

**A COMPARATIVE STUDY OF POSTOPERATIVE INGUINODYNIA IN OPEN
MESH HERNIA REPAIR AFTER ILIO -INGUINAL NERVE EXCISION OR
PRESERVATION**

BY

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M. S.

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Under the guidance of

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LIST OF ABBREVIATIONS USED

BP	-	Blood Pressure
h/o	-	History of
i.e	-	that is
NA	-	Not Answered
No	-	Number
PR	-	Pulse Rate
t	-	Student's t
X ²	-	Chi square test

ABSTRACT

Background:

Chronic inguinal neuralgia is one of the most significant complication following inguinal hernia repair. Routine ilioinguinal neurectomy has been proposed as a means to avoid this complication. The purpose of this report is to evaluate the effect of ilioinguinal neurectomy on chronic groin pain following open mesh hernia repair compared with ilioinguinal nerve preservation.

Materials And Methods:

In this prospective randomized study 56 patients undergoing open mesh repair for inguinal hernia are divided into two groups. In Group A, ilio inguinal nerve preserved and in Group B ilio inguinal nerve excised. Postoperative chronic groin pain and wound complication are compared between the two groups. The results are finally analyzed and compared for the two groups using Chi Square test.

Results:

There was reduction in the intensity of groin pain in the ilio inguinal nerve excised group than the preserved group till 6 month but the there was no significant difference in groin pain from 6 month and post operative hypoesthesia was more in nerve excised group and complications like seroma, are comparable in two groups. There was no Pus collection or hernia recurrence in both groups.

Conclusion:

Although results are nearly similar in both groups, routine ilio inguinal neurectomy has no major complications and reduces the intensity of groin pain in the early post operative periods and reduces the risk of ilio inguinal nerve entrapment under the mesh, sutures, staples and reduces the incidence of chronic inguinodynia.

Key words: Hernia ; Inguinal canal; Ilio inguinal Nerve ; Neuralgia; Neurectomy; Groin.

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INTRODUCTION

Inguinal hernias are the commonest of all hernias and adult inguinal open mesh repair accounts for 15% of operations in general subjects.

Inguinodynia (groin pain > 3 months after hernia operation) is the second most common complication occurring after inguinal hernia repair. Incidence rates from 0% to more than 37%¹⁻⁷. This pain is usually due to post hernioplasty nerve entrapment. These patients usually present with groin pain for varying lengths of time, while most report pain immediately after their inguinal operation. Various groin pain syndromes may develop usually from scar tissue, reaction to prosthetic material, or involvement of a nerve in staples or suture material during repair of the hernia.

Postoperative groin pain, or neuralgia, is common to varying degrees following groin hernioplasty. During open hernia repair, the ilioinguinal, iliohypogastric, and the genitofemoral nerves are most commonly injured⁸ and cause mesh inguinodynia⁹. Nerve injury is usually due to entrapment of a portion of the nerve in the mesh or suture line placed in one of the soft tissue layers. When the conservative approach does not succeed, groin re-exploration can be performed to ligate or excise affected nerve branches.

Factors proposed as predictors of chronic pain are intensity of early post operative pain³⁻¹⁰, degree of specialization and experience of the surgeon¹¹ and the type of surgical procedure used.

Liem et al² found a lower incidence of pain after laparoscopic hernia repair (2%) than an open non mesh hernia repair (14%).

Dirkensen et al⁴ found no difference in the development of chronic pain after a Bassini repair (12%) versus laparoscopic repair (15%).

Hay et al⁶ in a large multicenter trial found overall pain incidence of 7% with no significant differences among the different types of non mesh open hernia repairs.

Rutkow and Robbins¹² in contrast found a chronic pain incidence of 0% in their case series of recurrent hernias using a tension free mesh repair.

Chronic inguinal neuralgia can be severe and may require numerous interventions for treatment¹³.

Along with a poor outcome and patient dissatisfaction, post operative neuralgia is further augmented as a complication for the surgeon by the accompanying risk of litigation. In fact 5% - 7% of patients who experience post herniorrhaphy neuralgia will sue their surgeons with virtually all such cases resulting in an out of court settlement¹⁴.

Management may involve local anaesthetics injections, medical therapy, multiple pain medications and or additional surgeries¹³.

Several authors detail the methods for prevention of nerve injury and stress the need for understanding the inguinal anatomy and preservation of nerves during hernia repair and inguinal incision closure^{15,16}.

The ilioinguinal nerve is at most risk for entrapment because it lies immediately beneath the divided external oblique fascia and can be included in sutures used in the hernia repair or to re-approximate the external oblique fascia or muscle can adhere to the ilioinguinal nerve or iliohypogastric nerve during healing¹⁷.

Other operations such as Pfannenstiel incision, low lying appendectomy incisions, iliac crest bone harvest and even infraumbilical midline incisions may also injure or entrap these nerves and their diagnosis and treatment are similar to the post herniorrhaphy patient¹⁷.

The concept of routine neurectomy in surgery is not unique to inguinal hernia repairs. Routine neurectomy often is performed during axillary and neck dissection in which the intercostobrachial and greater auricular nerves respectively are sacrificed¹⁸ .

Routine excision of the ilioinguinal nerve in an attempt to decrease the incidence of chronic inguinodynia has been proposed^{13,19} , yet controversies persist and the procedure is not widely accepted.

Inguinodynia is seen in 21% of the inguinal nerve preservation group in earlier studies ,which is a high incidence of post surgical pain. There is a need to know the outcome of nerve excision on post operative groin pain . So this study has been taken to compare the postoperative inguinodynia in open mesh hernia repair after ilioinguinal nerve excision or preservation.

AIM AND OBJECTIVES

PRIMARY OBJECTIVE:

To evaluate and compare the postoperative groin pain after ilio-inguinal nerve excision or preservation in open mesh hernia repair.

REVIEW OF LITERATURE

Embryology^{20,21}

There is no doubt that the first appearance of the mammal, with his unexplained need to push his testicles out of their proper home in to the air made a mess of the three layered abdominal wall that had done the reptiles well for million years.

In a highly synergistic way the skin, the parietal peritoneum and the embryologic and anatomic entities between them produce the future pathway for the testis. The skin will form the scrotum in male and labia in female. The embryologic entities between the skin and peritoneum permit the process vaginalis to penetrate them and form the inguinal canal. The downward journey of the testis to the scrotum is thus allowed, descent of the ovary outside the peritoneal cavity however is forbidden.

INGUINAL REGION

The Testis originally lies on the posterior wall of the abdomen at the level of the upper lumbar vertebrae on the medial side of the mesonephrons near the lower pole of the mesonephros by a peritoneal fold, called mesorchium. The descent or rather the migration of testis into its corresponding scrotal chamber is accomplished by following the lead of the fibromuscular band – Gubernaculum testis. It arises mainly within a peritoneal fold called the plica inguinalis which stretches from the inguinal region to the lower end of the mesonephros. The gubernaculum attains greatest development about the sixth month when it becomes a stout thick cord and is attached above to the lower end of the testis and below, it pierces through the abdominal wall in its passage to the bottom of the scrotal pouch, thereby forming the inguinal canal.

Along with it a process of peritoneum, the processus vaginalis descends into the scrotum dragging with it thin fascial prolongations of the layers of the abdominal wall. Thus the processus vaginalis receives coverings from the aponeurosis of the external oblique and internal oblique muscles and from fascia transversalis.

As the passage through the abdominal wall occurs the testis and cord structures are surrounded by vestiges of the external oblique (external spermatic) ,internal oblique (cremasteric fascia and muscle) and transversalis (internal spermatic) fascia.

The testicle appears during the first month of intrauterine life as a swelling at the caudal end of the genital ridge. It enlarges rapidly and by the 6th week has a mesentery and bulges into, but remains behind the peritoneum.

In the second month the testis begins to descend and about the third month it migrates to the iliac fossa where it lies near the brim of the deep inguinal ring. It traverses the inguinal canal during the seventh month reaching the superficial inguinal ring at the eighth month and finally reaches the bottom of the scrotum about the end of eighth month. The ovarian descent normally ceases after 12th week at the area of the pelvic brim.

The blind extremity of the processus vaginalis gets invaginated in the form of cup for the reception of the descending testis. As the migration of the testis proceeds, the gubernaculum shortens and eventually atrophies, but some trace of the gubernaculum persists at the bottom of the scrotum below tunica vaginalis. The shortened remains of the gubernaculum form the scrotal ligament fixing the testis to the bottom of the scrotal pouch.

By the end of the eighth month the cavity of the upper part of the processus vaginalis disappears and its peritoneal wall forms a fibrous cord. The lower part of the

processus vaginalis is thus entirely cut off from the general peritoneal cavity and consists of two layers, the parietal portion of tunica vaginalis lining the scrotum, while visceral portion of that membrane is applied on to the surface of the testes. In female, the gubernaculum extends from the lower poles of the ovaries to the labium majus through the inguinal canal. A pouch of peritoneum is called the canal of Nuck, similar to the processus vaginalis in the male accompanies the gubernaculum along the inguinal canal into the labium majus, this is normally obliterated well before birth. The occasional persistence of the vaginal process after birth serves as the genesis of induction of inguinal hernia in the female.

Anatomy of groin^{22,23,24}

The groin or inguinal region is a transitional area in which the thigh and the abdomen are joined.

The pelvic skeleton

The pelvic bones include the iliac bones, pubic bones and ischial bones which with sacrum forms a complete circle. These pelvic bones attached to the lumbar vertebral column via sacrum at approximately 60°.

Superficial fascia of Anterior abdominal wall

The superficial fascia above umbilicus is single layer and contains fat. Below umbilicus, it divided into

- 1) Superficial fatty layer (fascia of Camper).
- 2) Deep membranous layer (fascia of Scarpa) which is continuous below with Colle's fascia and above umbilicus it merges with fatty layer.

The Fasciae contain -

- (a) Variable quantity of fat
- (b) Cutaneous nerves
- (c) Cutaneous vessels
- (d) Superficial lymphatics

Cutaneous nerves of anterior abdominal wall

- 1) Lower six thoracic nerves
- 2) Iliohypogastric nerve
- 3) Ilioinguinal nerve

Cutaneous arteries

- 1) Anterior cutaneous arteries, branches of superior and inferior epigastric arteries
- 2) Lateral cutaneous arteries, branches of lower intercostal arteries
- 3) Superficial inguinal arteries which supply lower abdomen,
 - a) Superficial epigastric artery
 - b) Superficial external pudendal artery
 - c) Superficial circumflex iliac artery

Cutaneous veins:

These veins accompany the arteries and the superficial inguinal veins drain into great saphenous vein.

Lymphatics

Lymphatics above the umbilicus drain into the axillary lymph nodes and those below the umbilicus drain into the superficial inguinal lymph nodes.

Anterior abdominal wall musculature

The muscle bundles and fibrous tissues are arranged in layers and each muscle is covered by fascia. The flat lateral abdominal muscles are inserted via a laminated

aponeurotic sheet which further enhances integrity of abdominal wall. These laminae contribute to rectus sheath. Ultimately, it inserts in the midline, forming the linea alba.

Muscles

- (1) External oblique muscle
- (2) Internal oblique muscle
- (3) Transverse abdominis
- (4) Rectus Abdominis
- (5) Cremaster muscle
- (6) Pyramidalis muscle**

Ligaments and Fasciae

I. Inguinal Ligament (Poupart's ligament)

Formed by lower border of the external oblique aponeurosis, is thickened and folded backward on itself which extends from anterior superior iliac spine to pubic tubercle. The lateral half is rounded and oblique, medial half is grooved upward and horizontal.

Extensions of inguinal ligament:

- 1) Lacunar ligament or Gimbernat's ligament
- 2) Ligament of Cooper or Pecteneal ligament
- 3) Lateral crus of superficial inguinal ring
- 4) The ligament of Henle is the lateral vertical expansion of the rectus sheath that inserts on the pecten of the pubis

5) Reflected Inguinal Ligament (Colle's Ligament) is aponeurotic fibers from the inferior crus of the external inguinal ring that extend to the linea alba.

II. Fascia Transversalis

It lines the inner surface of transverses abdominis and separates the anterior abdominal muscles from the peritoneum.

Consists of 2 laminae:

1) Posterior Lamina (Preperitoneal space of Bogros)

2) Anterior Lamina

Rectus Sheath

This is an aponeurotic sheath covering the rectus abdominis muscle. It has 2 walls, anterior and posterior.

a) Above the costal margin

Anterior wall -- External oblique aponeurosis

Posterior wall – Deficient, rectus rest directly on costal cartilage

b) Between costal margins and the arcuate line

Anterior wall – Aponeurosis of external oblique

Anterior lamina of the aponeurosis of internal oblique

Posterior wall – Posterior lamina of the aponeurosis of internal oblique and aponeurosis of transverses muscle.

c) Below the arcuate line (semicircular line of Douglas)

Anterior wall – Aponeurosis of all the three flat muscles of abdomen

Posterior wall– Deficient, rectus rests on fascia transversalis

Contents of rectus sheath

(A) Muscles

- 1) Rectus abdominis
- 2) Pyramidalis muscle

(B) Arteries

- 1) Superior epigastric artery
- 2) Inferior epigastric artery

(C) Vein

- 1) Superior epigastric vein
- 2) Inferior epigastric vein

(D) Nerves – Terminal parts of lower six thoracic nerves.

Inguinal Canal

This is an oblique passage in the lower part of the anterior abdominal wall situated just above the medial half of inguinal ligament. It is about 4 cm (1.5 inches) long and is directed downwards, forwards and medially which extends from the deep inguinal ring to superficial inguinal ring.

Deep inguinal ring is an oval opening in the fascia transversalis situated half an inch (1.25 cms) above the midinguinal point.

Superficial inguinal ring is a triangular gap in the external oblique aponeurosis. It is shaped like an obtuse angled triangle. The base of triangle is formed by pubic crest. The two sides of the triangle form lateral and medial margins of the opening. At and beyond the apex of the triangle the two crura unite by intercrural fibres.

Boundaries

A) Anterior wall – formed by

In its whole extent by - (1) skin (2) superficial fascia (3) external oblique aponeurosis. In its lateral 1/3 by - fleshy fibers of the internal oblique muscle.

B) Posterior wall – formed by

In its whole extent by - (1) The fascia transversalis (2) extra peritoneal tissue (3) The parietal peritoneum.

In its medial 2/3 by - Conjoint tendon and reflected part of inguinal ligament

In its lateral 1/3 by - The interfoveolar ligament (Hesselbach's Ligament) which is a thickening of the transversalis fascia at the medial side of the internal inguinal ring.

C) Roof – It is formed by the arched fibers of the internal oblique and transversus abdominis muscle.

D) Floor – It is formed by the grooved upper surface of the inguinal ligament and medial end by the lacunar ligament.

Structures passing through the canal

1) The spermatic cord in males or round ligament of uterus in females enters the inguinal canal through deep inguinal ring and passes out through superficial inguinal ring.

- 2) The ilioinguinal nerve enters the canal through the interval between external and internal oblique muscles and passes through superficial inguinal ring.

Constituents of spermatic cord

- 1) The ductus deferens
- 2) The testicular arteries, cremasteric arteries and artery of the ductus deferens
- 3) The pampiniform plexus of veins
- 4) The genital branch of genitofemoral nerve
- 5) The plexuses of sympathetic nerves around artery to Ductus deferens
- 6) Remnants of processus vaginalis

Coverings of spermatic cord

From within outwards –

- 1) Internal spermatic fascia derived from fascia transversalis and it covers the cord in its whole extent.
- 2) The cremasteric fascia consists of the muscle loops of cremasteric muscle and the intervening areolar tissue. It is made up of internal oblique and transverses abdominis muscles and covers the cord below the level of these muscles.
- 3) The external spermatic fascia is derived from external oblique aponeurosis and covers the cord below the superficial inguinal ring.

Hesselbach's triangle - It is a weak spot in the anterior abdominal wall through which the direct inguinal hernia protrudes. It is bounded

- 1) Medially by outer border of rectus abdominis muscle
- 2) Laterally by inferior epigastric vessels

3) Inferiorly by medial part of inguinal ligament.

The floor of this triangle is formed by fascia transversalis. This triangle is bisected by median umbilical fold which is formed by obliterated umbilical artery. The part of it with in conjoint tendon is Hessert's triangle

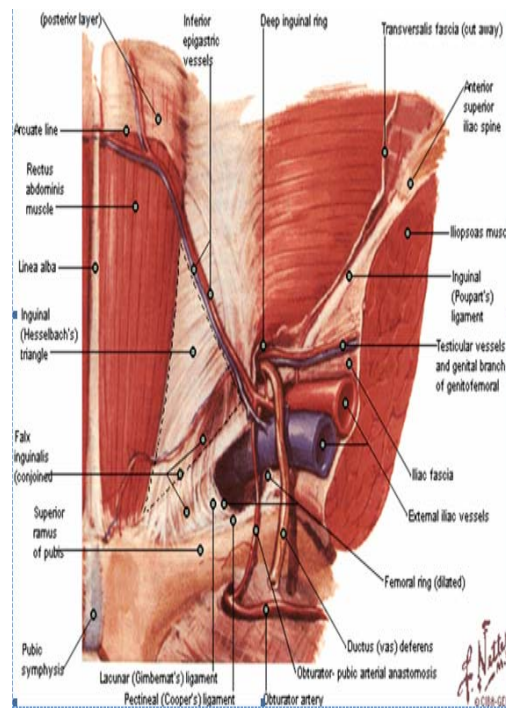
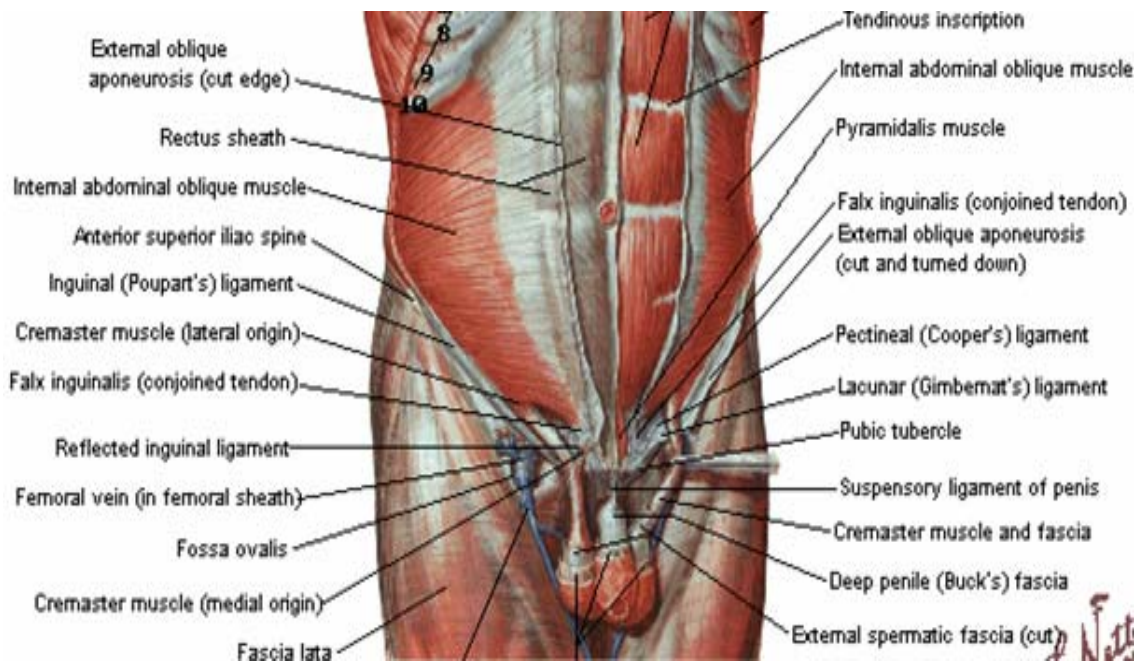


