

A DISSERTATION ON
COMPARATIVE STUDY BETWEEN OPEN AND
LAPAROSCOPIC INGUINAL HERNIA REPAIR



Dissertation submitted in partial fulfillment of regulation for the award of
M.S. Degree in General Surgery

(Branch I)



The Tamilnadu

Dr. M.G.R. Medical University

Chennai MAY 2020

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CERTIFICATE

Certified that this is the bonafide dissertation done by **DR. G.Kiruthika** and submitted in partial fulfilment of the requirement for the Degree of M.S. General Surgery, Branch I of the Tamilnadu Dr.M.G.R. Medical University , Chennai.

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DECLARATION

I solemnly declare that the dissertation titled “**COMPARATIVE STUDY BETWEEN OPEN AND LAPAROSCOPIC INGUINAL HERNIA REPAIR**” was done by me from December 2017 to December 2018 under the guidance and supervision of **PROF. DR. A.NIRMALA, M.S, D.G.O.**

This dissertation is submitted to the Tamilnadu Dr.M.G.R. Medical University towards the partial fulfilment of the requirement for the award of M.S.Degree in General Surgery (Branch I).

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CERTIFICATE OF APPROVAL

To
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Dear **Dr.Kiruthika G**

The Institutional Ethics Committee of Coimbatore Medical College, reviewed and discussed your application for approval of the proposal entitled "**Comparative Study between open and Laparoscopic Inguinal Hernia Repair.**"-No.0112/2017.

The following members of Ethics Committee were present in the meeting held on 30.11.2017.conducted at MM - II Seminar Hall, Coimbatore Medical College Hospital Coimbatore-18

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We approve the Proposal to be conducted in its presented form.

Sd/Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.


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ACKNOWLEDGEMENT

I owe my reverential gratitude and humble thanks to Lord God Almighty for all his mercy, for being with me and showering abundant blessing upon me throughout the course of the study.

I am obliged to record my immense gratitude to DR. B. ASHOKAN Mch , The Dean , Coimbatore Medical College Hospital for providing all the facilities to conduct the studies.

I express my deep sense of gratitude and heart felt thanks to Professor DR. A.NIRMALA , M.S , Head of Department of General Surgery for her dynamic guidance , constant help and encouragement throughout the study.

I express my respectful gratitude and indebtedness to my guide Professor Dr. A. NIRMALA M.S.,D.G.O, for her valuable guidance and support.

I would like to express my sincere thanks to, Professor Dr. V. Lekshminarayani, Dr.Srinivasan,Dr.Narayanamoorthy. I deeply thank Dr.R.Ravi M.S,D.L.O, Dr.P.Murugadasan M.S, Dr.Kavitha M.S., Assistant professors of surgery , for all the needful help they have provided for the study.

I acknowledge my gratitude to our Registrar Dr.Ravi M.S and all my assistant professors of Department of surgery for their encouragement and support.

I am thankful to The ETHICAL COMMITTEE of Coimbatore Medical College for permitting me to proceed with this dissertation.

Lastly , I am grateful to all the patients whose cooperation made this work possible

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INTRODUCTION

Hernia is defined as a protrusion of a viscus or a part of a viscus through an abnormal opening in the walls of its containing cavity. It is derived from the latin word 'hernios' meaning rupture. Most commonly seen in the inguinal region followed by paraumbilical/incisional hernia. Inguinal hernia occurs in about 15% of adult population and inguinal hernia repair is one of the most commonly performed surgical procedure. In the era of minimal invasive surgery, hernia repair has seen a paradigm shift from open to laparoscopic technique. Evolution in the treatment of inguinal hernias has equalled to the technological developments in this field. The most significant advances to impact inguinal hernia repair have been the addition of prosthetic materials to conventional tissue repairs. The laparoscopic inguinal hernia repair includes Totally Extraperitoneal approach (TEP)/Trans Abdominal Preperitoneal approach(TAPP).

Over 60 randomized trials have compared laparoscopic surgery with Lichtenstein repair. Following introduction of mesh for hernia repair, newer measures focus on post hernioplasty pain syndrome, quality of life and return to normal activities. They show although laparoscopic operation takes longer to perform, proven advantages are reduced pain both following surgery, more rapid return to full activity and reduced chance of wound complications.

A repair that results in an asymptomatic recurrence will not be as clinically significant as a repair that imparts a significant amount of chronic pain, but does not lead to recurrence⁽¹⁵⁻¹⁷⁾.

AIM OF THE STUDY

The aim of this study is to prospectively compare the results of open mesh technique and laparoscopic repair for inguinal hernia and to compare operative time, post operative pain, return to normal activities and complications.

REVIEW OF LITERATURE

During 1500 BC, hernias were treated with trusses and bandage. Surgery for inguinal hernia was started during 1st century AD . Based on anatomy of defect i.e , inguinal vs femoral first report of groin hernia was classified which dates back to 14th century and the anatomical descriptions of direct and indirect inguinal hernia was first reported in 1559. Celsus performed the surgery initially through an incision in the neck of the scrotum, the hernia sac was dissected off, the spermatic cord transected at the external ring along with orchitectomy. Principles emphasized mass ligation and en block excision of sac, cord and testis distal to the external ring in 700AD

Tissue Repairs

Marcy, an American surgeon was the one to provide a definitive & corrective hernia repair. He recognized the importance of the fascia transversalis & closing internal ring. After that he published his report of two patients, where he utilized carbolised catgut torn suture the ring., the procedure was a failure as the hernia sac was neither ligated nor the posterior wall of inguinal canal repaired. In 1881, Lucas championniere, reported the first case in which the external oblique aponeurosis was slit to reveal the canal, which allowed the dissection & ligation of sac at internal ring under direct vision.

Bassini¹³ revolutionized the surgical repair of inguinal hernia with his novel anatomical dissection & low recurrence rates. He recognized the two important cause of failure of procedures performed at that time beign non

anatomical one layer tissue repair & the other was left out larger internal opening, through which spermatic cord passes.

In 1890, Bassini's repair emphasized both on high ligation of sac at the internal ring as well as suture reinforcement of posterior inguinal canal as triple layered repair. This was a massive leap forward and has been the basis of open repair for over 100 years. The recurrence was just 5 among 250 patients. He was called the 'Father of modern herniorraphy'.

William Halsted added another layer of repair approximating internal oblique fascia to Cooper's ligament. In Halsted I repair, the spermatic cord was transplanted to the subcutaneous tissue. Since the cord is sometimes quite sensitive, in Halsted II, the cord was placed under external oblique aponeurosis.

Lotheissen, in 1898 introduced technique of Cooper's ligament repair by affixing Poupart's ligament to the pectineal ligament, in repairing both femoral and inguinal hernia. In 1940, Chester McVay popularized the Cooper's ligament repair with addition of a relaxing incision to reduce the increased wound tension. All these techniques have shared the primary goal of reducing long term hernia recurrence rates.

Over 150 modifications to Bassini's operation have been described with little or no benefit except for the Shouldice modification. Shouldice of Toronto described multilayered tissue repair. Recurrence rate in <1%, reported failure rates of less than 2%, but technically demanding operation. Suturing only the local tissues without addition of any prosthetic material.

A hernia repair done with undue tension is doomed to failure. This failure is not due to inherent weakness of tissues, but due to ischemic necrosis of the tissues caused by pressure of sutures under tension. In the early 20th century efforts have been started towards a repair that imparts least tension to the tissues that are brought together to repair the hernia defect.

Darn effect

In early 20th century Darn repairs were first introduced to reduce wound tension by using either autologous tissue or synthetic suture to bridge the gap between fascial tissues. In 1918, Handley introduced use of silk .

Patch graft repairs

In 20th century ,Patch in form of sheet of natural tissues, biological materials or synthetic sheets or weaves to fill in the gap in the weakened posterior wall of the canal. Initially silver wire filigree sheets, tantalum metal sheets were used. However, metal fatigue causes fragmentation of these materials and hernia recurrence. Natural tissues such as flaps of fascia from the thigh, fascialata, abdominal wall, sheets of skin proved uniformly disappointing.

Prosthetic mesh repair

Usher in 1958, popularized the use of modern monofilament polymer plastics in the form of woven or knitted sheet of polyamide, polypropylene, followed by polyester, polytetrafluoroethylene sheets. Lichtenstein and Gilbert

used a plastic mesh patch across the inguinal floor, deep to or in front of repaired fascia transversalis.

History of inguinal hernia repair is incomplete without mention about preperitoneal repair. Described in Europe in middle ages. This approach was started practicing towards the end of 19th century.

Preperitoneal repair

Cheatele, introduced the modern era of transabdominal extraperitoneal repair. He tried with midline incision, but later utilized low transverse or Pfannenstiel incision. The advantage of this procedure is prosthesis can be placed between hernia contents & hernia defect, avoiding entry into the inguinal canal, therefore nerves that course through the inguinal canal are avoided with minimal manipulation of spermatic cord. This approach was strongly recommended and popularized by Nyhus and Read between 1968 and 1979. Stoppa recommended this technique for problematic cases in which repeated repairs of the multiple recurrent hernia has been done.

Nyhus and Condon popularized iliopubic tract repair. This combines a preperitoneal tissue based repair with the implantation of mesh. By suturing, transversalis fascia to Cooper's ligament, the leaflets of transversalis fascia are sutured to the iliopubic tract to tighten the ring, addressing femoral, direct & indirect inguinal hernias. Kugel's repair aims to maximize on preperitoneal approach, while minimizing on the length of the skin and fascia incision.

The prolene hernia system, was constructed to take advantage of the benefits of the anterior and preperitoneal repair, using an open approach. The mesh consists of 2 large flaps with an intervening connector and the overlay flap has a split to accommodate the spermatic cord. The underlay is positioned in the preperitoneal space, while overlay rests on the inguinal floor. The overlay flap reinforces the inguinal floor similar to a tension free repair and the underlay portion overlaps the direct, indirect and femoral hernia defects.

Laposcopic repairs

Ger , introduced laparoscopic transperitoneal closure of internal orifice of inguinal hernia with metal clips as minimal access surgery. Since 1990, this technique is gaining its popularity. The advantage of this approach is that in experienced hands, it is quick, relatively atraumatic, bilateral hernias can be repaired in same sitting, clinically unsuspected contralateral hernias can be identified and repaired. Post op recovery and return to activity is rapid as the procedure is relatively painless. The disadvantage of this procedure is that it needs general anaesthesia, with future risk of adhesion and port site hernias.

The surgical complication included small and large bowel perforation, bladder laceration, mesh erosion into bladder, transient testicular pain, scrotal hydrocele, pelvic osteitis, nerve entrapment syndrome particularly lateral cutaneous nerve and genitofemoral nerve.

The predominant techniques in laproscopic procedures includes,

1. Transabdominalpreperitoneal (TAPP) repair
2. Totally extraperitoneal (TEP) repair
3. Intraperitoneal onlay mesh (IOPM)

Incidence

About 75% of all abdominal wall hernias are found in the groin. 95% accounts for inguinal hernia with the remainder being femoral hernia defects.

Inguinal hernias are more common in men than in women and the ratio is 9:1. Although femoral hernias are found more often in women, the inguinal hernia is still the most common hernia in women. The overall life time risk of developing a groin hernia is approximately 27% in males and 3% in females. Prevalance increases with increasing age. About 2/3rd of inguinal hernias are indirect. Laparoscopic studies have reported rates of contralateral defects as high as 22% with 28% of them to be symptomatic during short term follow-up.

The true measures of success for various types of hernia repair can be analysed based on various studies.

Conventional repair has been withdrawn nowadays, because of more number of recurrences. There are many randomized prospective trials that compares incidence of recurrence between conventional repair, tension free

repair, and laparoscopic repair. Both laparoscopic and tension free repair have been credited with much lower recurrence rate than conventional repairs.

After the use of prosthetic mesh repair, the attention of the surgeons has been turned from recurrence to the concept of inguinodyniai.e; chronic significant post hernioplasty pain. The incidence of this varies between 6 - 31%.

In study conducted by Deba kumar et al comprising of sixty cases laparoscopic hernia repair revealed less post operative pain, better cosmetic result, improves recovery. Seroma beign the most common complications in both groups(6.6%)with no recurrence reported in both groups over one year follow up⁵.

In a combined prospective and retrospective study conducted by Abid et al observed 5% recurrence in laparoscopic arm and 2.5% in open arm .Persistent pain incidence reported to be 3.5% who underwent laproscopic repair, with higher rate in open method of 16.5%. Only 2-4% were adversely affected by chronic groin pain. Laparoscopic procedure remains not only choice for bilateral and recurrent hernia but also for primary, unilateral hernias⁷.

In an open labelled, prospective, randomized comparative study conducted by Chetan et al⁶ among 50 patients reported no major complications in both groups, with time taken to return to normal daily activities and work, post operative pain was significantly less in laparoscopy group providing a less

postoperative morbidity in experienced hands with limitation being operating time.

Anatomy of the inguinal region

The surgeon must have a comprehensive understanding of the anatomy of the groin to select and use various options of hernia repair properly, lowering the incidence of recurrence and complications. These anatomic considerations must be understood in both anterior and posterior aspects, so as to encounter different situations.

