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LAPAROSCOPIC ANATOMY OF THE GROIN

“You can judge the worth of a Surgeon by the way he does a hernia “ Thomas Fairbank (1876-1961)

“No disease of the human body, belonging to the province of the surgeon, requires in its treatment, a better combination of accurate, anatomical knowledge with surgical skill than hernia in all its variants.” – Sir Astley Paston Cooper, 1804.

“I know more than hundred surgeons whom I would cheerfully allow to remove my gall bladder but only one to whom I should like to expose my inguinal region” – Sir Henage Ogilvie

Inguinal Hernia is the most frequently encountered clinical situation requiring surgery in men, all over the globe .The history of Hernia Repair is the history of Surgery. Minimal Invasive Surgery has a big role in Inguinal hernia repair, but there is always a role for Open techniques. Mastering the Anatomy is the key for sound hernia repair

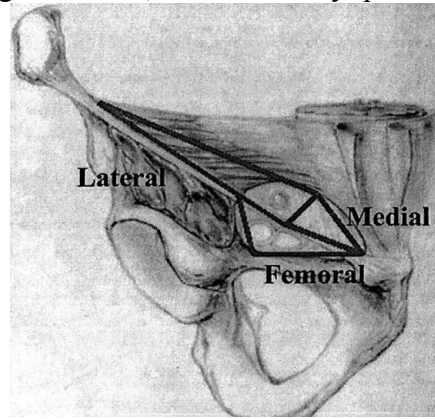
The laparoscopic view of the groin anatomy is quite different!

- The laparoscopic view is essentially a posterior approach view. Most surgeons are well versed and used to the anterior approach . Changing to a laparoscopic approach needs knowledge of the posterior approach.
- Certain structures that are clearly visible during the open approach (such as the ilioinguinal nerve, inguinal ligament, pubic tubercle and lacunar ligament) are not as clearly visible with the laparoscope.
- Conversely structures that would require additional dissection during a open approach (such as Cooper’s ligament and the ilio-pubic tract) are clearly visible with a laparoscope.
- Open repair of inguinal hernia addresses the issue of the ‘point of origin’ rather than the ‘point of presentation
- The laparoscopic view is a ‘virtual view’ with a ‘2- dimensional’ handicap. There is the additional loss of tactile feedback.

In the following description, the surgical anatomy is described from the viewpoint of a surgeon performing a TAPP (Trans-Abdominal Pre-Peritoneal) groin hernia repair. However, all the structures and entities described below are also visualized in a TEP procedure.

THE 'MYOPECTINEAL ORIFICE OF FRUCHAUD'

In 1956, Henry Fruchaud espoused the theory that all groin (inguinofemoral) hernia originate in a single weak area called the Myopectineal orifice. This oval, funnellike, 'potential' orifice formed by the following structures, forms the 'Myopectineal orifice of Fruchaud'.



- Superiorly Internal oblique and transverses abdominis muscles.
- Inferiorly Superior pubic ramus.
- Medially Rectus muscle sheath.
- Laterally Iliopsoas muscle.

Weakness through this area leads to inguinofemoral hernia. Proper exposure of this area is important during a preperitoneal (posterior) repair.

- To avoid missing small hernia as well as
- To achieve adequate fixation.

The orifice is divided by the Iliopubic tract and the inguinal ligament into an 'inguinal' defect and a 'femoral defect'

THE PERITONEAL LANDMARKS : (3 ligaments and 3 fossae)

Median Umbilical Ligament :

This ligament ascends in the median plane from the apex of the bladder to the umbilicus. It represents the obliterated allantoic duct and its lower part is the site of the rare urachal cyst.

Medial Umbilical Ligament

This ligament represents the obliterated umbilical artery on each side and can be traced down to the internal iliac artery.

Lateral Umbilical Ligament

It is a misnomer as it is not a ligament. It is the ridge of peritoneum, which is raised by the Inferior Epigastric artery and its companion two veins as they course around the medial border of the internal inguinal ring and then pass upwards into the posterior rectus sheath.

Supravesical fossae

The infra-umbilical area between the median and medial umbilical ligaments. This is the site for the origin of the supravesical hernia.

Medial Umbilical fossae

The infra-umbilical area between the medial and lateral umbilical ligaments. This is the site for the origin of the femoral and direct inguinal hernia.

Lateral Umbilical fossae

The infra-umbilical area lateral to the lateral umbilical ligament. This is the site for the origin of the indirect inguinal hernia.

THE PREPERITONEAL SPACE

Understanding of the preperitoneal space and its extensions is crucial to the laparoscopic surgeon. The significance of the preperitoneal space lies in the fact that all posterior approaches for the repair of groin hernia have to traverse this area and work in it.

Boundaries of the preperitoneal space

Anteriorly - Anterior layer of the transversalis fascia

Posteriorly - The peritoneum.

Transversalis Fascia (of Gallaudet)

The current understanding of the Preperitoneal (properitoneal / extraperitoneal / pareito-peritoneal) space is tied up intrinsically with the anatomy of the transversalis fascia in the infra-umbilical region. The current understanding of the transversalis fascia envisages this fascia as a two layered (**bilaminar**) structure (confirmed by the laparoscope). Superiorly, the two layers of the transversalis fascia are two distinct entities and inferiorly they insert onto the Cooper's ligament. The anterior layer is adherent to the rectus abdominis muscle. The posterior layer lies in between the anterior layer and the peritoneum. It divides this space into an anterior (vascular space) and a posterior (**Space of Bogros**).

. Most importantly, it bridges the space between the transverses abdominis arch superiorly and the inguinal ligament and the Cooper's ligament inferiorly. This crucial area is the "**Achille's heel**" of the groin! It is here that direct inguinal herniation occurs.

Condensations of the transversalis arch form three named structures in this area.

- **Interfoveolar Ligament**

This condensation of the transversalis fascia, whose fibres are oriented in a vertical direction in comparison to the rest of the fascia forms the medial margin of the internal inguinal ring. It has no significant strength.

- **Iliopubic Tract**

The Iliopubic tract is a thickened lateral extension of the transversalis fascia, which runs from the superior pubic ramus to the iliopectineal arch and the anterior superior iliac spine. The iliopubic tract is distinct from the inguinal ligament, although intimately associated with the inguinal ligament with which it is often confused! It is anterior to the Cooper's ligament and posterior to the inguinal ligament. The iliopubic tract separates the internal ring from the femoral canal. It is visualized as a fibrous (white) tract.

- **Iliopectineal Arch**

This is a thickened, tough, fascial structure covering the iliac muscle arches from the anterior superior iliac spine inferiorly to the Iliopubic eminence. It gives origin to a portion of the internal oblique and transversus abdominis muscle as well as the inguinal ligament. It is an important structure as it is a key supporting structure of the lateral groin!

Laparoscopic surgeon should work in the Preperitoneal space ie. In the posterior space of Bogros to prevent unnecessary oozing.

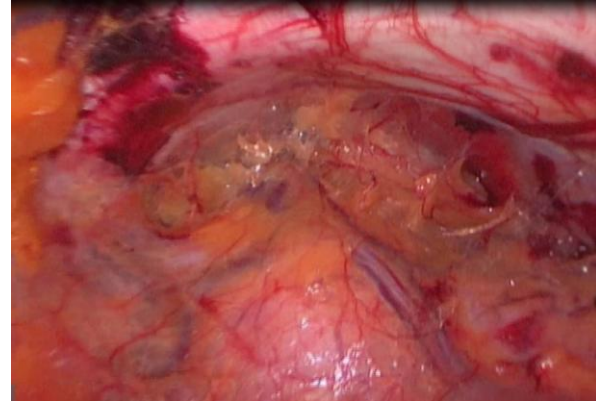
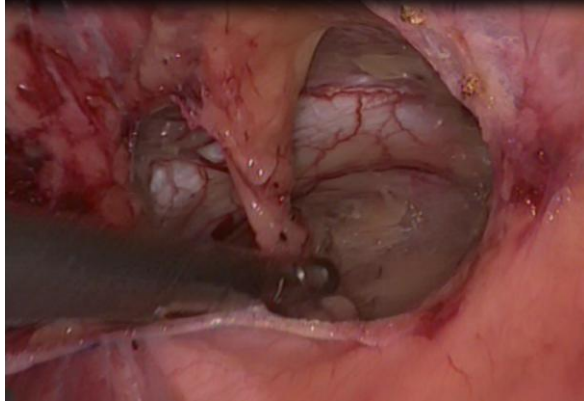
'Space of Bogros'

This 'preperitoneal space' is divided into two by the posterior lamina of the transversalis fascia. The posterior compartment has been now termed as the 'Space of Bogros (proper)', described by French anatomist Bogros in 1923. The anterior space has been termed as the 'Vascular Space'. In some places the posterior lamina is deficient (eg. At the deep inguinal ring), there the peritoneum adheres to the anterior lamina.

Medially it is continuous with the space of Retzius.

'Prevesical space of Retzius'

The preperitoneal space that lies deep to the supravescical fossa and the medial umbilical fossa is the Prevesical space of Retzius (described in 1858, by Swedish anatomist Retzius). This space contains loose connective tissue and fat. Dissection of this space during a laparoscopic hernia repair is mandatory to enable proper mesh overlap of the hernial defect to aid in proper mesh placement/ fixation



Space of Retzius

Contents (preperitoneal space)

The preperitoneal space is filled up with a variable amount of connective tissue, fat, vessels, nerves and various viscera. The contents are listed below.

Vascular

Arteries

- External iliac artery with branches
- Deep circumflex iliac artery
- Inferior epigastric artery and its branches

Veins

- External iliac vein with tributaries
- Inferior epigastric veins
- Deep circumflex iliac vein
- Deep venous circulation

Nerves

- Lateral femoral cutaneous nerve
- Genitofemoral nerve
 - Genital branch
 - Femoral branch
- Femoral nerve
- Ilioinguinal nerve
- Iliohypogastric nerve
- Sympathetic plexus

Lymphatics and lymph nodes

- External iliac group of lymph nodes and associated lymphatics

APPLIED ANATOMY

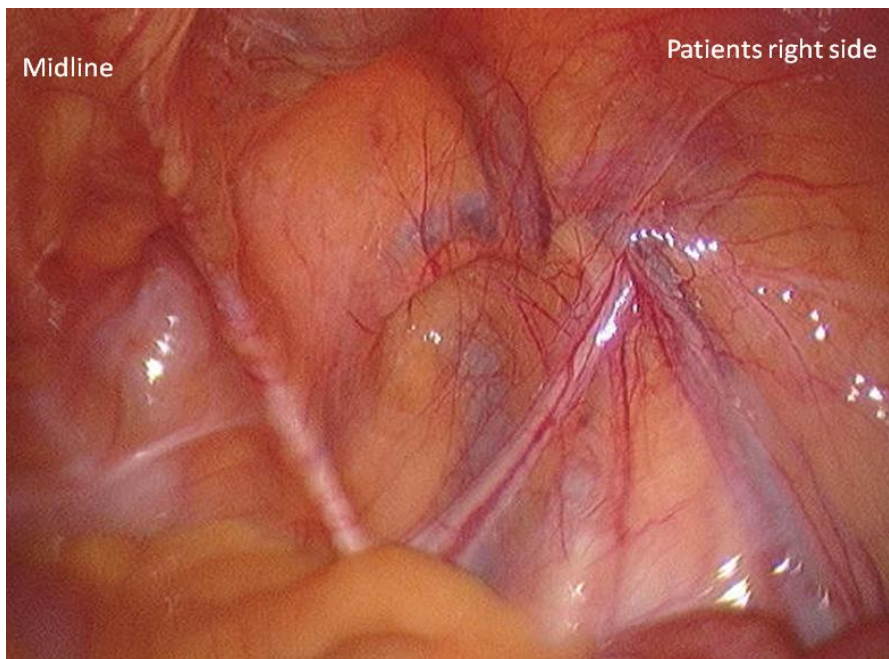
LANDMARKS FOR TRANSABDOMINAL PREPERITONEAL HERNIA REPAIR :TAPP

PHASE – I

Inguinal Anatomy with the peritoneum intact

With the introduction of the laparoscope into the abdomen, 5 (five) important landmarks will need to be identified in the infra-umbilical region!

- Inferior Epigastric vessels
- Medial Umbilical Ligament
- Spermatic vessels
- Vas Deferens
- Trapezoid of Disaster



1. Inferior Epigastric vessels

The Inferior Epigastric artery is prominently visualized during laparoscopic preperitoneal dissection of groin hernia.

Implication

It forms the lateral border of the Hasselbach's triangle. Identifying these vessels differentiates between direct and indirect inguinal hernia.

Bleeding from an 'injured' Inferior Epigastric artery can be quite brisk.

Identification

A small calibre vessel, it arises proximal to the inguinal ligament from the external iliac artery, ascends in a medial direction on the anterior abdominal wall toward the lateral border of the ipsilateral rectus muscle, running between the two lamellae of the transversalis fascia.