Fig. 1 (A) Anatomy of inguinal canal (B) Vessels near the inguinal region

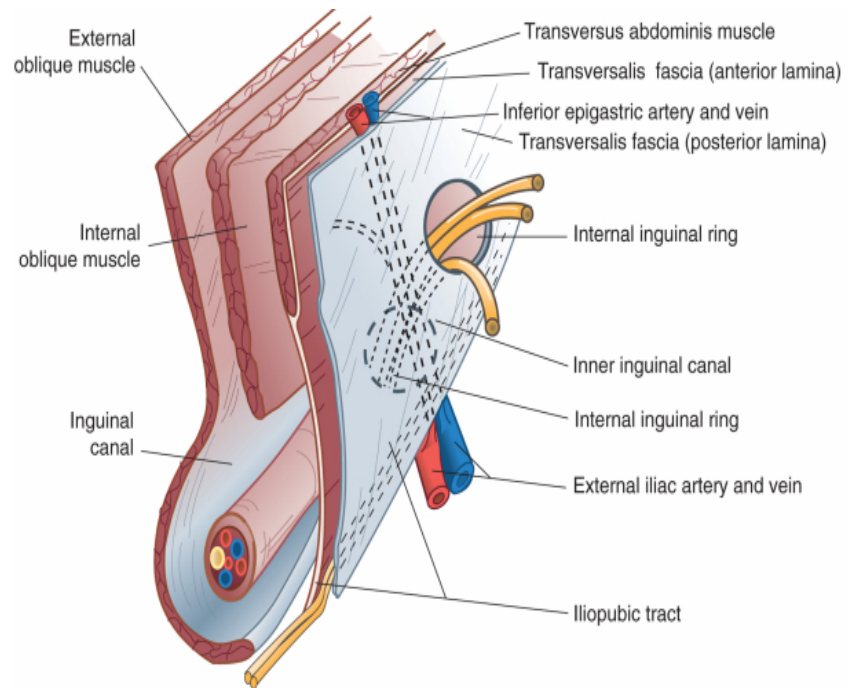


Fig.2. (A) Posterior view of inguinal region (B) Right sided indirect uncomplicated incomplete inguinal hernia

AETIOLOGY AND PATHOPHYSIOLOGY OF PRIMARY INGUINAL HERNIA^{25,26}

The cause of hernia is multifactorial and it is assumed that the following factors involved.

1. **Evolution** : The absence of posterior rectus sheath below the arcuate line, is only a rather substantial, transversals fascia unsupported by muscles or aponeurosis, resisting the intra – abdominal pressure and holding the breach between the upright posture that had been changed from quadripedal to bipedal locomotion. Mammals that walk on four limbs have permanently patent processus vaginalis but do not develop hernia. The reason in these animals the thigh is flexed forward. The groin structures are not stretched under tension and inguinal canal lies in upward direction. The weight of abdominal contents is directed forward and downward away from the inguinal region in to anterior wall of the upper abdomen. So inguinal canal is not subjected to significant gravitational stress. In humans upright posture causes gravitational stress to pass down to lower abdominal wall, which structurally is not designed. Further inguinal contents pressing on its internal opening tend to dilate it and allow the loops of bowel to enter the canal.

2. **Congenital and anatomical factors** :
 - a. **Patent processus vaginalis** : Is the prime cause of indirect inguinal hernia in infants and children. The development of processus vaginalis, its migration and its final obliteration are intimately linked to the descent of the testis from the abdominal cavity into the scrotum. After the testis reaches its final destination the lumen of the processus vaginalis is obliterated between the internal ring and the upper pole of the testis. The entire processes vaginalis does not necessarily indicate that hernia is present or does it mean

that one will necessarily develop in future. The incidence of patent processus vaginalis in adults who do not develop hernia during their life is up to 20%.

- b. Subtle variations in the attachment and arrangement of abdominal muscle.
 - c. Females are particularly free of direct inguinal hernia. The narrowness of the interval between the transverses arch and the inguinal ligament is an important factor in protecting women against direct hernia. On the other hand, musculoaponeurotic attachments in women is such that they frequently develop femoral hernia. Other factors that are significant in the etiology are the number of aponeurotic fibers in the transverses aponeurosis which determines the intrinsic strength of the layer. The disposition of the transverses arch in relation to the iliopubic tract indirectly determines the size of the inguinal gap or defect in the Hasselbach's triangle.
 - d. The obliquity of the inguinal canal, which during sudden exertion increase the intraperitoneal pressure, compresses the anterior and posterior walls of the canal there by occluding the canal.
3. **Shutter mechanism:** The accepted explanation for his is the physiologic "Shutter mechanism" which is activated when the abdominal muscles contract to increase intra abdominal pressure.

As the internal oblique and transverse abdominis muscles contract their lower fibers forming the myoaponeurotic roof of the inguinal canal "The conjoint tendon" that arches over the spermatic cord also sharply contracts and as the fibers shorten, the arch straightens out and descends to come to lie close to or on the inguinal ligament and so covers and protects the fascia transversalis. The shutter also passes down in front of the internal ring and counteracts the pressure on the ring which is made up of the thickened

bands of the iliopubic tract and fascia transversalis causing the ring to close like a sphincter snugly around the cord. At the same time the external oblique muscle contracts its aponeurosis which forms the anterior wall of the inguinal canal becomes tense and presses on the internal ring and on the weak posterior wall of the inguinal canal and so reinforces them by counter pressure against the intra abdominal forces that push outwards. The inguinal ligament is also pulled upwards by the same contraction to become convex clinically.

4. **Raised intra abdominal pressure:** When intra abdominal pressure is actively raised the shutter mechanisms are automatically activated to counteract the increased pressure and hernia does not occur. But when intra abdominal pressure rises passively and the abdominal muscles are relaxed, Shutter mechanism is not activated, so fascia transversalis is left on its own to withstand the increased intra abdominal pressure and if patent processus vaginalis is present or if the fascia transversalis is not sufficiently strong enough become attenuated by prolonged pressure and stretching. It gives away and hernia appears. This situation seen in pregnancy, ascites due to cirrhosis, ventriculoperitoneal shunt and peritoneal dialysis. The balance between the resistance of the abdominal wall and the intra abdominal pressure may upset even in a fit young man who is suddenly called upon to lift an extremely heavy weight that he is not accustomed or trained to lift, immediately develops pain in the groin and hernia down to the scrotum..
5. **Integrity of the fascia transversalis²⁷:** The ability of the fascia transversalis to withstand physiologic and pathologic elevations in the intra abdominal pressure is dependent on the state of the collagen fibers that make up its tissues and give its strength.

The factors that interfere with normal production of collagen or cause its increased

destruction or abnormal production of collagen fibers decreases the strength of transversalis fascia. These factors include congenital connective tissue disorders like Marfan's, Ehler's Danlos and Hurler – Hunter syndromes and mesenchymal metabolic defects.

It is found that substances in cigarette smoke inactivate antiproteases in lung tissues and so upset the protease/antiprotease System which is responsible for destruction of elastin and collagen of the rectus sheath and fascia transversalis and predispose to herniation in smokers.

6. **General contributing factors :** Other like weakening of muscle and fascia by advancing age, lack of physical exercise, obesity, multiple pregnancies.

Loss of weight and body fitness as may occur after illness, operation or prolonged bed rest, cosmetic operative incisions such as very low and unduly long transverse abdominal incisions for gynecological, urological and appendectomy incision. Pulmonary diseases like COPD and emphysema, prostatism, chronic constipation, diverticular disease, genito-urinary causes like cystitis, cystocele, urethrocele contribute to formation of groin hernia.

Components of inguinal hernia

- 1. The Sac :** Different parts of the Hernial sac :
 - A. Mouth :** This is path between the sac interior and the abdominal Cavity.
 - B. Neck :** This is narrowest section between the mouth and the body of sac.
 - C. Body :** It lies between the neck and the fundus.
 - D. Fundus :** This is the blind end or the distal most part of the sac. The sac consists of a diverticulum of peritoneum, which is divided into mouth, neck, body and fundus. This is funnel shaped in early stage of hernia. In cases occurring in infancy and child – hood the sac is grossly thin. In chronic longstanding hernia the sac becomes thickened and opaque or even cartilaginous, and at times inflammation may cause adhesions between the inner wall and the contained viscera or between opposite sides of the sac if no viscera intervenes.
- 2. Contents of hernia :** These can be almost any abdominal viscus, except the liver, but the commonest are;
 1. Fluid – the most common content, derived from peritoneal exudates.
 2. Omentum – Omentocele (Syn – Epiplocele)
 3. A loop of intestine – enterocele (Usually small intestine, but in some instances, large intestine or vermiform appendix).
 4. A portion of the circumference of the intestine – Richter’s hernia.
 5. A portion of bladder wall, or a diverticulum of the bladder.
 6. Ovary with or without the corresponding fallopian tube.
 7. Meckel’s diverticulum – Littre’s Hernia.
 8. Two loops of intestine in the manner of ‘W’ – Maydl’s hernia.
 9. Rarely stomach, spleen, caecum may be found in the sac.

1. **Coverings :** All the coverings of the sac of hernia are derived from the various layers of the abdominal wall through which the sac passes. In a given hernia these coverings may vary as per the duration and size of the hernia. In long standing cases they become atrophied from stretching, or become so amalgamated especially at the neck of the sac and often become so much thickened to produce strangulation.

Coverings in case of an indirect inguinal hernia are, from inside out, as follows:

1. Extra peritoneal fatty tissue.
2. Internal spermatic fascia.
3. Cremasteric fascia.
4. External spermatic fascia.
5. Two layers of superficial fascia and
6. Skin

In case of a direct hernia the coverings are as follows :

1. Extra peritoneal fatty tissue.
2. Fascia transversalis.
3. Conjoint tendon.
4. External oblique aponeurosis.
5. Two layers of superficial fascia.
6. Skin.

Classification of inguinal hernias, clinical classification :

This is based on the clinical presentation of hernia – Reducible, Irreducible, Obstructed, Strangulated, Inflamed.

Reducible Hernia : In this contents will completely get reduced into the peritoneal cavity on their own or on manipulation. A reducible hernia imparts an expansile impulse on coughing.

Irreducible Hernia : When the content of the sac cannot be completely emptied from the sac. This can happen due to adhesions, narrowing of the neck or fixity of the contents of the sac.

Obstructed (Syn. Incarcerated hernia) : irreducibility + Features of intestinal obstruction. The features are :

- a. The hernia is irreducible but painless.
- b. The sac is lax and not tender.
- c. Cough impulse may be present, usually absent.
- d. Features of intestinal obstruction.

In this type of hernia there is no arrest of blood flow to the sac and its contents.

Strangulated Hernia : Irreducibility + Features of Intestinal obstruction + arrest of blood supply to its contents leading to gangrene. The features are :

- a. The hernia is irreducible and painful.
- b. The sac is tense and tender.
- c. Cough impulse absent.
- d. Features of intestinal obstruction present.
- e. Intestinal obstruction may not be present particularly in case of Omentocele, Richter's hernia and Littre's hernia.

Inflamed Hernia : A very rare condition and mimics in many aspects a strangulated hernia. This occurs when its contents such as an appendix, a salpinx or a Meckel's diverticulum becomes inflamed. The features are (a) Overlying skin becomes red edematous (b) Swelling becomes painful, tender and swollen (c) it is not associated with intestinal obstruction.

T.S.D. CLASSIFICATION : Bendavid of the Shouldice Hospital has proposed the TSD (Type, staging and Dimension) classification scheme. Five types of groin hernias are described : Type – I or anterolateral (Formerly indirect) : Type II or anteromedial (Formerly direct) : Type – III or posteromedial (Formerly femoral) : Type – IV or posterolateral (Formerly prevascular) and Type – V or anteroposterior (Formerly inguinofemoral) each type is characterized by three stages which denote the extent of herniation anatomically.

Type – I

Stage -1 : Extends from the deep inguinal ring to the superficial inguinal ring.

Stage – 2: Goes beyond the superficial inguinal ring but not into the scrotum.

Stage – 3 : Reaches into the scrotum.

Type –II

Stage -1: Remains within the confines of the inguinal canal.

Stage–2: Goes beyond the superficial inguinal ring but not into the scrotum.

Stage – 3: Reaches in to the scrotum.

Type III :

Stage – 1: Occupies a portion of the distance between the femoral vein and the lacunar ligament.

Stage – 2: Goes the entire distance between the femoral vein and the lacunar ligament.

Stage – 3: Extends from the femoral vein to the pubic tubercle (Recurrences, destruction of lacunar ligament).

Type IV:

Stage – 1: Located medial to the femoral vein: Cloquet and Laugier Hernias.

Stage – 2: Located at the level of the femoral vessels : Velpeau and seragini hernias.

Stage – 3: Located lateral to the femoral vessels : Hasselbach and Part Ridge hernias (It should be noted that in Type-IV hernias, the stage does not imply the severity of the lesion).

Type V:

Stage – 1: It has lifted or destroyed a portion of the inguinal ligament between pubic crest and the femoral vein.

Stage – 2: Has lifted or destroyed the inguinal ligament from the pubic crest to the femoral vein.

Stage -3: Has destroyed the inguinal ligament from the pubic crest to a point lateral to the femoral vein.

In the T.S.D. Scheme, the ‘D’ refers to the diameter of the hernia defect at the level of the abdominal wall. Where a defect is not circular but ovoid or elliptical, the widest later lateral measurement is recorded in centimeters. There is also a series of sub classifications for Type II hernias with the letters “M,L,C,E,” denoting whether a defect is located through the medial, lateral, central or entire portion of the posterior wall of the inguinal canal, respectively.

Gilbert classification of inguinal hernia

Indirect:

Type I : Snug internal ring, intact canal floor.

Type II : One fingerbreadth internal ring, intact canal floor.

Type III : Two – finger breadth internal ring. Defective canal floor. (scrotal and sliding hernias).

Direct

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.

Nyhus classification of groin hernias

Type I: Indirect inguinal hernia – internal inguinal ring normal

(Eg. Child's hernia).

Type II: Indirect inguinal hernia – internal ring dilated but posterior inguinal wall intact, inferior deep epigastric vessels not displaced.

Type III: Posterior wall defects

- a. Direct inguinal hernia.
- b. Indirect inguinal hernia – internal ring dilated, medially encroaching or destroying the transversalis fascia of the Hesselbach triangle (e.g. Massive scrotal, sliding or pantaloons hernia).
- c. Femoral hernia.

Type IV: Recurrent hernias.

Classification as per patency of processes vaginalis

It is classified into vaginal or congenital type, infantile type, funicular type, and interstitial type.

Vaginal : The processes vaginalis has failed to become obliterated in any part of its course. The hernia therefore descends to the base of the scrotum and the testis is behind it and is close to locate.

Infantile : When the processes vaginalis is closed at the internal ring only and the hernia descends either behind the unobliterated processus or invaginating it. This hernia is difficult to diagnose clinically unless associated with infantile hydrocele.

Funicular Hernia : Here the processes vaginalis is closed at its lower end, so the sac of the hernia is separate from the sac of the tunica vaginalis. The testis lies below the hernia and can be felt separately from the contents of the hernia sac. Most of the indirect inguinal hernias belong to this category and are commonly seen in adults. It is usually acquired but can be congenital.

Interstitial Hernia : In this hernia the sac is caught between the different layers of the abdominal wall during development. Depending upon the position of the sac this type of hernia is further classified into three types:

- A. Intraparietal or Pre – peritoneal: when the sac lies between the transversalis fascia and peritoneum.
- B. Interparietal: when the sac lies between internal and external oblique abdominal muscles.

- C. Extraparietal type: The sac lies superficial to the external oblique muscle. These types of hernia are often associated with ectopic or retained testis. They give rise to inguinal swelling rather than inguinoscrotal swelling. By putting the abdominal muscles into action, it is possible to determine whether the hernia is superficial or deep to the abdominal muscles.

Classification depending on the contents of hernia

- a. Omentocele or Epiplocele – when the sac contains omentum.
- b. Richter’s hernia – when the sac contains a portion of circumference of intestine.
- c. Littre’s hernia – the sac contains Meckel’s diverticulum.
- d. Enterocoele – when the sac contains coils of intestines.
- e. Cystocele – when the hernia contains the urinary bladder.
- f. Other varieties –
 - I. Sliding or hernia – en – glissade (Contents – Caecum, Urinary bladder).
 - II. Maydl’s hernia or Hernia –en- W (Contents – W - shaped loop of intestine).
 - III. Hernia of vermiform appendix.
 - IV. Hernias containing female reproductive organs.
 - V. Hernias containing some abnormal viscera like stomach, spleen.
 - VI. Dual hernia (Saddle or Pantaloon). Hernia on either side of epigastric vessels.

In Richter’s hernia part or the circumference of the intestine, which is herniated, in 5% of cases, undergoes strangulation. It is serious and treacherous hernia as it presents with mild obstructive symptoms, which may mislead the diagnosis.

In Maydl’s hernia, W-shaped coil of intestine herniates through the inguinal canal. The segments of bowel proximal and distal to an infolded portion of hernia remain viable

and free from effects of constriction and the central loop, which lies inside the canal in the peritoneal cavity, gets strangulated.

In Littre's hernia the sac contains Meckel's diverticulum. If the sac contains any other viscera it becomes a mixed Littre's hernia.

In sliding hernia sac is composed not wholly of peritoneum but in part by viscus such as caecum or colon, which has no complete peritoneal investment.

In cystocele, which occurs indirect type of hernia, usually a diverticulum rather than whole of bladder is found.

Herniation of bladder into inguinal canal is classified into three varieties depending on the extent of peritoneal covering.

1. Extraperitoneal : Is rarest of the three varieties and bladder is usually opened mistaking it for the sac. In this variety anterolateral surface of extraperitoneal part of the bladder is involved.

2 .Paraperitoneal : In this variety bladder always lies on the inner side of the sac. The superior surface of the bladder forms the inner wall of peritoneal sac. This is the most common variety of the three and easily treated.

