Transabdominal exposure and dissection — As with most laparoscopic procedures, the peritoneal cavity is entered during transabdominal preperitoneal (TAPP) hernia repair. The major advantage of the posterior approach to groin hernias is that all three hernia defects (direct, indirect, and femoral) are well-visualized and in close proximity to each other, allowing easy repair of any type of groin hernia.

To obtain exposure and dissect the preperitoneal space:

- Access the peritoneal cavity using standard techniques (eg, Hasson, Veress needle) above the umbilicus using a 10 mm cannula. Once access to the peritoneal cavity has been established, insufflate the abdomen and place two additional cannulas (5 mm) bilaterally in a horizontal plane with the umbilicus.

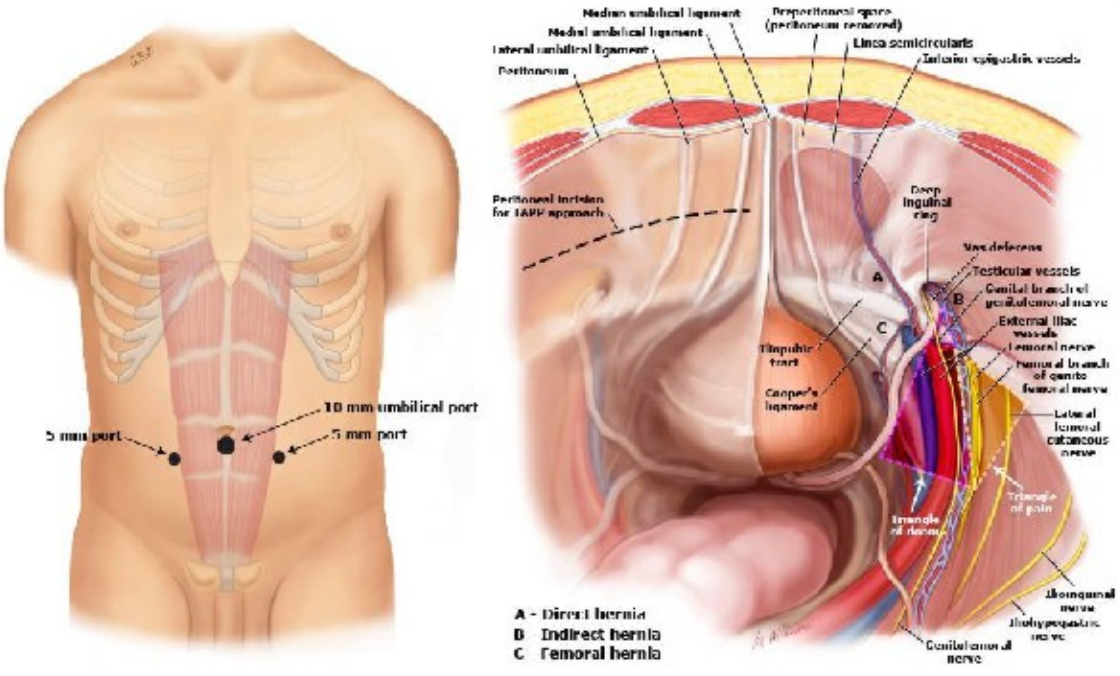


Figure 3.8.1: Transabdominal exposure and dissection

- Identify the median and medial umbilical ligaments, bladder, inferior epigastric vessels, vas deferens, spermatic cord, iliac vessels, and hernia defects.
- Incise the peritoneum beginning at the lateral edge of the median umbilical ligament at least 4 cm above the hernia defect and extending 8 to 10 cm laterally.
- For patients with bilateral hernias, a single transverse peritoneal incision extending from one anterior superior iliac spine to another on the opposite side can be used rather than two separate peritoneal incisions.
- It is important to make the incision sufficiently above the hernia defect to allow dissection of 2 to 3 cm of normal fascia to provide sufficient mesh overlap after mesh placement.

- Develop the peritoneal flap in the avascular plane between the peritoneum and the transversalis fascia. Mobilize the peritoneal flap to expose the pubic symphysis, Cooper's ligament, iliopubic tract, cord structures, inferior epigastric vessels, and hernia spaces.
- Be careful to identify and avoid injury to the femoral branch of the genitofemoral and lateral femoral cutaneous nerves.
- Gently reduce a direct inguinal hernia from the preperitoneal fat using gentle traction. Indirect sacs should be mobilized from the cord structures and reduced into the peritoneal cavity.

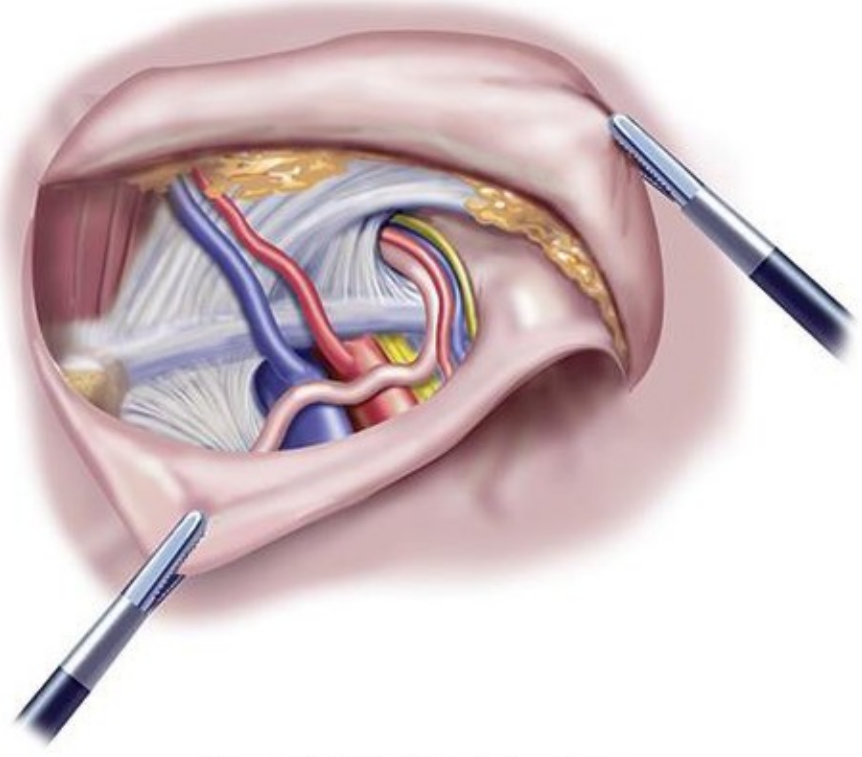


Figure 3.8.2: Cord structures

- A larger hernia sac that is difficult to mobilize from the cord without undue trauma to the vas deferens or vasculature to the testicle can be divided just distal to the internal ring, leaving the distal sac in situ within the inguinal canal.

- Sac division does not negatively impact patient outcomes compared with complete sac reduction.

Mesh Placement and Fixation

Although some surgeons support no fixation of mesh, it is recommended that mesh fixation should be preferred rather than no fixation for laparoscopic hernia repair to avoid the complications associated with mesh migration and mesh shrinkage.

Stapling/tacking injuries to the nerves are the most common source of postoperative neuralgia following laparoscopic hernia repair.

This complication should be suspected if severe groin pain develops in the recovery room and should prompt the surgeon to return to the operating room to remove the offending tack.

Inadvertently entrapping or otherwise injuring a nerve can also lead to chronic pain. Although the nerves are essentially never seen during laparoscopic hernia repair except in the thinnest of patients, nerve injuries can be prevented by avoiding the known course of the nerves relative to points of mesh fixation.

Metallic fixation devices (eg, Protak) provide greater fixation strength but can cause serious complications such as adhesion formation or tack erosion into hollow viscera.

Other devices (eg, AbsorbaTack, Permasorb, or SorbaFix) are bioabsorbable but provide less fixation strength over time. Compared with tacks, fibrin glue has been associated with less chronic groin pain when used to secure mesh during hernia repairs.

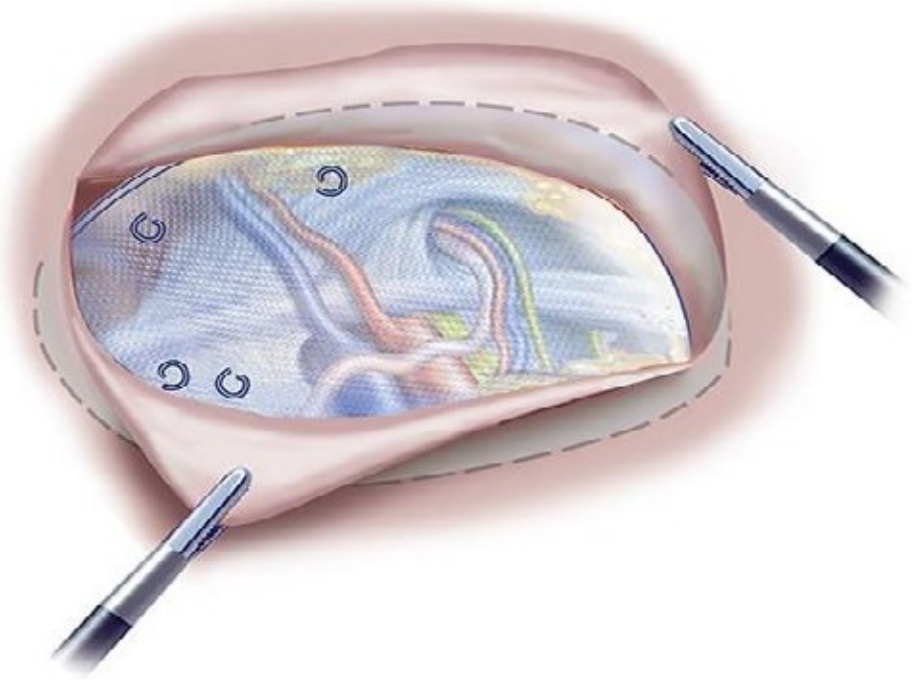


Figure 3.8.3: Mesh Placement and Fixation

- Typically use three to four tacks for mesh fixation, one in the pubic tubercle, sometimes a second tack in Cooper's ligament, one tack at the superior edge of the mesh at the medial edge, and one tack at the superior edge of the mesh just lateral to the inferior epigastric vessels.
- **Closure** - Following the fixation of the mesh, the inferior peritoneal flap that is developed during TAPP repair should be positioned over the mesh to isolate it from the peritoneal cavity using running sutures, staples, tacks, or a biological sealant.
- Avoid gaps when closing the peritoneum to minimize the likelihood of future small bowel herniation and obstruction within this space.
- Once the hernia repair is completed, a long-acting local anaesthetic (eg, **bupivacaine**) can be sprayed onto the preperitoneal space and surfaces for pre-emptive analgesia.

- The ports are removed, and the cavity (TAPP) is decompressed. The fascia at the 10 mm umbilical cannula should be sutured to reduce the chance of future incisional hernia.

3.9 IPOM: Intraperitoneal Onlay Mesh Repair

The surgical area is prepared and draped as normal. A 10-mm skin incision is made along the lower edge of the umbilicus. A small retractor is used to expose the midline. A Veress needle is inserted into the abdominal cavity to create pneumoperitoneum, and the pressure is maintained at 12–14 mmHg. Then, a 10-mm trocar and a 30° laparoscope are placed for exploration. A 5-mm skin incision is made in the lateral edge of the rectus abdominis at the umbilical level on each side of the abdomen for a 5-mm trocar and surgical instruments. The above description is for a closed establishment of pneumoperitoneum. The open establishment of pneumoperitoneum can also be used based on the surgeon's preference and the patient's condition.

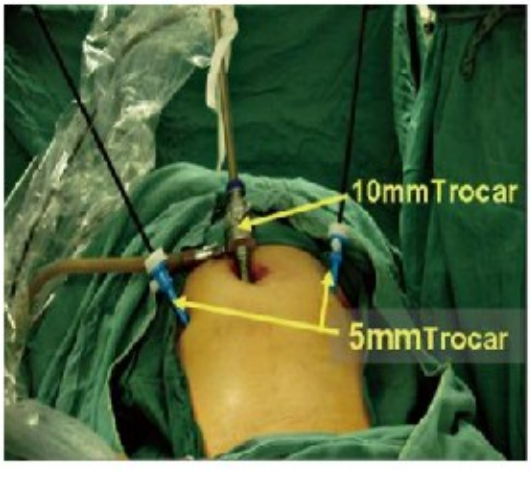


Figure 3.9.1 : Trocar Placement : IPOM

Dissection of the Mesh Placement Area

- The omentum or the organs in the hernia sac are grasped using a non-traumatic clamp and are moved back into the abdominal cavity.
- The peritoneum around the myopectineal orifice is exposed clearly.
- All adhesion structures, including the ileocecal portion and the sigmoid colon, are separated to the cephalad side.

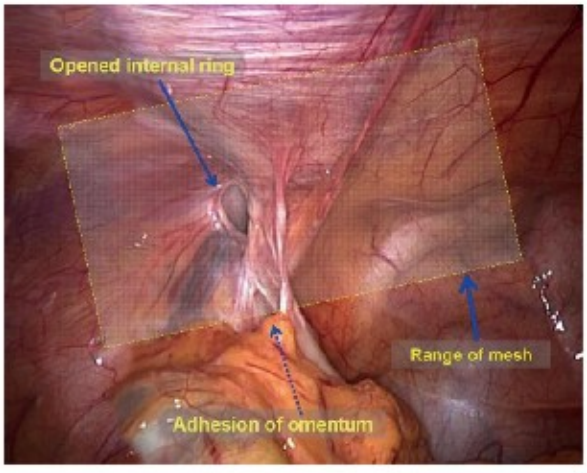


Figure 3.9.2: The area for mesh placement

- At level of the Cooper ligament, the medial umbilical fold is incised horizontally to facilitate flat placement of the mesh. Diathermy scissors are then used to incise the closed umbilical artery; if bleeding is significant, it should be ligated

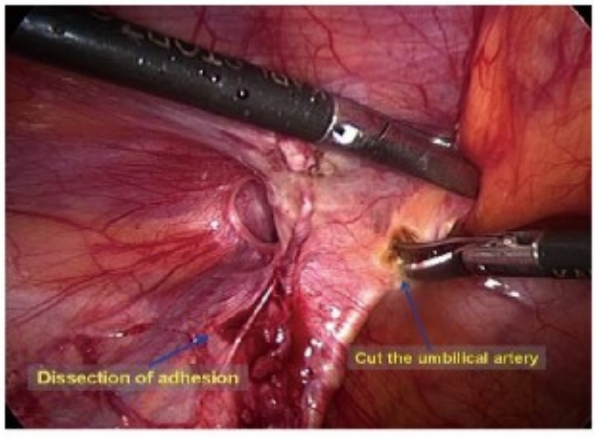


Figure 3.9.2: The medial umbilical fold is incised, and the umbilical artery is divided

- When the area around the myopectineal orifice is dissected completely, the mesh can be placed at this time.
- In some patients, the peritoneum and the fat layer of the pubis surface are too thick. In such cases, it is difficult to determine the location of the Cooper ligament and the Corona Mortis vessels. To avoid damage to blood vessels when placing spiral tacks, the parietal peritoneum can be incised at the site whereby the umbilical fold was incised to expose the Cooper ligament and the Corona Mortis vessels and to separate medially until the pubic symphysis is reached. It is recommended to incise the medial umbilical fold when performing an IPOM repair so that the mesh is exactly fixed to the Cooper ligament with care to avoid mesh migration or compression on the bladder wall.

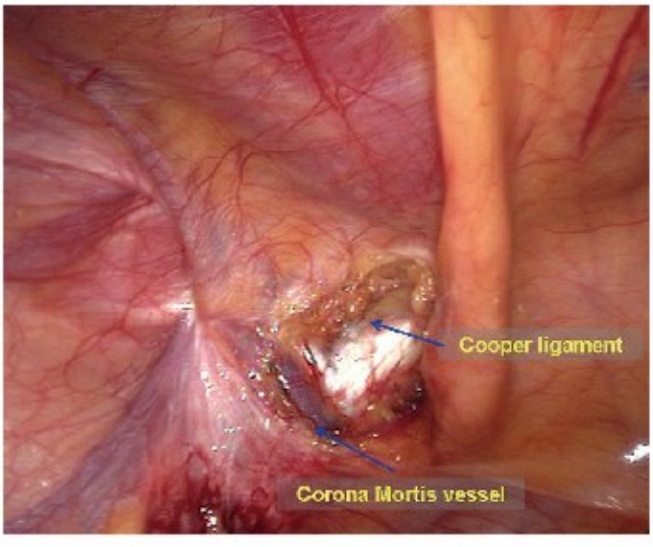


Figure3.9.3: Exposure of the Cooper ligament and the Corona Mortis vessels

Mesh Placement and Fixation

- The laparoscope is withdrawn from the abdominal cavity.
- A sheet of anti-adhesion mesh which is rolled into a cigarette-like roll, is introduced through the 10-mm port into the abdominal cavity, and the laparoscope is then placed into the abdominal cavity again. The long axis of the mesh should lie parallel with the iliopubic tract.
- The mesh is then unfolded, and the medial edge is pushed out until the pubic symphysis is reached, covering the Hesselbach triangle, the femoral hernia ring and the indirect hernia ring.
- The unfolded edge of the mesh should cover the defect with 3 cm extending beyond its edge. The anti-adhesion surface of the mesh should face the abdominal cavity.
- The mesh is initially fixed to the pubic tubercle and the Cooper ligaments with a spiral tack. The spiral tack on the Cooper ligament should not go beyond 5 cm lateral to the pubic symphysis to avoid damage to the Corona Mortis vessels.
- The lateral portion of the mesh is then unfolded flat; the tacks are tacked along the upper edge of the mesh at intervals of 3 to 4 cm until the lateral edge of the mesh is reached. Care is taken to ensure that the tacks cannot be placed at spots lower than the iliopubic tract and to ensure not to injure the vessels when placing tacks along both sides of the inferior epigastric vessels.
- In IPOM repair, the mesh is usually fixed to the pubic symphysis, the Cooper ligaments and the lower abdominal wall. The portion of the mesh arching across the iliac vessels does not need to be fixed to the peritoneum.
- Care must be taken not to damage the blood vessels and the nerves during suturing. The medial umbilical incision does not need to be sutured to the anti-adhesion mesh.