Visualisation

The artery is most prominent close to its origin from the external iliac artery at the medial margin of the internal ring.

Fat may obscure these vessels in obese patients.

2. Medial umbilical ligament (Obliterated Umbilical Artery)

Implication

Can be confused with the inferior epigastric artery!

DO NOT dissect medial to it during a TAPP procedure! Medial dissection to the medial umbilical ligament would put the urinary bladder at risk to injury.

Identification

It courses from the Internal iliac artery as its last branch towards the umbilicus.

It becomes apparent midway between the internal ring and Cooper's ligament.

Visualisation

It is made apparent by its mesentery. It can be differentiated from the inferior epigastric artery by its course toward the umbilical trocar whereas the inferior epigastric vessels are directed toward the lateral border of the rectus.

3. Spermatic vessels

Implication

Forms the lateral border of the 'triangle of doom' and the medial border of the 'triangle of pain'.

Identification

The testicular artery and vein descend caudally in the retroperitoneum and enter the internal ring on its posterior aspect from a cranial direction. They travel directly over or slightly lateral to the external iliac artery and vein and are joined by the vas deferens before entering the ring.

Visualisation

Easily visualized as they are covered only by peritoneum.

4. Vas deferens**Implication**

Forms the medial border of the 'triangle of doom' and 'quadrangle of disaster'.

Identification

From the internal ring, it can be traced medially as it curves over the pelvic brim to disappear behind the bladder. It joins the testicular vessels before entering the internal ring from an inferior and medial direction.

Visualisation

Easily visualized as it is covered only by peritoneum.

5. 'Trapezoid of Disaster' (Labeled by Seid)**Implication**

Lying beneath the peritoneum and transversalis fascia (within this triangle) are the external iliac artery and vein and may be damaged with serious consequences!

No dissection should take place in this area!

No staples should be placed in this area!

Identification

It is formed by the meeting of the vas deferens and the testicular vessels at the internal ring, which forms the apex of the triangle.

Visualisation

Easily identified and visualized as the vas deferens and the testicular vessels are covered only by peritoneum.

6. 'Triangle of pain'**Implication**

It describes the area in which the femoral branch of the genitofemoral nerve, the lateral femoral cutaneous nerve and femoral nerve lie.

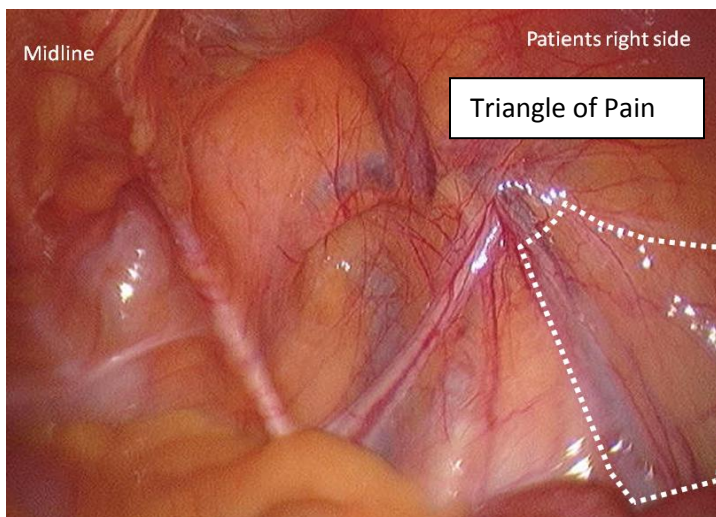
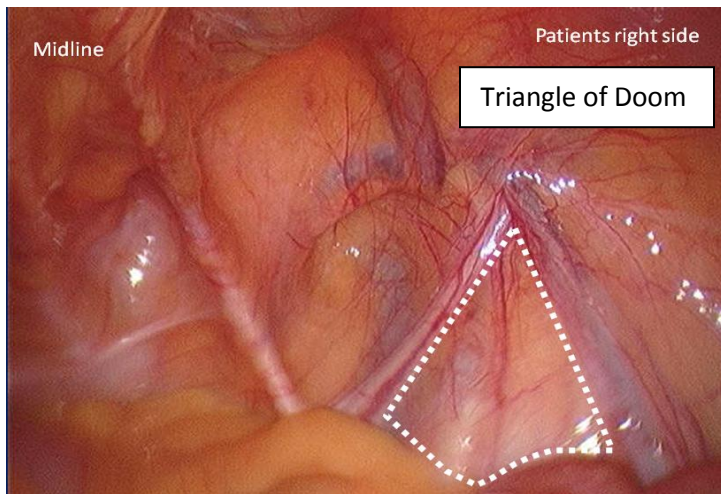
If a surgeon uses staples, he must avoid using it in this area!

Identification

It is bound inferomedially by the gonadal vessels and superolaterally by the iliopubic tract.

Visualisation

The 'triangle' is easily distinguished as its borders are recognized easily. (The iliopubic tract is more readily recognized after the peritoneal flaps are raised.)

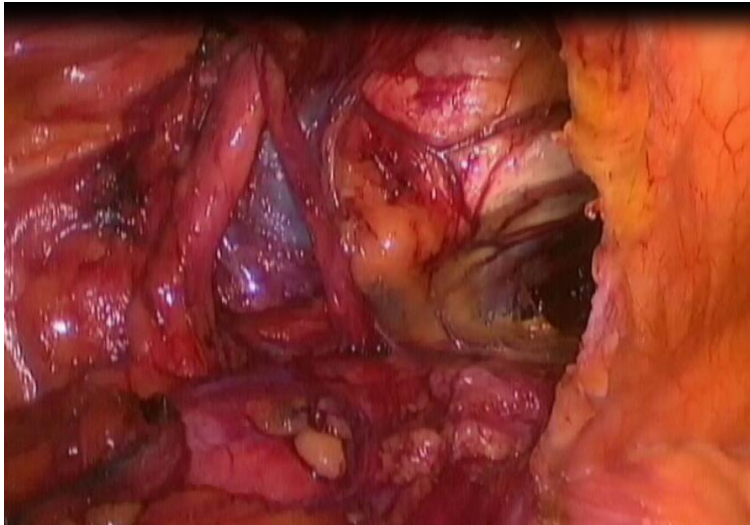


PHASE – II

Inguinal anatomy with the peritoneum incised

After the peritoneum is dissected away, 4 (four) additional structures need to be identified. They are:

- Internal Inguinal/ Spermatic ring
- Iliopubic tract
- Cooper's ligament
- Femoral canal



1. Internal Inguinal / Spermatic ring

Implication

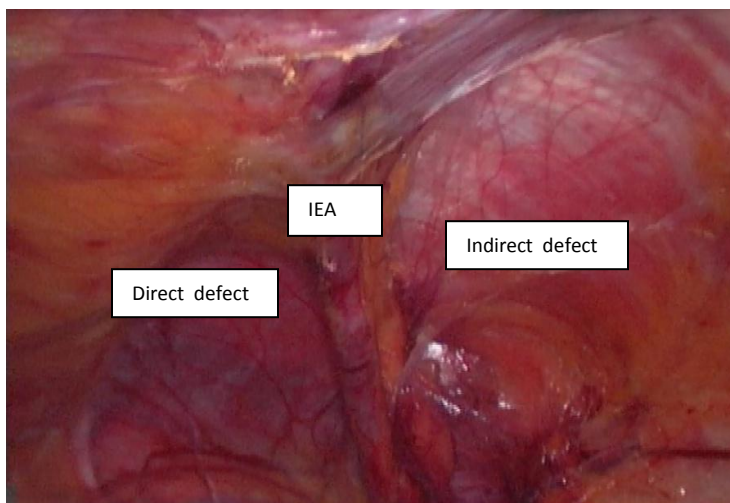
Denotes the site of origin of an indirect inguinal hernia.

Identification

The most reliable indicator of the internal ring is the junction of the testicular vessels and the spermatic cord. The inferior border is bound by the iliopubic tract.

Visualisation

The appearance of the ring varies depending on the hernia defect. Sometimes the ring is made prominent by the pneumoperitoneum.



Medial to IEA : Direct defect

Lateral to IEA : Indirect defect

2. Iliopubic tract

The Iliopubic tract is thickened lateral extension of the transversalis fascia, which runs from the superior pubic ramus to the iliopectineal arch and the anterior superior iliac spine.

Implication

The iliopubic tract separates the internal ring from the femoral canal. The iliopubic tract is distinct from the inguinal ligament, although intimately associated with the inguinal ligament with which it is often confused!

Laterally, staples/ tacks should never be placed below the iliopubic tract !

Identification

It originates laterally from the iliopectineal fascia and the anterosuperior iliac spine and inserts into the superior pubic ramus lateral and superior to the Cooper's ligament.

It is anterior to the Cooper's ligament and posterior to the inguinal ligament.

Visualisation

It is visualized as a fibrous (white) tract.

3. Cooper's ligament

This ligament is a condensation of the transversalis fascia and periosteum located lateral to the pubic symphysis. It is several millimeters thick, densely adherent to the pubic ramus and joins the Iliopubic tract and lacunar ligaments at their medial insertions.

Implication

This ligament is used to anchor the mesh initially.

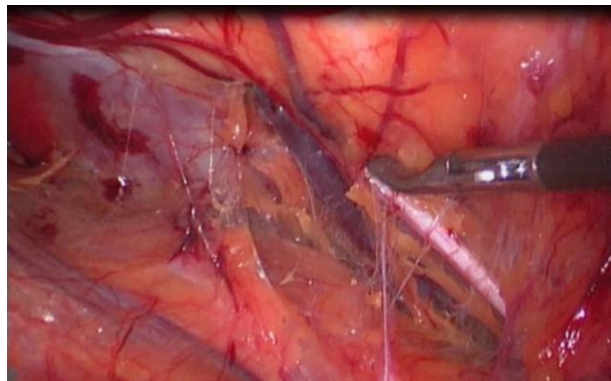
Identification

It takes a curvilinear course medial and inferior to the insertion of the iliopubic tract to form the prominence of the pelvic brim anteriorly. The Cooper's ligament can readily be palpated as a thick, strong fibrous band and is shiny when freed from surrounding fat and soft tissue. It is visualized as a fibrous (white) curvilinear structure.

Visualisation

The Cooper's ligament is readily visible when adipose tissue does not cover it.

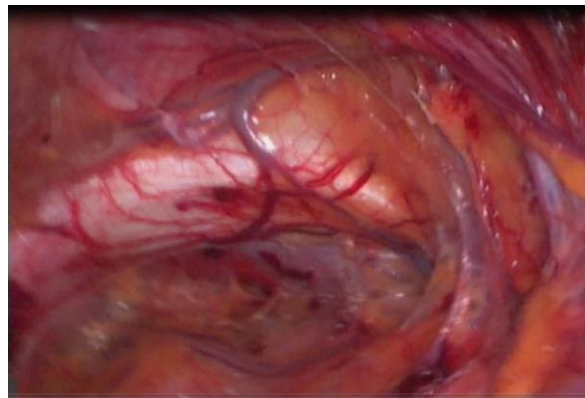
Otherwise, visualisation needs it to be freed of surrounding adipose tissue.



CAUTION : Mobilising adipose tissue around the Cooper's ligament can injure an aberrant obturator artery, which might course over it. Injury to this vessel results in distressing bleeding. This unfortunate morbidity has resulted in the naming of this vessel as - 'Crown of Death' / 'Corona Mortis'.

'CORONA MORTIS' / CROWN OF DEATH /CIRCLE OF DEATH

The pubic branch of the Inferior Epigastric artery courses in a vertical fashion inferiorly, crossing the Cooper's ligament and anastomosing with the obturator artery. In 25-30% of individuals (can be as high as 70-80%), the pubic branch is large and can replace the obturator artery. This large arterial branch (Aberrant obturator artery) can partially encircle the neck of a hernia sac and be injured in a femoral hernia repair. It could also be injured while exposing the Cooper's ligament by freeing it of areolar-adipose connective tissue. Because of this possibility an enlarged pubic branch of the Inferior Epigastric artery has in the past been known as the - 'Corona Mortis'. The danger injury in this area is more significant for obturator veins.



4. Femoral canal

Implication

It denotes the potential site of origin of a femoral hernia.

Identification

The canal lies posterior to the iliopubic tract. The anterior border is formed by the inguinal ligament, the medial border by the lacunar ligament, the posterior border by the pectineal ligament and the lateral border by the femoral vein.

Visualisation

It is a potential space (in the absence of a femoral hernia).

TECHNICAL ISSUES RELATING TO LAPAROSCOPIC SURGICAL ANATOMY

ISSUES RELATING TO EXPOSURE /VISUALISATION

- Any hernia above the iliopubic tract is an inguinal hernia and one below is a femoral hernia.
- The inferior epigastric artery should be accurately differentiated from the obliterated umbilical artery to help differentiate direct from indirect inguinal hernia.
- The dissection should expose the following structures-
 - Cooper's ligament
 - Iliopubic tract
 - Testicular vessels
 - Internal ring
 - Spermatic cord
 - Musculo-aponeurotic transverses abdominis arch.
 - The preperitoneal tissue should be completely elevated along the peritoneum to reach the correct plane (Space of Bogros). Dissection outside this space leads to bleeding

ISSUES RELATED TO DISSECTION

- Dissection in the 'Trapezoid of Disaster' must be avoided!!!
- While dissecting around Cooper's ligament, take care to avoid injury to the branches of the Obturator vein.

