"MESH FIXATION BY PDS TACKERS OR VICRYL INTACORPOREAL SUTURES IN TRANSABDOMINAL PREPERITONEAL INGUINAL HERNIA REPAIR A RANDOMIZED CONTROL TRIAL"

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LIST OF ABBREVIATIONS USED

AD: Anno Domini

ASIS: Anterior Superior Iliac Spine

BMI: Body Mass Index

C: Celsius

MMPs: Matrix Metalloproteinases

N/A: Not Available

ppm: Parts Per Million

%, per cent: Percent

PVP: Polyvinylpyrrolidone

ABSTRACT

Background: Inguinal hernia repair is a common surgical procedure, with laparoscopic transabdominal preperitoneal (TAPP) repair being a widely used technique. Mesh fixation during TAPP can be performed using various methods, primarily sutures or tackers. While both techniques aim to secure the mesh and prevent recurrence, they may differ in terms of postoperative pain, operative time, and complication rates.

Aim: This study aimed to compare postoperative pain, operative time, and complication rates between mesh fixation using Vicryl intracorporeal sutures and PDS tackers in patients undergoing TAPP inguinal hernia repair.

Materials and Methods: In this randomized controlled trial, 60 patients undergoing elective laparoscopic inguinal hernia surgery at KLES Dr. Prabhakar Kore Hospital & MRC, Belagavi, were enrolled between January 2023 and December 2023. Patients were randomly assigned to two groups: 30 patients received mesh fixation with Vicryl intracorporeal sutures (suture group), and 30 patients with PDS tackers (tacker group). Postoperative pain was assessed using the Visual Analog Scale (VAS) at 1 day, 1 month, and 3 months post-surgery. Operative time and complication rates were also recorded. Statistical analysis was performed using SPSS v20.0.

Results: Both groups had comparable gender distribution and hernia characteristics. The operative time showed no significant difference between the suture group and the tacker group. However, postoperative pain scores were significantly lower in the suture group at 1 month and 3 months compared to the tacker group ($p<0.05$). No significant difference was observed in the complication rates between the two groups.

Conclusion: Mesh fixation using Vicryl intracorporeal sutures in TAPP inguinal hernia repair is associated with lower postoperative pain at 1 month and 3 months compared to PDS tackers, without extending the operative time. These findings suggest that sutures may offer better postoperative pain management and could be preferred for enhanced patient comfort. Further studies with larger sample sizes and longer follow-up periods are recommended to confirm these outcomes.

Keywords: Inguinal hernia, TAPP, laparoscopic surgery, mesh fixation, sutures, tackers, postoperative pain.

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INTRODUCTION

Most patients are aware that there is a bulge beneath the skin on the abdomen wall. Self-diagnosis is prevalent. Although the hernia is mostly painless, some individuals may report feeling heavy or painful. Sharp, sporadic aches might indicate tissue pinching. A high danger of strangling should be communicated to the surgeon by severe discomfort. It is important to ascertain if the hernia will go away on its own or requires assistance.[1]

The most common hernia in both men and women, although far more prevalent in males, is the inguinal hernia, which patients frequently refer to as a "rupture." There are two main kinds, with anatomical, causal, and complication differences that are significant. Nonetheless, because of their similar morphology, comparable surgical repair methods, and equal final strengthening of the compromised anatomy, they are frequently referred to as inguinal hernias together.[2]

In situations with early asymptomatic direct hernia, it is safe to advise against active therapy, especially for older patients who do not want surgery. It is important to advise these people to seek medical attention right away if their hernia gets bigger or starts to cause symptoms. Although they are not advised, surgical trusses can be necessary for certain individuals who reject all surgical procedures. An easy and frequent procedure to treat an inguinal hernia is elective surgery. Even in individuals who are at high risk, it may be performed under local, regional, or general anesthesia with little danger.[3,4]

Furthermore the hernia repair can be done by either an open technique for mesh fixation or through a laproscopic method. Lichtenstein's repair and laparoscopic surgery have been compared in more than 60 randomized studies. “They demonstrate that even if a laparoscopic procedure requires more time to complete, there are established benefits, such as less

discomfort during the procedure and for up to five years following it, a quicker recovery period before returning to normal activities, and a lower risk of wound complications including infection, hemorrhage, and seroma. Patients who experience a hernia recurrence following open surgery and those with bilateral cases benefit most from laparoscopic surgery. While there exist other techniques for mesh fixation in laparoscopic hernia repair, suture is the most often used approach. Other fixation methods include the use of adhesive and tackers."[5,6]

In this study we would like to collect data by repairing the hernia laparoscopically and fixing the mesh with sutures and tackers and comparing the different data available from these patients.

REVIEW OF LITERATURE

Historical background

Hernia stands as one of the most ancient conditions documented in human history. The surgical correction of hernias traces its origins back to the ancient civilizations of Egypt and Greece.[7] In "De Semine," Galen (129-199 AD) provided an accurate depiction of the inguinal canal.[8] In his work "De Re Medica" in the 1st century, Celso provided an early description of surgical techniques. He suggested that for a medium-sized swelling, a single incision would suffice, while for larger swellings, two linear incisions were necessary, followed by removal of the cord. Vessels were then identified, tied, and cut. This period reflected a clear lack of anatomical knowledge. Five centuries later, Paolo D'Egina recommended cauterization and advocated for tying and dissecting the entire sac, implying the ligation of the cord. In 1559, Caspar Stromayr discussed the etiology, morphology, and treatment of hernia. August Gottlieb Richter emphasized not only closing the sac but also repairing the wall defect, underscoring the evolving understanding of hernia treatment over time.[8,9] Bassini developed the precursor to the modern inguinal hernia operation in the late 19th century. His discovery highlighted the significant role of the transversalis fascia in the pathophysiology of inguinal hernias. Bassini's technique involved a physiologic reconstruction of the inguinal canal by suturing the conjoint tendon and transversalis fascia with the inguinal ligament. This operation remained the gold standard for nearly a century.[10] Shouldice pioneered the use of local anesthesia for inguinal hernia repair. The Shouldice technique involves repairing three layers, reducing tension and post-operative pain.[11] Witzel's initial attempt at inguinal hernia repair using silver mesh resulted in numerous complications, leading to the abandonment of this approach.[12] Polypropylene was introduced by Nobel Prize winner Giulio Natta with Karl Ziegler in 1954[13] The first mesh repair was performed by Usher in 1958. [8,9]

Inguinal hernias make up 75% of all abdominal wall hernias globally. Inguinal hernia repair is among the most common general surgical procedures worldwide, representing around 10–15% of all surgical interventions, ranking second only to appendectomy.[14] Over 20 million inguinal hernia repairs are conducted globally each year, with operation rates varying from approximately 100 to 300 per 100,000 population annually. In India, the estimated annual incidence of inguinal hernias is 1,957,850.[14–16] With the low incidence, still inguinal hernia presents with the clinical classification like incarceration and strangulations.

Hernias are predominantly found in males compared to females. “Men are eight times more likely to develop hernias and 20 times more likely to require surgical repair compared to women.[17,18] In males, the lifetime risk of developing inguinal hernia is approximately 25%, while among females, it is around 5%. Women typically present with inguinal hernias at a median age of 60 to 79 years, whereas men present at a median age of 50 to 69 years.[19] Inguinal hernias make up 96% of all inguinal hernias, with femoral hernias comprising the remaining 4%. Regardless of gender, indirect inguinal hernias are the most prevalent type. Among males, direct hernias account for approximately 30% to 40% of inguinal hernias.”[19–21]

Abdominal wall

Surgeons must understand the varying consistency and function of tissues in the abdominal wall, crucial for hernia repair. Fascia, a condensed connective tissue, is integral. In relation to the inguinal canal, notable fasciae include Camper's, Scarpa's, Innominate, and Cribriform. Aponeurotic tissue, organized connective tissue with measurable strength, such as the crura of the external oblique, is also significant.

Layers of anterior abdominal wall

The Anatomy of the inguinal region is of particular interest due to its relevance to hernia pathology. The layers of the anterior abdominal wall from deep to superficial are: -

- Parietal peritoneum
- Extraperitoneal fat
- Transversalis fascia
- Transversus abdominis muscle
- Internal oblique muscle
- External oblique muscle
- Deep fascia
- Membranous layer of Scarpa's fascia
- Fatty layer of Camper's fascia
- Skin

Layers

1. Superficial ("Camper's fascia)
2. Deep ("Scarpa's fascia)
3. External oblique
4. Internal oblique
5. Transversus abdominus
6. Transversalis fascia
7. Parietal peritoneum

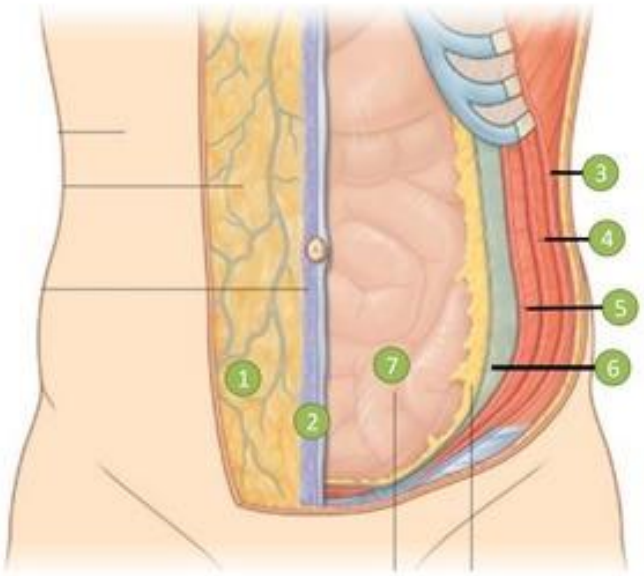


Figure 1: Anterior abdominal wall[22]

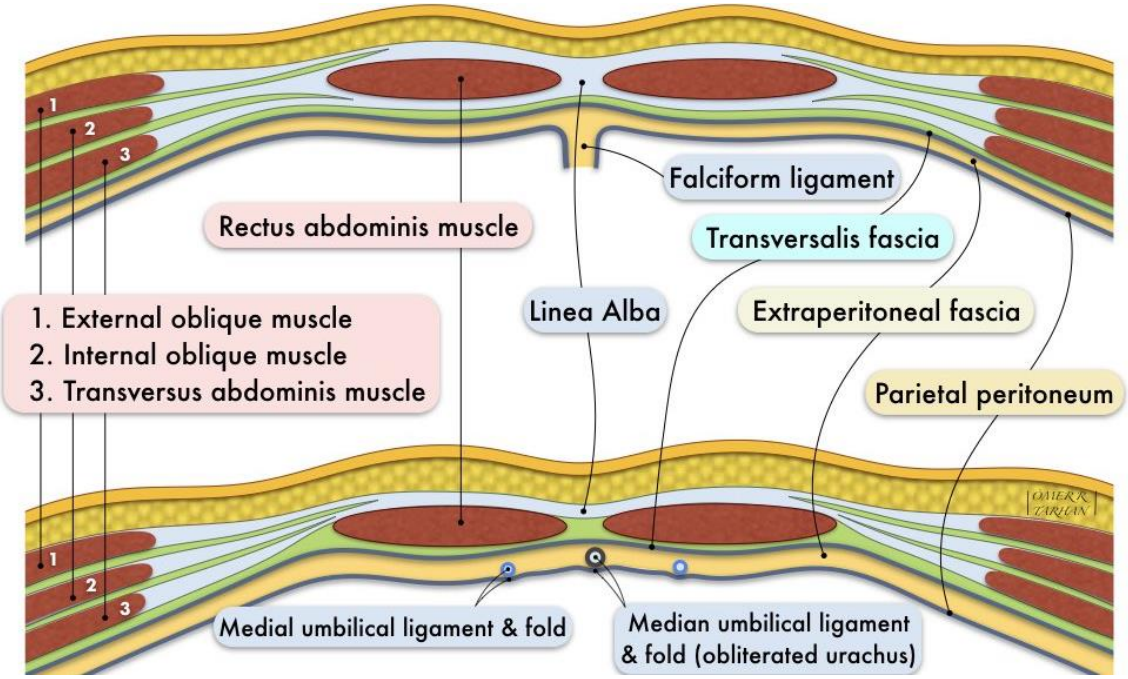


Figure 2: Surgical anatomy of anterior abdominal wall

Embryology:

"In the final three to four weeks of gestation, the embryo changes from a disc shape to a fetal one. While the endodermal and mesodermal disc layers fold to form the gut tube and ventral body wall, the ectodermal disc layer folds to generate the neural tube. The mesoderm is the source of the abdominal wall's muscles and fascia."[23]

During fetal development, the testis descends into the scrotal chamber guided by the gubernaculum testes, which originates from the plica inguinalis. By the sixth month, the gubernaculum transforms into a thick cord, connecting the testis to the scrotal pouch via the inguinal canal. The process vaginalis accompanies the gubernaculum, dragging abdominal wall fascial prolongations into the scrotum. These processes are covered by the aponeurosis of the external oblique, internal oblique, and fascia transversalis. As the testes and cord structures penetrate the abdominal wall, they are enveloped by remnants of the external, internal, and

transverse spermatic fascia. In the first month of intrauterine life, the testicle initially appears as a swelling at the caudal end of the genital ridge and subsequently develops a mesentery, remaining behind the peritoneum.[24] "During fetal development, the testis descends gradually: starting in the second month, it moves to the iliac fossa, reaches the deep ring by the beginning of the seventh month, passes through the inguinal canal in the seventh month, the superficial inguinal ring in the eighth month, and finally reaches the scrotum by the end of the eighth month." Ovarian descent typically concludes after the 12th week of pregnancy, near the pelvic brim.