Figure 3.9.4: Diagram of a completed mesh fixation

4

VENTRAL HERNIA REPAIR

Authors - Dr Sheefali Chandra, Dr Akshay Anand, Prof Abhinav Arun Sonkar

4.1 Introduction

A Ventral hernia is defined by a protrusion of intra abdominal content through anterior abdominal wall defects. The defect may be spontaneous or acquired. Ventral hernias of the abdomen are also defined as a non-inguinal, nonhiatal defect in the fascia of the abdominal wall. Annually, there are about 350,000 ventral hernia operations. The repair of these abdominal wall defects is a common surgery performed by general surgeons. Surgery is typically recommended for individuals with acceptable operative risk, symptomatic hernias, or those at elevated risk of developing complications from a hernia.

Types

Categorised as:

1.Primary ventral hernia

- Umbilical
- Epigastric
- Spigelian
- Lumbar

2. Incisional hernia

* includes parastomal and port site

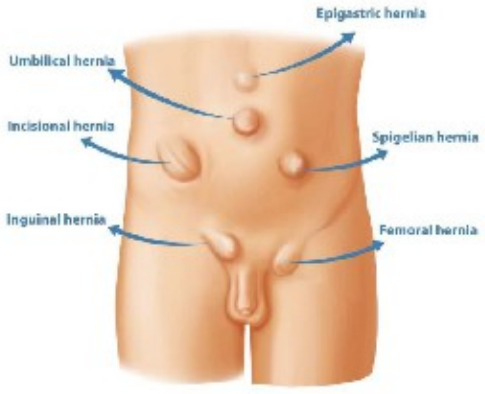


Figure : 4.1.1 : Ventral Hernia

Ventral hernia formation is complex and multifactorial, and hernias may be congenital or acquired. **Congenital hernias** are present from birth and include complex entities such as omphalocele and gastroschisis, or more straightforward defects such as primary umbilical or epigastric hernias. More than 80% of primary congenital umbilical hernias will close spontaneously before the age of 5 and will not require repair. However, congenital epigastric hernias may be symptomatic with incarcerated preperitoneal fat and require surgical intervention.

Acquired ventral hernias are of the spontaneous or incisional variety. Spontaneous hernias most often occur at weaknesses of the abdominal wall, along the midline, or at the arcuate line or spigelian fascia. However, trauma to the abdominal wall may also lead to herniation in other locations. Incisional hernias are defined as any ventral herniation that is located at a previous surgical site or incision, including trocar sites. Spontaneous ventral hernias are diagnosed in adulthood and are usually the effect of increased abdominal pressure related to obesity, pregnancy, ascites, or other factors. Increased abdominal pressure leads to enlargement of the hernia defect as well as increased likelihood of incarceration.

Epigastric hernias occur at the midline above the umbilicus where perforating neurovascular bundles travel through the fascial layers that interlace to create the linea alba.

These defects are usually quite small but often have an incarcerated mushroom of preperitoneal fat that can be quite symptomatic for the patient.

Umbilical hernias occur through the base of the umbilicus or in the surrounding tissue. The umbilical ring is formed as the flat discus of fetal cells begins its three-dimensional fold and is surrounded by the amniotic cavity. It eventually fuses with the linea alba and rectus complexes, and the umbilical cord is created. Here the linea alba is penetrated by the umbilical veins and arteries and after birth a cicatrix is formed as these vessels degenerate into the falciform and umbilical ligaments. It is thought that this is the weakest part of the abdominal wall; either the cicatrix itself or the tissues surrounding it are weak, allowing for vulnerability and the formation of umbilical or periumbilical hernias. Other patient factors may add to the stress of the abdominal wall and contribute to the formation of ventral hernias, such as disorders of collagen formation, sleep apnea, steroid use, and smoking or chronic lung diseases.

Incisional hernias occur in up to 40% of patients after midline laparotomy. An innate problem with suture closure of laparotomy is that tension is required to approximate the rectus abdominis muscles and counter tension of the lateral abdominal wall musculature. Such tension may contribute to overtightening of sutures and ischemia to the midline tissues. There are three types of incisional hernias: acute wound dehiscence and evisceration due to sutures tearing through tissue, subacute with early gapping of the tissues approximated under tension, and chronic remodeling of the scar tissue causing "Swiss-cheese" or "cheese-cutting" hernias, formed as sutures cut through the weakened scar tissue. Thus, technical factors such as slipped knots, tension, and overtightened sutures can predispose to hernia development. Surgical site infection (SSI) has also been found to increase the risk of hernia by 50%.

Risk factors

- ✓ older age
- ✓ congenital defect
- ✓ obesity
- ✓ smoking
- ✓ chronic cough
- ✓ wound infection
- ✓ comorbid diseases

Most patients are asymptomatic. Patient can present with symptoms ranging from severe pain to life-threatening conditions like obstruction or strangulation. The incidence of incisional hernia after midline laparotomy is 10-20%, 70% occurs in the first 5 years, and 30 % in 5-10 years. Ventral hernia repairs are mostly elective (90%) procedures unless emergency repair is mandatory.

4.2 Etiology

Etiologies of a ventral hernia can be broken down into 2 main categories; acquired or congenital. The vast majority of hernias that general surgeons see and treat are acquired; however, some individuals live with their ventral hernias from birth for prolonged periods of time before having them surgically repaired. Common causes of acquired ventral hernias include previous surgery causing an incisional hernia, trauma, and repetitive stress on naturally weak points of the abdominal wall. These naturally occurring weak points in the abdominal wall include the umbilicus, semilunar line, ostomy sites, bilateral inguinal regions, and esophageal hiatus.

Obesity is a large component of hernias as well because it stretches the fascia of the abdomen causing it to weaken.

Specifically, the action of repetitive weight gain and loss leads to weakening.

4.3 Epidemiology

In 2006, 348,000 ventral hernia repairs were performed in the United States, and it was estimated to cost approximately $3.2 billion. This is a large burden on the healthcare system with the majority of the cost coming from emergency repairs or complications postsurgically. In the post-operative setting, patients have an approximately 10% risk of developing a hernia following a midline laparotomy, 5% following a transverse muscle splitting incision, and less than 1% following laparoscopic repair.

Anatomy & Pathophysiology

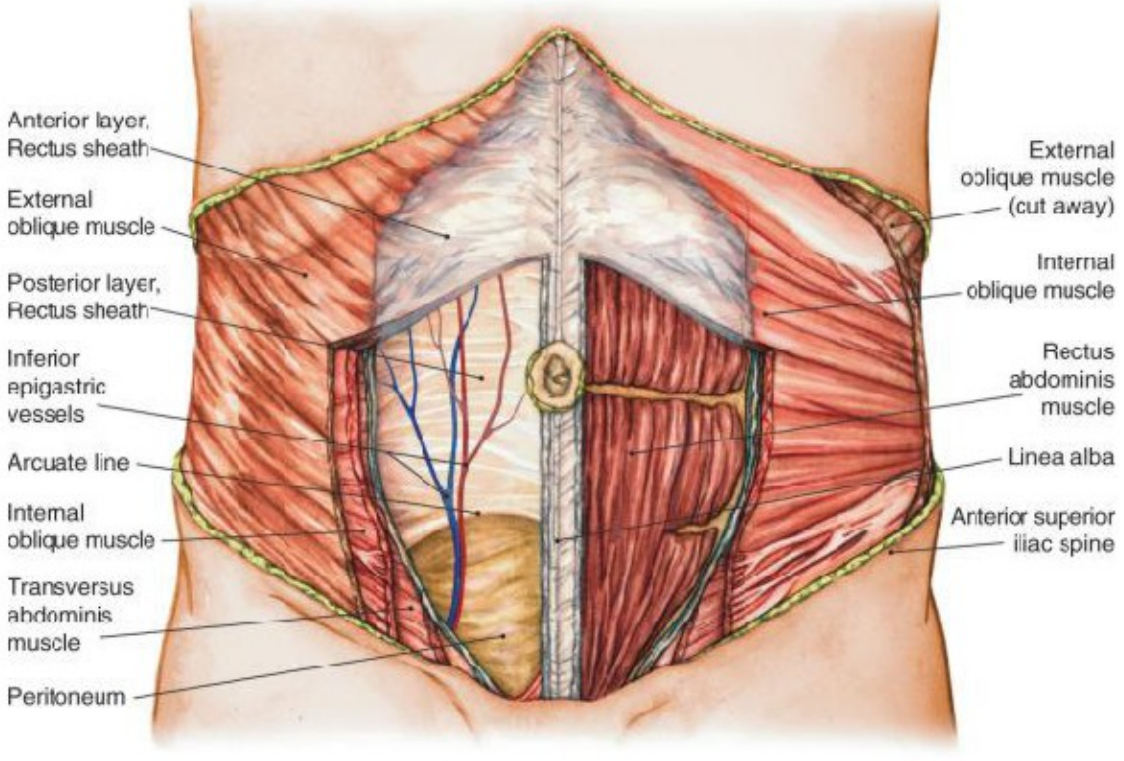


Figure 4.3.1: Anterior Abdominal Wall

The anterior abdominal wall is made of many layers including skin, fat, fascia, muscle, and peritoneum. The order of the layers changes depending on the location you enter the abdomen perpendicularly.

A point approximately midway between the umbilicus and pubic symphysis is an imaginary line called the arcuate line. At this point, the layers of the abdomen, with respect to the rectus, change in orientation. Above the arcuate line, the fascia of the internal oblique aponeurosis envelops the rectus muscle. The external oblique aponeurosis always lies anterior to the internal oblique aponeurosis and the transversus abdominis aponeurosis always posterior to it. However, below the arcuate, line all 3 layers of aponeurosis become anterior to the rectus muscle, and it is no longer enveloped. Instead, the only fascial layer below the rectus is the transversalis fascia which is separate from the transversus abdominis aponeurosis.

The vascular supply to the abdomen can be subdivided into three zones based upon regional anatomy. A regional vascular map initially described by Huger provides a simplistic, yet reliable model for illustration. Zone I is located in the anterior midline portion of the abdomen in the vicinity of the rectus abdominis and is supplied by the deep epigastric arteries. Specifically, the superior and the deep inferior epigastric arteries supply the rectus muscle and the overlying skin and subcutaneous tissues. Zone II encompasses the caudal aspect of the anterior abdominal wall and derives its vascular supply from four main arterial systems. The superficial external pudendal and superficial epigastric arteries are both derived from the femoral artery and supply the superficial fascia and skin in this area. The inferior epigastric and deep circumflex arteries supply the musculature in this area. Zone III is described as the most lateral aspect of the abdominal wall cranial and it derives its vascular supply from the intercostal and lumbar arteries, which arise from the aorta.

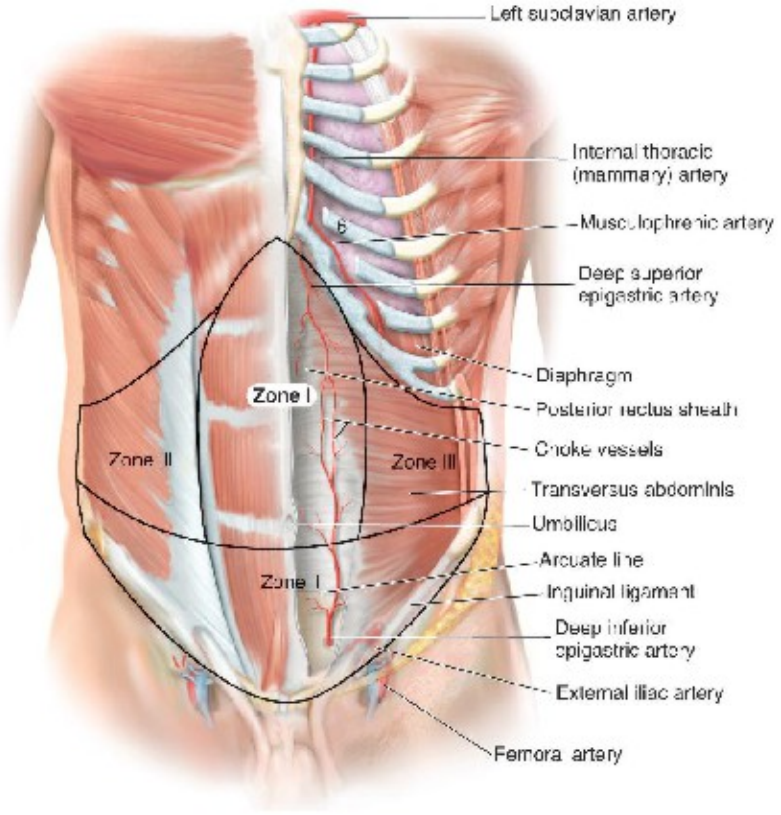


Figure 4.3.2: Vascular Supply to the Abdomen

Repetitive stresses on the abdominal wall from increased intra-abdominal pressure lead to microscopic tears of tissue. Over time this can decrease the strength of tissue, predisposing individuals to hernia formation. Several instances cause increased intra-abdominal pressures that place individuals at increased risk including constipation, physical labor, childbirth, excessive coughing from lung disease or even frequent vomiting from diseases like bulimia nervosa.

Tissue strength following surgery can only achieve an 80% tensile strength of the previous maximum. This effect is additive as well, so after a second midline laparotomy, the maximum tissue strength would be 80% of 80%, which is 64%. This 80% predicted tensile strength is under perfect conditions as well assuming no evidence of malnutrition or infectious complications.

History and Physical examination

The presentation of an abdominal wall hernia is usually pain, swelling or fullness at the site of occurrence that can change with position or Valsalva. In some cases when a hernia is incarcerated or strangulated, the enlargement may be erythematous or cause an asymmetry. In most cases, the diagnosis of an abdominal hernia can be made by history and physical exam but severe obesity, which is a major risk factor, can limit the exam. It is very important that during the exam the patient is examined in multiple positions as hernias can change with exertion or even standing.

There are additional questions that should be explicitly asked of patients presenting with ventral hernias. Beginning with the history of present illness, details surrounding the hernia should include the first time they noticed it, any inciting events, associated pain, erythema, constipation, nausea or vomiting, size of the bulge, change in size, what causes the change in size, history of previous hernias, weight change and a detailed surgical/medical history. Important social questions including the patient's occupation, dietary habits, exercise habits, smoking history, and alcohol consumption should also be included in the history. Patients should be asked specifically about the family history of a connective tissue disorder as this is typically hereditary and can lead to hernia formation.

Evaluation before surgery

Multiple adjunct examinations can be performed to assist with diagnoses including ultrasound, CT scan or MRI. If the diagnosis is in question or even the size of the hernia defect in unclear these studies can be ordered to aid in diagnosis or preoperative planning. Preoperative medical clearance is another important aspect in operative planning. Each surgeon should follow a set of guidelines for this and assume the need for a general anesthetic.

It is possible to do open ventral hernia repairs without general sedation; however, it is unlikely the patient will be completely relaxed, and therefore, it makes the operation more challenging with a possibly inferior result. The risk of ventral hernia repair varies greatly from low risk with a small umbilical hernia to a major risk with a large component separation. Patients with lung disease of a prolonged history of smoking would benefit from pulmonary function tests pre-operatively. It is also important to make sure that any screening exams are performed before abdominal surgery, it would be unfortunate to have to perform a colectomy for colon cancer on a patient 6 months after doing a ventral hernia repair. There should be strict adherence to discontinuation of antiplatelet and anticoagulation medications secondary to hematoma formations increasing the probability of infectious complications.

Staging in ventral hernia

Unfortunately, there is not currently a universal classification system for ventral hernias. One of the more accepted classification systems is the European Hernia Society (EHS) classification system. They separated the system into primary abdominal wall hernias and incisional abdominal wall hernias. A primary ventral hernia that not associated with a previous operation is usually in a limited number of locations, subdivided into midline and lateral, while the classification can be limited to 2 variables: length and width. The classifications of incisional abdominal wall hernias are more complicated as they can occur anywhere on the abdomen, but again, they are documented in terms of length and width. The limitation of this system is that it does not include individual patients risk factors and wound classification. However, a classification complex enough to encompass all of the important variables would be difficult to remember and unlikely to be embraced by the surgical community.

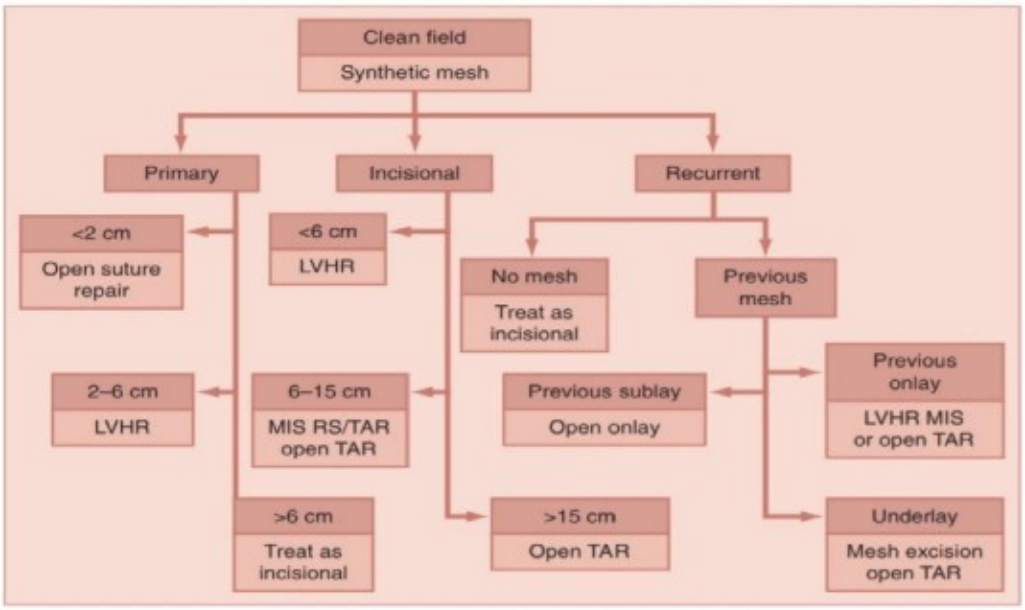
In instances where a significant amount of the visceral contents are in the hernia sac, some sources define this as half of the abdominal contents; it is considered to be a ventral hernia with loss of domain.