3 . Intraperitoneal hernia : Is rare and usually secondary in origin. The hernial sac is lateral to deep epigastric artery. The upper and posterior portion of the bladder enters the sac and in addition, loops of small intestine and omentum may be found

Anatomical classification : In this type of classification the location of the hernia sac in relation to certain anatomical structures is noted and accordingly the hernias classified. In case of inguinal hernia the landmark taken is inferior epigastric artery. Hernia lying medial to this artery is called the 'direct hernia' and that lying lateral to it called as 'indirect hernia'.

Classification according to Descent of the Sac

- A. Bubonocele : The hernia is limited to inguinal canal, the processes vaginalis having being obliterated at superficial ring.
- B. Funicular : In this type, the processes vaginalis is closed only at its lower end, just above the epididymis. When the sac is opened the contents of the sac can be separately felt from testis which lies below the hernia.
- C. Complete : The processes vaginalis is patent throughout, the testis appear to lie within the lower part of hernia.

Clinical features^{28,29}

History

Age : Inguinal hernias occur at all ages. They may be present at birth or appear suddenly in 80 years old. The peak time of presentations is in the first few months of life, in the late teens and early 20's and between 10 and 60.

Sex : male : Female – 20 : 1

Occupation : Heavy work, especially lifting, puts a great strain on the abdominal muscles. If there is an underlying weakness, the appearance of a hernia may coincide with strenuous physical effort. Hard labour workers, sportsmen and weight lifters are more prone.

Associated Diseases : Many a times hernia is due to diseases causing weakness of anterior abdominal wall like obesity, previous lower abdominal operations, ascites and Malgaigne's

bulges. Certain diseases lead to increase in abdominal pressure such as prostatic enlargement, stricture urethra, chronic cough and respiratory disorders and chronic smoking.

Local Symptoms : The commonest symptoms are discomfort, heaviness and pain in the initial stage. The patient complains of a dragging, aching sensation in the groin, which gets worse as the day passes. A swelling in the groin is the second most common complaint. This may be a small lump of 2 – 3 Cms. Or huge lump going as down s to the knee level. Patient feels that it get smaller when he lies down and bigger when he strains or stands. If the hernia becomes very painful and tender, then it is probably strangulated. If hernia is reduced encase, patient may complain of pain on touching the scrotum.

H/O frequency of micturition may be there in cystocele.

Systemic Symptoms : If the hernia is obstructing the lumen of a loop of bowel the patient may complain of one or more of the four cardinal symptoms of intestinal obstruction : colicky abdominal pain, vomiting, abdominal distension and absolute constipation. In late cases of strangulation where gangrene has set in, patient can present with features of peritonitis more so if perforation of bowel has occurred.

Signs : On inspection in standing position a bulge or swelling will be seen in groin. This might disappear in lying down position if the hernia is reducible spontaneously. Impulse on coughing is present in reducible hernia. Loss of rugosities of scrotal skin in large inguino – scrotal hernias is seen.

Visible peristalsis is seen in enterocele. Malgaigne’s bulges are seen in lax abdominal wall.

An indirect hernia is sausage or pear shaped and lies parallel to the inguinal ligament. After reduction it reappears more laterally and runs down above the inguinal ligament towards the

scrotum. A direct hernia is more rounded, more medial, bulges forward and tends not to go down to scrotum. After reduction it reappears in a forward direction.

On Palpation : Reducing the hernia by manipulation is called Taxis and it is performed in lying down position of the patient. As the hernia is reduced following features are noted:

- a. Gurgling sound felt in enterocele.
- b. In enterocele first part takes longer time to reduce and in omentocele later part takes longer time.
- c. Impulse on coughing is felt.

Internal ring occlusion test : Internal ring is occluded and patient is asked to cough. If a bulge is seen medial to the occluding finger then it is a direct hernia, if not indirect.

Finger invagination Test : After reduction of the hernia this test may be performed to palpate the hernial orifice. The skin is invaginated from the bottom of the scrotum by little finger, which is pushed up to palpate the pubic tubercle. The finger is then rotated and pushed further up into the superficial inguinal ring. Normal ring is a triangular slit, which admits only the tip of a finger. When patient is asked to cough the examining finger will be squeezed by approximation of two pillars . A palpable impulse will confirm the diagnosis.

Hernioplasty

Earlier in the 1960, techniques using biocompatible meshes were introduced. Later in the 1980's and 1990's amazing spread of prosthetic methodologies took place and in 1984 Lichtenstein introduced tension free hernioplasty.

It is herniotomy and reinforced repair of posterior wall of the inguinal canal by filling the gap between the conjoined tendon and inguinal ligament by either autogenous material or heterogenous material.

Indications of hernioplasty-

- (1) Cases of indirect hernia – in patients with poor muscle tone
- (2) All cases of direct hernias
- (3) All cases of recurrent hernias
- (4) Patient who do strenuous jobs or suffering from chronic bronchitis, enlarged prostate etc

(1) Lichtenstein tension – Free Hernioplasty

A 5cm skin incision which starts from the pubic tubercle and extends laterally within Langer's line is made. External oblique aponeurosis is opened and its lower leaf freed from spermatic cord and upper leaf from underlying internal oblique muscle. The cord with its cremasteric covering is separated from the floor of inguinal canal and pubic bone.³⁰ Cremasteric sheath is incised longitudinally and indirect hernial sac is freed from the cord to a point beyond the neck of sac and inverted into the abdomen. In complete nonsliding scrotal hernia, the sac is transected at the midpoint of the canal leaving the distal section in place and anterior wall of distal sac is incised to prevent postoperative hydrocele. In case of direct hernias, the large sacs are inverted with absorbable suture. A thorough exploration of groin is necessary to rule out co-existing femoral hernia.

A sheet of 6 x 11 cm of mesh³⁰ is used. The medial end of the mesh is cut to the shape of the medial corner of inguinal canal with the cord retracted upwards, the rounded corner is sutured with nonabsorbable monofilament suture material to the anterior rectus sheath on the pubic bone

and overlapping the rectus sheath and periosteum by 1 to 1.5 cm. This is a crucial step in the repair, because failure to cover this bone with the mesh can result in recurrence. This suture is continued to attach the lower edge of the mesh to the inguinal ligament up to a point just lateral to internal ring. If there is a concurrent femoral hernia, the mesh is also sutured to Cooper's ligament 1 to 2 cm below its suture line with the inguinal ligament to close the femoral ring. A slit is made at the lateral end of the mesh, creating two tails, a wide (2/3) one above and a narrower (1/3) below. The upper wide tail is grasped with hemostat and passed underneath the spermatic cord, this positions the cord between two tails of the mesh. The wider upper tail is crossed and placed over the narrower one and held with hemostat and sutured to the inguinal ligament lateral to the deep ring. The upper edge of the patch is sutured in place with two interrupted absorbable suture, one to rectus sheath and other to the internal oblique aponeurosis just medial to the internal ring. Upward retraction of upper leaf of external oblique during this phase of repair is important because it results in the appropriate amount of laxity in giving a dome like configuration for the patch when the retraction is released. This laxity assures a true tension free repair.

Using a single nonabsorbable monofilament suture the lower edges of each of the two tails are fixed to inguinal ligament just lateral to completion knot of the lower running suture. This creates new internal ring made of mesh and maintains normal integrity of internal ring. The excess mesh on lateral side is trimmed, leaving at least, 5cm beyond the internal ring. This is tucked underneath the external oblique aponeurosis which is then closed over the cord with an absorbable suture.

Complications of inguinal hernia repair

(I) Wound infection in hernia repair

Bacterias commonly involved are – Staphylococcus aureus

Staphylococcus Epidermidis³¹

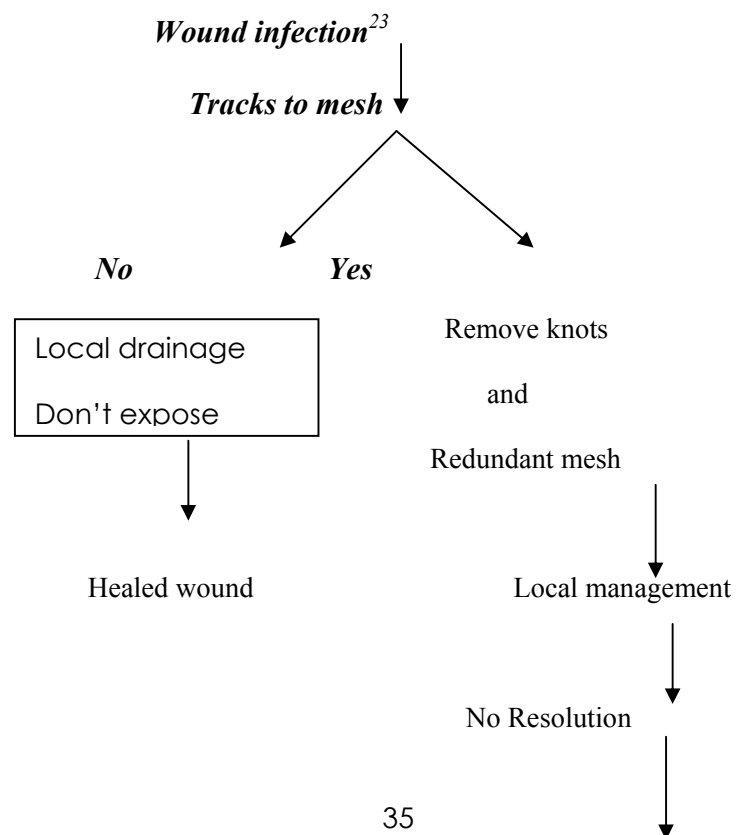
Group A streptococcus³²

E-coli³³

Clinical presentation– Fever, pain and signs of inflammation around infected area.

Treatment –

- 1) If a localized area of infection- drainage of pus, If extensive area of infection- requires opening of wound / debridement with antibiotics depending on culture sensitivity.
- 2) In case of Infected mesh-



Complete removal of

Incorporated mesh

(II) Cord and testicular complications

- 1) Hydrocele
- 2) Hematocele
- 3) Complications involving vas deference
 - (a) Dysejaculation syndrome
 - (b) Transection of Vas
- 4) Nerve injuries - Commonly genitofemoral and ilioinguinal nerve involved.
- 5) Damage to blood vessels of testicles
- 6) Ischemic orchitis and testicular atrophy
- 7) Testicular pain
- 8) Infertility

(III) Chronic pain after inguinal herniorrhaphy - classified as

- (a) Nociceptive-
 - 1) Somatic
 - 2) Visceral dysejaculation
- (b) Neuropathic-
 - 1) Neuroma pain
 - 2) Projected pain

Neural anatomy of groin ²⁷

The nervous anatomy of the region is quite variable, with 60% of patients showing variations of greater and lesser degree from the norm . However, an understanding of the normal anatomy and the areas in which the various nerves are at risk will prevent damage to them and prevent the potential for chronic pain.

The inguinal region is innervated by the ilioinguinal, iliohypogastric, and genitofemoral nerves (**Fig.3**).

It is these nerves that also are at greatest risk of injury during surgery or during the healing phase.

The lumbar plexus lies in the posterior part of the psoas major muscle. It consists of the ventral rami of L1-3 and most of L-4. It also has a branch from T-12. The gray rami communicantes join adjacent to the origin of the rami. The first lumbar ramus then divides in two, the upper branch forming the iliohypogastric and ilioinguinal nerves, the lower branch joining with the second lumbar ramus to form the genitofemoral nerve.

The lumbar plexus is well protected by muscle and retroperitoneal fat and so is out of harm during both open and laparoscopic herniorrhaphy. It is at risk of damage during epidural anesthesia. Disc herniation or foraminal impingement on the nerve roots as they exit the spinal canal may be a source of referred pain to the groin. L₁₋₄ disc herniation or osteophyte impingement is uncommon, but certainly may be cause for chronic pain. This must be entertained in the patient with previous hernia repair and new onset of chronic pain in whom other modalities of treatment have failed.

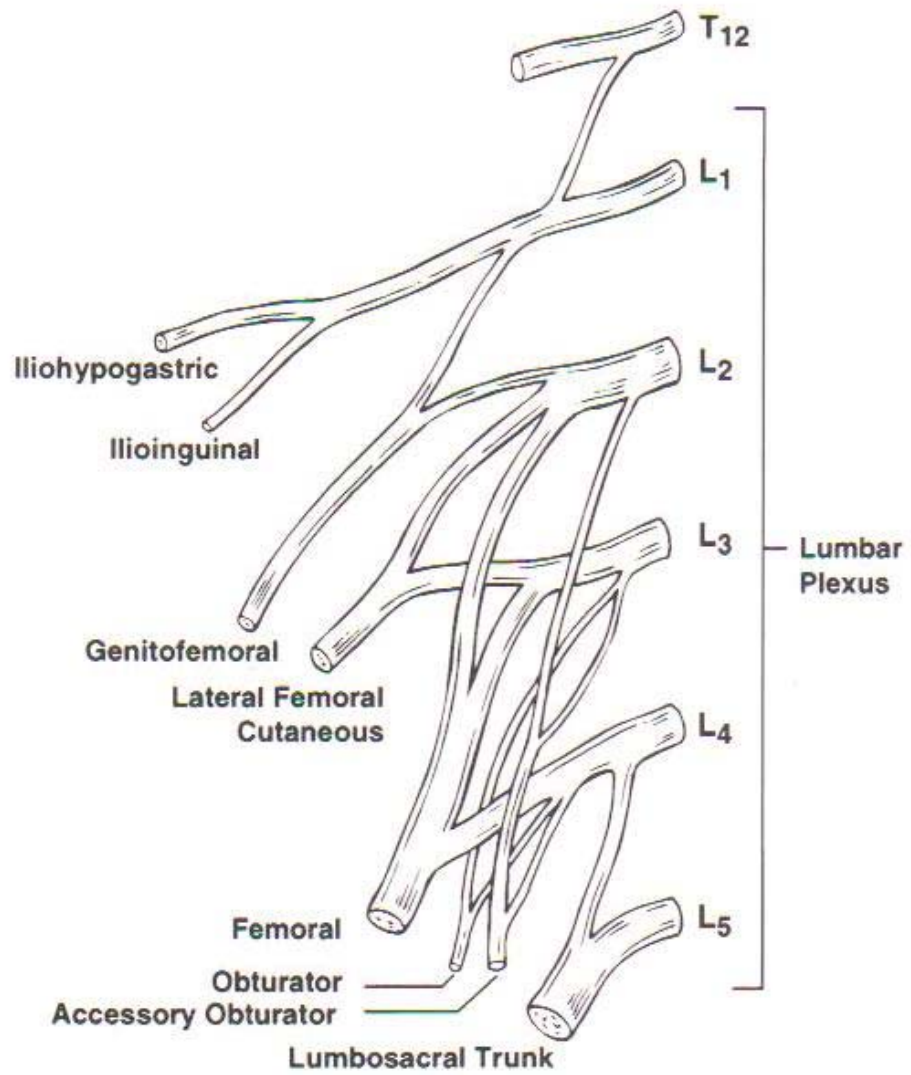


Fig 3 : Origins of the Iliohypogastric , Ilioinguinal , Genitofemoral and Lateral femoral cutaneous nerves from Lumbar plexus.

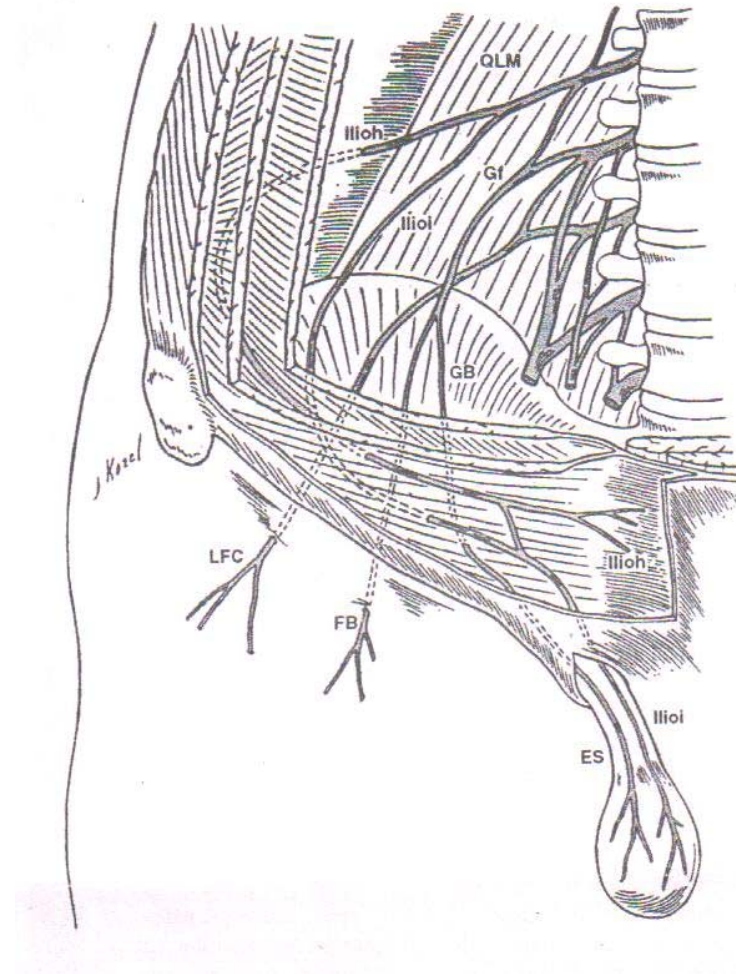


Fig 4 Course of the Genitofemoral , Iliohypogastric Ilioinguinal , Lateral femoral cutaneous nerves.

The ilioinguinal nerve is the inferior branch of the L-1 ramus. It emerges from behind the psoas along with or just inferior to the iliohypogastric nerve. It passes obliquely across the quadratus lumborum muscle, perforates the transversus abdominus muscle near the anterior end of the iliac crest, and then pierces the internal oblique muscle to run along the inguinal canal until it leaves by the external ring. It may do so by exiting directly through the ring or by piercing the fascia just adjacent to the ring. It provides motor function to the internal oblique and sensory innervation to the medial thigh and scrotum or mons pubis and adjacent labia majora. It is this nerve that is classically described as the primary cause of groin pain.