As the testis migrates, the "gubernaculum shortens and eventually atrophies, leaving a portion at the bottom of the scrotum beneath the tunica vaginalis. The scrotal ligament, composed of truncated remains of the gubernaculum, connects the testis to the bottom of the scrotal pouch. By the end of the eighth month, the upper section of the processus vaginalis and its peritoneal wall form a fibrous cord." The lower half of the processus vaginalis becomes entirely isolated from the general peritoneum, consisting of two layers, with the parietal component lining the scrotum and the visceral section adhering to the surface of the testes.

In females, analogous to the processus vaginalis in males, there is a canal of Nuck, a peritoneal pouch extending down the inguinal canal into the labium majus. This is typically obliterated long before birth. The rare persistence of the vaginal process after birth can lead to inguinal hernia in females.

Muscles of abdominal wall

Anterolateral abdominal wall muscles: The "anterior chest wall is reinforced and laterally displaced by three large, flat paired muscles: the transversus abdominis, internal oblique, and external oblique. These layers combine anteromedially to form the rectus sheath, encompassing

the rectus abdominis and pyramidalis muscles. The aponeuroses of these muscles unite to form the linea alba in the midline.

External oblique: The external oblique is the outermost muscle of the anterolateral abdominal wall, with fibers extending from the fifth to the twelfth ribs inferomedially. As it approaches the midclavicular line, it forms an aponeurotic sheath that crosses the rectus abdominis and ends at the linea alba in the midline." When contracting, it works in conjunction with the internal oblique to rotate and laterally flex the spinal column. Its inferior boundary is formed by the inguinal ligament, which connects the anterior superior iliac spine (ASIS) to the pubic tubercle.

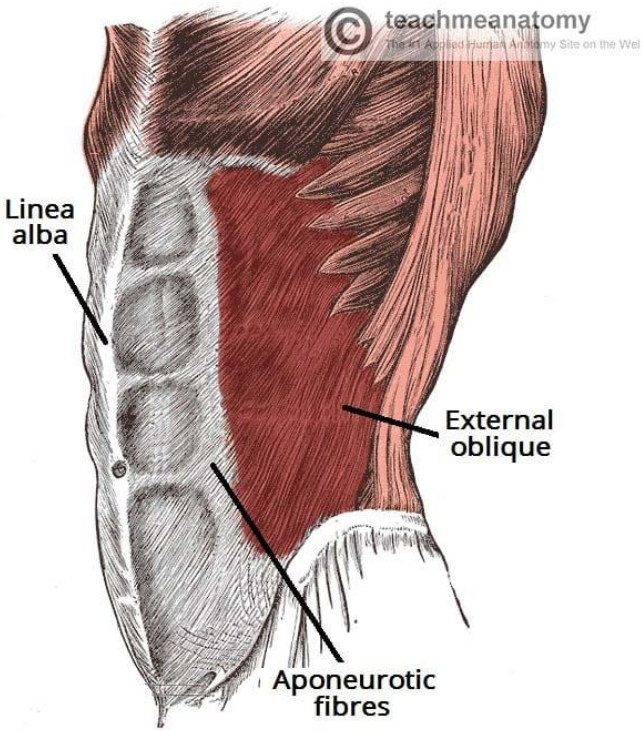


Figure 3: External oblique

Internal oblique: The muscle described lies beneath the external oblique and "contributes to the rotation and lateral flexion of the spinal column when contracted together with the external oblique. It is formed by the iliac crest, lateral inguinal ligament, and lumbar fascia. Its fibers

run superomedially and orthogonally to the external oblique before becoming aponeurotic. Its intermediate contributions to the rectus sheath differ from its upper and lower fibers. The rectus sheath is encircled by upper fibers that divide anteriorly and posteriorly, with each fiber descending before reaching the abdominal rectus muscle. Posteriorly, the rectus sheath is incomplete, lacking an aponeurotic layer between the rectus abdominis and the transversalis fascia, ending inferiorly at the "arcuate line." All layers converge medially to join the linea alba in the midline, irrespective of their relationship with the rectus abdominis."

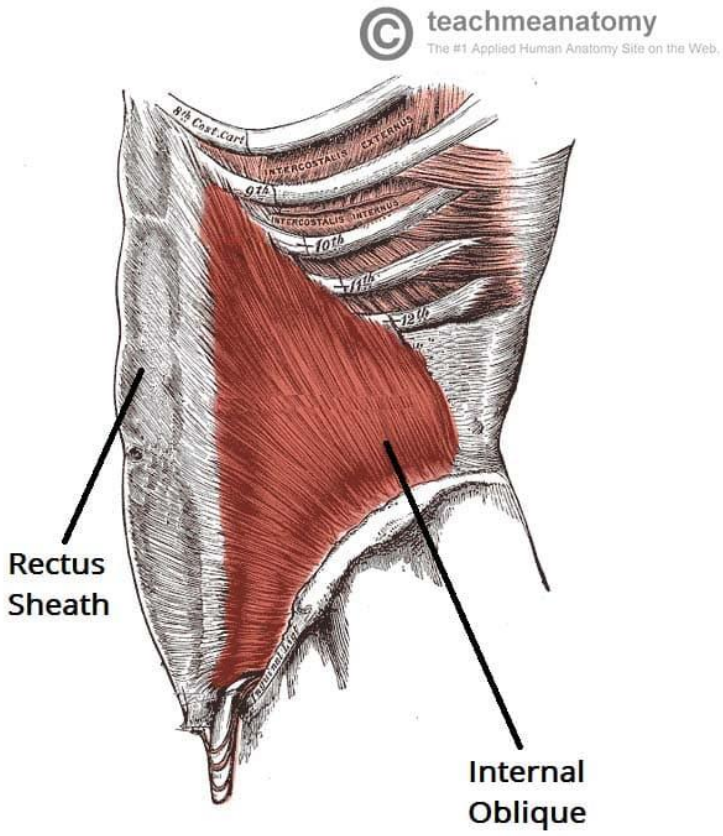


Figure 4: Internal oblique

Transversus abdominis: The deepest among the anterolateral muscles, this muscle comprises the lumbar fascia, iliac crest, lateral inguinal ligament, and the fifth through tenth costal cartilages. Its fibers run transversely until they enter the rectus sheath and become aponeurotic. Its upper end contributes to the posterior rectus sheath as it travels posteriorly to the rectus

abdominis muscles. Below the arcuate line, its aponeurosis contributes to the anterior sheath by traveling anteriorly to the muscle. Contraction of the transversus abdominis compresses the abdominal contents, and its inferior border combines with the internal oblique to form the conjoint tendon.

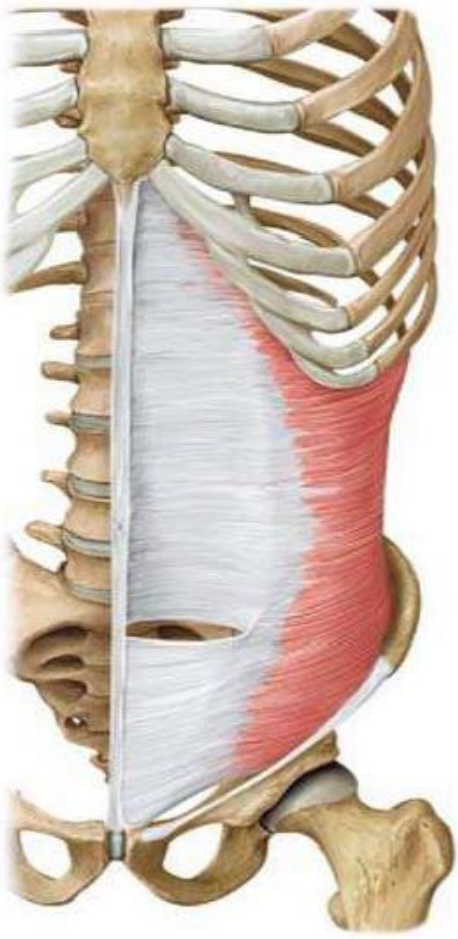


Figure 5: Transverse abdominis

Rectus abdominis: This "long, thin muscle within the rectus sheath runs vertically parallel to the linea alba. Originating from the pubic symphysis and crest, it ascends superiorly to attach to the fifth, sixth, and seventh costal cartilages. As a powerful flexor of the spinal column, it features three tendinous crossings dividing each muscular belly into four segments. The

anterior rectus sheath is attached to these tendinous junctions, forming the recognizable "six-pack" appearance, often seen in athletes."[25]

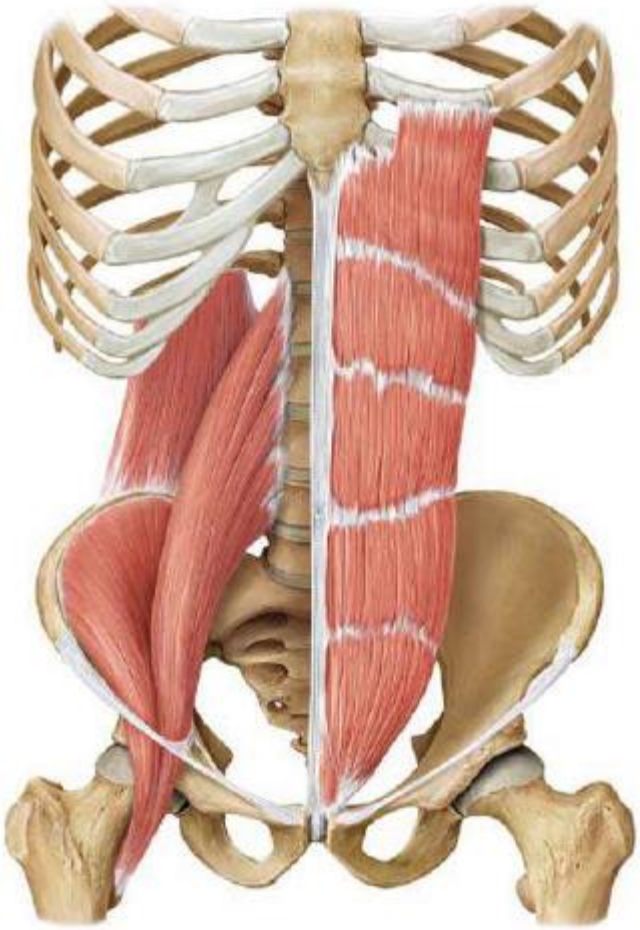


Figure 6: Rectus abdominis

Pyramidalis: This small triangular muscle lies anterior to the rectus abdominis within the inferior rectus sheath. Contraction of this muscle tightens the linea alba and originates from the pubic body. Bilateral symptoms are present in approximately eighty percent of individuals.

Inguinal region

The inguinal region is located below the anterior upper part of the iliac spines, bordered medially by the pubis and upper pubic ligament (Cooper's) and laterally by the epigastric

vessels and the condensation of the transverse fascia at the inner ring. It is inferiorly bounded by the anterior femoral sheath, inguinal ligament, and iliopubic tract, and superiorly by the transverse abdominal aponeurosis and arch. The inguinal canal is an oblique channel through the lower part of the anterior abdominal wall, facilitating the passage of structures such as the testis in males and the round ligament of the uterus in females. Its passage through the abdominal muscles weakens the lower medial part of the anterior abdominal wall, making it susceptible to hernias.

In adults, the inguinal canal is approximately 4 cm long, extending from the deep inguinal ring downward and medially to the superficial inguinal ring. The deep inguinal ring is formed by a hole in the fascia transversalis, while the superficial inguinal ring is formed by a hole in the aponeurosis of the external oblique muscle. In newborns, the deep ring lies almost directly posterior to the superficial ring, resulting in a shorter canal. As the child grows, the deep ring moves laterally.

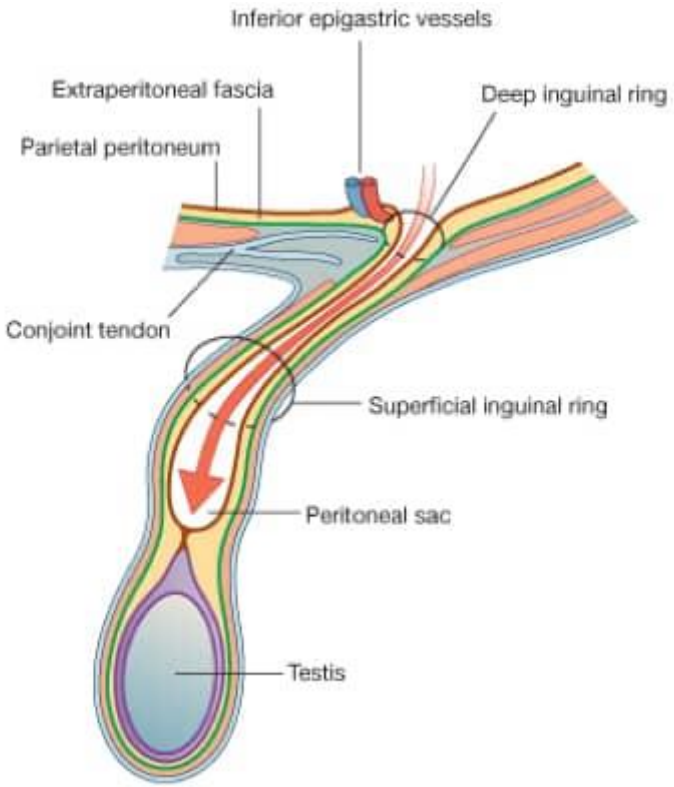


Figure 7: Showing the inguinal canal in adult[26]

The Myopectineal Orifice of Fruchaud serves as the location for most indirect, direct, femoral, and some interstitial hernias in patients. Its boundaries consist of the following:

Inferior: Pectineal ligament

Laterally: Iliopsoas muscle

Medially: Rectus muscle

Superior: Conjoint tendon

Inguinal canal Function:

In males, the inguinal canal facilitates the passage of the cord structures (spermatic cord) to and from the testis and the abdominal cavity. In females, the smaller canal allows for the passage of the round ligament of the uterus from the uterus to the labium majus.