ISSUES RELATED TO FIXATION OF MESH

- Staples or sutures should not be placed lateral to the cord or below the iliopubic tract (Trapezoid of Disaster) to avoid injury to the branches of the genitofemoral nerve and the lateral femoral cutaneous nerve.
- Staples should not be placed lateral to the internal ring in the endopelvic fascia to avoid injury to the ilioinguinal nerve.
- Cooper's ligament should be properly exposed as the initial fixation is performed to this structure.

LAPAROSCOPIC INGUINAL HERNIA REPAIR : THE TAPP TECHNIQUE

Ger reported the first laparoscopic hernia repair in 1982 by approximating the internal ring with stainless steel clips. The laparoscopic trans-abdominal Preperitoneal (TAPP) repair was a revolutionary concept in the hernia surgery and was introduced by Arregui and Dion10 in the early 1990s. Laparoscopic groin hernia repair can be done by TAPP approach and also Total Extra Peritoneal (TEP) approach. Both the techniques of laparoscopic hernia repair reproduce the concept of Stoppa by placing a large mesh in the pre-peritoneal space to cover half of the abdominal wall and all the weak areas(myopectineal orifice of Fruchad) including area of internal ring, Hasselbach's triangle and the femoral ring. The advantages of laparoscopic repair include the same decreased incidence of recurrence observed with the Stoppa technique with the added benefits of lesser pain, reduced discomfort, short hospital stay and early resumption of normal daily activities.

Patient Selection

Laparoscopic inguinal hernia repair is an advanced laparoscopic procedure. In the initial part of the learning curve, patient selection is important.

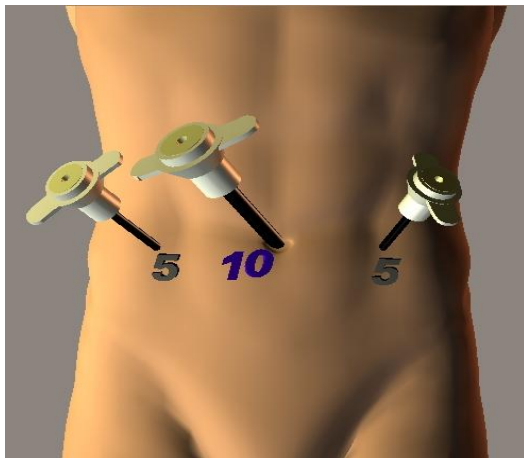
- Indirect hernial sacs are closely applied to the cord structures and are more often complete, making dissection difficult.
- Left sided hernias are more difficult to dissect than the right sided ones.
- Bilateral hernia repair during the learning curve may significantly increase the operating time.
- Recurrent hernias and irreducible hernias should be repaired only after expertise is gained in repair of simple hernias.
- Direct or small indirect primary hernias in lean and thin subjects are the best.
- Indirect, left sided hernias, large, irreducible or complicated hernias in obese patients are best avoided during the learning curve.

Anaesthesia and Position of the Patient

- Laparoscopic TAPP hernia repair is performed under general anesthesia.
- In elderly subjects, a detailed cardiorespiratory work up should be done prior to surgery for safe general anesthesia and pneumoperitoneum.
- The patient is asked to pass urine just before shifting to the operation theatre.

- If the patient is more than sixty years of age, has symptoms of prostatic enlargement or post void residual volume is more than 50 ml, it is advisable to place a Foley's indwelling catheter prior to surgery. This may be removed 24 hours after the surgery.
- Perioperative prophylactic antibiotics are administered.
- After induction of anesthesia, irreducible hernial contents, if any, are reduced before painting & draping is commenced.
- The patient lies supine with both arms tucked by the side, to make room for the surgeon and his assistant to stand at shoulder level.
- The head end of the table is kept 15 degree low to facilitate creation of pneumo-peritoneum and move the bowel away from the operative field.
- The monitor is positioned at the foot end of the patient.
- The operating surgeon stands on the side opposite to hernia.

Port Placements :



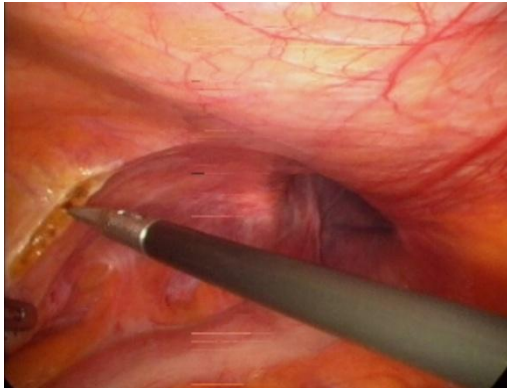
10 mm Camera port at Umbilicus

Two 5mm working ports at the level of umbilicus in the mid-clavicular line

Operative Steps :

Step 1– Incising the Peritoneum

- After inserting the telescope, all the anatomical landmarks normally seen before peritoneal reflection are identified as described in the previous chapter
- Contents of the hernial sac, if any, are reduced with the help of atraumatic bowel forceps.



Peritoneal incision extends from Anterior Superior Iliac Spine to Medial Umbilical ligament

- In case of irreducible hernias, the bowel contents need to be handled with care.
- In case of omentum, a tear should be avoided as it may cause bleeding.
- Peritoneal incision extends from above the anterior superior iliac spine to the medial umbilical ligament .Extending it medially beyond the medial umbilical ligament will increase the chances of injury to the urinary bladder, particularly if the urinary bladder is not empty

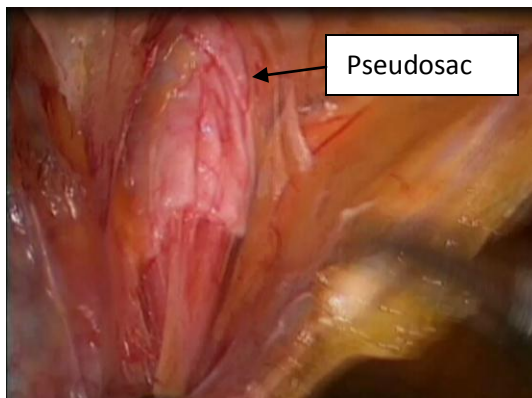
Step 2 – Raising the Peritoneal Flap

- The correct plane of dissection of the peritoneal flap from the transversus muscle is anterior to the pre-peritoneal fascia through the loose areolar tissue, stripping all the fascia and fat with the peritoneum so that the fibers of the tranversus muscle are bare
- The flap is raised by both blunt and sharp dissection.
- Generally the plane is avascular but any small vessel is carefully cauterized before division.
- Care should be taken to avoid injury to the IEVs while raising the peritoneum medial to the internal ring. The IEVs are a very important landmark in laparoscopic inguinal hernia surgery. These vessels should always be left attached to the muscle and should never be included in the flap otherwise they may come in the way of dissection and may get injured.
- The plane of dissection is easier on the medial side and blunt dissection is sufficient since the areolar tissue is loose and the peritoneum is not adherent to the rectus muscle.
- On the medial side, continued caudal dissection will identify the shiny Cooper's Ligament and the pubic bone

- Laterally, the peritoneum is slightly adherent to the transversus muscle and sharp dissection may be required, particularly on the left side.
- Care should be taken not to enter into the transversus muscle, which may bleed if injured.
- It is easier to raise only the lower flap than to raise a lower and an upper flap

Step 3 – Dissection of Medial peritoneum and Direct Sac

- Dissection is continued medially to the pubic symphysis to visualize the Space of Retzius .The medial dissection should go across the midline to the opposite side for a few centimeters, particularly for a direct hernia so that the mesh can be placed with a good overlap over the defect.
- A direct defect is encountered medially above the cooper’s ligament . In a direct hernia, the hernial sac consists of peritoneal out pouching with a variable amount of extra-peritoneal fat which may sometimes be very large. The direct sac can be easily separated from pseudosac .The pseudosac is essentially thinned out fascia transversalis, identified by its glistening appearance and belongs to the parietal wall.
- . In case of large direct hernias, after reducing the sac, the dome of the pseudosac can be fixed to the pubic bone by stapler to prevent postoperative hematoma or seroma formation.

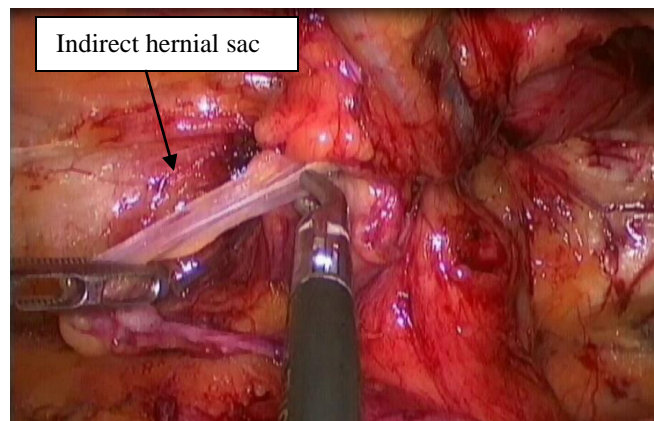


Step 4 – Lateral Dissection

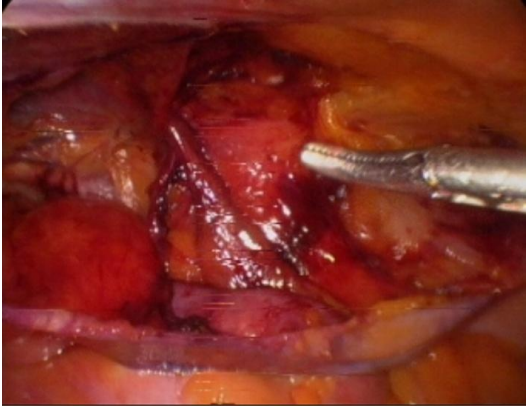
- After the medial dissection, the flap is raised Lateral to the internal ring till the anterior superior iliac spine and carried posteriorly over the psoas muscle.
- Care is taken during this dissection to avoid injury to the nerves overlying the psoas muscle namely lateral cutaneous nerve of the thigh laterally and the femoral branch of the genito-femoral nerve medially.

Step 5 - Dissection of Indirect Hernial Sac and peritoneum over the cord Structures

- Dissection of indirect hernial sac is the most demanding step in laparoscopic inguinal hernia repair and is best done after the medial and lateral dissection has been completed.
- In long standing hernias, the sac becomes densely adherent to the cord structures. The hernial sac is anterior and lateral to the cord structures.
- Dissection of the sac is performed close to the peritoneum. With a grasper in the left hand, the sac is pulled to the left and the cord structures are dissected away from the sac with the right-handed instrument.
- A small indirect hernial sac can be easily dissected out into the peritoneal cavity.



- In case of large/ scrotal indirect hernias, complete dissection of the sac may not be advisable as chances of injury to the cord structures are increased. In such a situation the sac is circumferentially dissected so that a window is created between the sac and the cord structures and then sac may be divided after traction beyond the external ring. The distal part is left in situ but one should ensure that there is no bleeding from the cut end of the distal sac.
- After reducing the sac, the dissection is continued proximally by stripping the peritoneum with both blunt and sharp dissection over the cord structures to expose and skeletonise the vas and gonadal vessels
- Any lipoma associated with the gonadal vessels is also dissected and drawn inwards.
- No dissection should be done deep to the cord structures in the triangle of doom to avoid injury to the great vessels



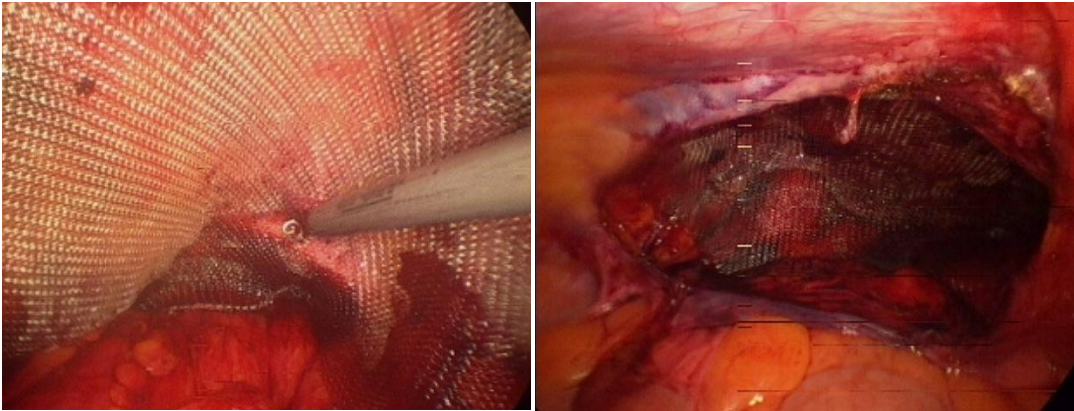
Step 6 – Preparation and placement of the Mesh

- Haemostasis should be secured before the mesh is placed and any blood/serum sucked out. If a prominent vein is seen coursing horizontally over the Cooper's ligament, it should be cauterized, else it may be a source of troublesome bleeding when the mesh is being fixed to the Cooper's ligament with tacker.
- A polypropylene mesh of 15cm (transverse) X 10 cm (vertical) is used for repair on each side.
- The mesh is now rolled completely and introduced into the operating field through the 10 mm umbilical port by removing the telescope. The telescope is then reinserted.