The iliohypogastric nerve emerges as the upper branch of the first lumbar ramus. It emerges lateral to the psoas muscle and runs in front of the quadratus lumborum muscle. Above the iliac crest, it perforates the transversus abdominus to provide the musculature with its innervation. Here, it divides into two branches, the lateral branch passing through internal and external oblique just above the iliac crest to supply the posterolateral gluteal skin. The anterior cutaneous branch runs between the transversus abdominus muscle and internal oblique muscle until about 2 cm medial to the anterosuperior iliac spine, where it passes through the internal oblique muscle. It then proceeds medially and pierces the external oblique aponeurosis above the external ring. It innervates the supra-pubic skin and has branches to the subcostal and ilioinguinal nerves. **(Fig 5)**

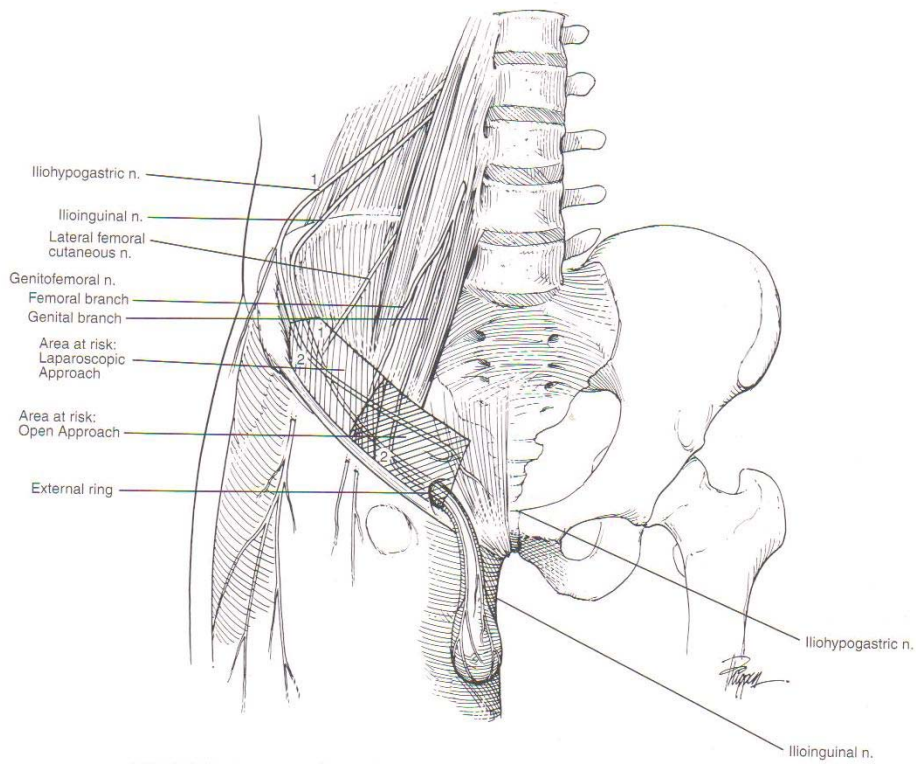


Fig. 5 Ilio hypogastric and Ilio inguinal nerves showing the areas at risk in hernioplasty. (1) Point at which the nerve pierces the transversus abdominus muscle ; (2) Point at which the nerve pierces the internal oblique.

The nerve is at risk of damage in two areas. Laparoscopically, it can be damaged internally as staples are placed through the transversus abdominus, anchoring in the internal oblique muscle. This has been recognized as a cause of postoperative and chronic pain in laparoscopic hernia repair. It can be avoided by minimizing the number of staples placed laterally and ensuring that they do not penetrate too deeply. A low, laterally placed trocar may also damage this nerve. It is again at risk during open herniorrhaphy when dissecting above the inguinal canal after dividing the external oblique aponeurosis, especially if a high incision is used initially. Other incisions such as appendectomy incisions, caesarean section incisions, and previous hernia incisions may all alter the course of the nerve or even entrap the nerve, putting it at risk of damage and chronic pain.

The genitofemoral nerve arises from the L-2 ramus. It passes obliquely through the psoas muscle, exiting on the medial border near the L-4 spinous process. It then travels caudally on the psoas, passing behind the ureter and dividing superior to the inguinal ligament. The genital branch follows the external iliac artery, passes through the internal ring into the inguinal canal and innervates the cremasteric muscle and scrotal skin or mons pubis and labia majora. There is a lot of cross innervation, of the nerves, so that even when one nerve is divided proximally, there is seldom complete anesthesia, but rather hypoesthesia in the affected area.

The femoral branch passes laterally to the iliac artery then behind the inguinal ligament, then traverses the femoral sheath anterior to the femoral artery and supplies the skin anterior to the femoral triangle. If the cord is skeletonized one can get anesthesia on the scrotum from division of the genital branch. This is routine in a Shouldice repair. It is sacrificed when doing hernia repairs in women; however, they may have decreased

sensation in the labia majora.

PHYSIOLOGY OF PAIN

Pain is defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" by the International Association for the study of Pain .

This means that several components must be in place. First, there must be an intact neural path from the nociceptor to the brain . **(Fig 6)**

This means that there is an event that causes a nerve receptor (nociceptor) to convert the event (heat, stretch, position, etc.) into an electrochemical message that travels along the spinothalamic tract to the thalamus and on to the cortex. Next, the stimulus must then be perceived as painful. If there is no perception with the associated emotional response, we do not have pain. Finally, the perception and expression of the pain in a patient is affected by the person's emotional state and environment. The same stimulus in a calm, reassuring environment may be perceived as less painful than the identical stimulus when the patient is alone, worried, and overwhelmed. Small cutaneous nerves are routinely incised with virtually every surgical incision. Major cutaneous nerves are also often removed during surgical procedures such as neck and axillary dissections. When these sensory nerves are excised, there are usually abrupt patterns of numbness followed by gradual recovery based on collateral nerves¹³.

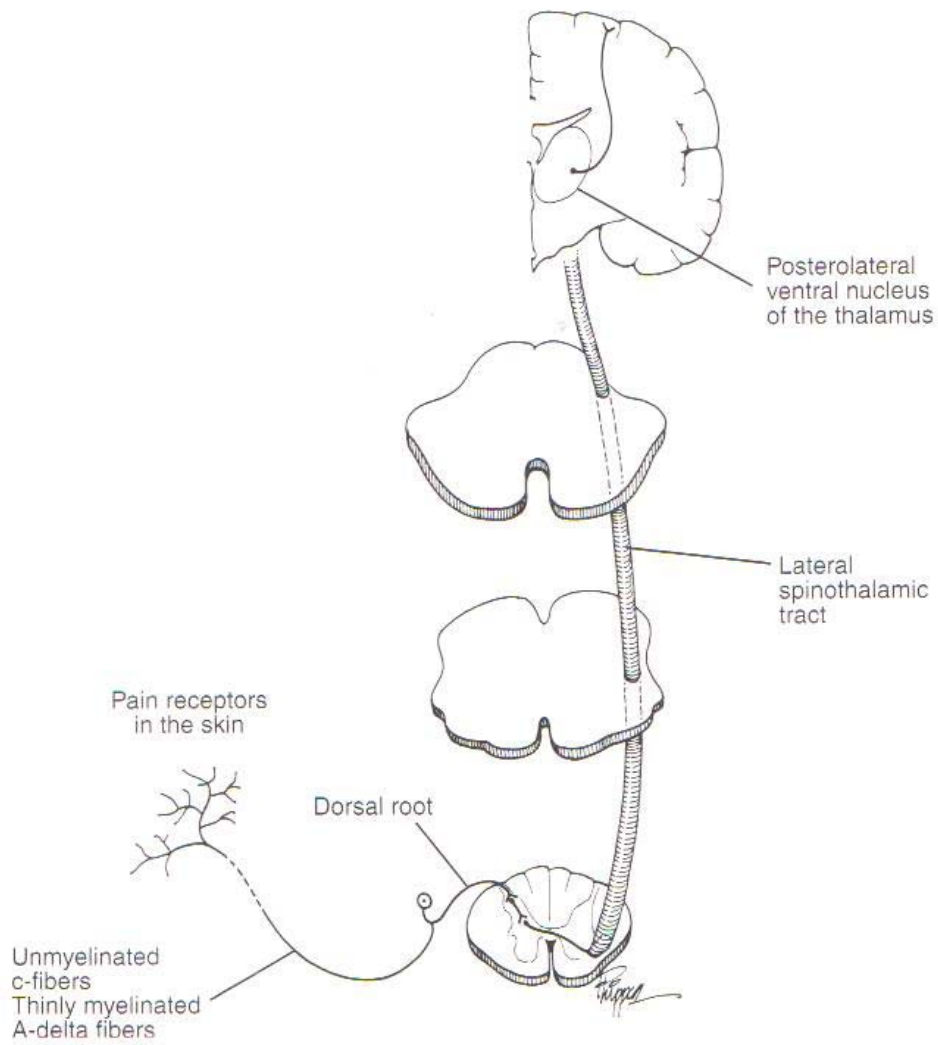


Fig. 6. Intact Neural pathway

Pain itself can be divided into two types:

1. Nociceptive pain

2. Neuropathic pain

Classification	Symptoms	Example
Nociceptive		
Somatic	Aching, gnawing, throbbing, cramping	Incisional pain
Visceral dysaejaculation	Colicky, squeezing	Early appendicitis
Neuropathic	Sharp, electrical, burning	
Centrally generated		Spinal cord injury
Peripherally generated		Postherpetic pain Ilioinguinal neuralgia
Sympathetically maintained		Reflex sympathetic dystrophy

Nociceptive pain can be subdivided into two groups: **Somatic and Visceral.**

4 processes are required for somatic pain perception: transduction, transmission, modulation, and perception. There are specific nociceptors in the cardiovascular, respiratory, gastrointestinal, and genitourinary systems. Neuropathic pain is a result of injury to a neural structure. This injury results in the spontaneous and atopic firing of the nerves. Neuropathic pain is subdivided into three subgroups: peripherally generated, centrally generated, and sympathetically maintained. This is characterized by autonomic dysregulation. A classic example is reflex sympathetic dystrophy, where one sees vasomotor changes, edema, sweating, and eventual atrophy. It is important that the various types of pain be differentiated as their management can be quite different. Groin pain as a result of a high lumbar disc protrusion will not respond to a neurectomy of the ilioinguinal nerve, even though the pain felt is very similar.

Pain itself can be acute or chronic: in acute pain there is a stimulation of a nociceptor. This can be a pain receptor in the skin or a stretch receptor in the bowel wall. This results in an appropriate physiologic response of pain perception as well as the

associated autonomic hyperactivity: hypertension, tachycardia, sweating, vasoconstriction, etc. It implies an intact neurologic system. The acute pain is a response to actual or impending tissue damage and ceases when the threat is removed or the damage ceases. Its purpose is to protect the organism from harm.

Chronic pain is the perception of pain when there is little or no threat to the tissue, yet the patient perceives the pain as if the area were being damaged. There is no associated autonomic response. This is both a psychological as well as a physiologic alteration in response. The actual function of the nervous system is reorganized (neuroplasticity). This is not just a peripheral event secondary to tissue damage, but a central sensitization where target cells modify their gene expression, resulting in enhanced response to future stimuli. There are physiologic, biochemical, cellular, and molecular changes that occur in the central nervous system, resulting in a "reprogramming" of the perception of pain rather than just a continuance of noxious stimuli.

Furthermore, as there are cortical changes, factors such as stress, secondary gain, or financial compensation may all affect change here. There is lowering of the threshold for excitation of neurons and nociceptors. Therefore, one can get excitation of neurons without stimulation of the nociceptor (atopic firing) or one can have a lowering of the excitation threshold so that nerves and nociceptors fire at lower levels of stimuli. All this results in a reduction of the pain threshold (allodynia). There is also an exaggerated or increased response to noxious stimuli (hyperalgesia). The pain is deemed to be chronic if it persists more than 3 to 6 months after the injury. The irony of the situation is that the initial injury may have long since healed. Chronic pain is an inappropriate response to an innocuous stimulus.

The surgeon who wants to be able to identify and manage chronic pain in the postoperative patient must take a careful history and do physical examination to delineate the nature and the source of the pain. This includes associated signs and symptoms, such as the nature and duration of the pain, as well as localization and reproducibility of the areas of hyperalgesia, hyperesthesia, hypoesthesia and anesthesia. Local areas of anesthesia and hyperesthesia are not uncommon in patients with chronic pain after hernia repair. Dysesthesia and allodynia are less common. Patients who have postoperative anesthetic areas are also more likely to have chronic pain. Careful examination may reveal which of the nerves, if any, are involved. However, up to 20% of patients with inguinal incisions have associated numbness up to 2 years postoperatively. Most of these have no associated concurrent nerve or tendon injury, but rather have an area of anesthesia caused by the division of the small nerve fibers that innervate the skin just inferomedial to the incision. This area is about 2 to 5 cm wide and runs the length of the incision along its inferior border . **(Fig 7)**

At 1 year post-hernia repair, 25% of patients have the anesthetic area. At 2 years, there is a small decrease to 20%. Interestingly enough, most patients are unaware that they have this anesthetic area, and they do not complain about it.

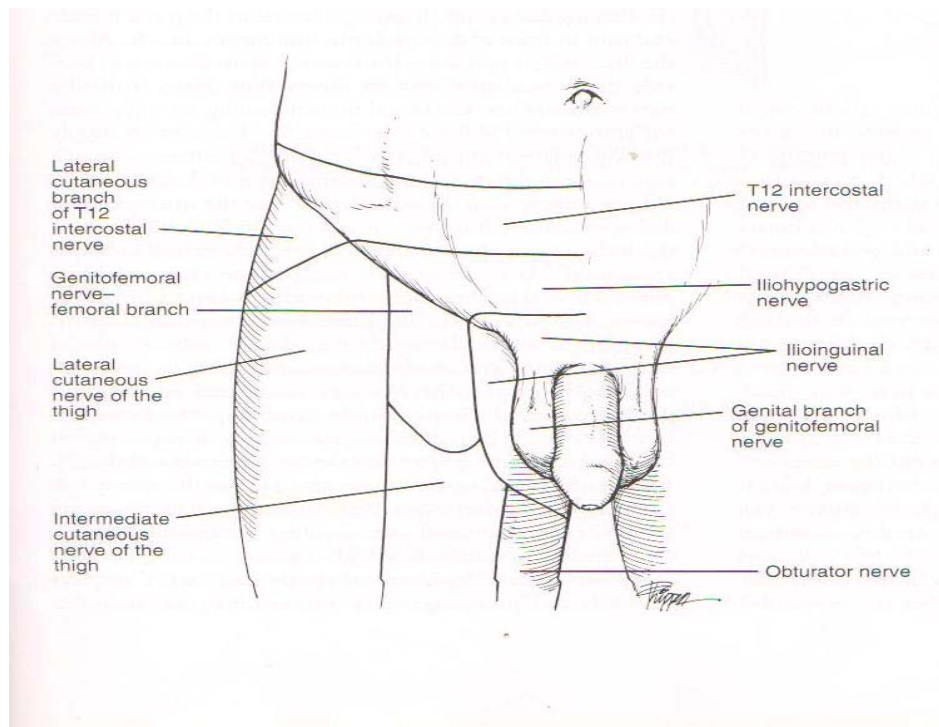
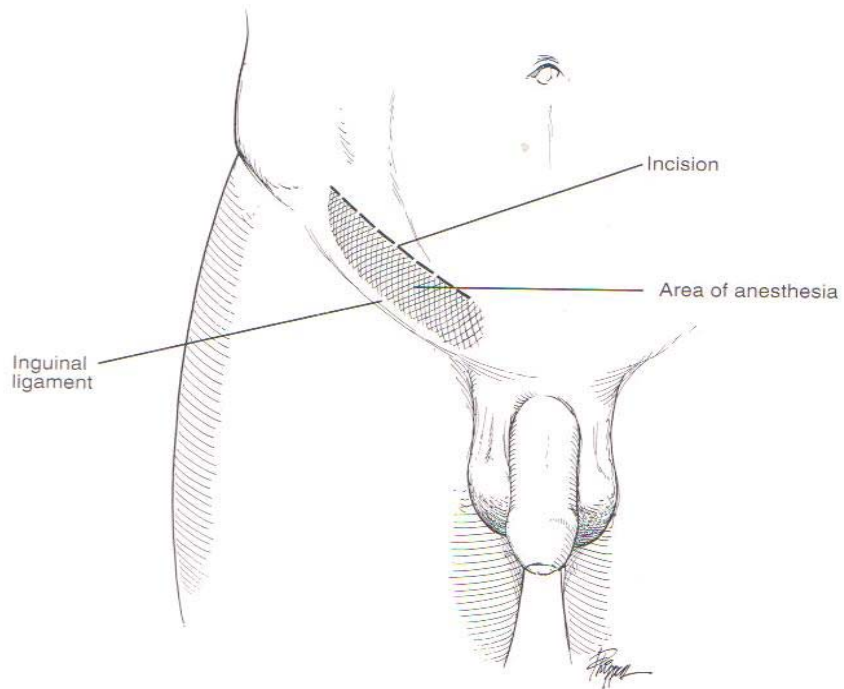


Fig 7. (A) Normal area of post operative anesthesia after inguinal hernia repair
 (B) Sensory innervation of the groin and anterior thigh

Nociceptive Pain:

Nociceptive somatic pain is akin to ligamentous or tendon injury. As in other parts of the body, the pain is a tugging, burning, dull type of pain, which is brought on by lifting or stretching. The patient may have a dull background ache not associated with activity. The flares of pain could last for several hours and could be aggravated by abdominal muscle use or stretch. Most patients prevent or reduce the severity of pain on standing up by pressing over the tender area. This also works for other activities involving abdominal muscle contraction or stretching. On a visual analog pain scale, patients have an average of "2," with the worst pain being "7" ("0" being no pain and "10" being the worst pain possible). These patients on physical examination have an area of tenderness over the medial insertion of the inguinal ligament. Carnett's maneuver may worsen the patient's pain.

Here the examiner palpates the affected part of the anterior abdominal wall with the patient tensing the abdomen by raising his head off the bed or doing a partial sit-up. Carnett's sign (relief of tenderness or pain) is indicative of intraabdominal pathology. Worsening of the pain with tension (muscle contraction) is consistent with nociceptive abdominal wall pathology. These patients have poor results with ilioinguinal or iliohypogastric nerve blocks or neurectomy. Heat, antiinflammatories, and local injection help these patients somewhat. The etiology is not clearly understood. It may be a strain of the pectineal muscle. Others suggest that the suture material is at fault. Either the suture is too unyielding and cuts into the tissue when tension (such as a sneeze or cough) is applied, or the sutures are spaced too far apart, resulting in a concentration of force over a relatively small area when increased strain is applied. Either way, these patients obtain relief of their pain with the removal of the suture.

Neuropathic Pain:

Neuropathic pain presents as electrical or brief sharp pain. It may be provoked by movement or it may occur spontaneously. The pain may be single or may occur as multiple bursts of pain over a span of time. It is unpredictable and may have no associated trigger. In some patients, there may be a defined movement or position that triggers the pain. The pain is maximal almost instantaneously and then is gone 30 to 60 seconds later. There is rarely any residual pain, but frequently the patient's activity is interrupted. Furthermore, patients who have a specific trigger avoid the motion or position that causes the pain, altering their lifestyle, and affecting the quality of life despite the brevity of the actual painful stimulus. These symptoms can occur concurrently with those of somatic ligamentous pain. It is important to identify these as two separate types of pain requiring individual management, for the management of one may not result in the relief of the other. Physical examination may show an area of anesthesia or hypoesthesia associated with the respective affected inguinal nerve .