Types of Ventral hernia repairs

Laparoscopic ventral hernia repair when compared against open techniques has consistently shown decreased overall complication rates, decreased hospital length of stay, and a quicker return to work.

Although it has not been consistently statistically significant, a large portion of available literature shows the recurrence rates are slightly lower in laparoscopic repair. The disadvantages of laparoscopy include a higher potential for visceral injury, and it is technically more difficult. There has been development of wristed laparoscopic instruments that give additional freedom of motion during operating but additional research is needed to detect significant benefits.

Robotic ventral hernia repairs have also become popular secondary to increased freedom of motion during surgery. Closing the fascial defect robotically is far easier from a technical standpoint than attempting it with classical laparoscopic instruments. The benefits of laparoscopy are retained secondary to the smaller incisions that can be maintained. Robotic surgery is typically more expensive and has longer operative times than laparoscopy, and at this point, no landmark trials have demonstrated superiority of robotic surgery in comparison to laparoscopy.

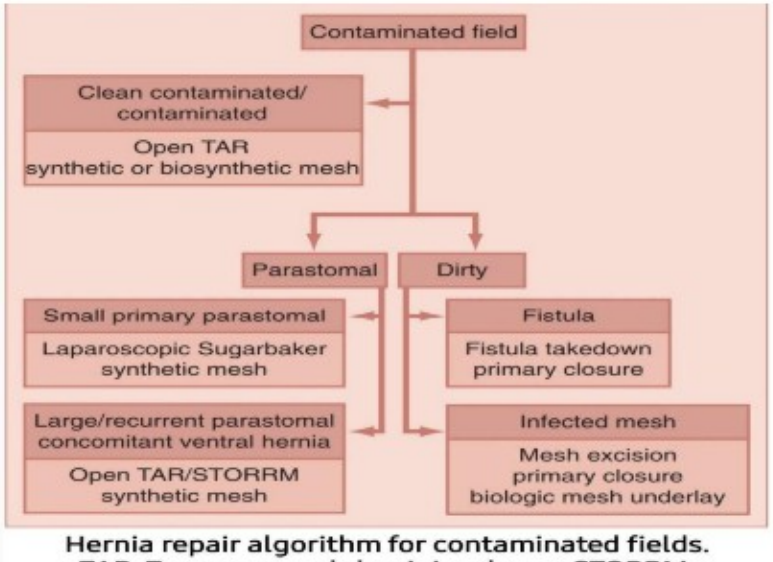


Hernia repair algorithm for clean fields. LVHR, Laparoscopic ventral hernia repair; MIS, minimally invasive surgery; RS, Rives-Stoppa; TAR, transversus abdominis release.

Figure : 4.3.3 : Hernia Repair algorithm for clean fields

Component separations can be performed several different ways and are typically reserved for large defects in which a tension-free closure cannot be achieved. All of the techniques require adhesiolysis with reduction of the hernia and typical mesh placement. The open technique with an onlay mesh consists of developing large skin flaps, about 5 cm beyond the midline, exposing the lateral portions of the rectus. The external oblique is then incised 2 cm lateral to linea semilunaris and extended superiorly and inferiorly while separating it from the internal oblique. This allows medialization of the rectus muscle and closure of the defect. Mesh is then used to reinforce the closure in an onlay fashion. It is estimated to allow for tension-free closure of defects up to 10 cm in diameter. During the endoscopic component separation, the hernia is reduced after adhesiolysis and incisions are made laterally to the rectus. The external oblique fascia is incised, and the muscle is split all the way to the posterior fascia.

A balloon is then inserted along the posterior fascia and inflated underneath the external oblique muscle down the level of the anterior superior iliac spine creating a large space. Using additional ports, the external oblique can then be incised to allow medialization of the rectus and repair of the hernia.



Hernia repair algorithm for contaminated fields. TAR, Transversus abdominis release; STORRM, Stapled transabdominal ostomy reinforcement with retromuscular mesh.

Figure : 4.3.4 : Hernia repair algorithm for contamiated fields

Transversus abdominis muscle release (TAR), also known as a posterior component separation, is another option for large hernias and consists of developing the retro-muscular space from the medial rectus into the space between the transversus abdominis and internal oblique. After the posterior rectus sheath is released, it is incised laterally, and the transversus abdominis is released medial to the linea semilunaris to expose a broad plane that extends from the central tendon of the diaphragm superiorly, to the space of Retzius inferiorly, and laterally to the retro-peritoneum on both sides. This preserves the neurovascular bundles innervating the medial abdominal wall. The mesh is placed in a sublay fashion above the posterior fascial layer but below the rectus and internal oblique muscles. The posterior rectus fascia then is advanced medially and closed while the linea alba is restored anterior to the mesh.

These cases can be very long cases and technically very challenging.

4.4 Prosthesis/ Mesh

The introduction of prosthetics has been a game changer in the repair of ventral hernias, and today the use of mesh reinforcement is recommended in the majority of ventral hernia repairs. Prosthetics used in hernia repair are in constant evolution and no "ideal" mesh has been discovered. The qualities of the ideal mesh include good tissue incorporation, limited foreign body reaction, and sufficient strength to withstand the forces of the abdominal wall along with good flexibility and compliance.

Prosthetics are first divided by material type and can be synthetic, biologic, or biosynthetic. Synthetic meshes are usually made of polypropylene, polyester, or polytetrafluoroethylene (PTFE). Biologic meshes are either cadaveric allograft or xenograft tissue grafts that are processed to reduce host reaction and improve tissue integration. Finally, the newest category of biosynthetic meshes are made of slowly absorbable biodegradable synthetic polymers. Synthetic and biosynthetic meshes can be further divided into monofilament or multifilament construction, micro- or macroporous, and heavy, midweight, or lightweight types. Finally, to reduce visceral adhesion and fistula formation, there are covered meshes made for intraabdominal placement.

Mesh Positioning

The most appropriate positioning of mesh within the abdominal wall is as big a question as which type of mesh to use. Neither of these questions has been answered in the literature, although 75% to 80% of hernia repairs involve mesh to reduce the risk of recurrence. Mesh can be placed as an onlay, sublay, underlay, or interposition.

Onlay mesh is placed above the anterior rectus sheath, whereas sublay mesh is positioned within the layers of the abdominal wall, typically retromuscular or in the preperitoneal plane.

An underlay mesh is placed within the abdominal cavity underneath the peritoneum. Recurrence rates are lowest with sublay or retromuscular mesh placement, followed by underlay mesh placement. Interposition mesh placement has the highest recurrence rate, reported to be as high as 80%. Interposition mesh placement is fraught with complications and also holds the highest SSI rate, whereas sublay mesh placement has the lowest SSI rate and lowest rate of mesh excision. However, there is significant discrepancy in the literature regarding outcomes related to mesh location, which accentuates the need for clinical decision making during ventral hernia repair. Mesh location, like mesh type, should be decided based upon patient characteristics, anticipated technique, and the characteristics of the hernia in question.

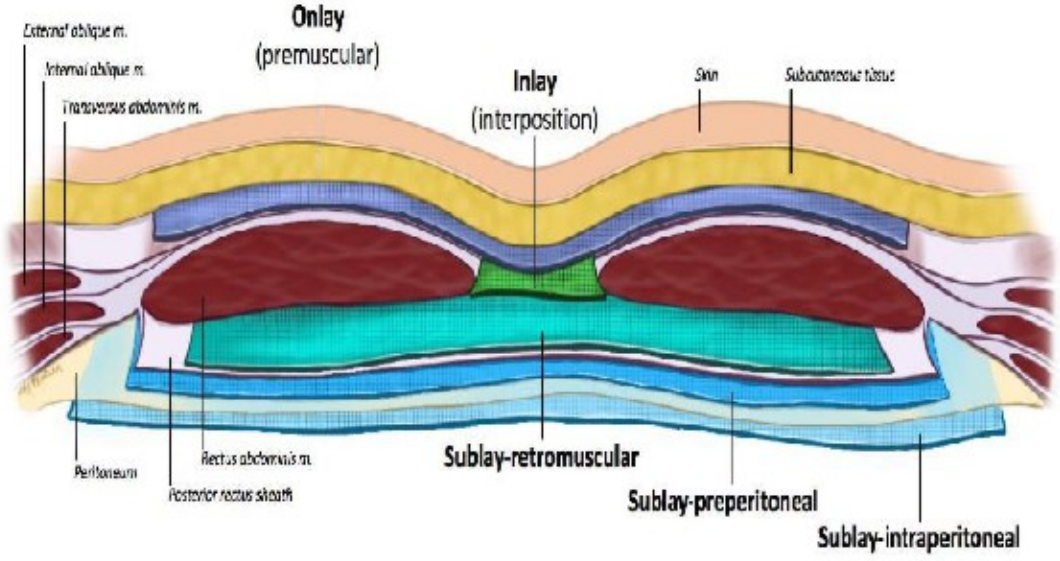


Figure 4.4.1: Mesh Positioning

Indications of surgery

A. **Elective asymptomatic ventral hernia** – 23% of all are asymptomatic
   a. depending on the type, defect size, and symptoms.
   b. incidence of acute presentation is 5-15%
   c. Should undergo surgery to prevent acute complications.

B. **Elective symptomatic ventral hernia**- should undergo surgical repairs
   a. perioperative assessment and counselling is extremely important.
   b. expectant management if there is a contraindication to surgery or anaesthesia

C. **Emergency hernia repair** – should be performed without delay
   a. contamination of the operative field
   b. best practice calls for primary sutures (simplest) with low complication rates.

Perioperative management

- Refrain from smoking 4–8 weeks prior to surgery.
- Weight loss is recommended for obese patients.
- 24 hrs strict blood sugar monitoring and control is mandatory for diabetic patients (HbA1c>6.5%).
- Abstinence from alcohol for 1 month preoperatively.
- Other co-morbidities, such as COPD with active bronchitis and congestive heart failure also associated with higher infection and recurrence rates.
- Prophylactic antibiotics are recommended to prevent wound complications.

Laparoscopic vs Open Hernia repair

- Laparoscopic repair has short-term benefits lower rates of SSI and mesh infection, less pain, and faster recovery.
- More incidences of bowel injury in laparoscopic technique (4.3% vs 0.81%)

- No differences for postoperative seroma, hematoma, bleeding, bowel obstruction, reoperation or recurrences.
- Laparoscopic repair is indicated for patients with increased risk of wound complications, and hernia with <10cm defect size.
- Open technique preferred for patients with primary ventral hernias, incarcerated or obstructed hernia, complex one with large defects/ loss of domain, contaminated or active EC fistula, abdominal skin grafts
- Quality of life was same beyond 6 months for both the groups.

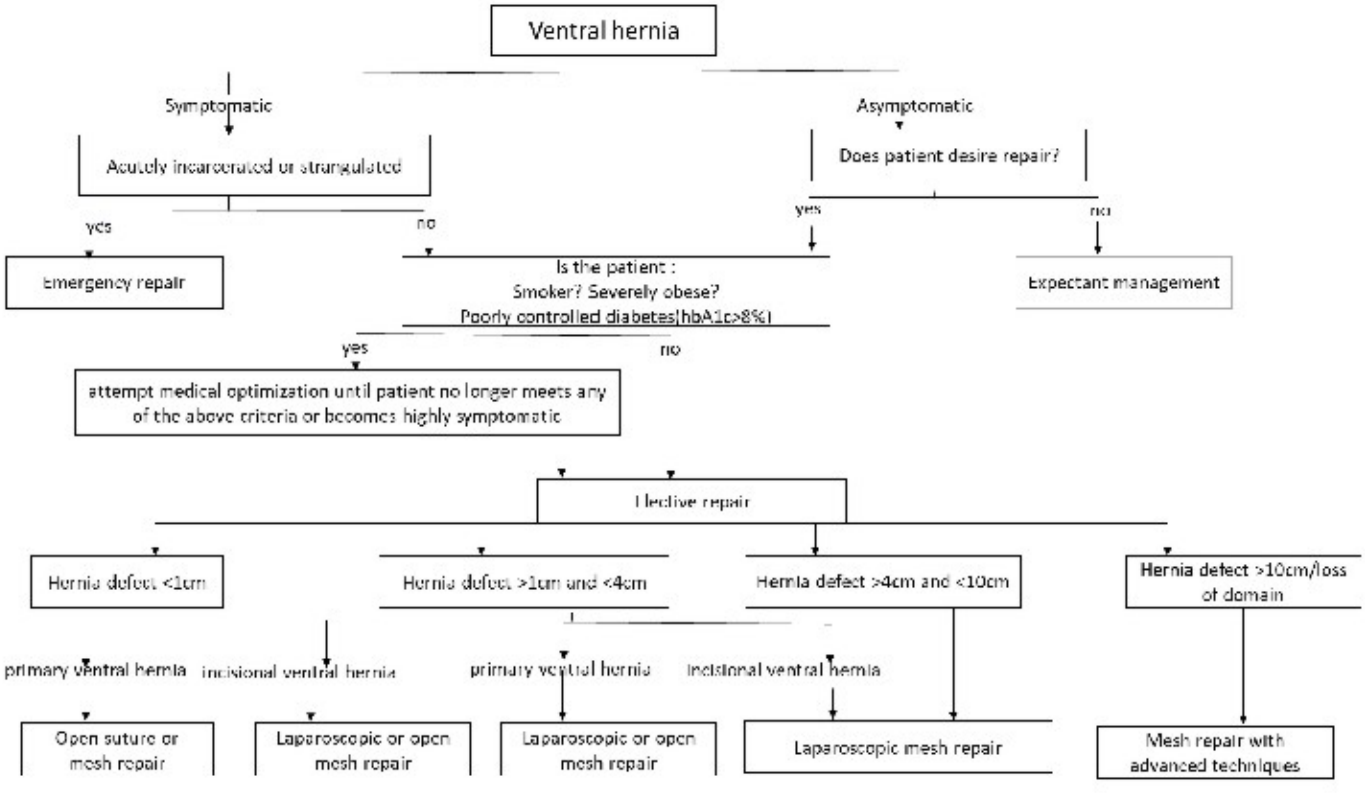


Figure 4.4.2 : Algorithm of VahHernia

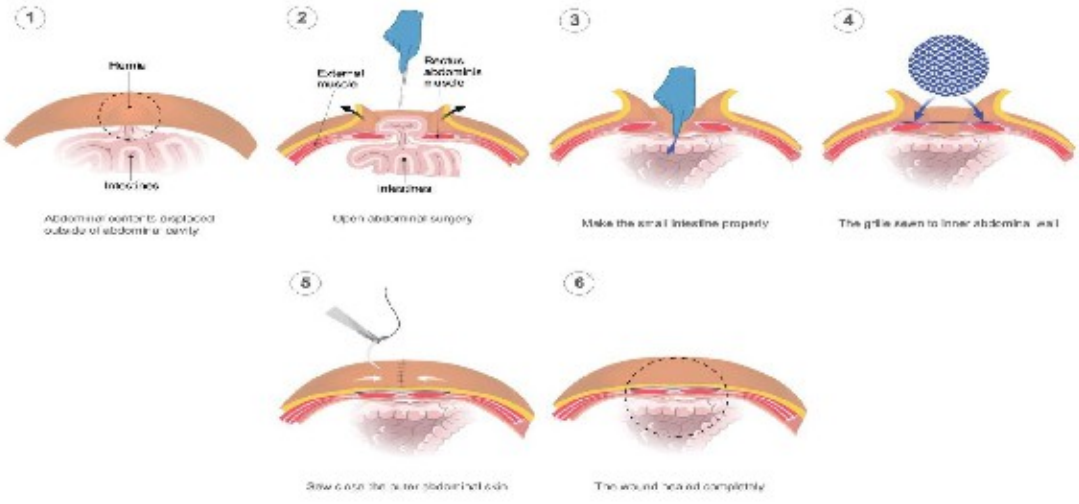


Figure 4.4.3 : Vertral Abdominal Hernia Surgery

Various Clinical Scenarios

1. **Acutely incarcerated or strangulated ventral hernia**
   Difficult to reduce due to small fascial defects and high risk of injuring incarcerated organs.
   - ✓ Options after contamination control-
     - primary suture repair
     - mesh repair (biologic/synthetic/biosynthetic mesh)
     - staged repair
   - ✓ The laparoscopic approach or creating large flaps should be used cautiously

2. **Primary ventral hernia < 1cm**
   - ✓ Mostly umbilical, some epigastric
   - ✓ Simple suture repair with or without mesh reinforcement
   - ✓ Laparoscopic approach – obese patients and increased risk of wound infections

3. **Incisional ventral hernia < 1cm**
   - ✓ Usually arise at trocar site after previous laparoscopic surgery
   - ✓ Mesh repair is suggested for all incisional hernias (including <1cm)
   - ✓ Suture repair in such hernia results in recurrence

4. **Ventral hernias between 1 and 10 cm**
   - ✓ Open repair in thin patients (defect size 1-4cm)
   - ✓ Laparoscopic mesh repair in clean field (defect size 4- 10cm
   - ✓ Laparoscopic repair in obese patients, increased risk of wound infections and patients with significant diastasis recti bordering hernia defect.