Layers of anterior abdominal wall in inguinal region

1. Skin
2. Subcutaneous tissue/superficial fascia
3. Deep fascia (innominate fascia/Gallaudet's fascia)
4. External oblique aponeurosis, including inguinal ligament, lacunar , reflected part of inguinal ligament
5. Spermatic cord
6. Internal oblique muscle, transverse abdominis, aponeurosis falxinguinalis and conjoint tendon
7. Anterior lamina of fascia transversalis
8. Posterior lamina of fascia transversalis

9. Preperitoneal

10. Peritoneum

The groin is made up of a complex network of muscles, ligaments and fascia and these are interwoven in a multiplanar fashion.

Skin and subcutaneous tissue:

The subcutaneous tissue is the superficial fascia of the anterior abdominal wall. It has 2 layers.

1. A superficial fatty layer called campers fascia. This continues with the superficial fascia of the thigh
2. Deep membranous layer called Scarpa's fascia. This fuses with the deep fascia of the thigh below the inguinal ligament.

The subcutaneous tissue includes, the superficial circumflex iliac, superficial epigastric and external pudental vessels. If encountered during surgery these vessels can be retracted or divided when necessary.

The deep fascia/ innominate or gallauder's fascia is inconspicuous by its presence.

Superficial inguinal ring is a triangular defect in external oblique aponeurosis just above and medial to pubic tubercle. It forms spermatic fascia around spermatic cord.

Table 1: Muscles of anterior abdominal wall

MUSCLE	ORIGIN	INSERTION	NERVE SUPPLY
External oblique muscle	lower 8 ribs directed medially and inferiorly	broad aponeurosis into the xiphoid process, linea alba, pubic crest, pubic tubercle and the anterior half of iliac crest.	Lower 6 thoracic nerves Iliohypogastric nerve Ilioinguinal nerve
Internal oblique muscle	lumbar fascia, the anterior 2/3rd of iliac crest, the lateral 2/3rd of inguinal ligament -directed superiorly, laterally and slightly inferiorly	lower 3 ribs and their costal cartilages, xiphoid process, linea alba and pubic symphysis.	Lower 6 thoracic nerves Iliohypogastric nerve Ilioinguinal nerve

Transverse abdominis muscle	lower 6 costal cartilages, the lumbar fascia, the anterior 2/3rd of iliac crest, the lateral 3rd of inguinal ligament	xiphoid process, the lineaalba and pubic symphysis.	Lower 6 thoracic nerves Iliohypogastric nerve Ilioinguinal nerve
Rectus abdominis	two heads from the anterior surface of pubic symphysis and pubic crest	5th,6th,7th costal cartilages and the xiphoid process.	Lower 6 thoracic nerves
Pyramidalis:	anterior surface of the pubis	lineaalba.	Subcostal nerve.

The strength and continuity of the transverse abdominis muscle and aponeurosis is essential for the prevention and treatment of inguinal hernia. Transversalis fascia is the connective tissue that underlies the abdominal wall musculature and this forms the floor of inguinal canal.

The rectus abdominis muscle is enclosed between the aponeurosis of external oblique, internal oblique and transverse abdominis which together forms rectus sheath.

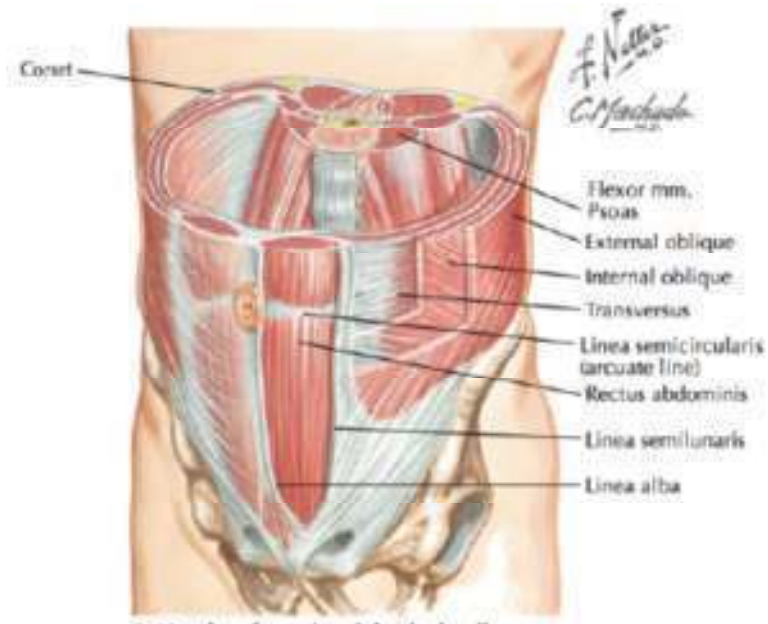


FIG .1 External oblique muscle

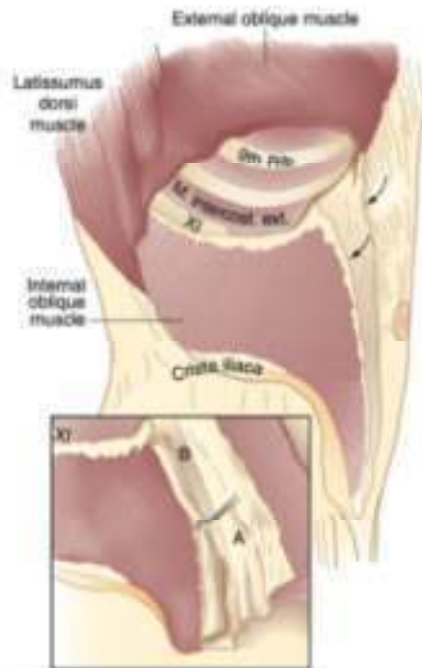


FIG 2.Internal oblique muscle

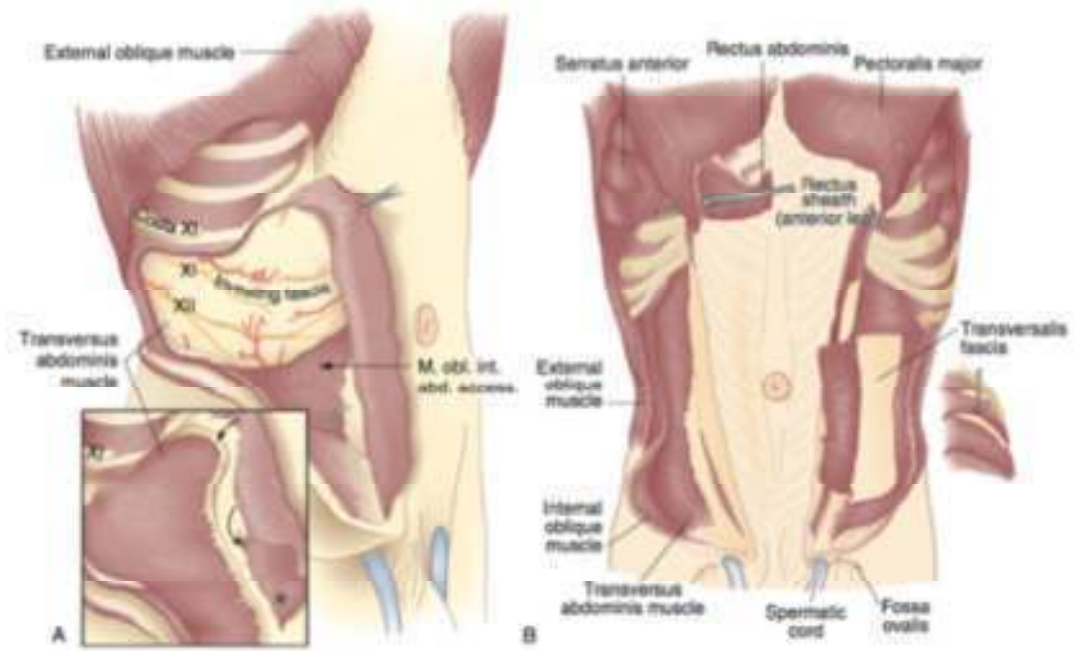


FIG 3. Transverse Abdominis Muscle

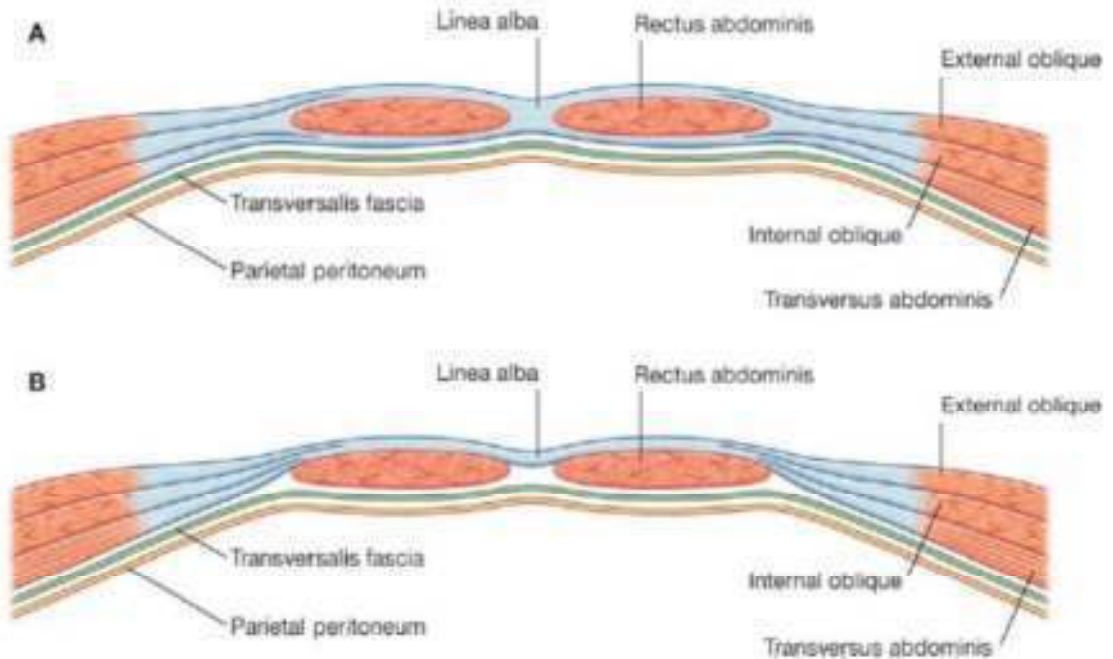


FIG 4. Rectus abdominis

Arterial supply of anterior abdominal wall muscles

- Superior epigastric artery- terminal branch of internal thoracic artery.
- Inferior epigastric artery- branch of external iliac artery.
- Deep circumflex iliac artery- branch of external iliac artery
- Lower 2 posterior intercostal arteries- branch of descending thoracic aorta.
- 4 lumbar arteries- branch of abdominal aorta.

Venous drainage of anterior abdominal wall

1. Superficial veins of the anterior abdominal wall- this forms a network around the umbilicus and diverges out of the umbilicus.

Above the umbilicus: the veins drain via, lateral thoracic vein into the axillary vein

Below the umbilicus: the veins drain via superficial epigastric into femoral vein.

2. Deep veins of the anterior abdominal wall follows the arteries of the same name.
 - a. Superficial epigastric vein into internal thoracic vein
 - b. Inferior epigastric vein into external iliac vein
 - c. Deep circumflex iliac vein to external iliac vein
 - d. Posterior intercostal veins into azygos veins
 - e. Lumbar veins to inferior vena cava

Lymphatic drainage of anterior abdominal wall

1. Superficial lymph vessels: Above the umbilicus- anterior axillary lymph nodes.

Below the umbilicus- superficial inguinal lymph nodes

2. Deep lymph vessels:

Drains in the internal thoracic, external iliac, posterior mediastinal , paraaortic lymph nodes.

Table 2 : Nerve Supply of Inguinal region

NERVE	ORIGIN	COURSE	SUPPLY
Ilioinguinal nerve	Arise from L1	Lateral border of psoas major muscle, crosses internal oblique muscle enters inguinal canal and exits through the superficial inguinal ring.	Skin of the upper and medial thigh. Males: supplies penis and upper scrotum Females: supplies mons pubis and labia majus
Iliohypogastric nerve	Arises from T12-L1	Pierces the deep abdominal wall and travels between	Internal oblique and transverse

		internal oblique and transversus abdominis muscle	abdominis muscle
Genitofemoral nerve	Arises from L1-L2	Emerges along the anterior aspect of psoas. Genital branch - enters the inguinal canal, just lateral to inferior epigastric vessels and travels through the superficial inguinal ring	Males : supplies scrotum and cremaster muscle. Females : supplies mons pubis and labium majus. Femoral branch - courses along femoral sheath
Lateral femoral cutaneous nerve	Arises from L2-L3	Emerges from lateral border of psoas muscle. Crosses iliacus muscle obliquely towards AS 1S and passes inferior to inguinal ligament.	Supplies lateral aspect of thigh

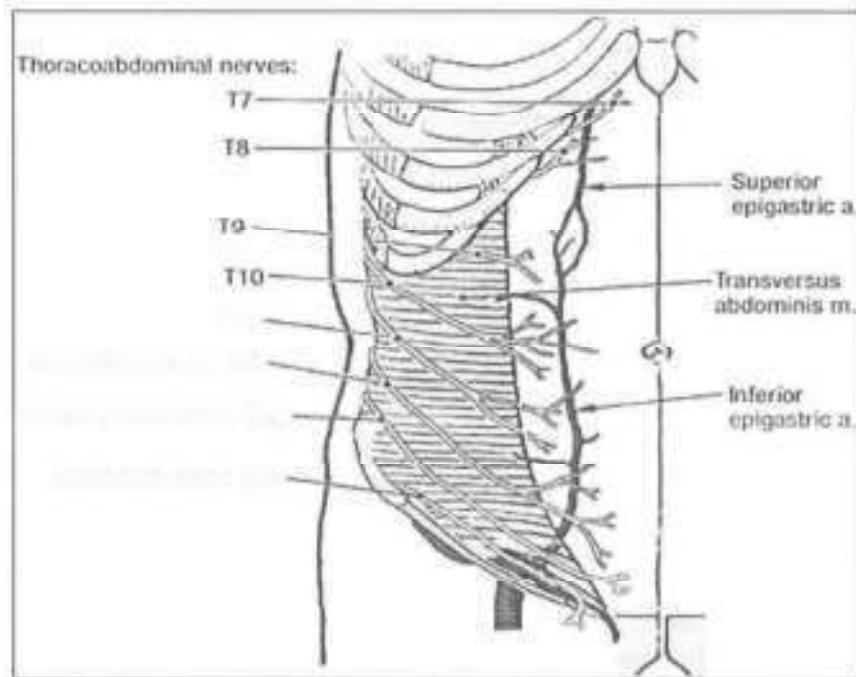


FIGURE 5 : BLOOD SUPPLY AND NERVE SUPPLY OF ANTERIOR ABDOMINAL WALL

Inguinal canal

Extends from deep inguinal ring to superficial inguinal ring directed downwards and medially. About 4cm length in adults.