This may include numbness on the medial thigh (which is innervated by the genitofemoral nerve) between presentations. This allows one to better approach the patient with neuropathic pain. If the pain is that of a neuronal, local injection or a simple division of the nerve just lateral to the neuroma should be adequate. If the pain is consistent with scarring of the nerve, with no well-defined point, local injection will have little effect and neurolysis has to be done more laterally to ensure that the nerve is free from scar. Patients with only mesh and tension-free repairs are not immune from chronic pain. Patients report neuropathic pain despite the fact there are few stitches or staples. The

likely cause for this are either that the large amount of scar that a mesh provokes envelops the nerves ,or as the divided nerve end regenerates they come in contact with the mesh and become irritable.

NEURALGIA (INGUINODYNIA) AFTER INGUINAL HERNIORRHAPHY OR HERNIOPLASTY

Persistent neuralgia and paresthesia in the inguinal region after inguinal or other lower-abdominal surgery (especially Pfannenstiel's incisions) are uncommon (and frequently denied) complications that may result in severe morbidity in our patients. Surgeons who perform large numbers of inguinal herniorrhaphies per year will attest that neurapraxia and hypoesthesia will occur in upwards of 15% to 20% of their patients following open hernia repair, but these symptoms usually will abate by 3 to 4 months postoperatively. Patients who develop a chronic pain syndrome (neuralgia, inguinodynia) fortunately are few, but when these occur they can be devastating to the patient and extremely frustrating to the surgeon.

ILIOINGUINAL NEURALGIA is characterized by symptoms similar to genitofemoral neuralgia with burning pain over the lower abdomen, which radiates down into the inner portion of the upper thigh and into the scrotum or labia majora. Unlike genitofemoral neuralgia, the pain can occasionally be reproduced by gently tapping over an area of point of tenderness (Tinel's sign) or by extending the thigh or hip. Distinguishing genitofemoral neuralgia from the manifestations of ilioinguinal neuralgia can be difficult and can result in misdiagnosis and inappropriate treatment. At times, differentiation is impossible. Both entities must be considered in all instances of inguinal pain, and appropriate evaluations must be performed.

Surgical Treatment

If an ilioinguinal (iliohypogastric) nerve block provides complete or substantial relief, surgical exploration of the previous inguinal incision and identification of the ilioinguinal and iliohypogastric nerves is initially recommended. The entire nerve as far proximal and distal as possible should be removed, to include the entrapped segment. Both the ilioinguinal and iliohypogastric nerves, if identified, should be removed because of the numerous nerve twigs connecting these main branches. The nerve ends are routinely ligated with an absorbable suture. Some authors recommend folding the cut ends of the nerves back on itself into muscle to prevent neuroma formation²⁸. Nahabedian and Dellon recommend extending the nerve resection into the preperitoneal fat deep to all muscle²⁹.

If the ilioinguinal block does not substantially relieve pain, and the L1-2 block or transpsoas block result in substantial pain relief, genitofemoral neurectomy should be the initial surgical approach. This is especially true in patients who have previously undergone repeated remedial groin explorations. If pain is partially relieved by both blocks, one should consider staged surgical exploration of these nerves.

Proximal genitofemoral neurectomy is approached through a small transverse flank incision similar to that for lumbar sympathectomy. The oblique and transverse abdominal muscles are divided, if necessary. The retroperitoneum is exposed, and the psoas major muscle and ureter are identified. The genitofemoral nerve can be identified as it penetrates the psoas muscle, usually as a single trunk along the medial edge. A 4 to 5cm section of the genitofemoral nerve proximal to the assumed site of entrapment is excised to include the bifurcation. Because of frequent variation in the site of nerve bifurcation, both

branches of the genitofemoral nerve must be identified to ensure resection of the proximal genitofemoral nerve trunk or both branches in situations when the bifurcation occurs within the substance of the psoas muscle. A segment of the proximal ilioinguinal nerve is also frequently excised during genitofemoral neurectomy. Hypoesthesia of the labia majora and skin over the femoral triangle, and loss of the cremasteric reflex are the only reported side effects of genitofemoral and ilioinguinal neurectomy.

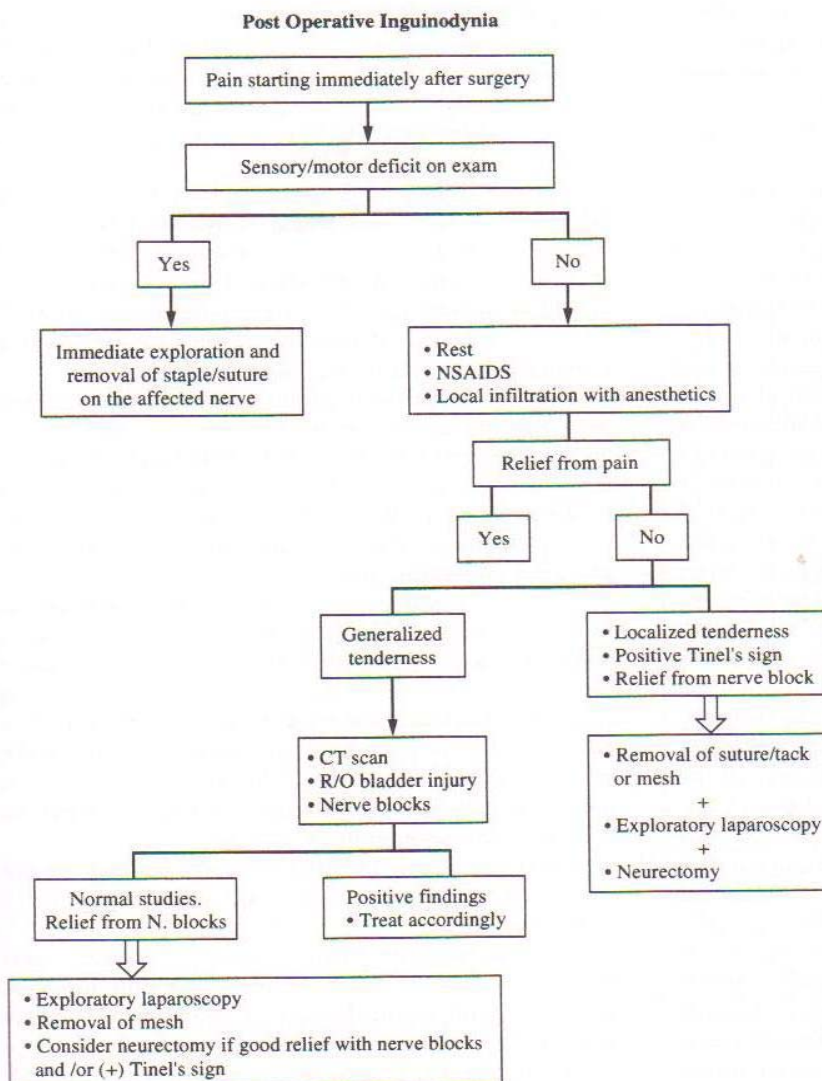


Fig 8. Algorithm for Post operative inguinodynia

Malekpour F et al.³⁸ conducted a double blind randomized clinical trial on 121 patients undergoing open anterior mesh repair of inguinal hernia from April 2005 to 2006. The ilio inguinal nerve was excised in half of the patients and preserved in the other half. Study showed neurectomy decreases post surgical pain after elective inguinal hernia repair.

Ravichandran et al.¹⁹ conducted a pilot study in which patients with bilateral inguinal hernia underwent surgery, with the ilioinguinal nerve preserved on one side and divided on the other. But the differences in post surgical pain between the 2 sides was nonsignificant.

Dittrick GW et al.¹³ reviewed 90 patients who underwent a Lichtenstein tension-free repair with onlay mesh. The patients were not matched nor were they equivalent. Sixty-six patients underwent excision and 24 patients nerve preservation. The incidence of neuralgia was significantly lower in the neurectomy group versus the nerve preservation group after 5 months (3% vs. 26%, $P < 0.001$). Paresthesia in the distribution of the ilioinguinal nerve was higher but not statistically significantly so in the neurectomy group (18% vs. 4%, $P = 0.1$). Lower incidence of neuralgia was maintained at 1 year (3% vs. 25%, $P = 0.003$) and the incidence of paraesthesia again was not higher.

Madura JA et al.¹⁷ In their study 100 patients were treated for inguinal nerve entrapment, including 52 men and 48 women with an average of 45 ± 14 years. Most patients had inguinal hernia repairs or Pfannenstiel incisions. Mesh was found in 27% of patients. Symptoms included pain (100%), radiation of pain to the thigh and/or genital area (59%), and postural pain (59%). And reported the effectiveness of inguinal neurectomy for inguinal nerve entrapment to relieve pain in post surgical patients. Five percent of patients had minor complications. There was abnormal nerve histopathology in 18%. Total pain relief was attained in 72% of patients, patients relief in 25%, and no relief in 3%. Two patients complained of numbness

postoperatively. Multifactorial analysis showed recurrent hernia repair as a significant predictive factor. And concluded most successful method available to relieve post - incisional pain is surgical resection of the involved nerves with reasonably good long-term pain relief.

Fitzgibbons RJ et al.³⁹ Chronic postherniorrhaphy groin pain, which is defined as pain lasting more than 3 months, occurs with greater frequency than was previously thought. The incidence in recent studies ranges from 0 to 53%. Neuropathic groin pain is caused by damage to a nerve in the groin region and may be due to partial or complete division, stretching, contusion, crushing, suturing, or electrocautery. These patients may be best treated by immediate re-exploration before scar tissue develops. Otherwise, the authors scrupulously avoid surgery before 1 year to allow the possibility of spontaneous resolution. When groin exploration is required, neurectomy and neuroma excision are performed. The results are often less than satisfying.

Charles P Heise et al⁹. 20 patients were evaluated. Three patients had their initial repair performed laparoscopically. Symptoms persisted for 12.2 ± 1.7 months before remedial surgery. Four patients underwent inguinal reexploration and mesh removal ; 16 had mesh removal plus ilioinguinal or iliohypogastric neurectomy. Good to excellent results were achieved in 12 out of 20 patients (60%) . Average followup time was 15.9 ± 3.1 months. Two of 3 patients who had laparoscopic herniorrhaphy had favorable outcomes (67%). Ten of the 16 patients who had mesh removal plus neurectomy reported good to excellent result (62%) compared with 2 of 4 reporting the same with mesh excision only (50%). Eleven patients had pain relief with preoperative nerve block. Of these, 9 had elective neurectomy resulting in good to excellent results in 5 (56%). Remedial inguinal exploration and mesh removal with or without neurectomy resulted in favourable outcomes in 60% of patients with mesh herniorrhaphy chronic groin pain . It appears that coincident neurectomy affords better result than mesh removal alone.

Cathy H Lee et al⁴⁰. In patients with painful groins, excellent relief of pain was achieved in 68% and restoration of function achieved in 72%. Ten percent had a poor result. The best results were for ilioinguinal and iliohypogastric, which were 78% and 83% excellent for both pain relief and restoration of function, with 11% and 17% having a poor result, respectively. The worst results were for the small group of patients with a genitofemoral nerve problem, 50% of whom had an excellent and 25% a poor result. Patients who were likely to get Lateral femoral nerve entrapment were those with a nerve located above or within the inguinal ligament. Complications included bruising and cautery injury to the Lateral femoral nerve. Groin pain of neural origin can be relieved with a high degree of patient satisfaction by considering whether one or more of four different nerves are the source of that pain and by treating the appropriate nerve by either neurolysis or resection.

Peter Stulz et al⁴¹. In his study 23 patients had a ilio inginal and /or iliohypogastric nerve entrapment syndrome following common surgical procedures in the lower portion of the abdomen. The diagnostic triad of nerve entrapment after operation comprises burning or lancinating pain near the incision that radiates to the area supplied by the nerve, clear evidence of impaired sensory perception of the nerve and pain relieved by infiltration with anaesthetic for local effects at the site where the two nerves leave the internal oblique muscle. Surgical repair of the scar with resection of the compromised nerve is the most effective treatment. 16 patients became symptom free after neurectomy, 7 still had chronic pain in the scar.

Irving L Lichenstein et al¹⁵. In cause and prevention of post herniorrhaphy neuralgia concludes that if particular lower abdomen nerve is incriminated in neuralgia its division will cure the problem.

Wantz GE⁴². Hernia surgeons have recommended that nerve ends should be ligated or intentionally severed to reduce chronic pain but with no documentation regarding the outcome of these recommendations.

Maurice Y. Nahabedian et al³⁷. In outcomes of the operative management of nerve injuries in the ilioinguinal region states for the nerve injury with groin pain options include repair of the nerve or resection and burial of the proximal stump. They found that its best to resect the injured nerve and allow retraction of the proximal segment into the retroperitoneum. These are non critical nerves and repair may cause pain and formation of neuroma.

L Krahenbuhl et al⁴³. In retroperitoneal endoscopic neurectomy for nerve entrapment after hernia repair states after open hernia repair, damage to genitofemoral nerve, ilio inguinal nerve and the ilio hypogastric nerve occurs and most of these patients can be treated by local neurolysis or neurectomy if a neuroma can be found. Only genitofemoral nerve damage should be treated on a first attempt by lumbar neurectomy.

Amid PK⁴⁵, suggests that all three inguinal nerves should be treated by neurectomy because intercommunicating nerve fibers may result in persistent symptoms if only a single nerve is divided. Division of the nerves may relieve the pain, but there is the potential for neuromas to occur when regenerating nerve fascicles spill outside the neurilemma and may cause severe pain. Several methods are described to prevent neuroma formation, including burying the cut end of the nerve in to muscle, end – to – side nerve anastomosis, and epineural ligation and flap.

Experimentally, treatment of the nerve end with electrofulguration, YAG laser destruction, and tissue biogules also are reported to prevent neuroma formation.

Marcello Picchio et al⁴⁶. Results of the 302 group A and 291 group B patients who made an office visit 1 year postoperatively, pain was absent in 231 (76.5%) and 213 (73%) (difference, 3.30% 95% confidence interval, - 3.68% to 10.28%), mild in 55 (18%) and 60 (21%), moderate in 11 (4%) and 9 (3%) and severe in 5 (2%) and 9 (3%), respectively (P=.55; Pearson 23 test). At 1 month and 6-month follow up visits, no difference was found between the 2 groups with respect to pain, but loss of pain or touch sensation were significantly greater when the ilioinguinal nerve was divided. One year after operation, the 2 groups were also comparable with respect to loss of pain sensation, but touch sensation remained decreased in group B. At telephone interview, the presence of chronic pain was similar in both groups and concluded that pain after open hernia repair with polypropylene mesh is not affected by elective division of the ilioinguinal nerve; sensory disturbances in the area of distribution of the transected nerve are significantly increased.

METHODOLOGY

Source of data :

56 Patients undergoing open mesh hernia repair for inguinal hernia admitted to wards in Department of Surgery BLDEU'S Shri B. M. Patil Medical College and Hospital Research center, in the period of one and half year during Oct. 2008 and May 2010.

Study Design:

Details of cases will be recorded including history, clinical examination and investigations . All patients will be operated for open mesh hernia repair for inguinal hernia. Patients will be randomized either to control group (where ilioinguinal nerve is preserved) or study group (where ilioinguinal nerve is excised) in the operating room. Probable benefits or problems according to nerve preservation or excision were explained.

Inguinal hernia of patient was repaired using the open tension free mesh technique described by Lichtenstein¹⁵ .

All standardized incision will be made 2.5 cms above and parallel to medial 3/5 inguinal ligament .

Surgical technique was the same in both the group and surgery was performed with patient under spinal anaesthesia. Local anaesthetics were not used.

In the study group –Ilioinguinal nerve was cut sharply with a blade 1-2cm lateral to internal inguinal ring and 3-4cm of the nerve was excised, neither electrocautery nor suture material was used in dividing the nerve³⁰ .

Mesh was fixed with 2-0 polypropylene sutures, fascial layers with polypropylene, skin closed with non absorbable suture material .

Post operative intra venous antibiotics and NSAIDS were used.

A Sample size has been arrived based on

1. Incidence of hernia in population is 5% out of which 75% are inguinal hernia.

Allowable error is considered 15%. Formula used for calculation of sample size is

$$n = Z\alpha^2 pq/d^2$$

,Using this fomula sample size is **n=56**

Observation will be based on the predefined criteria

Sample Size: 56 Cases

- 1) In 28 cases ilio inguinal nerve was preserved with open mesh hernia repair (Lichtenstein tension – free) Group A.
- 2) In 28 cases ilio inguinal nerve was excised with open mesh hernia (Lichtenstein tension - free)Group B.

Duration: One and half year

Inclusion criteria

- ❖ Patients with inguinal hernia > 18 yrs of age.

Exclusion Criteria:- : Patients with

- ❖ *Diabetes*
- ❖ *Incarcerated hernia*
- ❖ *Bilateral hernia*
- ❖ *Recurrent hernia*
- ❖ *Peripheral Neuropathy*

The investigations done are:

- ❖ HB%, TLC, DLC, ESR, BT, CT
- ❖ Urine examination
- ❖ HIV, HbsAg
- ❖ RBS, Blood Urea, Serum Creatinine, Chest X-ray (When age of the patient > 35 years or if necessary)
- ❖ USG if required

Outcome -

Severity scores were rated on visual analog scale(VAS) 1-10, because of the subjectivity of pain, determination of its severity has caused difficulty in most studies. VAS has been used as a standard scale rating pain. The reliability and validity of this scale among other pain scale has been acceptable.

Follow up was done.

1month, and 6 month.

Pearson's Chi square test was used to categorize the data.

Level of significance $P \leq 0.05$

1. During post operative period complication are noted in hospital

- ❖ Seroma,
- ❖ Haematoma,
- ❖ Pus collection
- ❖ Hypoesthesia
- ❖ Recurrence

Statistical Analysis-

The results are finally analyzed and compared for the two groups using Mann-Whitney U Test, Z test or chi square test and percentage of type of complication are measured.

Method-

After taking the informed consent, patients are randomized and divided in two groups A and B .

In Group A- Open mesh hernia repair with ilio inguinal nerve preservation (Control group).

In Group B - Open mesh hernia repair with ilio inguinal nerve excision (Test group)

All the procedures are carried under standardized Spinal anesthesia. Closure of the abdominal layer are done with continuous prolene 2-0 for external aponeurosis, intermittent plane catgut 2-0 for subcutaneous tissue and mattress suture with 2-0 non absorbable suture for skin closure.