“Various theories attempt to explain hernia formation:

- Russel's theory suggests a perforated sac as a cause.

- Reid's metastatic emphysema theory attributes it to smoking.

- Cloquet's lipoma theory implicates the action of fat accumulation.”

- Fruchaud's theory describes a large opening in the lower abdomen divided by the inguinal ligament, with inguinal hernias passing through the upper part and femoral hernias through the lower part.

- Denervation theory suggests ilioinguinal nerve injury following appendectomy.

- The oblique pelvis theory proposes that individuals with a high internal oblique arch are more prone to inguinal hernias, while femoral hernias are more common in females due to the less common occurrence of indirect hernias in females.

- The wide female pelvis theory posits that a low arch of the internal oblique provides a more efficient shutter mechanism, leading to a wider femoral ring and a higher incidence of femoral hernias in females.

- “Uglavasky theory attributes hernias to chronic increased intra-abdominal pressure.

- Peacock's theory suggests defective collagen synthesis.

- Walk's theory implicates weakness in the abdominal wall.

- Kith's theory suggests stress-related degeneration of connective tissue in the fascia transversalis."

- - Dr. Desarda's theory proposes the loss of strength and the physiologically dynamic nature of the posterior wall of the inguinal canal, with the absence of aponeurotic extension in the posterior wall and the loss of strength in cremasteric fascia and musculo-aponeurotic structures around the inguinal canal as causes of hernia formation.[27]

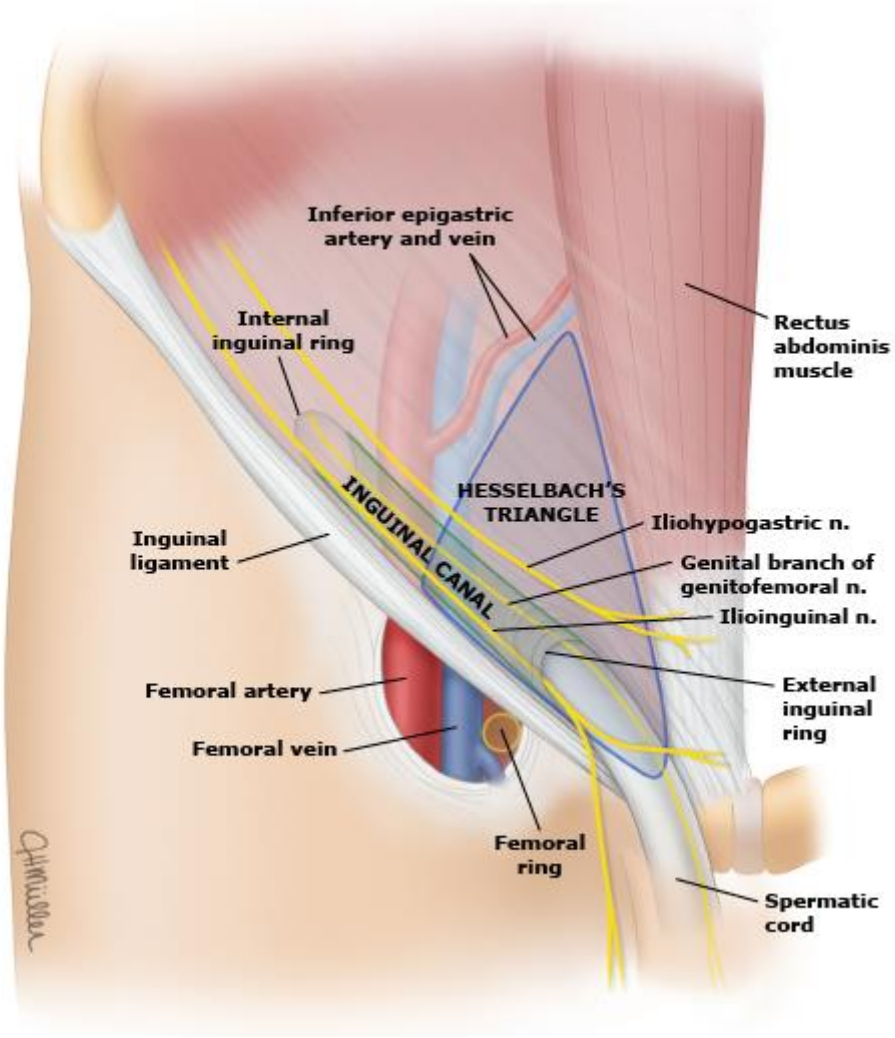


Figure 8: Inguinal hernia anatomy[26]

Boundaries of inguinal canal;

- "The inguinal canal is structured as follows:
- - The anterior wall is composed of the aponeurosis of the external oblique muscle.
- - The posterior wall is formed by the transversalis fascia and the conjoint tendon.
- - The floor consists of the superior surface of the inguinal ligament.

- - The roof is formed by the internal oblique and transversus abdominis muscles.”

Inguinal hernia Components

- “The hernia sac comprises a diverticulum of the peritoneum, which can be subdivided into the body and the fundus.
- - The "mouth" refers to the opening between the interior of the sac and the abdominal cavity.
- - The "neck" is the narrowest segment, located between the mouth and the body of the sac, and is a common site of obstruction.
- - The "body" lies between the neck and the fundus.
- - The "fundus" is the blind end of the sac.”

Structure passing through the canal

Female: obliterated processus vaginalis, lymphatics from uterus and round ligament.

Males: spermatic cord, testicular artery, vas deference and its artery, cremastric artery, autonomic nerves, vaginalis, Obliterated remains of processus Pampiniform plexus of veins, Genital branch of genitofemoral nerve and Testicular artery

Although the ilioinguinal nerve is a component of the inguinal ring, it enters the canal via piercing the internal oblique muscle, i.e., it enters from the side rather than the rear. It is located in front of the cord and exits the canal via the superficial ring.

Hernia Contents

- Omentocele

- Enetocele

Coverings

- Extraperitoneal tissue
- Internal spermatic fascia
- Cremastric fascia
- External spermatic fascia
- Skin

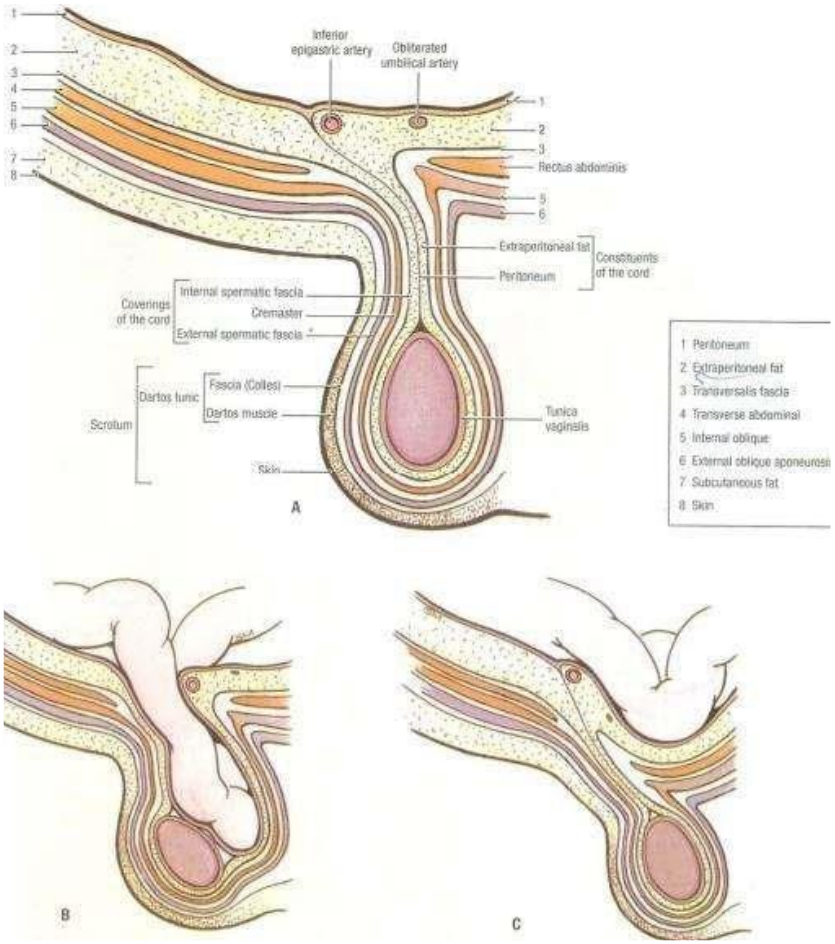


Figure 9: Covering 0f inguinal hernia (A), Indirect (B) and Direct (C)[26]

Contents of the spermatic cord:

It contains:

- Ductus deferens and its artery
- Testicular artery and veins
- Cremasteric artery and nerve
- Pampiniform plexus of veins
- Artery to vas deferens
- Sympathetic nerve fibres
- Genital branch of the genitofemoral nerve
- Lymphatic vessels

Preperitoneal space[28]

The laparoscopic approach to inguinal hernia surgery offers access to the peritoneal and preperitoneal areas from the posterior aspect. It involves five intraperitoneal points of reference: the bladder, the psoas muscle, the inferior epigastric arteries, peritoneal folds, and two potential preperitoneal locations. The "boros" (preperitoneal) gap contains preperitoneal fat and areolar tissue and is situated between the peritoneum and the posterior lamina of the transversalis fascia. The space of Retzius, located above the bladder in the most medial part of the preperitoneal space, is also accessed during the procedure.

Space of Bogros

The posterior lamina of the transversalis fascia divides the preperitoneal region into two sections. The posterior compartment is termed the 'Space of Bogros (proper),' described in 1923 by French anatomist Bogros. The anterior space is referred to as the 'Vascular Space,' where dissection is avoided. In instances where the posterior lamina is absent, such as in the deep inguinal ring, the peritoneum adheres to the anterior lamina. This region is continuous medially with the Retzius space.

Prevesical space of Retzius:

The Prevesical space of Retzius, described by Swedish anatomist Retzius in 1858, is a preperitoneal region situated deep to the supravesical fossa and the medial umbilical fossa. It is characterized by loose connective tissue and fat. Dissection of this area is essential during laparoscopic hernia repair to ensure adequate mesh overlap of the hernial defect and to assist with proper mesh placement and fixation.

Blood supply

Arterial Supply

External iliac artery branches

Inferior epigastric arteries

Deep circumflex iliac

The internal spermatic or the testicular artery are direct branches of the aorta.

Venous Drainage

Venous drainage from the testis occurs via the pampiniform plexus and the spermatic cord. Typically, three or four veins from the plexus drain into the abdomen through the deep inguinal

ring within the inguinal canal. This plexus, composed of fine veins, is intricately intertwined with the interstitial fat of the spermatic cord. The left internal spermatic vein drains into the left renal vein, while the right side's drainage joins the inferior vena cava.

Nerve distribution

- The abdominal wall receives innervation from the first lumbar and lower six dorsal nerves. Nerves connect the transversus abdominis and internal oblique muscles. Sensory innervation to the inguinal region is supplied by the first and second lumbar nerves, as well as the eleventh and twelfth dorsal nerves. Cutaneous branches of the lumbar plexus include the genitofemoral, lateral femoral-cutaneous, obturator, iliohypogastric, and ilioinguinal nerves. During inguinal hernia surgery, three nerves are typically involved: the iliohypogastric nerve, ilioinguinal nerve, and genital branch of the genitofemoral nerve.

Risk factors for Hernia:

The various factors contributing to development 0f inguinal hernia are; Old age, Prior hernia, Race – Caucasian, Male gender, Patients with family history, Chronic cough, Smoking of cigarette and Abdominal wall injury.

In women, residing in rural areas and being taller were found to be independently associated with a higher incidence of acquired inguinal hernia. Women with lower BMI and height were relatively dominant among those with femoral hernia and emergency presentations.[29]

Role of biochemical mediatros, collagen and extra cellular matrix in hernia formation

Collagen, the primary biomechanical strength component of connective tissue, “functions as a scaffold in various forms, including type I, II, and III. Type I collagen, which forms thick

collagen fibrils, provides greater mechanical strength compared to the thinner type III collagen fibrils. The bulk strength of type I collagen is attributed to the presence of intermolecular and intramolecular covalent bonds formed by the hydroxylation of lysine and glycosylation of hydroxylysine, respectively."[30,31]

The quantity and ratio of Type I/III collagen production and deposition significantly affect connective tissue quality. During remodelling and maturation, collagen fibres increase in diameter as the ratio of Types I and III collagen changes. Alterations in the Type I/III collagen ratio lead to reduced tensile strength and mechanical stability. Changes in collagen subtypes play a crucial role in the pathogenesis of hernias, making them a significant focus in the investigation of hernia origin.[32–34]

Matrix metalloproteinases (MMPs) are zinc-dependent endopeptidases with extracellular activities, comprising a family of at least 15 proteins. MMP-1 and MMP-13 are the main enzymes responsible for the turnover of fibrillar type I, II, and III collagen. "Changes in the expression of MMP-1 and MMP-13 proteins can lead to alterations in the ratio of type I to type III collagen at the protein level. Hernia patients often exhibit overexpression of MMPs and immature collagen isoforms."[35] as well as in individuals with inguinal and incisional hernias.[36,37]

Etiology:

- Congenital hernia: Inguinal hernia occurs within a pre-existing sac or defect and may clinically manifest later due to various triggering factors, similar to indirect inguinal hernia. Risk factors for developing an indirect inguinal hernia include anatomical configuration and a patent processus vaginalis. However, the patent processus vaginalis is not the sole cause of hernia origin, as individuals with this condition may not necessarily develop a hernia. The descent of the testis brings the processes with it,

increasing the predisposition to hernia. Inguinal hernia is more common in males compared to females.