5. **Large (>10cm) or complex hernia**
   - ✓ Standard laparoscopic repair(Laparoscopic IPOM)
   - ✓ In large hernias, advanced techniques advised such as component separation before mesh placement(restores abdominal wall function)
     - Component separation- dividing portions of anterior/posterior rectus sheaths.

Rules for Mesh Placement

- ✓ The radius of the mesh should be at least four times the radius of the defect
- ✓ Mesh overlap should be 5 cm in all directions.
- ✓ In the laparoscopic approach- a tacker or suture fixation can be used
- ✓ Adhesive fixation – increased risk of recurrences
- ✓ Recommended – suture fixation in combination with tacks (non-absorbable) provides more fixation strength

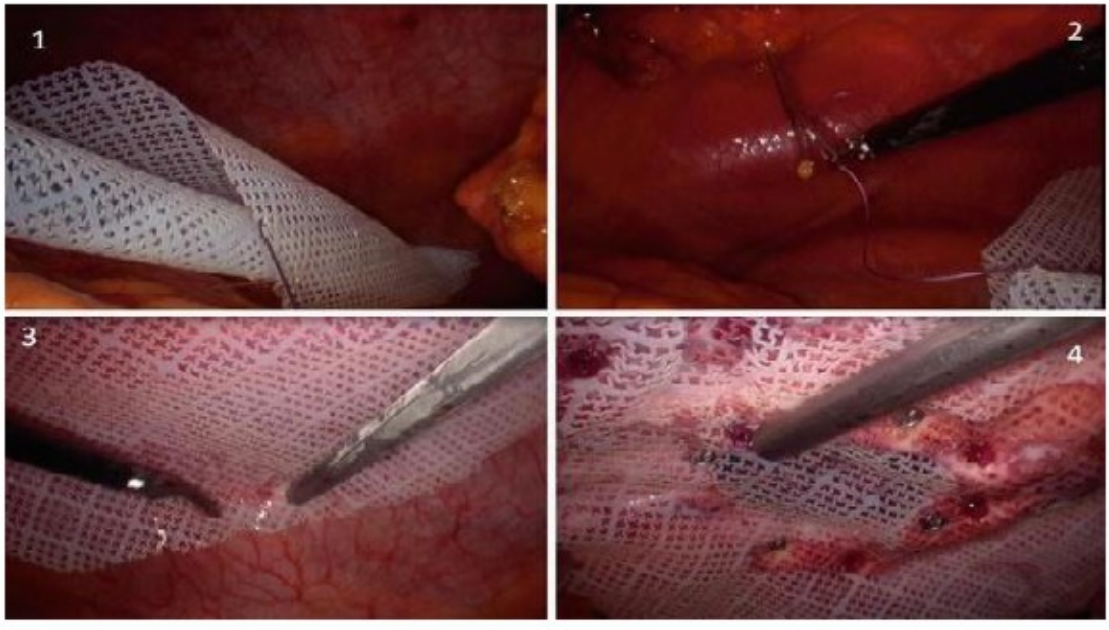


Figure 4.4.4 : Mesh Placement

Complications

1. Post operative pain
2. Seroma formation
3. Post operative ileus
4. Enterotomy (intraoperative/ delayed) - 6% incidence
5. Surgical site infections
6. Seroma
   - ✓ Post operative seroma following hernia repair is common (incidence rate of 35%).
   - ✓ Asymptomatic- may resolved spontaneously.
     Persistent- aspirate under sterile conditions.
   - ✓ Recurrent/ symptomatic- surgical drainage and excision of seroma lining.
   - ✓ Cauterization of hernial sac, use of pressure dressings, suture closure of hernia defect reduces the seroma formation

7. Mesh infection is a catastrophic complication of ventral hernia repairs because it is typically followed by a second operation that is more complex and associated with a high chance for recurrence of a hernia. There are many risk factors including a high body mass index (BMI), chronic obstructive pulmonary disease (COPD), abdominal aortic aneurysm repair, prior surgical site infection, mesh type, longer operative time, lack of tissue coverage of the mesh, enterotomy, and surgical site infections. With a mesh infection, it is much more common to require explanation of the mesh, but salvage is a possibility with antibiotics.

8. Respiratory morbidity following ventral hernia repair is specifically a concern of abdominal wall reconstruction secondary to decreasing the volume of the abdominal cavity. This exerts upward pressure on the diaphragm and can lead to hypoxia and intubation. There are institutions with protocols to prevent morbidity after these demanding surgeries. Evidenced-based literature to prevent respiratory morbidity includes sufficient pain control using PCA, regional blocks or epidurals, early ambulation after surgery, and not routinely using nasogastric tubes.

9. Evidence does not support the use of lung expansion therapies such as deep breathing exercises, incentive spirometry, and CPAP, but they are still commonly used.

Postoperative and Rehabilitation Care

Patients should limit themselves to a 10-pound (4.5 kg) lifting restriction within the first week, 20 pounds (9 kg) for the second week, and slowly advance to full activity over a period of 6 weeks. It is important to limit the narcotics during the postoperative phase secondary to addiction potential and to prevent constipation. Multi-modal pain control with acetaminophen, anti-inflammatory, neuropathic, and muscle-relaxing medication, in addition to narcotics, have been shown to decrease opiate usage. Additional adjuncts including regional blocks, long-acting, local anesthetics, as well as post-surgical nerve blocks have also been successful in decreasing opiate usage. Stool softeners and laxatives in the postoperative phase are common practice to prevent straining and bloating. There are typically no dietary restrictions, but patients should eat a high fiber diet in the postoperative period. Patients can shower in the 24 to 48 hours window following surgery.

It is useful to provide patients with postoperative instructions at multiple points throughout their preoperative and postoperative course. Offering literature on the topics is useful as well. Patient education has been shown in multiple specialties to help prevent postoperative complications.

5

MANAGEMENT OF SPECIAL HERNIA TYPES

Authors - Dr Ranjith Kumaran R, Dr Akshay Anand, Prof Abhinav Arun Sonkar

5.1 Internal Hernias

An internal hernia (IH) is defined as the protrusion of abdominal viscera, most commonly small bowel loops,through a peritoneal or mesenteric aperture into a compartment in the abdominal and pelvic cavity. Hernial orifices can be congenital, including both normal foramina or recesses and unusual apertures resulting from anomalies of peritoneal attachment and internal rotation, or acquired if caused by inflammation, trauma and previous surgery, like gastric by-pass for bariatric treatment and liver transplantation. Due to the growing popularity of these surgical procedures, the overall incidence of internal hernias has been recently increasing. Although relatively uncommon, they represent a potentially life-threatening condition and a surgical emergency since the bowel entrapment in one of the defects can lead to acute intestinal obstruction with rapid evolution, if left untreated, into strangulation and ischemia. According to various investigators, internal hernias cause up to 5,8% of all small bowel obstruction (SBO), with a high overall mortality rate that can exceed 50%.

The most common manifestation of an internal hernia is strangulating SBO, that occurs after a closed-loop obstruction. However, the clinical manifestations range from mild digestive symptoms to acute abdomen, as symptom severity relates to duration and reducibility of the hernia and the presence or absence of strangulation and incarceration. IHs may remain clinically silent if easily reducible, but the larger ones often cause mild discomfort ranging from constant vague epigastric pain to intermittent periumbilical pain as they occasionally show spontaneous reduction, abdominal distention, nausea and vomiting.

Physical examination may reveal a palpable mass of herniated loops with localized tenderness.

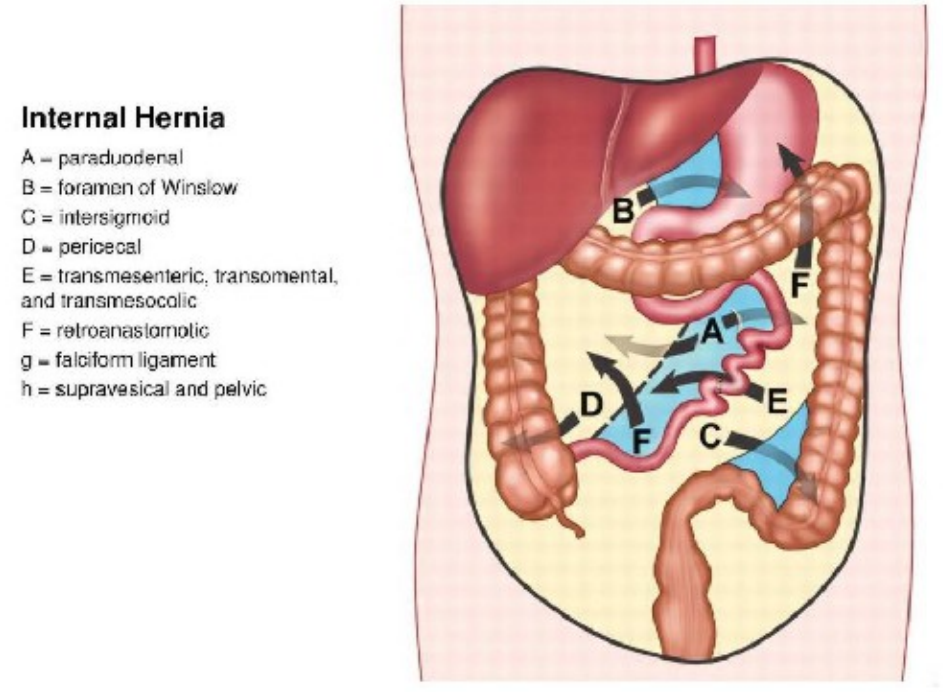


Figure 5.1.1: Internal Hernia

This non-specific clinical presentation often leads to a delay in diagnosis, in most cases made at the time of laparotomy, and consequently in proper treatment, carrying risk of serious complications; therefore, when the possibility of internal hernia is considered, a rapid imaging evaluation is necessary to aid an early diagnosis and a prompt intervention. Multidetector Computed Tomography (MDCT), with its wide availability, has become the first line imaging technique in these patients and play an important role in the preoperative diagnosis and planning of surgical intervention.

Classification

According to the traditional classification devised by Welch, eight main types of internal hernia can be identified on the basis of the topographic distribution of bowel loops related to the anatomic location of the orifice.

According to the classification of internal abdominal herniations devised by Ghahremani, can be separated in to six main groups: paraduodenal hernias (50%-55% of internal abdominal herniations), hernias through the foramen of Winslow (6%-10%), transmesenteric hernias (8%-10%), pericecal hernias (10%-15%), intersigmoid hernias (4%-8%) and paravesical hernias (< 4%).

Paraduodenal hernias account for over half of reported internal hernias. They are basically congenital in origin, representing entrapment of small intestine beneath the mesentery of colon probably occurring due to abnormal embryological rotation of midgut and variation in peritoneal fixation and vascular folds.

Two types of paraduodenal hernias must be distinguished: left-sided paraduodenal hernias and right-sided paraduodenal hernias. Most occur on the left side (75%) through the fossa of Landzert and proceed into the descending mesocolon or distal transverse mesocolon. One-fourth occurs on the right side through the fossa of Waldeyer and proceeds into the ascending mesocolon. Clinical manifestations of paraduodenal hernias can be quite variable from mild abdominal cramps or discomfort to symptoms of bowel obstruction. Postprandial pain with postural variation is a characteristic symptom.

Left-sided paraduodenal hernias are caused by the raising up of a peritoneal fold by the inferior mesenteric vein as it runs along the lateral side of fossa and then above it. LPDHs occur when duodenal segments and jejunal loops, more often proximal, prolapse through *Landzert's fossa* (or *paraduodenal fossa*), an aperture found in 2% of autopsy located at the duodenojejunal junction (a zone of confluence of the descending mesocolon, transverse mesocolon and small bowel mesentery), behind the descending mesocolon and to the left of the fourth part of the duodenum.

This peritoneal pocket is bordered anteriorly by a peritoneal fold lifted up by the inferior mesenteric vein (IMV) and ascending left colic artery that run at the anteromedial edge of the fossa.

The small intestine may herniate through the orifice posteriorly and downward to the left, lateral to the ascending limb of duodenum extending into descending mesocolon and left part of the transverse mesocolon. The free edge of hernia thus contains the inferior mesenteric vein and ascending left colic artery.

Right-sided paraduodenal hernias are congenital diseases that may be related to the incomplete or absent 180° rotation of the embryological intestine.

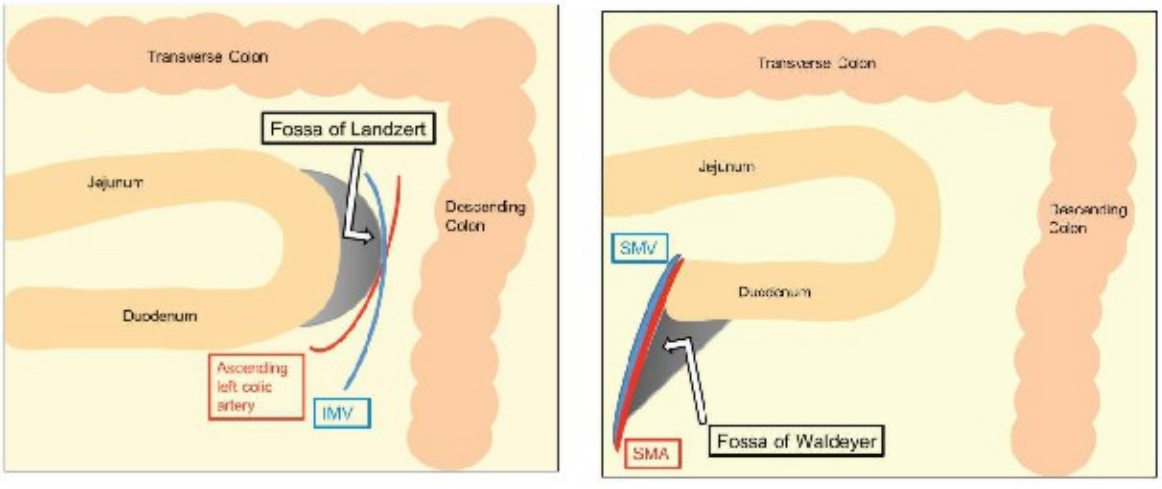


Figure 5.1.2: Right-Sided Paraduodenal Hernias

In RPDHs bowel's herniation occurs through the *Waldeyer's fossa* (or *mesentericoparietal fossa*), a congenital uncommon defect in the first part of the jejunal mesentery observed in no more than 1% of the population at autopsy. The recess is located inferior to the third portion of duodenum, behind the root of the small bowel mesentery and extends rightward and downward into the ascending mesocolon. The superior mesenteric artery (SMA) along with the superior mesenteric vein (SMV), runs along the anteromedial edge of the fossa and represents the landmark for RPDHs.

The typical clinical presentations of right and left-sided paraduodenal hernias are similar; however, both conventional barium studies and CT can be used to distinguish between the two.

Internal abdominal hernias through the foramen of Winslow account for 6%-10% of all internal hernias. The small bowel is the herniated viscera in 60%-70% of cases. The terminal ileum, cecum and ascending colon are involved in about 25%-30%. Other viscera such as the transverse colon, gallbladder and omentum have also been reported. The formation mechanism of these hernias is distinct from that of paraduodenal because the foramen of Winslow is a normal peritoneal opening allowing a communication between the lesser sac and the remainder of the peritoneal cavity. The foramen is situated in the portacaval space lying between the portal vein anteriorly and the inferior vena cava posteriorly including the portal vein, common bile duct and hepatic artery.

Predisposing factors include an enlarged foramen of Winslow and excessively mobile intestinal loops because of a long mesentery or persistence of the ascending mesocolon. Patients present with acute onset of progressive upper abdominal pain and small bowel obstruction. Physical examination usually reveals localized tenderness and distension in the epigastric regions. Radiographical features of internal abdominal herniations through the foramen of Winslow can vary depending on which of the organs are entrapped.

Transmesenteric hernias are 5%-10% of internal abdominal herniations overall and are the most common internal hernia in children. In fact, almost 35% of those hernias occur during the pediatric period due to a congenital defect in the small-bowel mesentery in the ileocecal region, while in adults, surgical procedures raise the opening of a foramen, through which the bowel crosses. Most occur on the right side of the greater omentum. Furthermore, a high incidence of transmesenteric hernias after abdominal surgery has been described, especially after the creation of a Roux-en-Y anastomosis.

Clinical symptoms frequently include signs of acute small-bowel obstruction. Because of the absence of a limiting hernial sac, it can often be difficult to distinguish between a transmesenteric hernia and a small-bowel volvulus. Because of the difficulty of identification, detection of a group of small bowel loops and abnormalities of the mesenteric vessels plays an important role in diagnosis of transmesenteric hernia. CT shows that converging mesenteric vessels are located at the entrance of the hernial sac and there is displacement of the main mesenteric trunk.

Pericecal hernias account for only 6%-13% of internal abdominal herniations. The pericecal fossa is located behind the cecum and ascending colon and is limited by the parietocecal fold outwards and the mesentericocecal fold inwards. Pericecal hernias usually involve an ileal loop that goes through a defect in the cecal mesentery and occupies the pericecal fossa, especially the right paracolic gutter. Clinical symptoms are often characterized by episodes of intense lower abdominal pain, like a colicky right lower quadrant pain very similar to the appendiceal pain, often causing confusion. Through barium or CT, pericecal hernias occur as dilated and fixed small-bowel loops located posteriorly and laterally in relationship to the cecum, often into the right paracolic gutter.