Figure 9 (A) : Inguinal Hernia Incision

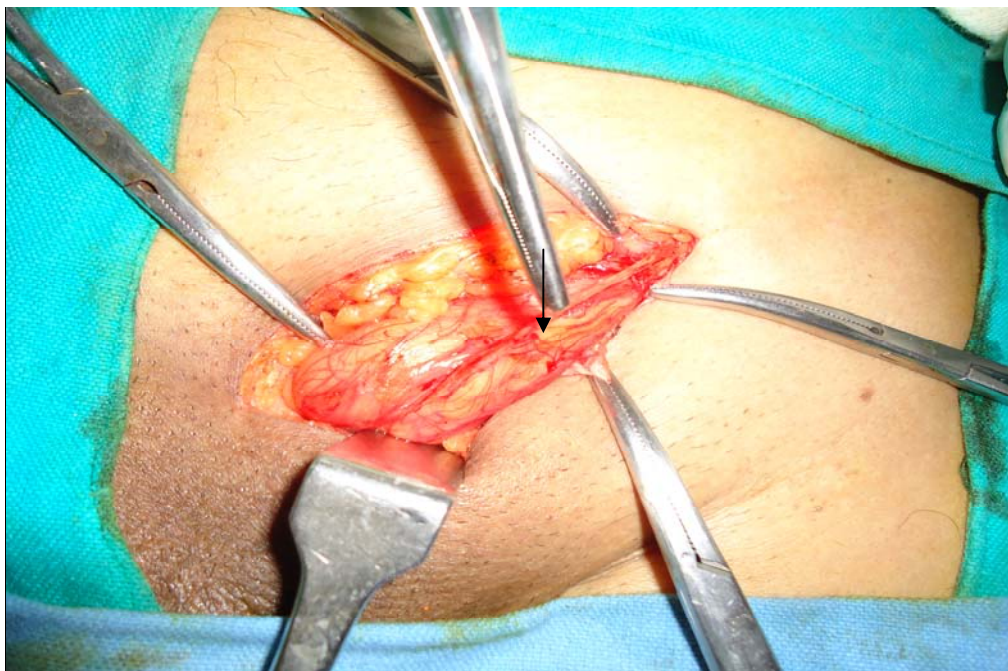


Figure 9(B): Ilioinguinal nerve entering the inguinal canal

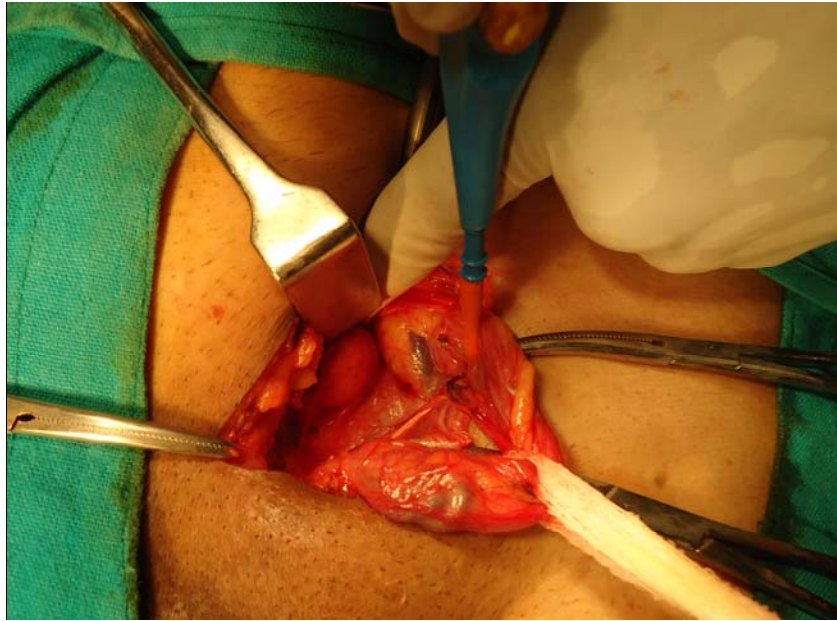


Figure 10(A) : Spermatic cord skeletonized

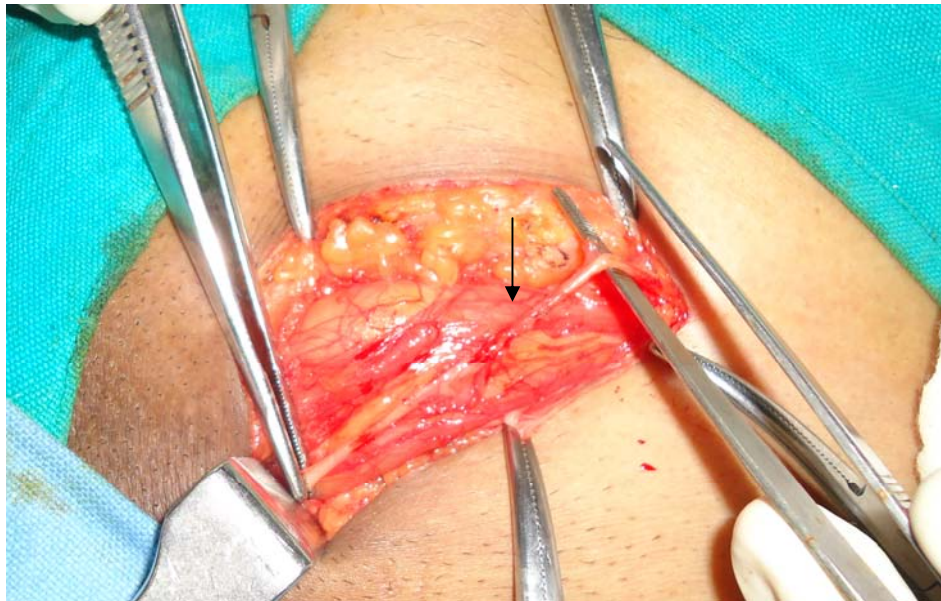


Fig 10 (B) Demonstration of Ilioinguinal nerve and traction given before excision.

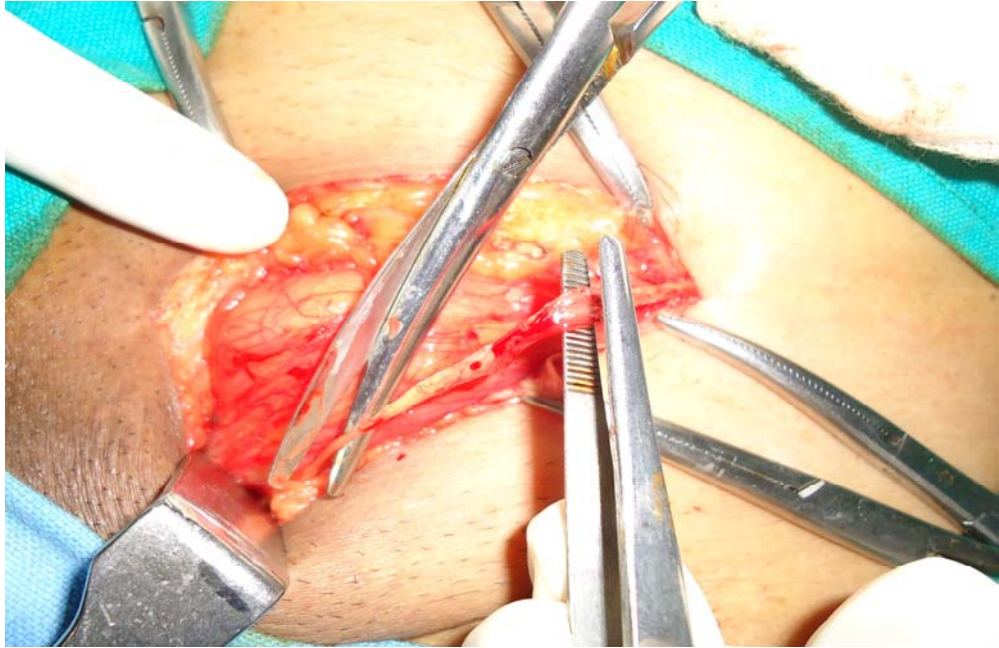


Fig 11 (A) Ilio inguinal nerve being excised medially

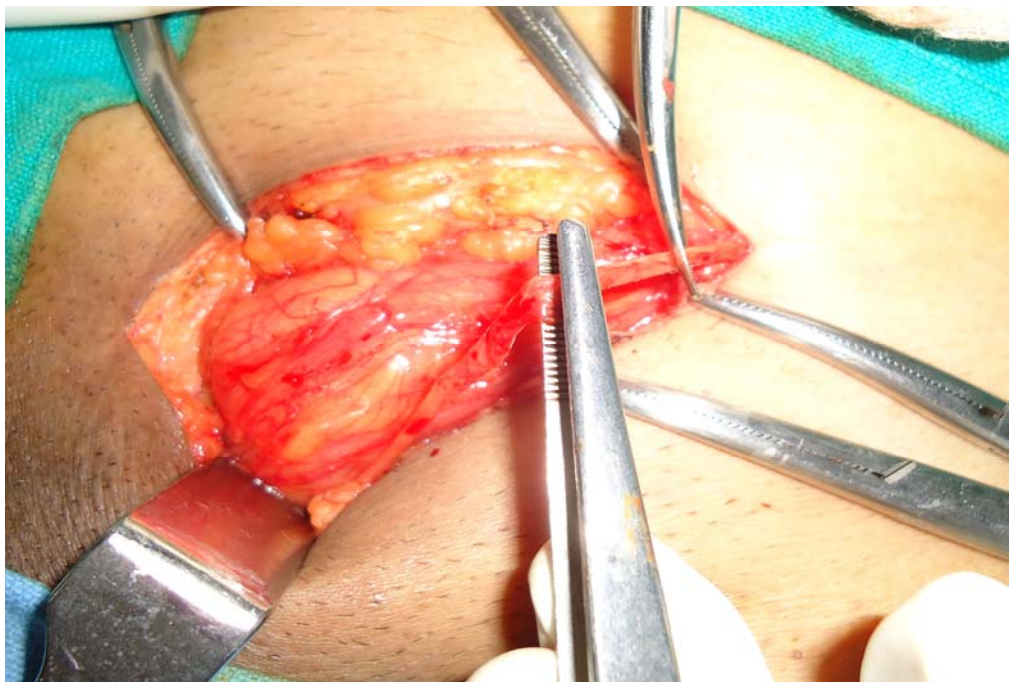


Fig 11(B) Ilioinguinal nerve being excised lateral to internal ring.

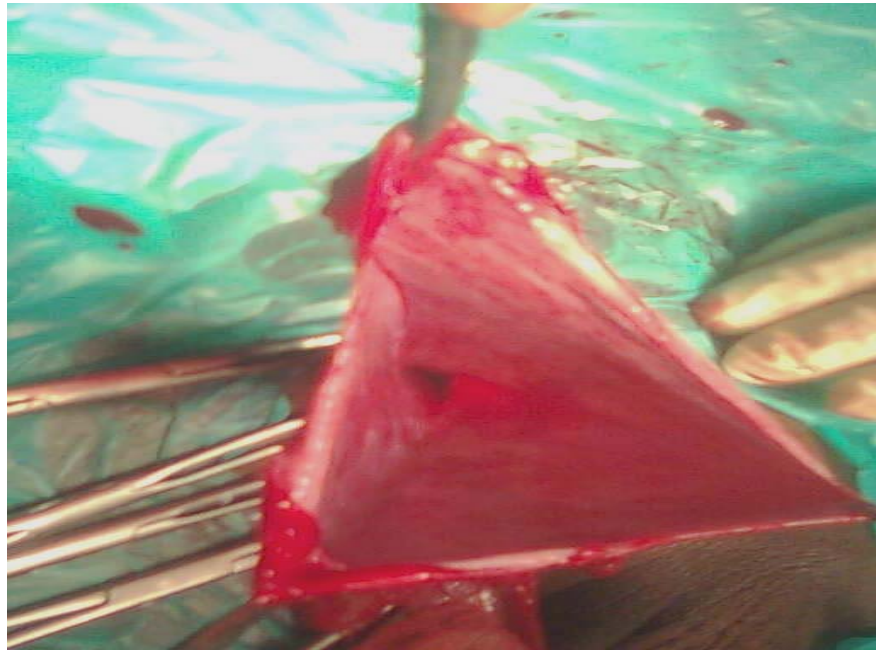


Fig 12 (A) Demonstration of Indirect inguinal hernial sac

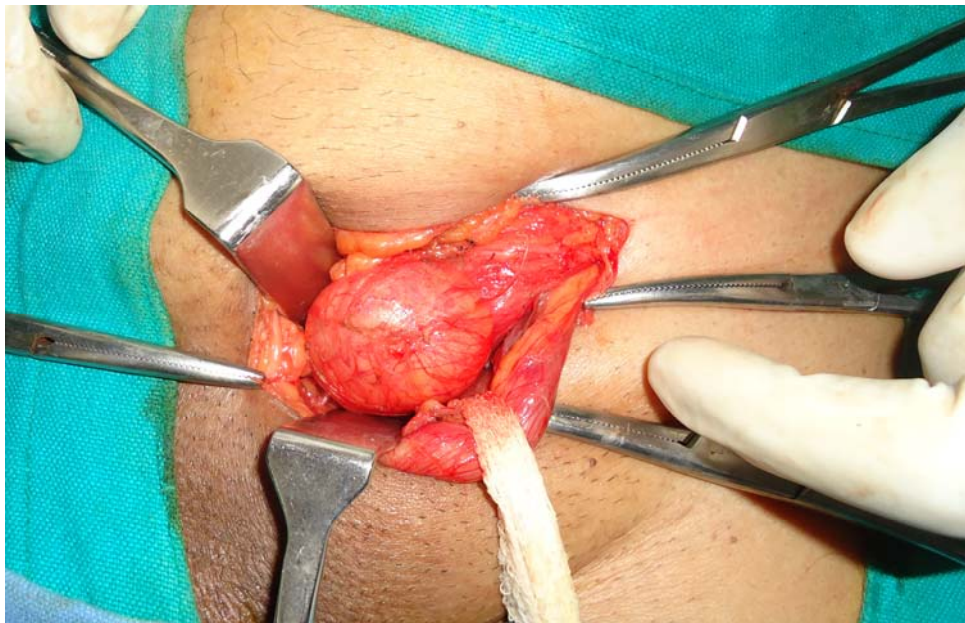


Fig 12 (B) Demonstration of Direct inguinal hernial sac

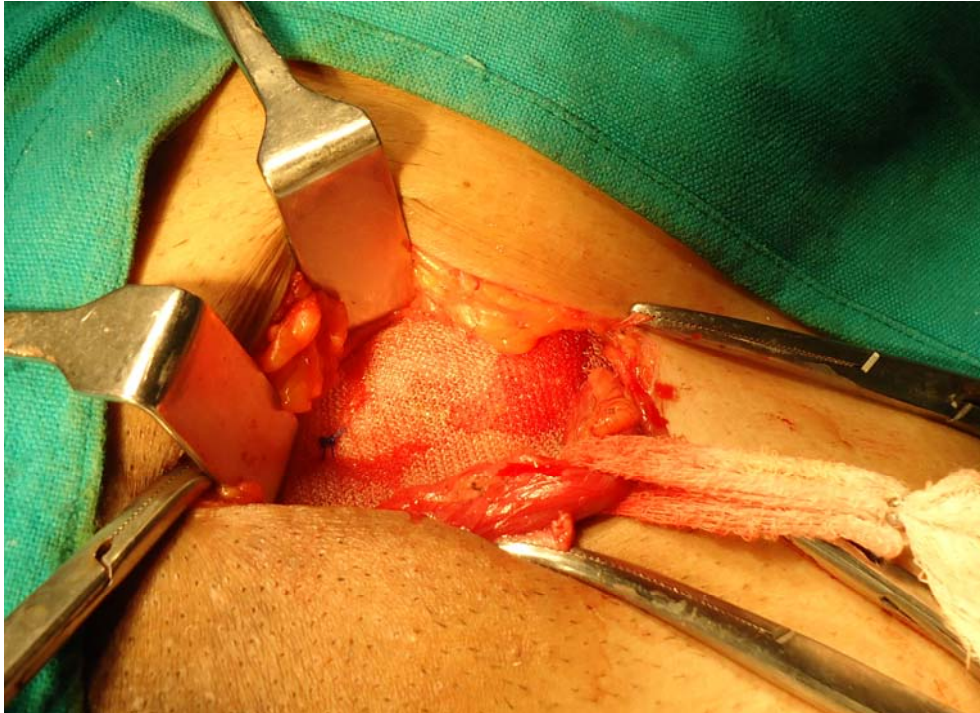


Fig 13 (A) Prolene mesh 6 X 11 cm fixed by prolene 2-0 sutures – Lichtenstein's Tension free mesh hernioplasty.



Fig 13 (B) Skin closed with non absorbable suture material. (Ethilon 2-0).

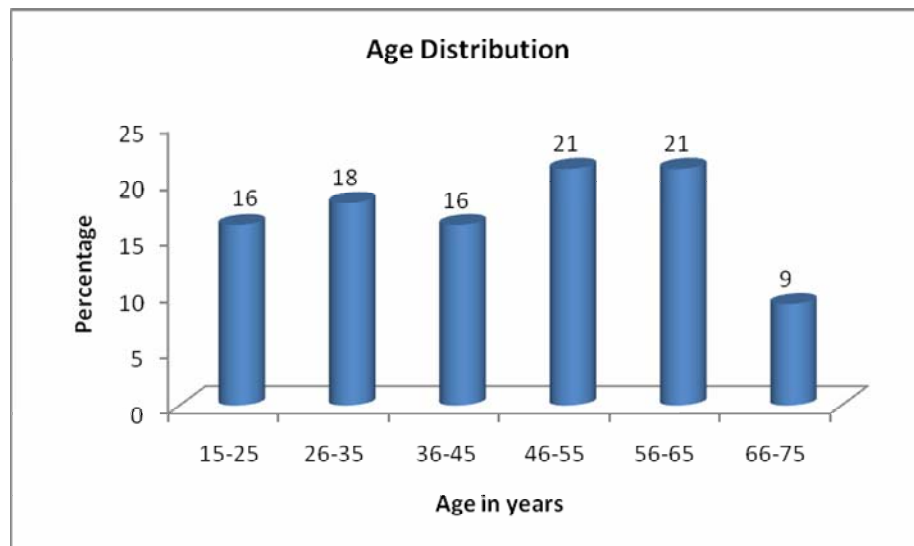
RESULTS

1.Patient Demographs

56 patients with inguinal hernia were randomized prospectively to either ilioinguinal nerve preserved group or excised group during open mesh hernia repair . There were no significant demographic difference between two groups noted [Table - 1].