- The mesh is taken to the area of dissection and the lower part of the mesh is unrolled.
- The medial border of the mesh should reach the midline and in direct hernia must cross over to the opposite side for a wide overlap.
- See through property of the Prolene mesh, by virtue of its large pore size, is very helpful in proper positioning of the mesh.

- The mesh is fixed to the Cooper's ligament at two points with tackers



- It is spread over the anterior abdominal wall, to cover the defect widely.
- Tackers are applied over the medial and upper border of the mesh to anchor it to the underlying muscles .
- No tackers should be applied on the lower and lateral parts of the mesh below the ileo-pubic tract to avoid injury to the nerves (triangle of pain).
- In case of bilateral hernia repair, the meshes should overlap each other in the midline and are fixed to each other with stapler so that they function as one mesh.

Step 7 – Reperitonealisation

After placement of the mesh, the peritoneal flap is closed over the mesh to prevent bowel and omental adhesions. The peritoneal flaps can be closed either with sutures or tacks .



A few keys points should always be remembered to keep the recurrence rate close to zero

- The peritoneum should be stripped from the midline the medially to the anterior superior iliac spine laterally.
- Proximally the peritoneum should be stripped off the cord structures for a distance to prevent indirect recurrence.
- In direct hernia, the dissection should cross the midline.
- Mesh of 15 x 12cm is recommended, so that the entire myopectineal orifice is covered with wide overlap.
- The mesh should lie in the pre-peritoneal space without any folds, particularly at the corners. If the mesh is getting folded, the pre peritoneal space should be dissected further.
- For Bilateral repair, the mesh of both sides should overlap in the center.
- The mesh should be fixed over the cooper's ligament with minimum two staples.
- The polypropylene material has memory and after it is unrolled inside,it may again roll back and leave the defect uncovered.
- Fixing the upper margin of the mesh further decreases the chances of the mesh rolling back and can help in obtaining a zero recurrence.

LAPAROSCOPIC INGUINAL HERNIA REPAIR : THE TEP TECHNIQUE

The history of inguinal hernia repair over several decades implies how innovations are adopted into surgical practice through combination of scientific and subjective processes. The techniques of laparoscopic hernia repair have evolved in parallel with experience and technology. The laparoscopic approach is based on the principle of tension free repair, which has been well established by open operation by Nyhus and Stoppa. The greater availability of space in the extraperitoneal approach facilitates the insertion of a much bigger mesh.

Patient selection

- TEP groin hernia repair is an advanced laparoscopic procedure. It requires greater skills of laparoscopic dissection and manipulation as the working space available is limited.
- It has a long learning curve and must be done only after acquiring experience in basic laparoscopic procedures and when the learning curve is over.
- Except for strangulated hernia, at present there are no absolute contraindications for this procedure.
- Relative contraindications include patients unfit for anesthesia, obese and pregnant patients and patients with a history of lower abdominal surgery.

Surgical Technique

The procedure is done under general anesthesia (regional anesthesia if the patient is unfit for general anesthesia).

The patient is catheterized or asked to empty the bladders before surgery and prophylactic antibiotic is given at the time of induction of anesthesia.

After induction, complete reduction of the contents of the hernial sac is ensured.

Step 1 : Extraperitoneal access

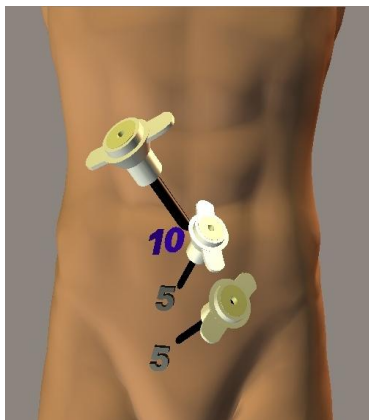
- A 10mm infraumbilical transverse incision is made.
- The anterior rectus sheath is exposed and transverse incision is then made on the anterior rectus sheath to one side of the midline to avoid inadvertent opening of the peritoneum

- The margins of incised sheath are held in stay sutures using vicryl 1-0
- The rectus muscle is retracted laterally from the midline and by finger dissection a space is created between the rectus muscle and the posterior rectus sheath.

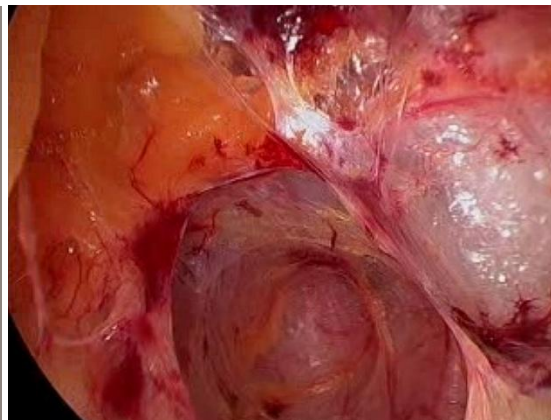
Step 2 : Dissection of Extraperitoneal Space

Balloon dissection of the extraperitoneal space

- A self made balloon is then inserted in this Preperitoneal space. The balloon trocar used by us is an indigenously made trocar where we tie two finger stalls of a size 8 latex surgical glove on the tip of the 5 mm laparoscopic suction cannula .The balloon trocar is the inflated with 100-150ml of saline. It not only creates an initial working space but also brings about hemostasis by balloon tamponade. The balloon is then deflated and the cannula is removed.
- A 10 mm Hassan’s cannula (blunt tip cannula) mounted with a conical sleeve is then introduced into the preperitoneal space through the infraumbilical incision .The conical sleeve snugly fits into the incision and is secured with stay sutures. The insufflation tubing is attached to the Hasson’s Cannula and insufflation is begun with pressure setting at 12 mm Hg.
- A 10 mm 30° telescope is used. The camera is introduced through the sub umbilical port and preperitoneal space is visualized. The other two working ports are placed in the preperitoneal space.
- First, a 5 mm port is placed about 2-3 cm above the pubic symphysis in the midline and second, a 5/10 mm port is placed in the midline midway between the two placed ports (subumbilical and suprapubic)



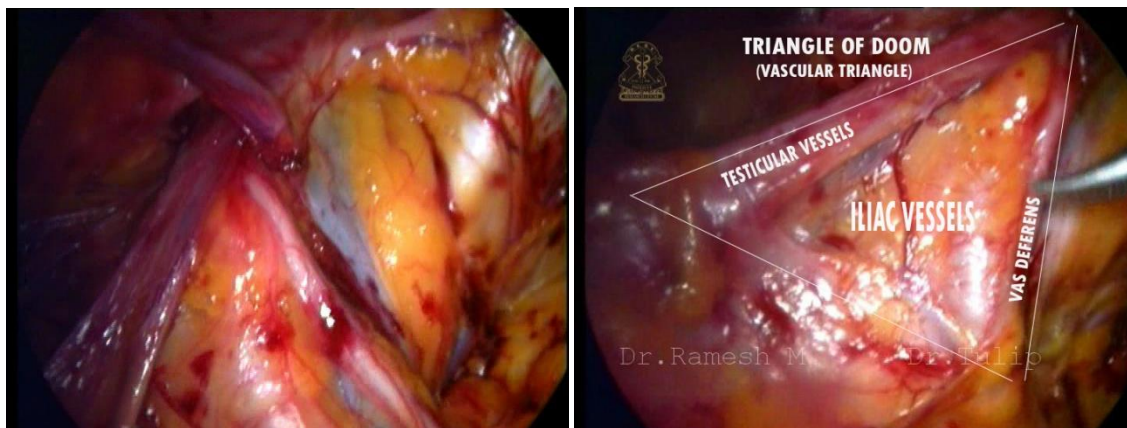
Port placements in TEP



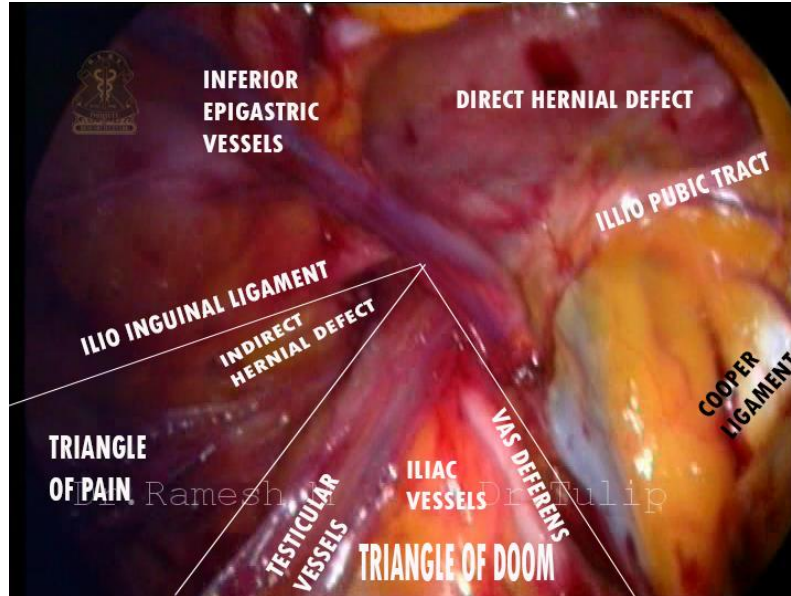
Extraperitoneal space creation

Alternatively Extraperitoneal space can be dissected using blunt telescopic dissection dissection

- The surgeon stands on the side opposite to the operating side / or side where hernia is present. Dissection in extra peritoneal space begins by dividing the loose areolar tissue in the midline using sharp and blunt dissection. The first landmark / reference point i.e. the pubic bone is identified which appears as white glistening structure in the midline. The pubic bone is visualized and bared of all connective tissue creating a shelf extending about 2-3 cm in the retropubic space, which acts as a shelf to place the mesh .
- The dissection is then traced laterally towards the side of the hernia. In case of direct hernia, the hernial sac is visualized as a weakness in the Hasselbach’s triangle medial to the inferior epigastric vessels. On the other hand, in the indirect hernia, the inferior epigastric vessels are seen before the hernial sac, which is encountered laterally.
- Once the adhesions are lysed or hernial sac is reduced as in direct hernia, the anatomical landmarks which now become visible are Cooper’s ligament, iliopubic tract, femoral canal and the inferior epigastric vessels
- The spermatic cord lies immediately inferior and lateral to the inferior epigastric vessels. The adhesions all around the cord are lysed with caution as the external iliac vessels lie just below the cord structures. The peritoneal extension (sac) is seen as a white glistening structure lying anterolateral to the cord .The sac is completely dissected off the cord structures and reduced.
- In cases of complete hernia, attempt should not be made to completely reduce the sac as excessive traction and dissection causes severe postoperative pain and edema. The sac should be transected and ligated using a catgut endoloop or by intracorporeal sutures, leaving the distal sac open in situ .



- The peritoneal sac with reflection is completely reduced. The vas deferens is seen lying separately on the medial side and gonadal vessels are seen on the lateral side forming a triangle. This triangle, known a “**triangle of doom**”, is bounded medially by the vas deferens laterally by gonadal vessels with its apex at the internal inguinal ring and the base is formed by the peritoneum. No dissection should be carried within this triangle as it contains the external iliac vessels.



- Dissection is continued lateral to the cord structures to create adequate space for the placement of mesh.
- The lateral space contains loose areolar tissue, which is completely divided using sharp and blunt dissection. The psoas muscle is seen lying on the floor on which lateral cutaneous nerve of thigh and genito femoral nerve can be seen transversing. The anterior superior iliac spine marks the lateral boundary of the dissection.

Step 3 : Preparation and placement of the Mesh

- Haemostasis should be secured before the mesh is placed and any blood/serum sucked out.
- A polypropylene mesh of 15cm (transverse) X 10 cm (vertical) is used for repair on each side.
- The mesh is now rolled completely and introduced into the operating field through the 10 mm umbilical port by removing the telescope. The telescope is then reinserted.
- The mesh is placed over the space created so that it covers the sites of direct, indirect, femoral and obturator hernias
- The mesh is secured in place with the help of tacks. After adequately spreading the mesh, which extends from the midline medially, to lying over the psoas muscle on the lateral side, preperitoneal space is deflated.