In new born babies, the deep inguinal ring is almost superimposed on superficial inguinal ring. So, the inguinal canal is very much shorter in length and the obliquity is slight.

Superficial inguinal ring

It is a triangular opening in the external oblique aponeurosis 1.25cm above the pubic tubercle. Bounded by a superomedial and inferomedial crus, normally admitting just tip of little finger

Deep inguinal ring:

An 'U' shaped condensation of the transversalis fascia, lies 1.25 cm above the inguinal ligament between symphysis pubis and anterosuperior iliac spine.

Transverse abdominis aponeurotic arch, forms the superior crus of the deep inguinal ring. Iliopubic tract forms the inferior crus of the deep inguinal ring. Medially, the deep inguinal ring is related to the inferior epigastric vessels, which branches upwards from the external iliac vessels.

Boundaries of the inguinal canal

Anteriorly: Skin

Superficial fascia

External oblique aponeurosis

More laterally the internal oblique muscle.

Posteriorly : In its whole extent ; Fascia transversalis, extraperitoneal tissue

Parietal peritoneum

In its medial 2/3 rd

Conjoint tendon, Reflected part of inguinal ligament

In its lateral 1/3 rd

Interfoveolar ligament

Superiorly :Arched fibers of lower edge of internal oblique muscle,
Transverses abdominis muscle and aponeurosis.

Inferiorly - Grooved upper surface of inguinal ligament

In its medial end -lacunar ligament.

In males, inguinal canal transmits spermatic cord, ilioinguinal nerve and genital branch of genitofemoral nerve.

In females, it transmits, round ligament of uterus, ilioinguinal nerve and genital branch of genitofemoral nerve.

Coverings of the spermatic cord:

- External spermatic fascia - derived from external oblique aponeurosis.
- Cremasteric fascia - derived from internal oblique muscle.
- Internal spermatic fascia - derived from fascia transversalis.

Table 3: Contents of spermatic cord

Vas deferens
Testicular artery
Cremasteric artery
Artery to vas deferens
Pampiniform plexus of veins
Cremasteric vein Veins to vas deferens
Sympathetic nerves (testicular plexus)
Testicular lymphatics

Inguinal ligament (poupart's ligament)

External oblique aponeurosis-thickened and folded backwards on itself, extending from anterosuperior iliac spine to pubic tubercle.

Fossa related to the lower anterior abdominal wall

Above the inguinal ligament, in the posterior surface of the anterior abdominal wall, there are three shallow fossa.

- Midline - Median umbilical ligament(formed by obliterated urachus)
- Medially - medial umbilical ligament
(formed by obliterated umbilical arteries)
- Laterally - lateral umbilical ligament
(contains inferior epigastric artery)

Supravesical fossa : lies between median and medial umbilical ligament

Medial inguinal fossa : lies between medial and lateral umbilical ligament

Site of direct inguinal hernia

Lateral inguinal fossa : lies lateral to inferior epigastric arteries

Contains internal ring. Site of indirect inguinal hernia.

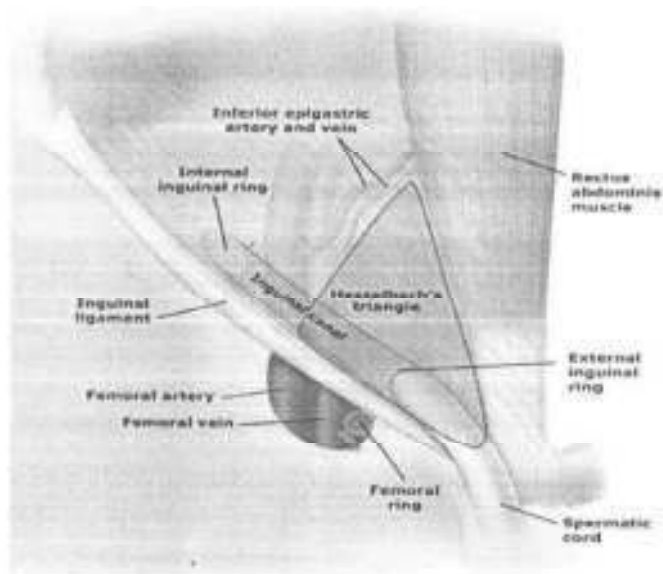


Figure 6 : HESSELBACH'S TRIANGLE

Hesselbach's triangle

Boundaries :

- Medially - lateral edge of rectus abdominis
 - Superolaterally - inferior epigastric artery
 - Inferolaterally - inguinal ligament
- Most of the direct inguinal hernia and external supravescicalinguinal hernia occurs through this hesselbach's triangle.

Iliopubictract:

It is a fibrous condensation of endoluminal fascia. It extends from anterior inferior iliac spine to the pubic tubercle. It contributes to the inferior border of deep inguinal ring. Also forms the anterior margin of femoral sheath, together with transversalis fascia.

Cooper's ligament (Pectineal ligament): Formed by tendinous fibers of the lacunar ligament and aponeurotic fibers of internal oblique, transverses abdominis, and pectineus muscles. It works as a firm anchor for muscular, tendinous and fascial layers of the groin, it is used in surgical hernia repair.

Preperitoneal anatomy seen in laparoscopic hernia includes triangle of doom, triangle of pain and circle of death.

Table 4: Triangle of Doom

Medially	Vas deferens
Laterally	Vessels of spermatic cord
Contents	External iliac vessels Deep circumflex iliac vein Femoral nerve Genital branch of genitofemoral nerve

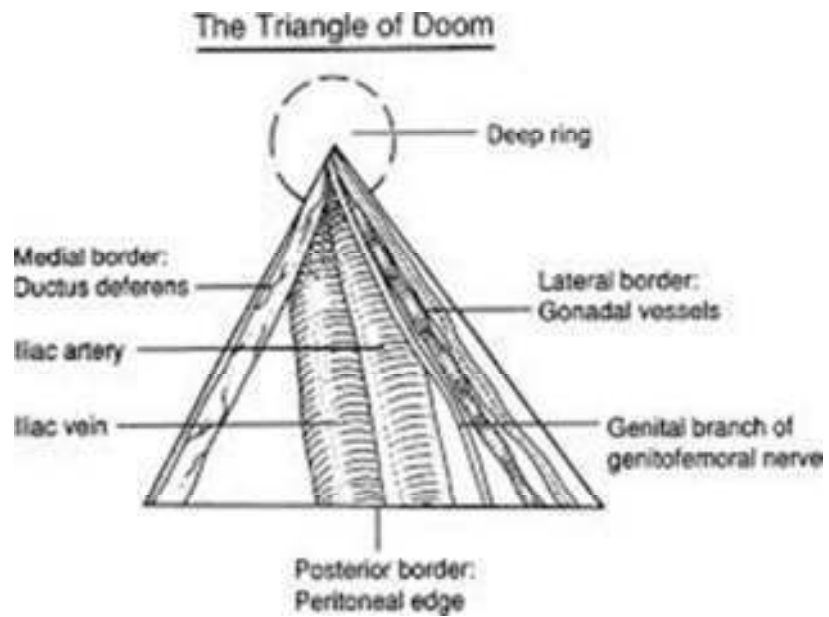


Figure 7: Triangle of Doom

Table 5 : Triangle of Pain

Medially	Iliopubic tract
Laterally	Gonadal vessels
Contents	Lateral femoral cutaneous Femoral branch of genitofemoral and femoral nerves

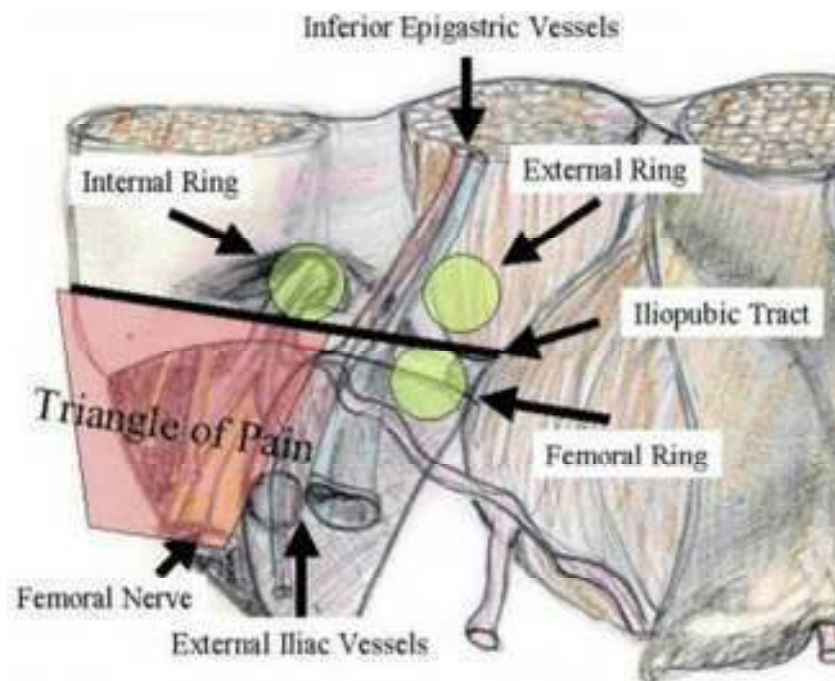


Figure 8 : Triangle of Pain

Circle of death – vascular continuation formed by common iliac, internal iliac, obturator, inferior epigastric, external iliac vessels

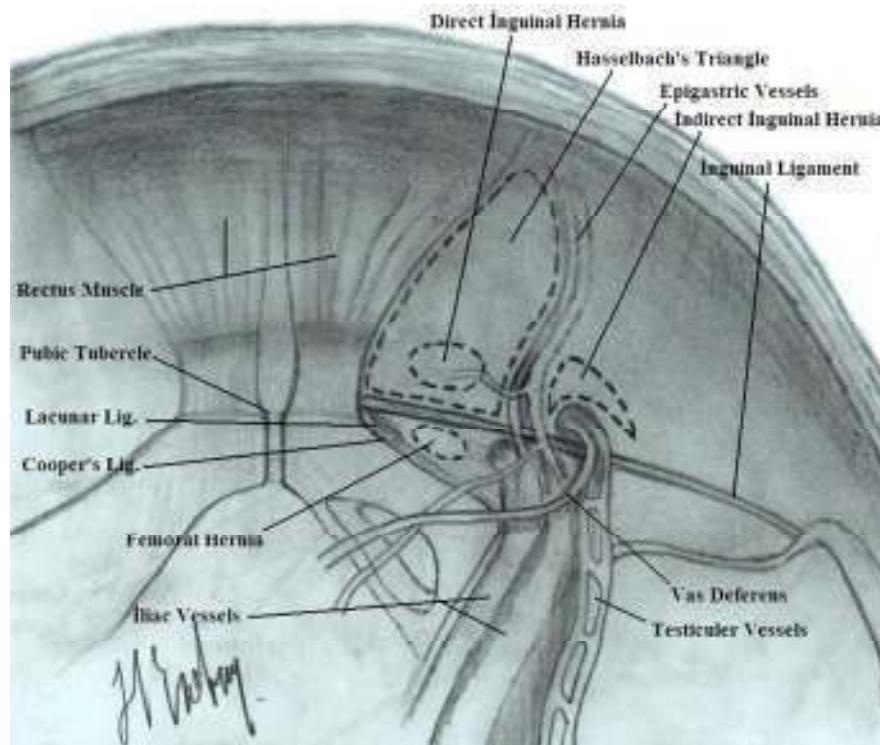


Figure 9: Circle of Death

Inguinal hernia

A hernia is a protrusion of a part of a viscus or whole of the viscus, through an abnormal opening in the wall of the cavity which contains it.

Congenital hernia

Commonly occurs in paediatric age group. The processus vaginalis is a diverticulum of peritoneum, that precedes during the descent of the testis from

the intra-abdominal space in to the scrotum. Normally between 36 and 40 weeks of intrauterine life, the processus vaginalis closes.

Persistence of the processus vaginalis, leads to the occurrence of indirect inguinal hernia, particularly in premature babies.

In females, similarly persistent patent canal of nuck causes indirect inguinal hernia.