Age Distribution	No of Patients	Percentage %
18-25	9	16
26-35	11	18
36-45	9	16
46-55	11	21
56-65	11	21
66-75	5	9

Graph 1



t- value= 0.055

P-value= 0.0956

Inference :

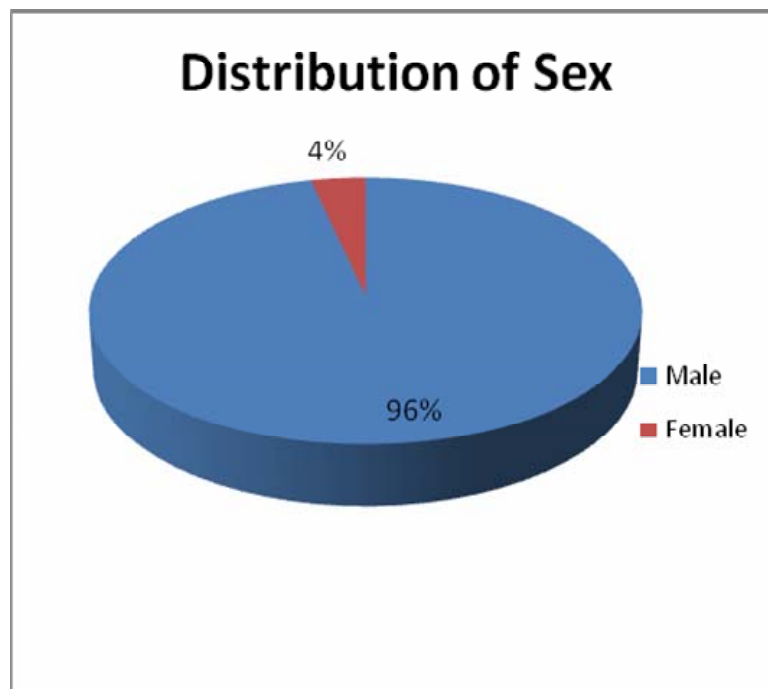
- Mean age of patients in group A i.e, Nerve preserved group is 45.36 ± 15.98 and in Group B i.e, Nerve excised group is 45.61 ± 17.9 .
- In the present study age of the patient varied from 18-75yrs with highest prevalence of inguinal hernia noted in the age group of 46-65 yrs.

- **2 Sex Distribution**

In this study total of 56 patients were randomised prospectively for open mesh repair out of which a Male preponderance of inguinal hernia was seen i.e, 96% and Female incidence were 4%. Table 2.

	No of Patients	Percentage %
Male	54	96
Female	2	4

Graph 2

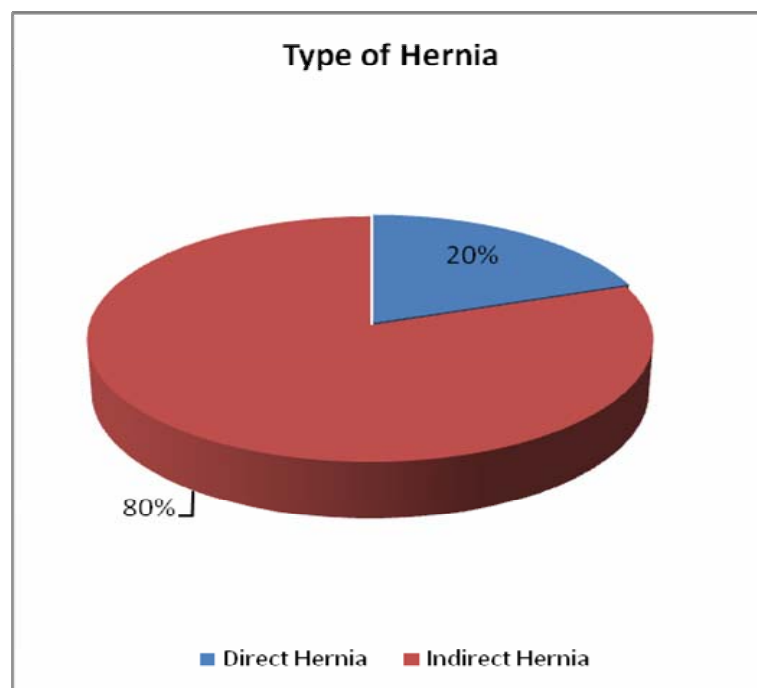


3 Type of Hernia

In this study out of 56 patients with inguinal hernia, Indirect inguinal hernia were 80 % and Direct inguinal hernia were 20%. **Table 3.**

	No of Patients	Percentage %
Direct	11	20
Indirect	45	80

Graph 3



4 Post operative pain.

Post operative pain is assessed by visual analogue scale at 1 month , 6 month after the surgery. In our study results are analyzed with Pearson's chi square test. Results are shown in Table 4 .

Inference

Groin Pain score is less during 1 month , when nerve is excised and no statistically significant reduction seen in pain score from 6 month.

PAIN SCORE (MEAN±SD)

Post operative	Nerve Preserved Group	Nerve Excised Group	Chi square test	P value
1 month	3.0±0.77	2.57±1.0	6.171	0.013
6 month	1.61±1.03	1.04±1.07	0.487	0.485

Table 5

1 Month Groin Pain	Nerve Preserved		Nerve Excised	
	%	No of pt.	%	No of pt.
	Low	21	6	54
Moderate	79	22	46	13

Graph 4

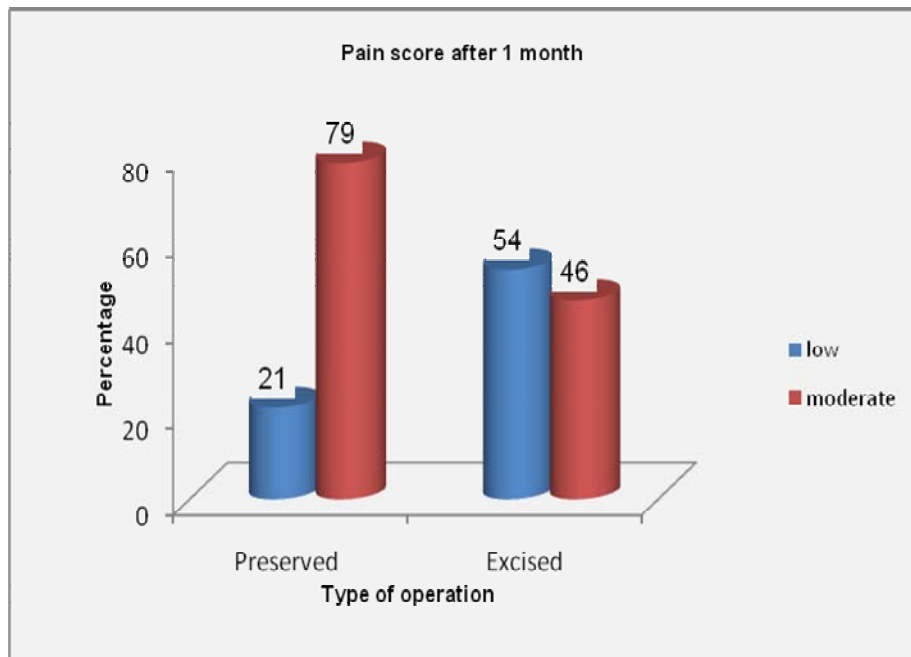
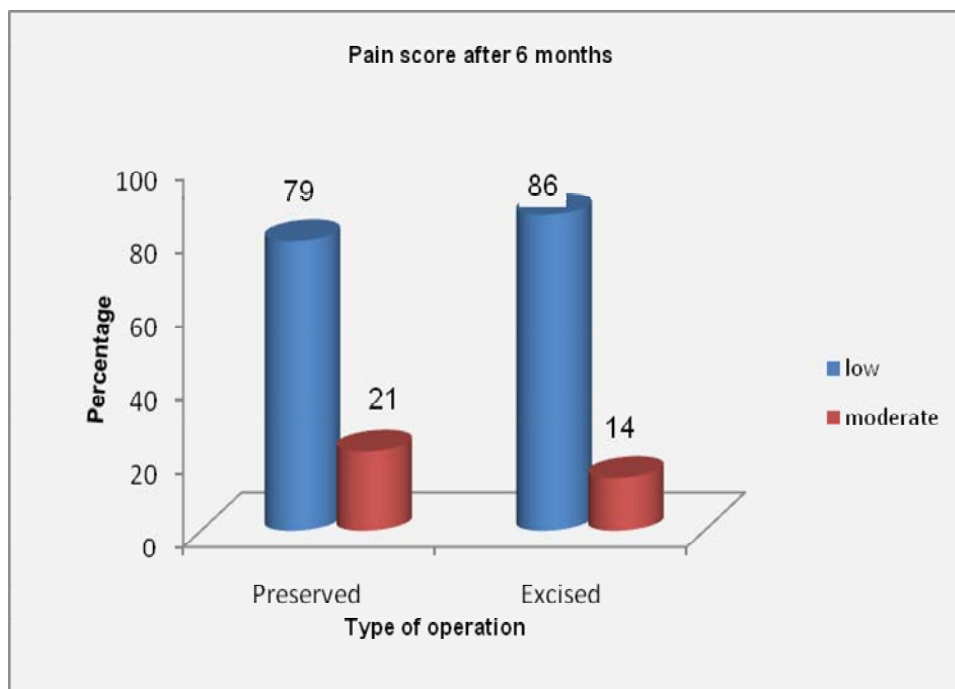


Table 6

6 month Groin Pain	Nerve Preserved		Nerve Excised	
	%	No of pt.	%	No of pt.
low	79	22	86	24
moderate	21	6	14	4

Graph 5



Groin Pain score is comparatively less during 1 month, when nerve is excised where as there is no statistically significant decrease in groin pain at 6 month between the ilio inguinal nerve excised and preserved group .

Complications

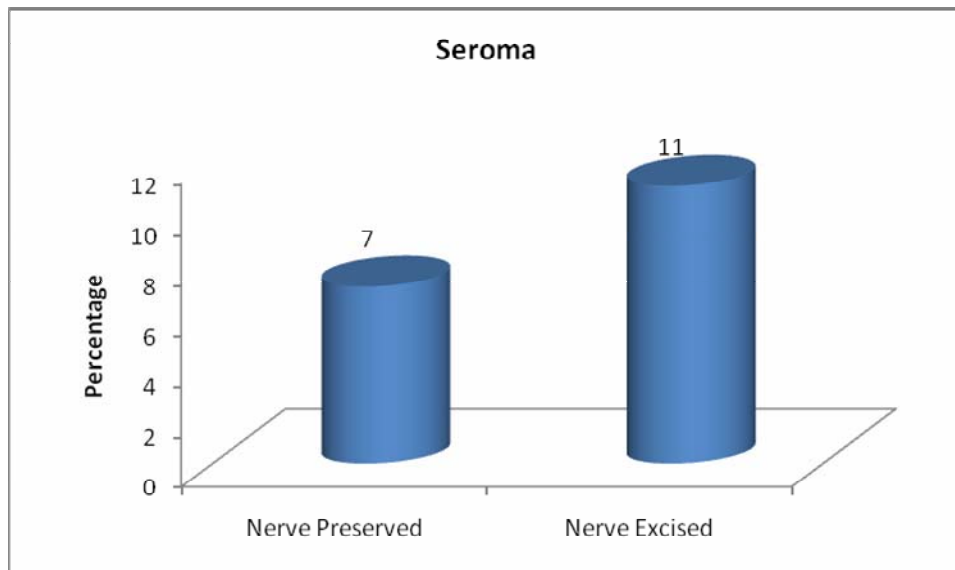
In our study inguinal hernia surgery complications were assessed .

- a) Seroma
- b) Hypoesthesia

Table 7 **SEROMA**

Group	Yes	No	Total
Nerve Preserved	2	26	28
Nerve Excised	3	25	28

Graph 6



Mann Whitney U test

P = 0.645

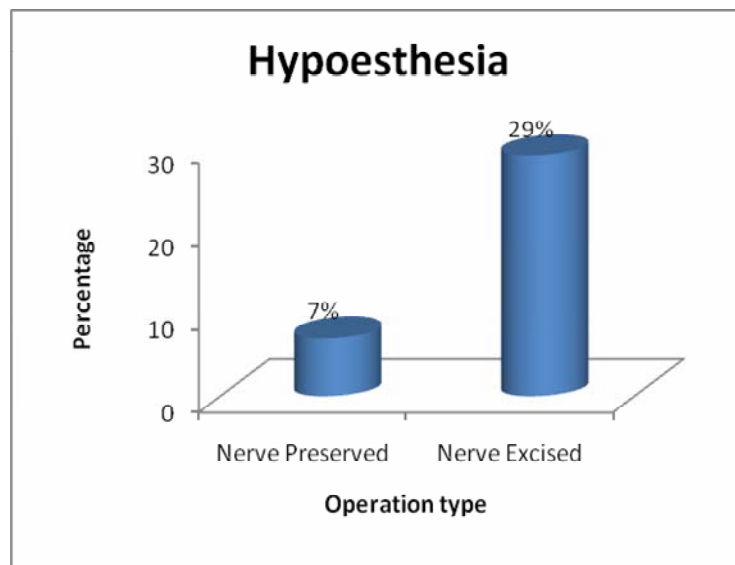
Seroma rate in both the groups are same as the p value > 0.05 which is not statistically significant

Table 8

HYPOESTHESIA

Group	Yes	No	Total
Nerve Preserved	2	26	28
Nerve Excised	8	20	28

Graph 7



Mann Whitney U test

P = 0.002

Hypoesthesia is seen more when nerve is excised which is statistically significant as the p value < 0.05.

In our study there were no hernia recurrences and no purulent collection.

DISCUSSION

Chronic groin pain is one of the most debilitating long-term complications after inguinal hernia repair, which can significantly affect the patient's satisfaction and quality of life after the operation.^{3,10} A proposed mechanism for the development of postoperative chronic groin pain is the inflammation and fibrosis induced by the mesh, which is in close proximity to the ilioinguinal nerve¹⁹. In addition, unintentional injury or strangulation of the ilioinguinal nerve during suturing may also contribute to the phenomenon. There is increasing evidence to suggest that prophylactic excision of ilioinguinal nerve during open hernia repair is not only associated with minimal morbidities but also can potentially decrease the incidence of chronic groin pain following operation.^{13,47-48}

The first randomized trial to address this problem by Ravichandran et al was underpowered and no definite conclusion could be made.¹⁹ Results from subsequent trials regarding chronic groin pain following elective neurectomy have been inconsistent.

Dittrick et al¹³ reported a significantly lower incidence of chronic groin pain in patients who had elective neurectomy during open inguinal hernia repair when compared with the control group.¹¹ However, these results were not confirmed in a recent randomized controlled trial by Picchio et al,⁴⁶ who found similar incidence of chronic groin pain between ilioinguinal nerve excision group and control.

The results of present study was compared with those of previous studies as follows:

Table 9

	Malekpour et al	Ditrick et al	Our study
TOTAL PATIENTS	121	90	56
Male	95%	77%	96%
Female	5%	22%	4%
Age(yrs)	45±18	62±16	45±16

In the present study total 56 patients were studied , 28 in ilio inguinal nerve excised group and 28 in nerve preserved group. Age range of 18-75yrs. Mean age of 45.36±15 in nerve preserved group and 45±17yrs in nerve excised group .P=0.0956

In Malekpour et al study 121 patients were studied , 61 in nerve excised group and nerve preserved group, Age range of 18-86yrs. Mean age 45±18 yrs.

In Dittrick et al total of 90 patients were studied , 66 in nerve preserved group and 24 in the nerve excised group. Age ranged from 18-80yrs. Mean age of 68±14yrs in nerve excised group and 58±18 yrs in nerve preserved group.

In Wilfred Lik-Man Mui et al study 100 patients were studied , 50 in nerve preserved group and 49 in the nerve excised group. Age ranged from 18-80yrs. Mean age of 65±10.1 in nerve excised group and 63±16.3 yrs in nerve preserved group.

In Zacest et al study 26 patients were studied , Mean age was 48.7 yrs for the effect of ilioinguinal neurectomy for chronic pain.

In the above studies total number of patients , randomisation of patients, Age range and Mean age in either group is comparable with present study.

In the present study 96% were male patients and 4% were female patients which is comparable with Malekpour et al , Dittrick et al and Zacest et al study of 95%,5% and 77%,23%and 60% and 40% respectively.

Here in this study incidence of inguinal hernia is less in female population as can be compared with Malekpour et al , Dittrick et al study.

Comparison of post operative groin pain of present study with similar studies.

Table 10

Post operative	Malekpour et al	Dittrick et al	Our study	P
1 month	0.7±0.7	2.0±0.0	2.57±1.0	0.013
6 month	0.6 ±0.8	2.5 ±0.7	1.04±1.07	0.485

In the present study we found a groin pain score in ilio inguinal nerve excised group assessed on visual analog scale of 2.57+/- 1.0 at 1 month which is comparable with Dittrick et al study 2.0+/-0.0 but Malekpour et al study at 1 month noted a score of 0.7+/- 0.7 which is less when

compared to nerve preserved group and is statistically significant ($P=0.013$) This is comparable with Makekpour et al.

At 6 month in present study we noted a pain score of 1.04 ± 1.07 in ilioinguinal nerve preserved group when compared with Dittrick et al of 2.5 ± 0.7 and Malekpour et al of 0.6 ± 0.8 . which shows no statistically significant decrease in groin pain ($P=0.485 > 0.05$) This comparable with dittrick et al.

In Zacest et al after ilio inguinal neurectomy at 2 week follow up 14 (74%) of 19 patients noted pain improvement. When followed up for 3 yrs 27.8% patients had completely relieved of pain better in 38.9% and no better in 16.7% patients in nerve excised group.

In Wilfred Lik-Man Mui et al study incidence of groin pain at 6 months was significantly lower in nerve excised group than nerve preserved group i.e,8% vs 28.6 % $P= 0.008$.

In Picchio et al⁴⁶ study post operative groin pain was absent in 73 % in ilioinguinal nerve excised group 70% nerve preserved group. At 1 month and 6 month follow up no difference was found between the 2 groups in groin pain , but loss of touch sensation was significantly greater when ilioinguinal nerve was excised. 1 yr after operation the 2 groups were comparable with respect to loss of pain but touch sensation remained decreased in nerve excised group, which is not comparable with present study.

Complications like seroma , hypoesthesia, pus collection , haematoma and hernia recurrence were assessed in our study

Seroma rate of 7 % in nerve preserved group and 11% in nerve excised group was noted in our study which is comparable with 18% and 24% respectively in malekpour et al study.

Hypoesthesia in present study was noted 29% in ilioinguinal nerve excised as compared to 7 % in nerve preserved group more during 1 month follow up. In Malekpour et al the intensity of hypoesthesia decrease from 0-3 to 0 by 6 month on visual analog scale and no cases of hypoesthesia occurred in any patient in either group at 1 yr after surgery.

No haematoma, No pus collection and no hernial recurrence were seen in any patients in either group when followed upto 6 months. In Malekpour et al study complication consisted of 12 cases of post surgical haematoma, 5 in nerve preservation group and 7 in nerve excised group and 1 hernial recurrence in the nerve preserved group, which is not comparable with our study.

CONCLUSION

Post operative groin pain is not an uncommon problem, with thousands of hernioplasties being performed each year, even a small incidence of 1-2% can result in large number of patients with neuropathies. Laparoscopic hernia repair techniques have not seemed to eliminate this complication.

If we have to know the true incidence of these problems and outcome of their treatment, we must pay careful attention to patients postoperative complaints and then intervene appropriately.

Based on the observation made in this study there was significant decrease in groin pain score in ilioinguinal nerve excised group when compared to ilioinguinal nerve preserved group at 1 month follow up and there was no significant decrease in groin pain score in ilioinguinal nerve excised group at 6 month compared to nerve preserved group.