The sigmoid mesocolon is a peritoneal fold that anchors the sigmoid colon to the pelvic wall and near the left common iliac artery there is a potential site for an internal hernia. **Herniation of small-bowel segments through the mesosigmoid** occurs because of an incomplete defect of the mesentery. These types of internal hernias account for 6% of all internal hernias and are divided into three groups: intersigmoid hernia, transmesosigmoid hernia and intermesosigmoid hernia.

Intersigmoid hernia, the most common type, is herniation into a peritoneal pocket formed between two adjacent sigmoid segments and their mesentery, the intersigmoid fossa, situated in the attachment of the lateral aspect of the sigmoid mesocolon.

In the transmesosigmoid hernia, the small bowel loops goes through a foramina in the sigmoid mesocolon, especially the left lower of the abdomen, posteriorly-laterally to the sigmoid colon. Intramesosigmoid hernia is incarceration with a hernial sac through a congenital defect, present in only one of the constituent leaves of the sigmoid mesentery.

Supravesical hernias, although rare, are the cause of most pelvic hernias. Herniation occurs in the supravesical fossa, between the remnants of the median and the left or right umbilical ligaments. Herniated bowel loops can either remain within or extend above the pelvis. Internal supravesical hernias are divided into three categories: anterior, lateral, and posterior, which are based on whether the course is in front of, beside or behind the bladder.

5.2 Parastomal Hernia

A different type of hernia that can affect the abdominal wall is a parastomal hernia. It is estimated that up to 30% of patients with ostomies can develop parastomal hernias. Some types of ostomies are at higher risk than others. Loop colostomies are at the highest risk followed by end colostomies, loop ileostomies, and end ileostomies.

Classification of parastomal hernias

	Rubin	Devlin	Gil and Szczepkowski
Type 1	Peritoneal hernia sac through dilated stomal canal	Interstitial hernia with hernia sac located between layers of abdominal muscles	Parastomal hernia without coexisting cicatricial hernia and without abdominal wall deformation
Type 2	Intrastomal hernia	Subcutaneous hernia	Parastomal hernia associated with cicatricial hernia without deformation of abdominal wall
Type 3	Subcutaneous prolapse	Intrastomal hernia	Large, isolated parastomal hernia without coexisting cicatricial hernia with abdominal wall deformity
Type 4	Pseudohernia	Peristomal hernia with stomal prolapsed	Large parastomal hernias with coexisting cicatricial hernia with abdominal wall deformity

Table 5.2.1: Classification of Parastomal Hernia

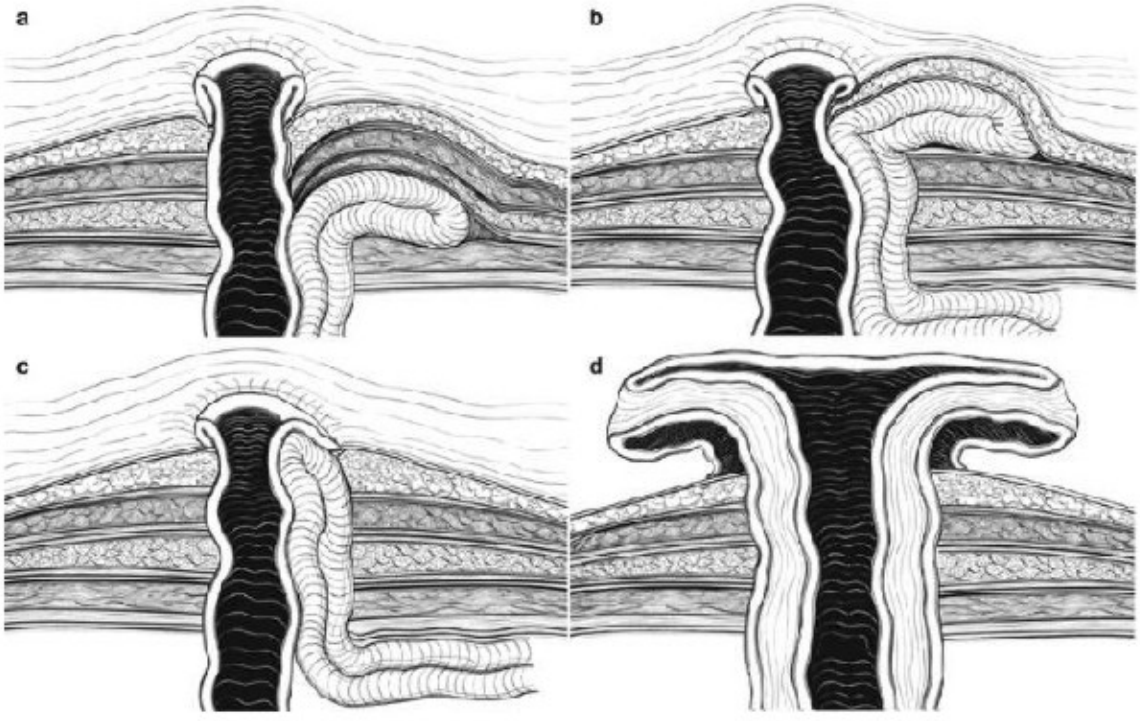


Figure 5.2.1: Parastomal Hernia

Currently, the only strategy to prevent hernia formation is the use of a prophylactic mesh when the ostomy is created. Patients that are planning an ostomy reversal typically have the repair delayed until the reversal of the ostomy, but sometimes the repair can be an emergency. There are multiple types of repairs, and the 2 that will be discussed here include the modified Sugarbaker and keyhole techniques. Both procedures can be performed laparoscopically or open. After adhesiolysis, the modified Sugarbaker technique consists of lateralizing the bowel by tracking the bowel from the hernia sac between the abdominal wall and the prosthesis into the peritoneal cavity. Essentially putting a patch over the defect and having the bowel enter the abdominal cavity laterally to the mesh. The keyhole technique is performed by making a slit in the mesh and fitting the mesh around the bowel before fixating the mesh, thereby patching the defect.

In some studies, the Sugarbaker technique had a lower incidence of recurrence but larger studies are needed to achieve statistical significance.

5.3 Port Site Hernias

Laparoscopic port site hernias are a growing problem within the incisional hernia category given the increasing use of laparoscopy and robotics, and the exploration of single-site minimally invasive approaches. The incidence of port site hernias has been shown to be between 0% and 5.2% in several studies. 96% of port site hernias occur at 10-mm and larger port sites, and 86% occur at the umbilicus. However, more recent studies have shown rates reaching 22% to 39% after ventral hernia repair with large mesh and bariatric surgeries.

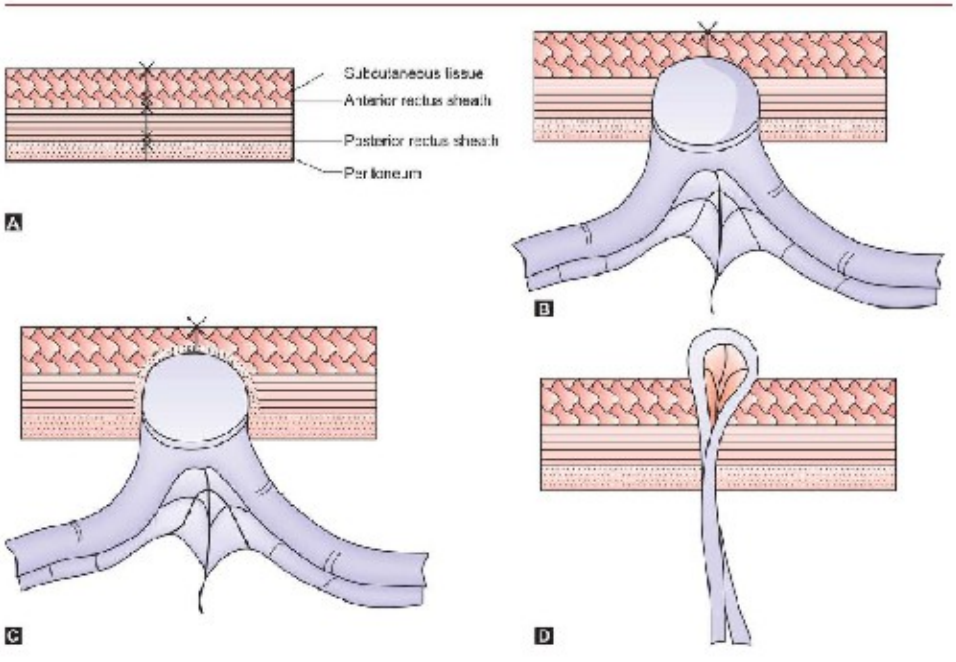


Figure 5.3.1: TYPES (shown in figure) –(b) Acute onset (c) Delayed onset (d) Special type

It is generally believed that any port larger than 5 mm in diameter should be closed to prevent port site hernias. However, it remains controversial, and we believe that dilating, noncutting trocars less than 12 mm do not require closure.

Single-incision laparoscopic and robotic surgeries have been found to have slightly higher incidence of port site hernias of 3%, although this has improved over time and more recent studies have shown no difference. Port site hernias may be difficult to diagnose because they may occur early, late, intrafascially, or as Richter-type hernias. Wound- and patient-related factors may also play a role in the formation of port site hernias: infection, delayed healing, steroids, collagen disorders, obesity, and increased abdominal pressure are all known to predispose to herniation.

5.4 Spigelian Hernia

Adriaan van der Spiegel, a Belgian anatomist, was the first to describe the semilunar line as a concave region at the lateral border of the rectus muscle formed by the aponeurosis of the IO. More than 100 years later, in 1764, Klinkosh identified the "hernia of the spigelian line" as a distinct entity.

Although spigelian hernias are rare (accounting for 0.1% to 2% of all abdominal wall hernias), its diagnostic incidence has been rising because of improved imaging technology and incidental identification during laparoscopy. Spigelian hernias usually occur in the sixth and seventh decades and affect both sexes and sides equally. Most are acquired, and nearly 50% of patients with spigelian hernias have a history of previous laparotomy or laparoscopy. Other factors that have been implicated in contributing to the development of these hernias are alterations in compliance of the abdominal wall as a result of morbid obesity, multiple pregnancies, prostatic enlargement, chronic pulmonary disease, and rapid weight loss in obese patients.

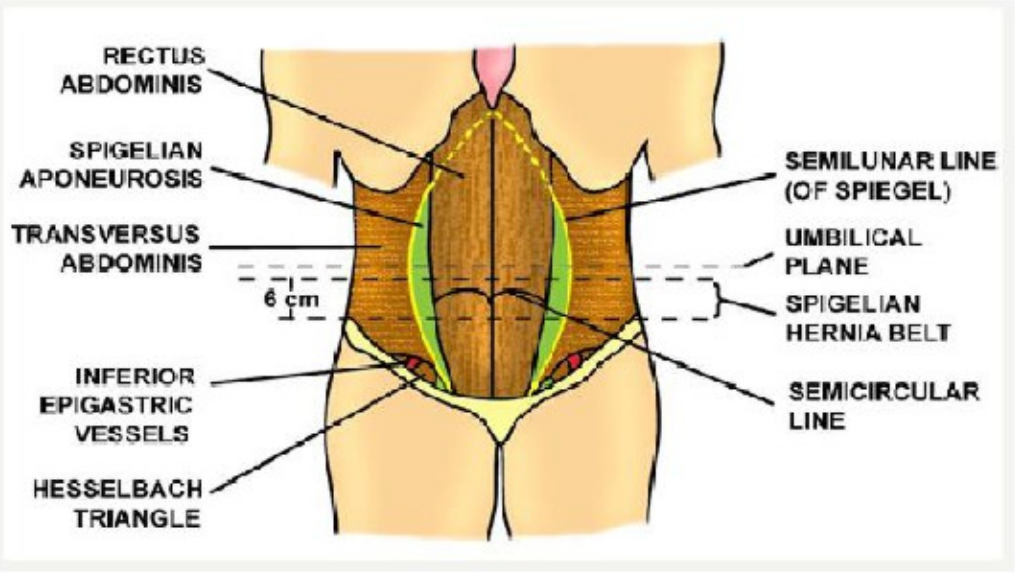


Figure 5.4.1: Spigelian Hernia

A spigelian hernia is a challenge to diagnose and requires a high index of suspicion. Pain is the most common initial complaint. The fascial defect is masked by the intact overlying EO aponeurosis, thus complicating physical examination. In addition, a palpable mass (when present) may mimic an abdominal wall lipoma or desmoid tumor. Although abdominal imaging may be helpful, the findings of unusual abdominal complaints in the proper anatomic location should alert one to the possibility of a spigelian hernia. More than half of all spigelian hernias are diagnosed intraoperatively. Given the small neck of these hernias, 20% to 30% require emergency intervention. Thus, even incidental spigelian hernias should be repaired electively to avoid incarceration. Surgical management of these hernias has typically been accomplished via a transverse incision and primary repair. Primary repairs have been associated with a low, but real recurrence rate of about 4%. As expected, mesh repairs have been successfully applied to treat spigelian hernias. Few or no recurrences at long-term follow-up have been reported by investigators. More recently, laparoscopic repair of spigelian hernias has also been reported and found to be safe and effective, although long-term recurrence outcomes are awaited.

Evidence-based surgical recommendations are limited by the rarity of this condition, and a recommendation regarding suture- or mesh-based repair (either open or laparoscopic) is not clear at present for the treatment of spigelian hernias.

5.5 Suprapublic Hernias

The abdominal oblique aponeurosis, rectus abdominis musculature, and rectus sheath insert on the symphysis pubis. Suprapubic hernias result from disruption of these musculotendinous elements of the lower abdominal wall and usually occur after blunt abdominal trauma or pelvic surgery. The origin of traumatic suprapubic hernias is often through a ruptured rectus muscle at or near its insertion to the pubic bone. In contrast, incisional suprapubic hernias develop as a result of apical pubic osteotomy or iatrogenic detachment of the rectus muscle from its pubic insertion to improve visualization during pelvic surgery. Inadequate tissue purchase inferiorly during closure may result in hernia formation, although infection and other patient factors may also play a role. Radical prostatectomy is the most common operative procedure that leads to the development of a suprapubic defect. Similar defects are also seen after operations involving the uterus, urinary bladder, and sigmoid colon. Suprapubic hernias may manifest as vague lower abdominal discomfort, urinary symptoms, or a palpable mass. The diagnosis of a suprapubic hernia may be missed because of the similarity of features with more common inguinal hernias. However, a thorough physical examination will demonstrate close proximity of the mass, defect, or both to the pubis and not the external inguinal ring. Although suprapubic hernias may be a source of significant abdominal pain, bowel incarceration requiring emergency repair is extremely rare.

Primary repair of traumatic suprapubic hernias may be a viable alternative if the herniorrhaphy is undertaken without delay.

With time, the rectus muscle retracts and can lead to significant tension if primary repair is performed. Thus, a mesh repair is preferred for most traumatic and incisional suprapubic hernia repairs. Several approaches to mesh placement for suprapubic hernias have been described. The open preperitoneal approach provides excellent delineation of the bladder and pubis and allows for appropriate inferior fixation of the mesh in contrast to an onlay style of repair. The laparoscopic approach to suprapubic herniorrhaphy can also allow for a solid repair, provided that mobilization of the bladder is performed. This can be facilitated by using a three-way urinary catheter. The bladder is instilled with 300 mL of saline and can be clearly visualized for adequate mobilization to expose the entire pubis, Cooper ligament, and the iliac vessels. This is imperative to prevent inadequate overlap of the mesh and early recurrence. Regardless of the approach (open or laparoscopic), the dissection can be challenging because of the close proximity of these hernias to bony, vascular, and nerve structures, and to the bladder.

5.6 Lumbar Hernia

Lumbar hernias are exceedingly rare, posterolateral, abdominal wall defects containing retroperitoneal fat or viscera. Lumbar hernias were first described several hundred years ago. Barbette suggested the entity of a lumbar hernia in 1672, but the first published case in the medical literature was in 1731 by DeGarangeot. He reported the first incarcerated lumbar hernia on autopsy. Twenty years later, Ravaton described the surgical reduction of a strangulated lumbar hernia. The French surgeon Jean-Louis Petit in 1774 was the first to describe an inferior lumbar hernia through the anatomic boundary now often referred to as *Petit triangle*. More than two centuries after its first description, Grynfelt and Lesshaft independently reported visceral herniation through a superior lumbar defect, now commonly known as a Grynfelt-Lesshaft hernia.

Lumbar hernias occur through a parietal wall defect in the lumbar region whose boundaries are the 12th rib superiorly, the iliac crest inferiorly, the erector spinae muscle medially, and the posterior border of the external abdominal oblique laterally.

They can be classified anatomically into superior or inferior lumbar hernias based on two well-defined areas of weakness. **The superior lumbar triangle** is an inverted triangle bordered by the 12th rib superiorly, the internal abdominal oblique muscle anterolaterally, and the quadratus lumborum muscle posteromedially. The latissimus dorsi and the aponeurosis of the transversalis muscle form the roof and the floor of the triangle, respectively. Areas of weakness include the region immediately below the costal margin where the transversalis fascia is not reinforced by the external abdominal oblique muscle, the area at which the 12th dorsal intercostal neurovascular bundle penetrates the fascia, and the area between the ligament of Henle and the inferior costal margin.

The inferior lumbar triangle, or Petit triangle, is an upright triangle bordered by the iliac crest inferiorly, the external abdominal oblique muscle anterolaterally, and the latissimus dorsi posteromedially. The floor is formed by the lumbodorsal fascia and transversalis muscle. A medially displaced latissimus dorsi muscle, alterations in the origin of the external abdominal oblique muscle, and the presence of a Hartmann fissure at the vertex of the triangle may increase the likelihood of visceral protrusion through the inferior lumbar triangle. Herniation occurs more commonly in the superior triangle as it has a greater surface area, is a more vulnerable area of weakness (there is only transversalis fascia at its lower margin), and is not penetrated by neurovascular bundles.