Acquired hernia

Two important factors important for the development of hernia are:

1. Weakness of the abdominal wall musculature.
2. Increased intraabdominal pressure

Causes of abdominal muscle weakness

1. Obesity :- Excessive fat causes separation of muscle fibers and thereby muscle weakness, leading to direct inguinal hernia.
2. Repeated pregnancy
3. Surgical incisions - division of ilioinguinal nerve during appendicectomy
4. Tissue biology in inguinal hernia - decreased ratio of collagen type I to type III, causes decreased wound tensile strength.

5. Connective tissue destruction -occurs following, smoking, ageing, connective tissue Damage, systemic illness, leads to reduction in the strength of transverse aponeurosis and fascia.

Causes of increased intra-abdominal pressure

- Whooping cough in childrens
- Chronic cough in tuberculosis, chronic bronchitis
- Enlarged prostate
- Bladder neck obstruction or urethral stricture
- Straining at heavy weight lifting
- Prolonged vomiting
- Constipation or straining at defecation
- Intraabdominal malignancy

Mechanisms that prevent inguinal hernia

1. Obliquity of the inguinal canal - The posterior wall of the inguinal canal comes and gets apposed to the anterior wall. This prevents the abdominal wall contents to come out through the inguinal canal.

2. Shutter mechanism - arched fibers of the internal oblique and transverse abdominis. During raised intraabdominal pressure, this muscle gets contracted

and this brings the arched fibers of the internal oblique and transverse abdominis towards the floor.

In patients with higher position of aponeurotic arch, during muscle contraction the arch does not reach the inguinal ligament. This leaves a weak area in the posterior wall of the inguinal canal, causing direct inguinal hernia.

3. Sphincteric action at the deep inguinal ring -

The transversus abdominis muscle contracts and this pulls the transversalis fascia sling superiorly and laterally. This pulls the deep inguinal ring superiorly and laterally and also closes the deep inguinal ring around the cord.

4. Ball valve action of the cremaster muscle

The cremasteric muscle contracts and the spermatic cord is pulled up into the canal and plugged into the deep inguinal ring. Strong fibers of internal oblique in front of deep inguinal ring prevent indirect inguinal hernia and similarly, strong conjoint tendon in front of Hesselbach's triangle prevents direct inguinal hernia.

Parts of hernia

Hernia consists of three parts

1. The sac
2. The contents of the sac
3. The coverings of the sac

The sac

It is a pouch of peritoneum that comes out through the abdominal musculature.

It consists of four parts

- Mouth
- Neck - the most constricted part
- Body - it is the main portion of the sac
- Fundus

Contents : Viscus that lies within the sac

Enterocoele : Loop of intestine.

Omentocele / epiplocele : omentum.

Cystocoele : content is urinary bladder / part of posterior wall

Richter's hernia : a portion of circumference of bowel

Littre's hernia : meckel's diverticulum.

Amyand's hernia : appendix which is often incarcerated

Maydl's hernia: when two loops of intestine is in the manner of W

Coverings

It is the layers of the abdominal wall that covers the hernia sac.

Classification of hernia

Depending on the clinical characteristic, it is classified as

1. Reducible hernia
2. Irreducible hernia
3. Obstructed / incarcerated hernia
4. Strangulated hernia
5. Inflamed hernia

Reducible hernia

When a hernia reduces spontaneously, on lying down or manually reduced by the patient or by the surgeon. The two most important characteristics of hernia is its reducibility, Impulse on coughing .

Irreducible hernia

Contents of the hernia cannot be returned back to the abdomen, Causes of irreducibility :

1. Adhesions of the contents to each other.
2. Adhesions of the contents to the sac.

3. Adhesions between the sac
4. Narrowing of the neck of the sac due to fibrosis, in case of continued use of truss.

Obstructed hernia

It is irreducible hernia with obstruction, but blood supply is not interfered

Characteristic features of obstructed hernia

1. Expansile cough impulse, not present.
2. Hernia is irreducible.
3. Patient does not complain of pain.
4. The hernia is lax and not tender.
5. Features of intestinal obstruction present.

Strangulated hernia

It is irreducible hernia with obstruction to blood flow

Pathology:

As the neck of the sac becomes very much constricted, intestinal obstruction occurs initially, by intestinal dilatation.

The venous return gets disturbed and the intestines becomes congested and bright red followed by oozing of serous fluid from the intestinal wall in to

the sac. Later, the arterial supply to the intestine also gets impeded. Gradually, the intestine starts to lose its tone and becomes flabby. The viability of the intestine starts diminishing and there is translocation of bacteria from the intestinal lumen into the sac. Thrombosis of the mesenteric vessels occurs. Gangrene starts to appear at the place of constriction in the antimesenteric border and progresses to the whole of the intestine.

Inflamed hernia: Due to inflammation of contents of sac, e.g., inflamed appendix or Meckel's.

Characteristic features of inflamed hernia

1. Overlying skin becomes red and edematous.
2. Hernia is painful, swollen and tender.

Anatomical classification of inguinal hernia

1. Direct inguinal hernia
2. Indirect inguinal hernia

Direct inguinal hernia

A direct inguinal hernia is one which protrudes out through the posterior wall of the inguinal canal (Hesselbach's triangle). The sac lies medial to the inferior epigastric artery. More common in elderly, 50% are bilateral.

Clinical picture

Appears as a spherical shaped, forward bulge, incomplete, does not descend into scrotum, reduces spontaneously on lying down.

Three finger test - impulse felt on middle finger.

Finger invagination test - impulse felt on the pulp of finger.

Ring occlusion test - swelling appears medial to occluding finger.

Indirect inguinal hernia / oblique inguinal hernia:

An indirect inguinal hernia, the abdominal contents enter the deep inguinal ring, traverse the length of the inguinal canal and exit through the superficial inguinal ring. This occurs through the preformed partial or completely patent processus vaginalis. It is bilateral in 12% of cases. Occurs both in male and female in the ratio of 20:1. More common in younger age group.

Clinical picture

Descends obliquely medially and downwards, pyriform shaped. May extend downwards into the scrotum, as complete one.

Three finger test - Impulse felt on the index finger

Finger invagination test - Impulse felt on the tip of the finger

Ring occlusion test - Swelling does not appear medial to occluding finger.

Types of indirect inguinal hernia (EXTENT)

1. Bubonocele - sac is confined to inguinal canal
2. Funicular hernia - Here the hernia is limited to just above the testis as the processusvaginalis is closed just above the epididymis. Testis is palpable separately.
3. Complete hernia - The hernia sac descends down to the bottom of the scrotum, lying in front and at sides of the testis. Testis can be felt posterior to the hernia sac.

Classification of groin hernias

Fruchaud, is the one who described the concept of the myopectineal orifice. He described transversalis fascia, as common site of weakness predisposing to all types of hernias. Hence the hernia treatment should be goaled at restoring the integrity of this orifice to prevent recurrences following repair.

Table 6: Nyhus classification

Type I	Indirect hernia, internal ring normal, typically in infants, children and small adults
Type II	Indirect hernia, internal ring enlarged without impingement on the floor of the inguinal canal; does not extend to scrotum

Type IIIa	Direct hernia;size is not taken into account
Type IIIb	Pantaloon hernia
Type IIIc	Femoral hernia
Type IV	Recurrent hernia;modifiers A-D are sometimes added,which corresponds to indirect,direct,femoral and mixed.

Table 7: Gilbert classification

This classification is based on the intraoperative assessment of the Internal ring.

Type I	Small , indirect
Type II	Moderate ,indirect type
Type III	Large, indirect type
Type IV	Entire floor, direct type
Type V	Diverticular, direct
Type VI	Pantaloon hernia
Type VII	Femoral hernia

Treatment

Indications of surgery

1. In childrens, all inguinal hernias should be repaired without delay, because of risk of incarceration and strangulation. In elderly, the patient should be operated on elective basis, because of the associated medical problems
2. The small, wide necked direct inguinal hernias in elderly patients that pop out and back on coughing can be left alone unless they show signs of growing.

Preoperative assessment

1. To quit smoking.
2. Grossly overweight patients should be advised to reduce their weight before surgery.
3. Cardiovascular, pulmonary, renal pathologies and conditions such as diabetes mellitus should be looked for and controlled.

Anaesthesia

Performed under general and spinal anaesthesia

Operative techniques

Herniotomy

In children's, as the pathology is persistent processus vaginalis and not the posterior wall weakening, herniotomy is the treatment of choice. After preliminary dissection, Sac is identified, separated from the cord by blunt dissection to minimize trauma to the cord. Sac opened, contents reduced, transfixed at the neck & excess sac excised. Wound closed in layers.

Herniorrhaphy

The success of a hernia repair depends on tension free closure of the hernia defect. Previous methods of just closing the hernia defect has resulted in increased recurrence rate. Hence the techniques of inguinal repair have now improved to bridge the defect with either natural tissues or synthetic materials.

The surgical approach to hernia repair can be open or laparoscopic. Open inguinal hernias can be performed through anterior or posterior approach. Anterior repairs are now the most commonly used approach.

Technique of anterior repair

The skin incision is made in the groin transversely or slightly curvilinear above the medial two third of inguinal ligament for about approximately 6 to 8 cm. Dissection is deepened through the subcutaneous tissue and Scarpa's fascia. Few veins coursing along the subcutaneous tissue should be identified, ligated and divided between haemostatic clamp to

achieve perfect haemostasis and to prevent haematoma formation. External oblique aponeurosis and superficial inguinal ring are identified and slit opened at the level of the apex of superficial inguinal ring. Inguinal canal is now exposed. Superior flap is raised by finger dissection between the external oblique aponeurosis and internal oblique muscle. Inferior flap is raised so as to reveal the shelving edge of the inguinal Ligament.

Mobilization of the spermatic cord:

The spermatic cord is mobilized at the level of pubic tubercle. This can be done both by blunt and sharp dissection. The ilioinguinal nerve, iliohypogastric nerve, genital branch of the genitofemoral nerve are identified and preserved.

The cremasteric muscle overlying the spermatic cord is dissected parallel to the line of fibers and the spermatic cord is skeletonised. The cremasteric artery and vein can be encountered now at the level of internal ring.

Damage to this structure could result in significant amount of bleeding. Hence these vessels should be identified and avoided or cauterized or ligated and divided.

Identification of the sac

A direct hernia can be seen posterior to the cord as it protrudes through the weakness in the floor of the inguinal canal. An indirect inguinal hernial sac is located deep to the cremaster muscle. After dividing the muscle

longitudinally, the sac can be seen in an anterolateral position to the cord, extending superiorly through the internal ring.

A hernia will present with both the direct and indirect component in the same inguinal canal.

High ligation of the sac:

In case of indirect hernial sac, the sac is separated carefully from the cord structures up to the level of internal ring. The sac is opened and inspected for any visceral contents within. The sac is now transfixed at the level of the neck at the internal ring. This reduction of the hernia sac into the preperitoneal space is called high ligation of the sac, excess sac is then excised. In case of larger sac, the sac is opened just close to the internal ring. The proximal one is ligated and the distal sac left undisturbed. In case of direct- hernia, as there is no true sac reduction can be achieved during posterior wall repair.

Anterior tissue repairs

Before the advent of prosthetic mesh repair, tissue repair was advocated. Even now, tissue repair has an important role in the treatment of inguinal hernia, in places where there is contraindication for use of prosthetic mesh.

The Indications for tissue repair are :

- In case of contaminated operative field i.e., strangulated hernia.

The various tissue repairs are

- Bassini repair
- Shouldice repair
- Mcvay repair.

Bassini repair

This is a triple layer repair, done to restore the integrity of the pelvic floor. This is the basic approach and once popular technique for non anatomic repair.² Here the transverses aponeurosis, internal oblique musculoaponeurotic arch, transversalis fascia is sutured to the inguinal ligament, with repair of the medial end of the internal inguinal ring. This repair has a high incidence of neurovascular injury and higher recurrence rate.

Shouldice repair

It is a multilayered repair done under local anaesthesia. Repair of the posterior wall i.e., transversalis fascia and tightening of the internal ring is the basis of this tissue repair².

Here, the transversalis fascia is split opened starting from internal ring to pubic tubercle and then the four layered repair is started. The shouldice hospital

utilizes 32 or 34 gauge stainless steel wire as a continuous suture, but now modern surgeons are using synthetic suture materials.

The first layer repair consists of suturing the free edge of the lower transversalis to the posterior surface of upper transversalis fascia and lateral part of posterior rectus sheath, in a continuous imbricated fashion, starting medially at pubic tubercle to the internal ring, thus tightening the transversalis fascia at internal ring.

The second layer is continued by suturing the upper transversalis flap to the base of lower edge of inguinal ligament as a running suture and this ends at the pubic tubercle with the first layer.

The third layer continuous suture is started at the internal ring by suturing conjoined tendon medially with inguinal ligament laterally till the pubic tubercle.

The fourth layer includes suturing the anterior rectus sheath medially with the posterior aspect of external oblique aponeurosis laterally.

The cord is now rested on the new inguinal floor.

This procedure has an excellent outcome in respect to recurrence rates.

The recurrence was found to be <1%. Here the tension is distributed throughout the inguinal canal due to multiple, continuous overlapping suture lines. However, the shouldice repair dissection is complicated and doing this Procedure requires excellent anatomical knowledge and excellent surgical

Hands. Thus the low level of recurrence rate in shouldice repair is attributed to the experience of the surgeon.