LAPAROSCOPIC TAPP OR TEP FOR INGUINAL HERNIA

Laparoscopic Inguinal hernia repair depends mainly on understanding the endoscopic anatomy of the groin. The primary indications for laparoscopic hernia repair were bilateral and recurrent Hernia , but advantages of Laparoscopic surgery has driven the present world into Minimally Invasive techniques .

Laparoscopic TAPP or TEP repair is based on the primary and secondary outcomes .

Primary outcomes:

Serious adverse events (including visceral injuries and vascular injuries)

Persisting pain

Hernia recurrence

Secondary outcomes:

Duration of operation

Conversion

Hematoma

Seroma

Wound Infection

Mesh Infection

Port site hernia

Length of hospital stay

Time to return to usual activities

Persisting numbness

Quality of Life

Guidelines for laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal Hernia [International Endohernia Society (IEHS)]

- During the third meeting of the network International Endohernia Society (IEHS) held in Stuttgart, January 2008
- Ten surgeons from four continents showed that guidelines for standardization of operative technique
- The guideline development process started in June 2008
- Consensus Conference organized for February 2009 in Delhi
- Evidence based medicine

ISSUES DISCUSSED :

- Laparoscopy in Complicated Hernia
- TAPP or TEP in uncomplicated Hernia
- TAPP in Complicated Hernia
- TEP in Complicated Hernia
- Re TAPP / TEP for Recurrent Inguinal Hernia

Laparoscopic surgery in complicated hernia feasibility, risks, and benefit

Statements :

- TAPP and TEP are possible therapeutic options in scrotal hernia

Operation time, complication rate, and frequency of recurrences are higher than in normal hernia repair

Sero-hematoma formation is the most frequent complication

Results will improve with gaining experience

Complete reduction of hernia sac is possible

- The higher recurrence rate may result in some of these cases (large hernia openings), because the standard mesh size (10 × 15 cm) was too small.
- In large hernia openings a mesh with less flexural stiffness (lightweight) or insufficient overlapping may be pushed into the defect.

Recommendations :

- TAPP and TEP may be safely used when performed by surgeons with a higher level of experience in either technique
- In large hernia openings (>3–4 cm), a larger mesh may be used (12 × 17 cm)
- In large direct defects (>3–4 cm), a stapled fixation of the mesh to the symphysis, Cooper's ligament and rectus muscle may be done
- In large indirect defects (>4–5 cm), the overlapping of the mesh has to reach approximately 1–3 cm lateral to the ASIS

Uncomplicated inguinal hernia

Statements :

- Potentially serious adverse events are rare after both TAPP and TEP
- Regarding overall complication rate, there is no obvious difference between TAPP and TEP
- TAPP and TEP show a noticeable “learning curve.”
- TEP is more suitable for regional anesthesia.
- Unsuspected hernias on the contralateral side are easier to detect with TAPP.

Recommendations

- Both techniques are acceptable treatment options for inguinal hernia repair, but there is insufficient data to allow conclusions to be made about relative effectiveness of TAPP compared with TEP.
- In selected patients having a contraindication for general anesthesia, TEP in regional anesthesia can be done.

The incidence of incipient unsuspected contra lateral hernia is 11.2–20%.

- Laparoscopic hernia repair (TAPP) has a major advantage of allowing the surgeon to explore the site contra lateral to the clinically diagnosed hernia without any additional dissection steps.
- In TEP, the contra lateral medial space can be explored easily, but the exploration of the deep inguinal ring may be difficult.

TAPP for incarcerated and strangulated inguinal hernia

Statements

- Operation time is longer than in uncomplicated hernia
- Complication rate and recurrences are similar to uncomplicated cases
- Advantage of laparoscopy is that bowel viability can be observed during the whole time of procedure

- Reduction of hernia content or cutting the hernia ring if necessary for reduction may be safer when overlooking both peritoneal and Preperitoneal space.

Recommendations:

- TAPP may be used for the repair of incarcerated or strangulated inguinal hernias, but the technique should be reserved for surgeons with extensive experience in the TAPP technique.
- Compromised bowel that is encountered during TAPP repair of strangulated hernia may be resected after the completion of the TAPP repair (after allowing time for the bowel to declare its viability).
- The resection should be performed extra corporeally for intestine or may be performed intracorporeally for omentum or appendix.

TEP for incarcerated and strangulated inguinal hernia

Statements :

- The conversion rate ,recurrence and complication rates are higher
- A drawback to the TEP vs. TAPP approach for the strangulated inguinal hernia is that TEP does not allow inspection of the bowel without laparoscopy

Recommendations :

- TEP may be used for repair of both incarcerated and strangulated inguinal hernias; however, the data on the subject are scant
- The umbilical port can be converted from a preperitoneal port to an intraperitoneal port to assess bowel viability when it is in question.

TAPP inguinal hernia repair after failed TAPP/TEP

Statements :

- Re-TAPP is possible
- Operation time is longer and morbidity higher compared with repair of primary hernia, re-recurrence rate are similar
- There is a steep learning curve.
- TAPP is superior to TEP

Recommendations : TAPP repair of recurrent inguinal hernia after prior TAPP or TEP may be performed; however, it should only be attempted by experts in TAPP inguinal hernia repair

Pitfalls of TAPP and TEP repair for recurrent inguinal hernia

Statements :

- The presence of two or more meshes in the inguinal region does not seem to enhance the frequency of chronic pain
- Removal of a previously implanted Preperitoneal mesh may increase the risk for injury to urinary bladder, bleeding complications, and substantial defects of the peritoneum

Recommendations :

- Old mesh should be left in place
- The re-repair should be defect-adapted

CONCLUSIONS :

- Master one technique : Both techniques have learning curves
- Recurrence rate same
- Start with TAPP and then move on to TEP

TAPP :

- Familiar during other laparoscopic procedures
- Unilateral Inguinal Hernia
- Strangulated / Obstructed hernia
- Other intraabdominal procedures
- Other Ventral Hernia
- Previous lower abdominal surgery
- In case of **diagnostic uncertainty** despite extensive use of the diagnostic tools—ultrasound, CT scan, MRI: TAPP is the approach of choice
- **When at laparoscopy no hernia opening is visible in patients with strong clinical suspicion of hernia, a Preperitoneal exploration is indicated**

TEP :

Steep learning curve compared to TAPP

The incidence of peritoneal tear is 47%

TEP most suitable for bilateral Inguinal Hernia

TEP is cost effective

No sutures

No tackers

Can be done under regional anesthesia

COMPLICATIONS OF LAPAROSCOPIC INGUINAL HERNIA REPAIR

Laparoscopic hernioplasty is an advanced laparoscopic surgery. Operative technique and experience determines the frequency of complications, time of recovery, and rate of recurrence. A proper technique is essential to achieve good results.

A. Intra operative complications

Urinary Bladder Injury :

The urinary bladder should be emptied before surgery either by self-voiding or by catheterization. A full bladder can create lot of difficulties during medial dissection and also becomes prone to injury. The bladder may sometimes become full intra-operatively if the anaesthetist infuses fluid rapidly or the procedure becomes prolonged. In such a situation, it is preferable to insert a catheter intra-operatively than to struggle with a full bladder.

Bowel Injury:

The patient should be in a head low position to move the bowels away from the operating field. During TAPP repair, as in all pelvic surgeries, possibility of thermal injury to the bowel exists. The insulation of the instruments should be checked, use of electrical energy should be kept to minimum and while moving the hand instrument, the foot should be off the cautery pedal to prevent accidental thermal injury to intraperitoneal structures.

Bleeding:

Inferior epigastric or gonadal vessels can cause bleeding during dissection. Gentle careful dissection will avoid bleeding. Mostly, bleeding may be controlled with monopolar cautery or clips. The most disastrous of all is the iliac vessel injury (in the Triangle of Doom), which requires an emergency conversion.

B. Post Operative Complications

Seroma or Hematoma Formation:

Seroma formation is a common complication after laparoscopic hernia surgery.

The incidence is in the range of 5 – 25%.

Seromas generally form at the end of one week and are a cause of significant distress to the patient, since they look like a recurrence.

If the possibility of seroma formation is discussed with the patient before surgery, it goes a long way in alleviating their distress.

They are common after large hernia and direct hernia repair.

Seroma formation is more common during the learning phase and decreases with increasing experience.

Gentle careful dissection and perfect haemostasis will decrease the incidence.

The pseudosac can be tacked to the pubic bone with 2 or 3 tacks in large direct hernia to prevent Seroma formation.

The scrotum should be completely deflated at the completion of surgery, before the ports are taken out. If seroma is expected, scrotal support should be used for the first 7 to 10 days to prevent their formation.

Seromas mostly resolve by 4 to 6 weeks.

The patient needs to be reassured about the spontaneous resolution of the swelling.

If it does not resolve in 8 weeks, it may be aspirated under aseptic precautions.

Urinary Retention:

The incidence of urinary retention after laparoscopic hernia repair is about 1.3 – 5.8%.

It is usually precipitated in elderly subjects, especially if symptoms of prostatism are present.

These patients are best catheterized prior to surgery and the catheter removed on the morning after the surgery.

Neuralgia:

This complication is reported to be between 0.5 – 4.6% depending on the technique of repair.

Understanding the anatomy and location of the nerves lateral to the internal ring and avoiding stapling in the area of the nerves has decreased the incidence.

No staples are applied for fixation of the mesh lateral to the cord and below the ileo-pubic tract, in the region the triangle of pain.

A general rule is that the stapler should be fired only when the tip of the stapler can be felt by the other hand on the anterior abdominal wall.

If the tip of the stapler cannot be felt with the other hand, it is too posterior and is in wrong position.

Port site Hernia:

Hernia can occur at the 10mm port sites. The sheath of 10 mm port should always be closed with vicryl suture.

Mesh infection:

Infection of the mesh is a serious complication after any hernia repair.

Thorough aseptic precautions during handling of the mesh are important.

The hand instruments and ports should be properly sterilized.

The mesh should not come in direct contact with the skin.

Changing gloves before handling the mesh is a wise precaution.

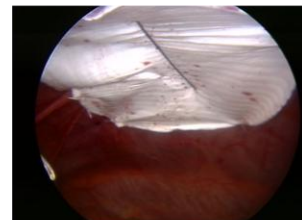
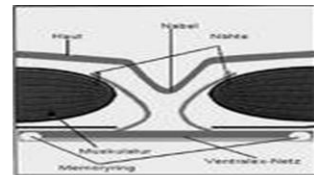
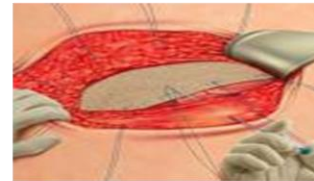
MESH SELECTION

MESH :

- Surgically designed sterile woven material
- Used as a “ patch “or “screen” above or under the weakness or as a “plug “into the defect
- Acts as a scaffolding for new growth of one’s own tissue which incorporates mesh into the tissues
- Tension free repair is the “ Benchmark “ of hernia surgery

TYPES OF REPAIR

- On lay /Overlay – Above rectus
- Inlay – To the edges
- Underlay - Below Peritoneum
- Sand witch – Overlay + Underlay



IDEAL MESH :

- Biocompatible & Noncarcinogenic
- Withstands Physiologic Stress for long time
- Promotes Strong Tissue Ingrowths
- No Substantial contraction
- No adhesion to viscera
- Resists colonization and infection
- No added pain
- Readily available
- Acceptable cost

TYPES OF MESHES :

Various properties of the mesh type can affect the way body responds to the mesh

- Synthetic
- Composite
- Biological

Synthetic meshes :

Polypropylene

Polyester

PTFE

Composite meshes :

Visceral facing – Non tissue in growth side

Parietal facing – Tissue incorporating side

- **Vipro** - Prolene + Vicryl
- **Parietex** - Polyester + Collagen layer

- **Proceed** - Prolene + Polydioxanone + Oxidised regenerated cellulose
- **Atrium C- Qur** - Prolene + Omega -3 fatty acids
- **Gore Dual mesh/ Dual mesh plus** – Dual layer of e – PTFE + Chlorhexidine and Silver (Visceral side brown)
- **Sepramesh** - Prolene + Polyglycolic acid + Sodium hyalurate +carboxymethylcellulose + polyethylene glycol

PROPERTIES OF ABSORBABLE BARRIER COATED MESHES

Mesh	Manufacturer	Permanent	Barrier	Longevity (days)	Weight (gm/m ²)
Parietex Composite	Covidien	Polyseter	Atellocollagen Type 1, Polyethelene glycol, glycerol	20 days	75
C- Qur	Atrium	PP	Omega 3 fatty acids	90-180	50
Proceed	Ethicon	PP	Oxygenated regenerated Cellulose + Polydioxanone (PDS)	Within 30 days	45
Sepramesh	Davol	PP	Seprafilm	Within 30 days	102

Biological mesh :

Large sheets of collagen , processed to remove cellular elements and to reduce the foreign body response