In addition to the anatomic classification, lumbar hernias can further be categorized as congenital or acquired based on etiology. Congenital defects of the lumbar region make up 10% to 20% of lumbar hernias.

Although often unilateral when presenting early in life, some patients may have bilateral hernias and develop symptoms in late adulthood as a result of progressive posterolateral abdominal muscle weakening. Congenital lumbar hernias are most often associated with lumbocostovertebral syndrome, although it has been reported with vertebral anomalies, anal atresia, cardiac defects, tracheoesophageal fistulas, renal anomalies, and limb defects (VACTERL syndrome), congenital diaphragmatic hernia, and atrial septal defects, among other congenital malformations.

Acquired lumbar hernias constitute the majority of lumbar defects encountered clinically and can be subdivided into primary or secondary acquired hernias. Primary acquired hernias occur spontaneously, are often small in size, are confined to the borders of the superior or inferior lumbar triangles, and represent 55% of acquired lumbar hernias.

Risk factors for the development of a primarily acquired lumbar hernia include advanced age, chronic malnutrition or debilitation, obesity, chronic cough, and previous wound infections or a history of sepsis. On the other hand, secondary acquired hernias are often the result of trauma or previous surgical procedures in the lumbar region. These defects may be diffuse, extending beyond the margins of the lumbar triangle. It is a rare complication of surgical procedures involving flank incisions. Examples include open partial or complete nephrectomy, adrenalectomy, and abdominal aortic aneurysm repair. It may also occur at previous bone graft donor sites. The iliac crest is a common donor site for autogenous bone grafts given that it is easily accessible and supplies ample amounts of both cancellous and cortical bone. Herniation of intraabdominal contents through the resulting bone defect is uncommon, occurring only in up to 5% of cases.

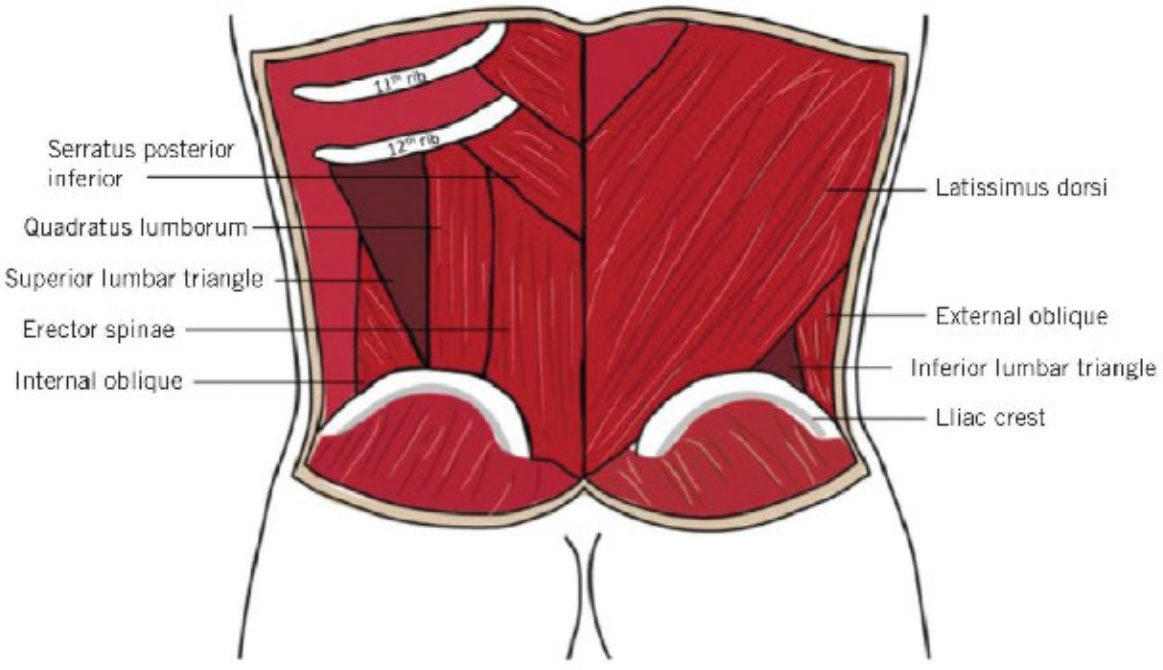


Figure 5.6.1: Petit Triangle

Clinical presentation

Patients usually present with a small protruding mass in the lumbar region that may be symptomatic or asymptomatic. Most patients are males in their fifth or sixth decade of life. The differential diagnosis includes but is not limited to a lipoma, rhabdomyoma, sarcoma and other malignant growths, abscess, hematoma, or a renal mass. Pain is variable and can range from mild local discomfort to severe, diffuse intestinal colic. Depending on the contents of the hernia, the pain can travel down the distribution of the sciatic nerve or be referred to the anterior abdomen, especially when incarceration or panniculitis is present. Patients may also have gastrointestinal complaints such as nausea, vomiting, and/or bloating. When a mass is palpated in the lumbar region, it is often soft and fluctuates in size. In addition, the mass may protrude with coughing or bearing down and even produce bowel sounds on auscultation based on the contents of the hernia. Lumbar hernias may contain retroperitoneal fat, small and large intestine, omentum, appendix, stomach, cecum, ovary, spleen, and rarely the kidney.

Urinary obstruction or oliguria may be the presenting symptoms in patients having renal contents within the hernia sac. Pain in the lumbar region accompanied by the signs and symptoms of intestinal obstruction is suggestive of an incarcerated or strangulated lumbar hernia.

Diagnosis of Lumbar hernia

Although the diagnosis can be made upon physical exam in the majority of cases, lumbar hernias may be less apparent when the hernia defects are smaller than 5 cm in diameter. Computed tomography (CT) is the preferred diagnostic modality in patients who present with signs and symptoms concerning for a lumbar hernia. It can provide useful information about the size of the fascial defect and allow for the assessment of hernia sac contents and regional anatomic relationships. Magnetic resonance imaging (MRI) may also be performed to confirm the diagnosis of a lumbar hernia.

Ultrasonography is an alternative imaging modality that may be more appropriate in emergency settings. Although less accurate than CT in depicting anatomy, it is fastidious, less costly, effective, and does not expose the patient to ionizing radiation. The diagnosis can be made with visualization of a hernia orifice in the posterolateral abdominal wall, which will appear as a defect in the echo line of the aponeurosis.

Treatment

The natural progression of lumbar hernias is a gradual increase in size over time. Despite this, approximately 25% of patients will present with incarcerated bowel, and 10% to 18% will demonstrate evidence of strangulation.

Given the risk of associated complications and the increased complexity of repairing large hernias, surgical intervention upon diagnosis of a lumbar hernia is prudent when the patient's medical condition permits. The repair of a lumbar hernia is challenging, and various techniques of repair have been described, including simple repair, musculofascial flaps, free grafts, and repair using synthetic mesh.

5.7 Obturator Hernia

The obturator hernia was first described at the Royal Academy of Sciences of Paris by Pierre Roland Arnaud de Ronsil in 1724. More than 100 years later, Obre performed the first successful repair. Currently, these rare defects represent only 0.05% to 1.4% of all hernias encountered by clinicians. An obturator hernia occurs when intraabdominal viscera or extraperitoneal tissue project through the obturator canal, an osteofibrous tunnel that courses from the pelvis to the proximal thigh and is penetrated by the obturator neurovascular bundle.

The foramen is created by the superior pubic ramus superiorly, the body and inferior ramus of the pubic bone interiorly, and the ramus and body of the ischium inferiorly. Loss of the protective extraperitoneal areolar and adipose tissue overlying the obturator canal creates various anatomic pathways through which herniation can occur. In the most common pathway, the hernia sac protrudes through the external opening of the canal along the anterior division of the obturator nerve, with the sac lying beneath the pectineus muscle of the thigh.

Clinical presentation

Often referred to as "the little old lady's hernia," obturator hernias are usually discovered in thin, elderly females in their seventh to eighth decade of life. Obturator hernias are 6 to 9 times more common in women.

This is likely secondary to differences in pelvic bone anatomy and angulation given females have a larger and wider pelvis with a horizontally inclined obturator canal. Malnutrition and a thin body habitus are also significant risk factors. Emaciation results in a loss of preperitoneal fat and connective tissue normally concealing the obturator canal. Conditions that increase intraabdominal pressure and promote laxity of the pelvic floor, such as pregnancy and multiparity, may potentially predispose patients to herniation. Of note, obturator hernias occur predominantly in the right pelvis due to the fact that the sigmoid colon often covers the left obturator foramen. The hernia sac usually contains small bowel, although other organs, including the colon, appendix, Meckel diverticulum, bladder, and adnexa have been reported.

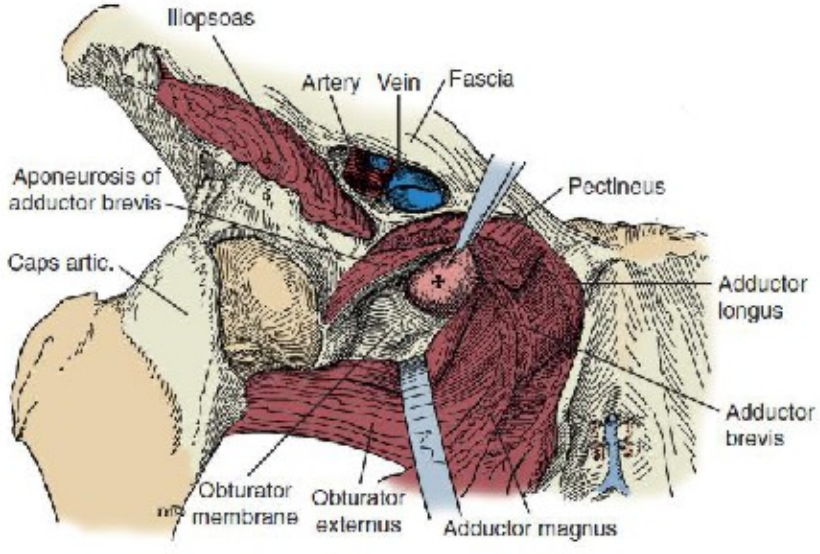


Figure 5.7.1: Obturator Hernias

Diagnosis

Diagnosis of an obturator hernia is challenging and requires a high clinical suspicion and an astute diagnostician because the condition is rare and often presents with nonspecific abdominal complaints. The overwhelming majority of patients present with an acute small bowel obstruction. A palpable mass in the groin is uncommon, but it may be appreciated upon a rectal or vaginal examination.

The Howship-Romberg sign, although considered pathognomonic of obturator herniation, is demonstrated in only 15% to 50% of cases. This physical finding is confirmed by pain in the medial thigh from obturator nerve compression elicited by extension, abduction, and medial rotation of the ipsilateral lower extremity. The Hannington-Kiff sign, or an absent adductor reflex, may have increased specificity in comparison to the Howship-Romberg sign but occurs less frequently. This maneuver is performed by percussing the medial thigh (over the adductor muscles) 5 cm above the patellar tendon. A positive sign is manifested by the absence of muscular contraction.

Abdominal radiography is often the first study performed in patients who present with findings suggestive of bowel obstruction. Plain radiographs may demonstrate dilated small bowel loops with an intraluminal gas shadow overlying the obturator foramen, which should raise suspicion of an obturator hernia. However, CT is the preferred diagnostic modality because it has greater than 90% accuracy and increased sensitivity for detecting an obturator hernia.

Treatment

A patient with an obturator hernia is typically female, elderly, frail, malnourished, has multiple comorbidities, and presents with an acute intestinal obstruction. As a result, surgeons may prefer to conservatively manage such patients, given their inherently high surgical risk.

Despite this, urgent surgical intervention is crucial in the management of obturator hernias because the rate of strangulation reaches 50% to 75% and may increase further with any delay in treatment. The classic surgical approach is through an exploratory laparotomy, although in recent years, inguinal and laparoscopic extraperitoneal techniques have been described. Exploration by laparotomy allows a complete assessment of intraabdominal viscera and pathology and evaluation of both obturator canals and facilitates bowel resection if required. It is performed through a lower midline incision and preferred in patients with suspected intestinal perforation, strangulation, or peritoneal inflammation.

6

OPEN HERNIA REPAIR - A BRIEF REVIEW

Authors - Dr Ranjith Kumaran R, Dr Akshay Anand, Prof Abhinav Arun Sonkar

6.1 Introduction

Worldwide, inguinal hernia repair is one of the most common surgeries, being performed in more than 20 million people annually. The lifetime occurrence of groin hernia - viscera or adipose tissue protrusions through the inguinal or femoral canal - is 27–43% in men and 3–6% in women. Inguinal hernias are almost always symptomatic, and the only cure is surgery. Based on multiple large systematic reviews, various hernia society guidelines generally advocate the use of mesh in a tensionfree technique for hernia repair. Hernia recurrence rates using mesh typically range from 1% to 5% and are estimated to be significantly lower than nonmesh repairs. The ideal mesh used for inguinal hernia repair should be lightweight, macroporous, and inexpensive. Still, the use of mesh in contaminated fields and complicated hernia repairs remains controversial with evidence to suggest that it may be done safely in certain circumstances.

In conclusion, the new International Guidelines of the HerniaSurge Group recommend only the open mesh technique Lichtenstein and the laparo-endoscopic mesh techniques TEP and TAPP as repair techniques in inguinal hernia surgery. The non-mesh open technique Shouldice is only indicated when a patient refuses a mesh and/or after a shared decision making with a patient or when a mesh is not available.

The open anterior approach to inguinal hernia repair remains the most common approach to primary unilateral hernias. The exact choice of repair may vary depending on the use of mesh as well as operative technique.

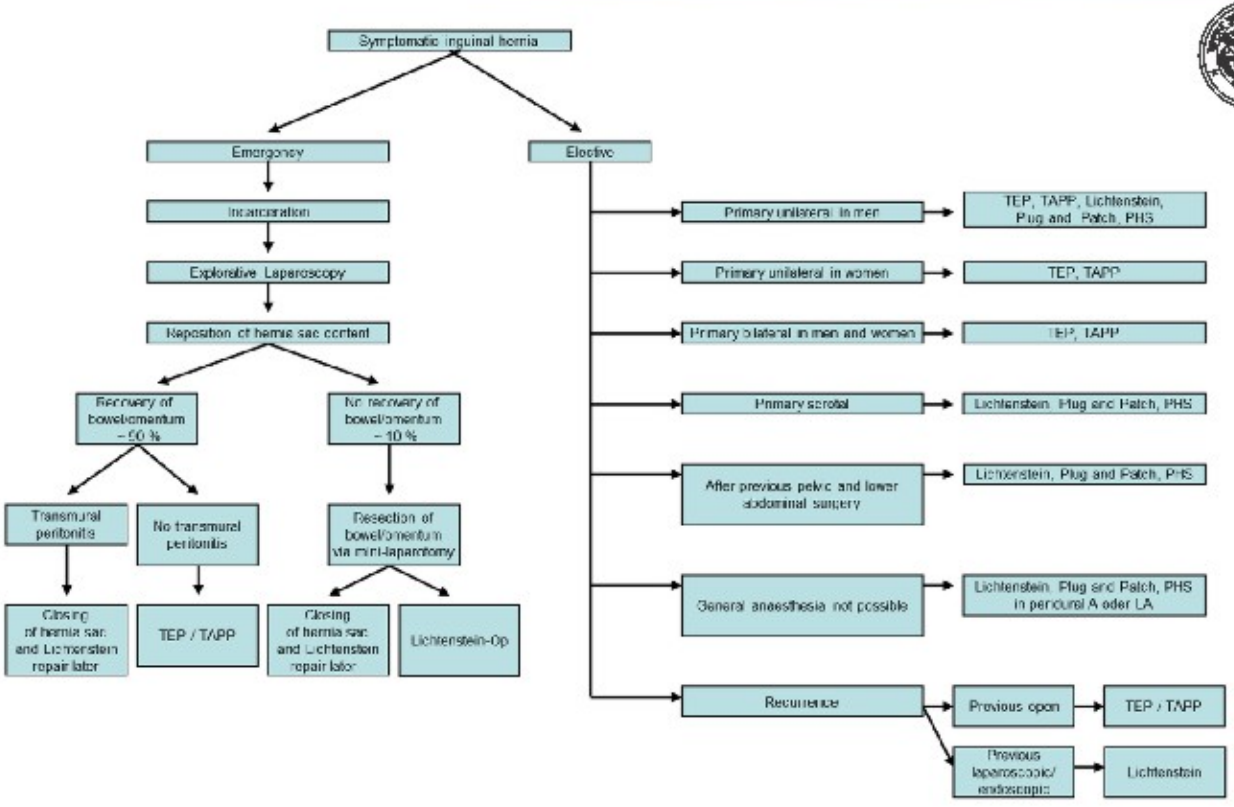


Figure 6.1.1 : Algorithm of Symptomatic Inguinal Hernia

6.2 Conventional Anterior Open approach (common to both tissue & mesh repairs)

Open anterior inguinal hernia repairs generally follow the same initial steps: skin incision along the lines of Langer, deepening of the incision through Camper and Scarpa fascia to the external oblique aponeurosis, and incision of the external oblique through the external ring. Once the external oblique aponeurosis has been incised, the superior flap is created by bluntly sweeping off the internal oblique muscle. The ilioinguinal and iliohypogastric nerves are identified and preserved. Selective use of neurectomy is advocated in cases of inadvertent trauma or presumed injury due to mesh entrapment. Inferiorly, the cord structures are separated from the inferior flap of the external oblique aponeurosis and blunt dissection is carried onto the pubic tubercle. Using both index fingers, the surgeon creates a window behind the cord structures at the pubic tubercle to allow for passage of a Penrose drain.