Mcvay repair (Cooper's ligament repair)

Only open tissue –base technique repairing both inguinal and femoral hernia defects, introducing the concept of the relaxing incision as a tension reducing maneuver. After lateralization of the cord, the transversalis fascia is opened through a transverse incision. Now the preperitoneal space can be entered. Similarly, the Cooper's ligament is identified and freed of its attachments, 2-4 cm vertical incision is made at the lateral border of anterior rectus sheath, starting at pubic tubercle and extending superiorly. This helps in relaxing, significant amount of tension following tissue repair.

Now, the Cooper's ligament is sutured to the upper flap of the transversalis fascia, starting from the pubic tubercle towards the femoral sheath. Now, the cooper's ligament is sutured to the femoral sheath. This closes the femoral canal. The suturing is now continued further between the transversalis fascia and iliopubictract, laterally until the deep inguinal ring is reached thus, narrowing of the internal ring is achieved.

This procedure has an excellent long term outcome but the disadvantages includes, longer operative time, more extensive dissection, injury to femoral vessels, thromboembolism of femoral vessels.

Darn repairs

The principle of the nylon darn operation is to reinforce the weakened or torn posterior wall of the inguinal canal with the muscles of the musculoaponeurotic arch, as well as a simple lattice work of monofilament nylon suture under no tension, on which is laid a buttress of fibrous tissue.

The nylon darn solves the problem of early recurrence, since the nylon lattice will hold the area intact during the first year, until the natural connective tissue collagen scar matures to its full strength. The nylon being indestructible will maintain the integrity of the repair for many years.

Pure prosthetic anterior mesh repair :

Billroth, then recognized weakened abdominal wall tissue should be reinforced with some prosthetic material. Initially, tantalum metal sheets, silver-wire filigree sheets, fascia lata, sheets of skin are used. These prosthesis failed due to metals being fragmented, biological tissues being rejected and suffered infection. Then he realized that, this artificially produced material should have the density and toughness of fascia and tendon.

Usher, in 1959 introduced the mesh technique bringing Billroth's dream to come true. Marlex mesh was used in repair. The posterior wall was opened and marlex mesh was sutured to the undersurface of the medial margin of the defect and to the shelving edge of the inguinal ligament. This is proposed as "tension eliminating repair".

MESH:

The term mesh refers to prosthetic material, a net or a flat sheet, used to strengthen a hernia repair. Mesh can be used to

- Bridge a defect - mesh is simply fixed over the defect.
- Plug a defect - mesh is pushed in to the defect.
- Augment a repair - defect is closed with sutures and then the mesh is added for reinforcement.

Mesh types

1. Biological mesh

These are derived from donor tissues, such as human dermis, porcine dermis, porcine small intestine submucosa, bovine dermis, bovine pericardium. Collagen rich tissues are harvested and treated to remove cellular elements. The collagen then scaffolds and with additional extracellular ground materials are strong enough to provide enough mechanical support for an intact hernia repair.

Used in cases of infections, such as strangulated inguinal hernia, where synthetic mesh is relatively or absolutely contraindicated.

2. Synthetic mesh

Polypropylene mesh

Knitted construction of polypropylene mesh fibers .

Stable, Hydrophobic, electrostatically neutral and non absorbable.

Polyester mesh

- Promotes inflammatory reaction similar to polypropylene.

Polytetrafluoroethylene mesh (PTFE and e-PTFE)

- This mesh does not promote ingrowth in to viscera and therefore makes it useful in IPOM or TAPP repairs
- These are smooth, soft and strong.
- Polyamide mesh

Properties of an ideal mesh

Chemically inert, non carcinogenic.

- Not physically modified by tissue fluids.
- Not excite inflammatory or foreign body reaction.
- Easy to handle & sufficiently pliable
- Optimum thickness, Capable of resisting mechanical strain & provides adequate strength.
- Be permeable and allow tissue ingrowth with in it-preventing dislocation or migration.

- Stimulate fibroblastic activity to allow incorporation in to tissue, rather than sequestration or encapsulation.
- Should preferably be macroporous, monofilament, transparent and should resist infection.

Lichtenstein's tension free repair¹⁴

This was the first inguinal hernia repair, done with prosthesis, he coined the term "tension - free hernioplasty"

In Lichtenstein tension free hernioplasty, the posterior wall was reinforced by insertion of a sheet of mesh, rather than suturing anatomic structures that are not in apposition. Lichtenstein's Technique introduced in 1984 is currently the best evaluated and most Popular technique among different open mesh repair.

Technique of the procedure

The skin and subcutaneous tissues are incised. The external Oblique aponeurosis is split opened to expose the inguinal canal. The superior and inferior flap raised, thus the external oblique aponeurosis is separated from the internal oblique muscle, exposing internal oblique aponeurosis.

The cord is mobilized and lateralized. When lifting the cord, care is taken to include the ilioinguinal nerve. Care is taken to avoid injury to ilioinguinal nerve.

The cremasteric sheath is incised to expose the indirect sac. Removal of cremasteric muscle leads to hanging of testis and also dysfunction of Cremaster muscle, leading to dysej-culation. This also, exposes the genital nerve, vas deferens, paravasal nerves to the mesh.

This mesh irritation causes chronic inguinodynia and testicular pain.

An indirect sac is dissected free up to the neck of sac and invaginated into the preoperitoneal surface. Ligation of the peritoneum causes severe postoperative pain as it is highly innervated and the mechanical pressure causing ischemic necrosis.

The direct sac is invaginated by an absorbable imprecating suture.

A sheet of monofilament macro porous polypropylene mesh of size 8 x 16 cm is placed over the posterior wall, covering 2 cm medial to the pubic tubercle, 3-4 cm above the hesselbach's triangle, 5-6 cm lateral to inguinal ring. The mesh is secured with a nonabsorbable monofilament suture at the insertion of rectus sheath to the pubic bone, overlapping the bone by 1-2 cm and continued to attach the lower edge of the patch to the inguinal ligament. Medially the upper edge of the patch is sutured to the rectus sheath and internal oblique aponeurosis. Few interrupted sutures are placed superiorly, between the mesh and internal oblique aponeurosis. Fixing mesh to the internal oblique muscle is avoided to prevent injury to the intramuscular segment of iliohypogastric nerve. With a slit in the mesh to accommodate the spermatic cord, the upper and lower edge of the patch is fixed to the inguinal ligament,

lateral to the cord. The excess mesh on the lateral side is tucked below the external oblique aponeurosis, leaving at least 5 cm beyond internal ring.

External oblique aponeurosis is closed, constructing new superficial inguinal ring for the exit of spermatic cord. Wound is then closed in layers.

Plug and patch technique

A modification of the Lichtenstein repair, known as the plug and patch technique was developed by Gilbert and later popularized by Rutkow and Robbins²³. This technique involves placement of a plug, shaped in to a flower or umbrella configuration, with the apex pointed intraabdominally.

Laparoscopic hernia repair²

First performed by Ger in 1979 has evolved into a common and effective procedure. The most important difference between laparoscopic and open approaches for inguinal hernia repair is anatomical ,laparoscopic approach uses mesh to repair the hernia defect in a plane posterior to defect, whereas the open approach repair the hernia anterior to defect. Three different approach includes TAPP , TEP ,IPOM

TAPP (Transabdominal preperitoneal) – placement of mesh along the anterior abdominal wall,thereby repairing the hernia posterior to the defect. Ports are generally placed through umbilicus and laterally at midclavicular line at level of umbilicus.

Hernia defect is visualised from within peritoneal cavity, median umbilical ligament (urachal remnant), medial umbilical ligament (umbilical artery remnant), lateral umbilical fold (reflection of peritoneum over inferior epigastric vessels) are identified. Parietal peritoneum is then incised from medial umbilical ligament towards anterior superior iliac spine superior to hernia defect, exposing epigastric vessels, Cooper's ligaments on both sides. In direct hernia peritoneal sac is pulled back within peritoneal cavity, in indirect hernia, the peritoneal sac is retracted off the cord structures and pulled back within peritoneal cavity. A large polypropylene mesh is placed between the peritoneum and transversalis fascia covering the entire myopectineal orifice, mesh being stapled/tacked to pubic tubercle medially, Cooper's ligament inferiorly, anterior superior iliac spine laterally.

The intraperitoneal onlay mesh technique (IPOM) developed as a simplified version of TAPP repair³¹. Laparoscopic technique does not involve extensive mobilization of peritoneal flap and dissection of preperitoneal space. A large mesh is stapled/sutured directly posterior to peritoneum to repair hernia. Disadvantage of this technique is direct exposure of intraabdominal contents and high risk of adhesion formation, erosion of mesh into bowel contents

The TEP approach is currently popular technique, performed entirely within preperitoneal space not involving the peritoneal cavity, insufflating between the anterior abdominal wall tissues and peritoneum posteriorly. TEP repair allows a large prosthetic mesh to be placed through a laparoscopic port

into preperitoneal space and is then positioned deep to hernia defect to repair the hernia from a posterior approach.

Complications of inguinal hernia surgery

- I. Wound infection.
- II. Seroma, haematoma
- III. Chronic groin pain
- IV. Cord and testis injury.
- V. Recurrence
- VI. Osteitis pubis.
- VII. Prosthetic problems
- VIII. Laparoscopic problems^{11,12,13}
 - a. Vascular injury
 - b. Visceral injury
 - i. Bowel perforation
 - ii. Bladder perforation

Inguinodynia

It is persistent pain in the groin occurring after hernia surgery. This may occur in the immediate postoperative period or months or years after hernia surgery that impairs the quality of life of the patient.

Potential causes of inguinodynia

Surgical technique

1. Mesh adherence
2. Nerve entrapment
3. Osteitis pubis
4. Compromise of spermatic cord
5. Inappropriate tack placement laparoscopically or suture placement with open technique.
6. Neuropathy secondary to exaggerated scarification process.
7. Idiosyncratic response to mesh implantation

Inguinodynia of neuropathy

The pain presents as a sharp localizing pain, numbness or as paresthesia in the cutaneous distribution of nerve. It is difficult to identify the exact nerve which causes the symptoms, due to overlapping distribution of the nerves.

Nerve entrapment leads to sharp localizing pain, where as nerve division causes numbness over the distribution of the nerve.

Initially the cause of inguinodynia was considered to be mesh. But, subsequent researches have showed that the pain was due to accidental entrapment of the sensory nerve with the sutures used to fix the mesh. Hence, precise recognition of the sensory nerves during hernia surgery such as ilioinguinal nerve, iliohypogastric nerve, genital branch of the genitofemoral nerve is necessary.

Classification of pain

- Visceral pain
- Somatic pain
- Neuropathic pain

Visceral pain

This is due to injury to the sympathetic nerve plexus. This pain is usually experienced during some visceral function, such as ejaculation.

Somatic pain

This is due to damage to ligaments and muscles during surgery. This type of pain is most commonly encountered. This type of pain can be reproduced during exertion or movement of the abdominal wall. Somatic pain can be treated with rest, NSAIDS and reassurance.

Neuropathic pain

This is due to nerve damage or nerve entrapment. This is a sharp localized pain which can be sensed as a burning or tearing one along the area of nerve distribution which may occur in the immediate postoperative period.

Nerves injured

- Ilioinguinal nerve
- Iliohypogastric nerve
- Genital and femoral branches of the genitofemoral nerve
- Lateral cutaneous nerve of thigh.

Treatment of neuropathic pain

- Mild pain - can be treated with NSAIDs
- Moderate pain - can be treated with nerve directed injections of steroid or anaesthetics,
- Severe pain - can be treated with neurectomies.
 - This produces relief in about 72% of patients.

Cord and testis injury

Spermatic cord is a well vascularised structure. During mobilization, dissection and lateralization of the cord structures, there is a risk of injury to, pampiniform plexus of veins, testicular artery and vas deferens.

Scrotal haematoma

During handling of the spermatic cord, there is a risk for vessel injury and localized haematoma formation or significant scrotal haematoma. Scrotal haematoma presents as a bluish black discolouration of the scrotal wall. This condition is self limiting and can be treated with reassurance, warm and cold compresses.

Wound infection

This is a clean surgically created wound, the risk of surgical Site infection is reported to be 1% - 2% after open inguinal hernia repair. Incidence being less with laparoscopic hernia repair. Many studies have Shown that, there is no need for prophylactic antibiotics.

Seroma :

A seroma is a localized collection of fluid. This develops in the first week of post operative period.

Causes

1. Extensive dissection in repair of larger hernias.
2. Following use of prosthetic mesh repairs - as the body tries to adapt with the foreign body through a normal reaction.

Treatment

- Observation.
- Warm compression.
- Aspiration may lead to infection.

Osteitis Pubis

This occurs when suture or surgical tacker³² is placed too deeply in to the periosteum of pubis, in the pubic tubercle. Patient complains of pulling, aching or throbbing pain in pubic area. Symptoms are exaggerated by twisting or squatting. Diagnosis is made by direct manual pressure on the os pubis

Treatment

- NSAIDs
- Local injection of corticosteroids.

Urinary retention

This occurs due to post operative pain and use of narcotic analgesics. In case of spinal anaesthesia, the incidence of urinary retention was found to be

about 13% .There is no need for prophylactic catheterization. Treatment is to limit IV hydration, prophylactic tamsulosin, Short term catheterization.

Mesh plug

This is the exaggerated fibrosis or scarring to the presence of the mesh. The mesh shrinks excessively, scars and retracts away from the host tissue.

In case of polypropylene mesh, the mesh shrinkage accounts to be about 40%. Mesh shrinkage also leads to recurrence of the hernia.