1st biological mesh – 1999

Allow neovascularisation – Regenerative matrix – fibroblast – Collagen

Used in contaminated / infected field

Tensile strength decreases over time leading to recurrence

- Porcine sub mucosa
- Porcine dermis
- Bovine pericardium
- Cadaveric skin

Comparison of 4 Biologic Prosthesis in Ventral Hernia Repair in Animal

	Cross-Linked Bovine Pericardium (A)	Non-Cross-Linked Bovine Pericardium (B)	Porcine Derived Cross-Linked Dermal Collagen (C)	Dermal Matrix Obtained From Human Cadaveric Split-Thickness Skin (D)
Adhesion coverage, mean %	31	28	25	26
Tensile strength at 6 months	2025	743	2596	736
Abdominal wall-prosthesis breaking strength (mean, gf)	729	870	622	745

Meshes are also classified based on pore sizes

Type 1: totally macroporous prosthesis, pores > 75 microns; example prolene, marlex

Type 2: totally microporous prosthesis; pores < 10 microns; example gortex or dual mesh

Type 3: macroporous prosthesis with microporous components; example Teflon, mersilene

Type 4: biomaterials with submicronic pore size; example cilastic, cell gard

	Covidien Parietex Composite	Bard Composix E/X	Bard Ventralex	Ethicon Proceed	Atrium C- Qur	Gore Dual Mesh	Sepramesh
Adhesion prevention	+++	+	+	+	?	+	++
Tissue integration	++	+	+	+	+	-	++
Shrinkage	+	+	+	+	+	-	+
Elasticity	++	-	-	+	?	-	+
Ease of fixation	++	+	++	+	+	-	+
Protected edges	Y	Y	Y	N	N	N	N

Polypropylene

- Schmitt and Griman in 1967 first described successful use of polypropylene mesh in contaminated wounds
- Subsequent reports showed good initial healing but were fraught with long term complications
- Those complications are chronic infection, fistula formation, erosion into bowels or through skin grafts
- Jones and Jurkoyiun in 1989 reviewed 14 studies, 128 patients, and found 55 overall complication rate - enteric fistulization being the most common.

Advantages :

- Good tensile strength
- Extensive fibroblast in growth, incorporation by the host and can be used in contaminated fields

(Franklin ME et al. Lap ventral and incisional hernial repair. *Surg Lap End* 8(4):294-299 1998

285 lap ventral hernia and 520 lap inguinal hernia using IPOM with polypropylene mesh. 1 fistula formation (0.14%), 4 mesh infections (0.50%), and 6 reoperations for bowel obstruction secondary to mesh adhesions (0.75%). Relaparoscopy 27 patients (19 incisional, 8 inguinal): 1/3 no adhesions, 1/3 mild adhesions, 1/3 severe.)

Disadvantages :

Major complications with polypropylene not evident until years later

- Adhesion formation
- Erosions
- Enterocutaneous fistula

It is extremely difficult to lyse adhesions to polypropylene without causing enterotomies

ePTFE

Advantages :

- Microporous, smooth texture minimizes tissue in-growth and limits adhesion formation and bowel injury
- Combined with a large pore second layer it can adhere well to the abdominal wall

Disadvantages :

- Microporous construction limits ability of macrophages to destroy bacteria
- Mesh infection is not well treated by antibiotics and requires mesh removal
- Does not integrate well into host tissue when not combined with a large pore mesh
- Mesh shrinkage

Polyester

- *Parietex* (polyester and atelocollagen type 1, polyethylene glycol, glycerol) Covidien, Hamilton, Bermuda
- Polyester mesh incorporates well into the abdominal wall
- Collagen covering on the visceral surface protects bowel and dissolves as the polyester is incorporated

Ethicon Proceed

- Multilayered tissue separating mesh comprised of:
- PROLENE* Soft polypropylene Mesh
- Monofilament polypropylene encapsulated with polydioxanone (PDS)
- Designed for strength, durability, and adaptability
- Oxidized regenerated cellulose (ORC) fabric

Minimizes tissue attachment

Plant-based material (non-animal)

- Absorbable polydioxanone (PDS)

Creates a flexible, secure bond between the mesh and ORC layers

Advantages :

- Lightweight Monofilament Construction

Less foreign mass

Flexible scar tissue

Strong tissue incorporation

- Excellent Handling

Low profile

Blue-striped surface distinguishes the parietal

from the visceral side

- Resists Bacterial Colonization

No ePTFE

Lightweight, macro porous, monofilament mesh structure

Allows fluid flow-through

- Recovers to Original Shape Once Placed

Easily deployed and positioned once inside abdominal cavity

Conforms to anatomy

Readily customized

Disadvantages

- Low clinical efficacy
 - Contraction of the Prolene Soft by 34%
 - No memory shape, difficult to manipulate, tends to adhere to tissue when wet
 - Meticulous haemostasis must be achieved*
 - Low intra-op light
 - No overlap over the edges
 - De-lamination cases due to resorbable PDS may induce seroma, higher sepsis risk
 - Low resistance to suture
- ***IFU WARNINGS PROCEED Mesh** has an ORC component, which must not be used in cases in which appropriate hemostasis has not been established. Tissue attachment to the mesh can result if appropriate hemostasis is not achieved

Atrium C- Qur and C- Qur Edge

- Atrium's new C-QUR™ Mesh technology combines lightweight ProLite Ultra™ polypropylene surgical mesh with a proprietary, highly purified Omega 3 fatty acid bio-absorbable coating.
- C-Qur edge features a reinforced edge design for enhanced fixation stability and ease of use.
- Fatty acid may have antimicrobial properties.
- Resorption of the coating occurred within 3 to 6 months

Advantages :

- Animal testing show minimal adhesion and good tissue integration
- Fatty acid may have antimicrobial effect (not validated in clinicals)
- Transparent, good visibility of landmarks

Disadvantages :

- Lack of human studies

Gore Dual Mesh / Dual Mesh Plus

- Gore Dual mesh is a dual layer of ePTFE
- Visceral side is composed of ridges and valleys, called as Corduroy, to create porosity (22 µm).
- The smooth visceral side of the material is brown
- GORE-TEX® DUALMESH® PLUS Biomaterial is impregnated with two antimicrobial agents – chlorhexidine and silver – intended to inhibit bacterial colonization of the prosthesis for a period of up to ten days post-implantation

Strengths :

Used for many years

Weaknesses :

- No tissue integration
- High rate of seroma
- Need strong fixation: tacks and sutures
- Highest Shrinkage among material
- High density
- Opaque: cannot see the anatomical landmarks, vessel and nerves
- Shiny surface under lap

“The use of antimicrobial-impregnated ePTFE mesh with silver/chlorhexidine in laparoscopic ventral hernia repair is associated with noninfectious postoperative fever. In our patients, the evaluation and management of these fevers resulted in a significantly longer hospital stay.” Cobbs, Am Surg. 2006 Dec;72(12):1205-8;

Sepramesh IP

- Sepramesh™ IP Bioresorbable Coating / Permanent Mesh is co-knitted using polypropylene (PP) and polyglycolic acid (PGA) fibers to result in a two-sided mesh with a PP surface and a PGA surface.
- The mesh is coated on the PGA surface with a bioresorbable, chemically modified sodium hyaluronate (HA), carboxymethylcellulose (CMC) and polyethylene glycol (PEG) based hydrogel.
- PGA Fibers maintain 50% of the reinforcement strength during the 1st 28 days
- Bioresorbable coating protects for up to 14 days while peritoneum heals
- Hydrogel swells to cover sutures, tacks and mesh edges

Strengths

- Animal studies show low rate of adhesions
- Good mechanical properties (burst strength and suture retention)
- Translucent
- Good memory shape

Weaknesses

- Lack of human studies
- Requires 12mm or 15mm trocar for lap insertion (8x15, 10x20, 15x20, 20x30)

SELECTION OF MESHES

Depends on

- Type of repair
- Clinical situation
 - Preperitoneal – Synthetic mesh
 - IPOM - Composite mesh
 - Contaminated field – Biological mesh

Potential Mesh Related Complications

- Infection
- Intestinal adhesions
- Bowel obstructions
- Erosion of the prosthesis into the adjacent hollow viscous
- Contraction of prosthesis

MESH FIXATION DEVICES

Primary GOAL in hernia repair is decrease in recurrence

The peritoneum is a mobile organ that can allow for mesh movement and migration along its surface

Fixation is required to keep the mesh in flush with the peritoneum

- Recurrences are caused by rolling up of the mesh, incorrect stretching of the mesh or by incomplete covering of the hernia defect.
- Fixation required to prevent displacement and recurrence
- Point fixation alone does not guarantee the securement of the mesh to the abdominal wall
- Additional transabdominal sutures are also required

IDEAL MESH FIXATION DEVICE

- The device would penetrate through the mesh and Preperitoneal fat to securely seat itself in the abdominal fascia without protruding too far into the subcutaneous tissue or skin.
- Strong enough to hold the mesh in place despite being subjected to transient intraabdominal pressures of more than 200N in obese patients.
- No free sharp ends that could injure the tissues if unseated.
- Inert and cause minimal inflammatory nerve pain
- Low adhesiogenic profile
- Compatible with the use through 5mm port
- Not be difficult to remove if the mesh needed to be removed

MESH FIXATION :

One of the most controversially discussed topics in this field up to now is the type and technique of fixation . Area of incremental interest is the correlation of fixation and incidence of postoperative pain .

Mesh fixation device can be

- Tackers
- Sutures
- Glues

Many studies have compared the efficacy of tackers v/s sutures and tackers v/s glues on the basis of

- Cost effectiveness
- Tensile strength
- Operative time
- Acute postoperative pain
- Chronic postoperative pain

TACKERS :

PRINCIPLES OF APPLICATION OF TACKERS

- Hold the tissues to the tackers at 90 degree angle to ensure the construct is adequately seated, as it may need to be removed if the shoulder protrudes from the mesh
- Depth of at least 4mm of tissue in which to seat the tack
- Any free or loose tack should be removed because visceral injury is possible with the sharp point
- **Absorbable tack** -Follow the logic that the point fixation devices are only necessary until mesh incorporation into the abdominal wall is complete

Material	No of constructs	Material	Permanent ?
Pro Tacker	30	Titanium	Yes
Salute	10 , 30	Stainless Steel	Yes
Endouniversal Multifire Endohernia Stappler	10		Yes
Absorba	20	Polymer	8 months
Easy tack	5 , 12	Polylactic acid	2 years
I - Clip	10	Polylactic acid	1 year

COMPLICATIONS OF TACKERS

Neuralgia or paresthesia : Nerve entrapment

Pubalgia: stapling of the prosthesis to coopers ligament

Bleeding or hematomas in Retzius space

Intestinal obstruction , Erosions , Fistula

SUTURE FIXATION :

- The tensile strength of the transabdominal suture is 2.5 times greater than that of the tacker
- Cadaveric pig studies have shown that the optimal distance between fixation points is about 1.8 cm
- Cost effective alternative to tacker fixation
- Requires longer time
- Significantly less postoperative pain
- Twice the fixation strength
- Avoids the tack related complications

FIBRIN GLUE :

- Fibrin sealant as an atraumatic alternative to mechanical mesh fixation
- In terms of tensile strength and mesh dislocation, fibrin glue is equivalent to stapling
- Less chance of chronic post operative pain
- Chronic pain is not always due to staples, but may be caused by post operative fibrous scar around the staples-lead to nerve injury

FIXATION v/s NON FIXATION

- In TEP repair the mesh gets stabilised intrinsically due to preperitoneal placement :
Sandwich effect – between the peritoneum and abdominal wall
- The more common cause for recurrence of hernia are

Inadequate dissection

Smaller sized mesh

IEHS (International Endo Hernia Society) Guidelines :

- Fixation and Nonfixation of the mesh are associated with equally low recurrence rate in both TAPP and TEP ; however in most studies the hernia opening was small (< 3cm) or not measured
- Staple fixation : Increased groin pain compared to Nonfixation
- Fibrin glue : less pain , less cost and less recurrence
- Larger size defect (> 4cm) – fixation mandatory

LAPAROSCOPIC VENTRAL HERNIA REPAIR

GENERAL INFORMATION :

- Ventral hernia, a collective term for Incisional , Umbilical, and other anterior abdominal wall hernias
- Laparoscopic Ventral hernia repair was first performed in 1993 by LeBlanc
- Incisional hernia is formed in 3-20% of laparotomy incisions
- It constitutes 10-15% of all hernia repairs
- 17% will develop incarceration or strangulation

Primary Open repair of Ventral Hernia without mesh :

- Recurrence rate 25%-45% after first repair
- 58% recurrence after second attempt

Primary Open repair of Ventral Hernia with mesh :

↓ 10-20% recurrence

↑ 12 % infection rate and wound complications

The increase in wound complications in Open Ventral hernia repair is related to

- Large incision
- Extensive dissection
- Drains
- Mesh
- Co-morbidities

Laparoscopic Repair of Ventral Hernia is associated with

- ↓ wound complications
- ↓ Recurrence rate
- ↓ Hospital stay
- ↓ pain
- Early return to work and routine activities
- Coverage of “Swiss cheese” defects