Once the Penrose is placed for retraction, dissection of the cord is performed in order to identify an indirect hernia sac.

The indirect hernia sac is then dissected free from the cord structures up to the level of the internal ring. The sac can either be high-ligated with division and suture closure or it can simply be inverted and reduced into the preperitoneal space. High ligation is performed after incising the cremasteric muscle longitudinally to fully mobilize the sac. If a direct hernia is present, a purse-string suture can be placed in the transversalis fascia at the base of the hernia to allow for inversion and closure of the hernia.

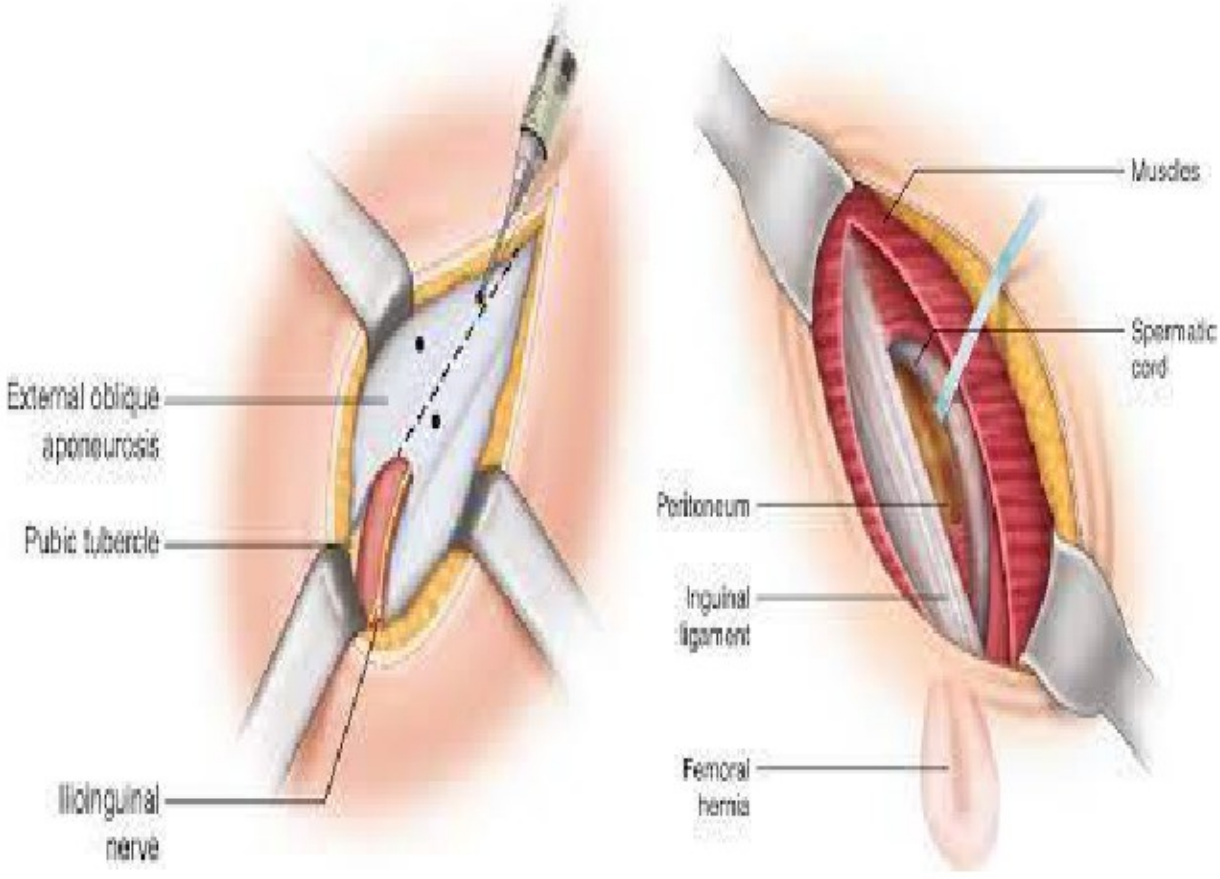


Figure 6.2.1: Open Anterior Inguinal Hernia

6.3 Lichtenstein Repair

Initial steps of the Lichtenstein repair are similar to the steps described previously. High ligation is performed after incising the cremasteric muscle longitudinally to fully mobilize the sac. Similarly, direct hernias are circumferentially dissected and reduced back into the preperitoneal space. A large mesh prosthesis is then tailored to the shape and size of the patient's anatomy to facilitate overlap of 2 cm onto the pubic tubercle, 4 cm above Hesselbach triangle, and 5 to 6 cm lateral to the internal ring. The mesh is sutured to the pubic tubercle on either side and then secured in a continuous fashion along the shelving edge of the inguinal ligament inferiorly until it is at least 1 cm lateral to the insertion of the internal.

oblique muscle into Poupart ligament. Similarly, the mesh is secured superiorly to the rectus sheath and subsequently to the internal oblique aponeurosis with interrupted sutures.

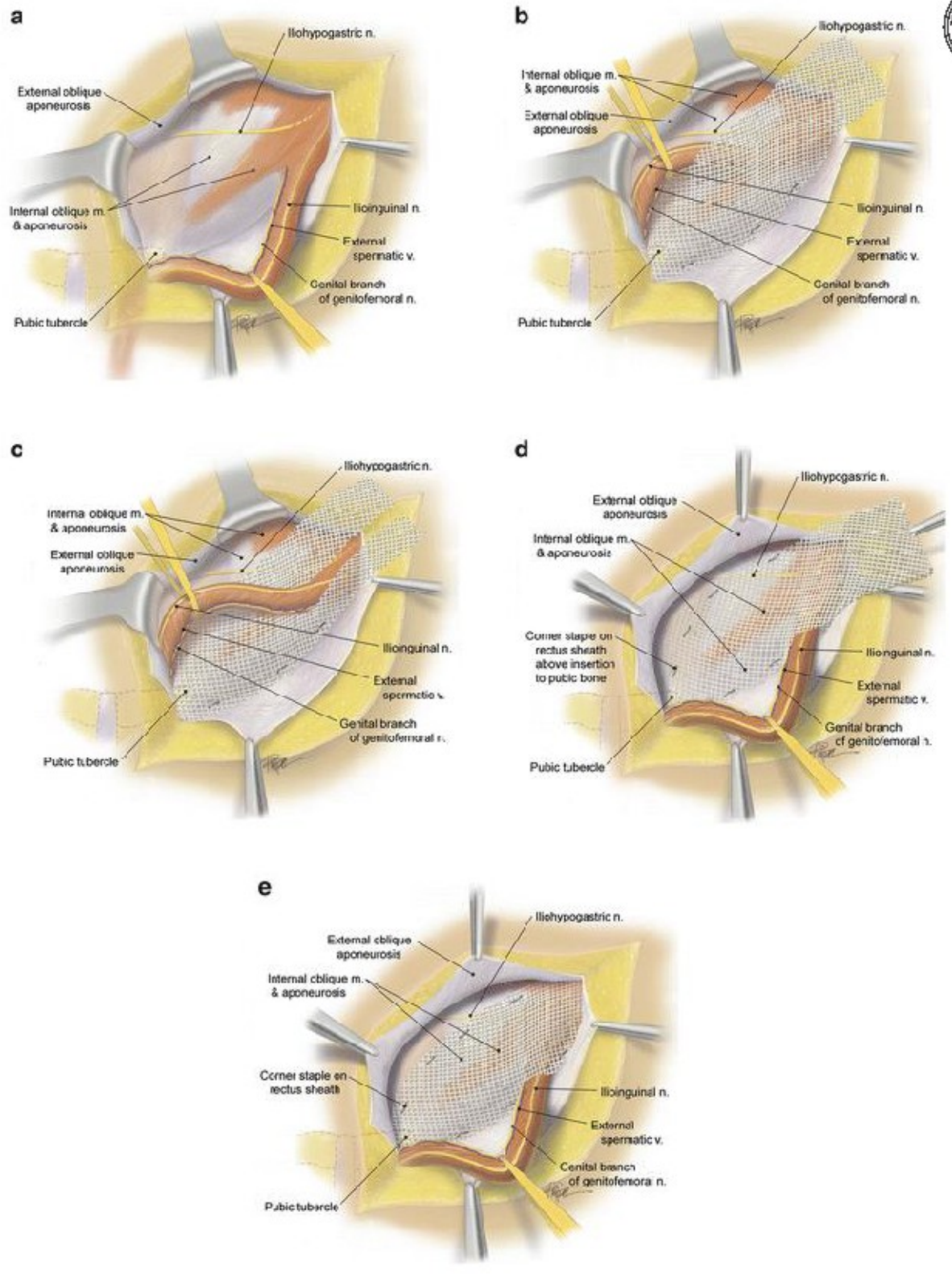


Figure 6.3.1: Lichtenstein Repair

Two tails are created in the mesh by incising it from the lateral edge to create a slit that encircles the spermatic cord and reconstructs the internal ring. The mesh tails encircling the cord are anchored in a fashion that overlaps the superior and inferior tails in a manner that creates a new internal ring fitting snugly around the spermatic cord. This is accomplished by suturing the tails together and tucking the ends of the tails under the external oblique aponeurosis. Creation of this shutter valve at the internal ring is a critical step for preventing indirect hernia recurrence. The superior and inferior tails can then be secured to the underlying internal oblique and fascia. Care should be taken not to entrap the ilioinguinal, iliohypogastric, or genital branches of the genitofemoral nerves when placing sutures. The main limitation of this technique is that it does not address femoral hernias.

Plug-and-patch technique

The plug-and-patch technique begins in a similar fashion to the conventional anterior approach. For a direct hernia, a plug is fashioned from rolled mesh, or a prefabricated plug may be used, and the plug is inserted into the hernia defect and secured to the edges with suture. The plug can similarly be positioned within the indirect hernia and secured in place along the edges as well. In this way the plug can act as a preperitoneal underlay mesh. The patch is then positioned in a fashion similar to the Lichtenstein technique along the inguinal space. Limitations of this technique include the possibility of meshoma and pain requiring mesh explantation, mesh migration, and erosion of the mesh into adjacent organs/ structures.

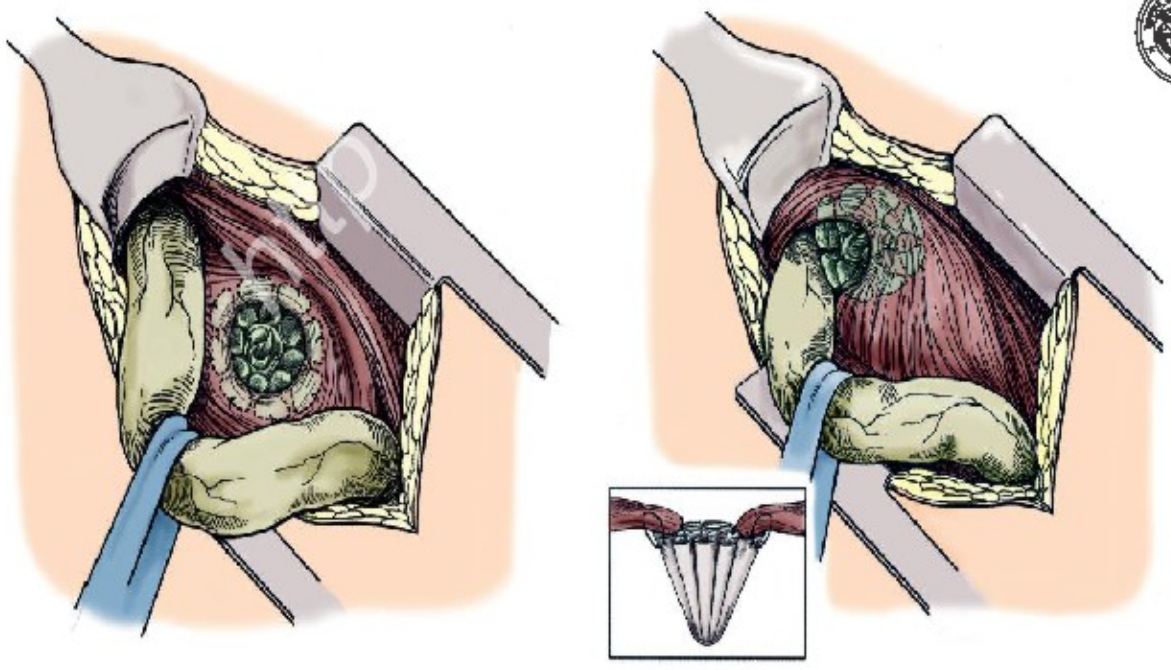


Figure 6.3.2: Plug-and-patch technique

6.4 Preperitoneal Mesh Repair

Preperitoneal mesh placement plays a central role in many hernia repair techniques, including those described by Nyhus-Condon, Wantz, Read, Rives, Stoppa, and Kugel. The key component of the preperitoneal repair is placement of a large mesh in the preperitoneal space between the transversalis fascia and the peritoneum. The preperitoneal space is accessed anteriorly through the inguinal floor to allow for placement of the mesh. Subsequently, the mesh is secured with interrupted sutures and serves as reinforcement of the transversalis fascia. The external oblique is then closed in a continuous fashion. A limitation of this approach is the need for blunt dissection in the preperitoneal space, which can lead to structural injury, hematoma formation, and potential scar tissue formation, thus limiting future surgical dissection.

Tissue/Non-mesh repairs

Numerous types of tissue repair are described in the surgical literature. The most commonly used tissue repairs in modern times are those of Shouldice, Bassini, and McVay.

Among the nonmesh repairs, the Shouldice technique is preferred because it has the lowest associated recurrence rate. Nonetheless, nonmesh repairs have a reported recurrence as high as 35% and have been shown to be clearly inferior to tension-free mesh repair through several randomized controlled trials.

The Shouldice Technique is an anterior approach that involves division of all the layers of the floor of the inguinal canal with reduction of the hernia followed by reconstruction of the inguinal canal. Once the transversalis fascia is split from the internal ring to the pubic crest, reconstruction of the canal is performed using a four-layer overlap technique and continuous suture. The repair starts at the pubic tubercle by approximating the iliopubic tract to the underside of the lateral edge of the rectus muscle. The suture line then continues by tacking the lateral flap of transversalis fascia to the medial flap, which is composed of the transversus abdominis, transversalis fascia, and internal oblique muscle.

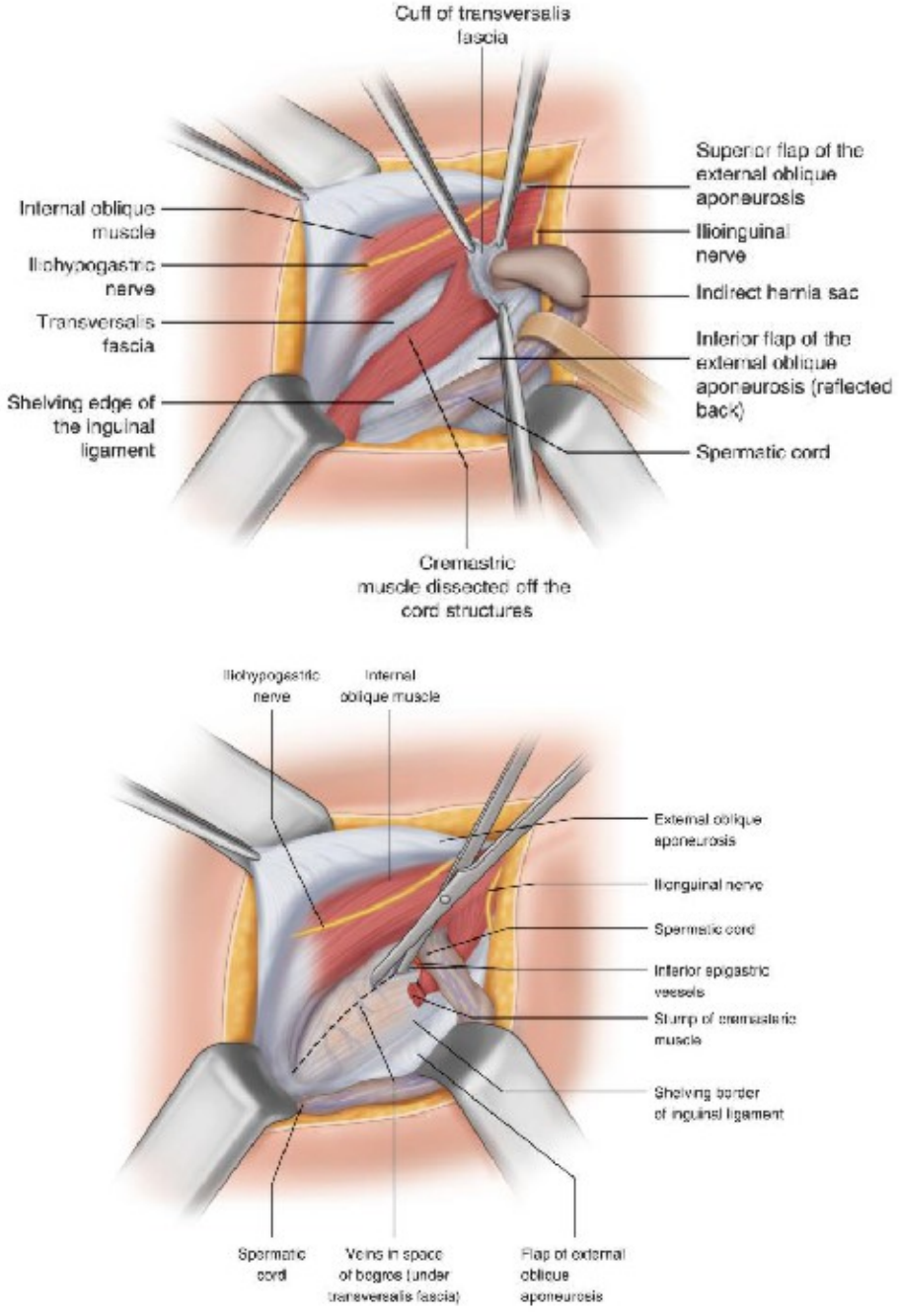


Figure 6.4.1: Shouldice Technique

Reconstruction of the internal ring is performed by securing the transversalis fascia to the cremasteric muscle. Reversing back toward the pubic tubercle, this suture line approximates the medial flap tissue to the shelving edge of the inguinal ligament. The internal oblique and transversus abdominis are then approximated to the shelving edge of the inguinal ligament.