Recurrence

This occurs mostly due to failure in technical aspect. Hernia recurrence is more common in patients with direct hernia. Medial recurrence is more common. Recurrence usually occurs through floor of inguinal canal, near the pubic tubercle as the suture line tension is greatest.

Causes

- Excessive tension on the repair
- Failure to include musculoaponeurotic margin in repair
- Improper mesh size and placement or mesh displacement
- Failure to close the patulous internal ring
- Chronically elevated intraabdominal pressure
- Deep surgical site infection
- Poor collagen formation in the wound

MATERIALS AND METHODS

STUDY DESIGN

Prospective study

STUDY POPULATION

Patients – male and female presenting with inguinal hernia

SAMPLE SIZE

In this prospective study a total of 50 patients with inguinal hernia were enrolled into two comparative groups ,namely Lichtenstein's and laparoscopic hernia repair

INCLUSION CRITERIA

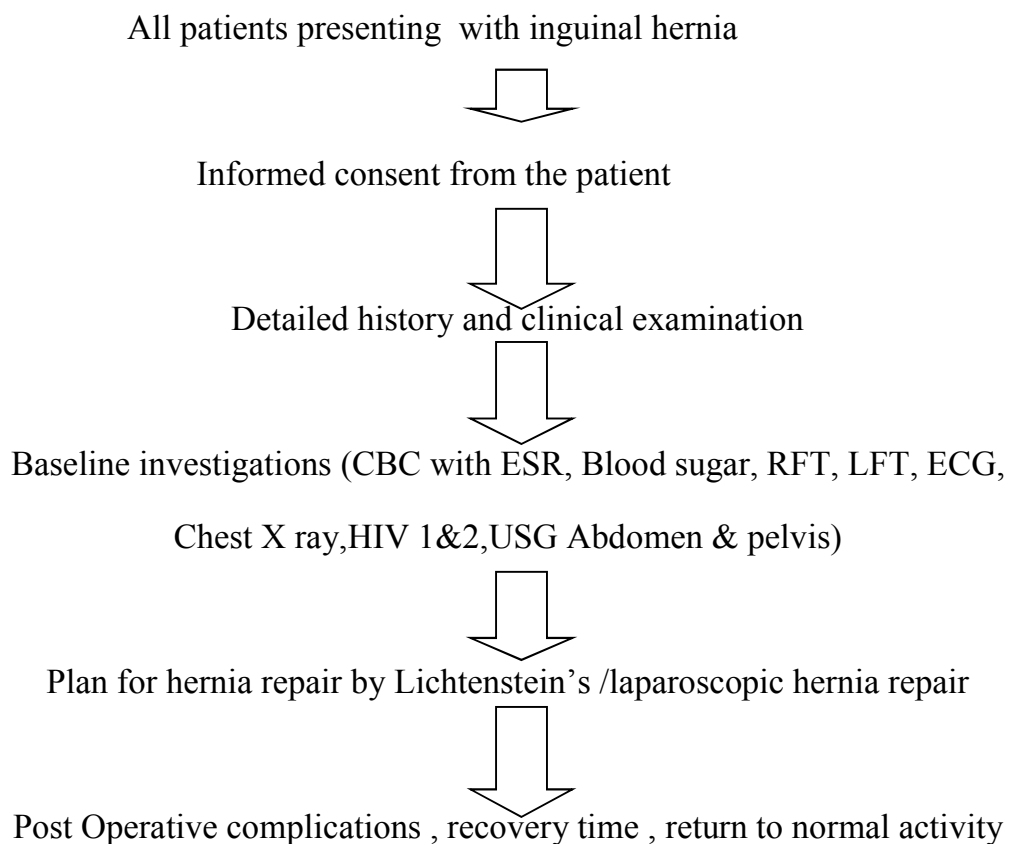
- All male and female patients with inguinal hernia consented for inguinal hernia repair
- Incomplete hernia
- Recurrent hernia

EXCLUSION CRITERIA

- Age >80 years
- Age <12 years
- Pregnancy

- Scrotal abdomen
- Obstructed hernia
- Medically unfit patients (chronic asthma, COPD, Cardiac diseases)

METHODOLOGY



Operative procedure :

A single dose of antibiotic was given prior to surgery and this is followed for about three days postoperatively.

The procedure was carried out by Lichtenstein technique and laparoscopic repair.

Post operative care and complications

Post operatively the patient was monitored regarding pain, wound site bleeding, seroma, hematoma , wound sit infection

The amount of postoperative pain by, visual analog scale and also duration of surgery, the amount of wound infection, seroma, return to daily activities. The patients were discharged as per their postoperative outcome

Pain is an unpleasant sensory and emotional thing experienced due to actual or potential tissue damage.

Pain assessment - It is a subjective experience, both psychological and physiological assessed by

Quantitative pain scale

Numerical pain rating scale

Wong - baker faces pain rating scale

Visual analog scale

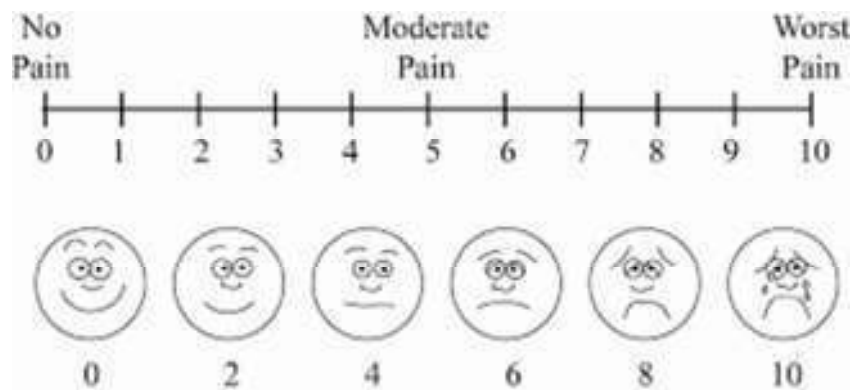
Qualitative pain scale

Mcgill questionnaire (Ronald melzack in 1975)

Verbal rating scale :

Visual Analog Scale

VAS or visual analogue scales use a vertical or horizontal line with words that convey "no pain" at one end and "worst pain" at the opposite end. Patients are asked to place a mark along the line that indicates your level of pain.



Mayo clinic chronic pain lists their pain as :

0- 1 : no pain

1- 3 : mild pain

4 - 5 : discomforting - moderate pain

6 - 7 : distressing - severe pain

8 - 9 : intense - very severe pain

10 : unbearable pain.

RESULTS AND OBSERVATION

Table 8: Distribution of study participants

Groups	Frequency	Percentage (%)
Open inguinal repair	25	50.0
Laparoscopic inguinal repair	25	50.0
Total	50	100.0

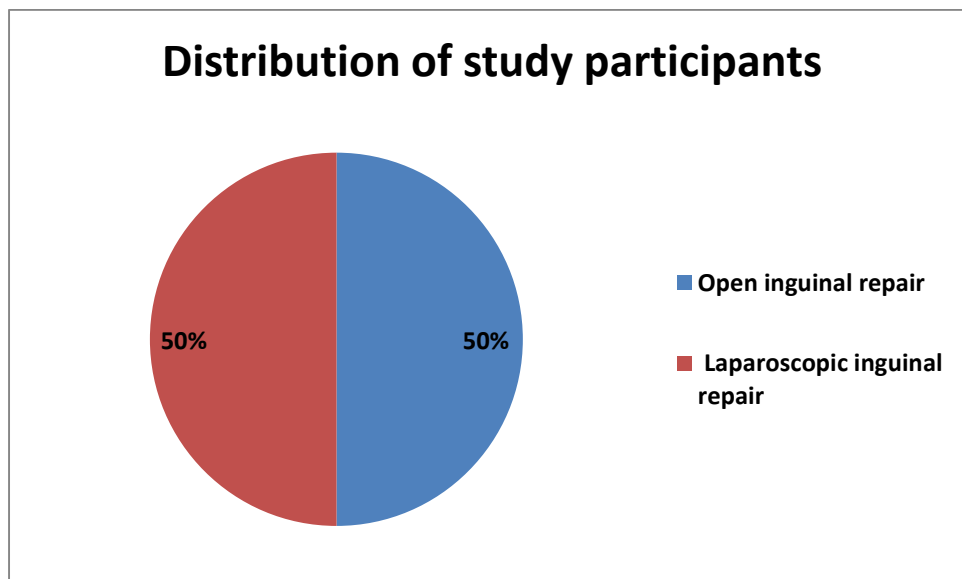


Table 9: Mean age of the study group

	Groups	N	Mean	SD	P value
AGE	Open inguinal repair	25	51.04	13.427	.277
	Laparoscopic inguinal repair	25	55.40	14.274	

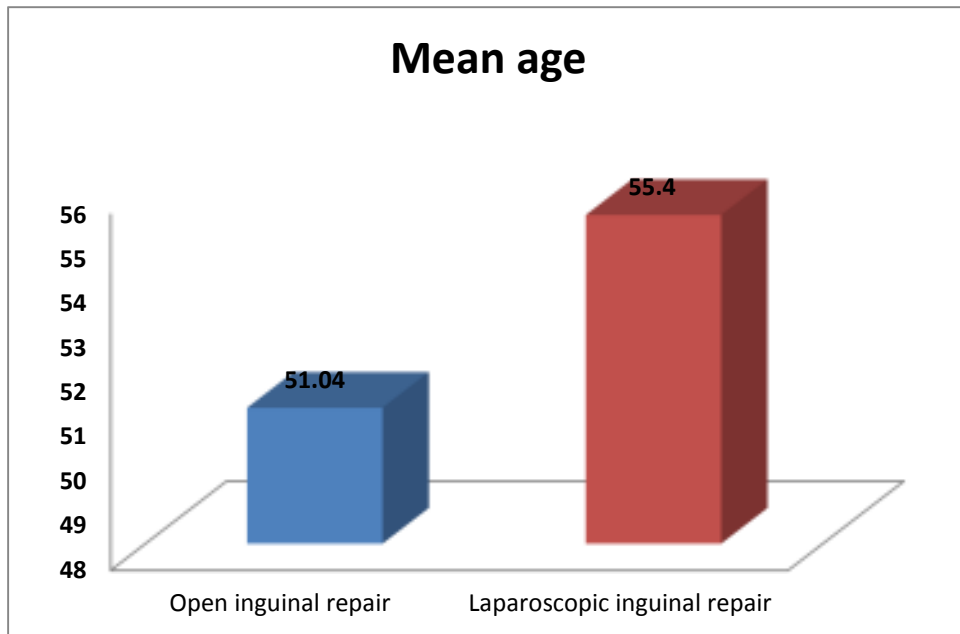


Table 10: Gender distribution of study group

Groups	Gender		P value
	Male	Female	
Open inguinal repair	24(96.0%)	1(4.0%)	.312
Laparoscopic inguinal repair	25(100.0%)	0(0.0%)	

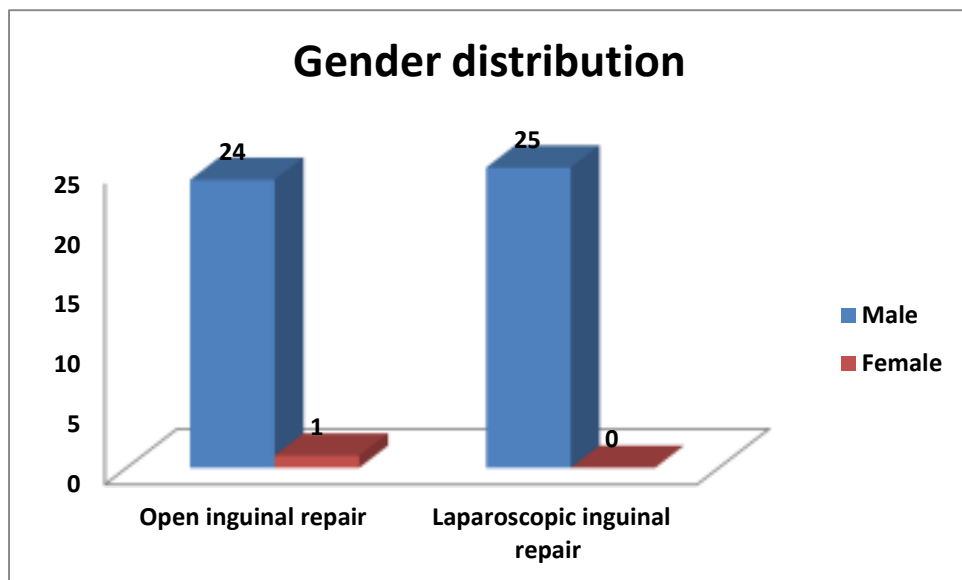


Table 11: Side distribution of study group

Groups	Side				
	BILATERAL	LEFT	RIGHT	LEFT RECURRENT	RIGHT RECURRENT
Open inguinal repair	2(8.0%)	4 (4.0%)	17 (68.0%)	1(4.0%)	1(4.0%)
Laparoscopic inguinal repair	8(32.0%)	6(24.0 %)	9(36.0 %)	1(4.0%)	1(4.0%)