PRINCIPLES OF LAPAROSCOPIC VENTRAL HERNIA REPAIR

- Access to the abdominal cavity
- Adhesiolysis
- Repair of the defect

ACCESS TO ABDOMINAL CAVITY :

- Palmer's space with verres needle
- Blunt trocar with open technique
- Optical trocar entry
- Remote from hernia site

Trocar requirements:

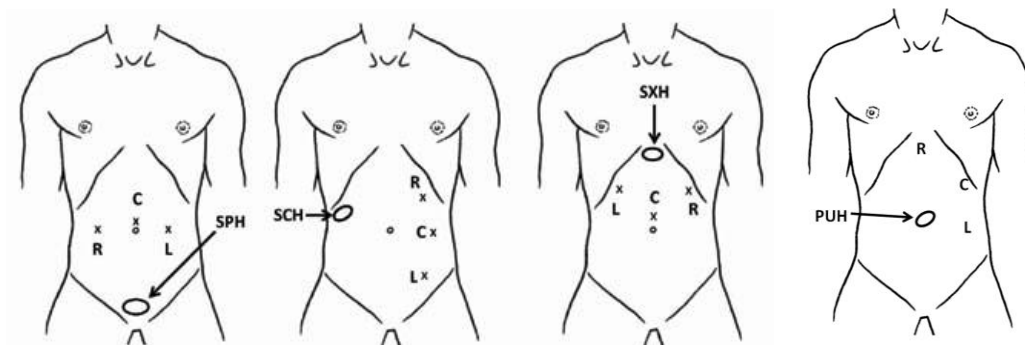
One 10 mm and 5 mm trocars

Port Placements :

Depends on the site of hernia

C: Camera , R : Right hand working port , L : Left hand working port

SPH : Suprapubic hernia , SCH : Subcostal hernia , SXH : Sub Xiphoid hernia , PUH : ParaUmbilical Hernia

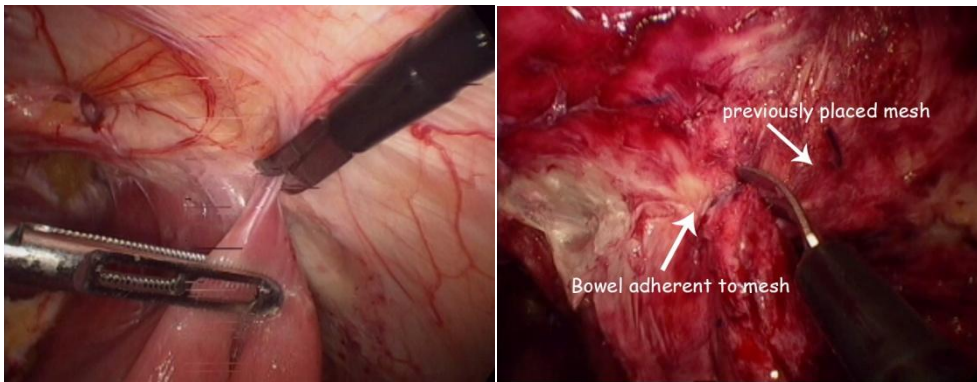


ADHESIOLYSIS :

A bowel injury may occur during LVHR, particularly in cases where extensive adhesiolysis is performed by surgeons with less experience

TIPS AND TRICKS OF ADHESIOLYSIS :

- Blunt and Sharp dissection
- Limited to freeing the abdominal wall for mesh
- Should be done near the abdominal wall away from the adherent tissue
- Judicious use of energy sources : Avoid monopolar diathermy
- Recurrent Incisional hernia : Do not try to separate the bowel from mesh
- Do not hesitate to insert extra ports

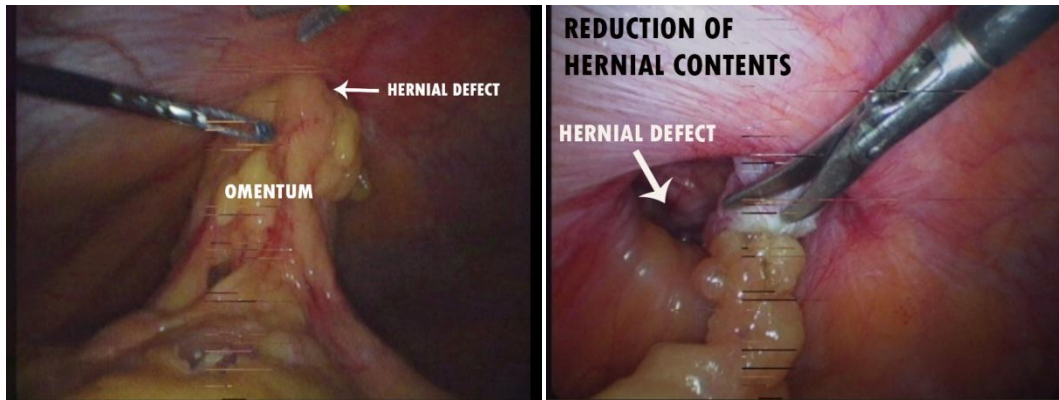


Adhesiolysis by sharp dissection with scissors

REPAIR OF THE DEFECT :

Before the repair of the hernia defect one should ensure that

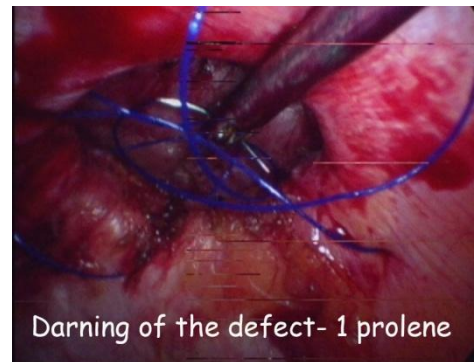
- Full extent of defect identified
- Presence of multiple defects defined



The defect is closed (darned) with monofilament No 1 Polypropylene before mesh is placed and fixed .



Swiss cheese pattern of defects



Darning of the defect- 1 prolene

SIZING THE MESH AND FIXATION :

- What is the best way to measure the mesh?
- 3 options
 - Intracorporeal with pneumoperitoneum
 - extracorporeal with pneumoperitoneum
 - extracorporeal desufflated

With extracorporeal measurement, the diameter of the outer (skin) circle is larger than the inner (peritoneal) circle . This difference is proportional to the size of the patient. This results in overestimation of hernia size and mesh by 1.7 to 3.1 cm.



Retrieval of transfascial sutures using
Carter-Thomson suture device



Transfascial sutures

Once the defect is measured a mesh is selected that provides at least 5 cm of overlap from the edge of the defect. The mesh is fixed both by transfascial sutures and tacks . We use No 1 PDS for the transfascial sutures and also tackers to fix the mesh . The mesh is secured at the periphery with tackers . We also use another row of tackers around the hernia defect in order to ensure proper fixation and also it helps to prevent the mesh herniating into the defect . This two rows of tacker application is called as “ **Double Crown Technique** “.



MANAGEMENT OF BOWEL INJURIES DURING VENTRAL HERNIA REPAIR

- LVHR continues to gain increasing popularity
- Complications tend to be fewer but may be more serious

INCIDENCE OF BOWEL INJURY DURING LVHR

- A recent literature search by LeBlanc demonstrated an enterotomy rate of 1.78%
- The overall mortality rate for these patients was 2.8%
- In the subset of patients where the injury was occult and recognition was delayed until after surgery (18%), the mortality rate was as high as 7.7%
- Predictably small bowel was injured 92% of the time

Factors which put the patient at higher risk of enterotomy

- Adhesiolysis longer than three hours
- Chronic obstruction
- Inflamed bowel
- Prior mesh incorporated into bowel

CATEGORIES OF BOWEL INJURIES :

- **Immediately recognized injuries** : Initial port entry or from bowel manipulation and adhesiolysis
- **Missed injuries** : During adhesiolysis. Usually recognized as a septic response in the first 24 hours post-operatively
- **Delayed injuries** : Result of progression of a serosal injury from an energy source. Present within the first 5 days postoperatively

HOW TO MANAGE ENTEROTOMIES DURING LVHR ?

Depends on

- The extent of the bowel injury
- Contamination
- Experience of the surgeon

Key points to remember !

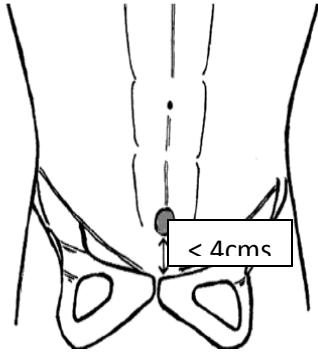
- Enterotomy does not mandate conversion to open repair nor preclude immediate LVHR
- LVHR may be completed in the setting of recognized bowel injury if repaired immediately with minimal spillage.
- In the event of a bowel injury repaired laparoscopically, LVHR may be performed with a delay of 3 to 7 days after giving broad spectrum antibiotics and when there are no signs of infection
- Conversion to laparotomy may be performed
- A primary open repair may be performed in the setting of gross spillage.
- An open prosthetic repair may be undertaken if conditions remain sterile
- Small laparotomy away from the hernia defect may be used to repair a recognized enterotomy followed by continuation of LVHR : The incision made away from the hernia and under direct visualization with the laparoscope, the injured bowel was brought through the incision and repaired extracorporeally. The incision can be then closed and the LVHR resumed
- Unrecognised enterotomy : Safest approach is repair, resection of the injury, mesh explantation and primary repair of the fascial defect if it can be closed

LAPAROSCOPIC REPAIR OF SUPRAPUBIC HERNIA :

THE TAPE (Trans Abdominal Partial Extraperitoneal) TECHNIQUE

Suprapubic or parapubic hernias are defined as those incisional hernias whose lower border is located less than 4 cm from the upper border of pubic arch.

The incidence of suprapubic incisional hernia range between 0.04% and 3.4 %.



They usually follow low vertical or transverse incisions following gynecological , open prostatic or rectal procedures and suprapubic catheterization.

The abdominal oblique aponeurosis , rectus abdominus muscles and rectus sheath are inserted on the pubic symphysis . An incision placed in close proximity to this musculotendinous insertion , incisional hernia can develop as a result of inadequate tissue purchase inferiorly during fascial reapproximation .

Recurrence rates following the repair of suprapubic hernias are high because of inherent difficulties including

- Complexity of dissection
- Close proximity to neurovascular structures
- Deficient posterior rectus sheath inferiorly
- Lack of adequate mesh overlap .

A sound knowledge of endoscopic groin anatomy is a prerequisite in managing these hernias laparoscopically.

The first laparoscopic repair for suprapubic incisional hernia was reported by Hirasu et al who described an IPOM technique using dual mesh . They used a composite mesh with 2-3 cm overlap, fixed only with tacks with no transabdominal sutures in seven patients . After a 4 to 9 month follow up in six of the patients , they had one (14.3 %) recurrence at 8 months .

Carbonell et al reported 36 patients undergoing laparoscopic suprapubic hernia repair with recurrence rate of 5.5 % . He used suture passer penetrating the periosteum of the pubic tubercle for placement of transabdominal sutures inferiorly. The e PTFE mesh was fixed both by transabdominal sutures and tacks . Transabdominal sutures taken through the periosteum of the pubis may result in osteitis pubis . Fixation of the mesh to cooper's ligaments which are tough ligamentous structures , is also expected to increase the strength and durability of repair .

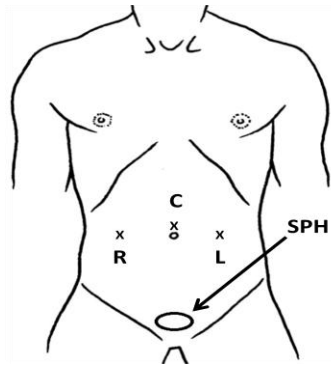
The TAPE (Trans Abdominal Partial Extraperitoneal) technique for suprapubic hernia was described by Chowbey et al in their series of 72 patients .They used polypropylene mesh for TAPE technique and for large defects or in multiple swiss cheese defects , a second composite mesh was used to overlap the proximal part of the hernia defect with a margin of 5 cm and the exposed proximal part of the prolene mesh , so that there was no exposure of the polypropylene mesh to the underlying bowel.

We have used TAPE technique for all our Suprapubic Incisional hernia repairs.

Port Placements :

10mm Supraumbilical Camera port

Two 5mm working ports in the lateral abdominal wall typically in the mid clavicular line .