The final suture line is then reversed; it runs laterally and secures the lower flap of the external oblique over the internal oblique in a similar fashion to the previous suture line. The major limitation of this technique is that it is technically difficult and hard to reproduce.

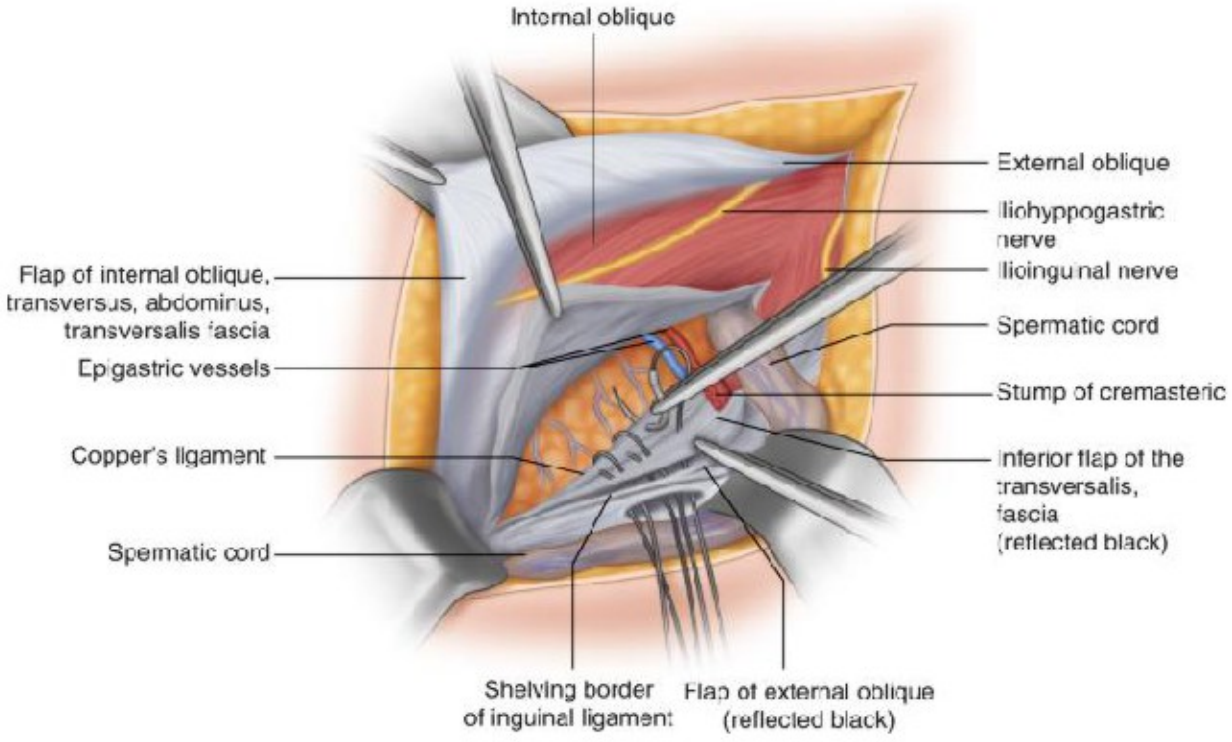


Figure 6.4.2: Inguinal Ligament

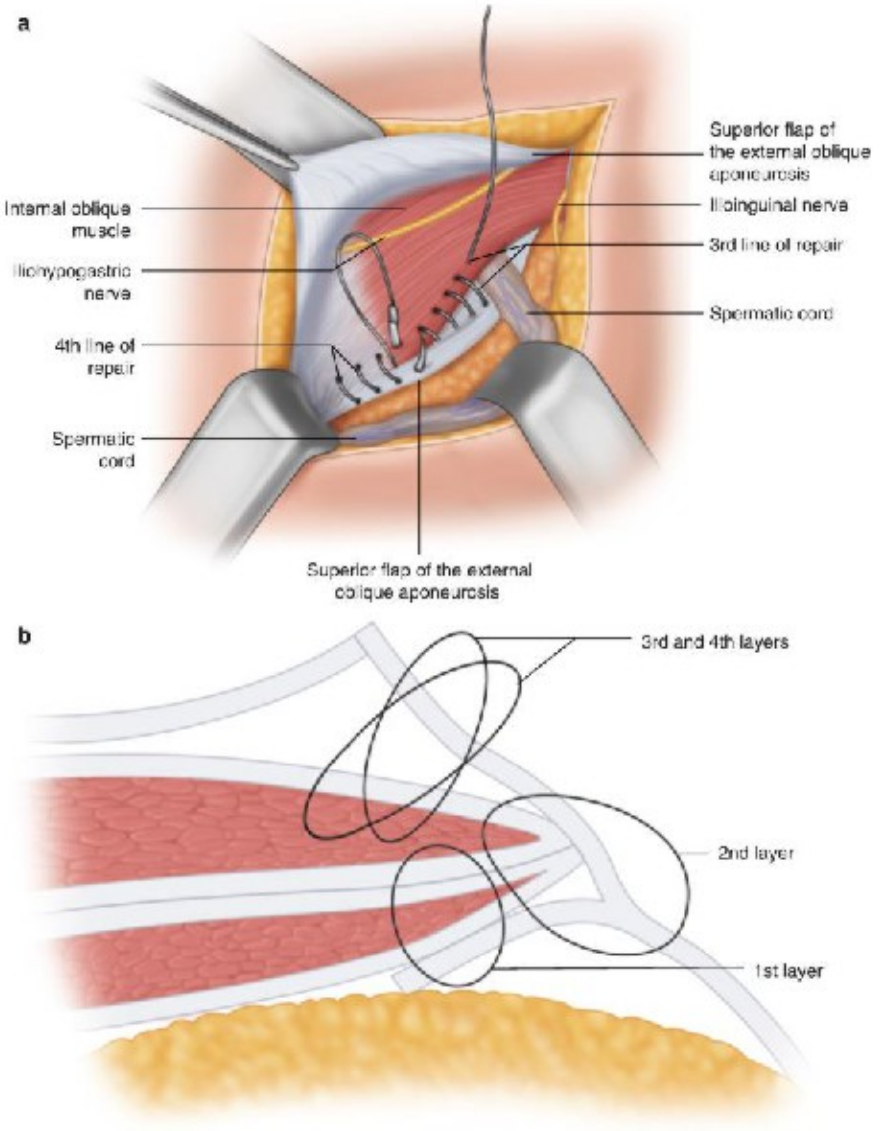


Figure 6.4.3: Inguinal Ligament

The Bassini repair strengthens the weakened inguinal floor by suturing the conjoined tendon to the inguinal ligament from the pubic tubercle to the area of the internal ring. This repair begins with the standard anterior approach and subsequently divides the transversalis fascia along the inguinal canal. Exposure of this space allows for inspection of possible femoral hernias. Once the hernia sac is high-ligated, reconstruction of the floor is performed by suturing the three layers of transversalis fascia, transversus abdominis, and internal oblique muscle to the inguinal ligament.

Classic descriptions of this technique include an initial stitch of the three layers to the periosteum of the pubic tubercle and the rectus sheath. Laterally, the repair extends until closure of the internal ring.

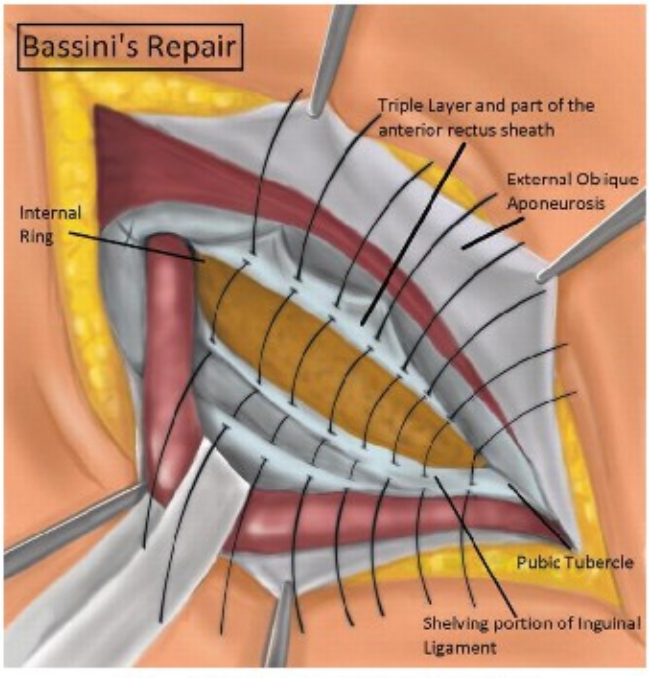


Figure 6.4.4: Bassini Repair

The McVay repair is similar to the Bassini repair except for the use of Cooper ligament instead of the inguinal ligament for the medial portion of the repair. The conjoined tendon is sutured to Cooper ligament from the pubic tubercle and extends along the ligament until as far as the edge of the femoral sheath. The final stitch to the Cooper ligament is known as the transition stitch and includes the inguinal ligament and may include the medial aspect of the femoral sheath as well. This repair is commonly used to address femoral hernias by narrowing the femoral ring, but it can cause considerable tension and requires a relaxing incision to accomplish. The relaxing incision is performed by incising the anterior rectus sheath from the pubic tubercle cephalad for several centimeters along the fusion of the external oblique aponeurosis with the sheath.

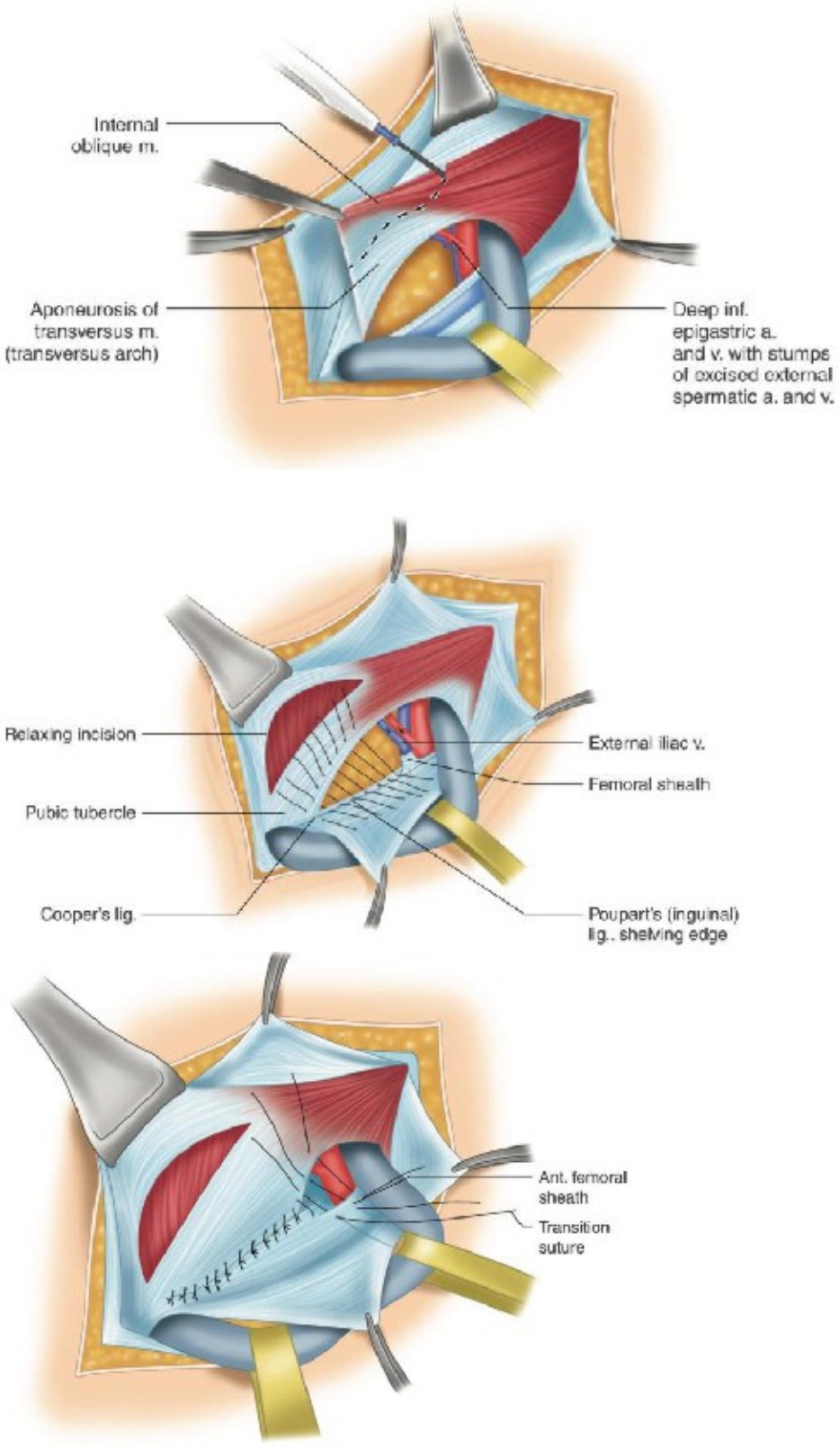


Figure 6.4.5: McVay Repair

6.5 Complications of Open Hernia repair

There are myriad postoperative complications associated with open inguinal hernia repair. These include but are not limited to surgical site infection, urinary retention, orchitis, seroma, hematoma, injury to the vas deferens, hydrocele, testicular descent, bowel or bladder injury, osteitis pubis, prosthetic complications, and wound complications. Although some of these complications are related to underlying disease processes, others are directly related to technical aspects of the repair.

Surgical site infections – Inguinal hernia repairs are generally considered clean operations except for instances of contamination, which may occur inadvertently or during the repair of strangulated hernias. The risk of surgical site infection is estimated to be up to 5% after open repair. The use of prophylactic preoperative antibiotics is controversial, with several studies concluding that there is no benefit to this practice. Moreover, the use of prosthetic mesh does not confer a greater risk of infection or substantiate the need for prophylaxis. Surgical site infections can generally be managed with open drainage, local wound care, and oral antibiotics. Mesh infection may lead to a chronically draining sinus tract and ultimately require mesh explantation.

Ischemic orchitis usually occurs between 1 and 5 days after surgery and results from the thrombosis of small veins of the pampiniform plexus. Presenting symptoms include a swollen and painful testis with possible low-grade fever. Management is supportive therapy with the addition of antiinflammatory medications, and the condition is usually self-limited. Ischemic orchitis may lead to testicular atrophy and is most commonly seen after the repair of a recurrent hernia.

Injury to the vas deferens may lead to dysejaculation syndrome, likely resulting from a stenotic lesion. Presenting symptoms include pain during ejaculation.

Injuries to the vas deferens recognized during hernia surgery should be managed immediately and reanastomosis should be attempted. Ipsilateral vas deferens transection may lead to infertility resulting from the development of sperm antibodies as a consequence of extravasated sperm.

Nerve injury and chronic pain (Inguinodynia) are often underrecognized and potentially debilitating complications of inguinal hernia repair. Nerve injury can occur from traction, mesh or suture entrapment, electrocautery, and transection. The nerves most commonly affected by open hernia repair are the ilioinguinal, iliohypogastric, and genital branch of the genitofemoral nerves. While chronic pain is often associated with nerve injury, it may also result from hernia recurrence, mesh-related problems, and infection. Chronic pain is defined as pain lasting longer than 3 months postoperatively and has been reported to range from 15% to 33%. A subset of patients suffering from chronic pain, ranging from 2% to 4%, experience debilitating pain that does not allow them to return to a preoperative level of functioning and can be completely disabling.

The clinical presentation of chronic pain after hernia repair can be heterogeneous and variable. Careful evaluation of symptoms and physical findings should be performed to help identify the cause. Imaging may aid in the confirmation of hernia recurrence as well as inflammatory processes that may contribute to the problem. Variable treatment modalities ranging from early use of antiinflammatory agents, analgesics, and anesthetic nerve blocks may be attempted. Patients with suspected nerve entrapment may be best served by reexploration and neurectomy. Mesh removal in cases of meshoma or nerve entrapment may be required in some cases. Early recognition and treatment are central to appropriate care for patients suffering from chronic pain. Moreover, as part of the informed consent process, patients should be counseled on the risk of chronic pain complications in the preoperative setting.

Recurrence rates after open tension-free inguinal hernia repair with mesh are generally low and estimated to range from 1% to 2%. Patients may present with a bulge upon examination, but occasionally the only symptom of a recurrence is pain. Hernia recurrences are usually caused by a variety of technical factors including excessive tension, improper mesh placement, missed hernias, failure to fully reduce the sac, inadequate closure of the internal ring, infection, and failure of the inguinal floor.

Recurrences are most common with direct hernias and occur near the pubic tubercle at the medial border of the repair. Factors associated with increased hernia recurrence include increased intraabdominal pressure secondary to a chronic cough, morbid obesity, and impaired wound healing. Recurrences after mesh repair are best managed by performing a mesh repair from a different approach. In the case of anterior open approaches, many surgeons advocate the use of laparoscopic repair for recurrent hernias. Similarly, anterior repair may be best suited for recurrent hernias performed in a preperitoneal fashion. Recurrent hernias should almost always be managed with a mesh repair.

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