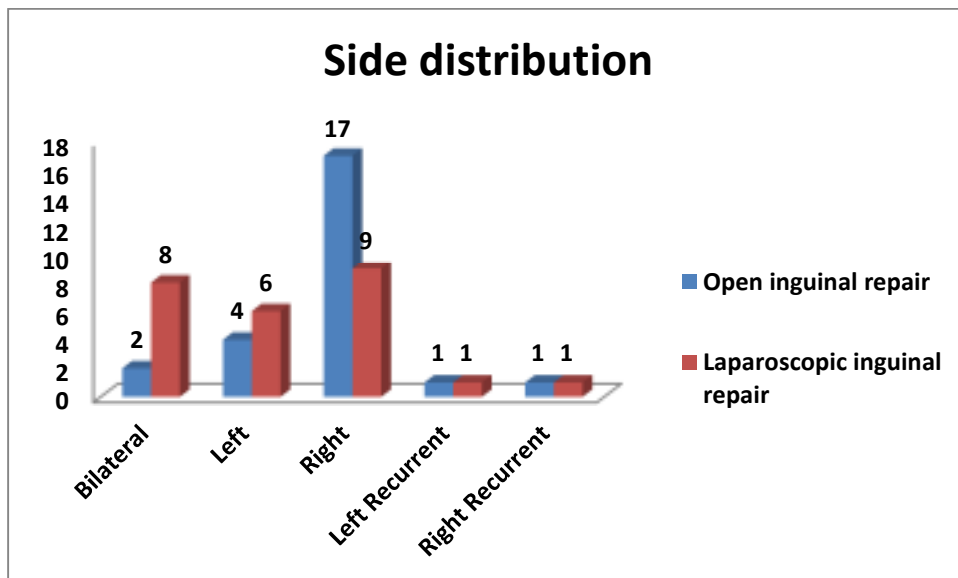


Table 12: Association of inguinal repair types with Operative time of the study group

	Groups	N	Mean	SD	P value
Operative Time	Open inguinal repair	25	50.00	7.708	.000*
	Laparoscopic inguinal repair	25	70.92	6.819	

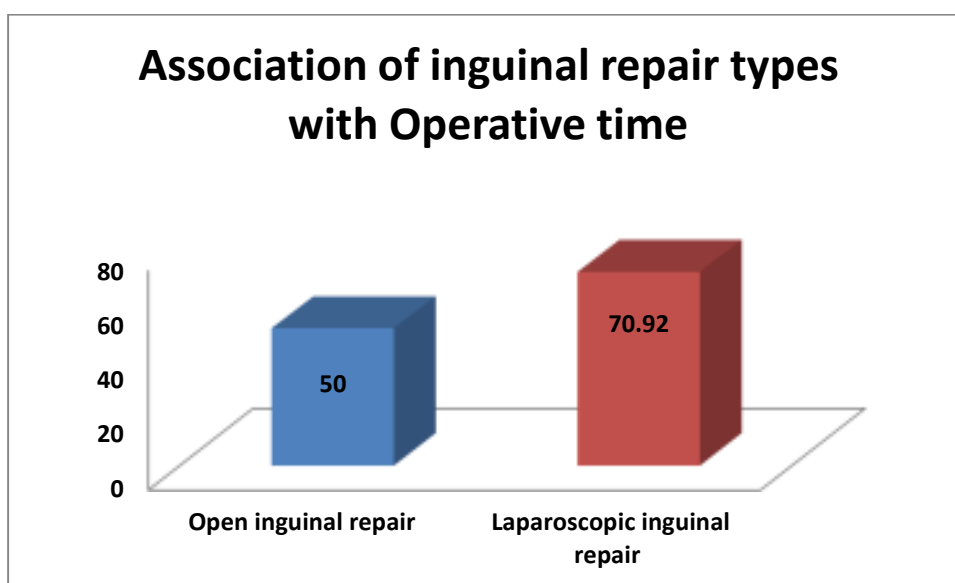


Table 13: Association of inguinal repair types with Post-Operative pain of the study group

	Groups	N	Mean	SD	P value
12 hours	Open inguinal repair	25	3.52	1.159	.000*
	Laparoscopic inguinal repair	25	6.00	.913	
24 hours	Open inguinal repair	25	5.44	.870	.000*
	Laparoscopic inguinal repair	25	4.40	.500	
48 hours	Open inguinal repair	25	5.96	1.172	.000*
	Laparoscopic inguinal repair	25	4.08	.572	

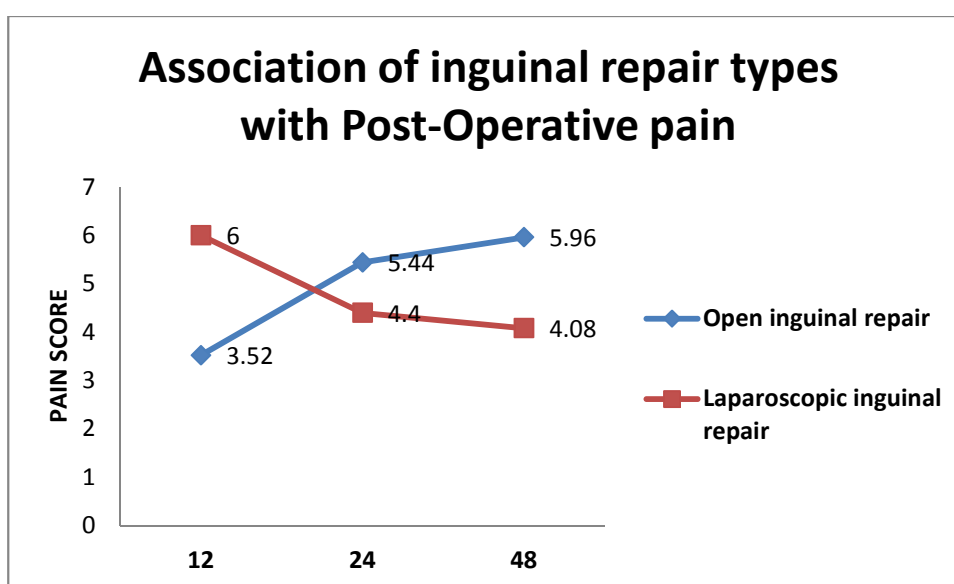


Table 14: Association of inguinal repair types with Post-operative drain in study group

Groups	Post-operative drain		P value
	Yes	No	
Open inguinal repair	2(8.0%)	23(92.0%)	.641
Laparoscopic inguinal repair	0(0.0%)	25(100.0%)	

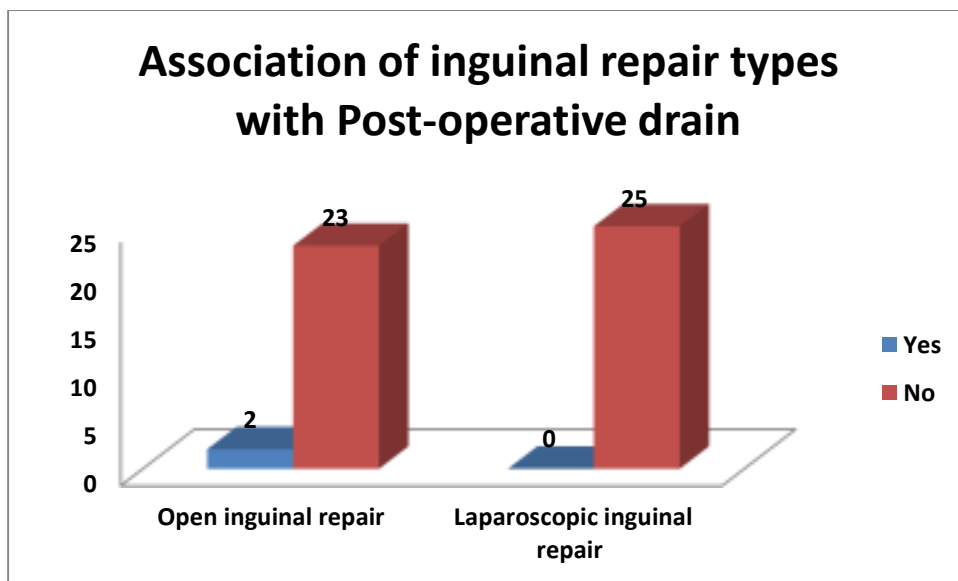


Table 15: Association of inguinal repair types with Hematoma study group

Groups	Hematoma		P value
	Yes	No	
Open inguinal repair	0(0.0%)	25(100.0%)	.146
Laparoscopic inguinal repair	2(8.0%)	23(92.0%)	

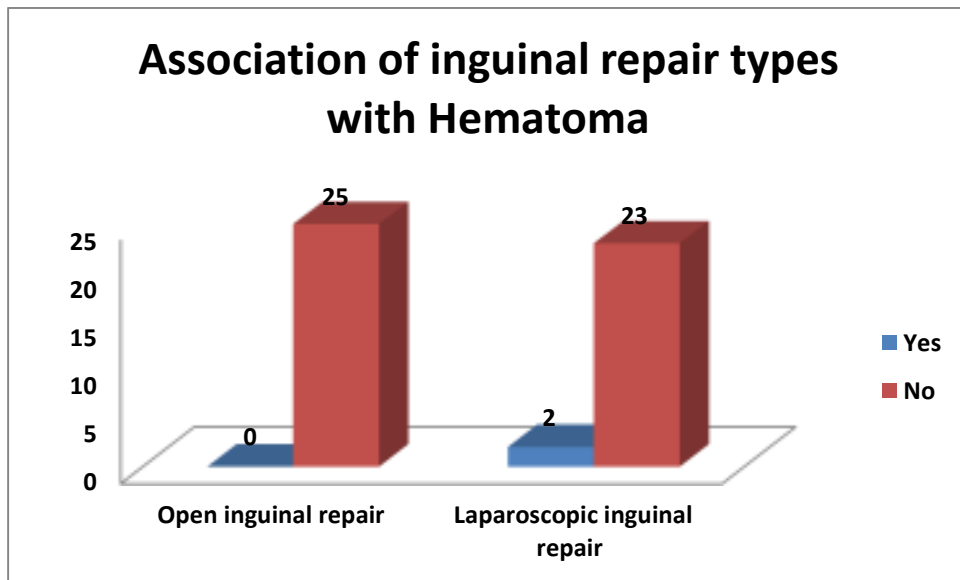


Table 16: Association of inguinal repair types with infection in study group

Groups	Infection		P value
	Yes	No	
Open inguinal repair	4(16.0%)	21(84.0%)	.648
Laparoscopic inguinal repair	3(12.0%)	22(88.0%)	

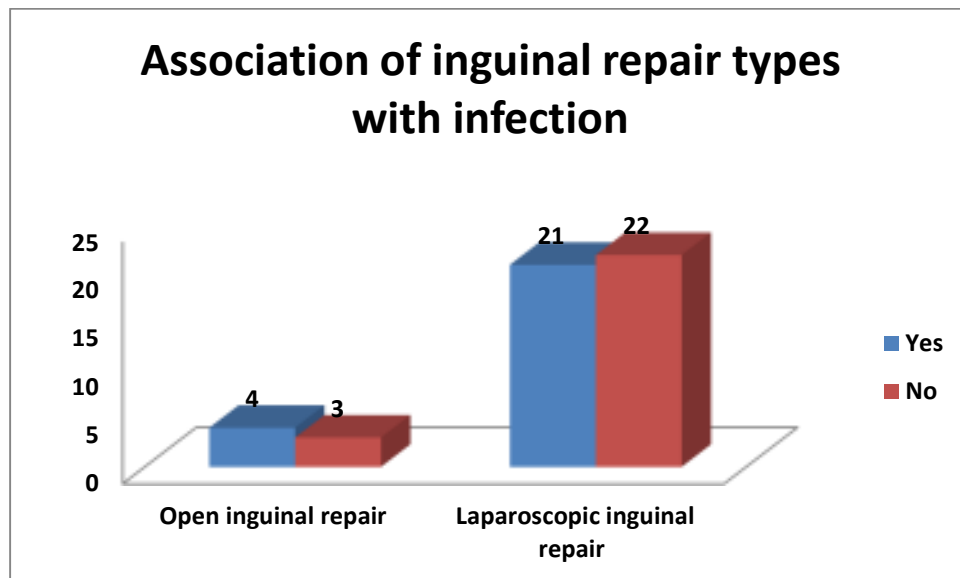


Table 17: Association of inguinal repair types with seromain study group

Groups	Seroma		P value
	Yes	No	
Open inguinal repair	5(20.0%)	20(80.0%)	.221
Laparoscopic inguinal repair	2(8.0%)	23(92.0%)	