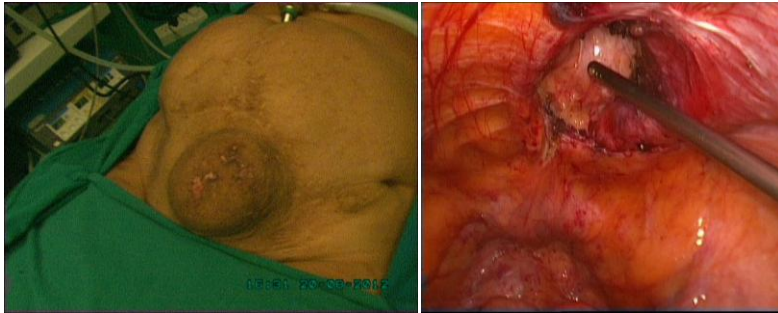
Parietex mesh was used in all the cases

.We have routinely catheterized all patients undergoing laparoscopic TAPE repair for suprapubic hernia . Another technique described is to use a three way foley's catheter and instill with 250 – 400 ml of saline ,so that the distended bladder is easy to identify .

The Principles of Laparoscopic Repair of Suprapubic Hernia by “ **TAPE TECHNIQUE** “ are as follows

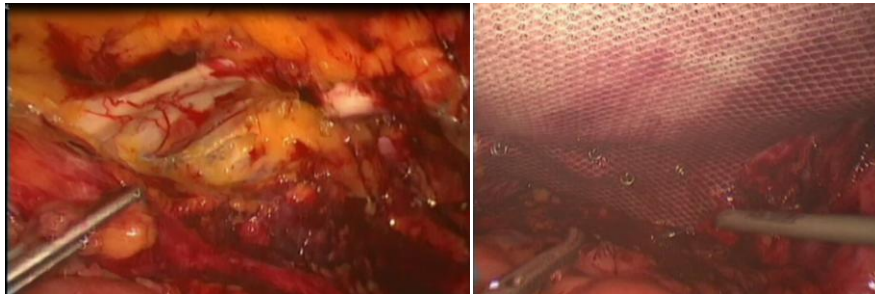
- Raising the peritoneal flaps from one anterior superior iliac spine (ASIS) and extending to the contralateral ASIS .
- The flap is dissected inferiorly defining the space of retzius and pushing the urinary bladder down .
- Pubic arch , coopers ligament and inferior epigastric vessels on both sides are defined.

- The mesh was placed 2 cm behind and beyond the pubic arch , fixed to the pubic tubercle and cooper's ligament on both sides.
- 5cm overlap of mesh from edge of defect
- The raised peritoneal flap was refixed to the mesh , thereby partially extraperitonising the mesh , using the TAPE technique.



Suprapubic Hernia

Laparoscopic view



Defining Coopers ligament and pubic tubercle

Parietex mesh fixed to Coopers ligament and pubic tubercle



Mesh Partially Extraperitonised

CHRONIC GROIN PAIN FOLLOWING HERNIA REPAIR

The terminology “Inguinodynia “ is used to define chronic pain following hernia mesh repair .

This may occur due to assortment of causes including mesh shrinkage , inflammation , scarification as well as surgical technique .

This relatively newly-recognized syndrome has become a modern day plague on the claims examiner, the treating surgeon and the patient .

Despite a “**million dollar work-up**” the patient may still complain of the same pain as they had from the inception .

It is particularly common in patients with pre-operative pain due to hernia and in patients who are of younger age.

Diagnosing chronic groin pain is difficult and needs a high level of patient co-operation.

Pain severity is subjective and will remain difficult to evaluate until better scoring systems are developed.

In most studies pain is measured subjectively prior to initiation of medical or surgical treatment. Occasionally, objective assessment tools like VAS are used or there is correlation with pre-operative pain scores before treatment is given.

There is currently a lack of consensus on the appropriate transition from medical to surgical management of these patients

Non-medical Reasons for Asserting Inguinodynia

Interestingly, the most current surgical literature reveals that over 90% of inguinodynia occurs in workers compensation patients.

1. Posturing for secondary gain
2. Legal representation
3. Loss of job
4. Loss of sexual prowess in the male
5. Loss of financial security or income

Potential causes of Inguinodynia

1. Breach of surgical technique

- a. Poor mesh placement
- b. Nerve entrapment
- c. Osteitis pubis
- d. Loss of domain
- e. Compromise of spermatic cord
- f. Inappropriate tack placement laparoscopically or suture placement with open technique

2. Neuropathy secondary to exaggerated scarification response

3. Plug repair with secondary concrete-like mass and possible neuropathy from resultant scarification

4. Idiosyncratic response to mesh implantation

5. Post-op infection or fistulization/sinus formation

6. Infected mesh-toxic shock syndrome

7. Gynecological causes

8. Inflammatory or irritable bowel disorder

The treatment of chronic groin pain can be a difficult ordeal for both the patient and the surgeon .

Many algorithms have been put forward for management of chronic groin pain but none of them has been proved in randomised trials.

Pain related to neuropraxia (intact axon and myelin sheath), is usually temporary and may resolve itself in around 6 months post- herniorraphy.

As time progresses, chronic groin pain disappears without treatment in 30% of the patients, remains mild in 45% and in 25% of them it persists as severe pain affecting their everyday life.

NON-SURGICAL TREATMENT

Lifestyle modification :

Chronic groin pain has been shown to be aggravated by walking, stooping or hyper-extension of the hip and relieved by recumbent position and flexion of the hip and thigh .

Hence, some clinicians have advised lifestyle changes, advocating sedentary lifestyle or sedentary occupations to negate the neuropathic pain caused by movement. It is not now recommended because of the availability of better medical and surgical modalities

Analgesics :

These include NSAIDs , opioids, muscle relaxants,antiepileptics and antidepressants. However, these drugs may not prove helpful in relieving all types of chronic groin pain.

The anti-depressants and antiepileptics are helpful in neuropathic pain whereas opioids or NSAIDs are usually minimally effective or ineffective for neuropathies . In most studies, NSAIDs were used as the first line analgesic treatment .

Nerve blocks :

Nerve blocks reversibly interfere with neuronal transmission, leading to temporary pain relief. This can, therefore, be both diagnostic and therapeutic.

The ideal nerve block would specifically anaesthetise the nerve proximal to the injury but this is technically challenging.

Various chemical agents used for blockade are shorter- or longer- acting local anaesthetics, steroids and glycerol as well as neurolytic solutions such as alcohol or phenol .

There is little published information on the success rate of nerve block as this depends on the experience of the surgeon or the anaesthetist performing the procedure.

Recently Ultrasound guided blocks have been shown to be highly accurate and selective for blockade of either the IIN or the IHN, thereby increasing success rates.

Alcohol or phenol injection has been tried for reducing chronic inflammation caused by mesh or postoperative fibrosis.

Neuro-destructive procedures, such as cryo-ablation which destroy the nerve fibres by coagulation at very low temperatures (-40 degree), have been shown to give some temporary pain relief. Following cryo treatment pain recurred due to axonal regeneration.

Radiofrequency pulses, working by thermo-coagulating nerves at very high temperatures, have been shown to cause temporary pain relief in ilioinguinal neuralgia .Again, definite evidence for their effectiveness is lacking

SURGICAL TREATMENT

The surgical treatment of chronic groin pain was first described by Stulz *et al* in 1982. They performed IIN neurectomy on 5 patients with chronic groin pain following inguinal hernia repair, achieving a 100% success rate.

Criteria for surgical treatment

- Surgical treatment is required if refractory pain persists after treatment with oral analgesics and/or local nerve(s) blockades.
- Nerve block must have resulted in a complete or substantial decrease in pain before neurectomy can be recommended.
- There are no defined limits on how often nerve blocks can be carried out and the practice has varied among surgeons worldwide.

Timing of surgical intervention

The timing of surgical intervention should ideally be at least 6 months after herniorrhaphy to give adequate time for any neuropraxia to settle and time to try medical management.

Surgical reintervention : “ Triple Neurectomy “

The newest surgical studies and research support surgical intervention with removal of the three main sensory nerves of the groin.

These nerves are the ilioinguinal, iliohypogastric and genito-femoral nerves .

70% of the patients good to excellent pain relief

20% of the patients experience no benefit

10% may experience a worsening of the neuropathy symptoms

Mesh removal

Formidable task even in experienced hands

Despite the mesh removal, if the patient continues to complain of pain Triple neurectomy is the option of choice.

Osteitis pubis

Injections with local anesthetics and a corticosteroid : Insufficient to alleviate the pain

Definitive treatment is to surgically remove the offending suture or tack

Measures to prevent / decrease incidence of Inguinodynia

Mesh shrinkage has been reported as a cause of inguinodynia (polypropylene mesh shrinkage of 46% has been measured and published)

Also been demonstrated that post-operative inflammation can be caused by the prosthetic material

- ? Polyester meshes as Alternative : May result in better tissue integration and less fibrosis
- Reabsorbable fixation devices
- Bioglues

VENTRAL HERNIAS IN THE BARIATRIC PATIENTS

Ventral hernia, a collective term for incisional, umbilical, and other anterior abdominal wall hernias, are common occurrences in the morbidly obese population. The correct management of these hernias in the morbidly obese has an important bearing on the overall outcome of the surgical management of this group of patients.

Morbidly obese patients who have concurrent ventral hernias pose a therapeutic dilemma for two reasons:

- Their weight predisposes them to a high recurrence rate, and
- The field contamination that invariably accompanies opening bowel in the operative field precludes the use of prosthetic meshes.

In addition new incisional hernias have been common long-term complications of open bariatric surgical procedures.

Etiology

Morbid obesity is a major risk factor for incisional hernias, with about 20% of patients undergoing open gastric bypass developing an incisional hernia.

It has been considered to be five times more potent as a risk factor compared to chronic steroid use.

Within the morbidly obese population undergoing gastric bypass surgery, previous incisional hernia, severe wound infection, type 2 diabetes, sleep apnea, and obesity hypoventilation are independently associated with increased risk.

On the other hand, preoperative weight, gender, and age do not appear to be associated with increased risk of incisional hernia formation.

Primary hernias, like umbilical hernias tend to be an acquired defect in over 90% of adults. About 8% of these are recurrent, with omental incarceration in 30%. The average size of the hernia defect in this population is 25.4cm with multiple defects in 5%.

Treatment

The challenge of managing ventral hernias in the morbidly obese patient arises from the dangers of deferring surgical repair and the risk of mesh infection where repair is undertaken concurrently with gastric bypass. 36% of patients whose hernia repair was deferred at the time of gastric bypass develop small bowel obstruction due to incarceration in the post operative period. The time interval for this complication is an average of 63 days (range 10-150 days) from the gastric bypass. The risk of infecting a prosthetic mesh by contamination with enteric contents is also well documented.

For the patient undergoing an LGB who is incidentally found to have one or more ventral hernias, every available option is suboptimal. Primary repair invites well known failure rates (22% to 49%) (7,10), while use of synthetic materials in the contaminated field risks a graft infection with subsequent failure. Deferring repair until significant weight loss has been shown to be dangerous with 36% of patients developing small bowel obstruction within a 6 month period. The use of absorbable mesh (eg, Vicryl mesh) is associated with recurrence rates of 75% and may not be a viable option.

The advent of newer biomaterial mesh may make ventral hernia repair in this group more successful. They provide a collagen framework containing several growth factors that encourages native tissue in-growth into the collagen matrix that is gradually and completely reabsorbed. Its potential to act as a focus of infection is minimal, making it more suitable for use in contaminated fields.

The ventral hernia management in patients undergoing LGB, the lowest recurrence rate was obtained with biomaterial mesh compared to a primary repair. Seroma formation is common, with most resolving without specific intervention. About 8% develop wound cellulites that resolve with antibiotics. With adequate preoperative and postoperative patient counseling and perseverance, a satisfactory outcome is achieved.

In this study, umbilical hernias that were similar than 3 to 4 cm in diameter were closed primarily with transfixion transabdominal suture using a technique similar to that used for closure of 12-mm trocar sites. Unfortunately, recurrence rate with this method was 22%. However, in defects smaller than 2 cm, there were no recurrences at 36 months follow up. This suggests that for defects larger than 2 cm, a Rives-Stoppa type of tension-free repair with a biomaterial graft would be a preferred option.

Clinical Pearls

Hernias still present a therapeutic challenge in the morbidly obese. It is important to make the morbidly obese patient aware of the potential intra operative discovery of incidental hernias and the high risk of recurrence associated with their repair. It is also essential to repair all incisional hernias in the morbidly obese population undergoing bariatric surgery, especially in the presence of omental incarceration, because of the high risk of strangulation bowel obstruction in the post operative period.

Reinforcing all defects with biomaterial mesh has been suggested in an attempt to reduce recurrence. If the defects are small (<2cm diameter), these could be repaired using the Carter-Thomson suture device with figure-of-8 stitches. If large (>2cm diameter), the use of biomaterial mesh can be a viable option for a repair concurrent with the gastric bypass. However, for defects larger than 5cm in diameter, a formal hernia repair using a dual layer [expanded polytetrafluoroethylene (PTFE) polypropylene] mesh as previously described at least 3 months prior to gastric bypass. With the PTFE side facing the peritoneal cavity, adhesions are minimal at re exploration.