- Acquired hernia
    - Several factors contribute to the development of inguinal hernia:
    - - Age: Elderly individuals are more prone to inguinal hernia due to progressive weakening of abdominal muscular tissue over time. Changes in the transversalis fascia, including a decrease in Oxytatum fibers and an increase in amorphous substances of elastic fibers, may be responsible for hernia development.
    - - Weight: Increased fat layers within the abdominal wall weaken the layers, increasing the risk of hernia.
    - - Respiratory causes: Conditions such as emphysema, chronic bronchitis, and pneumonitis can lead to difficult respiration, raising intraabdominal pressure and contributing to hernia formation.
    - - Elevated intraabdominal pressure: Conditions like constipation, diverticular disease, prostatism, and colonic carcinoma can cause straining during bowel movements, leading to increased intraabdominal pressure and hernia.
    - - Pregnancy: Pregnancy can also increase intraabdominal pressure, predisposing women to inguinal hernia.

Inguinal hernia can be precipitated or exacerbated by various factors:

- - Sudden increases in intraabdominal pressure due to activities like coughing or heavy lifting, as well as traumatic events such as blows or crush injuries, can lead to hernia formation.

- - Biological factors, including malnutrition and exposure to environmental toxins, may contribute to hernia development.

- - Iatrogenic factors, such as previous surgical procedures like appendectomy, can also increase the risk of inguinal hernia.

Anatomical location: Inguinal hernias "are classified according to the anatomic location 0f the abdominal wall defect. There are several classification schemes for Inguinal hernia, but for convenience and simplified as the direct and indirect inguinal hernia."

- Direct hernia

- Indirect hernia

Indirect inguinal hernia:

The indirect inguinal hernia typically protrudes at the internal inguinal ring, where "the spermatic cord exits in males and the round ligament exits in females. The sac originates just lateral to the inferior epigastric artery. This type of hernia is more common on the right side in both genders due to the later descent of the right testicle in males during infancy. Although most indirect inguinal hernias are congenital, they may not be clinically evident in the neonatal period or during childhood." Patients with a patent processus vaginalis may experience a failure in the "shutter mechanism," which shuts the internal ring to a slit. A noticeable inguinal hernia can arise from the protrusion of abdominal contents through the enlarged internal ring and into

the inguinal canal due to increased intra-abdominal pressure combined with diminished muscular tone or connective tissue diseases. [38–40]

Types of indirect hernia[41]

different types of inguinal hernias:

a) Vaginal: "The hernia descends to the base of the scrotum along with the testis, making identification challenging as the vaginal processes remain unobstructed throughout the course.

b) Funicular: The hernia sac extends through the superficial inguinal ring but doesn't reach the bottom of the scrotum. The vaginal processes are destroyed above the testis, allowing the testis to be felt independently of the hernia.

c) Infancy: Similar to the funicular type, but a peritoneal sac is discovered in front of the hernial sac during surgery, reaching as high up as the external ring.

d) Encysted: Similar to the vaginal type, but a process of peritoneum lies in front of the sac up to the external ring. Both types (c) and (d) result from a diverticulum of the processes vaginalis getting caught at the external ring during development.

e) Intestinal: In this type, a diverticulum of the processes vaginalis becomes trapped between layers of the developing abdominal wall."

Direct Inguinal Hernia:[41]

The direct inguinal hernia protrudes within Hesselbach's triangle, located medial to the inferior epigastric vessels. This triangle is formed by the inguinal ligament (Poupart's ligament) inferiorly, the rectus abdominis muscle medially, and the inferior epigastric vessels laterally. Direct hernias exit Hesselbach's triangle through both its outer and inner portions, resulting in

two subtypes: lateral direct and medial direct. Weakness in the floor of the inguinal canal leads to the development of direct inguinal hernias, often attributed to abnormalities in connective tissue caused by chronic overstretching or injury to the abdominal musculature.

Gilbert's Classification (Addition by Rutkow and Robbins)[42]

It is based on "anatomical and functional defects established intra-operatively, categorized Inguinal hernias in to 7 types. Type1, 2 and 3 were indirect hernias whereas type 4 and 5 were direct hernias.'

"Indirect Hernia

Type I: Snug internal ring, intact canal floor.

Type II: One finger breadth internal ring, intact canal floor. Not more than 4 cm.

Type III: Two-finger breadth internal ring. Canal floor is defective (Scrotal and sliding hernias)."

"Direct Hernia

Type IV: Entire canal floor defective, no peritoneal sac anterior to canal floor, intact internal ring.

Type V: Diverticular defect, admitting no more than one finger, internal ring intact.

Type VI: Consists 0f both direct and indirect components.

Type VII: Covers all femoral hernias."

Ponka's classification[43]

3 types of direct hernias:

1. “Diverticular hernia in the posterior wall with an intact inguinal floor;

2. Small defect on the medial aspect of Hesselbach's triangle near the pubic tubercle;

3. A large diffuse direct inguinal hernia of the entire floor of Hesselbach's triangle.

2 types of indirect hernia:

1. Sliding indirect inguinal hernia

2. Uncomplicated indirect inguinal hernia”

Clinical type of classification[44]

Reducible hernias are those that can be naturally or manually pushed back into the abdomen. “During reduction, the hernia typically emits a gurgling sound, and the first segment of the hernia is usually more difficult to reduce than the latter.” Reducible hernias often exhibit an expansile impulse when the patient coughs.

Irreducible hernias, on the other hand, cannot be returned into the abdomen but do not present with any other complications. This condition is often caused by adhesions between the sac and its contents or overcrowding within the sac.

Obstructed hernias are irreducible and contain intestines that are occluded from within, without any interruption to the bowel's blood supply. While symptoms are less acute compared to strangulated hernias, untreated obstruction can lead to strangulation.

Strangulated hernias occur when blood flow to the hernia's contents is severely compromised, leading to ischemia and potential gangrene. Femoral hernias are more prone to strangulation due to their narrow neck and surrounding anatomy.

Inflamed hernias result from inflammation of the sac contents or external sources. Symptoms include soreness, redness, and edema above the hernia, but stiffness is not typically present.

Classification of Hernia by Casten[45]

"Stage 1: Indirect hernia with a normal internal ring

Stage 2: Indirect hernia with an enlarged or distorted internal ring

Stage 3: all direct or femoral hernias"

NYHUS Classification[46]

This is based on the size of the internal ring and the integrity of the posterior wall.

According to this classification

- Type 1 is an indirect hernia with a normal deep ring;
- Type 2 is an indirect hernia with an enlarged deep ring;
- Type 3a is a direct inguinal hernia;
- Type 3b is an indirect hernia causing posterior wall weakness/ pantaloon hernia;
- Type 3c is a femoral hernia;
- Type 4 represents all recurrent hernias.

BENDAVID Classification[47] **[Type, Staging, Diameter (TSD) Classification]**

- "Type I: Anterolateral defect (indirect).
- Type II: Anteromedial (direct).

• Type III: Posteromedial (femoral).

• Type IV: Posterior prevascular hernia.

• Type V: Anteroposterior defect: Inguino-femoral hernia."

"The Halverson and McVay[48] classification divided hernias into 4 classes:

Class 1: small indirect hernia

Class 2: medium indirect hernia

Class 3: large indirect hernia or direct hernia

Class 4: femoral hernia"

Aachen hernia classification[49]

• Type L - Lateral hernia

• Type M- Medical hernia

• Type Mc-Combined hernia

• Type F-Femoral hernia

• Type I -Hernial orifice < 1.5 cm

• Type II -Hernial orifice 1.5-3cm

• Type III- Hernial orifice > 3 cm

Clinical features:

Inguinal hernias can occur at any age, with peak presentation times in infancy, late teens, early twenties, and between 40 and 60 years old. Indirect hernias are more common in young people compared to direct hernias. Heavy lifting or physically demanding jobs can exacerbate hernia development, particularly if there's underlying weakness like a patent processus vaginalis.

Symptoms of an inguinal hernia include a dull discomfort or heaviness in the inguinal region, sometimes accompanied by a visible bulge. Women may experience vague pelvic discomfort due to inguinal hernias. Moderate to severe pain is uncommon but may indicate incarceration or strangulation. Discomfort worsens with increased intra-abdominal pressure, such as during heavy lifting or straining, and typically resolves when the strain is relieved.

Patients often notice discomfort more at the end of the day or after prolonged standing, especially those in physically active professions. Pain with standing or straining may also be due to stretching of the ilioinguinal nerve, characterized by a radiating "twinge" that dissipates when the stretch is released.[50–52]

If the “hernia is obstructing the lumen of the loop of the bowel the patient. May complain of one or more of the four cardinal symptoms of intestinal obstruction.”

Vomiting- note the character of vomitus

Colicky abdominal pain

Abdominal distention

Absolute constipation.

Other complaints-

Constipation

Persistent coughing of chronic bronchitis,

frequency of micturition or urgency- benign enlargement of prostate

Physical examination & Diagnosis:

The symptom 0f the patients varies with the type, size, duration and presence or absence 0f complications.

Symptoms:

- Pain
- Swelling in inguino-scrotal region

Sign:

A globular or pyriform swelling that expands with coughing, typically reducible, is often a characteristic sign of hernia. Direct hernias originate from the posterior wall of the inguinal canal, whereas indirect hernias arise from the deep ring.

Mesh fixation

The material used for the mesh fixation include

Fibrin sealant / fibrin glue

Polypropylene suture (conventional method)

Wound healing following mesh placement[53–55]

“Whether the hernia repair comprises just tissues or a prosthetic graft, the typical healing process involves a series of actions that include platelet release and surrounding the injured

tissue. Macrophages and neutrophils enter the region to clear it of debris and bacteria, as well as to produce soluble chemicals necessary for the healing process. A fibrin matrix is deposited, which polymerizes and is directed into an optimal cross-linking configuration, resulting in dependable collagen.“

Complications from the usage of prostheses;

1. “Fibroblastic Response: Polypropylene and polyester materials trigger a rapid and robust fibroblastic tissue response with minimal inflammation.

2. Mesh Migration: Prosthetic mesh products can migrate from their original placement.

3. Infection Risk: Accumulation of serum or blood around the prosthesis creates an environment conducive to infection.

4. Visceral Adhesions: When placed inside the peritoneal cavity, prosthetic meshes can cause varying degrees of visceral adhesions, which can be mitigated by placing the omentum or an absorbable barrier between the mesh and the bowel.

5. Infection Management:

- Delayed infections involving non-absorbable prostheses may arise months or years after surgery.

- In cases of acute infection following groin hernia repair, it is recommended to promptly open the wound to the external oblique to prevent chronic sinus formation.”

Complications of the inguinal hernia[53–55]

Scaring

Infections

Seroma

Hematoma

Post-operative neuralgia

Recurrence

Factors effecting the woùnd healing[56,57]

Local factors

Hypoxia

Foreign body

Infection

Venous insufficiency

Systemic factors

Obesity

Diabetes mellitus

Disease: uraemia, anemia, jaundice, hereditary healing disorders

Alcoholism and smoking

Ischemia

Poor nutrition

Smoking

Cancer

Radiation therapy

AIDS

Neuropathic pain results from injury to the "ilioinguinal nerve, iliohypogastric nerve, and genital branch of the genitofemoral nerve. This damage can occur during surgical dissection, tissue retraction, or nerve entrapment caused by post-operative fibrosis, fibrosis related to mesh, or sutures used to secure the mesh.[58] Smeds et al., suggested that any partial or complete transection of nerve leads to neuroma formation and consequent pain."[59]

Non neuropathic pain is due to excessive scar formation from prosthetic mesh reaction, periosteum reaction from sutures or staples inserted into pubic tubercle.[58] Due to complications associated with sutured mesh fixation in open inguinal hernia repair, surgeons are opting for atraumatic mesh fixation using cyanoacrylate glue in Lichtenstein hernia repair. Cyanoacrylates, discovered in 1942, have become an alternative to sutures for mesh fixation.[60] Introduction of glue to surgical fixation of mesh has lot of importance in reduction of operating time and rate of complications. It has also reduced post operative pain and has helped in early discharge of patients.[61]

Various articles

In a study by Prasant Chandra et al., (2015). Between October 2012 and November 2014, 113 patients with inguinal hernia were registered in this study. "There were 24 indirect hernias (13 with fibrin glue and 11 with tacker), 69 direct hernias (33 treated with fibrin glue and 36 with tacker), and 8 pantaloon hernias (4 in each group). In the tacker group, every patient finished their follow-up, with the exception of one. A month later, the groups' seroma development showed no appreciable differences; nevertheless, the tacker group saw a greater incidence of seroma. After 15 and 30 days, the rates of return to work were significantly higher in the fibrin glue group. At 15 days, one patient in each group got orchitis, and four patients in the tacker

group had a hernia recurrence. Infections, allergic reactions, or anaphylaxis were not documented in either group."[62]