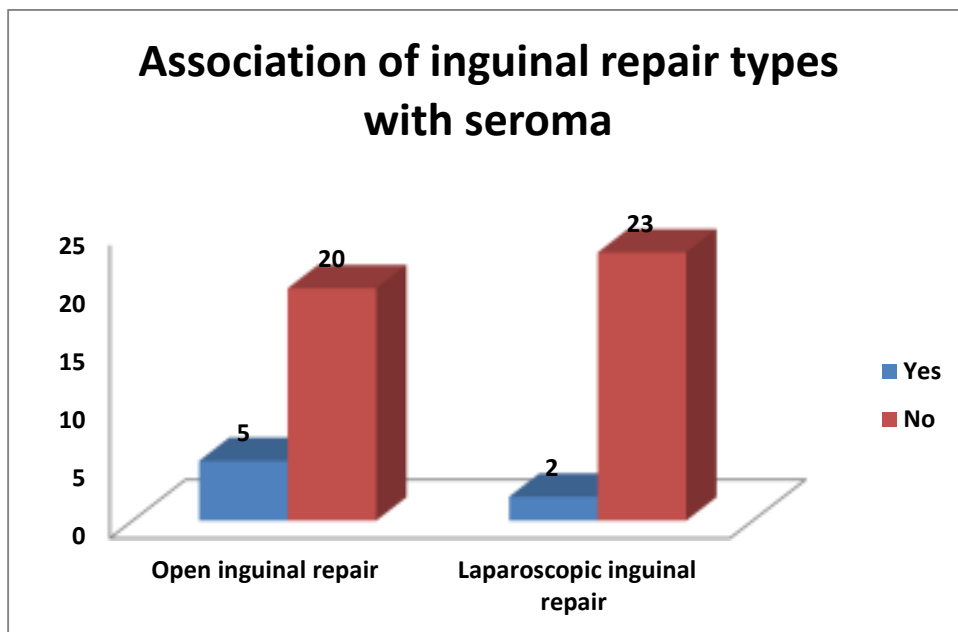
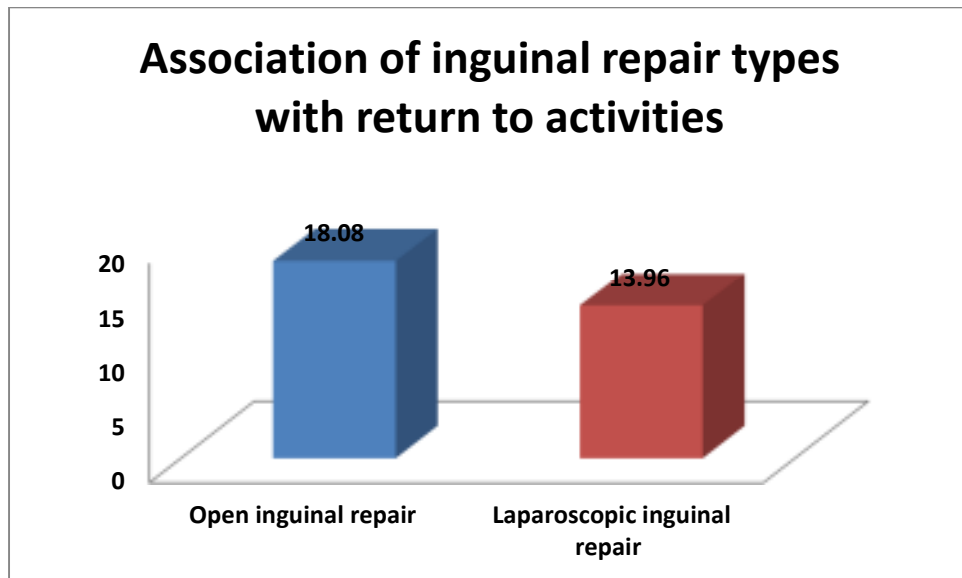


Table 18: Association of inguinal repair types with return to activities in the study group

	Groups	N	Mean	SD	P value
Return to activities	Open inguinal repair	25	18.08	3.135	.000*
	Laparoscopic inguinal repair	25	13.96	2.761	



DISCUSSION

An inguinal hernia is one of the most common surgical afflictions worldwide. The repair of an inguinal hernia has evolved through various stages, and the current standard method is to repair with a synthetic mesh. Mesh placement can be done either using an open approach or a minimal access approach. The standard landmark surgeries in this regard are tension-free repair invented by Irving Lichtenstein and Transabdominal preperitoneal inguinal hernia repair proposed. But the better among these two is still a debate. A total of 50 patients were enrolled in our study with each group consisting of 25 each. The techniques of mesh placement compared were the primary open onlay repair (Lichtenstein Tension free Hernioplasty) and Laparoscopic approaches i.e Totally extraperitoneal repair and Transabdominal Preperitoneal repair. The patients underwent surgeries in their respective units and followed up post operatively.

The intra-operative complications include hemorrhage, technical failure, conversion, injury to vas deferens, injury to vessels, injury to viscus, and major vascular injury. None of our patients had any intra-operative complication^{11,12}. Found no difference between the two groups in terms intra-operative complications. But a multicentre trial found intra-operative complications were more in a laparoscopic procedure. Again, it's the surgeon's laparoscopic skill which makes a difference. Similar to findings reported by other studies, the length of hospital stay was significantly shorter in the TAPP group and also had significantly more number of patients who were pain-free (P value 0.00)

compared to the open Lichtenstein group at 12hrs, 24hrs, and 48hrs postoperative period (Table 13). This was a unique finding regarding our study. Furthermore, the recovery from surgery after laparoscopic surgery was significantly faster. The open group experienced increased immediate post operative pain which led to slower recovery and resumption of regular activities. Hence, laparoscopic hernia repair by an experienced surgeon shortens the hospital stay significantly with faster recovery, thereby reducing the economic burden and partially compensates for the increased cost of laparoscopic surgery.

The postoperative complications of hernia repair include seroma, hematoma, wound infection. The mean time to return to work was 13 days in TAPP group, which was significantly lesser than the Lichtenstein group 18 days, ($p=0.000$). This was a universal finding as all other studies found laparoscopic TAPP had significantly less time to return to work.

CONCLUSION

Laparoscopic hernia repair is safe and provide less postoperative morbidity in experienced hands and definitely had many advantages over open repair such as early resumption of daily activities and work, better subjective and objective cosmetic results with some limitations like more operative time. For bilateral and recurrent inguinal hernias laparoscopic approach is recommended. From the results of this study we find the outcomes of laparoscopic inguinal hernia are comparable with open repair. Laparoscopic repair has an advantage of less post operative pain, decreased hospital stay, faster recovery and improved cosmesis. It may soon become the procedure of choice not only for bilateral and recurrent hernias but also for primary, unilateral hernias.

The open repair has a definite advantage over laparoscopic repair financially; however the decreased hospital stay and faster recovery may reduce the economic burden of laparoscopic surgery to some extent. The open repair remains a good option especially for older, high risk patients and easy to perform, inexpensive and can be done under local anesthesia. However, the trend in surgery today is in favour of minimally invasive surgery and rightfully so as our study proves.

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STUDY PROFORMA

NAME

IP NO

AGE

SEX

OCCUPATION

ADDRESS

DATE OF ADMISSION

DATE OF DISCHARGE

MARITAL STATUS

PHONE NO.

Chief Complaints :

Duration of swelling

onset

Site

Aggravating factor - h/o coughing/constipation(straining)

Relieving factors -spontaneous reducibility on lying down/manually

Past history –COPD/chronic cough/ischemic heart disease/diabetes mellitus/hypertension/ coronary artery disease/liver disease

Personal history –H/o smoking

Family history

Treatment history

Previous hernia repair/abdominal surgeries

EXAMINATION:

GENERAL EXAMINATION

Pallor/Pedal edema/icterus/cyanosis/clubbing/

Lymphadenopathy

Pulse rate

Blood pressure

SYSTEMIC EXAMINATION

CNS:

CVS:

RS :

P/A:

LOCAL EXAMINATION

SITE

SIZE

SHAPE

EXTENT

SURFACE

SKIN OVER SWELLING

VISIBLE PERISTALSIS

CONSISTENCY

REDUCIBILITY

GET ABOVE SWELLING

COUGH IMPULSE

RING OCCLUSION TEST

ZIEMANS TECHNIQUE

FINGER INVAGINATION TEST

AUSCULTATION

PERCUSSION

ABDOMINAL EXAMINATION

GROIN EXAMINATION

EXAMINATION OF INGUINAL LYMPHNODES

ANNEXURES

PATIENT CONSENT FORM

**STUDY TITLE: - COMPARATIVE STUDY BETWEEN OPEN AND
LAPAROSCOPIC INGUINAL HERNIA REPAIR**

STUDY CENTRE:

Coimbatore Medical College Hospital, Coimbatore.

PARTICIPANT NAME:

AGE/SEX:

I.P. NO:

I confirm that I have understood the purpose of treatment and procedure for the above study. I have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the possible complications that may occur during the interventional procedure. I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving any reason.

I understand that the investigator, regulatory authorities and the ethics committee will not need my permission to look at my health records both in respect to the current study and any further research that may be conducted in relation to it, even if I withdraw from the study. I understand that my identity will not be revealed in any information released to third

parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from the study.

I hereby consent to participate in this study of, **COMPARATIVE STUDY BETWEEN OPEN AND LAPAROSCOPIC INGUINAL HERNIA REPAIR.**

Date:

Signature of the patient & Name

Place:

Signature of the investigator & Name

NAME	AGE	SEX	Side of he	OPERATI VE TIME(mi ns)	POST			POST OP DRAIN	POST			RETURN TO WORK (days)
					12hrs	24 hrs	48 hrs		hematoma	infection	seroma	
PALANISAMY	65	M	BLIATERAL	76	3	5	7	NO	N	N	Y	20
GANESH	28	M	RIGHT	47	4	6	5	NO	N	N	N	15
JAMES	59	M	RIGHT RECURRENT	54	5	6	5	YES	N	N	Y	17
SAMINATHAN	67	M	RIGHT	43	7	5	6	NO	N	Y	N	16
MANIKANDAN	30	M	RIGHT	51	3	6	8	NO	N	N	N	18
VELLINGIRI	67	M	LEFT	44	4	5	5	NO	N	N	N	25
KUPPAN	60	M	RIGHT	46	2	6	6	NO	N	N	Y	17
MOHAN KRISHNAN	37	M	RIGHT	52	3	5	7	NO	N	N	N	20
BOSE	65	M	RIGHT	48	4	7	6	NO	N	N	N	15
ARJUNAN	48	M	RIGHT	48	3	5	7	NO	N	Y	N	14
UDAYAMOORTHY	28	M	RIGHT	53	4	6	4	NO	N	N	N	19
RAMESH	45	M	RIGHT	51	2	5	6	NO	N	N	N	16
BALAKRISHNAN	58	M	BILATERAL	70	3	4	5	NO	N	Y	N	24
KRISHNAN	50	M	RIGHT	43	4	6	7	NO	N	N	N	16
SUBRAMANIYAN	42	M	RIGHT	47	3	5	8	NO	N	N	N	17
AMMAVASAI	45	M	RIGHT	49	2	4	6	NO	N	N	N	18
SENTHIL	30	M	RIGHT	46	3	5	7	NO	N	N	N	20
RAMESH KUMAR	43	M	RIGHT	50	3	4	6	NO	N	N	N	14
MURUGESAN	46	M	LEFT	48	2	5	5	NO	N	N	Y	16
THANGAVEL	58	M	RIGHT	52	3	6	7	NO	N	N	N	15
VELLINGIRI	56	M	LEFT	47	4	5	6	NO	N	N	N	22
RANGASAMY	70	M	RIGHT	46	3	5	7	NO	N	N	N	24
NALLATHAMBI	60	M	LEFT	52	4	6	4	NO	N	Y	N	18
VISWANATHAN	69	M	RIGHT	45	5	7	5	NO	N	N	Y	20
THULASI	50	F	LEFT RECUURENT	42	5	7	4	YES	N	N	N	16

S.no	NAME	AGE	SEX	Side of hernia	OPERATIVE TIME(mins)	POST OP PAIN			POST OP DRAIN	POST OP COMPLICATIONS			RETURN TO WORK (days)
						12 hrs	24 hrs	48hrs		Hematoma	infection	Seroma	
1	JOSEPH	75	M	LEFT	68	5	4	6	NO	N	N	N	12
2	VINCENT	31	M	RIGHT	72	6	4	3	NO	N	N	N	10
3	DHARMARAJ	58	M	BILATERAL	80	7	5	4	NO	N	N	N	15
4	ELANGO	34	M	RIGHT	68	6	4	3	NO	Y	N	N	10
5	RAMASAMY	77	M	LEFT RECURRENT	75	5	4	4	NO	N	N	N	18
6	MADHUSUDHANAN	41	M	LEFT	65	7	5	4	NO	N	N	N	13
7	KALIMUTHU	55	M	BILATERAL	82	4	5	4	NO	N	N	Y	12
8	ANGAMUTHU	60	M	RIGHT	62	5	4	4	NO	N	N	N	10
9	SELVARAJ	61	M	BILATERAL	78	6	4	5	NO	N	N	N	15
10	ARUMUGAM	56	M	LEFT	68	5	4	4	NO	N	N	N	11
11	ANANDASUNDARAM	64	M	LEFT	65	6	5	4	NO	N	N	N	14
12	MURUGESAN	39	M	RIGHT	70	5	4	4	NO	N	N	Y	17
13	SUBRAMANI	59	M	RIGHT	65	6	4	4	NO	N	N	N	13
14	BASKARAN	70	M	BILATERAL	82	7	5	4	NO	N	N	N	18
15	NATARAJAN	77	M	LEFT	68	5	4	4	NO	N	N	N	14
16	SRINIVASAN	36	M	LEFT	65	6	5	4	NO	N	Y	N	12
17	JAYARAMAN	46	M	RIGHT	62	6	4	4	NO	N	N	N	10
18	RAMAKRISHNAN	48	M	RIGHT RECURRENT	67	8	4	5	NO	Y	N	N	15
19	SUBASH	33	M	BILATERAL	80	7	5	4	NO	N	N	N	16
20	DHANDAPANI	70	M	BILATERAL	78	6	4	4	NO	N	N	N	20
21	GOPAL	58	M	RIGHT	64	7	5	4	NO	N	N	N	15
22	VASU	49	M	RIGHT	67	6	4	4	NO	N	Y	N	13
23	KALIAPPAN	68	M	RIGHT	65	7	5	4	NO	N	N	N	15
24	DENNIS	50	M	BILATERAL	82	6	4	4	NO	N	Y	N	14
25	NATARAJ	70	M	BILATERAL	75	6	5	4	NO	N	N	N	17