In the ilioinguinal nerve excised group there was slight increase in the incidence of hypoesthesia in the medial aspect of groin due to injury to nerve supplying that area, which reduced over a period of time. There was no increase in seroma formation rate in ilioinguinal nerve excised group. There was no recurrence of hernia in both ilioinguinal nerve excised and preserved group and no pus collection seen.

Although chronic groin pain was less frequent in our study than reported by many previous studies, it is still wise to recommend ilioinguinal neurectomy in patients undergoing open hernioplasties. Thus ilioinguinal neurectomy is associated with a significantly lower incidence of post operative groin pain when compared to nerve preservation and reduces the risk of nerve entrapment.

SUMMARY

Our study was “To compare the effect of ilio inguinal nerve excision or its preservation on post operative inguinodynia after open mesh hernia repair”.

Total 56 patients were randomized in to two groups ,Group A (ilio inguinal nerve preserved group) and Group B (ilioinguinal nerve excised group). Open mesh hernia repair was done with ilio inguinal nerve excision or preservation depending on the groups. Post operative pain and Postoperative infection, Recurrence, Hypoesthesia were noted. Results were analyzed using Mann Whitney U test , and Chi Square tests.

Both the groups were having similar age groups ilio inguinal nerve preserved (45.36 ± 15.98) and ilio inguinal nerve excised group (45.61 ± 17.9), $P = 0.0956$. Post operative groin pain intensity was less comparatively in nerve excised group till 6 month and need long term follow up. Although hypoesthesia was seen more in nerve excised group intensity reduced with time, difference is statistically significant. Post operative seroma formation was similar in both the groups. No Pus formation and hernial recurrence were noted ,which needs follow up.

Although results were nearly similar in both groups, routine ilio inguinal neurectomy has no major complications and reduces the intensity of groin pain in the early post operative periods by reducing the risk of ilio inguinal nerve entrapment under the mesh , sutures or staples .

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PROFORMA

1) Name : CASE NO :

2) Age/Sex : IP NO :

: DOA :

: DOS :

5) Occupation : DOD :

6) Residence :

7) Chief Complaints : Swelling in inguinoscrotal region

Onset

Duration

Progress

Aggravating factors

Relieving factors

: Pain

Vomiting

Urinary complaints

Chronic cough

Other symptoms

9) Past History

10) Treatment history – Any surgery
Systemic illness.

11) Personal History – Diet
Appetite
Bowel/Bladder
Sleep
Habits

12) Family History

13) General Physical Examination

Built	Nourishment
Pulse	RR
BP	Pallor
Temp	Jaundice
Clubbing	Cyanosis
Edema	Lymphadenopathy

14) Local Examination:

INSPECTION	:	Size	Site
		Shape	position and extent

Skin over swelling

impulse on cough

Reducibility

position of penis

PALPATION : Temp: Tenderness
Size Shape
Position and extent consistency
Impulse on coughing Reducibility
Relation of testis and Spermatic cord
Ziemans technique
Invagination test
Ring occlusion test

PERCUSSION

AUSCULTATION

15) Other systemic examination

- Abdominal system
- Respiratory system.
- Cardiovascular system.
- Central nervous system.

16) INVESTIGATIONS UNDERGONE BY PATIENT:

1) BLOOD:

* Hb- gm% * TC- cells/cmm DC- N % L % M % B %

* Urea mg/dl * sugar(R) mg/dl * s.creatinine mg/dl

2) URINE * Alb : * Sugar * Micro

3) ECG

4) X RAY CHEST

5) USG ABDOMEN

17) FINAL DIAGNOSIS

18) Pre-operative management:

19) **Details of Surgery :**

Diagnosis	Operation Procedure

20) Post- operative Management;

20) Postoperative complications-

Swelling and induration

Mesh infection

Recurrence

21) Follow up at

1week

1month

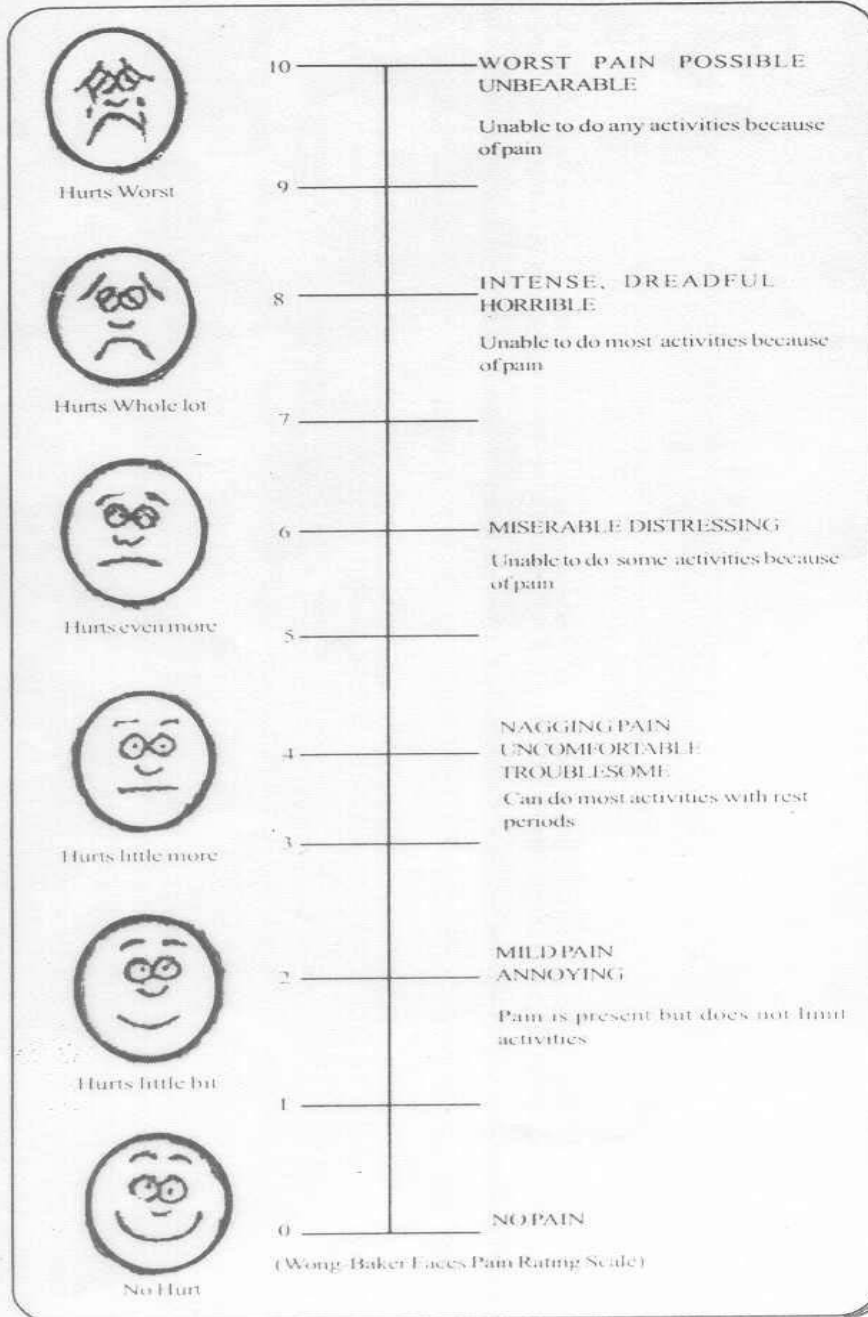
3month

6month

22) Inference :

23) Comments :

FIGURE-1
PAIN ASSESSMENT SCALE



SAMPLE INFORMED CONSENT

TITLE OF THE PROJECT : A COMPARATIVE STUDY OF POSTOPERATIVE INGUINODYNIA IN OPEN MESH HERNIA REPAIR AFTER ILIO-INGUINAL NERVE EXCISION OR PRESERVATION .

PRINCIPAL INVESTIGATOR :- DR.MANJUNATH .V

GUIDE : DR.ARAVIND V PATIL .
PROFESSOR OF SURGERY.

PURPOSE OF RESEARCH:-

I have been informed that this study will analyze post operative chronic groin pain after open mesh hernia repair with ilio inguinal nerve preservation or excision.

PROCEDURE :-

I am aware that in addition to routine care received and I will be asked series of questions by the investigator. I have been asked to undergo the necessary investigation, which will help the investigator as a part of routine management.

RISK AND DISCOMFORTS :

I understand that I may experience some pain and discomfort during the examination or during my treatment. This is mainly the result of my condition and the procedure of this study are not expected to exaggerate these feelings which are associated with the usual course of treatment.

BENEFITS:-

CONFIDENTIALITY:

I understand that medical information produced by this study will become a part of my Hospital records and will be subject to the confidentiality and privacy regulation of the said hospital information of a sensitive personal nature will not be a part of the medical records, but will be stored in the investigator's research file and identified only by a code number. The code key connecting name to numbers will be kept in a separate secure location.

If the data are used for publication in the medical literature or for teaching purposes no names will be used and other identifiers such as photographs and audio or videotapes will be used only with my special written permission. I understand I may see the photographs and videotapes and hear the audiotapes before giving this permission.

REQUEST FOR MORE INFORMATION:

I understand that I may ask more questions about the study at any time. Dr. Manjunath .V is available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of this study, which might influence my continued participation.

If during the study, or later, I wish to discuss my participation in or concerns regarding this study with a person not directly involved, I am aware that the social worker of the hospital is available to talk with me. A copy of this consent form will be given to me to keep for careful reading.

REFUSAL OR WITHDRAWAL OR PARTICIPATION:

I understand that my participation is voluntary and I may refuse to participate or may withdraw consent and discontinue participation in the study at any time without prejudice to my present or future care at this hospital. I also understand that Dr. Manjunath .V may terminate my participation in this study at any time after he has explained the reasons for doing so and has

helped arrange for my continued care by my own physician or physical therapist, if this is appropriate.

INJURY STATEMENT:

I understand that in the unlikely event of injury to me resulting directly from my participation in this study, if such injury were reported promptly, then medical treatment would be available to me, but no further compensation would be provided. I understand that by my agreement to participate in this study I am not waiving any of my legal rights.

I have explained to (Patient's / relevant guardian's name) the purpose of the research, the procedures required, and the possible risks and benefits to the best of my ability in patient's own language.

DR.MANJUNATH .V

Date

I confirm that(Name of the PG guide / Chief Researcher). Has explained to me the research, the study procedures that I will undergo, and the possible risks and discomforts as well as benefits that I may experience. I have read and I understand this consent form. Therefore, I agree to give my consent to participate as a subject in this research project.

Participant / Guardian

Date

Witness to signature

Date

CONSENT FOR PARTICIPATION IN RESEARCH

Mr./Mrs. _____ we are requesting you to enroll yourself in study titled conducted by DR.MANJUNATH.V postgraduate student in M.S General Surgery under the guidance of DR ARAVIND V PATIL, Shri.B M Patil Medical College and Hospital Research centre, Bijapur

You have been requested to participate in research because you are into the study group. During the study you will be asked some questions and you are supposed to answer to the best of your knowledge.

Your participation in research is voluntary. Your decision whether or not to participate in the study will not affect your relationship with B M P M C.If you decide to participate you are free to withdraw at any time.

The purpose of research is to compare ilio inguinal nerve excision or its preservation in post operative inguinodynia after open mesh hernia repair.

PROCEDURE INVOLVED:

If you agreed to participate in the study your are randomized and divided in to two groups. In one group Ilio inguinal nerve is cut and in other group Ilio inguinal nerve is preserved , to evaluate the effect on post operative pain after open mesh repair for inguinal hernia

RISKS AND BENEFITS:

There are no extra risks involved and benefits are to be evaluated.

ALTERNATIVES:

Even if you decline the participation, you will get the routine line of management.

PRIVACY AND CONFIDENTIALITY:

The only people to know that you are a research subject are members of the research team. No information about you or provided by you during the research will be disclosed to others without your written permission except:

- 1 .In emergency to protect your rights and welfare.
- 2.If required by law.

AUTHORIZATION TO PUBLISH RESULTS:

When the results of the research are published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information that is obtained in connection with this study and that can be identified with you will remain confidential.

FINANCIAL INCENTIVES FOR PARTICIPATION:

You will not be paid/offered any free gifts for participating in the research. You will not be reimbursed for expenses.

CONSENT STATEMENT

I undersigned _____ have been explained in my vernacular language about the study and my participation in the study is voluntary. If I want, I can withdraw at any time. Also I have been given enough time to clear my doubts and rights as study participant.

In case you have any questions related to the study, you can contact _____ Dr
MANJUNATH .V(Ph No _____)

In case you have any questions about my rights as a study participant, you can contact Dr

Signature or the Left Thumb print of Participant or legally authorized representative

Participants Name _____ Signature _____

Witness Name _____ Signature _____

Experimenter's Name _____ Signature _____

Date _____

Place _____

KEY TO MASTER CHART

Diag	:	Diagnosis
RDIH	:	Right direct inguinal hernia
LDIH	:	Left direct inguinal hernia
RIIH	:	Right indirect inguinal hernia
LIIH	:	Left indirect inguinal hernia
MP	:	Mesh Plasty

MASTER CHART

Sl No	IP NO	Name	Age/Sex	Diag	Procedure	Nerve		1 Month	6 Month	Seroma	Complication		Purulent collection
						Preserved	Excised				Recurrence	Hypoesthesia	
1	13258	Nilakanta	56/M	RIIH	MP	Y	N	2	1	N	N	N	N
2	13867	Pratap	36/M	LIIH	MP	Y	N	5	3	Y	N	N	N
3	15243	Govinda	48/M	RIIH	MP	Y	N	3	2	N	N	N	N
4	16187	Dondiba	36/M	LIIH	MP	N	Y	4	3	N	N	Y	N
5	16174	Nagappa	28/M	RIIH	MP	Y	N	3	0	N	N	N	N
6	16191	Sulochna	48/F	RIIH	MP	Y	N	5	1	N	N	N	N
7	16454	Gourama	70/F	RIIH	MP	N	Y	4	2	N	N	N	N
8	11962	Basalingappa	65/M	LIIH	MP	Y	N	2	1	N	N	N	N
9	5119	Danappa	58/M	RDIH	MP	N	Y	3	1	N	N	Y	N
10	5707	Bhima	65/M	LIIH	MP	N	Y	3	1	N	N	N	N
11	14936	Sidappa	55/M	LIIH	MP	N	Y	2	0	N	N	N	N
12	13991	Anil K	25/M	RIIH	MP	N	Y	3	2	N	N	N	N

13	13293	Madivalpa	30/M	RIIH	MP	N	Y	4	3	N	N	N	N
14	14668	Irappa	42/M	RDIH	MP	Y	N	3	2	N	N	N	N
15	1886	Anil Kdkl	24/M	RIIH	MP	N	Y	4	1	N	N	N	N
16	6750	J Pujari	30/M	RIIH	MP	Y	N	3	0	Y	N	N	N
17	7516	Prakash	38/M	RIIH	MP	N	Y	3	3	N	N	N	N
18	15033	Jetapa	30/M	RIIH	MP	N	Y	2	0	N	N	Y	N
19	5977	Nilkantapa	60/M	RIIH	MP	N	Y	4	3	Y	N	N	N
20	5284	Basavarj	32/M	LIIH	MP	Y	N	3	2	N	N	N	N
21	7539	Mantesh	22/M	RIIH	MP	Y	N	2	0	N	N	N	N
22	14189	Danaya	28/M	LIIH	MP	N	Y	2	1	N	N	N	N
23	15359	Ballapa Kuntoji	48/M	LIIH	MP	Y	N	3	2	N	N	N	N
24	14739	S Gowda	51/M	RIIH	MP	N	Y	4	0	N	N	N	N
25	1538	Vishwa	22/M	RIIH	MP	Y	N	3	2	N	N	N	N
26	2741	V Badra	52/M	RIIH	MP	N	Y	2	0	N	N	N	N
27	2350	I Patel	64/M	RDIH	MP	Y	N	4	3	N	N	N	N
28	4158	H Raya	60/M	RDIH	MP	Y	N	3	3	N	N	N	N
29	13777	Honappa	37/M	RDIH	MP	N	Y	2	1	N	N	Y	N
30	18047	Chandrappa	50/M	RIIH	MP	N	Y	2	0	N	N	N	N

31	4749	Bhimanna	25/M	LIIH	MP	N	Y	2	1	N	N	N	N
32	18072	Guranna	48/M	RIIH	MP	Y	N	3	2	N	N	N	N
33	18485	Kallappa	75/M	RDIH	MP	N	Y	0	0	N	N	Y	N
34	4009	KotturBasava	50/M	LDIH	MP	Y	N	2	1	N	N	N	N
35	14760	Ningappa Gowda	65/M	RIIH	MP	Y	N	3	2	N	N	N	N
36	186663	Revannayya	55/M	LIIH	MP	N	Y	3	1	N	N	N	N
37	11314	Shantaggowda Biradar	65/M	LDIH	MP	Y	N	4	3	N	N	N	N
38	10643	Seetaram chauwan	75/M	RIIH	MP	N	Y	2	1	N	N	N	N
39	11552	Tukkappa	65/M	LIIH	MP	N	Y	2	0	Y	N	Y	N
40	14736	Yallappa	32/M	RIIH	MP	Y	N	3	3	N	N	N	N
41	18289	Yashavant	70/M	LDIH	MP	Y	N	3	1	N	N	Y	N
42	189	Balusaab	65/M	LIIH	MP	Y	N	3	2	N	N	N	N
43	19811	Jayaram	45/M	RIIH	MP	N	Y	2	1	N	N	N	N
44	18583	Muttappa	48/M	RIIH	MP	Y	N	2	0	N	N	N	N
45	18641	Madivalpa	45/M	RDIH	MP	N	Y	2	0	N	N	Y	N
46	16759	Revappa	65/M	RIIH	MP	N	Y	2	0	N	N	N	N
47	16929	Ramesh	19/M	RIIH	MP	Y	N	3	3	N	N	N	N

48	15119	Rajendra	42/M	RIIH	MP	Y	N	3	2	N	N	Y	N
49	13064	Siddalingappa	35/M	RIIH	MP	N	Y	1	0	N	N	N	N
50	18596	Shivasharan	18/M	RIIH	MP	N	Y	3	2	Y	N	N	N
51	13264	Shivappa	25/M	RIIH	MP	Y	N	3	1	N	N	N	N
52	16735	Santhosh	30/M	LIIH	MP	N	Y	2	0	N	N	N	N
53	15708	Basavaraj	26/M	RIIH	MP	Y	N	2	0	N	N	N	N
54	17437	Ramesh	25/M	LIIH	MP	N	Y	3	2	N	N	Y	N
55	18211	Maruthi	66/M	LIIH	MP	Y	N	3	1	N	N	N	N
56	20703	Raju	48/M	RDIH	MP	Y	N	3	2	N	N	N	N