In a study by Latif Bagwan et al., (2020) "patients who had either a primary or ventral hernia were examined, operated on, and researched. Ninety years old was the oldest patient, while the youngest was only nineteen. The majority of patients belonged to the 46–65 age range. In the investigation, it was discovered that there were 90 male patients and 10 female patients, making men predominate. Even though all of the research participants had abdominal swelling, 56 of them also reported having concomitant discomfort, 28 had irreducibility, 10 had blockage, and only 6 had strangulation-related symptoms."[63]

n a study by Awanish Kumar et al.(2020) a study involving 69 patients (44 in the tack fixation group and 25 in the suture fixation group), the mean VAS (Visual Analog Scale) scores for post-operative pain at 24 hours showed no significant difference between the groups. However, VAS scores at 1 week, 1 month, 3 months, and 6 months were significantly lower in the suture group, indicating less pain compared to the tack group at 1 and 3 months. No significant differences were found in other post-operative complications between the two groups.[64]

In a study by Langenbach MR et al.(2020) after using tacks, "mean pain intensity was 16.9, which is slightly lower than after suture fixation (19.6, $p = 0.20$). The duration of surgery was about the same (83 vs. 85 min). When using tack fixation, significantly more fixation points were applied as compared to sutures (19 vs. 12; $p = 0.02$), although mesh size was similar. The complication rate was similar (tacks: 6/28 vs. sutures: 3/20). Cost of suture fixation was about 26 €, which is markedly lower than the 180 € associated with tacks. However, surgeons clearly preferred mesh fixation with tacks, because it is more comfortable especially in small hernias."[65]

In a study by Muhammad SS et al., (2020) From the computerized databases, five randomized controlled studies with a total of 1,001 patients were obtained. A random-effects model in laparoscopic inguinal hernia repair (LIHR) revealed that the two mesh fixation procedures did not significantly differ in terms of operating time, postoperative discomfort, complications, hospital stay, or hernia recurrence risk. Glue mesh fixation (GMF) on the other hand, was linked to a decreased chance of persistent groin discomfort.[66]

In a study conducted by Mehmood Z et al., (2021) to assess the transabdominal preperitoneal inguinal hernia by mesh fixation by polyglactin suture versus tacker. The mean age in group A was 49.93 years with a standard deviation of 13.82 years, while in group B, it was 45.4 years with a standard deviation of 13.56 years. There were statistically significant differences in operative time and pain scores between the two groups. Group A had a longer operative time compared to group B (p=.004), but the pain score was significantly lower in group A (p=.001). Additionally, the cost of tacker equipment was Rs. 10,000, whereas the cost of polyglycolic suture was Rs. 500. Using polyglactin suture for mesh fixation and peritoneal closure in transabdominal preperitoneal (TAPP) hernia repair is preferred due to its association with less postoperative pain. [67]

In a study conducted by Techapongsatorn S et al., (2022) to assess the mesh fixation technique for inguinal hernia repair. Between 2010 and 2019, thirty systematic review and meta-analyses (SRMAs) were examined, with 16 focusing on open hernia repair and 14 on laparoscopic repair. There was considerable overlap between the two, with 41 percent of open repairs and 30-57 percent of laparoscopic repairs being covered in multiple SRMAs. Evidence was adequate for assessing hernia recurrence, chronic groin pain, and operative time. “The impact of glue on hernia recurrence was inconclusive for both open and laparoscopic approaches (P = 0.816 and 0.946, respectively). However, glue was found to be significantly linked to lower

rates of persistent groin pain compared to sutures in open repair and compared to tacks in laparoscopic repair. SRMAs suggested that self-gripping mesh reduced operating time in open surgery, albeit with a modest improvement of only a few minutes (0.36-7.85 minutes, $P < 0.001$). In summary, this umbrella review revealed that among the outcomes studied, chronic groin pain and operating time were the only ones for which there was sufficient evidence supporting the effectiveness of glue and self-gripping mesh, respectively." [68]

In a study conducted by Aziz S et al., (2022) to assess the early outcome in patients undergoing suture fixation versus tack fixation of mesh in laparoscopic repair of inguinal hernia. The age of participants ranged from "18 to 60 years, with Group A having a mean age of 46.53 years (±10.01 S.D) and Group B having a mean age of 46.19 years (±9.58 S.D). In Group A, 98.6% of patients were male, while 1.4% were female, compared to 100% male patients in Group B. The mean pain scores at 6 hours and 24 hours postoperatively were 4.88 (±0.887) and 5.29 (±0.777) in Group A, respectively, and 3.43 (±0.962) and 4.11 (±0.703) in Group B, respectively. Group B had significantly lower mean pain scores than Group A at both time intervals ($p < 0.001$). However, early postoperative complications did not show significant differences between the two groups. In conclusion, suture fixation of mesh in transabdominal preperitoneal (TAPP) repair results in less postoperative pain compared to tack fixation." Other early postoperative problems such seroma, hematoma, urine retention, and neuralgia did not differ significantly between the two fixation techniques, though. To validate these results, more multicenter trials with longer follow-up times are required. [69]

AIMS & OBJECTIVES

Primary objective:

Compare post operative pain intensity in patients undergoing transabdominal preperitoneal inguinal hernia repair between tackers and suture.

Secondary objective:

Compare the following in patients undergoing transabdominal preperitoneal inguinal hernia repair between tackers and suture.:

1. The duration of surgery,
2. Duration of hospital stay,
3. Postoperative complications

MATERIAL & METHOD

Source of Data: Patients who will be admitted to KLES Dr. Prabhakar Kore Hospital & MRC, Belagavi and undergoing elective Laparoscopic Inguinal Hernia Surgery.

Study Design: Randomized Control Trail

Study Period: One Year (January 2023 – December 2023)

Sample Size: Sample size calculation when sample size is small:

n=Ny/((N-1)e+y)

Z = Z score for desired confidence interval

e = margin of error

p = estimated proportion who have

$q = (1 - p)$

y = Z2 p(1-p)

In our study,

$y = Z^2 p(1-p)$ y = 1.642 * 0.25 * 0.75 y = 0.50625

n=125X0.50625/((125-1)0.0237+0.50625)

n =29.68

Rounded up the Calculated Sample size of our study will be 60 .

Sampling technique:

Inclusion Criteria:

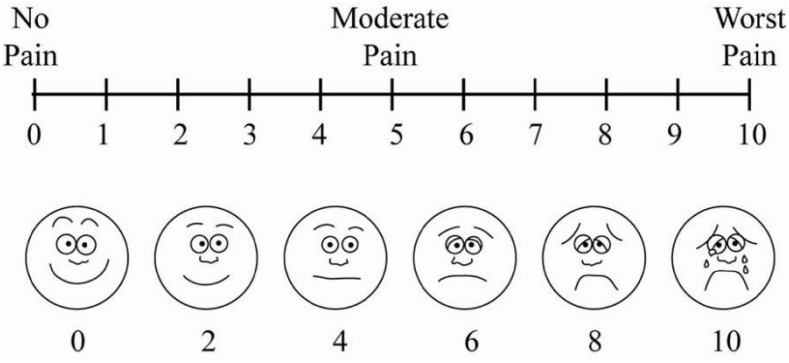
- Patients who have given informed consent
- All patients above 18 years of age undergoing elective laparoscopic surgery.
- Patients with unilateral or bilateral inguinal hernia.

Exclusion Criteria:

- Patients who have not given informed consent
- Patients with uncontrolled type2 diabetes mellitus, hypertension.
- Patients who had already been operated for the same.
- Generalized peritonitis
- Inability to tolerate pneumoperitoneum
- Uncorrected coagulopathy
- Hemodynamic instability

Study protocol: Patients who will be admitted to KLES Dr.Prabhakar Kore Hospital & MRC, Belagavi and undergoing elective Laparoscopic Inguinal Hernia Surgery. Patients are divided into 2 groups one whom mesh is fixed with tackers and another group with sutures. These 2 groups are compared regarding pain intensity, the duration of surgery, complication rate in TAPP procedure with prolene 2-0 sutures vs tackers. The data obtained from the above study will determine the better method of mesh fixation.

Visual Analog Scale (VAS) will be used to quantify pain if any.



Data collection procedure: Through proforma and visual analogue scale.

Does the study require any investigations or interventions to be conducted on patients or other humans or animals? If so, please describe briefly. YES

Laparoscopic transabdominal preperitoneal inguinal hernia repair.

Blood Investigations: Hb, WBC, Platelets, Urea, Serum Creatinine, Random blood glucose, PT/INR, aPTT, serum electrolysis, HbsAg, HIV

ECG

Chest x-ray AP view

STATISTICAL ANALYSIS

The data were “initially captured into the customized proforma which developed for the specific requirement of the study. Then this data was transferred to Microsoft Excel for analysis. Statistical Software IBM SPSS Version 23.0 was used for calculating the P value. Descriptive statistics was presented in the form of numbers and percentages. Comparison of proportions were done using Z test / Fisher's Exact test, comparison of means between the two groups was done using Unpaired 't' test and Association between two non-parameteric variables was done using Pearson Chi-square test.” A p value of < 0.05 was taken as statistically significant.

RESULTS

Present study total of 60 patients fulfilling inclusion criteria are included. The patients were divided into two groups as 30 patients in suture group and 30 patients in tacker group.

Table 1: Comparison of mean age of the patients between the groups

	Suture		Tacker		p-value
	Mean	SD	Mean	SD	
AGE	45.7	13.1	46.3	15.7	0.866

The mean age between the groups were comparable with no significant difference noted.

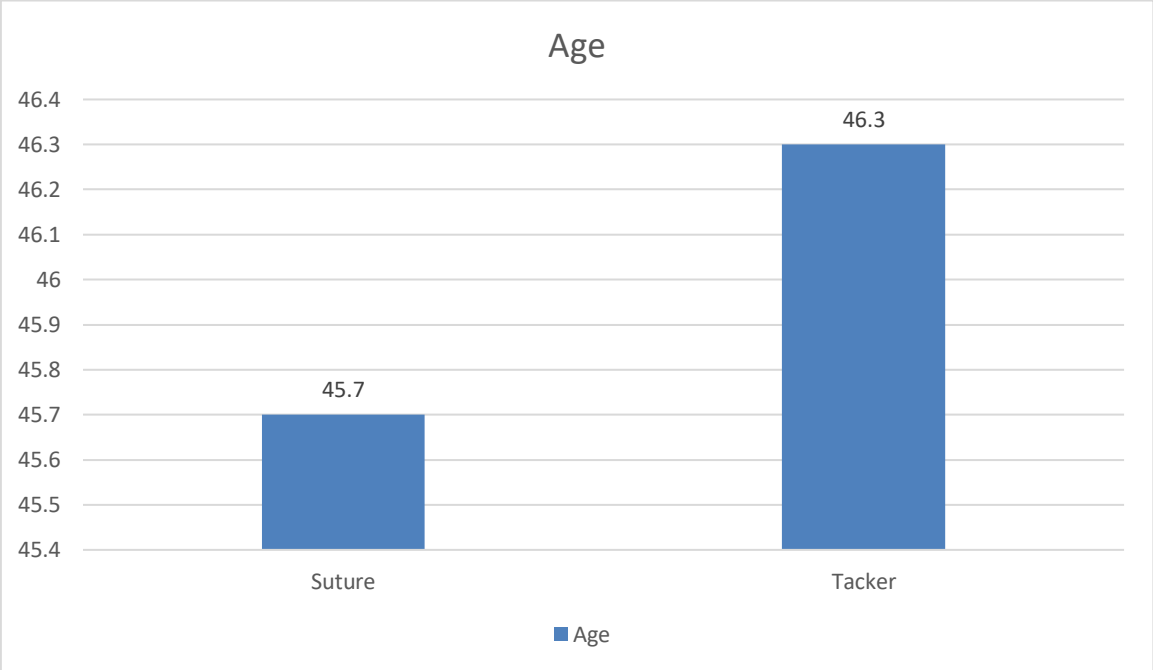


Figure 10: Comparison of mean age of the patients between the groups

Table 2: Distribution of gender between the groups

		Suture		Tacker	
		Count	Column N %	Count	Column N %
Gender	Female	8	26.7%	7	23.3%
	Male	22	73.3%	23	76.7%

Gender distribution between the group was comparable with overall male preponderance in the present study.

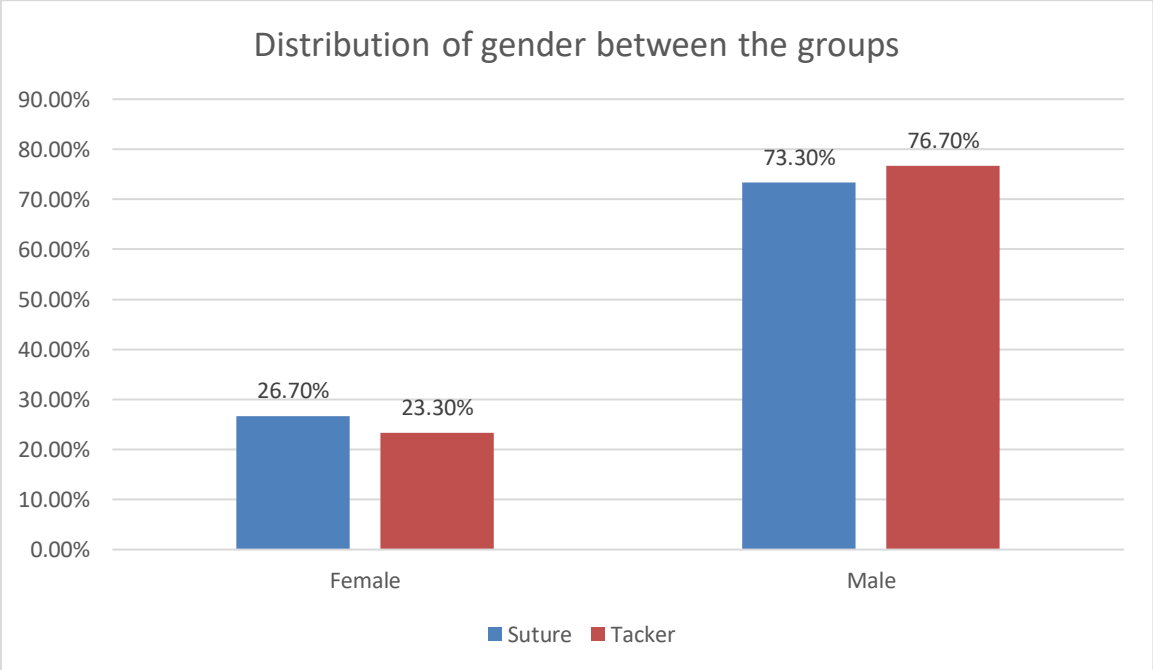


Figure 11: Distribution of gender between the groups

Table 3: Comparison of the diagnosis and type of inguinal hernia between the groups

		Suture		Tacker		Chi-square (p-value)
		Count	N %	Count	N %	
Diagnosis	Bilateral Inguinal Hernia	9	30.0%	8	26.7%	1.21 (0.54)
	Left Inguinal Hernia	9	30.0%	13	43.3%	
	Right Inguinal Hernia	12	40.0%	9	30.0%	
Inguinal hernia	Bilateral	9	30.0%	8	26.7%	1.21 (0.54)
	Left	9	30.0%	13	43.3%	
	Right	12	40.0%	9	30.0%	

There is no significant difference in the diagnosis of the patients and type of inguinal hernia between the groups.

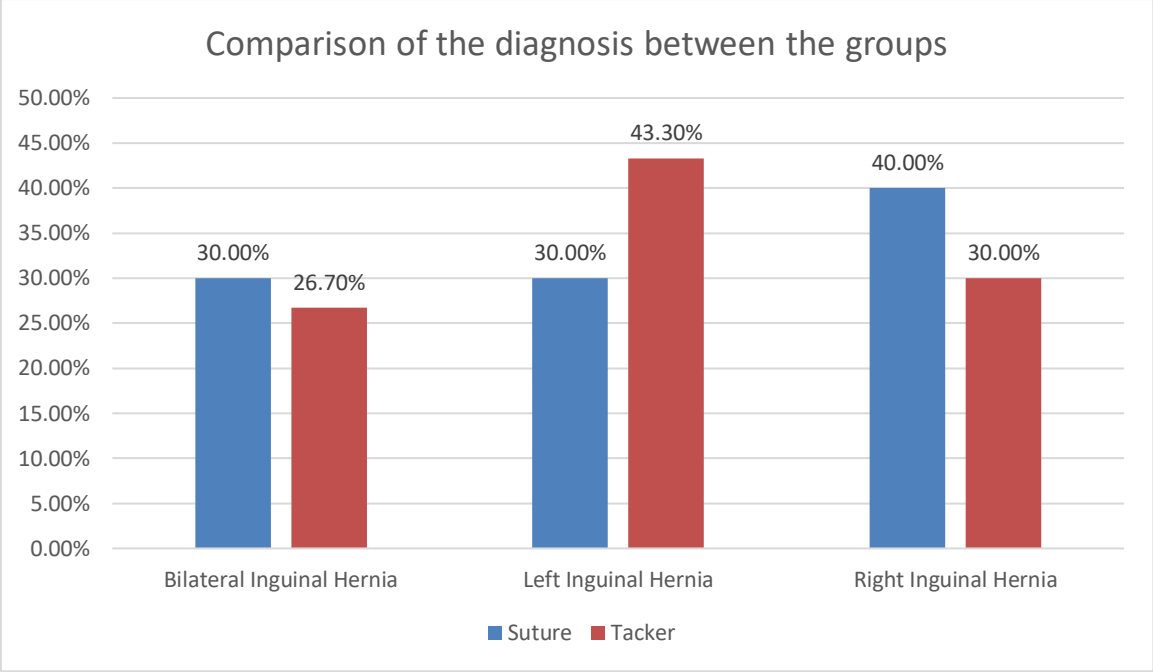


Figure 12: Comparison of the diagnosis between the groups

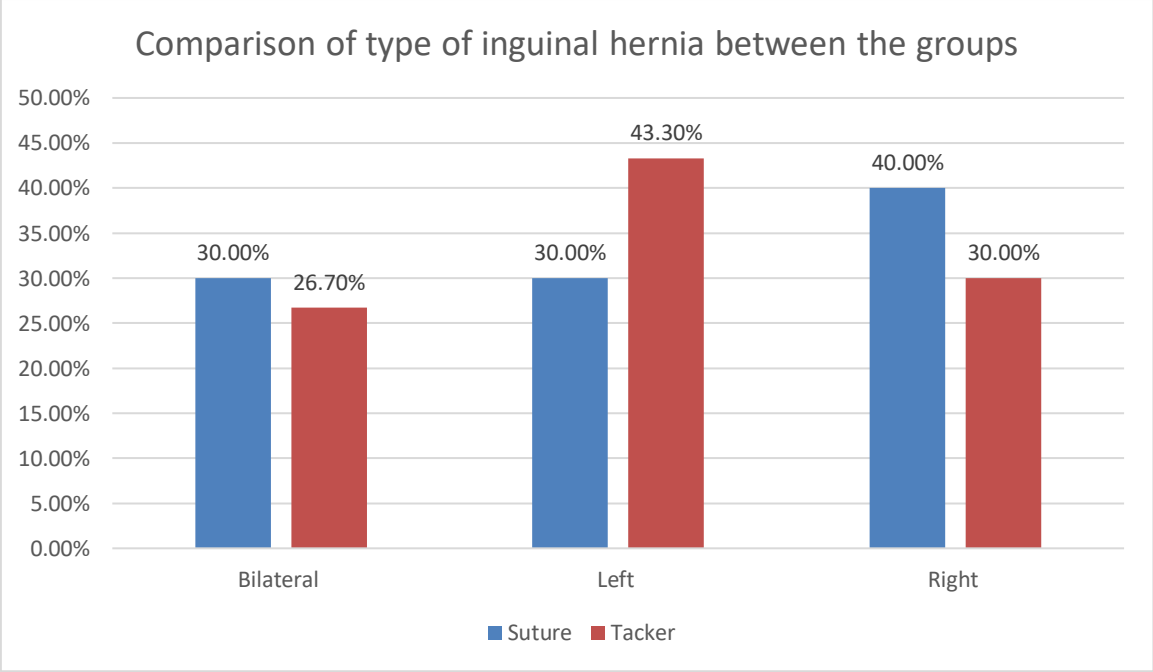


Figure 13: Comparison of type of inguinal hernia between the groups

Table 4: Comparison of the mean operative time between the groups

	Suture		Tacker		p-value
	Mean	SD	Mean	SD	
Operation time (mins)	82.0	31.5	74.0	24.0	0.27

The operative time in patients of both the group was comparable with no significant difference.

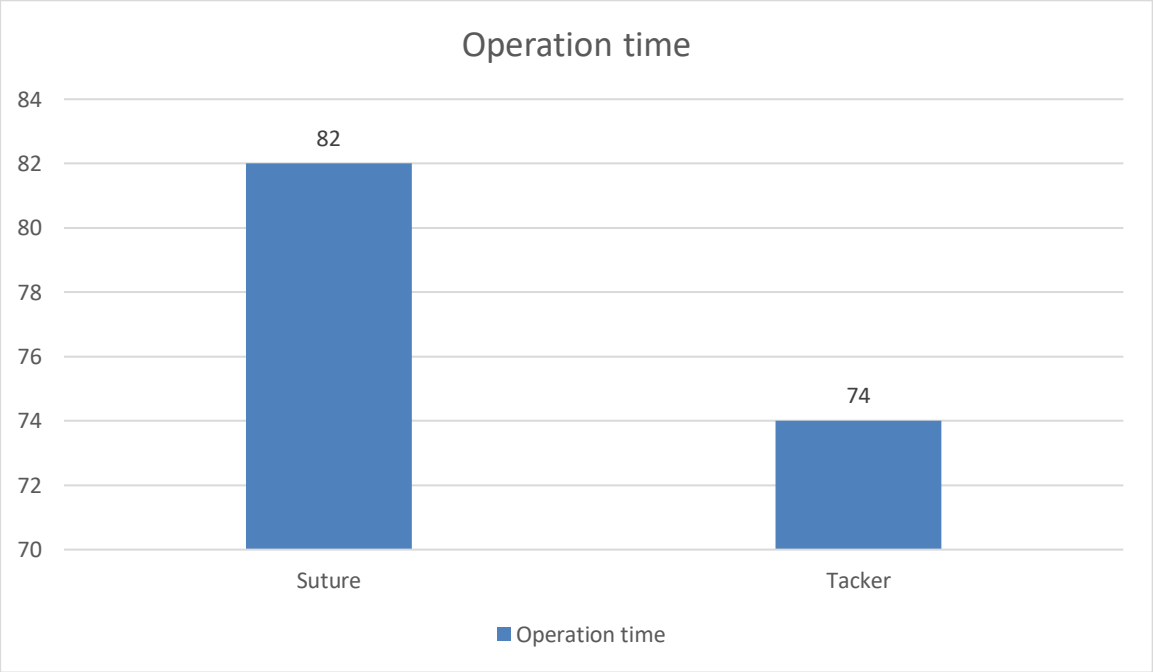


Figure 14: Comparison of the mean operative time between the groups

Table 5: Comparison of the post operative pain score between the groups

Pain	Suture	Tacker	p-value

	Mean	SD	Mean	SD	
POD1	7.9	1.6	8.1	1.1	0.51
POD7	5.2	1.7	5.5	1.4	0.55
POD14	3.2	1.6	3.5	1.3	0.42
POD 1month	1.3	1.2	2.2	1.1	0.02*
POD 3month	.6	.7	1.6	.9	0.02*

The pain score was comparable between both the group post operative days. 1st month and 3rd month the mean pain score was significantly lower in suture group compared to the patients in tacker group.($p<0.05$)

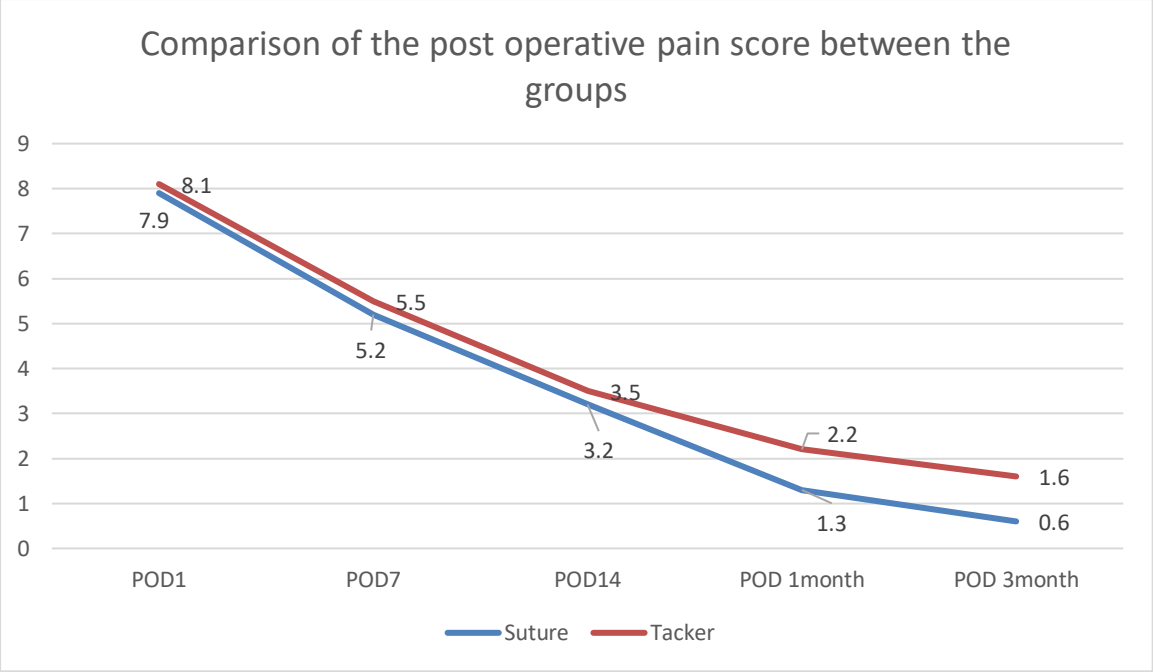


Figure 15: Comparison of the post operative pain score between the groups

DISCUSSION

There are two primary methods for mesh fixation in TAPP repair: PDS tackers and Vicryl intracorporeal sutures. PDS (polydioxanone) tackers provide a mechanical means of anchoring the mesh to the surrounding tissue. They offer the advantage of simplicity and speed, reducing the operative time. However, their use has been associated with potential drawbacks such as chronic pain, due to nerve irritation or muscle damage, and increased cost.

On the other hand, Vicryl (polyglactin 910) intracorporeal sutures involve manual suturing of the mesh to the tissue, which may take longer but can provide a more precise and controlled fixation. Vicryl is an absorbable suture material that minimizes the long-term presence of foreign bodies, potentially reducing chronic pain and other complications associated with non-absorbable fixation devices.

Present study the primary objective being the pain in the post operative period between the two groups The pain score was statistically significant in 1st month and 3rd month the mean pain score was significantly lower in suture group compared to the patients in tacker group.($p<0.05$)

However we would like to add in this study when a vicryl suture was introduced in the abdominal cavity the suture was lost and there was an increase in the operative time for the suture group and there are chances for the suture to break when suturing. One of the way to prevent suture loss is to park the suture to the median umblical ligament when not in use.

Present study total of 60 patients fulfilling inclusion criteria are included. The patients were divided into two groups as 30 patients in suture group and 30 patients in tacker group. Gender distribution between the group was comparable with overall male preponderance in the present study.

Similar to present study Mehmood Z et al., documented mean age in group A was 49.93 years with a standard deviation of 13.82 years, while in group B, it was 45.4 years with a standard deviation of 13.56 years, and these findings were comparable by age. [67] In study by Bagwan L et al., the age of patients ranged from 19 to 90yrs with majority of patients ranged in age from 46 to 65. In the research, 90 patients were male and 10 were female, indicating a greater predominance of men than women. Even though all of the research participants had abdominal swelling, 56 of them also reported having concomitant discomfort, 28 had irreducibility, 10 had blockage, and only 6 had strangulation-related symptoms.[63]

In similar to present study, Aziz et al., documented "mean age of patients was 46.55yrs with 98.6% were male with no significant difference between the groups." [69]

There is no significant difference in the diagnosis of the patients and type of inguinal hernia , length of hospital stay and postoperative complications between the two groups.

The operative time in patients of both the group was comparable with no significant difference in the two groups in the present study with group A mean , SD(82.0,31.5) ; and group B mean ,SD (74.0,24.0). (p:0.27)

In study by Prasant C et al., documented total "69 direct hernias (33 in fibrin glue and 36 in tacker), 24 indirect hernias (13 in fibrin glue and 11 in tacker), and 8 pantaloon hernia (4 in each group)." [62]

In concordance to present study Awanish K et al., documented that during the follow-up of patients for 1wk, 1m, 3m and 6m for mean VAS score during post-operative period, showed "significant difference at 1 and 3 months, suggesting less pain in the suture group. No significant difference was noted in other post-operative complications."[64]

Another study by Langenbach MR et al., the "duration of surgery was comparable between the groups (83 vs. 85 min). When using tack fixation, significantly more fixation points were applied as compared to sutures (19 vs. 12; $p = 0.02$), although mesh size was similar. The complication rate was similar (tacks: 6/28 vs. sutures: 3/20). Cost of suture fixation is markedly lower than tacks. However, surgeons clearly preferred mesh fixation with tacks, because it is more comfortable especially in TAPP hernia repair."[65]Compared to this study in this study there was significant post operative chronic pain in the tacker group and this could be because of significant inflammation associated with the tacker as it involves the peritoneum and the abdominal layers where as in suture we are just manipulating the peritoneum.

Mehmood Z et al., similar to present study documented lower mean score of pain among the patients of suture group. Hence concluded that using polyglactin suture for mesh fixation and peritoneal closure in transabdominal preperitoneal (TAPP) hernia repair is preferred due to its association with less postoperative pain. [67] Another study by Aziz et al., also did not document any significant difference in the post operative pain between the groups. They found that, in comparison to tack fixation, suture fixation of mesh in transabdominal preperitoneal (TAPP) repair causes reduced postoperative discomfort. Other early postoperative problems such seroma, hematoma, urine retention, and neuralgia did not differ significantly between the two fixation techniques, though.[69] The pain in the post operative period can be divided into pain into the pubic region in the tacker group can lead to ositits pubis.

In study by Chandra P et al., there was "no significant difference in seroma collection at hernial site in two groups up to 1 month follow-up, while there was significantly higher incidence of seroma in the tacker group thereafter. Significantly more number of people in fibrin glue group 68 and 90 %, respectively, returned to work during 15 and 30 days follow-up as compared to

the tacker group 46 and 64 %. One patient in each group developed orchitis at 15 days follow-up whereas recurrence of hernia was found in four patients in the tacker group. There were no reports of any allergic reaction , anaphylaxis, and infection in both groups."[62] In this study the suturing of the peritoneum it is an end to end suturing where as in tacking the peritoneum , posterior rectus , rectus muscle are involved which leads to significant inflammation.

Further research with larger sample sizes and extended follow-up is necessary to validate these findings and explore other potential benefits or drawbacks of these fixation methods. Investigating patient-reported outcomes, long-term recurrence rates will provide a comprehensive understanding of the optimal approach for mesh fixation in TAPP inguinal hernia repair.

SUMMARY

- Present study total of 60 patients fulfilling inclusion criteria are included. The patients were divided into two groups as 30 patients in suture group and 30 patients in tacker group.
- Gender distribution between the group was comparable with overall male preponderance in the present study.
- There is no significant difference in the diagnosis of the patients and type of inguinal hernia between the groups.
- The operative time in patients of both the group was comparable with no significant difference.
- The pain score was comparable between both the group post operative days till 1month . The post operative pain score at 1^{st} month and 3^{rd} month was significantly lower in suture group compared to the patients in tacker group.($p<0.05$)

CONCLUSION

In this study comparing mesh fixation methods in transabdominal preperitoneal (TAPP) inguinal hernia repair, two groups of patients, 30 with Vicryl intracorporeal sutures and 30 with PDS tackers, were analyzed. Both groups were comparable in gender distribution and hernia characteristics. The operative time was similar between groups, indicating no significant difference due to the fixation method. However, significant differences emerged in postoperative pain: while pain scores were initially comparable, they were significantly lower in the suture group than in the tacker group at both 1-month and 3-month follow-ups ($p<0.05$). This suggests that Vicryl intracorporeal sutures may provide better long-term pain management compared to PDS tackers, without impacting the duration of surgery. These findings support the use of sutures for enhanced postoperative comfort in TAPP inguinal hernia repair. Further research with larger cohorts and extended follow-up is needed to validate these results and assess other potential outcomes of these fixation techniques.

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ANNEXURE

INFORED CONSENT FOR “MESH FIXATION BY PDS TACKERS OR VICRYL INTACORPOREAL SUTURES IN TRANSABDOMINAL PREPERITONEAL INGUINAL HERNIA REPAIR A RANDOMIZED CONTROL TRIAL”

Name of Student/Principal Investigator:

Name of Guide/Co Investigators:

Primary objective:

Compare post operative pain intensity in patients undergoing transabdominal preperitoneal inguinal hernia repair between tackers and suture.

Secondary objective:

Compare the following in patients undergoing transabdominal preperitoneal inguinal hernia repair between tackers and suture.:

1. The duration of surgery,
2. Duration of hospital stay,
3. Postoperative complications

Introduction: Hernia maybe defined as a protrusion of abdominal viscera outside the abdominal cavity through a natural or acquired defect. Transracial sutures penetrate all layers of the abdominal wall, thereby enabling mesh fixation to the inguinal canal**.**
Though hernia is a very common ailment among surgical patients, irreducibility, obstruction, and strangulation are its common complication encountered in surgical practice as an acute emergency.

Although mesh fixation with tacks is convenient and time-saving in the laparoscopic repair of incisional and ventral hernias, the tensile strength of a mesh fixed by trans facial sutures is greater than when fixed by tacks .Trans facial sutures penetrate all layers of the abdominal wall, thereby enable fixation of the mesh to the entire Fascio muscular layer of the abdominal wall. In the present study, a comparison between the two most common methods of mesh fixation. tackers versus sutures was done

Explanation of procedure: The procedure will be done under general anesthesia in which the inguinal hernia surgery will be performed laparoscopic TAPP where in we perform peritoneal disscection followed by reduction of the hernia after which a 11X15cm mesh is introduced into the preperitoneal plane and will be fixed to the pubic symphysis with the help of a tacker or a suture and the preperitoneal space is either closed with vicryl intracorporeal suture or prolene tackers and the pain would be observed on the postoperative days.

Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact:
If you have any question or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study TACKERS VS SUTURES : An Prospective Observational study in mesh fixation in TAPP procedure with tackers vs monofilament sutures **in Dr.Prabhakar Kore Charitable Hospital .**

My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE -II – PROFORMA

Informed consent taken :

Date of consent:

Demographic data:

	Age: years old	M/F	**Gender:**
	Height: cm		

Weight: kg

Address: 1-Belagavi, 2-Outside Belagavi

Occupation: 1-Unemployed, 2-Unskilled, 3-Semi-skilled, 4-Skilled, 5-Professional

Education: 1-Illiterate, 2-Primary(1st-7thstd.), 3-High school(8th-10thstd.), 4-Intermediate,5-Degree & above

Socio-economic status: 1-Low, 2-Middle, 3-High

Date of Admission: d d M m y y y y

Date of interview: D d M m y y y y

Date of Surgery: D d M m y y y y

Date of Discharge: D d m m y y y y

History :

Inguinal swelling Y/N :

1-Right ,2-left ,3-Bilateral :

Sl.no	Date of surgery	Surgery Performed	Incision used	Indication for the surgery
1				
2				
3				
4				
5				
6				

Reducible:

Deep Ring Occlusion Test:

History of previous surgeries :

Ultrasound abdomen and pelvis:

Complications:

Intra operative findings:

Number of ports placed:

Adhesions :

1-prolene mesh, 2-other :

1-Tackers , 2- Sutures:

1-absorbable sutures , 2- non absorbable sutures :

1-Absorbable tacker , 2- Non absorbable tackers :

Number of tackers used :

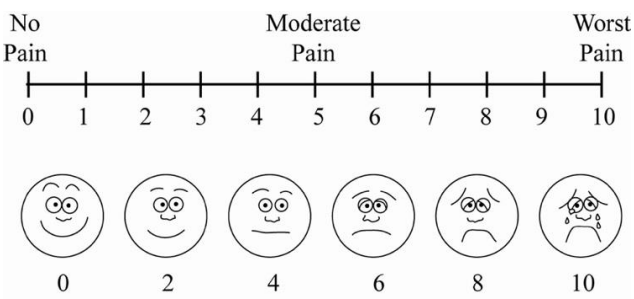
Operation time:

Intra operative complications:

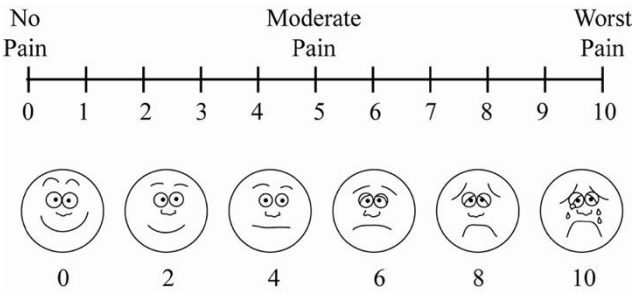
Post-operative

Post operative pain:

Day 1



Day 15



Hematoma: yes =1, no=2 :

Seroma formation: yes =1, no=2 :

Infection: yes =1, no=2 :

Surgical site infection: yes =1, no=2 :

Drain placed :yes =1, no=2 :

Reoccurrence's yes=1, no=2 :

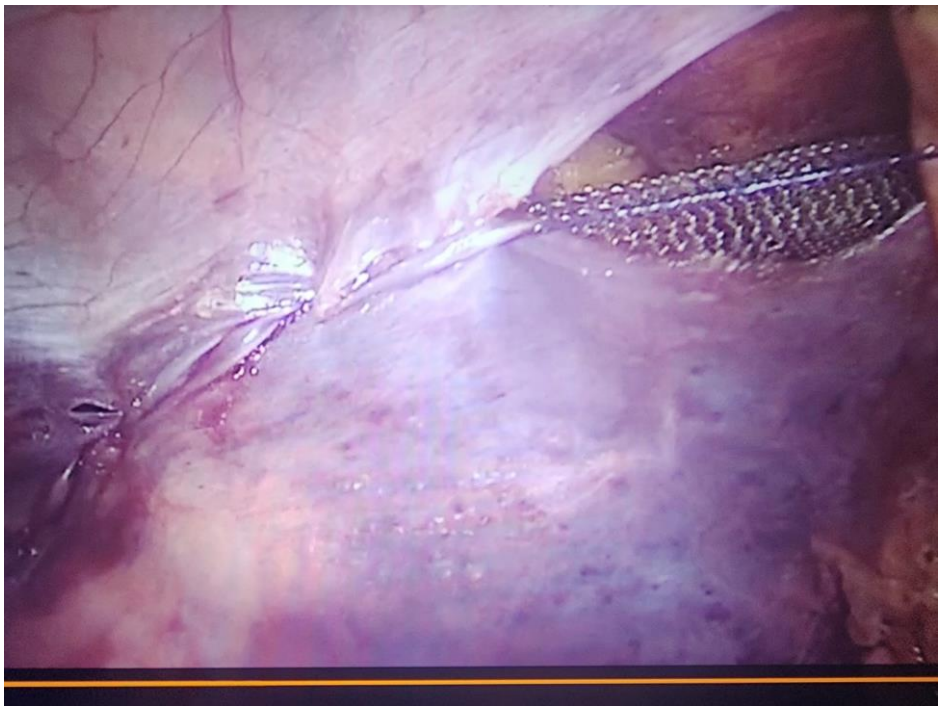
Scrotal swelling: yes =1, no=2:

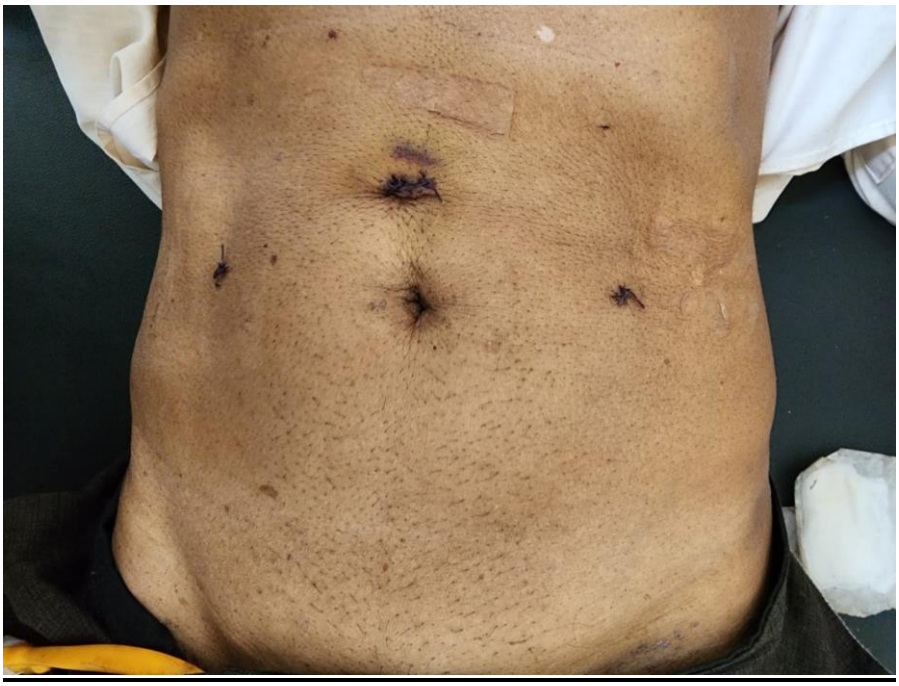
Return to work: yes =1, no=2

Disability: yes =1, no=2:

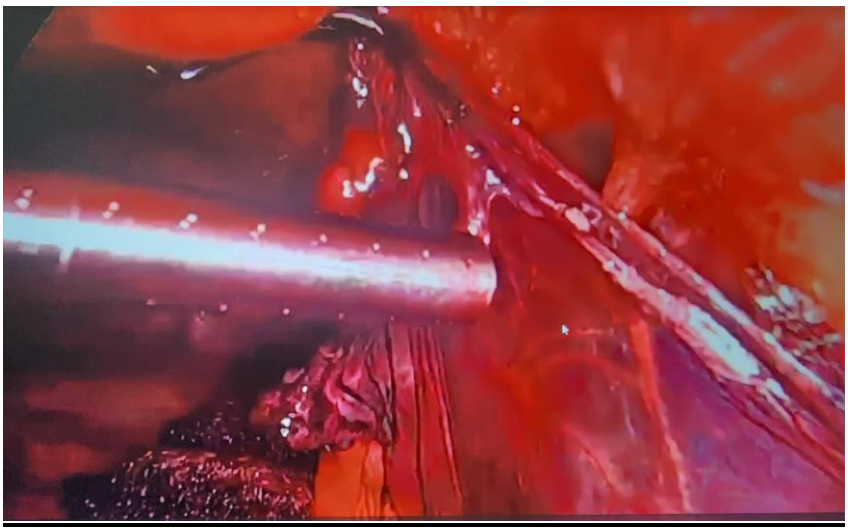
ANNEXURE – III PHOTOGRAPHS

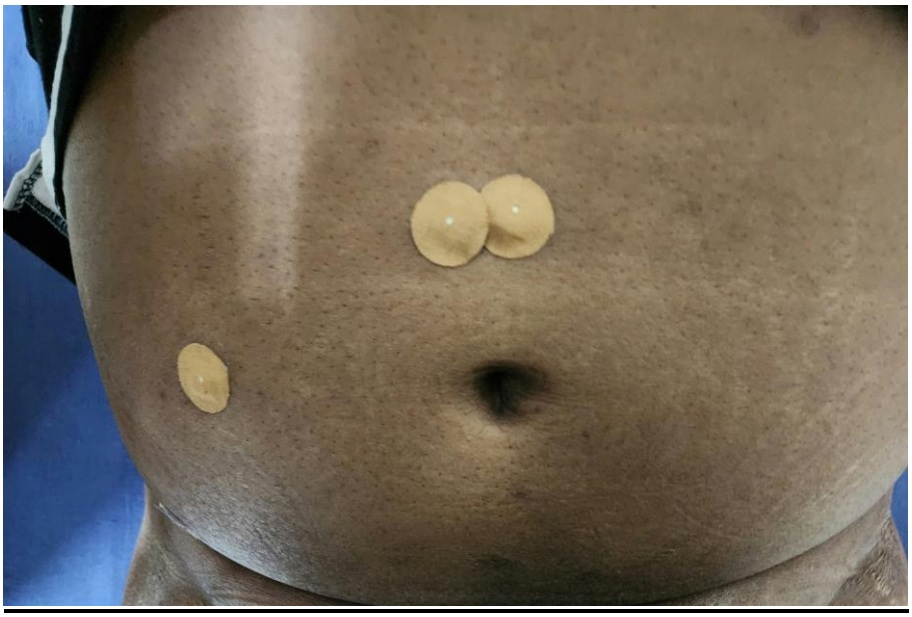
Mesh fixation and preperitoneal plane closure with suture





Mesh fixation and preperitoneal plane closure with tacker





ANNEXURE IV MASTER CHART

MASTERCHART

Sl No	Group	NAME	AGE/SEX	Gender	DIAGNOSIS	INGUINAL HERNIA	DEEP RING OCCLUION	OPERATION TIME ( )	POD 1 PAIN	POD 7 PAIN	POD 14 PAIN	POD 1 MONTH	POD 3 MONTH	COMPLICATIONS
1	Suture	Vimal	49	1	bilateral inguinal hernia	bilateral	positive	135	8	6	4	2	2	NO
2	Suture	Vajra Begum	22	1	Right Inguinal Hernia	right	positive	102	6	4	2	0	0	NO
3	Suture	Shainaz	24	1	Left Inguinal Hernia	left	positive	124	8	6	4	3	2	NO
4	Suture	Padmavathi	38	1	bilateral inguinal hernia	bilateral	positive	140	10	8	6	4	2	NO
5	Suture	Veerabharappa .B	29	1	Right Inguinal Hernia	LEFT	positive	128	8	6	3	2	0	NO
6	Suture	Jasmin	43	1	bilateral inguinal hernia	bilateral	positive	160	8	6	5	2	0	NO
7	Suture	Mallikarjun	31	1	bilateral inguinal hernia	bilateral	positive	110	10	8	5	4	1	NO
8	Suture	Vivek	45	1	bilateral inguinal hernia	bilateral	positive	105	10	8	6	2	0	NO
9	Suture	Prashanth.Patil	21	1	RIght Inguinal Hernia	left	positive	55	7	4	2	0	0	NO
10	Suture	Manoj Inchae	54	1	Right Inguinal Hernia	right	positive	81	10	7	5	2	1	NO
11	Suture	Prashanth .Patil	39	1	Left Inguinal Hernia	left	positive	76	6	3	1	0	0	NO
12	Suture	Ballappa	59	1	Left Inguinal Hernia	left	positive	62	9	5	3	1	0	NO
13	Suture	Shivanand	57	1	Right Inguinal Hernia	right	positive	62	8	5	3	0	0	NO
14	Suture	Shubhum Chougule	27	1	Left Inguinal Hernia	left	positive	45	9	7	5	2	1	NO
15	Suture	Dayanand	45	1	Right Inguinal Hernia	right	positive	70	6	3	1	0	0	NO
16	Suture	Appasab	60	1	Bilatreal Inguinal Hernia	bilateral	positive	75	8	4	1	0	0	NO
17	Suture	Prema	46	1	Right Inguinal Hernia	right	positive	49	9	5	4	2	2	NO
18	Suture	Mugulbasab	55	0	Right Inguinal Hernia	right	positive	75	7	4	2	0	0	NO
19	Suture	Bharam	57	0	Right Inguinal Hernia	right	positive	61	10	7	5	1	1	NO
20	Suture	Hussensab .M	55	1	bilateral inguinal hernia	bilateral	positive	110	10	8	6	3	1	NO

21	Suture	Satyappa	60	1	Right Inguinal Hernia	right	positive	49	5	3	3	1	0	NO
22	Suture	Jyashree	59	0	Left Inguinal Hernia	left	positive	55	7	4	2	0	0	NO
23	Suture	Sujatha Rajappa	58	0	bilateral inguinal hernia	bilateral	positive	86	9	5	3	1	1	NO
24	Suture	Akamadevi Nigappa	57	0	Left Inguinal Hernia	left	positive	74	5	3	1	0	0	NO
25	Suture	Shivalila Balappa	37	0	Right Inguinal Hernia	right	positive	48	8	6	2	2	1	NO
26	Suture	Shailaja Paramesh	37	0	Left Inguinal Hernia	left	positive	73	7	4	3	1	0	NO
27	Suture	Maktuma Mulla	32	0	Left Inguinal Hernia	left	positive	59	8	5	3	2	1	NO
28	Suture	Moneshwari Bhiku	55	1	Left Inguinal Hernia	left	positive	80	5	3	1	0	0	NO
29	Suture	Ashok Ganachari	60	1	bilateral inguinal hernia	bilateral	positive	69	9	6	3	1	1	NO
30	Suture	Dundappa	60	1	Right Inguinal Hernia	right	positive	42	7	4	2	0	0	NO
31	Tacker	Devaki	55	1	left inguinal hernia	left	positive	94	8	5	3	2	2	NO
32	Tacker	Vithobha	63	1	bilateral inguinal hernia	bilateral	positive	92	9	7	5	1	1	NO
33	Tacker	Gouravva	63	1	bilateral inguinal hernia	bilateral	positive	108	10	7	4	2	2	NO
34	Tacker	Shivalingayya	56	1	Right Inguinal Hernia	right	positive	114	9	8	4	3	1	NO
35	Tacker	Mallappa	57	1	Left Inguinal Hernia	left	positive	110	7	4	2	2	2	NO
36	Tacker	Prema	20	1	left inguinal hernia	left	positive	100	8	6	3	1	1	NO
37	Tacker	Balu Soumanna	71	1	Right Inguinal Hernia	right	positive	103	7	4	3	2	2	NO
38	Tacker	Basavaraj	30	1	bilateral inguinal hernia	bilateral	positive	90	10	7	3	2	1	NO
39	Tacker	Manohar	49	1	Right Inguinal Hernia	right	positive	45	6	3	1	1	0	NO
40	Tacker	Sidappa Patil	24	1	left inguinal hernia	right	positive	55	9	5	2	2	2	NO
41	Tacker	Channayya .H	22	1	left inguinal hernia	left	positive	84	8	4	3	3	1	NO
42	Tacker	Basvaraj >A	73	1	Bilatreal Inguinal Hernia	bilateral	positive	74	8	6	4	3	2	NO
43	Tacker	Suryanarayanan	55	1	Left Inguinal Hernia	left	positive	52	9	5	4	2	2	NO
44	Tacker	Arun	54	1	Bilateral Inguinal Hernia	bilateral	positive	45	7	6	5	3	3	NO
45	Tacker	Abhishek Pariyaer	19	1	Right Inguinal Hernia	right	positive	54	8	6	4	2	2	NO
46	Tacker	Annapurna	38	0	LEFT INGUINAL HERNIA	left	positive	49	9	6	3	1	1	NO
47	Tacker	Vijay	38	1	Right Inguinal Hernia	right	positive	64	7	3	1	1	0	NO
48	Tacker	Altaf Ahmed	48	1	Right Inguinal Hernia	right	positive	72	8	5	4	3	2	NO
49	Tacker	Iqbalahmed Yaqubali	58	1	Right Inguinal Hernia	right	positive	86	9	6	3	3	3	NO

50	Tacker	PremLalatha Shetty	46	0	bilateral inguinal hernia	bilateral	positive	100	10	7	5	4	3	NO
51	Tacker	Govindappa Ranagappa	60	1	Left Inguinal Hernia	left	positive	79	8	5	3	3	1	NO
52	Tacker	Sahiba Javed	38	0	left inguinal hernia	LEFT	positive	76	8	6	6	4	3	NO
53	Tacker	Bhartesh Pushpa	48	0	Right Inguinal Hernia	right	positive	60	9	7	4	3	2	NO
54	Tacker	Yenkappa Siddaplam	60	1	Left Inguinal Hernia	left	positive	39	9	7	5	3	1	NO
55	Tacker	Deepa Hosmani	27	0	left inguinal hernia	left	positive	47	6	3	2	0	0	NO
56	Tacker	Laxmavva Venkappa	58	0	RIght Inguinal Hernia	right	positive	51	8	4	5	3	2	NO
57	Tacker	Ayesha Wasem	36	0	bilateral inguinal hernia	bilateral	positive	70	9	7	4	3	2	NO
58	Tacker	Narayan Panurang	60	1	Bilateral Inguinal Hernia	bilateral	positive	112	8	6	5	4	3	NO
59	Tacker	Rajendra	38	1	Left Inguinal Hernia	left	positive	56	6	4	2	0	0	NO
60	Tacker	Abrar Ahmed	26	1	Left Inguinal Hernia	left	positive	40	7	5	3	1	1	NO